Draft

Willamette Subbasin Summary

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Prepared for the
Northwest Power Planning Council

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Willamette Subbasin Summary

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Willamette Subbasin Summary

Introduction

The Willamette Subbasin is big and complex. It is 12,000 square miles of forest, farms, and cities--home to 2.3 million people, 70 percent of Oregon's population. It also has the richest fish assemblage in Oregon, a system of wildlife refuges serving the Pacific flyway, extensive old growth reserves, and one of the nation's biggest rivers--now plumbed by 13 tributary dams that regulate flow and produce power.

One hundred and fifty years of development have left their mark. The Willamette enjoys cities large and small (nearly 100 in all), a diverse economy, farms producing over 200 types of commodities, fewer big floods. The natural world has been re-arranged to provide these benefits. Nearly all prairie habitat is gone; the continuous, side-channeled wetland complex of a big river is no more; the riparian network connecting uplands and lowlands has been disrupted. Addressing these Willamette losses even as the human population doubles in the next 50 years will be Oregon's "sternest environmental challenge", according to a panel of scientists who conducted an unprecedented survey of the state's ecosystem health last year.

The list of species that left with the habitat is long and includes meadowlarks, pond turtles, red-legged frogs, white-tailed deer, gray wolf--and salmon. Chinook, steelhead, bull trout, and cutthroat populations are all at risk.

The causes for these populations' decline are many. And there are many management efforts on-going to address these causes. This Subbasin Summary attempts to provide a foundation for understanding both. That makes the Summary long. There are lots of species to describe, many decline factors to address, and many programs to survey.

But what may set this Summary apart from others done so far are two themes: that there is a significant Bonneville Power Administration interest even in this "below Bonneville" environment; and that there are new Willamette-specific frameworks to provide a subbasin context to that interest--a context where restoration priorities are being brought into sharp focus.

Throughout the Summary, the tie to Bonneville interests is made deliberately and repeatedly. Frankly, this is to make explicit what in other "east side" subbasins has been implicit--namely, that operation of the Federal Columbia River Power System (FCRPS) has had significant impacts on fish and wildlife habitat. The Willamette's tie is primarily through the eight U.S. Army Corps of Engineer dams that produce hydropower. These dams are formally part of the FCRPS and have been so-recognized in Columbia River salmon recovery efforts--namely, the federal Columbia "BiOp" Reasonable and Prudent Alternative and its implementation plan and the Basinwide Salmon Recovery Strategy. The connection has also already been recognized for wildlife losses in the Fish and Wildlife Program. And the impacts of the Willamette's FCRPS dams have indeed been

significant in terms of habitat blockage, floodplain function, and flow and temperature regime alteration.

The Summary also provides information to put these impacts in context. The operation of the dams has not been the only cause of habitat loss. Habitat conversion for urban development, agriculture and forestry is a primary factor for decline for many species. However, the Summary documents that the mitigation efforts of cities and counties, other federal natural resource agencies, the State of Oregon, and non-governmental organizations can be counted in the hundreds of millions of dollars--whereas Bonneville investments to date represent a small percentage of that amount.

Recently these other mitigation efforts have led to new thinking about investment priorities. The Willamette Subbasin has become a laboratory of prioritization efforts. Spatially-explicit, subbasin-wide restoration recommendations have been developed by the Pacific Northwest Ecosystem Research Consortium (and supported by the Willamette Restoration Initiative, a Governor-established citizen restoration task force), the Oregon Biodiversity Partnership, the Forest Legacy Program, Oregon Wetlands Joint Venture, and the State of Oregon through its streamflow restoration program. These new efforts, if used, will assure the soundness of any future Bonneville investment while increasing strategic partnerships for restoration.

The Summary is written with three audiences in mind. It is hoped there is sufficient and well-documented information (both scientific and institutional) to aid informed decision-making on the part of the Council and Bonneville. Second, the Summary is intended to allow potential applicants to understand how their activities may be seen in context of the Fish and Wildlife Program and habitat needs. Third, the breadth and type of information herein may offer a good "head start" to those undertaking the subbasin planning process.

Subbasin Description

General Description

Subbasin Location

The Willamette River is the 13th largest river in the conterminous United States in terms of streamflow (Kammerer 1990). The Willamette is tributary to the Columbia River, providing approximately 15 percent of its annual discharge.

Topography/geomorphology

The Willamette River Subbasin is about 180 miles long and 100 miles wide, occupying nearly 11,500 square miles, or 12 percent of the State of Oregon. (Figure 2) The basin runs north-south between the Cascade Mountains on the east and the Coast Range on the west. Valley elevations range from about 10 ft. above sea level at the Columbia River to around 450 ft. in the southern basin. On the west side, upland elevations reach 4097 ft. at Marys Peak, the highest point in the Coast Range, and over 10,000 ft. on the east side at Mt. Jefferson and the Three Sisters. (Pacific Northwest

Ecosystem Consortium 1998) The Willamette Basin is composed of 30 percent valley floor (below 154 m (500 feet), 60 percent Cascade Mountain foothills and slopes (up to 3000m), and the remaining area consists of part of the Coast Range (up to 1200 m). (NMFS 2000)

The basin lies within the Cascadia geologic province which extends from British Columbia to Northern California. The province's western boundary lies 50-70 miles off the Pacific coast where the Juan de Fuca tectonic plate meets and slides beneath the North America plate. The eastern boundary is the crest of the Cascade Range. The northern two-thirds of the Willamette Valley is underlain by the Columbia River Basalt Group which flooded over southern Washington and northern Oregon around 15 million years ago. (Pacific Northwest Ecosystem Consortium 1998)

Climate/Hydrology

The Willamette Basin has cool, wet winters and warm, dry summers. Over 70 percent of annual precipitation occurs from October through March, but less than 5 percent falls in July and August. Average annual precipitation ranges from 40-50 inches in the valley to as much as 200 inches in the mountains. (Figure 1)Most precipitation falls as snow above 5,000 feet in the Cascades. Mean monthly air temperatures in the valley range from about 40 degrees F during January to above 60 degrees F during August.

Annual discharge of the Willamette River near its mouth at Portland averages 32,400 cubic feet per second (cfs)—or nearly 23 million acre-feet. Typical monthly flows at Portland ranged from about 8,000 cfs in August to about 70,000 cfs in December. Recorded extreme flows were 4,200 cfs in July 1978 and 283,000 cfs in January 1974, although the river reached an estimated peak flow of 460,000 cfs during the flood of February 1996.

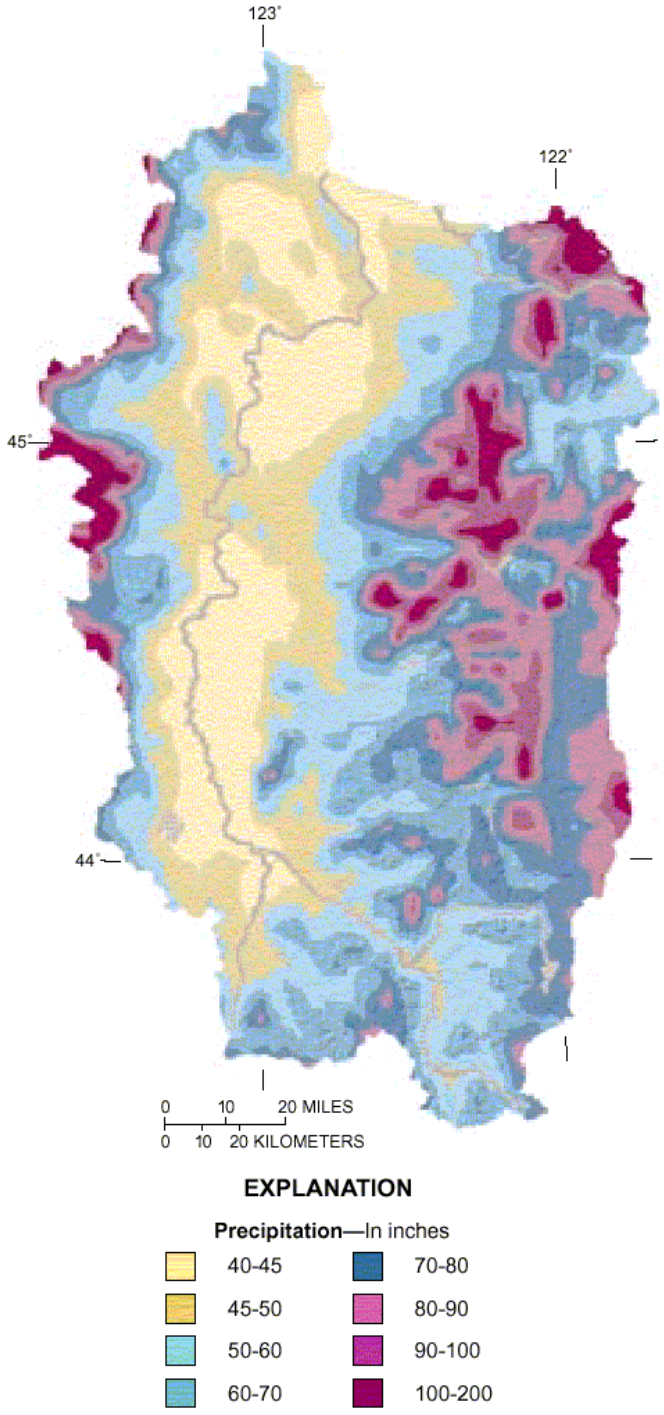


Figure 1. Mean annual precipitation in the Willamette Subbasin 1961-90 (Uhrich and Wentz 1999)

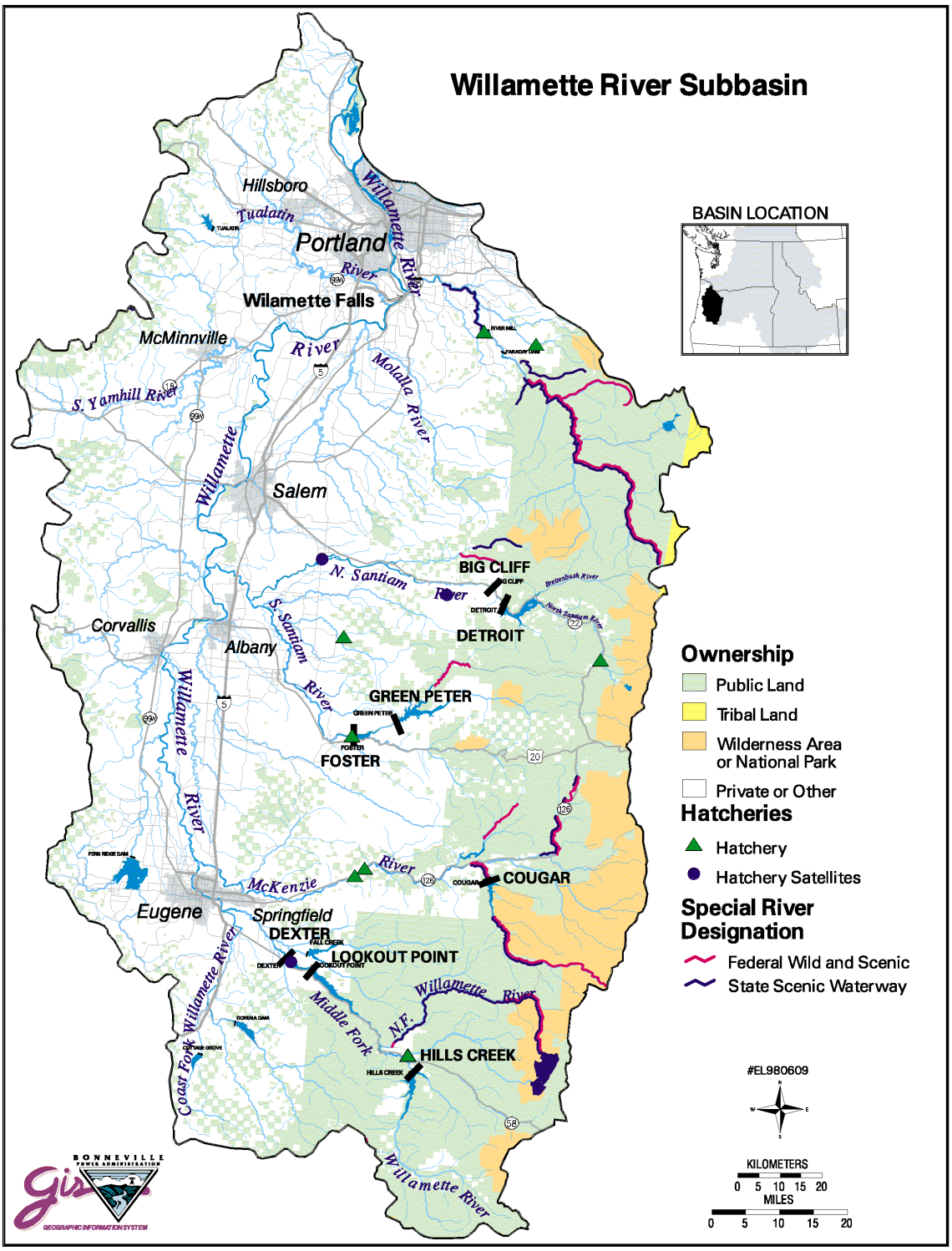


Figure 2. Willamette Subbasin (from NWPPC FY 2000 Draft Annual Implementation Work Plan, 1999)

Streamflow in the Willamette Basin reflects the seasonal distribution of precipitation, with 60-85 percent occurring from October through March, but with less than 10 percent during July and August. Releases from 13 tributary reservoirs are managed for water quality enhancement by maintaining a flow of 6,000 cfs in the Willamette River at Salem during summer months (U.S. Army Corps of Engineers 1989). Combined, the reservoirs control approximately 27 percent of the runoff from the watershed and provide approximately 1,600,000 acre feet of flood control storage in the Basin.

Major tributaries include the Calapooia, Clackamas, Coast Fork, Long Tom, Luckiamute, McKenzie, Mary's, Middle Fork, Molalla, Santiam, Tualatin and Yamhill Rivers. The tributaries have their headwaters along the eastern slopes of the Coast Range, the northern slopes of the Calapooya Mountains and the western slopes of the Cascade Range.

There are significant variations in streamflow regimes throughout the basin. Summertime flows in west-side streams originating in the Coast Range are extremely low. These streams include the Marys, Yamhill, and Tualatin Rivers. East-side streams in low-lying watersheds such as the Calapooia, Pudding, and Mohawk Rivers have similar flow patterns. Other streams with higher elevation headwaters generally have more favorable flow conditions. These include the Santiam and McKenzie Rivers. In addition, the federal flood control projects on these streams are used to augment flows below the dams, including in the mainstem Willamette River.

Land Use

Due in large part to the influence of the Coast and Cascade mountain ranges, 70 percent of the subbasin is forested. Agricultural land comprises 22 percent of the basin, and is located predominantly in the Willamette Valley. About one-third of the agricultural land is irrigated (Wentz et al. 1998) Urban areas account for 6 percent of the basin, primarily in the valley along the main stem Willamette River. Other land uses and water account for less than 2 percent of the basin area.

Approximately 35 percent of the watershed is in federal ownership. Most of the Federal land is located in the higher elevations of the basin in the Cascade and Coast Ranges and is managed by the U.S. Forest Service (USFS) and Bureau of Land Management (BLM). Over 90 percent of the valley floor of the Willamette River and its tributaries is privately owned.

Population and Economy

About 2.3 million people, or 70 percent of Oregon's population, live in the Willamette Basin. Portland, with 1.2 million people, is the State's largest metropolitan area. The three largest population centers of Portland, Salem and Eugene-Springfield are situated along the banks of the Willamette River and the Interstate 5 corridor. Population growth in the basin is expected to double to nearly 4.0 million by 2050 (Willamette Restoration Initiative 2001)

The Willamette Basin accounts for 51 percent of Oregon's total gross farm sales and 58 percent of Oregon's crop sales (Oregon Agricultural Statistics Service 1993) due

to production of grass seed, wheat, hay, oats, corn, and many specialty crops. The lower basin from Salem to Portland serves as the economic hub of Oregon, with a concentration of manufacturing, retail trade, and professional and business related services. Portland serves as a major seaport for trade between the western United States and Pacific Rim countries. The total value of Oregon's 1993 exports exceeded $6 billion. The majority of these exports were shipped through the Port of Portland at the confluence of the Willamette and Columbia Rivers.

Relation to Federal Columbia River Power System

There are 24 major hydroelectric power generation facilities in the Willamette basin (Bonneville Power Administration 2001), of which eight are operated by the U.S. Army Corps of Engineers under its Willamette Basin Project. (Table 1) The Willamette Basin Project is operated in conjunction with the Columbia River Basin Project to provide power to the Northwest power grid system. The electrical energy generated at these projects is marketed by the BPA throughout the Pacific Northwest and Pacific Southwest. It is therefore the impacts of these eight projects on subbasin fish and wildlife that forms the core of information around which this Summary is developed.

Generally, power is generated at Willamette projects as a "spin-off" from other water releases for flood control or environmental needs. Usually this power is distributed within the Willamette River basin and to nearby areas. However, during regional power emergencies arising from "cold snaps," BPA can call upon increased releases for generation as long as it does not negatively affect flood control. In response to a 1995 NMFS Biological Opinion, Columbia system operations were changed to reduce levels of total dissolved gas from spilling. As part of this, turbines at Willamette Project facilities are shut down, and water is spilled to provide for flows needed in the lower Columbia River.

Table 1. Willamette Basin Project Dams (Bastasch 1998)

Dam	Stream location	Volume (acre-feet)	Avg. Power Generated (megawatts, 1983-95)
Big Cliff*	N. Santiam	7,000	**133.6**
Blue River	Blue River	85,000	-
Cottage Grove	Coast Frk. Willamette	33,500	-
Cougar	**S. FRK. MCKENZIE**	219,300	205.4
Detroit	N. Frk. Santiam	455,000	526.5
Dexter*	Mid. Frk. Willamette	27,500	102.7
Dorena	Row River	77,600	-
Fall Creek	Fall Creek>Mid. Frk. Willamette	125,000	-
Fern Ridge	Long Tom R.	101,200	-
Foster	S. Santiam	61,000	135.6
Green Peter	Mid. Santiam	430,000	333.0
Hills Creek	Mid. Frk. Willamette	356,000	222.3
Lookout Point	Mid. Frk. Willamette	453,000	445.8
** re-regulating dams with little or no storage*			*Total: 2,104.9*

Fish and Wildlife Resources

Fish and Wildlife Status

Fish

The Willamette Subbasin contains the richest native fish fauna in the state. (Oregon Progress Board 2000) Fish species include salmon and steelhead, both fluvial and migratory populations of cutthroat trout, bull trout, sturgeon, lamprey, and other indigenous species, including the Oregon chub. There has been considerable manipulation of salmonid populations through hatcheries and the introduction of non-native stocks. Populations of exotic warm water species have proliferated because of ecosystem alteration. Exotic species include bass, crappie, and carp.

Salmonid populations have differentiated in response to major geographic features: Willamette Falls at Oregon City imparts distinct upstream/downstream characteristics (e.g., coho were native only below; cutthroat anadromy is rare above); and variations in Coast Range and Cascade environments produce east-west differences (e.g., Chinook and steelhead were historically nearly absent from Coast Range tributaries).
Many salmonid populations are under stress (Table 2).

Anadromous Fish

Spring Chinook

Spring chinook salmon population trends have all been strongly downward since 1991, due partly to poor ocean conditions (ODFW and WDFW 1995). The high proportion of hatchery fish in the total return and on spawning grounds indicate that populations of chinook salmon are not self-sustaining. ODFW identified spring chinook salmon in the McKenzie River as the only remaining, naturally reproducing subpopulation (64 FR 14322). Most naturally spawning chinook in other areas above Willamette Falls appear to have been heavily influenced by hatchery fish.

Most of the spring chinook in the Willamette River spawn above Willamette Falls at Oregon City. The only significant run in the Willamette below the Falls is on the Clackamas River. Approximately 55,000 fish passed through ladders at the Falls April through June 1946 (the first year of counting), and 45,000 fish in 1947 (Mattson 1948). Adult spring chinook passing Willamette Falls remained steady, at approximately 26,000 during the 1950s, increasing to more than 30,000 fish during the 1960s and 1970s, and increasing again to approximately 63,000 around 1990. The combined historic annual spring chinook run in the Willamette and Sandy River basins was likely several hundred thousand adults (ODFW 1995a). The overall size of the Willamette spring chinook salmon run has fluctuated annually, but has not changed significantly on average since 1946.

Table 2. Listed, proposed, and candidate populations fish species in Willamette River basin, Oregon listed under federal Endangered Species Act (by population and Evolutionary Significant Units [ESU*])

Listed Populations	Status[1]	Federal Register Citation
Chinook Salmon (*Oncorhynchus tshawytscha*)		
Lower Columbia ESU	(T)	64 FR 14308; March 24, 1999 [2]
Upper Willamette River ESU	(T)	64 FR 14308; March 24, 1999 [2]
Chum Salmon (*O. keta*)		
Columbia River ESU	(T)	64 FR 14508; March 25, 1999 [2]
Steelhead (*O. mykiss*)		
Lower Columbia River ESU	(T)	63 FR 13347; March 19, 1998 [2]
Upper Willamette River ESU	(T)	64 FR 14517; March 25, 1999 [2]
Bull Trout (*Salvelinus confluentus*)		
Columbia River Distinct Population Segment	(T)	63 FR 31674; June 10, 1998
Oregon Chub (*Oregonichthys crameri)*	(E)	58 FR 53804; October 18, 1993
Proposed Populations		
Coastal Cutthroat Trout (*O. clarki clarki*)		
Southwestern Washington/Columbia River ESU	(T)	64 FR 16397; April 5, 1999 (NMFS); 64 FR 57534; October 25, 1999 (USFWS) [3]
Candidates for Listing		
Coho Salmon (*O. kisutch*)		
Lower Columbia River/Southwest Washington ESU		60 FR 38011; July 25, 1995
Possible Candidate for Listing		
Upper Willamette Cutthroat Trout (O. clarki clarki)		considered by USFWS [3,]

1 T = Threatened; E = Endangered [Note: none of the salmon or steelhead ESUs in the Willamette River basin are proposed or listed as endangered.]

2 Critical habitat was recently designated on February 16, 2000 (65 FR 7764).

3 USFWS now has jurisdiction over coastal cutthroat trout range-wide.

* "A population or group of populations that is considered distinct (and hence a "species") for purposes of conservation under the Endangered Species Act. To qualify as an ESU, a population must 1) be reproductively isolated from other conspecific populations, and 2) represent an important component in the evolutionary legacy of the biological species" (NMFS 1992)

Willamette spring chinook salmon are "Gulf of Alaska" migrants, subject to harvest in British Columbia and southeast Alaska ocean fisheries. Unlike upriver Columbia spring chinook, Willamette chinook appear to be highly vulnerable to ocean fisheries. Willamette spring chinook contribute extensively to ocean and in-river fisheries (Cramer et al. 1996), and a large share of the run entering freshwater is captured in sport and commercial fisheries: 15-20 percent in the lower Columbia, 20-30 percent in

the lower Willamette, and 10-35 percent in tributaries. High harvest rates coupled with low ocean survival may have resulted in substantial overharvest of Willamette spring chinook in many years.

Upper Willamette River chinook are one of the most genetically distinct groups of chinook in the Columbia River Basin. Historically, passage by returning adults over Willamette Falls was only possible during the winter and spring high flow periods. The early run timing of Willamette River spring-run chinook relative to other Lower Columbia River spring-run populations is likely an adaptation to flow conditions at the Falls. Chinook salmon begin appearing in the lower Willamette River in February, but the majority of the run ascends the Falls in April and May. Low flows during the summer and autumn months prevented fall-run salmon from accessing the Upper Willamette River Basin. Historically there was a late spring-run chinook salmon that ascended the falls in June. These fish were apparently much larger (25-30 lbs.) and older (presumably 6 year olds) than the earlier part of the run. (Mattson 1963) The disappearance of the June run in the Willamette River in the 1920s and 1930s was associated with the dramatic decline in water quality in the lower Willamette River. (NMFS 2000)

There are six major subpopulations of spring chinook (Table 3).

Table 3. Major subpopulations of spring chinook salmon

Clackamas Subpopulation: The Clackamas River currently accounts for about 20% of the production in the Willamette Basin. The production comes from one hatchery and natural production areas located primarily above the North Fork Dam. (NMFS 2000)
Molalla and Pudding Subpopulation: ...The original run is believed extirpated because of extensive logging, agriculture, and ocean harvest during the 1960s (Cramer et al. 1996). Hatchery releases were started in 1981 to restore the run. There have been no recent observations of spring chinook in the Pudding River subbasin (ODFW 1999a).
Santiam and Calapooia Subpopulation: 71 percent of spring chinook production is estimated to have occurred above Detroit Dam (Mattson 1948). All access to upstream spawning habitat was lost because the dam was built without fish passage facilities. Historically, 85 percent of the production of spring chinook in the South Santiam system occurred above Foster Dam (Mattson 1948); adults are currently released above Foster Dam by ODFW. By the 1970s natural production in the Calapooia was thought to be minimal to non-existent (ODFW 1990c).
Middle Fork Willamette Subpopulation: This subbasin had the largest run of spring chinook above Willamette Falls (ODFW 1992). Dexter and Fall Creek dams blocked access to about 80 percent of the subbasin's habitat (ODFW 1990f).
McKenzie Subpopulation: The McKenzie produced roughly 40 percent of the spring chinook run above Willamette Falls (Mattson 1948). Non-Willamette hatchery fish were stocked as early as 1902. However, since that time only Willamette stocks have been released into the McKenzie. Cougar Dam, built in 1962 on the South Fork of the McKenzie River, has blocked access to 25 miles of some of the most productive spawning habitat historically available. Adult fish were initially (1962-1964) trucked above the dam and released, but this practice was discontinued because of mortalities in the bypass system (ODFW 1990e).
Coast Fork Willamette Subpopulation: Native spring chinook were never abundant in the Coast Fork Willamette River subbasin (ODFW 1992). Dorena and Cottage Grove dams currently block upstream access to spawning areas. Also, low flows and warm water discharge from the dams likely limit downstream chinook salmon production (ODFW 1990d).

Spring chinook salmon originally had access to approximately 1,400 miles of stream habitat within the Willamette River basin as estimated by NMFS through summation of stream miles from maps in the early 1970s.

Spring chinook salmon spawned historically in the Coast Fork Willamette, Middle Fork Willamette, Clackamas, McKenzie, Calapooia, Santiam, and Molalla rivers (Connolly et al. 1992 a and b; Howell et al. 1988; and Wevers et al. 1992 a and b, NMFS 2000). In addition, small numbers may have spawned in tributaries of the Pudding River (e.g., Abiqua Creek; Wevers et al. 1992a) and in the upper reaches of Gales Creek in the Tualatin River (Murtagh et al. 1992b). (Figure 3)

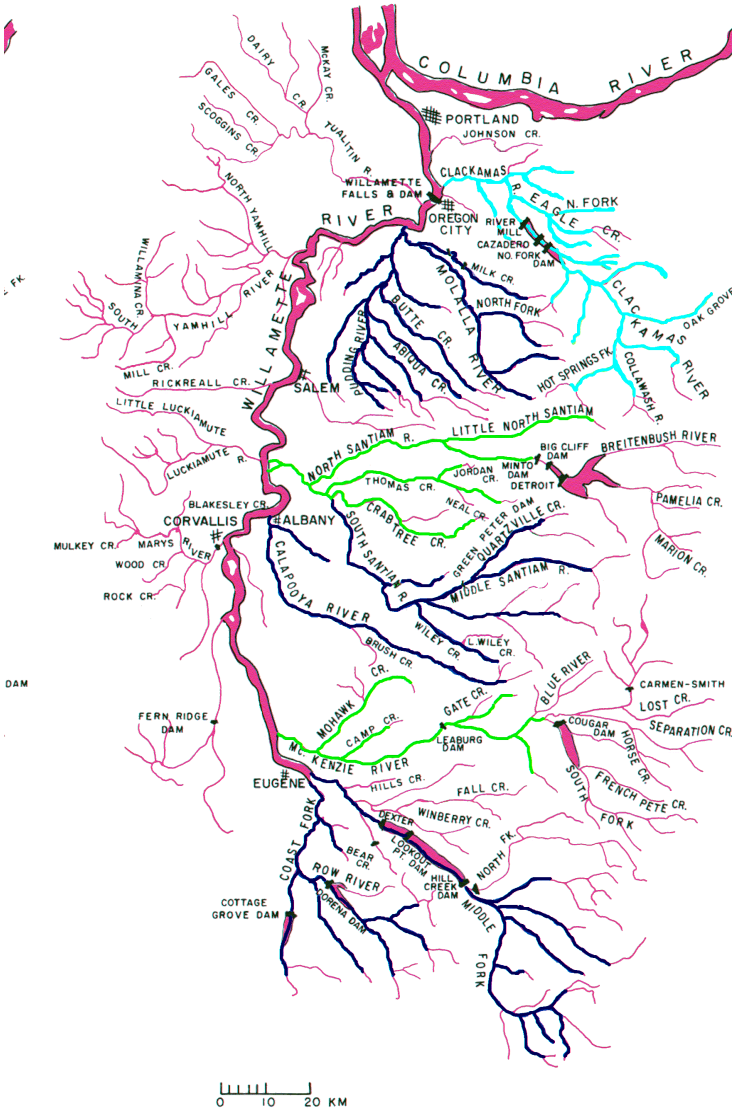


Figure 3. Current and historical spring chinook distribution. Green shows largely extinct populations; red shows existing. Clackamas population differentiated in blue. (Lichatowich 1999)

The Clackamas River historically contained a spring run of chinook salmon, but relatively little information about that native run exists. In a report to the U.S. Commissioner of Fisheries by Livingstone Stone based on stream surveys from 1875 to 1877, the Clackamas River was described as probably the most productive salmon stream in the Columbia River Basin. (Murtagh et al 1992a). However, as early as 1885 salmon runs were in decline:"... the salmon are not so plentiful now as they were, for some years ago the river was literally alive with Chinook salmon..." (Bairn 1886) Harvest and hatchery evidence suggests gillnetters caught 12,000 spring chinook on the lower Clackamas in 1893. (Taylor 1999) Currently, naturally spawning spring-run chinook salmon spawn from September to October (Olsen et al. 1992). The construction of the Cazadero Dam in 1904 and River Mill Dam in 1911 limited access to the majority of the historical spawning habitat for the spring run. In 1917, the fish ladder at Cazadero Dam was destroyed by floodwaters, eliminating fish passage to the upper basin (ODFW 1992).

The Clackamas River currently accounts for about 20% of the production in the Willamette Basin. The production comes from one hatchery and natural production areas located primarily above the North Fork Dam. The interim escapement goal for the area above the Dam is 2,900 adults (ODFW 1998a). This system is heavily influenced by hatchery production so it is difficult to distinguish natural from hatchery-origin spawners. Most of the natural spawning occurs above the North Fork Dam with 1,000- 1,500 adults crossing the Dam in recent years.

Both the McKenzie and the Middle Fork Willamette River subbasins were major natural production areas for spring chinook salmon in the upper Willamette River basin. Prior to dam construction, the McKenzie produced an estimated 40 percent of the spring chinook spawners above Willamette Falls (Mattson 1948). The Middle Fork Willamette's run accounted for roughly 21 percent of the spawning population above Willamette Falls in 1947 (Mattson 1948).

The Santiam River subbasin received 35 percent of the 1947 spring chinook salmon escapement above Willamette Falls, of which approximately 23 percent returned to the North Santiam River system and 12 percent to the South Santiam system (Mattson 1948). The mainstem Santiam River below the confluence with the North and South Santiam rivers also probably provided spring chinook habitat (Wevers et al. 1992).

Substantial natural production potential remaining in the Santiam subbasin in the late 1950s. (Willis et al. 1960) The North Santiam River was second only to the McKenzie River for chinook production in the Willamette River system at that time. From 1952 through 1959, an average of 1,400 adult chinook salmon were collected at the hatchery trap at Minto on the North Santiam River. The Little North Santiam River was estimated to be capable of supporting 5,000 to 10,000 fish. In a September 1946 spawning survey, 801 adult salmon were counted in the 8 miles on the Little North Santiam River from the mouth up to Elkhorn Falls; 273 chinook salmon redds were counted in the same reach in October 1954 (Willis et al. 1960).

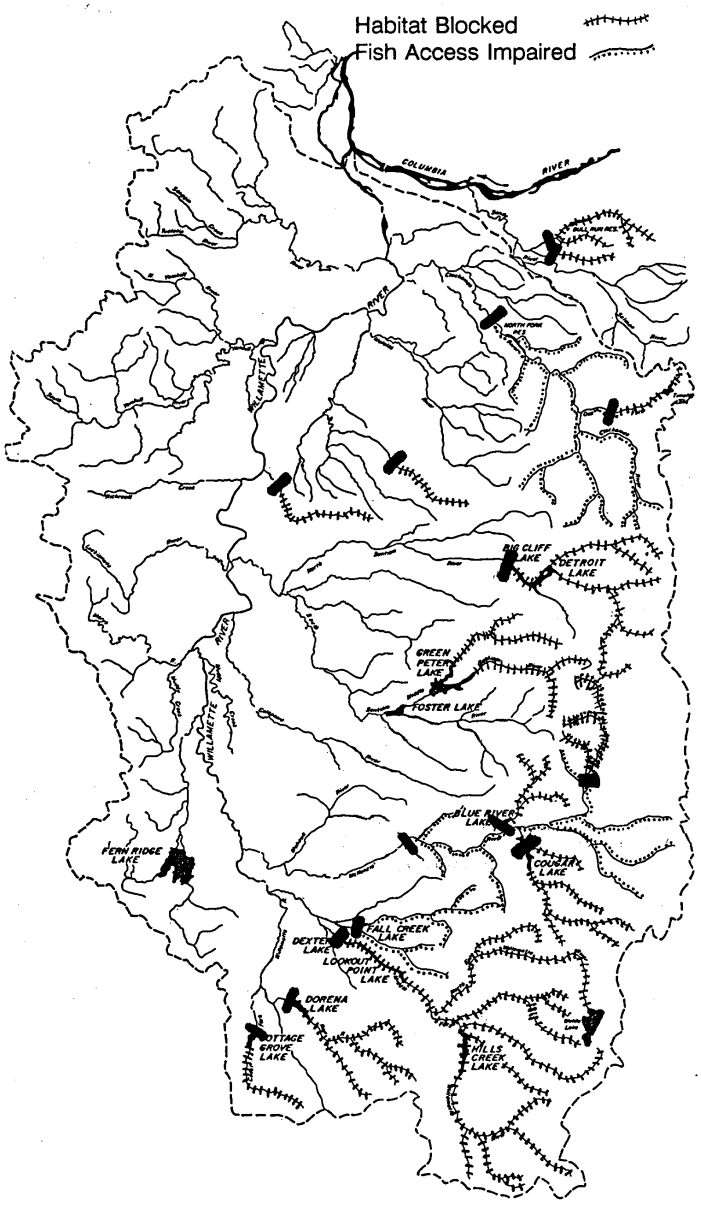


Figure 4. Spring chinook salmon habitat blocked by major Willamette dams (after Cramer et al. 1996)

Much historic spawning and rearing habitat has been inundated by reservoirs, or is not presently accessible above USACE dams (Figure 4). Bennett (1994) observed that dams constructed in the 1950s and 1960s on the Santiam, Middle Fork Willamette, and McKenzie rivers above Willamette Falls blocked over 400 stream miles that were originally the most important spawning areas for native chinook salmon.

Significant high quality habitat remains in the basin. ODFW lists the McKenzie, the North Santiam, Little North Santiam, and Clackamas (above North Fork Dam) Rivers as essential habitat for spring chinook (ODFW 1993). Nearly all present-day natural production of spring chinook salmon in the Willamette River basin occurs in the McKenzie (the only subbasin with significant production), Santiam, and Clackamas rivers (Willis et al. 1995; 64 FR 14308). A self-sustaining population may also exist in the North Santiam River basin. (Nicholas et al. 1995) NMFS has concluded that the naturally-spawned population of spring Chinook in the Clackamas River derives from the upper Willamette ESU. (64 FR 14308).

Limited natural production may occur in other subbasins including the Calapooia, Molalla and Pudding rivers, where hatchery spring chinook have been released to re-establish naturally reproducing populations. However, there is no evidence these populations are self-sustaining. The Middle Fork Willamette River and mainstem Willamette River do not provide much habitat suitable for spring chinook spawning (ODFW 1990b, 1990f). Some limited natural spawning may occur in Little Fall Creek, a tributary of Fall Creek, during high flow years (ODFW 1990f; Connolly et al. 1992a), and in the mainstem Willamette River above the mouth of the McKenzie River (Rien et al. 1992).

Designated critical habitat for upper Willamette spring chinook salmon presently extends upstream to Big Cliff, Green Peter, Blue River, Cottage Grove, Dorena, and Fern Ridge dams, and upstream of Foster, Cougar, and Dexter dams according to whether trap and haul operations move listed fish to habitat upstream (65 FR 7764).

Steelhead

Lower Columbia River Steelhead

Steelhead in the lower Willamette basin have been grouped by the National Marine Fisheries Service with the Lower Columbia River Steelhead Evolutionarily Significant Unit. This ESU includes tributaries to the Columbia River between the Cowlitz and Wind rivers in Washington and the Willamette and Hood rivers in Oregon. The ESU is composed of winter (fresh water entry November - April) and summer (fresh water entry May - October) strains. Steelhead populations in the Lower Columbia River ESU are genetically distinct from steelhead from the inland Columbia River basin, from the upper Willamette River, and from coastal streams in Oregon and Washington. (Busby et al. 1996) The Clackamas watershed may contain over 250 miles of winter steelhead habitat and it has been identified under the Northwest Forest Plan as high quality aquatic habitat. (StreamNet 1997) Designated critical habitat for this ESU includes the mainstem Willamette River below Willamette Falls (65 FR 7764).

Most stocks in the ESU for which data exist have been declining in recent years. However, a few have been increasing strongly, especially the non-native stocks of the Lower Willamette River and Clackamas River summer steelhead. (Busby et al. 1996). The Clackamas River is estimated to have winter and summer steelhead run sizes that are 1,300 and 3,500 fish, respectively (Busby et al. 1996). The trends for lower Willamette winter and summer steelhead runs are increasing at approximately 2.5 and 9.3 percent per

year, respectively. The trend for winter steelhead in the Clackamas River is slightly negative (-0.4 percent per year); for summer steelhead, the trend is positive (10.8 percent per year) Adults enter the lower Willamette and Clackamas rivers in February and March. Spawning begins in April, and peak activity occurs in May and June. (Busby et al. 1996).

Upper Willamette River Steelhead ESU

The Upper Willamette Steelhead ESU occupies the Willamette River and its tributaries upstream from Willamette Falls up to and including the Calapooia River. Upper Willamette River steelhead spawned mostly in the North and Middle Santiam River basins (Fulton, 1970), but also to some extent in tributaries up to the Calapooia River (ODFW 1995a). It is unlikely that steelhead were ever numerous in the McKenzie and Middle Fork Willamette river basins. (Busby et al. 1996). Figure 5 shows distribution of winter steelhead.

Native steelhead primarily inhabited tributaries on the basin's east side; cutthroat trout predominated in west-side streams (Busby et al. 1996). Cutthroat and rainbow trout co-occurrence is rare in the Willamette system. Therefore, winter steelhead in Coast Range streams may be naturalized rather than native (ODFW 1995a). However, steelhead probably had some historic distribution in westside tributaries to the Willamette River (e.g., Gales Creek in the Tualatin River basin) (Busby et al. 1996).

Major habitat blockages resulted from Big Cliff Dam (built in 1952) on the North Santiam River and from Green Peter Dam (build in 1967) on the South Santiam River. These dams, along with Dexter Dam, Dorena Dam, and Cougar Dam were identified by NMFS as the upper limit of steelhead distribution for critical habitat designation (64 FR 5750).

Determining population trends in this ESU is difficult because of limited historic distribution, the influence of hatchery summer run fish, and the limited amount of available information. ODFW has indicated that the South Santiam winter steelhead stock, an important wild population, may be unable to sustain itself.

Total numbers of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has ranged over the past several decades from approximately 5,000 to 20,000 spawners. The last run exceeding 15,000 occurred in 1988. Abundance during 1991-1998 was below 5,000 fish, and the run in 1992 was the lowest in 30 years. The estimated proportion of hatchery fish in natural spawning escapements ranges from 5 to 25 percent (64 FR 14524).

No estimates of pre-1960s abundance are available for this ESU. Based on 1989-1993 counts at Willamette Falls, the late-run (native) winter steelhead average run size was approximately 4,200, while early-run winter and summer steelhead averaged 1,900 and 9,700 respectively. NMFS estimated from angler catch data that approximate average escapements of winter steelhead were Molalla River, 2,300; North Santiam River, 2,000; and South Santiam River, 550.

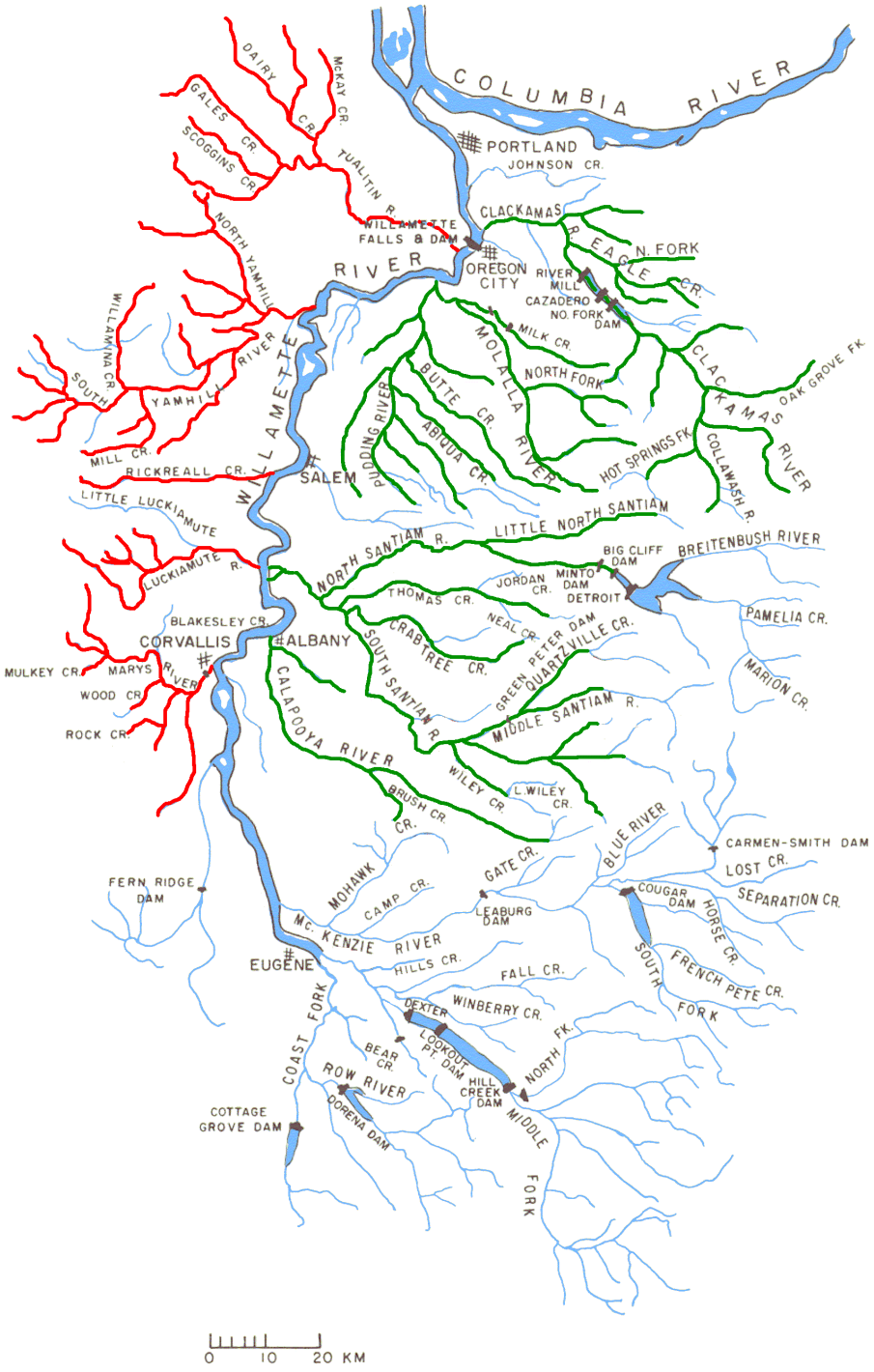


Figure 5. Winter steelhead distribution in Willamette Subbasin. Green indicates historic range; red probable recent introduction (Lichatowich 1999)

Designated critical habitat for upper Willamette River winter steelhead presently includes reaches and tributaries of the Willamette River upstream to, and including, the Calapooia River. In the Santiam River subbasin, critical habitat extends up to the base of Big Cliff and Green Peter dams (65 FR 7764).

Coho

Coho return to most Columbia River tributaries downstream from Bonneville Dam. With the exception of the Clackamas and Sandy River subbasins, wild coho populations downstream of Willamette Falls have probably been extirpated, because of high harvest rates, poor ocean conditions, habitat degradation, and other factors. The Clackamas population is the only one presently considered not to be endangered (Chilcote 1999).

The last significant, naturally-reproducing population of coho is in the Clackamas River above North Fork Dam. Native Clackamas coho begin returning to the river in October and spawn in February and March. From 1962-1979, thousands of non-native coho were introduced into the Clackamas River. Although hatchery releases above North Fork Dam have ceased, these fish persist as a naturally-spawning, self-sustaining population. These non-native coho begin returning to the Clackamas in August and spawn in November. The establishment of the early-run, non-native coho, coupled with over-harvest of the October portion of the run, has dramatically altered the coho return pattern at North Fork Dam since the early 1960s. The shift to a later time of passage at North Fork Dam for native coho corresponded to the increase in the gill net effort in late October and November (Cramer and Cramer 1994).

Native runs of Clackamas coho have been measured since 1950 by adult passage at River Mill (1950-1957) and North Fork (1958-present) dams. Total run size (native and hatchery) has ranged from 416 (1950) to 4,700 (1968). The native portion of the run has ranged from 309 (1958) to 3,588 (1968) (Cramer and Cramer 1994; Weitkamp et al. 1995). These escapement numbers do not include the contribution of native runs in the lower river. Lower Clackamas tributaries of Eagle, Deep, Foster, Clear and Richardson Creeks are thought to have some natural production of coho.

Coho salmon have also been released extensively throughout the upper Willamette River basins. More than 1.4 million eggs, 55 million fry, 5 million fingerlings, 8 million yearlings, and 40,000 adult spawners were released between 1951 and 1980. Releases occurred in all of the major river basins containing U.S. Army Corps of Engineer flood control projects (Williams 1983). Early-run hatchery stock are still released into Clackamas tributaries below River Mill Dam. In the early 1990s, approximately one million smolts were being released annually, producing an average return of 5,140 adults and 1,120 jacks since 1977 (ODFW 1992). Hatchery run returns to Eagle Creek hatchery were a record 39,000 fish in 2000 and up to 80,000 are expected in 2001.

Chum Salmon

Chum salmon were likely present in almost every river in the lower Columbia River basin. However, most of these populations disappeared by the 1950s (Rich 1942; Marr 1943; Fulton 1970). Population trends of Columbia River chum salmon have been

influenced strongly by harvest and hatchery production. ODFW's 1994 biennial report on wild fish identified chum salmon populations in the Columbia River as very depressed or extinct (Kostow 1995). The lower Willamette River basin has been designated as critical habitat (65 FR 7764). There is no evidence that chum salmon spawned historically above Willamette Falls. The species has been placed on the state of Oregon list of sensitive fish species (Kostow 1995), but does not receive substantial or specific protection.

Cutthroat trout (anadromous form)

There are two forms of cutthroat trout in the Willamette subbasin: anadromous ("coastal") and resident ("freshwater"). Coastal cutthroat trout from the lower Willamette River drainage appear more closely related to one another than to other groups. There appears to be differentiation between cutthroat trout from the Clackamas River basin and the Willamette River beginning in the vicinity of the North Santiam River basin and upstream (Johnson et al. 1999).

Coastal cutthroat trout in the lower Columbia River streams below Bonneville Dam are considered to be at moderate risk of extinction. (Nehlsen et al. 1991) Anadromous cutthroat trout in Oregon are believed to have declined significantly in the past decade, and population trends are presently downwards in many lower Columbia streams at rates estimated from 5 to 11 percent per year (Johnson et al. 1999).

Though long-term monitoring data are limited, creel surveys and fish counts at dams suggest that anadromous cutthroat populations may be experiencing widespread decline. (Nickelson et al. 1992) Coastal cutthroat in the Clackamas River are much less abundant than in the past, although freshwater forms appear abundant and well distributed throughout headwater and lower Clackamas River tributaries (Kostow 1995; Johnson et al. 1999).

NMFS concluded that the southwestern Washington/Columbia River ESU was likely to become endangered in the foreseeable future, based on concerns over widespread declines in abundance and small population sizes of anadromous cutthroat trout found throughout the lower Columbia River, as exemplified by near-extinction of anadromous cutthroat trout runs in the Hood and Sandy rivers. Reductions in the quantity and quality of nearshore ocean, estuarine, and riverine habitat, and recent increases in marine mammal and bird predators have probably contributed to declines, but the relative importance of these risk factors is not well understood (Johnson et al. 1999).

Lamprey

The Pacific lamprey is anadromous.. The lamprey enter streams from July to October; spawning takes place the following spring when water temperatures are between 50 and 60 degrees Fahrenheit. Spawning takes place in low gradient sections of water, with gravel and sandy bottoms. While in their 4-6 year larval stage lamprey occupy a special niche in the stream system, filtering microscopic plants and animals from the bottom sediments. They fall prey to a wide variety of species including trout, crayfish, and birds. Lamprey have similar freshwater habitat requirements as do some of the Pacific salmon, therefore they have encountered similar habitat problems. Though absolute historical population sizes of the lamprey are not known, it is clear that the fish, once a significant tribal subsistence food, have shown severe decline. (Streamnet 2001)

Pacific lamprey are a culturally important species and are a state protected species. Lamprey have experienced declines throughout much of their range. The Willamette basin population status is unknown, yet it is actively harvested for commercial use. Lamprey populations do however, appear to be doing better than populations in other basins. Currently there is no lamprey management plan for the Willamette Basin, though given its ecologic and cultural importance, developing one would seem an important priority.

Resident Fish

Resident native fish in the Willamette Subbasin include abundant populations of rainbow trout, as well as mountain whitefish and sturgeon. ODFW indicates the following species have also been documented in the Willamette Subbasin, but little is known about them: Western Brook Lamprey, Pacific Brook Lamprey, Chiselmouth, Tui Chub, Peamouth, Northern Pikeminnow, Longnose Dace, Leopard Dace, Speckled Dace, Redside Shiner, Largescale Sucker, Mountain Sucker, Bridgelip Sucker, Sandroller, Threespine Stickleback, Prickly Sculpin, Piute Sculpin, Shorthead Sculpin, Reticulate Sculpin, Torrent Sculpin. Recent investigations suggest that certain populations of speckled dace and of McKenzie rainbow trout may be sufficiently genetically distinct to qualify as new subspecies.

Information is provided below on resident fish populations that are in decline, including bull trout, Oregon chub, and cutthroat trout.

Bull Trout

The historic record, although limited, documents bull trout in the Clackamas River, North Santiam River, South Santiam River, McKenzie River, Middle Fork Willamette River, and Long Tom river basins (Goetz 1994). It is unlikely the Long Tom River ever supported a bull trout population because of the low elevation of its headwaters and subsequent lack of very cold water required by bull trout for spawning and rearing. Only one bull trout has been documented in the Long Tom based on ODFW creel records. The U.S. Fish and Wildlife Service listed bull trout in the Columbia River Basin (including the Willamette) as threatened in June 1998. (63 FR 31647).

Bull trout populations are considered “probably extinct” from the Clackamas and Santiam Basins by Oregon Department of Fish and Wildlife (Buchanan et al 1997). The ODFW continues to survey for bull trout in these basins.

Recent (since 1990) sightings in Hills Creek Reservoir suggest a few bull trout persist in the Middle Fork Willamette Basin, but it is also considered “probably extinct.” (Buchanan et al 1997). Goetz (1994) noted that bull trout in the Middle Fork Willamette River basin at that time occupied approximately 15 percent of their former range. (Taylor and Reasoner 1998).

The remaining stronghold for Willamette Basin bull trout is the McKenzie River Subbasin where three fragmented, local populations persist. Total adult abundance is estimated to be under 300 individuals. According to Buchanan et al (1997) the status of the bull trout in the mainstem McKenzie/Anderson Creek population is considered “of special concern”, and the populations in South Fork McKenzie and in Trail Bridge Reservoir are considered “high risk”. Historically, the McKenzie River probably

supported one or two fluvial populations prior to dam construction. Cougar Dam on the South Fork McKenzie River and Trail Bridge Dam on the mainstem McKenzie prevents interaction between the three bull trout populations.

Oregon Chub

Oregon chub, a small minnow species, prefer still water areas such as backwaters and sloughs, and are endemic to the Willamette River basin. Historically, Oregon chub were found throughout the Willamette subbasin between Oregon City and Oakridge, in the Clackamas, Molalla, South Santiam, North Santiam, Luckiamute, Long Tom, McKenzie, Mary's, Coast Fork Willamette, Middle Fork Willamette, and mainstem Willamette rivers.

Only 18 naturally occurring populations remain in the Santiam River, Middle Fork Willamette River, and in several smaller tributaries to the mainstem Willamette River. Eight of these populations exceed 500 fish, and nine number fewer than 100 individuals. Eight populations have been reintroduced recently in the Middle Fork Willamette (3), Santiam (2), Mid-Willamette (2), and McKenzie (1) subbasins. Four introduced populations total 500 or more fish. Currently eight populations meet the downlisting criteria (>500 fish and stable or increasing abundance trend for at least 5 years) (USFWS 1998a).

Current chub abundance appears related to the degree of connectivity of river habitat. (Scheerer 1999). Isolated habitats have the greatest densities. More-connected habitat seem to be more accessible to competing and predatory non-native fish species. Consequently, the number of chub is inversely-related to the number of non-native species.

While population trends of Oregon chub vary, several broad patterns are apparent (Scheerer et al. 2001):

- Populations in the Santiam system are declining, or recently extirpated in some cases;
- Populations in the Middle Fork Willamette River are stable or increasing in abundance;
- Populations in tributaries to the mainstem Willamette River are stable or increasing in abundance.

Cutthroat Trout (freshwater):

Cutthroat are present in all subbasins of the Willamette River above Willamette Falls, including the Long Tom River (Nicholas 1978). The upper Willamette River has probably never supported a substantial anadromous population of cutthroat trout; the primary life-history form above Willamette Falls appears to be freshwater migratory, a type that seems relatively rare below the falls. (Johnson et al. 1999) The presence of *Ceratomyxa shasta*, a parasite, in the lower Willamette River below the confluence of the Marys River is thought to effectively block the downstream migration of freshwater coastal cutthroat trout. (Johnson et al. 1999). Cutthroat are the only native trout on west side tributaries of the Willamette River, and on the east side tributaries they tend to be more abundant than rainbow only in the upper portions of the basins.

Occurrences in the Clackamas River are much less abundant than in the past when coastal cutthroat trout were described as abundant and well distributed throughout headwater and lower Clackamas River tributaries (Kostow 1995; Johnson et al. 1999) Nicholas (1978) found reports of good sport fishing for cutthroat in the mainstem Willamette River above Independence in the 1920s and 1930s, but the fishery was later eliminated by pollution. The population of cutthroat rearing in the Willamette River above Corvallis has rebuilt since the 1960s after pollution was curtailed.

Wildlife

Eighteen species have been extirpated from the Willamette since 1850 (Institute for the Northwest 1999), including the California condor, gray wolf, and Columbian White-tailed deer. The Willamette Subbasin, however, continues to offer valuable habitat that supports abundant numbers of a variety of species, including black-tailed deer, black bear, Roosevelt elk, and waterfowl. Because of habitat alteration and other causes, a number of species are either threatened or in decline. Some of these species are described in Table 4.

Table 4. Selected threatened or imperiled wildlife species of the Willamette Subbasin

Columbian White-tailed Deer (*Odocoileus virginianus leucurus*): Formerly common in bottomland and prairie woodland habitats throughout the Columbia, Willamette, and Umpqua Basins. By the early 1900s, the species was extirpated over most of its range, except in the Lower Columbia River and in Douglas County. Its decline was attributed to the conversion and loss of habitat for agriculture and urbanization, as well as to uncontrolled hunting. Riparian areas along major rivers are the preferred habitat for this threatened species. The possibility of reintroducing this species to the Willamette basin is being considered by the U.S. Fish and Wildlife Service.
Bats: Twelve of the 15 species which occur in Oregon are found in western Oregon; 6 are classified as sensitive species--indicating populations and critical habitat may be declining or that very little information is available regarding their population status or habitat needs. While hollow snags, caves, and other natural features can still be found in forested environments, in some cases, anthropogenic features such as attic, barns and even bridges are important roost areas in agricultural and urban environments.
Land birds: The loss and alteration of historic vegetation communities has impacted landbird habitats and resulted in species range reductions, population declines, and some local and regional extirpations. In western Oregon and Washington, 50 species have significant recent (1980-1998) and/or long-term (1966-1998) declining trends based on Breeding Bird Survey (BBS) data, while only 16 species have significantly increasing trends. Several other species which lack sufficient BBS data are considered by many to be declining (e.g., Oregon vesper sparrow, streaked horned lark, northern harrier). Additionally, formerly common species such as burrowing owl, Lewis' woodpecker, and yellow-billed cuckoo have been extirpated as breeding species from parts or all of the Westside Lowlands and Valleys. (Partners in Flight 2001)
Marbled Murrelet(Brachyramphus marmoratus): A small, robin-sized diving seabird that feeds mainly on small fish and invertebrates and breeds inland. It nests on large limbs of mature conifer trees in low-elevation, older forests, typically within 50 miles of the shore. Some marbled murrelet habitat exists in the Coast Range portion of the Willamette basin. Declines have been attributed to high rate of habitat loss and fragmentation, as well as mortality associated with net fisheries and oil spills.

Bald Eagle (Haliaeetus leucocephalus): Bald eagles breed throughout the Pacific Northwest and winter from the Alaska panhandle southward. In 1999, there were 343 known occupied breeding territories in Oregon and the Washington portion of the Columbia River Recovery Zone (Isaacs and Anthony 1999). They are most abundant during the winter when there is an influx of birds from the north, but there are substantial spring and summer nesting populations. Bald eagles occur throughout the Willamette Valley, with a significant wintering population in the Coburg Hills, east of Eugene.
Northern Spotted Owl (Strix occidentalis): Habitat typically has well-closed, multi-layered, multi-species canopy dominated by large overstory trees; a high incidence of large trees with various deformities; large accumulations of fallen trees; and sufficient open space below the canopy for owls to fly These attributes are usually found in old growth and at times in younger forests. (Thomas et al. 1990). The forested uplands of the Willamette subbasin include substantial existing and potential spotted owl habitat areas.
Great Grey Owl: The great grey owl is considered rare or uncommon throughout its range in Oregon. Historical records do exist for the Willamette Valley but no recent documentation has occurred. Since 1978, great grey owls have been reported on the west side of the Cascades on the Willamette National Forest (Platt and Goggans 1991). Expansion into this part of the Cascade range may be due to clear-cut logging which produced an increase in open habitat.
Harlequin Duck: Recent surveys determined that this species continues to occupy most of its historic range from the Columbia River south to the Middle Fork Willamette River in Lane County. (Thompson et. al, 1993). Some of the areas previously thought to have harlequin ducks appear to no longer be suitable due to disturbance created by developed land adjacent to the stream. Population estimates number in the hundreds rather than thousands, so the species is at higher risk than other Willamette waterfowl species
Spotted Frog: Historically, spotted frogs occupied areas in Linn, Lane, Benton, Multnomah, Lane, Columbia and Clackamas counties at ponds and lakes, some near rivers. Recent surveys suggest that this species may be extirpated from much of its former range. Only one known site, at 4,000 feet elevation, still exists. With a known upper elevation limit of 5,000 feet it is clear that the species had been driven to just the fringe of its range. Decline factors include hydrologic modifications, habitat loss, and non-native predatory fish and bullfrogs (Hayes 1994).
Foothill Yellow-legged Frog: Foothill yellow-legged frogs once inhabited many river basins draining to the Pacific Ocean, from southern California to northwest Oregon (Borisenko and Hayes 1999). Of almost 100 historic records of the frog in Oregon 14 come from the Willamette Basin. Currently 10 of the 14 are now considered to be partially or entirely isolated from the Willamette River and it's tributaries or inundated by Dorena, Foster and Lookout Point reservoirs. Frogs are currently found at only one of the historic locals within the Willamette basin. Decline factors include changes to hydrology from the large reservoirs, increased sediment and degraded water quality.
Oregon Slender Salamander: Oregon slender salamanders are endemic to the west-slope of the Cascades (Vesely 1999). They are most common in mature forests but may be found in very limited numbers in younger forests. The species is classified as sensitive largely due to the lack of information about population trends. It is thought, however, that forestry practices may contribute to degradation of suitable habitat through out-right removal of forests and reduction in forest canopy.

Red-legged Frog: The northern red-legged frog has been reduced or extirpated from much of its historic range in the Willamette Valley (Pearl 1998). The remaining populations appear to be few and scattered with significant declines since the mid-1970's (Nussbaum et. Al. 1983; St, John 1987; Blaustein and Wake 1990). Decline factors include alteration of hydrology, runoff from agricultural and urban developments, and non-native predatory fish. The red-legged frog inhabits both terrestrial and aquatic environs. Further research is necessary to determine its overall status in the Basin with particular attention paid to the Willamette Valley.
Western Pond Turtle: This turtle historically ranged from Puget Sound to Baja California (Holland 1994). Several historic records are known from throughout the Willamette Basin. Western pond turtles require both terrestrial and aquatic environs, including permanently flowing rivers, ephemeral streams, lakes,, wetlands, and reservoirs. The common variable is a relatively warm water temperature and refugia (logs, rocks, vegetation, undercut banks). Western pond turtles have a variety of predators including bullfrogs and non-native fish. Humans have impacted turtles through direct harvest for food or target practice, development of wetlands and nesting areas, traffic mortality, and alteration of hydrology. Western pond turtles are listed as a Sensitive species in Oregon with small populations relatively isolated from each other with a preponderance of older individuals. Reproduction and habitat loss are thought to be limiting factor in many of the populations.
Fender's Blue Butterfly (*Icaricia icarioides fenderi*) is a Willamette Valley endemic subspecies considered extinct until collected in 1985. It uses Kincaid's lupine as its primary larval food plant. Exotic grasses can preclude butterflies from using this source (Hammond 1994). Remaining upland prairie is extremely fragmented and populations of Fender's blue butterfly so small, that any recolonization from other populations is not expected to maintain the population. Extinction of remaining small populations is expected from localized events (63 FR 3863).

Habitat Areas and Quality

Habitat Types and Species Associations

The Willamette Subbasin has a tremendous variety of habitat types, ranging from floodplain wetlands to alpine meadows. In spite of the tremendous alterations in the landscape, it still contains significant elements of biodiversity.

For example, the valley is located in the Pacific Flyway and provides essential habitat for migrating and wintering waterfowl, shorebirds and neotropical migrants, and significant breeding duck populations. More than 30 species of ducks, geese and swans, and a large variety of shorebirds use Valley wetlands on a regular basis. More than 300,000 wintering waterfowl, including seven subspecies of Canada geese, winter in the Valley. (Oregon Wetlands Joint Venture 2001) The state's Sauvie Island Wildlife Area near Portland, for example, attracts peak concentrations of more than 150,000 waterfowl in the fall and is used by more than 250 species of birds. (Oregon Progress Board 2000)

The Willamette River and tributaries still support salmon and steelhead runs, though many are in serious decline. Aquatic habitats support limited populations of several at-risk species including western pond turtle, painted turtle, clouded salamander, western toad, northern red-legged frog, foothill yellow-legged frog, and the endangered Oregon chub. The few remaining fragments of native wetland prairie support several threatened, endangered, or sensitive plant species. (Oregon Wetlands Joint Venture 2001) For example, the 330 acre Willow Creek Preserve in West Eugene supports more than 200 species of native plants, 100 bird species, and 25 species of butterfly. (Oregon

Progress Board 2000) Restoration of hydrology and native floodplain plant communities at Tualatin River National Wildlife Refuge (USFWS) have resulted in increases in both diversity and abundance of fauna and flora. Over 140 new vertebrate species have been recorded using the refuge with populations of wintering waterfowl peaking at 50,000. Bald eagle, peregrine falcon, American bittern, and greater sandhill cranes are but a few representative species which have reclaimed historical use of restored floodplains.

A variety of classifications are used to describe the Willamette Subbasin's habitat and vegetation types. One of the broadest schemes is that of ecoregions. Ecoregions defined by the U.S. Environmental Protection Agency consider physiography, geology, soil, climate, potential vegetation, and land use and cover. EPA has developed a four-level system that describes ecoregions in increasing detail. The "Level IV" (or most detailed level) ecoregions are shown for the Willamette Subbasin in Figure 6.

These ecoregions support different kinds of habitat. On the valley floor, the Willamette River and Tributaries Gallery Forest ecoregion occupies the floodplains. It has deep, fertile, silty-clay soils, and supports riparian forests of cottonwoods, alder, Oregon ash, bigleaf maple and Douglas-fir. It is ringed by the Prairie Terrace ecoregion which once hosted prairies and savannas of Oregon white oak, Oregon ash and Douglas-fir. Agriculture mixed with urban and rural development now occupies this region. The Valley Foothills ecoregion is characterized by Oregon white oak and madrone on dry sites; Douglas fir and western red cedar on wet. Current land use supports forestlands, orchards, vineyards, Christmas tree farms, as well as rural residential development. The Western Cascades Lowlands and Valleys region is a volcanic landscape with conifer forests of Douglas-fir, western hemlock, western red cedar, interspersed with alder and vine maples. Forestry, recreation, and pastureland are prevalent land uses. The Western Cascades Montane Highlands occur at higher elevations where persistent snow creates an environment conducive to true firs and mountain hemlock. (Pacific Northwest Ecosystem Consortium 1998)

Evaluated collectively, the scope of at-risk taxa and habitat in the Willamette Basin is great. While twenty taxa in the Willamette Valley are listed under the federal Endangered Species Act, 155 more are thought to be at some level of risk of extinction. Fifty-nine at-risk taxa, both listed and non-listed, are considered globally-imperiled or globally- critically-imperiled, with fewer than twenty populations remaining worldwide. The high number of at-risk taxa in the Willamette Valley reflects the extent of habitat loss and degradation, which is estimated to have affected ninety-nine percent of the Valley's land area. Half the plant associations or community types described from the Willamette Valley are considered at-risk; nearly thirty percent are globally imperiled, or globally critically imperiled. For many taxa and plant associations, survival depends on conservation efforts in the Willamette Valley. Thirteen at-risk taxa are known to occur only in the Willamette Basin; eight more only extend outside the Willamette Basin into the rapidly developing Puget Trough of Washington. The Willamette Valley makes up over seventy-five percent of the range of distribution of seventy-one percent of the at-risk plant associations. (Nature Conservancy 2000)

ODFW has identified particular species of fish and wildlife as key indicators of change in Willamette Valley habitat types, as shown in Table 5.

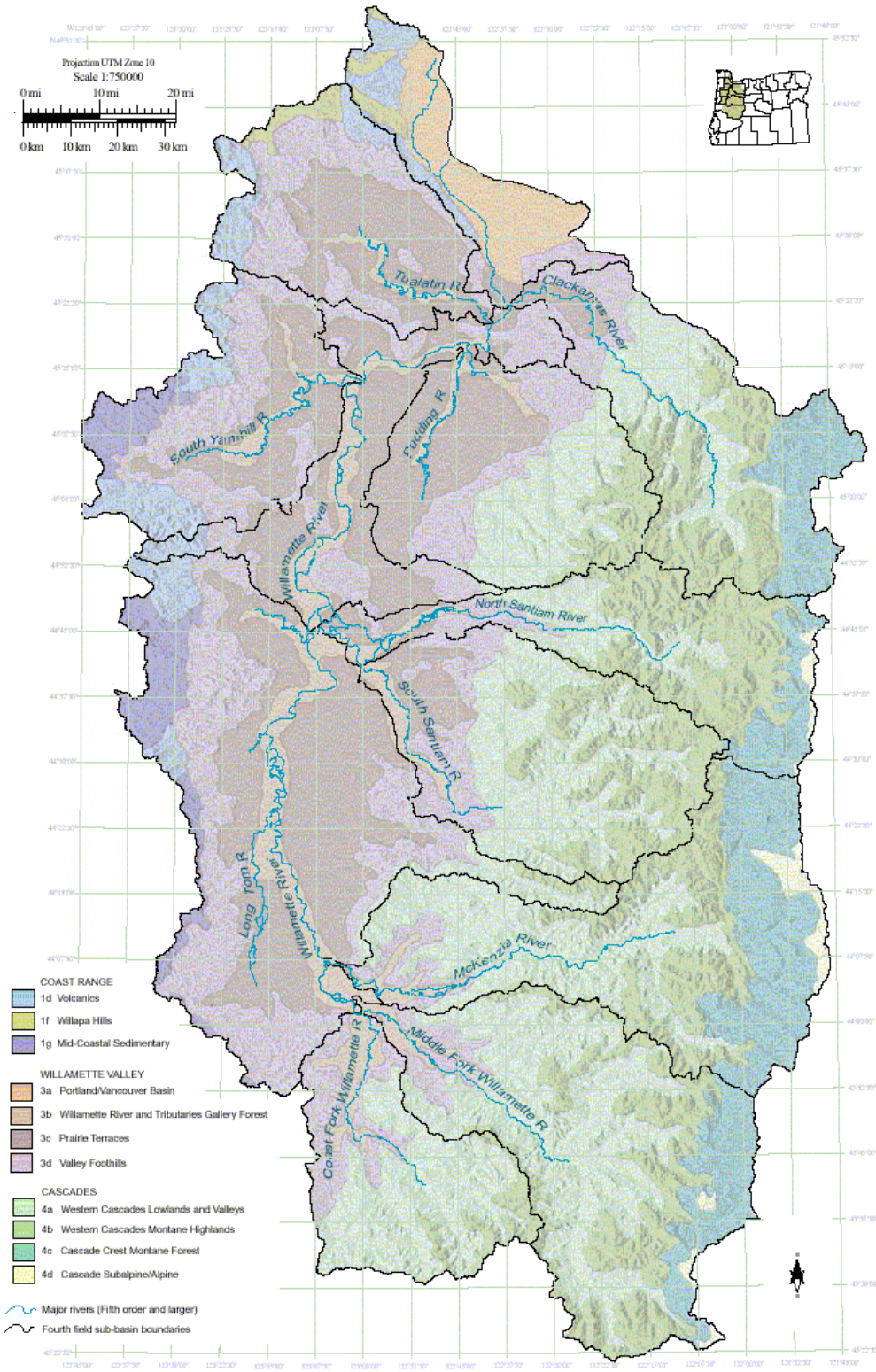


Figure 6 . Willamette Subbasin ecoregions (EPA Level IV; after J.M. Omernick)

Table 5. Indicators species in Willamette Valley habitat types

Habitat Type	Indicator Species
Aquatic (rivers, lakes, & ponds)	Fish: Bull, cutthroat, & rainbow trout, steelhead, chinook & coho salmon, Oregon chub, lamprey, sandrollers Wildlife: Pond turtles, red-legged frogs, painted turtles
Riparian	Great Blue Herons, yellow warblers, beavers, bald eagles
Wetland	Wood ducks, pond turtles, red legged frogs, painted turtles, dunlins
Grassland	Western meadowlarks, western bluebirds, rattlesnakes, streaked horn lark, Vesper sparrow
Oak Woodland	White breasted nuthatches, Acorn woodpeckers, Band-tailed pigeons
Hardwoods	Silver-gray squirrel
Conifer	Black-tail deer, elk
Rocky Habitats (cliffs, caves, & talus)	Rattlesnakes, Townsend's big-eared bat

Source: ODFW Draft Willamette River Basin Operational Plan

Aquatic habitats are of particular importance in the Willamette Subbasin, especially in relation to its anadromous fish. The most important stream habitats for salmon and steelhead occur in the Clackamas, Santiam, and McKenzie watersheds. (Existing habitat and fish distributions are described in more detail under Fish and Wildlife Status in the Fish and Wildlife Resources Section of this Summary.) In spring, melting snows create cold, faster flowing streams. Ecosystem productivity in upland streams is relatively low, with aquatic insects subsisting on material that falls into running water. In larger, slower tributaries, more plant material is produced and productivity increases. (Institute for the Northwest 1999).

Cold water fish species (including spring chinook, winter steelhead, cutthroat, and bulltrout) adapted to the variation of the Willamette system. At least 61 species of fish inhabit the Willamette River Basin, but nearly half are introduced (USGS 1997b). Many of these introduced species thrive in the warmer, more polluted water of the mainstem and large tributaries of the Willamette – sometimes to the detriment of salmonids. Comprehensive studies of the fish biota of the Willamette undertaken in the mid-1940s, late 1980s, and early 1990s have found that salmon are not the most abundant fish in the Willamette. There are far more northern pike minnow, crappie, bass and walleye, among others. In addition, many amphibians depend on the valley's aquatic systems; fourteen of which are considered at risk. (Institute for the Northwest 1999)

Major Forces Affecting Habitat Extent and Quality

Over the past 150 years, prairies have been largely converted to farmland, as have most of the riparian forest and wetlands. Large rivers have been dammed and channelized to reduce flooding. Open oak savannas and oak conifer woodlands have been logged or become closed-canopy forests. A growing urban population has replaced agriculture in many areas, and rural residential development continues to encroach on remaining woodlands. Due to the pattern of development, the Willamette Valley is the most altered

ecoregion in Oregon, with the most significant natural processes--fire and flooding--almost entirely excluded. (Oregon Progress Board 2000) (Habitat conversion is described in more detail under the Limiting Factors section of this Summary.)

As described in detail in Factors Specific to Hydropower Generation under Limiting Factors, the damming of major streams in the Willamette subbasin has severely affected the floodplain ecosystems of tributaries and mainstem Willamette. Effects include disruption of flow, water temperature change, downstream erosion, channel simplification, wetland loss, and habitat inundation by reservoirs.

The impacts of fire suppression in both lowlands and uplands has also led to major ecosystem changes. Historically, fire played a central role in most Pacific Northwest ecosystems. Fires originated largely from Native Americans' land management practices where from about 8000 to 150 years ago, they shaped Willamette habitats (Boyd 1986). Extensive fires were ignited by the Calapooya Indians in the late summer and early fall as part of their cultivation and collection of food plants and to assist with hunting efforts. Settlers documented frequent widespread fires (every one-to-three years) which probably burned into the forests, keeping Valley margins open and suppressing growth of Douglas fir. In the Upper Basin, the frequency of fires is not as well documented, but they were probably less frequent and less intense. (Nature Conservancy 2000) One effect of frequent burning by Native Americans was to prevent seedlings of woody plants from establishing in prairie and savanna habitats (Boyd 1986, Boag 1992).

Once fire ceased, many prairies, savannas, and seasonal marshes were invaded by trees and shrubs, and converted to forest stands. As early as 1852, young firs and oaks were reported growing up on what had previously been prairie. (Pacific Northwest Ecosystem Research Consortium 1998) In addition to reductions in acreage, the foothill savanna/prairie and open woodland types have changed markedly from presettlement times due to shifts in species composition and increased tree density that have resulted from fire suppression (Agee 1993). Suppression of fires allowed many foothill woodland stands to become dominated by closed-canopy Douglas fir (Towle 1983). This altered the understory to more shade tolerant herbaceous plants and resulted in an increase in shrub abundance, such as poison oak. (Nature Conservancy 2000)

In the Cascades Ecoregion, intensive timber harvest has left much of the Douglas-fir zone, especially private lands, in early successional stages (younger than 40 years). These stands lack key habitat attributes that would have existed historically after major fires, such as remnant large trees and snags, shrubs, and a spectrum of stand densities. In mid- to lower elevations of the Cascades, plantations established after timber harvest have higher tree densities and more simplified forest structure than what would result from natural disturbance. (Oregon Progress Board 2000)

Riparian areas have also been greatly changed by fire suppression and other management activities. According to the US Forest Service, the major factors that have influenced riparian condition in the western Cascades are (1) fire, (2) floods, (3) timber harvest and log transport, (4) road construction and residential development, and (5) flow regulation by dams. Because of their resistance to fire, prior to logging riparian areas had

relatively high densities of large conifer trees. Timber harvest in streamside areas resulted in a 50 percent or more loss of the large conifers in many drainages of this ecoregion. (Oregon Progress Board 2000)

There are numerous non-native aquatic and terrestrial plants in the Willamette Subbasin which have negatively impacted fish and wildlife habitat. The most widespread include Himalayan blackberry, English ivy, Scotch broom, clematis, and purple loosestrife. Recently, giant hogweed and kudzu have been discovered in the area. The spread of such invasive plants has a profound economic impact on agricultural production, natural resource management, fire suppression, and recreation. The Oregon Department of Agriculture estimates invasive weeds are costing Oregon citizens a total of about $100 million per year. (Oregon Department of Agriculture 2001) Discussions have begun at the local and regional levels in the Willamette Subbasin regarding the establishment of county weed boards and the development of a coordinated effort to gather information on the occurrence and spread of invasive species and share information on effective control methods.

Bullfrogs are impacting native fish and amphibian populations, and Scotch broom is threatening a number of sensitive prairie species such as Kincaid's lupine, Fender's blue butterfly and white rock larkspur. Non-native perennial grasses, especially reed canary grass, tall fescue, tall oatgrass, velvet grass, and orchard grass, invade native grasslands, changing their structure and crowding out natives. Purple loosestrife is a major threat to floodplain wetlands because of its ability to dominate all native wetland species and form monotypic stands with no biological diversity. Nearly half the fish in the Willamette River are non-native, posing a significant threat to Oregon chub, bull trout and native amphibians. (Willamette Restoration Initiative 2001)

A reflection of the fundamental changes to the subbasin's natural habitat is the number and type of at-risk plant species (Table 6).

Table 6. Threatened and endangered plant species of the Willamette Subbasin (includes both state and federal designations of threatened, endangered, and species of concern)

Scientific Name	Common Name	County Of Occurrence
Aster curtus Cronq.	White-topped aster	Clackamas, Lane, Linn, Marion, Multnomah
Aster vialis (Brads.) Blake	Wayside aster	Lane, Linn
Castilleja levisecta(Greenm.)	Golden paintbrush	Linn, Marion, Multnomah
Delphinium leucophaeum Greene	White rock larkspur	Clackamas, Marion, Multnomah, Washington, Yamhill
Delphinium pavonaceum Ewan	Peacock larkspur	Benton, Lane, Linn, Marion, Polk, Washington, Yamhill
Erigeron decumbens Nutt. var. *decumbens*	Willamette Valley daisy	Benton, Clackamas, Lane, Linn, Marion, Polk, Washington, Yamhill
Howellia aquatilis A. Gray	Howellia	Clackamas, Marion, Multnomah
Lomatium bradshawii	Bradshaw's lomatium	Benton, Lane, Linn, Marion
Lupinus sulphureus Douglas ssp. Kindaidii	Kinkaid's lupine	Benton, Lane, Linn,
Marion, Polk, Washington, Yamhill	Threatened	Threatened
Sidalcea nelsoniana Piper	Nelson's sidalcea	Benton, Linn, Marion, Polk, Washington, Yamhill

(Source: Willamette Restoration Initiative 2001*)*

Watershed Assessment

Watershed assessments are being conducted at a number of scales and by a variety of parties in the Willamette basin. These activities are consistent with and support the "RPA" habitat action for Restoring Tributary Habitat as found in the Columbia Basinwide Salmon Recovery Strategy:

> *"With the Northwest Power Planning Council, develop subbasin and watershed assessments and plans; ensure that assessments and plans are coordinated across nonfederal and federal ownerships and programs."*

Federal agencies conduct watershed analyses under protocols established by the Northwest Forest Plan (more fully described under Existing Goals, Objectives, and Strategies). Many state agencies and watershed groups employ watershed assessment methodologies developed by the Oregon Watershed Enhancement Board in the Oregon Watershed Assessment Manual.

The Oregon Watershed Assessment Manual includes information needed for a broad-scale screening that can be applied to Oregon's ecoregions to help understand regional watershed patterns. In the Willamette Subbasin, the manual includes information on Willamette River and Tributaries Gallery Forests, Prairie Terraces, Valley Foothills, Western Cascades Lowlands and Valleys, Western Cascades Montane Highlands, Cascade Crest Montane Forest, Cascade Subalpine / Alpine. Assessments conducted according to the manual are directed at broad-scale patterns and use water quality and fish habitat as indicators of watershed health. They identify:

- Areas with the highest potential for improvement
- High-priority areas for restoration
- The types of improvement actions that will be most effective

Assessments of the Entire Willamette Subbasin

A number of efforts have recently characterized aspects of watershed health at the subbasin scale.

The Oregon Department of Environmental Quality commissioned a study of the health of the entire length of the Willamette River. The study found health progressively diminished downstream, with upper reaches in good health and the lower reaches in poor health. (Tetra Tech. 1995) A similar finding was reached by a U.S. Geological Survey water quality study (Wentz et al. 1998). These findings are also addressed under Water Quality in the Limiting Factors section of this Summary.

In addition, in 1997 the Willamette Basin Task Force issued a report and a series of recommendations on the health of the Willamette watershed. The report identified three findings: 1) that the health of the watershed is at risk; 2) that the lack of a coordinated, basin-wide strategy for watershed management often prevents cost-effective solutions; and, 3) that economic and environmental problems will multiply with a corresponding loss of local control if coordination is not improved. To address these findings, the Task Force recommended creating an on-going, coordinated structure (the Governor responded by establishing the Willamette Restoration Initiative), increased incentives and adequate funding to pursue strategic investments, and increasing public involvement. (Willamette River Basin Task Force 1997).

The Pacific Northwest Ecosystem Research Consortium has also conducted a very detailed assessment of land use/land cover changes and effects on habitat through its Willamette Basin Alternative Futures Project. The Pacific Northwest Ecosystem Research Consortium was formed by the Environmental Protection Agency in 1996. Its goal was to increase understanding of the relationships among people, and, water, and other life in the Willamette Basin, and the cumulative effects of decisions made across the entire landscape.

The Consortium's research emphasis was on describing both historical (circa 1850) and current (circa 1990) natural and cultural conditions and trends. Based on this information, the Consortium developed three alternative future scenarios— that is, spatially explicit representations (maps) of the combined results of policy decisions regarding urban, rural residential, agricultural, forestry, and natural lands and associated water uses through the year 2050:

- The Plan Trend scenario represents the expected future landscape if current policies are implemented as written or, where no written policies exist, recent trends continue.
- The Development scenario reflects a loosening of current policies, across all aspects of the landscape, to allow freer rein to market forces.
- The Conservation scenario places greater emphasis on ecosystem protection and restoration, although still reflecting a plausible balance between ecological, social, and economic considerations as defined by the stakeholders.

The Consortium then evaluated the likely effects of these long-term landscape changes, from pre-Euro American settlement through 2050,on four selected resources of concern: water availability and use; ecological condition of streams; ecological condition of the Willamette River; and, terrestrial wildlife.

Based on this assessment, the Consortium concluded:

- Changes in the basin's stream habitat quality and biota over the next 50 year will be far less than the changes already experienced from Pre-Euro American Settlement to about 1990 under any of the future scenarios.
- Relative to Pre-Euro American Settlement conditions, Willamette Basin lowland streams have been significantly degraded by conversion of lands to agriculture and urban/residential uses. Median values for indicators of stream condition were estimated to be 30-90 percent higher historically than conditions around 1990.
- Within the limits of the Consortium's modeling, it appears that Plan Trend 2050 and Development 2050 scenarios would not result in any measurable worsening of stream biota and habitat quality in the Basin, overall. Most of the land converted to urban and residential uses in these scenarios is used for agriculture today. The models predict that converting agriculture to urban/residential uses will not, by itself, cause significant additional stream degradation beyond levels observed today.
- Measures implemented under the Conservation 2050 scenario would partially (by 20-65 percent), but not completely, restore lowland stream biota and habitat quality to Pre-Euro American Settlement conditions.
- Water withdrawals have had major impacts on habitat quantity in some streams. As a result, total habitat quantity in lowland streams was estimated as being about 7 percent greater historically than around 1990. Total habitat quantity in lowland streams is projected to further decline by four to eight percent by 2050, depending on the scenario.
- The above conclusions: apply to overall trends in stream condition within the Basin as a whole, not to individual stream reaches where changes may be substantially greater or less; and, because of modeling limitations, cannot be safely applied to any single specific human impact.

Consortium recommendations are detailed under Statement of Fish and Wildlife Needs.

By watershed

Federal land management agencies, watershed councils, soil and water conservation districts, and local governments have completed approximately 70 watershed assessments and analyses. More are underway and scheduled for completion in the next year. Assessments by local watershed groups are used to inform and guide individual action plans. The status of watershed analyses and assessments is shown in Table 7. The Willamette Restoration Initiative reviewed sets of watershed assessments that have been completed by eight watershed councils in order to identify common problems and priorities. The priorities flowing from these assessments are described under Existing Goals, Objectives, and Strategies.

Table 7. Watershed Assessments and Analyses in the Willamette Subbasin

WATERSHED AREA	***NON FEDERAL ASSESSMENTS COMPLETED***	***FEDERAL ANALYSES COMPLETED***	***ACTION PLANS***
UPPER WILLAMETTE			
Coast Fork Willamette	Mosby Creek (Weyerhaeuser, 01?) Source Water Assessment Report for Laying Creek (City of Cottage Grove, 00) Sharps Creek (Weyerhaeuser, 99)	Mosby Creek (Eugene BLM, 11/00) Sharps Creek (Umpqua NF and Eugene BLM, 3/99) Row River (Eugene BLM, 98) Cottage Grove Lake/Big River - Upper Coast Fork (Eugene BLM, 97) Bryce Creek (Umpqua NF, 97) Laying Creek (Umpqua NF, 95)	
Long Tom	Long Tom (Long Tom WC, 1/00) Amazon Creek Assessment (City of Eugene)	Long Tom (Eugene BLM, 10/00)	Long Tom Watershed Council Action Plan (10/00)
McKenzie	McKenzie River Subbasin Assessment (McKenzie WC, 2/00) 3 McKenzie River Subbasin Assessment Technical Reports (McKenzie WC, 2/00) Map of current McKenzie River Planning, Projects and Water Quality monitoring (McKenzie WC, 2/00)	Quartz Creek & Minor Tribs (WNF, 4/98) Horse Creek (WNF, 9/97) Blue River (96) Upper McKenzie (WNF, 8/95) South Fork McKenzie (WNF, 11/94)	McKenzie WC Action Plan (draft est 9/01)
Middle Fork Willamette	Little Fall Creek/Hills Creek (Weyerhaeuser, 2/97) Lower Middle Fork, Lost Creek and Little Fall Creek (Middle Fork WC, in progress)	Hills/Little Fall Creek (WNF, 2/98) Hills Creek, (WNF, 2/98) Lookout Point (9/97) Salt Creek (WNF, 9/97) Winberry/Lower Fall Creek (Corps/BLM/USFS 12/96) Upper Middle Fork (WNF, 8/96) North Fork of Middle Fork Willamette, (WNF, 9/95) Middle Fork Willamette, Fed (WNF, 8/95) Fall Creek	

WATERSHED AREA	***NON FEDERAL ASSESSMENTS COMPLETED***	***FEDERAL ANALYSES COMPLETED***	***ACTION PLANS***
MID WILLAMETTE			
Calapooia	Calapooia River (Weyerhaeuser, 8/98)	Calapooia River (Eugene BLM, 4/00)	
Greater Salem: Claggett Glen Gibson Mill Creek Pringle Creek	Claggett Creek Watershed Assess (in progress) Glenn Gibson Cr. Watershed Assess (in progress) Mill Creek Watershed Assessment (in progress) Pringle Creek Watershed Assess (in progress)		
Luckiamute		Rowell, Mill, Rickreal, Luckiamute (Salem BLM, 7/98)	
Mary's River	Mary's River - Prelim Assess (Mary's River WC, 4/99) Also: Mary's River Temp Study, Turbidity Study, and Oral History Project		
Pedee/Ritner	**PEDEE CREEK (PEDEE WC, IN PROCESS 2002)**		
Pudding	Some limited assessment by Marion County SWCD and DEQ		
Rickreall	Rickreall (Rickreall WC, 2001)	**ROWELL CREEK, MILL CREEK, RICKREALL CREEK, LUCKIAMUTE RIVER (BLM, 98)**	
Soap			
North Santiam	North Santiam (North Santiam WC, est. 2/02)	Little North Santiam (WNF, 12/97) Detroit Tributaries (WNF, 11/97) Breitenbush (WNF, 8/96) Upper North Santiam (WNF, 8/95)	Action Plan to follow completion of North Santiam Assessment
South Santiam	South Santiam (Santiam WC, 1/00)	Thomas Creek Riparian Reserve Assessment (Salem BLM, 4/97) Thomas Creek (Salem BLM, 12/96) Middle Santiam (WNF, 4/96)	Action Plan Summary (South Santiam WC, revised 1/00)

WATERSHED AREA	***NON FEDERAL ASSESSMENTS COMPLETED***	***FEDERAL ANALYSES COMPLETED***	***ACTION PLANS***
Yamhill	Salt Creek (Yamhill Basin Council, in progress) Upper South Yamhill (Yamhill Basin Council, in progress) Chehalem (Yamhill Basin Council, 6/01) Lower Yamhill (Yamhill Basin Council, 2/01) North Yamhill (Yamhill Basin Council, 2/01) Lower South Yamhill-Deer Creek (Yamhill Basin Council, 9/00) Mill Creek (Yamhill Basin Council, 12/99) Willamina (Yamhill Basin Council, 8/99)	Rowell, Mill, Rickreall, Luckiamute (Salem BLM, 7/98) Panther, Baker, Deer, Willamina Creeks (Salem BLM, 98) North Yamhill, (Salem BLM, 1/97)	Yamhill Basin Action Plan (revised 2/01) Action Plans to correspond with each non-federal assessment anticipated.
LOWER WILLAMETTE			
Clackamas	Rock & Richardson (CRBC, 11/00) Watershed Atlas (Metro, 97)	The first 5 areas include some federal land and will likely be done in partnership acc. to fed. guidelines. Basin Wide (est 6/03) ; *Deep Creek* (est 6/03); *Goose Creek* (est 6/03); *Clear Creek* (est fall 02); *Foster Creek* (est fall 02); *South Fork Clackamas* (Mt. Mood NF/Salem BLM, 2/97); *Roaring River* (Mt. Hood NF, 96); *Lower Clackamas* (Mt. Hood NF/Salem BLM, 96); *North Fork Clackamas* (Mt. Hood NF/Salem BLM, 9/96); *Oak Grove* (Mt. Hood NF, 9/96); *Collawash w/ Hotsprings* (Mt. Hood NF, 9/95); *Eagle Creek* (Mt. Mood NF/Salem BLM, 9/95); *Upper Clear Creek* (Salem BLM, 9/95); *Upper Clackamas* (Mt. Hood NF, 3/95); *Fish Creek* (Mt. Hood NF, 9/94)	Clackamas Basin Action Plan (00)

WATERSHED AREA	***NON FEDERAL ASSESSMENTS COMPLETED***	***FEDERAL ANALYSES COMPLETED***	***ACTION PLANS***
Columbia Slough*	3 Part Water Body Assessment (BES and CH2M Hill, 9/95) Culminating in the Columbia Slough TMDL (DEQ with EPA approval, 12/98) Columbia Slough Reconnaissance Study (Army Corps of Engineers, revised 8/93)	None	Columbia Slough Watershed Action Plan (est. 1/03)
Fairview Creek*	Fairview Creek Coordinated Resources Management Plan & Watershed Conservation Plan (92) Fairview Creek Water Quality Modeling Project Report (Metro, 92)		
Johnson Creek*	Integrated Johnson Creek Watershed Assessment (including subbasins) and Action Plan (est 06/04) Johnson Creek Restoration Plan - mainstem and floodplain (City of Portland - BES, 06/01) Crystal Springs Assessment and Priority List (City of Portland - Parks and Rec, '01) Salmon Restoration in an Urban Watershed: Johnson Creek, Oregon (Portland-Mult Progress Board, 2000) ESA Based Watershed Assessment (City of Portland ESA Response Program) Johnson Creek Resource Management Plan (5/95)		Action plan elements included in Johnson Creek Restoration Plan and Crystal Springs Assessment

WATERSHED AREA	***NON FEDERAL ASSESSMENTS COMPLETED***	***FEDERAL ANALYSES COMPLETED***	***ACTION PLANS***
Mollala		Molalla	
Tryon*	**TRYON CREEK (WEST MULTNOMAH SWCD, IN PROGRESS)**		
Tualatin*	Lower Tualatin Watershed Analysis (Washington County SWCD and Tualatin River WC, 8/01) Gales Creek (Tualatin River WC, 9/98) Hedges Creek Subbasin Plan (USA, 95) Beaverton Creek Watershed Management Plan (USA, 99) Upper Rock, Bronson with Willow Creeks (USA, 96) Fanno Creek Watershed Management Plan (USA, 97) Butternut Creek Subbasin Plan (USA, 92)	Middle Tualatin-Rock Creek (Salem BLM, 2/01) Upper Tualatin-Scoggins (Salem BLM , 2/00) Dairy McKay (Salem BLM, 3/99)	Tualatin River Watershed Action Plan (2/99)

* Assessment information included in natural resource based studies by City of Portland, Metro, Port of Portland etc. See "Additional Resources" section.
** Watershed Councils also have biennial work plans that guide yearly priorities and provide context for OWEB funding.

Key:

BLM: Bureau of Land Management
CRBC: Clackamas River Basin Council
DEQ: Department of Environmental Quality
OWEB: Oregon Watershed Enhancement Board
SWCD: Soil and Water Conservation District
TMDL: Total Maximum Daily Load
USA: Unified Sewerage Agency
WC: Watershed Council
WNF: Willamette National Forest

Limiting Factors

Summary of Limiting Factors Subbasin-wide

The ecological integrity of the subbasin has been seriously compromised (Benner and Sedell 1997) to produce important resource-based economies and growing urban areas. Ecosystems have been affected most by habitat conversion for farm-, forest- and urban-uses; deterioration of water quality; and alteration of the hydrological system; and suppression of floods and fires; (Oregon Progress Board 2000; Institute for the Northwest 1999).

Habitat Conversion in the Willamette Eco-regions

Habitat conversion has significantly changed the face of the Willamette Subbasin. The Willamette Valley was dominated by extensive and diverse riparian and wetland plant communities during pre-settlement times in the early 1800's (Johannessen et al. 1971). Settlement of the Willamette Valley, the endpoint of the Oregon Trail, brought dramatic changes to the landscape as it was cleared for pasture and drained for agricultural purposes (Boag 1992). Now only about 10% of the Willamette Valley remains in relatively natural vegetative communities. As further described in following sections, the streams and rivers which drained into the Willamette Valley have changed significantly since pre-settlement times, with flood control dams and stream channelization projects resulting in a vastly different hydrologic regime than previously existed for the Willamette drainage (Seddell and Foggatt 1984)

Habitats in the Willamette Valley can be classified into six major types: open water, bottomland forest, bottomland prairies, emergent wetlands, upland forests and foothill savanna/prairie. (Willamette Restoration Initiative 2001). As shown in Table 8, these habitats have undergone significant change which has had often severely limited fish and wildlife populations.

Table 8. Willamette Valley habitat types and losses

Open water, i.e. instream, habitat has been progressively reduced since 1850. Open water habitat includes primary channels, secondary channels, tributary reaches, and sloughs, as well as ponds and oxbow lakes. Over half the tributary and slough reaches along the river were lost between 1850 and 1932. The greatest losses of open water habitat have occurred in the upper reach where there was more habitat to lose. Loss of tributary and slough habitat in the upper reach is estimated at 84 percent. Only 400 miles of fisheries habitat along the river, out of nearly 1400 miles of pre-settlement habitat, are left today.
Bottomland forest includes all forest and shrub-dominated riparian and wetland habitats. This type, which once covered over 350,000 acres or approximately ten percent of the valley, has diminished to less than 100,000 acres. This loss is due to conversion to agricultural, industrial, residential, travel corridor and other uses. Remaining bottomland forests are subject to damage from stream channel and drainage alterations and invasion of non-native species. Some 35 at-risk taxa, including northern red-legged frog, sharptail snake, bald eagle, and Townsend's big-eared bat, are found in this habitat type.

Bottomland prairies, estimated to have occupied about 877,000 acres, or approximately 27 percent of the valley, originally included both wet and mesic (non-wetland) sedge- and grass-dominated habitats on the valley floor. At the time of European settlement, approximately one-third to one-half of the bottomland prairie type consisted of wet prairie, the remainder was mesic prairie. These mesic sites were very desirable for agricultural uses, and no remaining examples of this type remain. As of 1995, only about 4,900 acres of bottomland prairie were estimated to remain, a loss of 99 percent. This habitat type is home to some 36 at-risk species, including the Willamette daisy, painted turtle, northwestern pond turtle, and white-topped aster.
Emergent wetlands include marshes dominated by herbs and grasses, excluding the wet prairie type. Two plant associations within this habitat type, the Columbia sedge marsh and the Wapato marsh, are thought to be mostly restricted to the Willamette Valley. Emergent wetlands have historically occupied a very small part of the Willamette basin close to the mainstem. Emergent wetland vegetation is estimated to have originally covered only some 4,700 acres of the valley. As of 1995, this area had decreased to about 806 hectares total, a loss of about 58 percent. Twenty-nine at-risk species, including Aleutian Canada goose, and a number of snails, mussels, insects, and plants, utilize emergent wetlands.
Upland forests occur primarily at the margins of the Willamette Valley and in interior areas protected from the frequent fires that were set throughout much of the valley. However, in other areas throughout the valley, an open woodland occurred, consisting of widely scattered Douglas fir, with an understory of hazel, vine maple, and other shrubs or dense stands of ferns. Post-settlement fire suppression and logging have altered remaining woodland stands. This habitat type, originally estimated to cover roughly 362,000 acres, had decreased to less than 48,000 acres by 1995, a loss of about 87 percent. Some 31 at-risk species occupy upland forests in the Willamette Valley, including most of the sensitive mammal species, as well as the Cascade seep salamander, olive-sided flycatcher, and rare insects, ferns, lichens, and other plants.
Foothill Savanna/Prairie includes savannas dominated by widely spaced Oregon white oak, Douglas fir, ponderosa pine, or a mixture or one or more of these species, with an understory of native grasses and herbs. Over the last 150 years, the pre-settlement savanna/prairie mosaic has been almost completely lost. Nearly all sites from which fire has been excluded have been modified to closed-canopy woodland or forest. Originally covering some 1.7 million acres, this savanna/prairie habitat type now occupies an estimated 206,000 acres, a loss of 88 percent. This habitat type is used by 37 at-risk taxa, including Fenders blue butterfly and Kincaid's lupine, for which endangered and threatened status, respectively, have been proposed.

Based on the NRCS Natural Resources Inventory, from 1982 to 1997 approximately 10,000 acres of cropland, pasture, range and forestlands were converted annually to urban use in the Willamette Valley. However, much of this occurred in a "planned" sense in accordance with Oregon's land use planning program.

Water Quality

In the 1920s through the 1950s, deteriorated water quality in the lower Willamette River totally blocked fish passage during summer low flow periods (Willis et al. 1960). In dryer years, juveniles migrating after mid-June may have been lost, or the first returning adults in the fall delayed or lost due to pollution and low dissolved oxygen.

Recent studies by the Oregon Department of Environmental Quality (DEQ) and other agencies characterize mainstream Willamette water quality as ranging from "good "

in the upper river above Corvallis to "poor to marginal " in the reaches below Newberg Pool to the mouth. (Tetra Tech. 1995).

Much of the mainstem Willamette River and its tributaries exceed state water quality standards for such factors as bacteria, dissolved oxygen, nutrients, pesticides, temperature, and toxics. Bacteria contamination occasionally makes some segments of the Willamette unsafe for swimming and other water contact recreation.

In some areas, concentrations of toxic chemicals have been found in the tissue of some fish, triggering health advisories against eating fish from those areas. According to a recent *Oregonian* report (December 17,2000), three species of fish within a 26-mile stretch of the lower Willamette contain banned industrial compounds at rates that could make them unsafe to eat. The report followed another comprehensive fish study sponsored by DEQ, which found that fish between Willamette Falls and Salem contained a number of cancer-causing contaminants. In addition, the occurrence of fish deformities in the Newberg Pool has been found to be abnormally high. (DEQ 2000) The DEQ and other agencies have identified a critical need to gather and analyze more information on a systematic basis.

The U.S. Geological Survey has published numerous reports as part of its National Water Quality Assessment (NAWQA) Program in the Willamette Subbasin. In its Summary of Major Issues and Findings, the USGS offered nine conclusions about subbasin water quality, including that nutrients and pesticides are degrading water quality. (Table 9).

Table 9. Water Quality in the Willamette Basin, Oregon, 1991-95: Summary of major issues and findings from USGS NAWQA study

1. Relative abundance of fish species correlated best with instream and riparian habitat quality. Habitat and fish communities in agricultural and urban streams were degraded compared with those in other NAWQA Study Units
2. Erosion has increased downstream from dams
3. Ground water/surface water interactions are significant in large, gravel-bed rivers
4. Nutrients in streams and ground water are degrading water quality
5. Pesticides in streams are degrading water quality
6. Ground water quality generally has not been degraded by pesticides or volatile organic compounds (VOCs). Radon and dissolved solids concentrations and pesticide detection rates were low when compared with other NAWQA Study Units
7. Dioxins and furans were detected in all bed sediment and fish tissue samples, including those from forested reference basins
8. Although they have been banned since the late 1980s or earlier, organochlorine pesticides and PCBs are still present in bed sediment and aquatic biota from streams and lakes
9. Concentrations of trace elements in bed sediment from streams and lakes exceeded Environment Canada draft guidelines for protection of aquatic life at 26 of 52 sites; however, concentrations generally were low when compared with other NAWQA Study Units

Point Source Pollution

Point sources of pollution (industrial and municipal waste) are generally regulated by DEQ under the authority of the federal Clean Water Act. As a result, their relative contribution to the total pollution of the Willamette has declined over the last 30 years. They still, however, remain a significant source of pollution. The highest concentrations of dioxins and furans (industrial organic compounds) are found at sites with industrial and urban inputs. The U.S. Environmental Protection Agency (EPA) recently designated a six-mile stretch along the lower Willamette through Portland a federal Superfund site because of heavy toxic contamination.

In some cities, stormwater runoff from house roofs, parking lots, and streets empties into the same sewer system that carries human waste to sewage treatment plants. Heavy rainfall increases the volume of water, which overwhelms the system and allows overflow of raw sewage into the rivers. These "combined sewer overflows" (CSOs), are contaminated with bacteria from untreated sewage. In 1980, 31 Oregon communities had combined sewer systems. By 1995, they still existed only in Portland, Corvallis, and Astoria. DEQ is requiring Portland (where CSOs go directly into the Willamette River) to eliminate CSOs by 2011 and Corvallis to eliminate them by 2001. By the end of 2000, Portland had spent $300 million dollars removing about 53 percent of its CSO overflow volume from the Willamette River and Columbia Slough. To finish the job, Portland projects it will require a total expenditure approaching $1 billion. However, many creek systems in the Portland Metro area have "mini-CSO" problems because sanitary sewer pipes are routinely sited in creek corridors. These pipes are also subject to overflows.

Nonpoint Source Pollution

Nonpoint source pollution (runoff from farm, forestry, and urban activities) carries sediments, nutrients, bacteria, metals, pesticides, and other pollutants to basin waterways. Temperature modification can also be classified as a nonpoint source pollutant. According to a U.S. Geological Survey study, nonpoint sources account for 70-80 percent of the pollutants entering the basin today. A statewide study performed by DEQ found that agriculture accounted for 39 percent of all nonpoint water pollution, forestry 17 percent, boating 14 percent, and urban runoff 12 percent (Institute for the Northwest 1999; USGAO 1998). More than 50 different pesticides have been found in the Willamette River. Pesticide use in the basin is greatest in urban and agricultural areas, with approximately 4.5 million pounds used annually to control weeds, insects, and other pests. (Wentz et al. 1998)

The municipal use of natural streams as stormwater conveyance channels has resulted in extreme shifts in water flows, including flash flooding during heavy rain events, with unnaturally low flows at other times. Water is conveyed rapidly off the surface into the creeks, preventing groundwater infiltration, thus contributing to abnormally high erosion and sedimentation, as well as pollution from pesticides (landscaping related), heavy metals and elevated summer temperatures from road, parking lot and roof runoff.

Toxics

Toxic chemicals came into wide use in the Willamette Basin after World War II and now pose a serious threat to water quality. Pesticides such as DDT and dieldrin, as well as PCBs

(polychlorinated biphenyls, which were used in electrical equipment such as transformers), were used widely within the basin before their ban in the 1970s. These chemicals belong to a highly toxic, long-lasting group of substances known as PBTs (persistent, bioaccumulative, toxic pollutants)

A number of chemicals are particular problems in the Willamette Basin: chlorinated pesticides (which introduce DDT, DDE, and dieldrin into the environment); other pesticides (e.g., atrazine, chlorpyrifos, diazinon, malathion);organochlorines (PCBs, dioxin, and furans);other organics (e.g.,pentachlorophenol, and tetrachloroethylene);and metals (arsenic, cadmium, lead mercury, nickel, silver, and zinc).

There is a high degree of scientific uncertainty associated with these chemicals and their impacts on salmonids. For most of the studied pesticides, there are no aquatic life criteria, and their sublethal biological effects on fish health are unknown. Therefore when the basin's salmonids are exposed to often-complex mixtures of these chemicals, the biological consequences are very poorly understood. (Willamette Restoration Initiative 2001)

Water Temperature

Stream temperature is an important factor influencing aquatic habitat and directly affects the growth and survival of salmonids and other cold-water aquatic species. The effect on fish from changes in stream temperature varies by species and within the life cycle of a given species. Chinook salmon and bull trout are among the most sensitive of the cold-water fish species.

In general, a stream temperature standard of 64 degrees Fahrenheit exists statewide. Exceptions include a standard of 68 degrees for the lower Columbia and Willamette rivers; 55 degrees for cold-water fish spawning habitat; and 50 degrees for bull trout habitat. Most basin waterways do not meet temperature standards required to support anadromous fish populations.

Causes of increased temperatures include inadequate in-stream flows, lack of healthy riparian (streamside) vegetation for shading, warmed hyporheic (underground water flowing through streamside gravels), discharges of warm-water effluent (waste-water), and increased runoff from impervious surfaces such as roads and parking lots. (Willamette Restoration Initiative 2001)

Erosion and Sedimentation

Unnatural levels of erosion can result from numerous urban and rural activities, such as construction, road building, plowing, and timber harvesting. Agriculture, which occupies more land than urban areas in the basin, contributes more sediment to the river than any other activity. Urban areas, however, contribute the greatest amount of sediments on a per-acre basis, with the majority coming from stormwater runoff, sewage treatment facilities, and industrial sources. (Willamette Restoration Initiative 2001)

The Natural Resources Conservation Service and others compile subbasin information relating to watershed health, in part through its National Resource Inventory. The NRI is an inventory of land cover and use, soil erosion, prime farmland, wetlands, and other natural resource characteristics on non-Federal rural land in the United States (Table 10).

Table 10. Cropland erosion by hydrologic units in Willamette Subbasin

Hydrologic Unit Code	Watershed	Cropland Erosion (tons)	Cropland Area (acres)
17090001	Middle Fork Willamette	600	2,700
17090002	Coast Fork Willamette	600	2,500
17090003	Upper Willamette	188,200	314,300
17090004	McKenzie	5,600	9,900
17090005	North Santiam	33,300	30,800
17090006	South Santiam	28,500	51,900
17090007	Middle Willamette	274,900	200,600
17090008	Yamhill	510,900	135,100
17090009	Molalla-Pudding	296,000	155,800
17090010	Tualatin	167,600	73,800
17090011	Clackamas	40,300	16,100
17090012	Lower Willamette	46,100	14,100

Source: 1992 National Resource Inventory

Roads frequently generate overland flow from relatively impervious running surfaces and cutslopes. Additionally, interception of interflow at cutslopes can substantially increase the amount of runoff, converting subsurface flow to surface flow. Paved and unpaved road surfaces, ditches, culverts, and bridge approaches can accelerate runoff, sediments, and road-associated chemicals.

The impact and number of hydrologically-connected roads is difficult to quantify for the Willamette River subbasin, although models do exist for site specific calculations (United States Forest Service 1998). "…Road treatments to disconnect" roads from streams – to reduce the amount of hydrologically-connected roads – are usually simple, inexpensive, and effective in reducing road effects and risks to water quality and aquatic habitats…"

Efforts by some local road agencies to develop best management practices for road maintenance activities as part of their ongoing NMFS ESA response programs are being finalized and ultimately will have a cumulative benefit on fish and wildlife habitat.

The extent of roads in the subbasin is impressive. By one estimate, there a three-times as many road-miles as stream-miles (Willamette River Basin Task Force 1998). The stream-road interface creates new hydrologic connection, often creating increased "flashiness" and culverts which can impede fish migration (see Fish Passage Programs in the Existing Goals, Objectives, and Strategies section).

Alteration of Hydrology

The basin's water flows and waterways have been significantly altered through physical channel changes and floodplain drainage (damming, diking, channelization, road construction, increased runoff from impervious surfaces, surface drainage ditches and sub-surface tiling) and water diversion. Flow alteration caused by federal dams is addressed in Factors Specific to Hydropower Generation, below.)

Physical Channel Changes

Perhaps one of the biggest changes in the Willamette system has been through the construction of navigation and bank-protection structures. Beginning in 1870 the Corps initiated efforts to increase navigational flows by confining water from many braided channels into fewer by closing unwanted side-channels. Dredging spoils were also deposited into side-channels and gravel bars scraped away. In addition, downed trees and drift piles of large wood were systematically cleared—between 1870 and 1950, the Corps removed over 69,000 snags and overhanging trees. (Benner and Sedell 1997)

The River and Harbor Act/Flood Control Act of 1938 authorized the Corps to construct and maintain a navigation channel on the Willamette River from Willamette Falls to Eugene. The maintained channel ranged from 4.5 to 2.5 feet deep and up to 100 feet wide with additional depth provided by stream flow augmentation from the reservoirs. Owing to dwindling commercial navigation on the river, continued maintenance of the navigation channel above Willamette Falls was determined to be economically infeasible. The last maintenance dredging completed by the Corps of Engineers was in 1973. (U.S. Army Corps of Engineers 1999)

The Corps of Engineers' *Willamette River Bank Protection Program* is managed as part of its Willamette Basin Project (see Existing Goals, Objectives, and Strategies Section). It represents one of the earliest flood protection efforts in the basin, pre-dating the construction of flood control dams by many decades and has had at least as profound an impact on habitat as the dams. The program protects agricultural, suburban, and urban land from erosion along the mainstem Willamette River from New Era upstream to each of the Willamette Project dams. As of September 1996, the program had protected a total of 489,795 linear feet (or nearly 93 miles) of banks at 230 locations. Project components include riverbank revetments, pile and timber bulkheads, drift barriers, minor channel improvements, and maintenance of existing works for control of floods and prevention of bank erosion.

The impacts on habitat from these Corps activities have been profound. The upper mainstem Willamette River's channel length has been nearly halved as a result of these management activities, with a resulting 84 percent loss of tributary and slough habitat. (Benner and Sedell 1997; Institute for the Northwest 1999)

Water use

The right to use water in Oregon is established by an elaborate system of water rights, with first-claimed rights taking precedence over more recent requests. Nearly all of the available water in Willamette basin streams has now been allocated to farms, cities, and other uses.

Surface water withdrawals in the Willamette subbasin are estimated to be on the order of 466 million gallons per day. Some 371 dams in the basin store about 2.7 million acre feet of water. The Corps of Engineers alone stores 2.3 million acre feet behind eleven major dams. (Willamette Restoration Initiative 2001) Water withdrawals and/or interference from dam or diversion structures have been identified by ODFW as limiting Chinook, Coho, Steelhead, cutthroat trout, and bull trout in the Willamette basin. (Bastasch 1998)

In summer and fall, when flow is lowest, water demand peaks because of irrigation and municipal needs. Water supplies are not sufficient to meet all existing needs. State watermasters routinely cut-off many holders of "junior" water rights in the Willamette subbasin each summer so that holders of "senior" rights can get their water allocation. In addition, in many basin streams, flows are insufficient to meet fish and wildlife needs. Groundwater supplies are also under stress. Nearly a dozen areas in the basin are restrictively classified as "groundwater limited" because of water table declines. (Willamette Restoration Initiative 2001) Water demand is expected to increase with population and industrial growth and to serve changing agricultural markets (the role of the federal reservoirs in serving this need is being studied in the *Willamette River Basin Review* described under the U.S. Army Corps of Engineers' Willamette Basin Project in the Existing Goals, Objectives, and Strategies Section.

However, summertime flows below the federal dams are higher than they would be naturally. In addition, because of imports from the Trask, Nestucca and Bull Run Rivers, flows in the Tualatin may also be higher than natural.

Management Constraints

Institutional Capacity

The conservation and restoration of subbasin fish and wildlife is limited by a number of factors relating to law, regulation, coordination, communication (including information management) and resource allocation (including funding). The Willamette Restoration Strategy (Willamette Restoration Initiative 2001) seeks to assure that institutions and policies work in concert to restore subbasin watershed health especially in areas of improving local capacity, funding, public awareness, incentives, and coordination. It identified eight limiting factors of this nature (Table 11).

In its Strategy for Achieving Health Watersheds in Oregon (OWEB 2001) the Oregon Watershed Enhancement Board also identifies a number of measures needed to address existing limits to creating and maintaining healthy watersheds and natural habitats. These are categorized by three outcomes (effective investments, improved partnerships, and citizen understanding) to be achieved through 11 strategies, including integrating local priorities, established shared government priorities, enhancing public/private relationships, promoting local partnerships, and supporting local efforts.

Other institutional needs which, if not met, will continue to constrain watershed groups identified in a Watershed Needs Assessment (Willamette Restoration Initiative 1999) include: the need for additional funding to assist councils, SWCDs, and local organizations in developing program capacity and delivery; improved education about Willamette issues within the context of a unified restoration plan; improved cooperation between local watershed groups and decreased competition for scarce resources; and, consistency and accountability of institutions utilizing multiple methodologies to develop and implement a long-term, basin scale restoration plan. (Watershed council needs identified in watershed assessments are included in Appendix A).

Lastly, the Oregon Water Resources Department specifically notes limits to its ability to protect restored instream flows (see Streamflow Restoration Program, under Existing Goals, Objectives, and Strategies).

Table 11. Institutional limiting factors in the Willamette Subbasin as identified in the *Willamette Restoration Strategy* (Willamette Restoration Initiative 2001)

Local Capacity The capacity of cities, counties, watershed councils, soil and water conservation districts, and other community groups to achieve their goals is often hindered by inadequate technical, financial, and administrative support. (WRS Action 15, 21, 22, 27)
Funding Funding is almost always insufficient to cover basic restoration needs. The money that does exist is not necessarily administered in a way that brings the broadest ecologic benefits. (WRS Key Rec. 2, 3; Action 27)
Public Awareness and Community Stewardship The problems Willamette residents face are complicated and frequently do not lend themselves to instant understanding.. A coordinated, concerted public awareness campaign on a par with commercial advertising is critical to secure a more active public role to reduce damaging activities, participate in monitoring and restoration projects, and learn about improved management systems. (WRS Action 17, 18)
Incentives Environmental quality and economic vitality are sometimes seen as mutually exclusive, competing goals. While many basin residents express a strong desire for both, there is no shared vision or conceptual framework for achieving both. Properly designed and delivered incentives can bring market energies to conservation and move beyond regulatory minimums. The current design and delivery of incentives programs is inadequate to meet existing and future needs. (WRS Actions 4, 5, 15, 19, 20)
Coordination The number and complexity of policies, plans, and programs makes coordination difficult. The various groups working to address subbasin issues all have their own objectives and priorities, with no single entity to tie them together. As a result, their efforts are not always consistent, efficient, or effective. (WRS Actions 1, 8, 11, 14, 15, 16, 21, 23, 24, 26)
Leadership Basin leaders—both public and private—do not always understand and appreciate watershed issues and their significance. Partisanship and a lack of engagement can limit their ability to address the problems. (WRS Action 17)
Information Management Many entities—including federal and state agencies, tribal and local governments, and watershed groups—work hard to collect valuable environmental, social, and economic data. This data acquisition is often uncoordinated, however, and the resulting data are incompatible with, or inaccessible to, other related efforts. As a result, data distribution and management are difficult, which frustrates understanding and effective decision making. Scientific information is often not communicated in a way that facilitates policy or decision making. (WRS Actions 11, 25)
Results Measurement No shared vision, clearly defined goals and objectives, or consistent performance standards and measurements currently exist for conservation and restoration efforts. Consequently, there are no common yardsticks by which to measure results, make adjustments, and identify the most effective approaches. (WRS Key Rec. 3 and Action 25)

Lack of Landscape-based Management

Far more attention and resources have been devoted to conservation and restoration activities on publicly managed, forested uplands than on privately-owned urban and agricultural lands. This uneven management approach is in opposition to the natural connections and continuities inherent in the stream- and eco-systems of the Willamette Subbasin. Recent reports stress the need to address this disparity. The State of the Environment Report (Oregon Progress Board 2000) states:

> *Many of Oregon's key environmental problems are concentrated in the lowlands where most Oregonians live and work. With few exceptions, these problems are most critical in the lowlands of the major river basins…The greatest opportunity for improving Oregon's environment in this generation occurs on lands that Oregonians control: on state, county, and private lands. Much of what potentially can be achieved on federal lands is already reflected in new policies and plans for managing forest and range lands. Private lands have become increasingly important to solving many of Oregon's environmental problems for this generation…One of Oregon's greatest environmental challenges for this century lies in the Willamette Valley.*

In addition, the Pacific Northwest Ecosystem Research Consortium has noted in its conclusions (see also Statement of Fish and Wildlife Need):

> *"Efforts will be required across the entire landscape and in all environmental settings. To date, policies and projects have focused disproportionately on upland, forested systems. Because upland and lowland portions of the Basin support distinctly different types of habitats and species, a balanced effort in both areas will be required."*

The Willamette Restoration Strategy (Willamette Restoration Initiative 2001) takes note of this management disparity and identifies the improved use of landowner incentives as a critical need:

> *The "working landscape" ... produces an impressive array of goods and are cornerstones of both local and regional economies. The primary management focus of such land has been on commodity production, with unintentional and often serious impacts to native species and their habitats. However, negative habitat impacts from the working landscape can be reduced or eliminated with better understanding of natural systems and increased technical assistance to support good land stewardship. A landscape-based approach coupled with effective incentives promises a new relationship among farming, forestry, and habitat. The role of the working landscape in providing both economic and ecologic goods is an area of special importance in the Willamette Basin and needs immediate and careful attention.*

Factors Specific to Fish Declines

Salmon

In 1998 the Oregon Department of Fish and Wildlife convened a group of scientists to discuss the causes of decline among Willamette River salmonids. In its report *Factors Influencing Production Of Willamette River Salmonids & Recommendations For Conservation Actions* (Martin et al. 1998), the group identified factors for decline and also suggested key measures needed to support recovery. Decline factors are summarized in Table 12. (Key recovery needs are described under Statement of Fish and Wildlife Needs).

It was difficult to separate the long- and short-term factors for decline. It is probable that declining ocean productivity plus increasing predation rates as smelt decline, may make the recent declines appear more drastic than would be explained by long term loss of habitat complexity and genetic structure. The group also posited that it was possible that there is a lag effect of several generations before the cumulative factors for decline finally result in steep decline in fish numbers. The populations may compensate for a while, until ocean factors or other effects finally "gang up" on the fish stocks. It is possible that recovery may have a similar lag in results toward increases in stock abundance.

Table 12. Factors for Decline of Willamette Basin Salmonids (not ranked; Martin et al. 1998)

1. Blockage of headwaters on major tributaries by large hydro dams
2. Passage impediments on smaller tributaries by diversions and culverts.
3. Channelization, loss of complex island/sidechannel habitat, gravel removal, and stream system disruption from urbanization
4. Change in stream temperature regimes.
5. Deteriorating water quality particularly in the mainstem Willamette and lower reaches of key tributaries.
6. Loss of wetlands and riparian shade, structure and diversity.
7. Loss of quantity and quality of holding pools for adults and juveniles.
8. Change in flow regimes
9. Invasive fish, wildlife, and plant species
10. Loss of stock diversity
11. Excessive harvest rates in the past
12. Adverse ocean and estuary conditions.
13. Predation by birds, other fish, and marine mammals.

Bull trout

Bull trout populations have undergone severe declines in the Willamette River basin. (Goetz 1994). The construction of impassable dams and culverts is considered a major factor in their decline (Wevers et al. 1992; Goetz 1994) blocking migratory corridors and altering temperature and flow regimes. The average time to extirpation for eight populations in the Willamette Basin was calculated to be nearly 9 years after dam construction, with 15 years being the longest observed interval (Goetz 1994). Habitat degradation from land management activities, introduction or establishment of exotics (especially brook trout, which compete for habitat and hybridize with bull trout), water diversions, chemical treatment (in the Middle Fork Willamette), and loss of prey species, e.g., juvenile chinook and steelhead, have also been implicated in their demise. Decreases in juvenile chinook and steelhead abundance have also been suggested as a decline factor for bull trout populations in the same stream systems because adult bull trout are known to feed on juvenile chinook. (Ratliff and Howell 1992). Bull trout were once selectively removed in the belief that they harmed chinook salmon.

Oregon chub

The decline of Oregon chub has occurred for a number of reasons (USFWS 1998a):

- habitat alteration and loss (through side channel elimination, increased sedimentation of quiet water habitat, and reduced water quality);
- introduction and spread of non-native fish and amphibious species that prey on or compete with chub; and,
- population fragmentation through the construction of dams and influences on habitat distributions.

Cutthroat Trout

A number of activities have reduced habitat quantity and quality in the lower Columbia River basin. Water development projects on the Willamette and Sandy rivers and in smaller creeks in the lower Columbia River basin have resulted in numerous barriers that are impassable by anadromous salmonids, reducing the amount of available habitat. Habitat impacts due to logging activities probably have led to declines in coastal cutthroat trout population productivity in lower Columbia River tributaries downstream of the Willamette River (Kostow 1995; Johnson et al. 1999).

Factors Specific to Hydroelectric Power Generation

Federal Columbia River Power System—the Willamette Basin Project

The Willamette Basin Project has reduced the frequency of extremely high and low flows, and disrupted the once-dynamic rhythm of floods and dry spells. Flow and temperature regimes in the Willamette have been drastically altered due to extensive development of flood control structures in the upper basin (Hughes and Gammon 1987). Flood control modifications have largely disconnected the Willamette River from its braided channels, oxbows and sloughs—wetland types that characterized much of its historical floodplain. (Oregon Progress Board 2000) The loss of sloughs, islands, and side channels has not only destroyed habitat for fish and wildlife, but has also reduced the river system's ability to absorb floodwaters. (Oregon Progress Board 2000) The speed and severity of modern flooding has been exacerbated by the loss of the "sponge effect" of the natural floodplains. The Willamette Bank Protection Program, a major component of the Corps' Willamette Basin Project, is a primary cause of this disconnection. Its 93 miles of protection is described under Alteration of Hydrology.

Prior to the construction of the 11 water storage dams in the Willamette basin beginning in the early 1940s, frequent and substantial flooding was a dominant ecological process along the mainstem Willamette. Mainstem floodplains used to be refreshed by floods every 10 years which maintained vital ecological processes including nutrient exchange, sediment trapping and recycling, and the movement of large wood within the land and the river channel. (Oregon Progress Board 2000) This flooding now happens only once every 100 years. (Benner and Sedell 1997)

In addition, recent studies indicate that erosion has increased downstream from the Corps dams to compensate for sediment trapped by reservoirs. With dams capturing upstream sediment and reducing flood peaks, sediment characteristics in downstream reaches are affected proportionately more by channel velocities from bank protection,

channel incision, bank erosion, land-use conversions, and downstream sources of coarse sediments. That is, about the same amount of sediment is being transported as before dam construction—which means that amount trapped by the reservoirs is being made up for by channel- or other land-erosion downstream. (Wentz et al.1998)

Specific impacts of the federal Columbia River power system on fish and wildlife are described in detail, below.

Fish Impacts

Beginning 40 years ago, all Willamette Project dams (except Foster) completely blocked fish migration, either because no passage facilities were provided, or those provided did not work. Upper Willamette spring chinook and winter steelhead are no longer found above these dams (Table 13).

Table 13. Summary of Federal Columbia River Power System impacts on anadromous fish

Spring Chinook	
Santiam:	71 % of production occurred above Detroit Dam (Mattson 1948). All access to upstream spawning habitat was lost because the dam was built without fish passage facilities.
Middle Fork Willamette	Dexter and Fall Creek dams blocked access to about 80 percent of the subbasin's chinook habitat (ODFW 1990f).
McKenzie:	The McKenzie produced roughly 40 percent of the spring chinook run above Willamette Falls (Mattson 1948). Cougar Dam has blocked off 25 miles of some of the most productive spawning habitat historically available. (ODFW 1990e).
Coast Fork Willamette:	Dorena and Cottage Grove dams block upstream access to spawning areas. Also, low flows and warm water discharge from the dams likely limit downstream chinook salmon production (ODFW 1990d).
Steelhead	
Santiam	Major habitat blockages from Big Cliff Dam on the North Santiam River and Green Peter Dam on the South Santiam River.
Other watersheds	Dexter Dam, Dorena Dam, and Cougar Dam were identified by NMFS as the cut off of current steelhead distribution for the critical habitat designation for steelhead (64 FR 5750).

In addition to blocking migration, much historic spawning and rearing habitat has been inundated by reservoirs. (Figure 7). Dams built in the 1950s and 1960s on the Santiam, Middle Fork Willamette, and McKenzie Rivers blocked over 400 stream miles that were originally the most important spawning areas for native chinook salmon. (Bennett 1994)

Table 14 lists estimated spawning habitat for salmon and steelhead in the upper Willamette River basin prior to the construction of the dams. The estimates are for

mainstem habitat only. Considerably more spawning and rearing habitat was blocked in the tributaries (Fulton 1968; Fulton 1970). Cottage Grove and Dorena dams blocked the better quality spawning and rearing habitat in the Coast Fork Willamette subbasin. (Thompson et al. 1966)

Table 15 lists the approximate amounts of habitat lost to inundation by Willamette Project reservoirs, as represented by reservoir length. The actual amounts were slightly greater because of sinuosity of the river channel. Foster and Green Peter dams inundated approximately 19 percent of good quality anadromous fish habitat present above the Foster dam site. (Thompson et al. 1966)

Table 14. Estimated spawning habitat quantities above and below Willamette Project dams [for mainstems of streams shown, not tributaries] (Craig and Townsend 1946)

Stream	Lineal Miles Surveyed				Spawning Area Available (yds2)			
	Below Dam	Above Dam	Total	% Above Dam	Below Dam	Above Dam	Total	% Above Dam
N. Santiam.	66.2	61.1	127.3	48.0	1,875,001	800,778	2,684,779	30.1
S. Santiam.	87.7	63.5	151.2	42.0	2,352,539	874,278	3,226,817	27.1
McKenzie.	76.7	103.3	180.0	57.4	3,224,923	1,841,112	5,066,035	36.3
M. Fork Willamette	83.6	74.5	158.1	47.1	2,501,145	1,226,140	3,727,285	32.9
Total	314.2	302.4	616.6		9,953,608	4,751,308	14,704,916	

Table 15. Approximate miles* of river habitat inundated by Willamette Project reservoirs, Oregon (USACE project data)

Dam	**Stream**	**Length of Reservoir** (miles)
Big Cliff	North Santiam River	2.8
Detroit	North Santiam River	9.0
Green Peter	Middle Fork Santiam River	10.0
Foster	South Fork Santiam River	3.5
Blue River	Blue River	6.4
Cougar	South Fork McKenzie	6.5
Fall Creek	Fall Creek	10.3
Hills Creek	Middle Fork Willamette River	7.6
Lookout Point	Middle Fork Willamette River	14.2
Dexter	Middle Fork Willamette River	2.8
Dorena	Row River	5.0
Cottage Grove	Coast Fork River	3.0
Fern Ridge	Long Tom River	4.5

* does not necessarily account for former sinuosity

Willamette Project dams may also delay migration as adult salmon and winter steelhead are turned around and forced to search for spawning habitat elsewhere. Winter steelhead returning below Foster Dam are also delayed prior to collection and transport upstream. Any delays may result in reduced spawning fitness of the adults or survival and their progeny.

While the construction of the federal dams has severely curtailed any possible upstream migration of anadromous fish, it is also worth noting, that even should upstream passage of adults be restored, the extent to which downstream juvenile migrants are able to negotiate the difficulties presented by slack-water reservoirs is also problematic.

Fragmentation and isolation of bull trout populations have created a patchwork of remnant populations in the Columbia River basin (63 FR 31674). Barriers caused by the Willamette Project dams prevent bull trout from freely migrating between winter refuge areas and summer foraging areas, and prevent gene flow among the isolated populations. Fragmentation and isolation of fish populations resulting from dam operation has also been observed for resident cutthroat trout in the Long Tom River.

Oregon chub have also been affected by dams. Today, Oregon chub exist primarily as a series of isolated populations distributed in the Middle Fork Willamette and Santiam Rivers. Opportunities for migration may be limited to extreme flooding events; however, no data exists on either population structure or potential dispersal among populations. Dispersal (successful colonization) and genetic exchange between populations has likely been reduced substantially post-dams. In terms of dam influences, the Dexter/Lookout Point, Fall Creek, and Hills Creek projects appear to have the highest potential to affect Oregon chub populations. The Foster/Green Peter, Big Cliff/Detroit reservoirs have a moderate influence. (USFWS 1998a).

Wildlife

The Northwest Power Planning Council in consultation with the Bonneville Power Administration and the Corps of Engineers has identified wildlife losses attributable to hydropower facilities of the Willamette Basin Project (Table 16).

Table 16. Estimated wildlife losses due to Willamette Basin Project hydropower construction (losses are preceded by "-", gains by "+")

Species	*Total Habitat Units
Black--tailed Deer	-17,254
Roosevelt Elk	-15,295
Black Bear	-4,814
Cougar	-3,853
Beaver	-4,477
River Otter	-2,408
Mink	-2,418
Red Fox	-2,590
Ruffed Grouse	-11,145
California Quail	-2,986
Ring--necked Pheasant	-1,986
Band--tailed Pigeon	-3,487
Western Gray Squirrel	-1,354
Harlequin Duck	-551
Wood Duck	-1,947
Spotted Owl	-5,711
Pileated Woodpecker	-8,690
American Dipper	-954
Yellow Warbler	-2,355
Common Merganser	+1,042
Greater Scaup	+820
Waterfowl	+423
Bald Eagle	+5,693
Osprey	+6,159

From NWPPC 2000

Habitat Unit: a measure of habitat based on the acreage of a given habitat at a particular site multiplied by a suitability index factor under the Habitat Evaluation Procedure developed by the U.S. Fish and Wildlife Service. The suitability factor characterizes the amount of optimal habitat present. If a 20 acre site had a suitability index of .5 for blacktail deer, the site would be "worth" 10 habitat units.

Non-Federal Hydropower Facilities

For most non-federal hydroelectric power projects, the Federal Energy Regulatory Commission (FERC) must issue a license authorizing construction, or in the case of an existing project, continued project operation. Licenses are issued for a term of between 30 to 50 years, and exemptions are granted in perpetuity. Most hydroelectric projects serve other purposes such as navigation, flood control, recreation, and irrigation, and flow augmentation.

Projects authorized by Congress and operated by the U.S. Army Corps of Engineers or the U.S. Bureau of Reclamation do not require FERC licenses. All non-federal hydroelectric projects operating in Oregon, whether FERC-licensed or not, require either a state license or a power claim issued by the Oregon Water Resources Department. Relicensing takes a minimum of five years and involves a series of public reviews as well

as new studies to address current needs (including for environmental protection). At the end of this period, FERC either approves or denies a relicensing request. There are 18 active FERC projects in the Willamette Subbasin (Table 17).

FERC consults with the USFWS and/or NMFS under section 7 of the ESA once it receives an application to renew the license of an existing operation. This is done within the framework of ensuring compliance with National Environmental Policy Act. Often an applicant is required to develop a biological assessment. Based on this assessment, FERC works with the Services on a biological opinion which will result in a determination of species jeopardy, and where needed, a Reasonable and Prudent Alternative to the proposal that will avoid any jeopardy.

Oregon's Hydroelectric Application Review Team (including the Oregon Department of Fish and Wildlife [ODFW], Water Resources Department, and Department of Environmental Quality) develops a unified state position on hydropower projects during the relicensing process. ODFW evaluates project impacts on fish and wildlife and their habitats, and works with the applicant to design studies needed for future decisions. Once studies are complete, ODFW works with applicants to propose fish and wildlife mitigation measures that will reduce or offset project impacts.

Table 17. Active FERC hydroelectric power projects (identified by the Oregon Department of Fish and Wildlife)

Project Name (FERC #)	**Stream**	**Relicensing Issues**
Oak Grove (135)	Oak Grove. Fk. Clackamas	workgroups studying mitigation needs
N. FK./Faraday/River Mill Projects (2195)	Clackamas	Screening, passage; workgroups studying mitigation needs.
Sullivan Plant (2233)	Willamette Falls -Willamette R.	Fish passage, turbine mortality, workgroups studying mitigation needs.
Carmen-Smith (2242)	McKenzie	
Leaburg/Walterville (2496)	McKenzie R.	Fish passage, flow; ESA Section 7 consultation underway.
Blue River (3109)	Blue River>McKenzie	Mitigation for fish passage problems; cost share for temperature study.
Stone Creek (5264)	Stone Cr.>Oak Gr. Fk. Clackamas	Flows, velocities, mitigation for endangered plant
Canyon Creek (6414)	Canyon Cr.>Clackamas	No fish & wildlife concerns presently i.d.'d
Brunswick Creek (6564)	Brunswick Cr.>Tualatin	Blocks 2 miles of cutthroat habitat; res. stocked w. exotic rainbow.
LaComb (6648)	Crabtree Cr.>S. Santiam	Fish passage, flow problems, water quality
Falls Cr. (6661	Falls Cr.>S. Santiam	Screening improvements
Water Street (6943)	N. Santiam	Screening
Wolf Creek (7058)	[City of Portland water system]	No fish and wildlife concerns i.d.'d
Thompson's Mills (9169)	Calapooia R.	Flows
Woodcock Creek (1423)	Woodcock Cr.>Molalla	
Stayton (11429)		Flows, passage, water quality, screening
Albany Hydroelectric Project (11509)	S. Santiam	Screening, passage, flows, habitat protection
Bigelow (11512)	McKenzie R.	Screens, passage, bull trout mitigation req'd by ESA consultation

Existing and Past Efforts

Artificial Production

Hatchery operations have likely had a number of direct and indirect effects on listed fish species in the Willamette River basin. Potentially beneficial influences include supplementation of natural populations that are at critically low levels, and, depending on stream size and character, increasing nutrient inputs.

One of the principal adverse effects has been genetic change to populations through extensive inter-basin stock transfers at Willamette Project hatchery facilities and subsequent inter-breeding between wild and strayed hatchery fish. Fish derived from natural spawning likely have genes originating from non-native stocks. Consequently, the fitness of resulting offspring for successful spawning and survival in the wild may be in question.

Other adverse effects include increased competition between artificially- and naturally-produced juveniles for food and rearing habitat. Usually hatchery fish are larger on release than comparably-aged, naturally-produced fish and thus may have been able to outcompete. Furthermore, larger hatchery juveniles have been able to prey on smaller natural fish. Hatcheries have also been subject to diseases because of the increased density of fish in rearing facilities, and, upon release, these fish carry disease to natural stocks. Increased hatchery production may also have encouraged increased fishing, potentially resulting in over-fishing.

In July 2000, the National Marine Fisheries Service developed a Biological Opinion under Section 7 of the Endangered Species Act in consultation with the BPA and the Corps of Engineers on the effects of Willamette basin hatcheries on species listed under the act. (NMFS 2000) Hatcheries considered in the biological opinion are listed in Table 18.

The Corps and Bonneville Power Administration (BPA) fund over 90% of the artificial propagation programs which potentially affect listed spring chinook and winter steelhead in the Upper Willamette River ESUs. However, all of the hatcheries included in this consultation are operated and maintained by ODFW. The area considered in the Biological Opinion encompasses the entire Willamette River Basin from the mouth to the uppermost range of the defined ESUs.

The effects of hatchery program activities in the Upper Willamette River ESUs were cited by NMFS' status reviews as potential factors for the decline of these ESUs (Busby et al. 1996; Myers et al. 1998). Interbreeding among hatchery-origin and natural-origin fish and the incidental harvest of listed fish in commercial and recreational fisheries targeting abundant hatchery runs were identified as particular concerns.

Table 18. Willamette Subbasin Hatcheries (from NMFS 2000)

Clackamas Hatchery	The Clackamas Hatchery is located at approximately mile 23 on the Clackamas River which flows into the Willamette River approximately 2 miles downstream from Willamette Falls. The purpose of this spring chinook hatchery program is to mitigate for fisheries losses associated with hydropower development and habitat degradation within the sub-basin.
Marion Forks Hatchery	The purpose of this hatchery program is to mitigate for the loss of spring chinook production associated with the construction of Big Cliff and Detroit Dams on the North Santiam River, which blocked all upstream fish passage. The Marion Forks Hatchery is located above Detroit Dam, on the North Santiam River at river mile 73.
South Santiam Hatchery	The purpose of the hatchery program is to mitigate for fishery losses associated with the construction of Foster and Green Peter dams on the South Santiam River. The South Santiam Hatchery is located adjacent to Foster Dam at river mile 38. The South Santiam River is a tributary to the Santiam River, which flows into the Willamette River.
McKenzie Hatchery	The purpose of this hatchery program is to mitigate for fish production losses associated with the development and operation of Blue River and Cougar dams on the McKenzie River. The McKenzie Hatchery is located on the McKenzie River approximately 22 miles east of Springfield, Oregon. The proposed smolt production goal is 1.485 million fish.
Leaburg Hatchery	The purpose of this hatchery program is to mitigate for lost trout habitat caused by the construction of Blue River and Cougar dams and other Willamette Valley projects. Leaburg Hatchery is located on the McKenzie River approximately 23 miles east of Springfield, Oregon, and is used for egg incubation and rearing of summer steelhead and rainbow trout.
Willamette Hatchery	The purpose of the hatchery program is to mitigate for fishery losses caused by Hills Creek, Lookout Point, and the Dexter hydroelectric/flood control projects. The Willamette Hatchery is located along Salmon Creek, approximately 3 miles upstream from its confluence with the Middle Fork Willamette River.

Willamette Basin Hatchery and Genetic Management Plans (HGMPs) required under NMFS 4(d) rule are under development. Hatchery and Genetic Management Plans (HGMPs) are described in the final salmon and steelhead 4(d) rule (July 10, 2000; 65 FR 42422) as a mechanism for addressing the take of certain listed species that may occur as a result of artificial propagation activities. A number of "mini" HGMPs based on early NMFS guidance have been completed for spring chinook programs at Clackamas, Marion Forks, South Santiam, McKenzie, and Willamette hatcheries (Figure 7). An proto-type HGMP was also developed for the summer steelhead hatchery program at Leaburg Hatchery. As of October 2001, the Clackamas River winter steelhead HGMP is nearly complete and will be forwarded to NMFS in the near future. All other HGMPs within the Willamette are to be fully completed prior to September 2003.

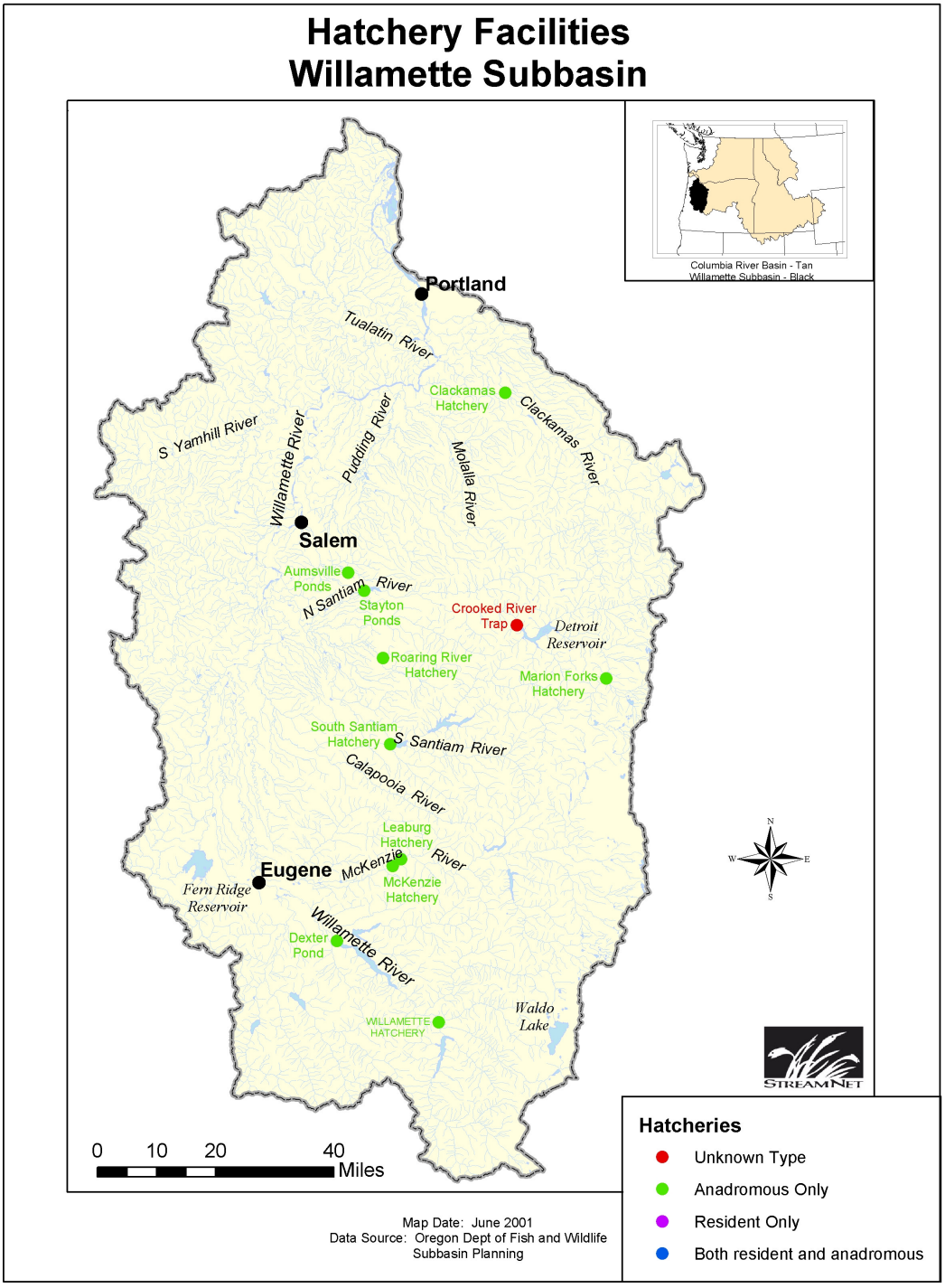


Figure 7. Willamette Subbasin Hatcheries

The July 2000 NMFS biological opinion considered the impacts of proposed actions by the BPA, Corps, and ODFW, including the release of a total of 5.7 million artificially propagated spring chinook, 570 thousand summer steelhead, and 325 thousand rainbow trout in the Upper Willamette River Basin. Table 19 lists annual release goals of hatchery fish in the Upper Willamette ESUs. Consequently, the Opinion identified three key issues regarding hatchery management in the Willamette basin:

1. Hatchery spring chinook cannot be differentiated from naturally-produced fish on the spawning grounds and in hatchery broodstocks.
2. Possible significant interbreeding between hatchery fish and natural fish in the wild resulting in the loss of local adaptation among the wild populations. Actual level of hatchery fish straying is uncertain.
3. The majority of hatchery production in the basin is to mitigate for habitat loss and degradation from Federal dams. However, the abundance of hatchery fish promotes fisheries which may significantly impact the remaining listed fish populations.

Table 19. Annual release goals of hatchery fish by location and species from artificial propagation programs in the Upper Willamette River ESUs. (Subbasins listed from upstream to downstream based on 4 th field HUCs. "N/A" represents hatchery production addressed

Release Location (subbasins except where noted)	Spring Chinook	Fall Chinook	Winter Steelhead	Summer Steelhead	Coho Salmon	Rainbow Trout	Total
Coast Fork Willamette	0	0	0	0	0	200,000	200,000
Middle Fork Willamette	1,427,240	0	0	157,000	0	0	1,584,240
Upper Willamette	0	0	0	0	0	0	0
McKenzie	985,000	0	0	108,000		125,000	1,218,000
South Santiam	1,021,000	0	0	144,000	0	0	1,165,000
North Santiam	667,000	0	0	161,500	0	0	828,500
Middle Willamette	0	0	0	0	0	0	0
Yamhill	0	0	0	0	0	0	0
Molalla	100,000	0	0	0	0	0	100,000
Tualatin	0	0	0	0	0	0	0
Clackamas	1,257,700	0	0	0	0	0	1,257,700
mainstem Lower Willamette River	260,000	n/a	0	0	n/a	0	260,000
Columbia River estuary*	900,000	n/a	n/a	n/a	n/a		900,000
TOTAL	6,617,940	0	0	570,500	0	325,000	7,513,440

* Juvenile releases in the estuary are from broodstock collected in the Upper Willamette spring chinook ESU.

The Opinion concluded that the proposed actions will likely result in changes in the abundance, productivity, population structure, and/or genetic integrity of the Upper Willamette River spring chinook and winter steelhead ESUs. NMFS found that:

- the hatchery programs as described in the proposed actions appreciably reduces the survival *and* recovery of listed spring chinook and thus, jeopardizes the continued existence of the Upper Willamette spring chinook ESU.
- the proposed actions do not appreciably reduce the survival and recovery of listed winter steelhead and thus, do not jeopardize the continued existence of the Upper Willamette River winter steelhead ESU.
- the proposed actions will not result in the destruction or adverse modification of critical habitat for the listed Upper Willamette River ESUs;
- the proposed actions do not jeopardize the continued existence or result in adverse modification of critical habitat for the following listed ESUs: Lower Columbia River chinook and steelhead, Columbia River chum, Middle Columbia River steelhead, Snake River spring/summer chinook, fall chinook, steelhead, and sockeye, and Upper Columbia River spring chinook and steelhead.

The reasonable and prudent alternative contained in the Opinion identifies four measures that will avoid jeopardy of the Upper Willamette River spring chinook ESU: 1) immediately reducing the number of hatchery fish spawning naturally; 2) modifying the numbers and release locations of hatchery fish to reduce adverse ecological effects; 3) development of locally adapted hatchery stocks; and 4) facilitating the identification of hatchery- and naturally-produced fish.

NMFS developed additional conservation recommendations related to hatcheries:

<u>All Agencies</u>

- Fund and/or continue to collaboratively develop Hatchery and Genetic Management Plans (HGMPs) for hatchery programs in the Upper Willamette River spring chinook and winter steelhead ESUs (before September 30, 2003 with spring chinook the highest priority)
- Develop distinguishable marks (or a representative sample) for hatchery spring chinook within each of the subbasins.
- Develop production plans that minimize transfers of fish among hatcheries for rearing.
- Consider relocating some of the mitigation hatchery production to Lower Columbia River “select areas” to reduce the number of surplus fish returning to hatcheries in the Willamette Basin.

<u>Agency Specific</u>

- The Corps should develop contingency plans on production goals (and release strategies) if future monitoring and evaluation suggests hatchery mitigation is not being utilized in fisheries and the percentage of hatchery fish on the spawning grounds is high.
- ODFW should recycle adult hatchery (of known origin) salmon and steelhead captured at hatchery facilities within the Willamette River Basin to promote the maximum harvest of hatchery fish in recreational fisheries and reduce the number of surplus fish at the end of the season.

Projects Funded by the Bonneville Power Administration

An estimated 2,300 Habitat Units have been generated from BPA-funded wildlife mitigation projects (Northwest Power Planning Council 2000). Habitat projects funded by the BPA are displayed in Table 20.

Fish and Wildlife Habitat Improvement Activities Funded and Managed by Others

OWEB funding

The Oregon Watershed Enhancement Board administers funds for the Oregon Plan and Healthy Streams Partnership. The recently developed Oregon Plan emphasizes treating the entire watershed and accountability of state agencies for implementing watershed improvement projects. This will result in a more ecosystem-based management strategy that should benefit all residents of the watershed. The Oregon Watershed Enhancement Board estimates that during the 1999-2001 period, over $8 million was allocated to the Willamette basin, split evenly between "capacity" expenditures (e.g., watershed council support, monitoring, planning and assessments and education) and "restoration" (e.g., land acquisitions, riparian treatment, and passage improvements) [Oregon Plan for Salmon and Watersheds, Annual Progress Report, 2001)

Table 20. Willamette Subbasin habitat projects funded by the Bonneville Power Administration

Project Title	Target Species	Project Description	Agency Name	Summary Description
Amazon/Willow Creek Wildlife Mitigation (Project No. 199205900)	Wildlife	Land Purchase / Enhancement	The Nature Conservancy	Habitat enhancement on existing mitigation lands and acquisition of 99 acres contiguous with the 330 acre Willow Creek Wildlife project area in Eugene, OR. Continue restoration and enhancement of native wet prairie and oak woodland habitat, reduce non-native species abundance, and apply hydrologic monitoring data to improve aquatic habitat. Target species include beaver, black capped chickadee, red-tailed hawk, valley quail, western meadowlark, yellow warbler, & western pond turtle. Funding for wildlife projects has included evaluations of the impacts of the Federal Columbia River Power System (FCRPS) on wildlife habitat and populations, planning for habitat protection and enhancement, and implementation of specific habitat protection and enhancement projects. (1992-2000; on-going, renewal expected). Future acquisition and enhancement work planned.
Ames Creek Restoration (Project No. 200103600)	Anadromous Fish	Passage	U.S. Forest Service	New project designed to improve in-stream passage for winter steelhead trout and spring Chinook salmon. When implemented this project will breach an old mill dam in order to open 4 miles of winter steelhead spawning habitat currently inaccessible to South Santiam River fish. (2001)
BPA Lands Support For Springfield Prod Facility (Project No. 199203900)	Anadromous Fish	Evaluation	-	Funded internal support project, i.e. BPA Lands support for evaluation of the Springfield Aquatic Production facility. 1992
Bull Trout Assessment - Willamette/McKenzie (Project No. 199405300)	Resident Fish	Assessment / Monitoring	Oregon Department of Fish & Wildlife (Hq)	Determine life history, distribution and habitat use of bull trout populations in the Upper Willamette Basin - Middle Fork Willamette and McKenzie Rivers. Information collected has allowed ODFW to complete a risk assessment, rehabilitation plan, and monitoring program for bull trout in the Middle Fork Willamette River. Assessing the potential for expanding bull trout distribution by re-introducing naturally-produced bull trout to recently opened habitat. (1994, 1998-2000 ; on-going)
Burlington Bottoms - Phase I (Project No. 199107800)	Wildlife	Enhancement / Maintenance	Oregon Department of Fish & Wildlife (Hq)	Develop management plan for Burlington Bottoms Wildlife tract near Portland, OR (417 acres). Protects, maintains, and enhances habitats for a diverse array of fish and wildlife, and maintains and increases habitat values (HEP) for wildlife, including state and federally listed species such as the bald eagle and red-legged frog. Biological objectives include: 1) an increase in native plant diversity on approximately 200 acres; 2) a reduction of exotic plant species in vigor and growth; 3) increased in songbird abundance and diversity; and 4) maintenance of current habitat for great blue heron, wood duck, beaver, yellow warbler, amphibians and reptiles, and others. Conduct O&M after purchase and implementation. Future maintenance and enhancement work planned. (1991-2001; ongoing)

Project Title	Target Species	Project Description	Agency Name	Summary Description
Insp Serv For Little Fall Creek Pass Re:86-090 (Project No. 198612400)	Anadromous Fish	Operations and Maintenance	Oregon Dept Fish & Wildlife (Hq)	Provide for the operation, maintenance, and repair of the Little Fall Creek passage facilities (Middle Fork of the Willamette). See 8609000. 1986
Little Fall Creek Maintenance Re:86-124 (Project No. 198609000)	Anadromous Fish	Passage	Weyerhaeuser Company	Construct fish ladders at two falls on Little Fall Creek, a tributary to the Middle Fork of the Willamette River. (Project 8609000 is the same as 8612400.)
McKenzie River Focus Watershed Coordination (Project No. 199607000)	Anadromous Fish	Planning	McKenzie Watershed Council	Fund ongoing operations of the McKenzie River Watershed Council to improve resource stewardship to protect fish and wildlife. Activities include action plan completion; coordinated planning, implementation, and monitoring of fish, wildlife and water quality improvement, public outreach and education and securing other funding. (1997 –2000; ongoing)
Assess McKenzie Watershed Habitat and Prioritize Projects	Anadromous Fish	Planning	McKenzie Watershed Council	Basin-wide habitat assessment and project prioritization for the McKenzie River watershed. (2000-2001; ongoing)
Mohawk Watershed Planning and Coordination (Project No. 199702200)	Anadromous Fish	Planning	East Lane Soil Conservation District	Fund watershed planning, education, seminars, and demonstration projects in the Mohawk Valley, a tributary of the McKenzie River.
Multnomah Channel Riparian Habitat Restoration (Project No. 199906600)	Wildlife	Restoration / Enhancement	Metro	Habitat restoration and enhancement focused on the complex of emergent tidal marshes, forested wetlands, sloughs, and small lakes found on the 306 acre site acquired to date. Restoration of the 24 acres of degraded riparian habitat along the Multnomah Channel and creeks includes re-vegetation with native plant material. Topographic, hydrologic, and wildlife habitat assessment information has been acquired for the development of site plans and designs for wetland enhancement projects. A watershed management plan for streams draining the adjacent Tualatin mountains onto Multnomah Channel bottomlands is being developed as well. Future acquisition and enhancements are planned. (1999-2001; on-going)
Oregon Trust Agreement Planning (Project No. 199208400)	Wildlife	Assessment	Oregon Wildlife Coalition	Using screening criteria, created a prioritized list of 276 potential wildlife mitigation opportunities and estimated costs for mitigating for wildlife losses in Oregon. Almost half of the sites were located in the Willamette Basin. (1992)
Oregon Trust Agreement Planning Project – Assessing Using GAP Analysis (Project No. 95-65)	Wildlife	Assessment / Planning	Oregon Wildlife Coalition	Refinement of project 199208400. Prioritized and depicted the contribution of each proposed mitigation site to target species and habitats and overall biodiversity in the state and/or eco-region. Identified and ranked lists of the highest priority project sites. Projects are implemented in the Willamette Basin on an annual basis from these lists through the Willamette Basin Mitigation Program, Burlington Bottoms, Amazon Basin, Multnomah Channel, and Tualatin River National Wildlife Refuge (NWR).1996

Project Title	Target Species	Project Description	Agency Name	Summary Description
Springfield Production Facilities (Project No. 199202300)	Anadromous Fish	Facility Design / Construction	Alleco Financial Corp.	Evaluate suitability of the old Ore-Aqua site near Springfield, OR, for fish production or research. 1992
Tualatin River National Wildlife Refuge Additions (Project No. 200001600)	Wildlife	Acquisition / Enhancement / Operations and Maintenance / Monitoring and Evaluation	U.S. Fish and Wildlife Service	Secures wildlife mitigation sites within the approved acquisition boundary of the Tualatin River NWR through protection, enhancement, and management activities for the benefit of fish and wildlife species in the Tualatin River watershed. Habitat acquisition and enhancement is focused on seasonal and emergent wetlands, Oregon ash riparian wetlands, coniferous forests, and Oregon white oak plant communities. Current year's activities include habitat enhancement, operations and maintenance, and monitoring and evaluation, and the acquisition of one property. Future acquisition and enhancements are planned. (1999-2001; on-going)
Willamette Basin Mitigation Program (Project No. 199206800)	Wildlife	Mitigation / Recovery	Oregon Department of Fish & Wildlife (Hq)	Cooperatively develop and implement measures to mitigate for wildlife habitat losses resulting from the construction of federally licensed hydro-electric dams and facilities. Through the use of easements, acquisitions, management plans, and enhancement activities, the program attempts to achieve the Council's mitigation goals for 19 target species and habitat while maintaining and improving water quality and quantity, habitat connectivity and functionality, biodiversity and overall ecosystem health. Efforts are primarily focused on projects located adjacent to the main stem Willamette River and it's major tributaries with special emphasis on riparian areas and confluences where greatest benefits to fish and wildlife can be realized. Project areas currently include the Willamette River near Oregon City and Canby, the North Santiam River near Stayton, the Muddy Creek and Mary's River confluence, the lower McKenzie River, the confluence of the Middle Fork and Coast Fork Willamette, the lower Middle Fork Willamette, and the lower Coast Fork Willamette. Conduct BEP analysis for the confluence of the Coast Fork & Middle Fork Willamette Rivers, complete data acquisition on western pond turtles, determine feasibility of acquisition, easements & site restoration. Gather information for site management plan. Future acquisition and enhancement work is planned. (1996-2003; on-going)
Willamette River Projects Wildlife and Habitat Loss Assessment (Project No. 198403600)	Wildlife	Mitigation / Recovery	Oregon Department of Fish & Wildlife (Hq)	Estimated the impacts of the reservoir inundation and water level fluctuations on wildlife and wildlife at the Willamette River Basin Federal hydroelectric facilities (Hills Creek Dam and Reservoir Project, Lookout Point Dam and Reservoir Project, Dexter Dam and Reservoir Project, Foster Dam and Reservoir Project, Green Peter Dam and Reservoir Project, Cougar Dam and Reservoir, Detroit and Big Cliff Dam and Reservoir Project). A total of over 30,000 acres and 94,000 Habitat Units were estimated to be lost as a result of the development of the eight facilities (Noyes et. al. 1985, 1985a-d, 1986). Studies assessed these impacts to develop mitigation recommendations. 1984

Project Title	Target Species	Project Description	Agency Name	Summary Description
Willamette River Projects Wildlife Mitigation Plan (Project No. 198606400)	Wildlife	Mitigation / Recovery	Oregon Department of Fish & Wildlife (Hq)	A wildlife habitat protection, mitigation, and enhancement plan for 8 federal hydroelectric facilities in the Willamette River Basin was completed in 1987 (Preston et al. 1987). This effort was prepared for BPA in fulfillment of section 1004(b)(1) of the NWPPC FWP. ODFW reviewed the status of past, present, and proposed future wildlife planning and mitigation programs at existing hydroelectric projects and prepared recommendations for mitigation for impacts to wildlife. This was the first BPA funded project assembling a list of potential mitigation sites in the Willamette Basin.1986
Willamette Hatchery Oxygen Supplementation	Anadromous Fish	Research		Determines survival of chinook salmon reared at various densities under conditions of oxygen supplementation, without detrimental effects on returns of adult salmon. Preliminary results from adult returns suggest that survival may indeed be inversely related to rearing density. (1990-2000; no renewal)
Willamette Spring Chinook Study (Project No. 198506800)	Anadromous Fish	Supplementation	Oregon Department of Fish & Wildlife (Hq)	Summarize previous supplementation efforts for spring Chinook and identify methodology and requirements for evaluation of supplementation test results in the Willamette River Basin. 1985

U.S. Corps of Engineers Restoration Projects

The Section 1135 program provides authorization and funding for small environmental restoration projects, either at the project site or off -project site when it is found that the USACE project contributed to the degradation of the environment. Section 1135 projects are cost-shared at 75 percent federal/25 percent local share.

The Section 206 program authorizes and funds small aquatic ecosystem restoration projects to improve the quality of the environment. Unlike section 1135, for Section 206 authority, there is no requirement that projects be linked to an existing USACE project. Section 1135 projects are cost-shared at 65 percent federal/35 percent local share. The USACE currently has four Section 206 projects ongoing in the Willamette River basin that may contribute to the recovery of salmon to varying degrees. Section 1135 and 206 projects are shown in Table 21.

Table 21. U.S. Army Corps of Engineers Section 1135 and 206 restoration projects

Section 1135 Projects	
Lower Amazon Creek Wetlands.	Construction began in summer 1999 to restore 398 acres of wet prairie wetlands adjacent to Amazon Creek, a tributary of the Long Tom River. The project will restore natural floodplain function and help improve water quality. The City of Eugene is the local sponsor. $5 million has been spent to-date (both federal and non-federal funds)
Fern Ridge Marsh.	This project will provide additional permanent marsh habitat for waterfowl and other species. The ODFW is the local sponsor. $500,000 has been spent to-date (both federal and non-federal funds)
Mission Bottom	This Corps is evaluating the potential for restoring flows into Mission Lake, an oxbow lake along the mainstem Willamette River at Mission Bottom State Park. Flows in the lake were affected by construction of a bank protection project by the USACE at its downstream outlet. Modification of the flows through the lake could have benefits for juvenile salmonid rearing habitat and other purposes. Oregon State Parks Department is the local sponsor.
Richardson Park.	This project would restore a small stream entering Fern Ridge Lake at Richardson Park, operated by Lane County. The stream, culverted when the park was constructed, will be daylighted and stream habitat restored for benefit of native cutthroat trout and other species. $250,000 has been spent to-date (both federal and non-federal funds)

Section 206 Projects	
Bowers Rocks	This project, currently in the feasibility phase of study, is evaluating the potential for restoring habitat and hydrology associated with a gravel pit and stream along the mainstem Willamette River at Bowers Rock State Park, near Albany. Modification of the streamflows to the gravel pit lake could have benefits for juvenile salmonid rearing habitat and other purposes. If determined to be feasible, the project is scheduled to be constructed in the summer of 2000. Oregon State Parks Department is the local sponsor.
Springfield Millrace	This project, currently in the feasibility phase of study, is evaluating opportunities to restore degraded habitat in the Springfield Millrace. The Millrace is an unscreened diversion channel. Restoration of the channel entrance and habitat areas within the channel, including the Springfield Millpond, may be beneficial for juvenile salmonids using the millrace. Local sponsor is the City of Springfield.
Eugene Delta Ponds	This project, currently in the feasibility phase, is evaluating opportunities for modifying hydrologic flow conditions through this series of old gravel pits and connecting them with the mainstem Willamette, with possible water quality and salmonid rearing benefits. The local sponsor is the City of Eugene.
Upper Amazon Creek	This is a new study authorized under the Water Resources Development Act of 1999. It will evaluate opportunities for restoring upper reaches of Amazon Creek, a tributary of the Long Tom River, as it flows through Eugene.

Conservation Partnership Accomplishments

Another measure of the accomplishments of the Conservation Partnership is the number of conservation contracts established with private landowners utilizing funding from USDA conservation programs. Since 1996 over 433 contracts, totaling over $9 million dollars have been written and funded in the Willamette Valley (Table 22).

Table 22. USDA conservation program investments (1996-2001)

Program	Contracts	Total $
EQIP	142	$2,642,464
WHIP	24	$191,532
WRP	27	$4,334,887
FIP	194	$671,918
CREP	46	$1,483,286
Total	433	$9,324,087

Source: NRCS

NRCS and the rest of the conservation partnership use the National Performance and Results Measurement System to report conservation progress on private lands. During federal fiscal year 2000 over 13,000 acres of resource management systems (RMS) were planned and almost 6,000 acres applied in the Willamette Valley. These RMSs benefit fish, wildlife, water quality and overall watershed health by reducing erosion, controlling non point source pollution and restoring riparian and upland wildlife habitat (Table 23).

Table 23. Performance summary for selected NRCS activities in FY2000 for the Willamette Subbasin

Performance Items	Total
Resource Management Systems Planned, acres	13,075
Resource Management Systems Applied, acres	5,748
Riparian Forested Buffers, acres	2,161
Tree and Shrub Establishment, acres	758
Nutrient Management, acres	5,426
Pest Management, acres	3,041
Wildlife Habitat Management, acres	5,537

From NRCS Performance and Results Measurement System, (http://sugarberry.itc.nrcs.usda.gov/Netdynamics/deeds/index.html)

Other Restoration Efforts

The U.S. Fish and Wildlife Service works with private landowners through its Partners for Fish and Wildlife Program to voluntarily restore wetlands and other fish and wildlife habitat. The program emphasizes the reestablishment of native vegetation and ecological communities for the benefit of fish and wildlife consistent with private landowners' needs. Many of these projects are located near existing National Wildlife Refuge System lands, or State Wildlife Management Areas. Under the cooperative agreements, the landowner agrees to maintain the restoration project as specified in the agreement for a minimum of 10 years. Tualatin River National Wildlife Refuge began a restoration program in 1997 to help recover losses of riparian, wetland, and adjacent upland oak/pine savanna habitats historically common to the Willamette Valley. To date, over 550 acres have been restored supporting long-term restoration and management needs on a landscape level. (Oregon Wetlands Joint Venture 2001)

EPA's Five Star Restoration Program was established to meet the goals of the 1998 Clean Water Action Plan. The Five Star Restoration Program brings together citizen groups, corporations, youth conservation corps, students, landowners and government agencies to undertake projects that restore streambanks and wetlands. The program provides challenge grants, technical support, and peer information exchange to enable community-based restoration projects. Major funding for the program is provided by EPA's Office of Wetlands, Oceans and Watersheds of the Office of Water, and by the National Marine Fisheries Service's Community-based Restoration Program for selected projects in coastal areas.

Another federal program which does provide resources to the State for local non-point source restoration projects is EPA's Section 319 CWA program. Under Section 319, EPA provides money annually to the state which in turn provides grants to local watershed groups, communities, cities, etc. for a variety of restoration projects. Over the years a multitude of restoration projects have been funded through this program.

Non-profit land trust organizations are also active in the valley. The Nature Conservancy manages the Willow Creek Preserve located mostly within Eugene's urban growth boundary. The Preserve has the greatest concentration of rare and imperiled wet prairie species in the Willamette Valley. The Three Rivers Land Conservancy promotes and protects scenic, open space, wildlife, natural and historic resources in the greater metropolitan area of Portland. The McKenzie River Trust protects the lands and waters of the 1400-square-mile McKenzie Basin, from which Eugene and Springfield draw 100 percent of their drinking water. The Greenbelt Land Trust is working with private landowners to protect lands in the Corvallis and Benton County areas. They were instrumental in the recent passage of an Open Space bond measure to purchase many wetland parcels in the area. The Oregon Water Trust is a non-profit organization working to preserve and enhance instream flows through Oregon's instream water right program (see also this Summary's section describing Oregon's Streamflow Restoration Program).

Many other organizations are working on restoration issues including Northwest Steelheaders, Trout Unlimited, Northwest Service Academy (AmeriCorps program), Salmon Corps, Ducks Unlimited and the Oregon Wetlands Joint Venture—a state-wide organization formed to promote protection, restoration and enhancement of wetlands and the systems on which they depend. (Oregon Wetlands Joint Venture 2001)

A 1999 survey conducted by the U.S. Army Corps of Engineers on behalf of the Willamette Restoration Initiative provides detailed documentation of on-going restoration and conservation programs in the Willamette basin. (TetraTech 1999)

Present Subbasin Management

Existing Management

The Federal Columbia River Power System

For purposes of this Summary, the first management "overlay" of critical interest is the body of federal law, regulation and planning that drives recovery in the Columbia River and its tributaries, including the Willamette.

Authorities and Implementation Mechanisms for Fish and Wildlife Management

Primary federal management drivers for Columbia River Basin recovery include: the Northwest Power Act, the Fish and Wildlife Coordination Act; the Fish and Wildlife Act; the Flood Control Act; the Water Resources Development Act; the Endangered Species Act; the Clean Water Act; the Federal Power Act; the Migratory Bird Treaty Act; and treaties between the US Government and the federally recognized Indian tribes of the Columbia River Basin. Other drivers in the Willamette Subbasin include the revised

statutes of Oregon, Oregon Administrative rules, and the plans and policies of state agencies, including the Oregon Plan for Salmon and Watersheds. The Fish and Wildlife Managers recognized under the Northwest Power Act have established goals and objectives for fish and wildlife management in the Columbia Basin. These are summarized in Appendix B.

Salmon Recovery

The National Marine Fisheries Service and the U.S. Fish and Wildlife Service issued Biological Opinions on the Federal Columbia River Power System in December 2000 delineating "reasonable and prudent actions" (RPAs) that three specific federal agencies must undertake to meet obligations under the federal Endangered Species Act.

In response, the three "action" agencies (Bonneville Power Administration, U.S. Army Corps of Engineers, and the Bureau of Reclamation) developed a Draft Endangered Species Act Implementation Plan in July 2001 built around a 5-year timeframe.

In addition, the Federal Caucus (a group of nine cooperating federal agencies) have developed a broader Columbia Basinwide Salmon Recovery Strategy to be used by all federal agencies to target actions needed to recover threatened and endangered salmon and steelhead in the Columbia River Basin. (Federal Caucus, Conservation of Columbia Basin Fish, Volume 1, December 2000)

Finally, NMFS and USFWS are in the process of completing a Biological Opinion on the U.S. Army Corps of Engineers Willamette Basin Project. In addition to the Corps, the Services have identified the Bureau of Reclamation and the Bonneville Power Administration as action agencies. The Biological Opinion is expected to be completed in 2002.

These efforts are explained in more detail, below.

Draft Endangered Species Act Implementation Plan

The Plan is a five-year blueprint that organizes collective fish recovery actions by the three action agencies: Bonneville Power Administration, U.S. Army Corps of Engineers, and the Bureau of Reclamation. The Plan looks at the full life cycle of the fish — also known as "gravel to gravel" management or an "All-H" approach (Hydro, Habitat, Hatcheries, and Harvest). It does not, however, describe the obligations of other Federal agencies, states, or private parties. It focuses on meeting the biological requirements of listed fish and calls for the development, implementation and testing of strategies for each H and for each species/ESU.

The Action Agencies' priorities for 2002–2006 emphasize short-term benefits and longer term needs consistent with the provisions of both the NMFS and USFWS BOs. Anadromous fish priorities include:

- Adult and juvenile fish passage improvements at dams, including spill and surface bypass.
- Investigation of future flow improvements
- In tributary rivers, enhancement of flows, riparian areas, passage, and screening.
- In the estuary, acquisition, restoration, and evaluation of habitats.
- Completion of sub-basin assessments and plans
- Implementation of Hatchery Genetic Management Plans and hatchery reforms.

Willamette Subbasin-Related Priorities are shown in Table 49 under Statement of Fish and Wildlife Need.

Basinwide Salmon Recovery Strategy

The Strategy sets out actions that can immediately stabilize populations and show results across all salmon life stages. It identifies actions in terms of Habitat, Harvest, Hatcheries, and Hydropower, and commits the federal hydropower system to fund these actions to mitigate for unavoidable mortality in the system. The Strategy (or "All H Paper") places a premium on habitat conservation in tributary areas.

For tributary habitats on non-federal lands, the federal agencies propose a "fast start" approach that will first fund action with immediate benefits, including:

- Removing passage barriers
- Screening diversions
- Purchasing in-stream flow rights,
- Restoring water quality, and
- protecting high-quality habitat through conservation easements or land purchase. (Federal Caucus, Conservation of Columbia Basin Fish, Volume 1, December 2000)

Willamette Subbasin priorities under the Strategy are described under Statement of Fish and Wildlife Needs.

ESA Consultation on Willamette Basin Project

The National Marine Fisheries Service and the U.S. Fish and Wildlife Service ("Services") are currently performing an analysis under Section 7 of the Endangered Species Act to determine whether ongoing operations of the U.S. Army Corps of Engineers' Willamette Basin Project would jeopardize the survival and recovery of ESA-listed species. The Services are in the process of reviewing information to make final jeopardy determinations for Columbia River bull trout, Upper Willamette River spring chinook salmon, and Upper Willamette River steelhead.

If the Services finally determine that Project operation would, in fact, so-jeopardize these species, the Services must identify a Reasonable and Prudent Alternative (RPA) that would at least partially restore basic fluvial ecosystem processes in the upper Willamette Basin. The Services expect that restoration of these physical and biological processes will allow the numbers, distribution and reproduction of listed fishes to rebound from their current depressed states.

An RPA would be expected to consist of measures that address:

1. Physical processes of the upper Willamette fluvial ecosystem, including:
   - disturbance;
   - flow regime;
   - sediment and large wood function;
   - riparian vegetation and floodplain function;
   - water quality; and,
2. Biological processes, including:
   - migration;
   - spawning;

- rearing;
- population trends; and,
- life-history diversity

Measures to address any RPA would also be likely to consider structural modifications such as retrofitting dams with upstream and downstream fish passage facilities and water temperature control structures.

The Services are considering a two-phase RPA that would likely establish both short- and long-term actions. Short-term actions would be intended for implementation immediately upon issuance of the biological opinion to restore some spawning, rearing and migratory habitat for listed fishes. The short-term component of an RPA would also probably include a comprehensive research and monitoring program, the results of which would help to clarify ecosystem and species-specific effects of the Willamette Basin Project. Results of research and monitoring could feed into a long-term component of the RPA, directing the restoration of underlying physical processes that will create and sustain suitable habitats for listed species in the basin.

The Services envision that implementation of any measures resulting from an RPA that averts jeopardy for Columbia River bull trout, Upper Willamette River spring chinook salmon, and Upper Willamette River steelhead by restoring physical and biological processes could substantially change the operation of the Corps' Willamette Basin Project. Whatever measures are instituted, the Federal agencies expect that the consultation will establish a long-term partnership among the Action Agencies (the Corps, BPA, and USBR), the National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

Existing Goals, Objectives, and Strategies

Overview of Management Intent: Programmatic and Large Scale Management Efforts

The Willamette Subbasin is diverse physiographically, ecologically, economically, and institutionally. There are myriad management responsibilities and programs influencing the subbasin's fish and wildlife. Nearly every state and federal natural resource agency has responsibilities and key interests in the Willamette.

Nevertheless, there has recently been an emergence of more coordinated and integrated management in the Willamette Subbasin. It is evident that the overall intent of management entities in the Willamette Subbasin is to protect and restore species and habitat through an integrated, ecosystem-based approach that respects local, tribal, and regional needs and targets strategic investment for environmental results.

In this section, the Summary attempts to identify and describe those programs and activities which most clearly both express and embody this new interest in integration. These programs both support and supplement the management intent described in 1, above. Specifically, they offer detailed information especially useful for meeting the needs for non-federal tributary lands: instream flows, water quality, habitat restoration opportunities, and passage barriers. (see also Basinwide Salmon Strategy, above)

The following subbasin management programs are of most significance in the Willamette subbasin and are described in detail in subsequent sections:

- Willamette Restoration Strategy / Oregon Plan for Salmon and Watersheds)
- Oregon Department of Fish and Wildlife Management and Operation Plans
- U.S. Army Corps of Engineers Willamette Basin Project
- Northwest Forest Plan, including the Aquatic Conservation Strategy
- Tribal Interests
- Willamette water quality planning and implementation
- Assessments and plans of watershed councils and Soil and Water Conservation Districts
- Local and regional government plans and activities
- The Lower Columbia River Estuary Partnership
- Streamflow Restoration Program
- Fish passage programs

Willamette Restoration Strategy/Oregon Plan for Salmon and Watersheds

The Willamette Restoration Strategy is the Willamette Basin Supplement to the Oregon Plan for Salmon and Watersheds. Specifically, the Strategy is a comprehensive and integrated approach for protecting fish and wildlife habitat, enhancing water quality, and properly managing floodplains—all while meeting the needs of a rapidly growing population. It was developed and is being implemented under the guidance of the Willamette Restoration Initiative (WRI). WRI was established by Governor Kitzhaber in 1998 with the appointment of a 26-member citizen Board of Directors. The Governor charged WRI with collaboratively developing and implementing the Strategy. It formulated guiding objectives shown in Table 24.

Table 24. Objectives of the Willamette Restoration Initiative

Strategies to Address Watershed and Ecological Processes
Protect clean water sources, improve degraded water sources, and address water quantity deficiencies in order to support fish and wildlife, recreation, human health, and other beneficial uses.
Protect and restore riparian, terrestrial, and instream habitats and processes sufficient to support self-sustaining levels of associated native fish, aquatic species, and wildlife populations.
Protect and restore the hydrologic function of floodplains.
Promote land and water management approaches that control invasive species, including those approaches that provide net benefits to native species.
Promote landscape-based approaches to watershed health that recognize diverse management objectives for the working landscape.
Strategies to Address Institutional Capacity
Integrate economic, political, and environmental factors.
Foster a new level of awareness, understanding of, and engagement with basin restoration efforts on the part of the public and decision makers.
Promote adequate, reliable funding for restoration that accounts for the broadest watershed health benefit.
Enhance local restoration capacity.
Establish a framework compatible with a statewide system to coordinate data acquisition, monitoring programs, information distribution and management, and the integration of science and policy.

The Willamette Restoration Strategy identifies 27 critical actions for addressing clean water, water quantity, habitat and hydrological processes, and institutional coordination. These actions incorporate over 200 discrete actions identified by state and federal agencies relating to salmon and watershed restoration. In addition, the Strategy promotes use of a new Willamette basin Habitat Conservation and Restoration Opportunities map (see Figure 9, Statement of Fish and Wildlife Need) to guide decision-making, and arrays ecosystem health indicators and provisional targets of desired future condition. Among the 27 actions, those shown in Table 25 represent a core management intent relating to the fish and wildlife mitigation.

Table 25. Mitigation-related actions in the Willamette Restoration Strategy (Willamette Restoration Initiative 2001)

Support the Willamette Basin total maximum daily load (TMDL) process, including coordination and communication.
Support effective implementation of the Agricultural Water Quality Management Plan process (Senate Bill 1010) and encourage its use to address species needs.
Support improvements to water quantity management efforts to meet water supply needs for ecologic and economic purposes.
Support the Corps of Engineers' ongoing assessment of flood-control reservoir operation by helping identify and communicate changes needed to address streamflow issues.
Establish science-based riparian area protection guidelines.
Support basin-wide scientific investigations of how to restore floodplain function.
Inventory, map, and conserve priority fish and wildlife habitats in the Basin.
Improve both upstream and downstream fish passage at dams, culverts, and water diversions.
Support improvements to hatchery and harvest management systems.
Prevent the introduction and control the spread of the most harmful invasive species.
Support funding for on-the-ground protection and restoration projects.
Improve delivery mechanisms for incentive programs, especially the Conservation Reserve Enhancement Program (CREP).
Increase public and consumer awareness of the Willamette watershed health issues.
Create an effective and cooperative strategy at the local level to fund and implement watershed action plans.
Create watershed technical assistance teams.
Establish a basinwide salmonid recovery coordinating council.
Improve Willamette Basin information management.

ODFW Management and Operational Plans

The management responsibilities of the Oregon Department of Fish and Wildlife were well-summarized in the John Day Subbasin Summary (ODFW 2001). The information immediately following is taken from that Summary.

ODFW "is responsible for protecting and enhancing Oregon fish and wildlife and their habitats for present and future generations. Management … is guided by ODFW policies, collaborative efforts with affected tribes, and federal and state legislation. Direction for ODFW fish and wildlife management and habitat protection is based on the

amendments and statutes passed by the Oregon Legislature through the 2001 session" as further described in state administrative rules (Table 26). In addition, ODFW has adopted Vision 2006 as a six- year strategic operational plan and has issued Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources (ODFW 1997a).

Table 26. Management regulations for the Oregon Department of Fish and Wildlife

Oregon Administrative Rule (OAR) 635 Division 07 -- Fish Management and Hatchery Operation	sets policies on general fish management goals, the Natural Production Policy, the Wild Fish Management Policy, and other fish management policies.
OAR 635 Division 008 -- Department of Wildlife Lands	sets management goals for each State Wildlife Area
OAR Divisions 068-071	sets deer and elk seasons
OAR Division 100 -- Wildlife Diversity Plan	sets outlines wildlife diversity program goals and objectives, identifies species listings, establishes survival guidelines, and creates other wildlife diversity policy.
OAR Division 400 -- Instream Water Rights Rules	provides guidelines for inflow measurement methodologies, establishes processes for applying for instream water rights, and sets forth other instream water rights policies.
OAR Division 415 - Fish and Wildlife Habitat Mitigation Policy	establishes mitigation requirements and recommendations, outlines mitigation goals and standards, and provides other mitigation guidelines.

A number of these plans and programs are described below and in Appendix C.

Fish Management Plans

The Oregon Department of Fish and Wildlife Department has adopted general policies on fish management, hatcheries, fish habitat and wild fish (OAR 635, Division 07). These are displayed in Table 27 and Table 28. In addition, the Department has developed specific fish management plans for watersheds in the Willamette Subbasin. These are displayed in Table 29.

Table 27. ODFW General Policies on Fish Management

General Policies
1. To the extent authorized by law, the Department shall seek compensation for losses of production due to development and other man-made causes. 2. Hatchery production shall be evaluated to determine if benefits exceed costs. 3. The number of hatchery fish stocked in the Willamette Basin, regardless of species and size, shall not be increased and stream systems not currently receiving hatchery fish shall not be stocked [except for research, rehabilitation, or as otherwise allowed by future Fish and Wildlife Commission decisions] 4. Stocking levels and areas shall be addressed in subbasin [watershed] plans
Fish Management Goals 1. Prevent serious depletion of any indigenous fish species through the protection of native ecological communities, the conservation of genetic resources, and control of consumptive uses such that fish production is sustainable over the long term. 2. Consistent with 1 above, • populations of naturally reproducing fish shall be managed to take full advantage of the productive capacity of natural habitats. • hatchery fish shall be managed primarily for the maximum benefit to consumptive users. • the Department shall address losses in fish productivity due to habitat degradation through habitat restoration rather than through long-term harvest restrictions.
Fish Habitat Policies 1. ODFW shall actively pursue and promote habitat protection and improvement necessary to achieve the objectives for subbasin fish resources management. 2. ODFW shall coordinate with and advise agencies that manage the land and water resources of the Willamette Basin. 3. Habitat protection shall be emphasized over habitat rehabilitation and enhancement. 4. Potential losses of fish production from habitat alteration shall be prevented or reduced to the extent possible.

Table 28. Summary of State of Oregon Wild Fish Policy

Wild Fish Management Policies

Protection of genetic resources shall be the priority in the management of wild fish to assure optimum economic, commercial, recreational, and aesthetic benefits for present and future residents of Oregon.

Operating Principles for Wild Fish Management

- Wild populations of the following species shall be managed under these operating principles: cutthroat trout, chum salmon, coho salmon, steelhead, rainbow trout, sockeye salmon, kokanee, chinook salmon, bull trout, mountain whitefish, white sturgeon, green sturgeon, and sensitive fish species
- To reduce hatchery/wild population interbreeding risk, naturally spawning hatchery fish shall be limited by both number in the natural spawning population and genetic characteristics.
- Use of hatchery fish to restore a depressed population may be allowed under certain conditions.
- The Department shall not authorize introductions of nonindigenous fish into locations where species hybridization may be expected to occur.
- The Department shall not authorize release of transgenic fish into locations where such fish may gain access to wild fish populations.
- Habitat:
  - The Department shall oppose habitat degradation that causes a population to experience a decline in abundance that if continued would likely reduce the number of spawners to 300 breeding fish.;
  - The Department shall oppose habitat degradation or the construction of artificial blockages that cause a population to be subdivided into fragments.
- The Department shall oppose any releases or transplants of fish of the same or different species that allow mortality from competition, predation or disease to cause a population to experience a decline in abundance that if continued would likely reduce the number of spawners to 300 breeding fish..
- The Department shall oppose harvest strategies that are the major cause for a population to experience a decline in abundance that if continued would reduce the number of spawners to 300 breeding fish or that would cause a population to be subdivided into fragments.
- In implementing the Wild Fish Management Rules, the Department shall pursue the most cost effective, least socially disruptive, and feasible strategy consistent with the wild fish policies and operating principles set forth in the rules.

Table 29. Summary of Willamette Subbasin fish management plans by watershed

Subbasin (Watershed) Fish Management Plans
Objectives common to all Willamette watersheds
1. Maintain and improve upstream and downstream passage for anadromous fish at dams, water diversions, other man-made obstacles, existing fishways and where appropriate, at natural barriers.
2. Protect existing streamflows and water quality form degradation associated with operations of dams, water diversions, effluents, mining, recreation and other in-stream activities.
3. Inventory stream and watershed characteristics that affect fish production.
4. Provide necessary in-stream flows for fish production.
5. Protect existing stream habitat from degradation associated with timber harvest, road construction, and related activities on forested watersheds.
6. Protect existing stream habitat in lowland areas from degradation associated with agricultural, residential and commercial development, and other human activities.
7. Improve the water quality of the subbasin
8. Provide adequate upstream and downstream passage for fish at water diversions, dams, and other artificial obstructions.
9. Develop subbasin specific knowledge that integrates fish distribution and abundance information, habitat characteristics and potential for improvement, and sensitive watershed areas into the Department's Habitat Database.
Additional Objectives for Santiam and Calapooia Subbasins
• Protect existing stream habitat in lowland areas from degradation associated with agricultural, residential, and commercial development, and other human activities.
Additional Objectives for McKenzie Subbasin
• Restore and enhance riparian and instream habitat to meet the production objectives for the fish species in the subbasin.
Additional Objectives for Clackamas, Middle Fork Willamette, Coast Fork Willamette, Long Tom, Coast Range Subbasins
• Generally, restore and enhance riparian and in-stream fish habitat.
• In the Upper Willamette Basin watersheds: Reduce the impacts of Hills Creek, Lookout Point, Dexter and Fall Creek dam on production of fish in downstream reaches

Wildlife Plans and Management Programs

The wildlife management objectives for Oregon and the Willamette Subbasin are established in the Oregon Revised Statutes and by the Oregon Department of Fish and Wildlife, primarily through individual species plans, and programs on sensitive species and wildlife diversity. Overarching statutes and major species program goals and objectives (including those for Oregon's Wildlife Diversity Plan, Black Bear Management Plan, Cougar Management Plan, Elk Management Plan, and Migratory Game Bird Program Strategic Management Plan) are found in Appendix C.

One of the most significant wildlife management programs in the Willamette Subbasin is the Wildlife Diversity Program which has two major purposes--to maintain sustainable native wildlife populations and to provide opportunities for the public's enjoyment of wildlife. The program goals and strategies relating most directly to sustaining native wildlife populations are shown in Table 30. (Specific wildlife needs

identified in the program are shown in Table 47 in the Statement of Fish and Wildlife Needs.)

Table 30. Oregon Wildlife Diversity Program goals and strategies (ODFW 1994-1998 Wildlife Diversity Program Actions)

HABITAT INVENTORY, MONITORING AND PRESERVATION: Identify, monitor, and assist in the preservation, restoration and enhancement of Oregon's wildlife diversity and recreational opportunities.
• Continue to develop and maintain a computerized geographic information system to inventory and monitor wildlife habitat…
• Develop guidelines for evaluating agency protection, restoration and enhancement actions.
• Develop acquisition standards and priorities.
• Acquire or otherwise preserve, restore or enhance important habitat areas.
• Influence land use/management patterns and intensities to preserve, restore and enhance habitats.
• Develop incentives and recognition programs to assist in the reservation, restoration and enhancement of habitats on private lands
SPECIES AND POPULATION STATUS SURVEYS AND MONITORING: Determine the status of species in Oregon and monitor the status of populations on a continuous basis for appraising the need for management actions, the results of such actions, and for evaluating habitat and other environmental changes.
• Refine and maintain the Oregon Species Information System to assure the continuous recording, analysis, storage, retrieval and reporting system for all species...
• Work with other state and federal agencies and the Oregon Natural Heritage Program to develop interagency agreements leading to data linkages to assure effective and efficient collection and management of species-related data, and to avoid [duplication]
• Maintain listings of species, populations or distinct smaller groups that are or could be facing extinction or extirpation in Oregon; categorize by endangered, threatened, sensitive.
• Determine the status of poorly known species or populations.
• Maintain listings of species, groups of species, populations or distinct smaller groups requiring special attention.
• Monitor populations of endangered, threatened and sensitive species, and populations of other species requiring special management attention; develop and establish monitoring procedures for those lacking such procedures.
• Monitor populations of widespread species.
• Record verified sightings of rare or unusual wildlife occurrences.
SPECIES MANAGEMENT: Identify, establish standards and implement management measures required for restoring threatened and endangered species, preventing sensitive species from qualifying as threatened or endangered, and maintaining or enhancing
• Determine limiting or threatening factors and management needs, where not already known.
• Plan and implement measures needed to restore, secure, maintain or enhance populations of threatened, endangered and sensitive species, and others requiring special attention.
REINTRODUCTION: Reintroduce extirpated species or populations as may be feasible.
OUTSIDE ASSISTANCE AND PARTNERSHIP: Seek outside opportunities, resources and authorities and cooperate with other agencies, private conservation organizations, scientific and educational institutions, industry and the general public in meeting plan objectives.
• Minimize/prevent disturbances to, or destruction of wildlife or degradation of wildlife habitats and habitat components, by encouraging voluntary action and/or supporting and participating in implementation and enforcement of federal, and local government [programs]
• Encourage public and private conservation and scientific organizations, scientific and educational institutions, industry and the general public to participate in the Wildlife Diversity Program.
• Provide wildlife information to cooperating agencies and organizations and the media in coordination with the Department's Information and Education Division.

Draft Willamette River Basin Operational Plan

This draft operational plan describes how Vision 2006, the six-year strategic plan for the Oregon Department of Fish and Wildlife is being implemented to protect and restore natural production of native fish and wildlife in the Willamette River Basin. This plan also identifies issues the Department is working on as a partner in regional efforts to recover fish and wildlife listed as sensitive, threatened or endangered under state and federal laws, and to restore the health of the Willamette River Basin watershed.

The over-arching objective of the Plan is to achieve "within-species diversity necessary to naturally sustain populations under the full range of environmental conditions they face over their life span, including utilization." The Plan's goals, outcomes, performance measures, and strategies relating to fish and wildlife management are in Table 31. The draft plan is attached in its entirety as Appendix D.

The Plan offers a mechanism for both displaying and targeting the development of specific long-range and interim objectives for fish and wildlife in the Willamette subbasin. Objectives are summarized at both the basin level (Table 32) and for individual watersheds in Table 33. (Specific fish and wildlife needs identified in the plan are described in the Statement of Fish and Wildlife Needs.)

Table 31. Summary of ODFW Willamette River Basin Operation Plan fish and wildlife management goals and objectives

GOAL 1: Healthy and sustainable fish and wildlife populations and their habitats.
Expected Outcome: Populations and communities of native fish and wildlife at an abundance and distribution in time and place such that they can naturally sustain themselves under the full range of environmental conditions they face over their life span including utilization.
Performance Measure: Fish and wildlife populations that reflect the diversity of native, natural habitats within Oregon and the values of its citizens.
Objectives: 1. Within the next six years, improved abundance and distribution of native freshwater and marine fish and wildlife populations. 2. Within the next six years, improved amount, distribution, and types of habitats that support a diversity of fish and wildlife species.
GOAL 2: Enhanced use and enjoyment of native and non-native fish and wildlife resources consistent with restoring and maintaining healthy native fish and wildlife populations.)
Expected Outcome: Sustainable opportunities for all Oregonians to use and enjoy fish and wildlife now and in the future.
Performance Measures: 1. Increased number and types of opportunities for people to use and enjoy fish and wildlife while maintaining optimal fish and wildlife populations. 2. Increased number of days of use and enjoyment of fish and wildlife and number and diversity of people who use and enjoy fish and wildlife
OBJECTIVE: WITHIN THE NEXT SIX YEARS, DEVELOPMENT AND MAINTENANCE OF VIABLE HARVEST OPPORTUNITIES IN BALANCE WITH SUSTAINABLE POPULATIONS OF GAME SPECIES.
STRATEGIES
Resource Management. The Oregon Department of Fish and Wildlife exists for the benefit of fish and wildlife resources and the public that uses and enjoys those resources.
1: Establish targets for the management of fish and wildlife populations and their habitats that balance the uses of lands and waters of the state with the values of Oregonians to ensure the sustainability of fish and wildlife populations.
2: Collect and analyze scientific information for use in decision-making.
3: Protect, and where necessary recover, existing fish and wildlife populations and their habitats.
4: Restore populations of fish and wildlife in habitats from which they have been extirpated or greatly reduced.
5: Minimize negative impacts of non-indigenous and exotic species (naturally and artificially produced) on native indigenous fish and wildlife.
6: Minimize the negative effects of native fish and wildlife on each other.
7: Minimize the adverse social and economic impacts caused by fish and wildlife.
8: Develop new opportunities and maintain/enhance existing opportunities for use of fish and wildlife.
Public Awareness and Support. The Oregon Department of Fish and Wildlife strives to build diverse and supportive constituencies and partnerships that are aware of and have ownership in fish and wildlife resource issues.
9: Assess the wants, needs and values of Oregonians to assist in establishing Department priorities and programs.
10: Provide information to the public that enables them to increase their awareness and knowledge of fish and wildlife resource issues and what they can do to protect, mitigate and restore fish and wildlife and their habitat.
11: Increase the number and diversity of participants in fish and wildlife-oriented activities that reflects Oregon's human demographics.
12: Maintain & develop effective and supportive partnerships that enable ODFW and its partners to reach mutual goals in resource management.

Table 32. Basinwide ODFW fish and wildlife abundance & distribution objectives for the Willamette Subbasin (from Oregon Department of Fish and Wildlife, The Oregon Plan, Willamette River Basin Operational Plan, Draft, July 1, 2001; NOTE: blanks represent areas ODFW is committed to performing additional analysis to specify targets)

Species	Long-Term	Interim
Fish & Aquatic Life		
Native aquatic species	A diversity index of at least ___ in the Willamette River and its tributaries as measured by ___ in ___	At least ___ by 2006.
Oregon chub (naturally produced)	20 populations, with at least 500 adults in each population; at least 4 pop's each in Middle Fork Willamette, Santiam, and Mainstem Willamette Trend: Stable or increasing for seven years	By 2008: 10 pops of at least 500 adults (at least 3 pop's in each subbasin) Trend: Trend: Stable or increasing for five year
Bull trout (naturally produced adults)	At least 5 local populations in core areas of Willamette Recovery Unit (McKenzie/;Middle Fork, Clackamas), with at least 1000 adults in each pop Trend: Stable or increasing for not less than 10 years	By 2012: 3 populations of at least 500 adults Trend: Stable or increasing for no less than five years
cutthroat trout (naturally-produced adults)	Increasing trend in numbers in their historical range in the Willamette River and its tributaries As measured by average density of at least ___ adults per square-meter in a sample of ___ randomly selected reaches in ___ streams.	At least ___ by 2006
resident rainbow trout (naturally produced adults)	Increasing trend in numbers in their historical range in the Willamette River and its tributaries As measured by average density of at least ___ adults per square-meter in a sample of ___ randomly selected reaches in ___ streams	At least ___ by 2006
Pacific lamprey (naturally-produced adults)	Increasing trend in numbers in the Willamette River and its tributaries as measured at Willamette Falls interim target of at least ___ by 2006	At least ___ by 2006
white sturgeon (naturally-produced adults)	Increasing trend in numbers of in historical range in the Willamette River and its tributaries as measured by an As measured by average density of at least ___ adults per square-meter in a sample of ___ randomly selected reaches in ___ streams	At least ___ by 2006

ODFW fish and wildlife basin-wide goals and objectives (continued)

Species	Long-Term	Interim
mountain whitefish (naturally-produced adults)	Increasing trend in numbers of in historical range in the Willamette River and its tributaries as measured by an As measured by average density of at least ___ adults per square-meter in a sample of ___ randomly selected reaches in ___ streams	At least ___ by 2006
sandrollers (naturally-produced adults)	Increasing trend in numbers of in historical range in the Willamette River and its tributaries as measured by an As measured by average density of at least ___ adults per square-meter in a sample of ___ randomly selected reaches in ___ streams	At least ___ by 2006
Wildlife		
naturally-produced sensitive wildlife species	Increasing trend in numbers of in their historical range throughout the Willamette River Basin, as measured by trends in target species, including western pond turtle, northern red-legged frog, yellow-legged frog, sharp-tail snake, western rattlesnake, western meadowlark, vesper sparrow, grasshopper sparrow, streaked horned lark, purple martin, and yellow-breasted chat.	at least ___ by 2006
black bear	Median ages of greater than 5 years for all bears, greater than 4 years for males, and greater than 6 years for females	
Elk	Bull: cow ratios 1:10, and abundances in Willamette-Valley Wildlife-Management Units as follows: Alsea 7,000 Indigo 4,700 McKenzie 5,200 Santiam 5,900 Siuslaw 4,000 Stott Mt. 1,500 Trask 5,200 Willamette De-emphasis zone Wilson 3,200	
black-tailed deer	Buck: doe ratios for of 1:5 (based on 1996-2000 herd composition averages)	
cougar	Median age in the Willamette Basin outside urban and agricultural areas greater than two years	

Table 33. Watershed-specific ODFW fish and wildlife abundance & distribution objectives (from Oregon Department of Fish and Wildlife, The Oregon Plan, Willamette River Basin Operational Plan, Draft, July 1, 2001; NOTE: blanks represent areas where ODFW is committed to performing additional analysis to specify targets; All numbers represent an "at least" minimum of naturally produced adults)

	Spring chinook		Winter steelhead		Coho		Bull trout	
Watershed	**Long-Term**	**Interim(2006)**	**Long-Term**	**Interim (2006)**	**Long-Term**	**Interim(2006)**	**Long-Term**	**Interim (2006)**
Calapooia	650	100	1170 (25 redds/mi)	15 redds/mi				
Clackamas	2900	1900	3000	1500	3000	800	___	Annual transfers of fry
Coast Range tributaries			675 (5 redds/mi)	3 redds/mi				
McKenzie	10,000	3-5,000					400 w increasing abundance	Expansion into underutilized areas
Middle Fork Willamette	___	___					___ re-introduced	Successful re-intro w. multiple age classes & spawning
Molalla	750	___	3,500	___				
Pudding	___	100	1,250	__				
Santiam							___	Annual fry transfers
N.Santiam	3,400	200	3,000	2000				
S. Santiam	1,400	200	1,900	450				
Tualatin			2,000	600				

U.S. Army Corps of Engineers Willamette Basin Project and other activities

The Willamette River Basin Project

The U.S. Army Corps of Engineers manages its Willamette Basin Project under the authority of the Flood Control and Water Resources Development Acts. The Project includes the operation and maintenance of thirteen federal dam and reservoir projects that have been constructed for flood control and other authorized purposes in the Willamette River basin. , The thirteen projects are: Detroit/Big Cliff, Green Peter, Foster, Blue River, Cougar, Fall Creek, Hills Creek, Lookout Point/Dexter, Dorena, Cottage Grove, and Fern Ridge. (As explained in Section I, eight of these dams produce hydropower for the Federal Columbia River Power System.) The Project also includes the Willamette River Bank Protection Program previously described in Alteration of Hydrology under Limiting Factors.

A major component of the Project is the Corps' annual flow plan for managing the reservoirs. The Corps coordinates with state and federal agencies to jointly develop an annual operating plan by June 1 of each year that ensures the most efficient use of water stored at each of the USACE dams on the Willamette River Basin for downstream fisheries and other purposes. In the early 1980s, the State established a policy that Oregon Water Resources Department would coordinate all requests by state agencies for special reservoir regulation at any Willamette project. State and federal agencies meet to discuss the previous year's flow management, the coming year's forecasted water supply, and dam operation. Based on these discussions, the Corps' Reservoir Control Center develops a water release plan.

The NMFS is also working on a separate consultation with the USACE on the effects of their proposed water temperature control tower at Cougar Dam on the South Fork of the McKenzie River. Cougar Dam causes water temperatures to be too warm in the winter and too cold in the summer for chinook salmon and other salmonids. The temperature control tower has been proposed as a chinook restoration project and is supported by NMFS and many other fisheries entities. The tower is intended to restore natural water temperatures, which should benefit all native species on the McKenzie River below the dam. The project is estimated to cost $70,000,000 and will be paid for by the Federal government.

As part of its project management activities, the Corps has also initiated a number of investigations (Table 34).

Other Corps Programs

The U.S. Army Corps of Engineers is also responsible for a number of programs relating to fish and wildlife management in the Willamette Subbasin.

Regulatory Permit Program: The USACE performs a variety of environmentally related permitting functions under the Clean Water Act, the Rivers and Harbors Act, and other authorities.

Willamette Harbor Deepening and Maintenance Dredging: The maintenance dredging program in the Willamette River below Willamette Falls, and the proposed

channel deepening activities, are closely associated with similar programs on the lower mainstem Columbia River..

Willamette River Environmental Dredging Study: The purpose of this study is to evaluate opportunities to enhance and restore the ecosystem in the lower Willamette River by identifying and evaluating remedies for eliminating contaminated sediments. This study, which falls under the Environmental Dredging Authority authorized in the Water Resources Developments Acts of 1990, 1996 and 1999, is intended to coincide with the state investigation and cleanup of contaminated sediments in the Portland Harbor and will augment other ecosystem restoration activities related to contaminated sediments.

Table 34. Willamette Basin Project investigations

Willamette Water Temperature Control Project: investigation of the feasibility of modifying operations at Blue River Dam and at Cougar Dam in the McKenzie River basin to restore water temperature regimes below these projects.
Willamette River Basin Review: This study began in June 1996 and was sponsored by the Oregon Water Resources Department. The study is investigating future water demand in the basin, particularly as it is related to operation of the Willamette Project during the summer conservation storage and flow release season.
Willamette Floodplain Restoration Study: The purpose is to evaluate opportunities to modify existing floodplain features that may help reduce flood damages by increasing natural flood management capability. The study includes examining the feasibility of restoring natural wetlands and promoting ecosystem functional restoration.
Santiam River Fish Passage Restoration Project: The USACE has proposed constructing a prototype model surface collection system near the points of entry of Quartzville Creek and the Middle Santiam River in Green Peter Reservoir, from which steelhead and salmon could be transported around the reservoir and dam. The Army has concurred the project's existing passage facilities have not functioned as intended and that modifications are needed.
Middle Fork Willamette River Fishery Restoration Project: A reconnaissance level study was initiated in 1995 and completed in 1997 that evaluated the potential to modify existing USACE dam and fish passage structures to restore native runs of spring chinook salmon and winter steelhead trout upstream of the Hills Creek and Lookout Point/Dexter projects (USACE 1997).

Northwest Forest Plan, including the Aquatic Conservation Strategy

The Northwest Forest Plan (NFP) was adopted in 1994 and prescribes a comprehensive long-term management approach for nineteen National Forests and six Bureau of Land Management districts in Oregon, Washington, and California. It amended Land and Resource Management Plans for the 19 National Forests and 7 Bureau of Land Management (BLM) Districts or portions of Districts within the range of the northern spotted owl

The Plan directs management of habitat for late-successional and old-growth forest-related species to provide for the species 'long- term health, while also providing for a predictable and sustainable level of timber harvest. The NFP represents a shift to an

ecosystem approach that crosses jurisdictional boundaries and puts in place analysis at the watershed scale to support decision making.

The NFP is implemented at an ecosystem province level through a Regional Interagency Executive Committee, supported by Provincial Interagency Executive Committee (PIEC), and provincial Public Advisory Committees. An interagency Regional Ecosystem Office provides coordination, monitoring, research and staffing functions to support NFP implementation. The Willamette Province is coincident with the Willamette basin. The Willamette PIEC is co-chaired by representatives of the Willamette National Forest and the Eugene District BLM.

The core components of the Northwest Forest Plan conservation strategy are:

- a network of late-successional and other reserves distributed across the landscape;
- an aquatic conservation strategy providing for delineation of riparian reserves and other measures to protect or improve aquatic and riparian habitats; and,
- a series of broadly stated standards and guidelines that guide management actions across the planning area.

One of the major components of the NFP is the Aquatic Conservation Strategy. The Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems on public lands, including salmon and steelhead habitat. The Aquatic Conservation Strategy is designed to meet the objectives shown in Table 35.

Table 35. Aquatic Conservation Strategy objectives

Maintain and restore:
• the distribution, diversity, and complexity of watershed and landscape-scale features.
• spatial and temporal connectivity within and between watersheds.
• the physical integrity of the aquatic system.
• water quality necessary to support healthy riparian, aquatic, and wetland ecosystems.
• the sediment regime under which an aquatic ecosystem evolved.
• In-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing.
• the timing, variability, and duration of flood plain inundation and water table elevation in meadows and wetlands.
• the species composition and structural diversity of plant communities in riparian zones and wetlands.
• habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

The Aquatic Conservation Strategy is implemented through a system of Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration:

- Riparian reserves provide habitat for Special Status Species and other terrestrial species. Riparian management widths are intended to provide a high level of fish, wildlife and plant habitat, and riparian protection until watershed and site analysis can be completed.
- A system of Key Watersheds offers critical refugia is for conserving habitat for at-risk stocks of anadromous and resident fish.
- Watershed analyses support ecosystem management at approximately the 20 to 200 square mile watershed level.
- Watershed restoration aids recovery of fish habitat, riparian habitat, and water quality, especially through control and prevention of road-related runoff and sediment production, and restoration of riparian areas and in-stream habitat.

Tribal Interests

General

There are 10 federally recognized tribes in Oregon. Two have reservation or trust lands in the Willamette Subbasin: the Confederated Tribes of the Grand Ronde (approximately 11,000 acres) and the Confederated Tribes of Warm Springs (approximately 17,000 acres). The Confederated Tribes of the Siletz offers services through a multi-county area in the subbasin. According to the 2000 Census, over 24,000 Native Americans live in the 9 counties comprising the Willamette Subbasin, or just over half of the Native American total in Oregon. (Oregon Legislative Committee on Indian Services 2001).

Confederated Tribes of Grand Ronde

Historically the Tribes of the Confederated Tribes of Grand Ronde (CTGR) lived throughout western Oregon where they fished and gathered along the rivers and wetlands of these lands. Fish and certain plant species remain both cultural and natural resources to the CTGR. Tribal Reservation streams support migratory fish species, including steelhead, coho, and pacific lamprey that travel through the Yamhill, Willamette, and lower Columbia and are affected by the water quality of these rivers. The Willamette Valley is included in the lands ceded under the treaty of January 22, 1855 by the Confederated Bands living in the Willamette Valley.

The streams of the basin are culturally important to the people of Grand Ronde who continue to fish and recreate in many of these rivers and streams today. The entire Willamette River watershed is listed as a priority water in CTGR's Unified Watershed Assessment. The Tribe places great value in the health of Willamette Basin streams and rivers. The CTGR have identified the Willamette River Basin as a priority watershed for study and restoration in the Confederated Tribes of Grand Ronde Unified Watershed Assessment. The fish populations of this basin are important resources that need to be protected for future generations. (Thompson and Feehan 2001).

Columbia River Intertribal Fish Commission (CRITFC)

CRITFC is the coordinating body of the four Columbia River treaty tribes--Nez Perce, Umatilla, Warm Springs and Yakima--for management of Columbia basin anadromous fish resources. The Commission provides technical and professional assistance to its member

tribes while working with state and federal agencies, local watershed communities, conservation groups, Native American organizations and other local, regional, national and international entities concerned with restoration and protection of Northwest fisheries. Within the framework of preserving Indian treaty rights, the Commission's primary goal is to rebuild Columbia River salmon and steelhead runs for the benefit of all people in the Pacific Northwest. (Oregon Legislative Commission on Indian Services 2001)

Historical tribal fisheries occurred throughout the lower Columbia, estuary and Willamette rivers, with a major fishery at Willamette Falls. In recent history, tribal fisheries have occurred only at Willamette Falls. However, the tribes have not relinquished their treaty-reserved fishing right throughout "all usual and accustomed fishing areas" as stated in their treaties with the United States in 1855. Species of special interest at Willamette Falls include spring chinook, steelhead and lamprey. Funding and management of hatcheries throughout this area have a substantial effect on local non-Indian fisheries, upstream tribal fisheries and fisheries along the West Coast.

CRITFC has developed a significant body of goals, objectives, actions and recommendations for species and habitat above Bonneville Dam. However, many could be equally applicable to fish and wildlife below Bonneville, including the Willamette Subbasin. These are expressed primarily through Wy-Kan-Ush-Mi Wa-Kish-Wit, the Spirit of the Salmon, The Columbia River Anadromous Fish Restoration Plan. Although specific actions are not identified in Wy-Kan-Ush-Mi Wa-Kish-Wit for the lower Columbia, estuary and Willamette River Subbasin, the CRITFC member tribes maintain an active presence in several forums as related to fisheries management, water quality and public outreach.

Wy-Kan-Ush-Mi Wa-Kish-Wit covers the following fish that spawn in areas above Bonneville Dam: chinook, sockeye, steelhead, coho, and chum salmon; Pacific lamprey; and white sturgeon. The geographic scope of the plan extends to the Columbia River Basin and Pacific ocean regions where these fish migrate and wherever activities occur that directly affect them. Simply stated, the plan's purpose is to put fish back in the rivers and protect the watersheds where fish live. Objectives are shown in Table 36.

Table 36. Objectives of The Spirit of the Salmon, the Anadromous Fish Restoration Plan of the Columbia River Intertribal Fish Commission

Objectives: • Halt the decline of salmon, lamprey and sturgeon populations above Bonneville Dam within seven years. • Rebuild salmon populations to annual run sizes of four million above Bonneville Dam within 25 years in a manner that supports tribal ceremonial, subsistence and commercial harvests. • Increase lamprey and sturgeon to naturally sustaining levels within 25 years in a manner that supports tribal harvests. • To achieve these objectives, the plan emphasizes strategies and principles that rely on natural production and healthy river systems.
Principles • Adaptive Management • Gravel-to-Gravel Management • Put Fish Back in the Rivers: • Protect Watersheds Where Fish Live • [Recognize Tribes'] Co-Management [Authority]: • Holistic Decision-Making

The Plan has 13 Technical Recommendations, including:

- Begin improving in-channel stream conditions for anadromous fish by improving or eliminating land-use practices that degrade watershed quality.
- Protect and increase in-stream flows by limiting additional consumptive water withdrawals, using the most efficient irrigation methods, preventing soil compaction and riparian vegetation removal and wetland destruction; where necessary, restore soil, restore riparian vegetation and re-create wetlands.
- Actively restore watersheds where salmon populations are in imminent danger of extirpation. Use "Coarse Screening Process" to develop demonstration projects.
- Use supplementation to help rebuild salmon populations at high demographic risk of extirpation.
- Use supplementation to reintroduce salmon to watersheds from which they have been extirpated.
- Use flow, spill, drawdowns, peak efficiency turbine operation, new turbine technology, and predator control projects to improve in-river juvenile salmon survival
- Improve water quality by eliminating sources of toxic pollution that accumulates in fish tissue and by reducing discharges of other contaminants to meet water quality criteria for anadromous fish.

Willamette Water Quality Planning and Implementation

In 1938, the State Authority (now known as DEQ) was created to clean up pollution in the Willamette River with a focus on regulating end-of-pipe or "point source discharges from cities and industry. This focus continued with passage of the federal Clean Water Act (CWA) in 1972. As point source discharges have been regulated, and their inputs controlled, management focus has shifted to non-point sources. (See Water Quality under

Limiting Factors.) Within the construct of the Clean Water Act several programs have been established to help address non-point sources. Under Section 303(e) of the CWA each state is required to develop a comprehensive water quality management plan. This management plan helps the state prioritize water quality problems, identify solutions and establish control measures. Water Quality Management Plans have to be developed and submitted to EPA every two years

Another program targeting non-point source pollution problems was established under Section 319 of the CWA. Under Section 319 a state must address non-point source pollution in a two- step process. First, each state prepares a non-point source assessment report that identifies waters impaired by non-point sources, classifies the sources contributing to water quality problems, describes the process for identifying the best management practices for controlling the sources, and discusses the state and local programs for regulating the pollution. This report is submitted to EPA for reviewed and approval. Assuming EPA approval, section 319 funds are then made available to the state for on the ground restoration projects

The Oregon Department of Environmental Quality's Total Maximum Daily Load Process

Probably one of the State's most comprehensive approaches in solving water quality problems in streams, lakes, rivers and estuaries is the State's Total Maximum Daily Load (TMDL) process.

The TMDL process begins when the waterbody appears on DEQ's 303(d) list, which identifies waterbodies not meeting water quality standards. (Figure 8) DEQ calculates pollution load limits that reflect the amount of each pollutant a waterway can receive and still not violate water quality standards. TMDLs take into account the pollution from all sources, including discharges from industry and sewage treatment facilities; runoff from farms, forests and urban areas; and natural sources such as decaying organic matter or nutrients in soil. TMDLs also include a safety margin for uncertainty and growth that allows for future discharges to a river or stream without exceeding water quality standards. TMDLs are set for subbasins or watersheds.

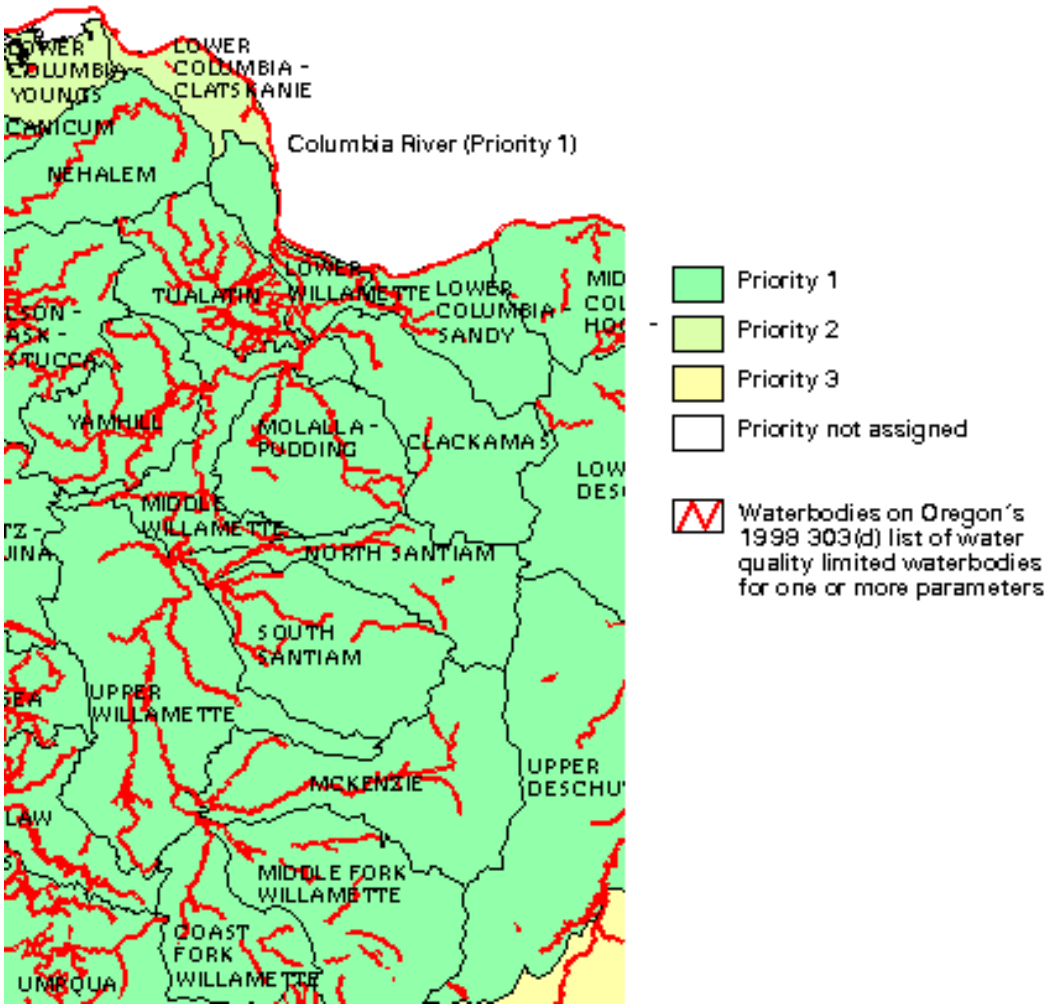


Figure 8. 1998 Western Oregon 303(d) priorities (Source: DEQ)

DEQ uses information from the TMDL process to establish permit limits on the amount of pollutant each pipe can discharge and limits on non-point sources that are controlled through various locally-developed water quality management plans. These plans to restore streams and rivers to water quality standards are developed by government agencies in cooperation with landowners and through key programs, including: the Oregon Department of Agriculture's Senate Bill 1010 process (described below); the Oregon Department of Forestry's Forest Practices Act; federal land management agencies' Northwest Forest Plan; and the actions plans of watershed groups.

These plans are sent to DEQ for inclusion in an overall water quality management plan, which DEQ then submits to the U.S. Environmental Protection Agency (EPA) along with the TMDL. EPA has the responsibility for approving the TMDL.

TMDLs are being calculated for a number of causes in the Willamette Subbasin. Temperature and bacteria violations account for about 2/3's of the listings. Some sections of the mainstem Willamette are listed for biological criteria, based on observed skeletal deformities in fish. The cause of the skeletal deformities is not known, however further studies are planned. Mercury is the cause of a number of listings, and appears to be largely the result of past mining activities. There are some scattered listings for various toxic materials, including dieldrin, DDT, arsenic, and PCB's. The remaining listings are for violations relating to excessive nutrients, dissolved oxygen, and pH violations.

There are about 150 individual pollution load limits still to be developed in the Willamette Basin. Most of the Willamette Basin TMDL's are to be developed by 2003. It is likely that water quality parameters in the mainstem Willamette River and its major tributaries are heavily influenced by flow, which is controlled by the presence and operation of flood control and hydropower dams. Therefore, DEQ is analyzing the Willamette River mainstem and these sub-basin rivers below major dams as one system. The pollutants of concern for the mainstem are bacteria, temperature, mercury, and for the Middle and Lower Willamette River, biological criteria (fish skeletal deformities).

These analyses and the allocations they lead to will be combined with an implementation plan (Water Quality Management Plan), all in one document. The DEQ is considering the development of a separate TMDL and Water Quality Management Plan document for the entire Basin to address mercury listings, which may result from unique sources such as abandoned mines.

TMDL's and Water Quality Management Plans for all other listings will be combined within nine separate sub-basin documents, one each for the Coast Fork Willamette, Middle Fork Willamette, McKenzie, Upper Willamette, North Santiam, South Santiam, Middle Willamette, Clackamas and Lower Willamette sub-basins. TMDLs for the Columbia Slough (part of the Lower Willamette) was completed in 1998 for the Tualatin basin in 2001. TMDL's for the Yamhill and Mollala/Pudding sub-basins are not scheduled to be completed until 2007.

Agricultural Water Quality Management Plans ("SB1010")

Senate Bill 1010 (passed in 1993 in as the Agricultural Water Quality Management Act; ORS 568.900 -568.933) gives the Oregon Department of Agriculture (ODA) authority to develop, implement, and enforce an agricultural water quality management program (WQMP) where required by state or federal law. SB 1010 provides a structure to develop and implement local WQMPs to prevent and control water pollution resulting from agricultural activities and soil erosion. It directs ODA to work with farmers and ranchers by developing WQMPs and rules for listed watersheds. The plans offer guidance to assist producers to prevent pollution problems wherever possible, and to alleviate any existing problems. (Table 37) Local Soil and Water Conservation Districts serve as the Lead Management Agency for developing and implementing these plans. Administrative rules accompany each plan to provide a regulatory backstop to ensure compliance.
The Willamette Restoration Strategy identifies improved support for this program as a critical action to restore watershed health. The Strategy further identifies that additional support is needed at the local landowner level, both for routine implementation and to determine how the plans can address fish population and habitat factors within the scope of

the federal Clean Water Act and Endangered Species Act. The planning process needs to recognize the highest-priority areas for protecting habitats, protecting fish and wildlife populations, and reducing watershed degradation. The schedule for completing WQMPs is shown in Table 38.

Table 37. Agricultural Water Quality Management Program activities of the Oregon Department of Agriculture

Education: Public/landowner education of SB 1010 process, landowner education on conservation planning and basin habitat needs.
Conservation Planning Support: Technical support and administration for developing and implementing of individual farm/ranch conservation plans.
Projects, including demonstration: Funding, supervision and design.
Monitoring: Rule compliance, baseline condition, trend, practice effectiveness.
Site Potential Assessment: An element of restoration.
Administration: Support for local administration of plan and rule implementation.
Biennial Plan Review: Review and update of plan and rules.

Table 38. Agricultural water quality management plan schedule in Willamette Subbasin (as of 12/00)

ODA Basin Planning Unit	Plan Development Begins	Plan Implementation Begins
Tualatin	complete	ongoing
Yamhill	complete	July 2000
Clackamas	ongoing	October 2000
Lower Willamette	ongoing	July 2001
Lower Columbia-Sandy	ongoing	January 2001
Mollala-Pudding-French Prairie-North Santiam	ongoing	October 2001
Southern Willamette Valley (McKenzie, Coast Fork Will., M.F. Willamette subbasins)	April 2000	July 2001
South Santiam	October 2000	January 2002
Upper Willamette (Marys, Long Tom, & Luckiamute subbasins)	October 2000	January 2002

Assessments and plans of watershed councils and Soil and Water Conservation Districts

Watershed Councils

There are 29 watershed councils in the Willamette Subbasin—18 of which have organized under ORS 541.360. According to this state law, a watershed council is "...a voluntary local organization designated by a local government group convened by a county governing body to address the goal of sustaining natural resource and watershed protection and enhancement within a watershed." Legislative guidelines provide that a watershed council

be a voluntary, local group; and that it represent a balance of interested and affected persons within the watershed.

All watersheds in the Willamette Subbasin face varying problems of poor water quality, increasing threats to water quantity and in-stream complexity, floodplain degradation and reduced off-channel storage, and loss of critical fish and wildlife habitat. The Willamette Restoration Initiative reviewed sets of watershed assessments that have been completed by eight watershed councils in order to identify common problems and priorities. A summary of identified actions is provided in Appendix A. Councils had four broad categories of shared management emphases -- 1) conservation and restoration, 2) monitoring and assessment, 3) education and information, and 4) institutional collaboration. Within the conservation and restoration theme, five common management priorities were apparent:

*1) Floodplain function and off-channel storag*e. Due to the extent of build-out in many floodplain areas, re-establishment of the full spectrum of historical stream/floodplain interactions is not feasible. However, allowing floodwaters access to the floodplain and connecting backwater channels to main channels is a prominent strategy for salmon and stream restoration.

2) *In-stream complexity.* Maintaining channel complexity through such features as large wood recruitment and pool and riffle sequences is important to juvenile salmonid feeding and rearing. Decreasing the effects of channelization by removing rip-rap and other bank hardening features will restore natural meanders, reduce flow velocities, and increase nutrient storage retention.

3) *Riparian and wetland restoration.* This effort would go a long way toward improving water quality and meeting multiple objectives for aquatic and terrestrial wildlife. As the transition zone between riverine and upland areas, riparian areas and wetlands are among the most biologically diverse.

4) *Water quality and water quantity*. Numerous factors across all economic sectors contribute to poor water quality in both urban and rural areas. Watershed councils can play an important role in helping their watersheds meet standards for designated beneficial in-stream uses. They can cooperate with irrigation districts and water managers to promote urban water conservation and re-use measures, as well as to promote use of efficient irrigation systems in rural areas.

5) *Fish and wildlife/habitat restoration.* The extent to which the other four broad conservation and restoration themes can be accomplished will determine the success of this theme. Other contributing factors include improving fish passage, using diversion screening, protecting at-risk species, controlling the spread of invasive plant and wildlife species, and creating wildlife corridors and connections to upland areas.

Soil and Water Conservation Districts (SWCDs) and Resource Conservation and Development Area Councils

Soil and Water Conservation Districts (SWCDs) are units of state or tribal government that are charged with identifying natural resource problems within their boundaries and offering assistance to resolving them. Guiding this assistance is a board of local leaders who know the people in their communities and who are familiar with conservation needs in the

district. Soil and Water Conservation Districts provide a direct link to landowners who are the key to implementing natural resource restoration and protection. The 45 Conservation Districts are members of the Oregon Association of Conservation Districts.

Resource Conservation and Development (RC&D) Area Councils are local people, representing local units of government working together to help improve and sustain local economies, the environment, and standards of livings.

Review of the annual plans listed reveals a number of common resource concerns and program activities shared by local soil and water conservation districts in the Willamette Valley, including: water quality management planning, water quality monitoring, coordination with watershed councils, demonstration projects, provision of technical assistance and noxious weeds programs. Most of these groups have programs and projects that run for a several years or more and involve many partner agencies as well as other grassroots groups, including watershed councils. (Table 39) The combined management intent of these groups is summarized in Table 40.

Table 39. SWCD, RCD, and NRCS management direction documents

Soil and Water Conservation District Work Plan References
• Benton Soil & Water Conservation District, 2001-2002 Annual Work Plan
• Clackamas County Soil & Water Conservation District, July 2000 - June 2001 Annual Work Plan
• East Lane Soil & Water Conservation District, Fiscal Year 2002 Work Plan
• East Multnomah County Soil & Water Conservation District, July 2000 - June 2001 Annual Work Plan
• Linn Soil & Water Conservation District, July 2000 - June 2001 Annual Work Plan
• Marion County Soil & Water Conservation District, 2001-2002 Work Plan
• Polk Soil & Water Conservation District, July 1, 2001 - June 30, 2002 Annual Work Plan
• Washington County Soil & Water Conservation District, July 1, 2001 - June 30, 2002 Annual Work Plan
• West Multnomah Soil & Water Conservation District, Annual Work Plan Fiscal Year 2001-02
• Yamhill Soil & Water Conservation District, Fiscal Year 1999 - 2002 Work Plan
Related Resources
• Cascade Pacific RC&D Area Plan, 1994
• Northwest Oregon RC&D Area, Inc., 2000-2002 Plan of Work
• NRCS Central Coast/Upper Willamette Basin Team, Strategic Plan, October 1, 2000 – September 30, 2001
• NRCS Lower Willamette Basin Team, Strategic Plan, October 1, 2000 – September 30, 2001
• NRCS Oregon, Strategic Plan, October 1999

The Conservation Partnership

The Conservation Partnership in Oregon is a unique coalition of local, tribal, state, federal groups that mobilizes staff and programs funding to help people and communities address natural resource conservation issues. Relying on mixed expertise, authorities, and common sense each member organization brings to the table, the Partnership strives to realize a

shared vision - local people making informed decision for healthy and economically viable lands. (Table 40)

The core partnership is made up of NRCS, USDA Farm Services Agency (FSA), USDA Rural Development (RD), the Oregon Soil and Water Conservation Commission, Oregon Association of Conservation Districts, Oregon Association of Resource Conservation and Development Area Councils, and Oregon Department of Agriculture - Division of Natural Resources. The Partnership is expanded at the local level to include individual soil and water conservation districts (SWCDs), watershed councils, tribes, environmental and user groups, in addition to other federal, state and local agencies needed to fully address resource needs.

Table 40. Oregon Conservation Partnership fish and wildlife habitat and water quality goals, objectives, and strategies (derived from NRCS state and basin strategic plans and from individual Soil and Water Conservation District workplans)

Goals: • Functional aquatic, wetland, riparian, and upland habitats, supporting diverse native fish and wildlife populations. • Quantity and quality of water acceptable for its intended uses and managed in an efficient and sustainable manner.
Objectives: • Focus fish and wildlife restoration efforts on the connectivity between uplands, riparian areas and wetlands within a watershed. • Furnish the technical and financial assistance needed by landowners to meet local, state and federal goals for fish and wildlife and water quality. • Utilize a cooperative approach between local groups (i.e. SWCDs and watershed councils), state and federal agencies having fish, wildlife and water quality responsibilities to provide technical assistance, implementation funding and environmental certainty to private landowners. • Develop partnerships to ensure participation through outreach and education of all interested parties. • Private land conservation is accomplished through voluntary, locally led approaches. • Carry out the Oregon Plan through watershed management. • Promote public awareness, interest and participation in natural resource protection program.

Table 40. Oregon Conservation Partnership fish and wildlife habitat and water quality goals, objectives, and strategies (derived from NRCS state and basin strategic plans and from individual Soil and Water Conservation District workplans) continued.

Strategies

- Ensure farm conservation plans and watershed plans contain scientifically-sound alternatives to enhance fish and wildlife objectives consistent with the requirements under the Endangered Species Act and with those of the landowner.
- Ensure farm conservation plans contain scientifically-sound alternatives to protect and improve water quality consistent with state water quality requirements (Agricultural Water Quality Management Plans, Total Daily Maximum Loads, and state water quality standards) and with those of the landowner.
- Market the concept that properly managed productive agricultural lands provide habitat for numerous species of concern.
- Work with state and federal agencies and private groups to coordinate the provision of technical and financial assistance to develop and implement conservation plans with private landowners.
- Provide a trained, qualified staff with the expertise needed to work with private landowners.
- Maintain partnerships to efficiently use and leverage available implementation funds (EQIP, WHIP, WRP, CRP, CREP, OWEB, 319, etc.).
- Implement adopted Agricultural Water Quality Management Area Plans (SB1010).
- Provide assistance to Confined Animal Feeding Operations (CAFOs) to eliminate or control pollution.
- Conduct educational and outreach efforts related to soil, water, and other natural resources.
- Maintain NRCS Field Office Technical Guides to provide the latest guidance, tools and technical standards for planning and implementation.
- Seek streamlined permitting processes and ESA consultations.
- Participate on local, state and regional initiatives to guide efforts to protect and restore fish and wildlife and water quality.

Local and Regional Government Plans and Activities

Local and regional governments in the Willamette basin have substantial management responsibilities relating to fish and wildlife, primarily through implementation of the environmental goals of Oregon's comprehensive land use planning program, as well as local responses to Endangered Species Act and Clean Water Act requirements.

Comprehensive Land Use Planning

Oregon's Land Use Planning Program was established in 1973 and requires 277 city and county governments in Oregon, including over 100 in the Willamette basin, to plan and zone land use consistent with 19 Statewide Planning Goals. The Oregon Department of Land Conservation and Development administers the program and reviews the consistency of local plans with the statewide goals.

Two of the 19 goals directly address activities affecting fish and wildlife--Goals 5 and 6.

Goal 5: Open Spaces, Scenic And Historic Areas And Natural Resources: Goal 5 covers more than a dozen natural and cultural resources such as wildlife habitats and wetlands. It establishes a process for each resource to be inventoried and evaluated. If a resource or site is found to be significant, a local government has three policy choices: preserve it, allow conflicting uses, or strike a balance between the two.

Goal 6: Air, Water And Land Resources Quality This goal requires local comprehensive plans and implementing measures to be consistent with state and federal regulations on matters such as groundwater pollution.

According to state regulations, local governments must adopt programs to protect natural resources and conserve scenic, historic, and open space resources for present and future generations. Resources that must be inventoried (mostly based on existing information) include:

- Riparian corridors, including water and riparian areas and fish habitat;
- Wetlands;
- Wildlife Habitat;
- Federal Wild and Scenic Rivers;
- State Scenic Waterways;
- Groundwater Resources;
- Natural Areas;

Local governments must identify which of these are significant and then develop programs consistent with state-mandated planning guidelines which include the following:

- "Natural resources …should be conserved and protected…"
- "Fish and wildlife areas and habitats should be protected and managed in accordance with the Oregon Fish and Wildlife Commission's fish and wildlife management plans."
- "Stream flow and water levels should be protected and managed at a level adequate for fish, wildlife, pollution abatement, recreation, aesthetics and agriculture."
- "Plans should provide for the preservation of natural areas consistent with an inventory of scientific, educational, ecological, and recreational needs for significant natural areas."

Thus, there is a mosaic of well-over 100 local and legally-binding plans that are required to address fish and wildlife habitat in some fashion.

Endangered Species Act and Clean Water Act Activities

Cities, counties, and special districts throughout the Willamette subbasin are responding to requirements of the federal Endangered Species and Clean Water Acts. Clean Water Act activities include the massive reconstruction of combined sewerage overflow systems in Portland and Corvallis, as well as necessary capital improvement projects undertaken as part of the Environmental Protection Agency's National Pollution Discharge Elimination System (NPDES) two-phase Stormwater Program. The Stormwater Program seeks to improve the quality of the nation's streams, rivers, lakes, and estuaries by managing stormwater runoff from urban and suburban areas, construction projects, and industrial sites. Phase I, promulgated by EPA in 1990, covered medium and large municipalities (i.e., populations over 100,000), construction sites over 5 acres in size, and 10 categories of

industrial activity. The Phase II program is the next step and covers smaller municipalities, urban areas adjacent to municipalities, and construction sites over 1 acre.

Local governments are also working to understand and meet requirements of the Endangered Species Act. Activities include conducting sampling to determine locations of populations of listed species, performing impact inventories to assess how local government operations are affecting species, and then fixing culverts, screening diversions, or physically protecting habitat areas (often in partnership with watershed councils).

Table 41 displays a sampling of on-going fish and wildlife habitat-related activities by local governments.

Table 41. Selected fish and wildlife habitat-related activities by local governments

Local Government	Activity
Metro (nation's only elected regional government, covering Washington, Multnomah, and Clackamas County areas)	Adopted "Title 3," a regional water quality approach to meet land use Goals 6 and 7 through erosion control, floodplain regulations, and water resource management areas. Is working on new regional plan for fish and wildlife habitat protection to meet Goal 5 with an emphasis on creating an interconnected, functional system of fish and wildlife habitat (Wiley 2001). Approved bond measure in 1995, providing $135.6 million to acquire natural areas, trail corridors, and greenways based on 1992 Metropolitan Greenspaces Master Plan. To date, Metro has acquired 6,535 acres of open space, including over 50 stream miles of riparian areas.
Eugene/Lane County	The West Eugene Wetlands Plan is a collaboratively developed wetlands management/land use plan adopted in 1992. It provides greater environmental and development certainty, a streamlined permitting process, and an acquisition and restoration program. The local governments are now studying how the West Eugene Wetlands can be linked to other natural resources in the region to provide a system of "rivers and ridges" that supports fish and wildlife as well as meets public recreation needs. (Wiley 2001)
Portland	*ESA activities*: performed environmental baseline of lower Willamette and Columbia R's. to improve road program species protection;. Surveyed all tributaries and are sampling fish from Willamette Falls to the mouth on a 4-year, year-round basis. *Clean Water Act*: Implementing Combined Sewer Overflows cornerstone projects that are removing much of the runoff that enters the combined system: installing stormwater sumps; diverting stream water out of the system; disconnecting downspouts; and creating separate pipes for sewage. Total est. CSO cost: $1 billion
Marion County	The Department of Public Works has initiated a park restoration program, a roadside native plant program, and salmon recovery efforts, as well as environmental education opportunities. The Salmon Recovery Plan establishes a set of road-related Best Management Practices to minimize county impacts and prioritize capital improvement projects to help restore habitat. Marion County Parks is restoring 20 acres of upland pasture at Bonesteele Park to an upland prairie ecosystem (estimated cost $70,000) to increase biodiversity, enhance wildlife habitat, and provide an educational and recreational resource. (http://www.open.org/~mpubwork/index.shtml)

Local Government	Activity
Clackamas County	A primary focus of the county's Goal 5 program is protection of riparian corridors. The buffer width for structure setback varies by the flow of a stream, ranging from 100 feet for "large" streams to 50 feet for "small" streams. Regulations in these areas address building location and footprint, sewage disposal, and vegetation preservation. The county has also adopted a surface water management ordinance. (Wiley 2001)
Washington County/Clean Water Services/multiple cities/SWCD/FEMA	Working on Healthy Streams Plan, a watershed-based effort to integrate ESA and Clean Water Act. Will address policy issues and intergovernmental agreements, evaluate public values regarding fish issues, perform an economic analysis, review operations and maintenance, and set priorities for on-the-ground projects. Completed Watersheds 2000 inventory, an exhaustive watershed database for further planning and analysis. Estimated project cost is $2.72 million. Clean Water Services has funded $1.5 million with surface water management fees. FEMA has pledged nearly $700,000.
Corvallis	By 2003, the City's ESA Response Plan will: identify and rank compliance options/strategies; specify a fiscally sound implementation program, including adjustments to the CIP, criteria for measuring progress, a monitoring strategy, and a formal process to review and adjust the program should it be necessary; reduce the City's legal liability under ESA; initiate a rigorous, scientific program to characterize baseline fish habitat conditions; evaluate city activities for impact on fish habitat; include a public involvement strategy and public education program. http://207.66.149.8/details.html

The Lower Columbia River Estuary Partnership (LCREP)

In 1995, Washington and Oregon joined together to address the environmental, recreational and economic issues facing the Lower Columbia River Estuary by establishing the Lower Columbia River Estuary Program (now Partnership). The Estuary includes the Columbia River below Bonneville Dam and the tidally influenced reaches of tributaries (which includes the Willamette up to Willamette Falls at Oregon City). The Partnership consists of agricultural interests, industry, ports, environmental groups, tribes, recreation groups, commercial fishing interests, and federal, state and municipal governments and agencies..

The Comprehensive Conservation and Management Plan is the result of this 3-year effort to preserve and enhance the river. The Plan identifies 43 actions that address seven priority issues (biological integrity, conventional pollutants, toxic contaminants, habitat loss, human impacts, institutional constraints, and public awareness) and contribute to the ultimate goal of restoring and maintaining the biological integrity of the Lower Columbia River Estuary. The actions are grouped by three categories: (1) habitat and land use; (2) education and management; and (3) conventional and toxic pollutants. Each action identifies implementing parties, costs, and ways to measure progress.

Streamflow Restoration Program

Streamflow restoration priorities have been developed for the Willamette Basin by the Oregon Department of Fish and Wildlife and Oregon Water Resources Department (OWRD), as a joint measure contributing to the Oregon Plan for Salmon and Watersheds.

Streamflow restoration priorities are watersheds in which fish have been negatively affected by low streamflows resulting from water use and in which there are good opportunities for improving streamflows. A complete listing of watersheds with the ODFW Needs rankings (what is biologically desired) and the OWRD opportunity rankings (what has high institutional potential) are in Appendix E. The Willamette Restoration Strategy (the "Willamette Chapter" of the Oregon Plan) identifies this streamflow restoration program as a critical action. (Willamette Restoration Initiative 2001)

Streamflow restoration involves several critical elements. Instream water rights are needed with sufficiently senior priority dates to provide the legal basis for protection of the flows instream. The acquisition of existing out-of-stream water rights and the transfer or lease of the rights instream represents one of the most viable methods for securing senior instream rights. Allocations of conserved water also provide a process for establishing senior instream water rights.

OWRD is charged with distributing water according to the priority dates of the water rights. When there is insufficient water for all rights, OWRD watermasters shut off the most junior rights to provide water to the more senior rights. Watermasters routinely perform this function each summer on many streams. The establishment of senior instream rights provides OWRD the legal basis for protection of instream flows, but does not ensure protection of the water instream.

Protecting flows instream depends on the availability of sufficient watermaster staff and water measurement capabilities to allow expeditious distribution when the instream water rights are not met. OWRD does not have adequate resources to initiate streamflow restoration in all of the areas in which there are high needs and good opportunities. Streamflow restoration priorities are displayed in Statement of Fish and Wildlife Needs (Table 52 and Figure 10)

OWRD is developing streamflow restoration plans for each of the priority watersheds for which the agency currently has resources to pursue streamflow improvements. Based on the characteristics of and opportunities in each of the priority areas, staff will consider inclusion of the following activities in the plans:

- Identification of water rights that may be available for transfer or lease instream and assistance to the Oregon Water Trust and other similar organizations in determining the value of the rights in streamflow restoration.
- Improvements in water use measurement and control through the installation of headgates and measuring devices, particularly at significant diversions, that are needed to allow the expeditious distribution of water.
- Improvements in streamflow measurement through the installation of gaging stations or staff plates needed to efficiently monitor streamflows and to determine when instream water rights are not met.
- Assistance to large water users, particularly municipalities and irrigation districts, in identifying water conservation alternatives that would contribute to streamflow restoration.
- Inventories of water diversions and development of distribution lists to aid in water distribution and regulation activities.

- Notification of ODFW staff when diversions with potentially inadequate fish screening and passage facilities are identified during inventories and water distribution activities.

OWRD will work to identify funding alternatives to allow expansion of activities in priority watersheds in which the agency has agreed to pursue streamflow restoration and to allow initiation of flow restoration activities in the remaining priority watersheds. Possible funding alternatives include Bonneville Power Administration funding, other federal funding, and state general funding for the 2003 – 2005 biennium.

To address instream flow needs, the Oregon Department of Fish and Wildlife will:

- Provide technical advice on flow needs based on where, when, and what fish and wildlife (species and life stage) are present and what the range of flows should be for successful reproduction, rearing, food production and foraging, habitation, and migration.
- Acquire in-stream water rights, as necessary, to ensure flows are adequate to meet the needs of fish and wildlife.
- Work with the U.S. Army Corps of Engineers to provide adequate river flows for migrating salmonids.

In addition, Oregon's Instream Water Rights Law allows water right holders to donate, lease, or sell some, or all, of their water rights for transfer to instream use. The Oregon Water Trust (OWT), a private, non-profit group, negotiates voluntary donations, leases, or permanent purchases of out-of-stream water rights in those streams where they will provide the greatest benefits to fish and water quality. These rights are then converted to instream water rights under Oregon law. OWT has recently begun leasing activities in the Willamette Basin and is working to identify key streams in need of flow restoration.

Fish Passage Programs

There are many inter-related activities to improve fish passage throughout the Willamette Subbasin. This section highlights activities relating to culvert inventory and re-design and diversion screening. Fish passage over major dams is addressed through FERC relicensing (explained under Limiting Factor), through the ESA Section 7 consultation process on-going between the Services and the Corps (previously described in Salmon Recovery section), and in specific management plans of the Oregon Department of Fish and Wildlife (described in Table 46, Statement of Fish and Wildlife Need).

Culverts (Road / Stream Crossings)

Fish passage assessments at road / stream crossings have been performed by Oregon Department of Fish and Wildlife, the U.S. Forest Service, Clackamas County, Clean Water Services and other local government and private entities. However, assessment methodologies vary considerably, dependent upon agency focus and need. Additionally, data regarding private and federal road / stream crossings is often unavailable or not in sufficient detail or format to be utilized as an effective recovery planning tool. Therefore, existing data and reports probably understate the degree to which connectivity limits fish migration and production within the Willamette River subbasin. The lack of a consistent, subbasin-wide fish passage barrier inventory inhibits the subbasin's ability to accurately reflect the loss of access to high quality spawning and rearing habitat.

Most local road authorities have begun the remediation process of replacing or retrofitting road / stream crossings within their jurisdictional responsibility that are barriers to either juvenile or adult fish passage. Currently, the driving force for these projects is culvert condition and capacity. The US Forest Service has been evaluating and replacing culverts that are fish passage barriers for a number of years. In 2000 the USFS began an intensive and complete inventory of all fish passage culverts on National Forest System lands in Oregon and Washington, with coordination of private landowners where feasible. A database designed specifically to hold the information is now in use and results are becoming available. The methodologies and databases are also being utilized by other entities.

Most agencies within the Willamette Subbasin have acknowledged the need for assessment of and remediation to road stream crossings that are passage barriers to adult and juvenile fish species. The status of these programs is not being comprehensively monitored. Clackamas and Multnomah Counties have developed progressive programs for addressing fish passage barriers, however funding is often reliant upon the grant writing ability of the perspective agency. The scope and scale of the problem varies widely, with Multnomah County having less than 100 crossings to address and Clackamas County having thousands. Washington County's Clean Water Services has recently completed Watersheds 2000, a large-scale assessment of streams predominantly within the Urban Growth Boundary. This study focused on stream health, including impacts of passage. Washington County Department of Land Use and Transportation has begun developing its fish passage assessment and prioritization program, but long term funding remains the outstanding limiting factor. Based on individual biological assessments, Multnomah County and ODFW have identified a need to reconstruct 48 culverts for fish passage at an estimated cost of $19 million. The county is also working with regional governments and watershed councils in determining basin restoration needs through consolidated inventories and environmental mapping analysis. Metro has mapped fish-blocking culverts in the region. For the purposes of identifying projects that may qualify for future federal transportation funding, Metro prioritized and identified approximately 150 of these culverts, that if correctly modified or removed, would provide the maximum number of miles of quality spawning and rearing habitat for ESA-listed salmonids.

Diversion Screening

ODFW continues to pursue screening of pump and ditch diversions in the Willamette River Basin to protect salmonids, food and game fish. In summer 1997, a survey of primarily mainstem diversions (Middle Fork at Jasper downstream through Multnomah Channel) located 504 pump diversions. Additionally, hundreds of pump and ditch diversions are located in tributaries to the Willamette River. ODFW has screened more than 100 diversions in the basin. ODFW is currently concentrating efforts on screening large diversions, primarily ditches, in the basin including the Santiam Water Control District (1,050 cfs) and Lacomb Irrigation District (65 cfs). ODFW cooperatively works with water users by offering a cost share program that pays 60% of the cost of screening up to $75,000 per screening project. The cost share cap may be exceeded if the Fish Screening Task Force and ODFW agree.

Species-Specific Management and Recovery Plans

Fish

Salmon and Steelhead Recovery Planning

Recovery planning efforts for West Coast salmon is organized into a series of discrete geographic areas, or domains. The intent is to develop area-based recovery plans for all listed anadromous salmonid ESUs within each domain. The ESA stipulates that these plans must contain the following elements:

1) Objective, measurable criteria for determining when delisting is warranted;
2) A comprehensive list of site-specific management actions necessary to achieve the plan's goal for recovery of the species; and
3) An estimate of the cost and time required to carry out those actions.

In addition, NOAA Recovery Planning Guidelines stipulate that recovery plans must include an assessment of the factors that led to population declines and/or which are impeding recovery. Finally, it is important that the plans include a comprehensive monitoring and evaluation program for gauging the effectiveness of recovery measures and overall progress towards recovery.

The National Marine Fisheries Service has designated the Willamette-Lower Columbia area as a recovery domain for listed salmon and steelhead. It has established a Technical Recovery Team of scientists to review studies and recommend de-listing goals and criteria. NMFS has also issued a "4(d) rule" to both acknowledge and encourage activities affecting listed species which are deemed to be allowed under the Endangered Species Act—that is, they have been determined to not result in a species "take." NMFS, in cooperation with the U.S. Fish and Wildlife Service, is conducting "Section 7" consultations with federal agencies to determine whether their actions jeopardize listed species—chief among these consultations is that involving the operation of the U.S. Army Corps of Engineers Willamette Flood Control Projects. NMFS is also working with the state, regional, and local organizations to design a community-based recovery process.

Bull Trout:

A bull trout recovery plan is being drafted by the USFWS with assistance from bull trout recovery unit teams in each of 23 recovery units. The Willamette Basin has been designated a bull trout recovery unit. Publication of the draft plan is expected by the end of 2001.

A working group comprised of representatives from federal, state, industry, and conservation groups was formed in 1989 to coordinate work on bull trout protection and recovery, and to draft a conservation strategy for the Willamette River basin. The working group was formalized as the Willamette Recovery Unit Team in 1999 to draft a bull trout recovery strategy for the Willamette Basin. When completed the strategy will become a chapter in the Draft Bull Trout Recovery Plan. The Team defined two core areas in the Willamette Recovery Unit, the Upper Willamette (McKenzie and Middle Fork subbasins) and the Clackamas where recovery actions will be focused. The Santiam was identified as a research need.

The goal for recovery of bull trout in the Willamette Recovery Unit as defined by the Team is to ensure the long-term persistence of self-sustaining complex interacting

groups of bull trout distributed across their historic range. In order to achieve the recovery goal, the following objectives have been defined:

1) Current distribution of bull trout within the Willamette Recovery Unit is maintained and bull trout are re-established in previously occupied habitats in the Middle Fork Willamette subbasin and potentially in the Clackamas and Santiam subbasins.
2) Stable or increasing trends in abundance of bull trout in the Willamette Recovery Unit are maintained. This will require increasing abundance within existing local populations and re-introduced populations.
3) Suitable habitat conditions for all bull trout life history stages and strategies are restored and maintained.
4) Genetically diverse populations of bull trout populations within the Willamette Recovery Unit are conserved. This will require reconnecting local populations within the Upper Willamette Core Area.
5) Public and agency awareness of bull trout value and importance of protection and restoration efforts are improved.

Priority conservation actions for bull trout in the Willamette Basin include: Addressing passage needs; maintaining and restoring critical habitat variables such as temperature, sedimentation, pools and side channels; continuing restrictive angling regulations; preventing additional introductions of non-native fish species; increasing enforcement against illegal harvest (ODFW 1997b), continuing re-introduction program in the Upper Willamette Core Area, and assessing feasibility for re-introducing bull trout into the Clackamas and Santiam subbasins.

Angling regulations have been changed to protect bull trout, including closure to angling for bull trout and catch and release of wild trout in all streams. Bull trout caught incidentally to other fisheries must be released unharmed. Increased enforcement to reduce poaching is ongoing through the Oregon State Police Cooperative Enforcement Program, and bull trout are given a high priority for protection.

Stocking of catchable rainbow trout is believed to have added pressure to native bull trout populations both through competition and increased angling activity. Stocking of catchable trout has been eliminated in areas important to bull trout

Although critical habitat for bull trout has not yet been designated by the USFWS, "the present or threatened destruction, modification, or curtailment of bull trout habitat" was identified by USFWS as one of the principle factors affecting the species (63 FR 31647). The three populations of bull trout identified by the USFWS that occur in the McKenzie River basin constitute the last known self-sustaining population group in Oregon west of the Cascade Mountain Range. All of the occupied habitat in the McKenzie River basin is obviously critical to the persistence of this population group.

Near term needs for bull trout include:

1) Continued monitoring and investigations into the distribution and abundance of known populations, e.g., seasonal use patterns and associated habitat

parameters, estimates of abundance to establish trends and measure population response to restoration, and extent and magnitude of nonnative species interaction and hybridization to better define treatment options;

2) Analyses to determine potential for restoration of bull trout populations into historic habitat and additional presence/absence surveys;

3) Restoration projects to address passage barriers, riparian habitat and structure; channel form and function; flow issues, and water quality problems.

Oregon chub:

The Oregon chub recovery plan (USFWS 1998) calls for establishing a sufficient number of secure managed populations distributed throughout the Willamette Valley. The recovery program's first priority is to maintain the existing populations; the second priority is to establish new populations through reintroductions and/or habitat enhancement to facilitate natural colonization in each of three subbasins: the Middle Fork Willamette, mainstem Willamette, and Santiam River. Recovery efforts will emphasize protecting, restoring and enhancing populations on public lands.

Priority conservation measures for existing and future Oregon chub habitats include: prevention of introduction or removal of non-native species when practical; prevention of inappropriate water diversions, fills or removals, water temperature change, excessive sedimentation or removal of cover; decreased pesticide and herbicide application and runoff; and restoration of floodplain habitats. Specific actions may include reducing logging-induced sedimentation, establishing buffer zones between agricultural land and Oregon chub habitat, and restricting chemical spraying. In addition, the Corps of Engineers has been asked to fund studies of the effects of hydropower project operations on Oregon chub populations, and to notify the Fish and Wildlife Service of any changes in operations that may affect Oregon chub habitat. The Oregon chub recovery plan is being cooperatively implemented by numerous state and federal agencies, as well as by key local stakeholders.

Cutthroat

In Oregon, the planting of hatchery coastal cutthroat trout was discontinued in lower Columbia River streams by 1994. Currently, only standing bodies of water such as lakes and ponds in the lower Columbia River area are planted with hatchery fish. The only current planting of hatchery coastal cutthroat trout in the Willamette River basin occurs in Cascade Mountain lakes, using a native brood stock of coastal cutthroat trout known as the Hackleman stock. The effects, if any, of these introductions on naturally spawning stocks are unknown but are currently under investigation by ODFW (Kostow 1995; Hooton 1997; Johnson et al. 1999). Steps have also been taken recently by the states of Washington and Oregon to reduce mortality due to directed and incidental harvest of coastal cutthroat trout (Johnson et al. 1999).

Wildlife management and recovery plans

ODFW species management plans have been previously described under ODFW Management and Operation Plans and in Appendix C. The Northwest Forest Plan (also described above) represents an old-growth species recovery strategy. In addition to these major efforts, there are at least two other approaches significant at the subbasin scale: the

Landbird Conservation Plan and the Willamette Subbasins network of public wildlife refuges and management areas.

Landbird Conservation Plan: Westside Lowlands and Valleys

Partners In Flight (PIF) has developed a Landbird Conservation Plan for Oregon and Washington, including a component dealing with westside lowlands and valleys. PIF is a cooperative conservation effort among government agencies, organizations, and individuals. PIF's initial focus was on conserving neotropical migrant species (that breed in North America, but winter in the tropics), but the focus now includes most landbirds requiring terrestrial habitats. The conservation emphasis in Westside Lowlands and Valleys is to:

- initiate conservation actions in accordance with the ecological potential of the site,
- emphasize conservation within high priority designated conservation areas and where opportunities exist (i.e., receptive land owners and land managers), and
- emphasize conservation at multiple scales.

The plan has three priority habitats in the Willamette subbasin:

- grassland-savanna
- oak woodland
- riparian

The plan recommends managing for groups of "focal species" within each habitat type as shown in Table 42. (Partners in Flight 2001)

US and State Refuge systems and Wildlife Management Areas

Fish and wildlife refuges and management areas represent important components of the Willamette Subbasin's overall fish and wildlife management framework. They offer vital nodes of often-high-quality habitat and potential future building blocks for a more connected system of lands managed for habitat purposes.

The US Fish and Wildlife Service manages the National Wildlife Refuge System which is the only nationwide system of federal land specifically managed and protected for fish, wildlife, and their habitats. The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the nation for the befit of present and future generations.

Four National Wildlife Refuges currently contribute to the protection and enhancement of Willamette Valley fish, wildlife, and plant resources. These refuges include William L. Finley (5,594 acres), Ankeny (2,835 acres), Baskett Slough (2,520 acres), and Tualatin River (3,058 acres). The Tualatin River National Wildlife Refuge Additions Project is an ongoing project with BPA. Funding to-date includes $1.4 million for the purchase of 230 acres. In addition, nearly $275,000 has been targeted for restoration and enhancement of habitats on 132 acres.

Table 42. Partners in Flight Westside lowlands and valleys Land Bird Conservation Plan Focal Species

Habitat	Attribute	Focal Species
Grassland-Savanna	large patches	western meadowlark *
	short grass - bare ground	streaked horned lark
	short grass- bare ground	common nighthawk
	moderate-tall grass	grasshopper sparrow
	burrows	burrowing owl
	scattered shrubs	Oregon vesper sparrow
	scattered shrubs	lark sparrow *
	wet prairie/grassland	northern harrier
	large oaks – cavities	American kestrel *
	large oaks – cavities	western screech owl
	large conifer trees	Lewis' woodpecker
Oak Woodland	large patches, large oaks	white-breasted nuthatch
	large oaks – cavities	acorn woodpecker *
	large oaks – cavities	downy woodpecker
	large oaks – cavities	ash-throated flycatcher *
	canopy edges and openings	western wood-pewee *
	young (subcanopy) oaks	bushtit *
	herbaceous cover	chipping sparrow *
	native shrub understory	Bewick's wren
	native shrub understory	house wren *
	native shrub understory	Nashville warbler
Riparian - Open Water	snags	purple martin
	snags	tree swallow
Riparian Shrub	dense shrub layer	willow flycatcher *
	dense shrub layer	yellow-breasted chat
Riparian Woodland	large canopy trees	red-eyed vireo
	large canopy trees	Bullock's oriole *
	subcanopy, tall shrub foliage	yellow warbler
	dense shrub understory	Swainson's thrush *
	dense shrub understory	wrentit *
	snags downy	woodpecker
	large, structurally diverse patches	yellow-billed cuckoo
	large, structurally diverse patches	red-shouldered hawk
	large, structurally diverse patches	Cooper's hawk

- Significantly declining population trend in the Southern Pacific Rainforest BBS Physiographic Region.

The Oregon Department of Fish and Wildlife manages a system of State Wildlife Management Areas (WMAs) throughout the state, including in the Willamette Subbasin, as described in Table 43.

Table 43. State Wildlife Management Areas in the Willamette Subbasin

Sauvie Island: The Sauvie Island WMA makes up about half of the 24,000 acre island complex of wetlands, farmed fields, deciduous forests, and lakes located at the confluence of the Willamette and Columbia rivers. About 8,000 acres are owned by ODFW and 3,500 acres are leased from the Division of State Lands. The WMA's primary purpose is to provide suitable habitat for waterfowl. Other objectives are providing wildlife oriented recreation and public hunting. Sauvie Island has the most user days of any WMA in Oregon at several hundred thousand per year. (ODFW 1993. Sauvie Island Wildlife Area Long Range Management Plan. 30pp.)
Fern Ridge: Established in 1957 under an agreement with the U.S. Army Corps of Engineers with 5,010 acres of federal land and water as wildlife habitat. The area is located within the 15,000 acre Fern Ridge Reservoir Project Area on the Long Tom River about 10 miles east of Eugene. Its goals are to: 1) Attract and support waterfowl in the southern Willamette Valley; 2) Manage for wildlife oriented public recreation compatible with conservation of wildlife resources; 3) Manage habitats for wildlife species diversity; and 4) Provide for wildlife and habitat oriented education opportunities. Habitats present on the area include the reservoir, grasslands, wetlands, and deciduous forests. Fern Ridge WMA has the second highest use by human visitors of any of the WMAs in Oregon. (ODFW 1993. Fern Ridge Wildlife Area Long Range Management Plan. 28 pp.)
EE Wilson: 1,600 acres of wetlands, fields, uplands, deciduous and coniferous forests, roads and open water located about 10 miles north of Corvallis, Oregon. Its goals are to: 1) Protect, enhance, and restore wildlife habitats which were historically present in the Willamette Valley, 2) Manage for wildlife oriented public recreation compatible with conservation of wildlife resources; and 3) Provide education opportunities relating to wildlife habitat and management. The WMA is one of the most heavily used in the state and offers recreational activities as diverse as mountain biking to rabbit hunting. (ODFW 1993. EE Wilson Wildlife Area Long Range Management Plan. 20 pp.)

Research, Monitoring, and Evaluation Activities

Subbasin Level

Federal Activities

Monitoring and Research Related to Salmon Recovery

As described under the Salmon Recovery section, a comprehensive research and monitoring program will likely form some part of a Reasonable and Prudent Alternative for avoiding the Willamette Project take of listed species. In addition, federal agencies have identified the Willamette River below the Corps dams as one of three critical stream reaches in the Columbia Basin for improving mainstem spawning and rearing habitat. Three sites will be chosen for monitoring (one below Eugene, one below Salem, and one above Multnomah Channel).

Northwest Forest Plan

The research, monitoring, and evaluation activities under the Northwest Forest Plan are guided by an interagency Strategic Research Plan. The Plan: identifies high-priority research themes to support ecosystem management activities; provides linkage to other federal research plans; guides interagency research coordination and the feedbacks; and promotes scientific information transfer to managers and other stakeholders.

Major research organizations involved are the Pacific Northwest and Pacific Southwest Research Stations of the USDA Forest Service; the Forest and Rangeland Ecosystem Science Center of the U.S. Geological Survey; the Pacific Northwest Ecosystem Management Research Program of the Environmental Protection Agency; and the Northwest Fisheries Science Center of the National Marine Fisheries Service.

The Federal research agencies have identified seven major research themes: (1) Understanding Ecological Systems; (2) Individual Species Research; (3) Developing and Evaluating Alternative Management Systems; (4) Resource Restoration and Enhancement; (5) Economic and Social Dimensions of Cultural and Natural Resources; (6) Research to support Monitoring and Inventory Systems; and (7) Decision Support Systems.

The Northwest forest Plan identifies three different types of monitoring requirements: Implementation monitoring, effectiveness monitoring, and validation monitoring. Implementation monitoring occurs annually to assess the degree to which The Northwest forest Plan standards and guidelines are being followed in project implementation. Results of the implementation monitoring are analyzed by a Provincial Monitoring Team made up of scientists form the Forest Service, BLM, US Fish and Wildlife Service, and Regional Ecosystem Office.

Bureau of Land Management Science Strategy and Bioregional Activity Catalogs

In September 2000, the BLM released a Science Strategy setting forth an overall approach to science. While the BLM does not have a specific research mandate, it seeks research support from science providers within and outside the Federal government. The BLM Science Strategy clearly acknowledges that social and economic values, political factors, and statutory and regulatory requirements must be considered, along with scientific information, in resource management decisions. It establishes a clear process for identifying science needs and assure their reflection in the BLM Strategic Plan and budget.

In implementing the Strategy, the BLM is currently compiling a catalogue addressing national, regional, and local science needs. The biogeographic region concept reaffirms existing need, often complex and long term, and builds upon unmet needs where much work remains to be done. Draft regional management issues in the Pacific Northwest place emphasis on:

1. Watershed Scale Needs: Information on physical and biological processes of headwater streams, evaluation of forest management activities and their effects on headwater drainages, and testing of various management practices to determine the efficacy of management prescriptions in mitigating actions and protecting headwater drainage systems.
2. Aquatic/Riparian System Needs: Science surrounding riparian reserves, Aquatic Conservation Strategy and salmon components of the Northwest Forest Plan.

Comprehensive inventory and assessment information of perennial water sources and streams, including baseline water quality information, and updated information on appropriate water rights.

3. Management and Protection of Salmonid Fish Needs: Information to understand an integrated approach to analyze habitat influences on salmonid populations; determine levels of protection, needed restoration, and management techniques/options for rebuilding and maintaining salmonid populations; understand the role of genetics and hatchery programs in protecting and restoring salmonid populations.

Pacific Northwest Forest and Range Experimental Station

The Pacific Northwest Forest and Range Experimental Station has a wide array of research interests within the Willamette sub basin. Established in 1925, the PNW Research Station is one of eight research units in the USDA Forest Service. It is headquartered in Portland with ten research locations in Alaska, Oregon, and Washington. Research, monitoring and evaluation in the region includes: aquatic and land interactions; ecosystem processes; resource management and productivity; and social and economic values.

One of the most important research activities of the PNW is through the H.J. Andrews Experimental Forest in the McKenzie watershed. Over its 15-year history the Andrews Long Term Ecological Research program has become a major center for analysis of forest and stream ecosystems in the Pacific Northwest. The H. J. Andrews Experimental Forest was established by the US Forest Service in 1948 and focused on research on the management of watersheds, soils, climate, streamflow, water quality, and vegetation. Development of data and information management systems as part of the science program has been a major accomplishment. H.J. Andrews is placing emphasis under the central theme: *Develop concepts and tools needed to predict effects of natural disturbance, land use, and climate change on ecosystem structure, function, and species composition*.

Northwest Fisheries Science Center / Willamette-Lower Columbia Technical Recovery Team

The Northwest Fisheries Science Center is one of five research centers of NOAA Fisheries (the National Marine Fisheries Service), and is responsible for providing scientific and technical support for the management, conservation, and development of the Pacific Northwest region's anadromous and marine fishery resources. Its multidisciplinary research--involving fisheries science, marine biology and ecology, genetics, biochemistry, molecular biology, oceanography, and aquaculture--is conducted in cooperation with other agencies (federal, state, local, and tribal), universities throughout the world, Pacific Rim and European countries, and in support of international treaties. The NWFSC is organized into five research divisions: Conservation Biology, Environmental Conservation, Fishery Resource Analysis and Monitoring, Fish Ecology, Resource Enhancement, and Utilization and Technologies. Research objectives are:

- understanding and mitigating the impacts of hydroelectric dams on salmon and ecological and genetic research on salmon in support of the Endangered Species Act
- evaluating effects of marine pollutants on coastal ecosystems throughout the United States
- enhancing the quality, safety and value of fishery products
- developing methodologies for marine aquaculture and salmon enhancement
- emerging fields of marine biotechnology

- assessing trends in fish abundance and potential fishery yield

Salmon related research is categorized around major themes: conservation, cumulative risk, ecology, education, fish health, genetics, habitat, harmful algal blooms, harvest, hatcheries, hydropower, and resource utilization.

NMFS has appointed an 11 member Technical Recovery Team for the Willamette-Lower Columbia recovery domain. TRTs produce technical documents on various aspects of recovery planning (e.g. population identification, viability modeling, etc.).Primary TRT tasks are to:

* Identify population/ESU delisting criteria
* Characterize habitat/fish productivity relationship
* Identify factors for decline and limiting factors
* Identify early actions for recovery
* Identify research, monitoring, and evaluation needs
* Serve as science advisors to groups charged with developing measures to achieve recovery goals

The Willamette-Lower Columbia TRT first met in May 2000. Draft products are expected to be available for public review in 2002.

Monitoring and evaluation is an essential component of recovery. It can be divided into four categories applicable to West Coast salmon recovery planning: implementation monitoring, project effectiveness monitoring, recovery program evaluation, and environmental monitoring. TRTs will play an important role in monitoring and evaluation.

1) *Implementation monitoring:* This monitoring determines whether management actions were implemented as required under a Recovery Plan.
2) *Project effectiveness monitoring:* This type of monitoring evaluates the linkage between specific management actions and the intended outcomes. In the absence of a full understanding of many of these cause-and-effect relationships, NMFS anticipates that many project-effectiveness evaluations will be intertwined with specific research projects.
3) *Recovery program evaluation:* As biological delisting criteria are formulated, the TRTs will identify how progress towards achieving these goals can be measured. The broad geographic scope of salmon recovery efforts will generally preclude comprehensive monitoring throughout a geographic region. Therefore, monitoring and evaluation will often need to target specific locales or populations as index sites for evaluating success.
4) *Environmental monitoring:* Factors outside the control of Recovery Plan actions, such as oceanic and freshwater environmental fluctuations, will affect salmon population parameters and progress towards recovery.

U.S. Geological Survey Willamette Basin National Water Quality Assessment Program / Willamette Basin Ground-Water Study

In 1991, the U. S. Geological Survey (USGS) began its National Water-Quality Assessment (NAWQA) program. The long-term goals of the NAWQA program are to describe the status and trends in water quality of large, representative parts of the Nation's

surface- and ground-water resources. Sixty study-unit investigations comprise the principal building blocks of the program and provide the foundation for regional and national assessment activities.. In 1991, the Willamette Basin was among the first 20 NAWQA study units selected for investigation. Conclusions of the Willamette NAWQA study were described under Limiting Factors.

Willamette Basin Ground-Water Study

The burgeoning population of the Willamette River Basin is putting unprecedented demands on water resources. Because surface-water resources are largely allocated, ground-water resources will be expected to meet growing demand. Developing a sound technical understanding of ground-water hydrology is therefore important. The study has the following objectives:

1. Provide a quantitative understanding of the regional ground-water flow system of the Willamette Valley.
2. Develop the understanding and tools necessary to quantitatively evaluate the timing, location and magnitude of streamflow depletion caused by ground-water pumping.
3. Characterize the unique hydrology of basalt aquifers within the Willamette Valley.
4. Develop a better understanding of the relations between well-yield and geology, well construction, and siting in low-yield areas.
5. Develop a better understanding of the origins and distribution of selected types of naturally occurring poor-quality ground water.

State Activities

Independent Multidisciplinary Science Team

The Team was established by the Legislature to provide scientific advice to the State on the Oregon Plan for Salmon and Watersheds. The IMST has two broad areas of work: Independent Projects and Review Projects. Independent projects deal with the scientific basis for management of resources and settings crucial to the Oregon Plan. Review projects represent ongoing or proposed activities that could influence accomplishing the mission of the Oregon Plan. Selected projects are displayed in Table 44.

Table 44. Selected projects of Oregon's Independent Multidisciplinary Science Team

Independent Projects
• Predation. This project evaluated the impact of predation by pinnipeds (seals and sea lions) and sea birds on salmonids. Technical Report 1998-1.
• Hatchery Management, Phase I. This project evaluated Oregon Plan hatchery strategies against criteria common to four independent scientific reviews of hatchery programs. Technical Report 1998-2.
• Forest Practices. This project is the first of several projects relating to land use in Oregon. It evaluated the scientific basis for forest practices, including the regulatory and voluntary aspects of them, with respect to the Mission of the Oregon Plan. The scope is Western Oregon. Technical Report 1999-1.
• Harvest Management (adult fish escapement to spawning). Report of a scientific workshop on harvest management Technical Report 1999-2 Report on scientific basis for harvest management as it relates to the Oregon Plan. Technical Report 2000-3.
• Western Oregon Lowland Resources (Land uses in western Oregon that are not forest and are not urban). This project will evaluate the scientific basis for the management of low land resources in Western Oregon as it relates to the Mission of the Oregon Plan. It includes a wide variety of agricultural land uses, estuaries and other low land systems. In progress.
• Hatchery Management, Phase II. This project is an evaluation of the results of the audit of hatchery operations conducted by ODFW. It is limited in scope and is relatively brief. It is complete is the subject of a letter report dated October 25, 2000..
• Hatchery Management, Phase III. This project evaluates hatchery management .Technical Report 2001-1.
Review Projects:
• Water Temperature Standards. This review is of the proposed water temperature standards of the state. It is underway and is expected to be completed in calendar year 2000. Monitoring Report, 1999. This is an annual report required of the IMST on the monitoring activities under the Oregon Plan.
• Native Fish Conservation Policy. This will be a review of ODFW Native Fish Conservation Policy, which is being developed to replace the existing Wild Fish Policy. In progress.

Source: http://www.fsl.orst.edu/imst/index.htm

Joint, Cooperative Activities

Pacific Northwest Ecosystem Research Consortium

As part of the follow-up to the Northwest Forest Plan, the U.S. Environmental Protection Agency (EPA) committed to a five-year research effort to support community-based environmental planning. The Willamette Basin was selected as one of the focal areas for EPA research because of its multiple land uses and the complexity of environmental issues being addressed by active citizen-based initiatives. To implement its research, EPA formed the Pacific Northwest Ecosystem Research Consortium, consisting of 34 scientists at ten different institutions, including Oregon State University, University of Oregon, the U.S. Forest Service, and the Environmental Protection Agency. The primary goal of the Consortium's research has been characterizing and evaluating the trajectory of landscape

change in the Willamette basin, including plausible alternative futures in pursuit of four basic questions:

- How have people altered the land, water, and biotic resources of the Willamette Basin over the past 150 years since Pre-EuroAmerican settlement?
- How might human activities alter Willamette Basin landscapes over the next 50 years, considering a range of plausible management and policy options?
- What are the expected ecological and socio-economic consequences of these long-term landscape changes?
- What types of management actions, in what geographic areas or types of ecosystems, are likely to have the greatest effect?

The project developed highly detailed coverages of land-use, landcover, demography, hydrography, and landform. In addition, spatially explicit ecological response models were developed to test differences between three different future scenarios. The project will be documented through the publication of a *Willamette Basin Planning Atlas* by OSU Press in 2002. Its conservation conclusions and recommendations are described under Statement of Fish and Wildlife Needs, Table 51.

Cooperative Forest Ecosystem Research Program (CFER)

The Cooperative Forest Ecosystem Research (CFER) program is a multidisciplinary, integrated research program to develop and convey research information to land managers in western Oregon. Acquisition of information that supports implementation of the Northwest Forest Plan is a top priority. CFER includes the USGS Forest and Rangeland Ecosystem Science Center, Oregon State University, the Bureau of Land Management, and the Oregon Department of Forestry. CFER has initiated three integrated research projects throughout western Oregon to answer questions at different scales of time and space:

- Stand Structure and Biotic Responses to Changes in Structure of Young Forests of Western Oregon
- Large Woody Debris in the Terrestrial and Aquatic Riparian Zone: Production, Recruitment, Retention, and Function
- Influence of Landscape Pattern and Composition on Species in Forested Ecosystems of Western Oregon

Project Level Activities

There is a huge assortment of species-, habitat and issue-specific investigations (i.e. monitoring and research study) being conducted by universities, non-governmental organizations, and agencies which regularly occurs in the context of their respective academic and land management activity.“ It is beyond the scope of this Summary to fully list all such projects. A number of project-scale RM&E activities have been previously described both under Existing and Past Efforts (especially in the BPA funding section, Table 20), Watershed Assessment (especially Table 7), and a number of the U.S. Army Corps of Engineer investigations described for the Willamette Basin Project. In addition, the Oregon Watershed Enhancement Board requires specific monitoring activities for most of the watershed restoration projects it funds.

Statement of Fish and Wildlife Needs

Summary of Willamette Subbasin Fish and Wildlife Needs

The Willamette Subbasin is a complex place. On the one hand, its ecosystems have been highly altered and, consequently, its fish and wildlife populations severely affected. On the other hand, it retains substantial areas of functioning ecosystems and other areas with high potential for restoration. The causes of ecosystem alteration are many and include direct habitat conversion for urban uses, agriculture, and forestry--as well as the disruption of flow, temperature, and biotic regimes resulting from the construction and operation of the multi-purpose reservoirs of the Willamette Project which support the Federal Columbia River Power System (FCRPS).

Overall, fish and wildlife needs in the Willamette can be categorized by habitat, monitoring, and institutional needs.

Habitat Needs

Fish and wildlife in the Willamette Subbasin need:

- Substantially increased areas where improved floodplain function facilitates vital ecological processes;
- more and better-connected habitat--both upland and lowland--especially through riparian areas and wetlands which connect the two;
- more natural streamflow regimes, especially in low-flow months;
- higher quality water with temperatures closer to natural historic patterns;
- improved access to critical habitats through the Willamette system, especially for anadromous or locally-migratory fish populations.

These needs have been commonly identified by a host of interests including watershed councils, districts, federal biological services, the Oregon Plan, and researchers. For example, in 1998 the Oregon Department of Fish and Wildlife convened a group of scientists to discuss the causes of decline among Willamette River salmonids. In its report, *Factors Influencing Production Of Willamette River Salmonids & Recommendations For Conservation Actions* (Martin et al. 1998), the group identified factors for decline and also suggested key measures needed to support recovery. The group's analysis of factors for decline was described above under Limiting Factors.

The group emphasized the need for a holistic, basin wide approach, as well as the benefit of applying many strategies in this highly altered environment—and agreed the focus must be on the entire aquatic community, not just "Cadillac species" such as chinook and steelhead. Key conservation measures are shown in Table 45.

Table 45. Key salmon conservation measures identified in *Factors Influencing Production Of Willamette River Salmonids & Recommendations For Conservation Actions*

1. Floodplain restoration (including active reconnection of off-channel sloughs and backwaters, altering flow releases from reservoirs, more effective riparian protection, and more functioning wetlands).
2. Hydrologic management to begin to restore the natural flow and temperature patterns to the extent possible.
3. Predator control, particularly in the short term, when runs are so low and alternate prey seems scarce.
4. Substantially reduced harvest rates on chinook and juvenile steelhead (including through incidental trout fisheries)
5. Reduced hatchery impacts by limiting effects of strays, reducing competition/predation of wild juveniles by hatchery releases, and by reducing the predator aggregation from massive releases of hatchery juveniles.
6. Reduce impacts from exotic fish species.
7. Land use regulations and incentives should be used to increase protection of currently productive habitats and to encourage future restoration.
8. Improved urban stormwater management
9. Nutrient enrichment through increased escapement of adult salmon and the artificial placement of fish carcasses.
10. Providing passage at dams and diversions.
11. Identify and protect key watersheds with high current production as salmon refuges to ensure a base for recolonization (e.g., the McKenzie, Clackamas, Sandy and Little North Fork Santiam).
12. Education and monitoring to inform people about the causes of habitat degradation and involve them in monitoring results.

The group prioritized these conservation measures into short and long-term actions.

Short term actions: The most important short-term action was reducing harvest on wild fish, followed by reduction of predation. Improving water quality, reducing effects of hatchery fish and instream habitat projects were next. The development of an education program also ranked high.

Long term actions: Restoring flood plain function and hydrologic integrity was the highest general priority. Improving water quality was by far the highest specific long-term priority of the group. Reclaiming lost habitat above dams and regulating land use to improve habitat and reduce erosion came next. Restoring genetic diversity among the stocks followed in long term priority.

In addition, as the state's responsible authority on fish and wildlife management, the Oregon Department of Fish and Wildlife has identified specific habitat needs for the Willamette Subbasin, primarily through its draft Willamette River Basin Operational Plan and its Wildlife Diversity Plan.

The Operational Plan (attached in its entirety as Appendix D) describes the need to:

1. Protect, and where necessary recover, existing fish and wildlife populations and their habitats by:

- Implementing action plans for protection and recovery of self-sustaining populations of fish and wildlife.
- Helping ensure water intakes (turbine, irrigation, municipal and industrial water supply, etc.) are properly screened to minimize negative effects on fish and wildlife populations.
- Regulating recreational and commercial harvest consistent with healthy and sustainable fish and wildlife populations
- Helping ensure instream flows and water temperatures are adequate to meet needs of fish and wildlife populations.
- Helping protect existing high quality habitat that is critical to the survival and prosperity of fish and wildlife populations. (Strategy 3, Actions 3.1-3.6)

2. Restore populations of fish and wildlife in habitats from which they have been extirpated or greatly reduced by:

- Helping restore existing low quality habitat to conditions that would ensure the survival and prosperity of fish and wildlife populations by:
- Helping ensure fish and wildlife populations have access to habitats necessary for them to survive and prosper.
- Developing and refining programs to enhance fish and wildlife populations in habitats from which they have been extirpated or greatly reduced. (Strategy 4, Activities 4.1-4.3)

The Operational Plan also more specifically identifies locations or areas of emphasis for fish and wildlife habitat improvements as shown in Table 46. These deal with fish passage and screening, streamflows, temperature, and population re-establishment.

Table 46. Specific fish and wildlife habitat improvement needs (ODFW Draft Willamette River Basin Operational Plan; action numbers in parentheses)

Screening:
Ensure water right holders properly screen their water intakes. (3.2.6.)
Initiate a program to screen all diversions (3.2.4)
Install or improve fish protection screening on: • the Eugene Water and Electric Board Walterville diversion canal.(3.2.3) • Stayton Power Canal (if the former PP&L plant is licensed) (3.2.4) • the main irrigation canal at Stayton (3.2.4) • Sidney ditch (3.2.4) • the 19th Street diversion (3.2.4) • Penn Annex lateral. (3.2.4) • Lebanon-Albany power canal on South Santiam (3.2.5) • Lake Oswego diversion from the Tualatin River (3.2.7) • PGE's three-dam complex on the Clackamas River (3.2.8) • Portland General Electric Sullivan Plant at Willamette Falls (2.2.3)
Fish Passage
Design and complete feasibility studies for providing fish passage at all projects where such work is not ongoing or planned. (4.2.11)
Develop or improve fish passage at: • Cougar and Detroit Dams. (4.2.4) • Dexter, Lookout Point, and Hills Creek dams for downstream-migrating juveniles. (3.2.12) • PGE's three-dam complex on the Clackamas River. (4.2.6) • Geren Island on the North Santiam River (4.2.7) • Lebanon Dam on the South Santiam River (FERC) (4.2.8) • Green Peter Dam (USACE) (4.2.9) • Thompson's Mill Dam and on the Calapooia River (4.2.12) • Brownsville Dam bypass on the Calapooia River (4.2.13)
Streamflows
Work with the U.S. Army Corps of Engineers to provide adequate river flows for migrating salmonids. 3.4.4.
Increase in minimum flows from the canals at Leaburg and Walterville facilities to improve rearing-habitat for juvenile chinook in the McKenzie River (3.4.5).
Temperature
Work with the U.S. Army Corps of Engineers to ensure structures designed to regulate discharge temperature are installed at Cougar and Blue River dams. (3.5.3)
Correct water temperature problems associated with water released from reservoirs in the North and South Santiam Rivers. (3.5.4&5)
Evaluate effects of construction of temperature control structures in Cougar Reservoir on bull trout. (2.2.4)

Table 46. Specific fish and wildlife habitat improvement needs (ODFW Draft Willamette River Basin Operational Plan; action numbers in parentheses) continued.

Population Re-Establishment / Fish transport
Determine the spawning and rearing potential for spring chinook in all habitats from which they have been extirpated or greatly reduced, e.g. above all U.S. Army Corps of Engineers dams. Develop priorities and schedule for restoring and enhancing spring chinook in these habitats. (4.3.1)
Construct surface collection system at the head of Green Peter Reservoir for transport of steelhead and other salmonids around the reservoir and dam on the Middle Fork Santiam River. (3.2.11.)
increase the number of chinook spawning in the Carmen-Smith spawning channel on the upper McKenzie River. (4.3.2.)
Transport adult spring chinook from the North Fork Ladder trap to underseeded habitat above North Fork Dam (e.g., Big Bottom). (4.3.3.)
Transport adult spring chinook above Fall Creek Dam to seed the spawning and rearing habitat. (4.3.7.)
Provide spring chinook access to production areas lost after the construction of Detroit Dam Work with the U.S. Army Corps of Engineers to. (4.3.8.)
Re-establish naturally produced spring chinook above Cougar Dam. (4.3.6.)
Evaluate effects of lack of spawning gravel below Cougar and Blue River dams on natural production of chinook in the McKenzie River. (2.2.5)
Continue habitat improvement and releases of hatchery chinook to reestablish naturally producing spring chinook in the Mohawk system. (4.3.10).
Release smolts in Abiqua Creek to provide a return of 100 adult spring chinook. (4.3.11.)
Release fingerling spring chinook, or excess hatchery-produced adult spring chinook into Little Fall Creek to increase natural production. (4.3.4.)
Continue to expand the distribution of Oregon chub by transferring individuals into new habitats as identified in the Oregon Chub Recovery Plan. (4.3.5)
Place surplus spring chinook adults, from South Santiam Hatchery, into the South Santiam River above Foster Reservoir to spawn naturally. (4.3.12)
Reintroduce bull trout into the Middle Fork Willamette Basin, Santiam Basin, and Clackamas Basin. (4.3.13.)

The Wildlife Diversity Program also calls out specific fish and wildlife needs in the Willamette Valley. Table 47 is a partial listing of those needs. The needs include better monitoring and inventory information and increased use of landowner incentives to manage for habitat improvements.

Table 47. Selected fish and wildlife needs in the Willamette Valley (ODFW Wildlife Diversity Program, 1994-1998 Actions)

Initiate and conduct Willamette Valley habitat inventory and complete GIS system.
Map and digitize acorn woodpecker localities and habitat in Willamette Valley for GIS tracking.
Develop incentives for managing/protecting acorn woodpecker habitat on private lands in Willamette Valley
Develop incentives for managing/protecting wetlands, oak woodlands, ash swales, grasslands and brushfields on private lands in Willamette Valley
Develop educational brochures for managing and protecting wetlands, oak woodlands, ash swales, grasslands and brushfields on private lands in Willamette Valley.
Develop incentives for managing/protecting sensitive grassland birds on private lands in Willamette Valley
Revisit a sample of red-legged frog historic localities in Willamette Valley and elsewhere in its range to describe current distribution, general abundance and general patterns of habitat use.
Determine distribution, abundance and population structure of painted turtle in Willamette Valley.
Develop management plan for painted turtle in the Willamette Basin.
Determine distribution, abundance and population structure of sharptail snake in Willamette Valley.
Develop protocol and conduct surveys for Willamette Valley grassland birds to locate nesting areas (horned lark, vesper sparrow, grasshopper sparrow, western meadowlark).
Develop list of known localities for 13 sensitive birds in Willamette Valley.
Measure and describe habitat at Camas pocket gopher sites in Willamette Valley.
Monitor marked western pond turtles at E.E. Wilson, Staley Creek, Coast Fork Willamette R., and Fern Ridge Reservoir.
Implement management plan for western pond turtle in the Willamette Basin.
Monitor population of black swift on Willamette National Forest.
Monitor number of purple martins colony sites and number of martins per colony in Willamette Valley and central coast estuaries.
Establish breeding populations of purple martin at Dorena, Cottage Grove, Lookout Point., Fall Creek, Rowena, and Fern Ridge Reservoirs.
Conduct coordinated shorebird counts in Willamette Valley 4 times per year as part of coordinated Pacific Flyway monitoring.
Monitor populations of western gray squirrel in Willamette Valley.
Develop and implement long-term monitoring strategy for black-tailed jackrabbit in Willamette Valley and training packet for volunteers.
Evaluate potential sites and establish additional populations of Oregon chub in native range of the Willamette River valley.
Develop volunteer monitoring programs for Willamette Valley Sensitive Species.
Work with state agencies and counties to synchronize Periodic Reviews within a Province or area beginning with Willamette Valley so habitat conservation is applied consistently.
Work with 1000 Friends of Oregon to promote wildlife habitat in Willamette Valley open-space areas.

Monitoring, Research and Evaluation Needs

Generally, the "MR&E" needs in the Willamette Subbasin involve improving the understanding of ecological systems and individual species, including habitat/productivity relationships; developing and evaluating alternative management systems; and improving the inventory of sensitive species by determining distribution, abundance and population structure. Additional research is needed in a number of areas, including the ecological function of lowlands (especially riparian areas in low elevation, low gradient streams), temperature modeling, and the effects of toxics in aquatic environments.

There is an especially critical need to develop more detailed and comprehensive inventories of passage barriers (especially with regard to road-stream crossings) based on common methodologies and shared through common data and mapping protocols.

The Oregon Department of Fish and Wildlife has identified critical research, monitoring, and evaluation needs in its draft Willamette River Basin Operational Plan, as shown in Table 48.

Table 48. ODFW critical research, monitoring, and evaluation needs (ODFW 2001, draft Willamette River Basin Operational Plan)

STRATEGY: Collect and analyze scientific information for use in decision-making.
ACTIVITY 1. Assess the status of freshwater and marine fish and wildlife populations and their habitats to assist in establishing Department priorities and programs and to improve our understanding of how populations are performing under the status quo. • Develop and implement protocols to measure and describe population traits of key indicator species…[incorporating] aerial photography, Geographic Information System data, limited ground surveys, habitat quality measurements, etc. ... • Describe species composition and relative abundance in key habitats. • Determine abundance, age-structure, population demographics, and taxonomy of key indicator species at the basin and subbasin scales • Describe distribution and relative abundance of juvenile life stages of key indicator species. • Describe current inventory and distribution of key fish and wildlife habitats using maps, field investigations, Geographic Information System data, aerial photography and "Landsat" satellite imagery. • Develop condition class rating system and describe the present condition class of key habitat types based on census routes within selected sub-samples of each habitat type and condition class.
Activity 2: Define and characterize limiting factors and factors for decline, including stresses that potentially influence fish and wildlife populations and their habitats, and interpret how the factors influence observed trends to improve our understanding of the relationships between fish and wildlife populations and landscape conditions. • Identify and describe factors, including environmental and human stresses, limiting survival and natural production of key indicator species (e.g. spring chinook in the Molalla River Basin) • Analyze relationships between factors and changes in abundance and other traits of key indicator individual species or species assemblages through time. • Evaluate losses (injuries and deaths) of juvenile fish resulting from operation of the Sullivan Plant (Portland General Electric). Refine operating criteria for the Sullivan Plant to reduce losses. • Evaluate effects of construction of temperature control structures in Cougar Reservoir on bull trout. • Evaluate effects of lack of spawning gravel below Cougar and Blue River dams on natural production of chinook in the McKenzie River. • Identify and determine the status of major prey species of key indicator species.

Table 48. ODFW critical research, monitoring, and evaluation needs (ODFW 2001, draft Willamette River Basin Operational Plan) continued.

ACTIVITY 3. Assess likelihood of meeting goals and objectives for fish and wildlife populations under current management actions based on our best understanding of limiting factors and factors for decline. • Develop parent-progeny estimates for key indicator species for as long a time series as possible. Analyze these estimates with regard full seeding of critical habitats. • Describe population dynamics and life history of key indicator species, including interactions with environmental factors. • Evaluate change in habitat quantity from present conditions into the future by establishing a network for information gathering that can be used to detect changes in wildlife habitat quantity.

ACTIVITY .4. Evaluate if and how current management programs can be improved to protect, mitigate and enhance fish and wildlife and their habitat.
• Characterize trends in abundance, age-structure, population demographics, etc of key indicator species at the basin scale, e.g. sampling at Willamette Falls.
• Characterize trends in abundance, age-structure, population demographics, etc. of key indicator species at the sub-basin scale, e.g. sampling at dams, spawning surveys, resting hole counts, etc.
• Characterize trends in habitat quality based on changes in condition class of key habitat types.
• Describe the relationships between trends in abundance, age-structure, population demographics, etc. of key indicator species, trends in quality of key habitats, and landscape conditions.
• Set priorities for protection, enhancement, mitigation, and restoration based on information such as the relationships between trends in abundance, age-structure, population demographics, etc. of key indicator species, trends in quality of key habitats, and landscape conditions.
• Design and implement monitoring and evaluation for specific management programs. Monitoring and evaluation will
  • Link information gathered with the program actions that affect change.
  • Identify key decision points or thresholds for defining changes in management programs (i.e., compliance monitoring: Were program actions implemented as intended?)
  • Define mechanisms for identifying new priorities and components for monitoring and evaluation (Identification of important stressors).
  • Enable public involvement, and be transparent and accountable.
  • Identify opportunities for cooperative monitoring programs and/or program development by other groups.
  • Identify roles and responsibilities for those involved in monitoring and evaluation.
• Use available information and analyses to evaluate the effectiveness of and, if appropriate, identify changes to current management programs to protect, mitigate and enhance fish and wildlife and their habitat (adaptive or experimental management).
• Help state and federal land management agencies design programs to monitor the success and effectiveness of stream riparian and water quality protection measures.

ACTIVITY 5. Develop or refine coordinated information system to store and access information for use in research, monitoring and evaluation.
Develop standard protocols for collecting and reporting data.

The Oregon Plan for Salmon and Watersheds has also identified key monitoring and evaluation needs. First, Oregon needs to develop a comprehensive restoration strategy. While restoration planning and prioritization generally occurs at the local level, larger-scale planning efforts are necessary to guide restoration investments towards actions that are most likely to produce the greatest gains in watershed health and species recovery. Second, Oregon needs to develop a comprehensive program for monitoring restoration effectiveness. Again, restoration effectiveness monitoring tends to occur at the local, or site-specific, level. Local monitoring efforts need to be coordinated with a larger-scale

restoration effectiveness monitoring approach to determine if restoration investments are producing the intended benefits in watershed health and species recovery across the landscape. (OWEB 1999)

Institutional Needs

Species declines will not be effectively addressed nor habitat protection assured unless a number of institutional needs are met, including:

- Improving habitat on private lands, consistent with their inherent objectives to produce revenue. This, in turn, entails needs to:
  - * expand and improve voluntary incentives programs, and,
  - * increase the capacity of local groups (especially watershed councils and districts) and agencies to market and help implement incentives programs.
- Improve coordination among all those working to manage Willamette subbasin habitats at site, watershed, subbasin, and regional scales by promoting frequent communication among landowners, local governments, watershed groups, agencies, and non-governmental organizations.
- Promote more strategic targeting of restoration investments throughout all scales of management by increasing consultation among.
- Promote improved regulatory coordination especially with regard to the federal Endangered Species and Clean Water Acts.

A number of institutional issues were identified in the development of this Summary and are highlighted in Appendix F.

Needs Resulting From Operation of Willamette Basin Project Dams

As described in previously, especially under Limiting Factors Specific to Hydropower Generation, the operation of Willamette Basin Project dams supporting the Federal Columbia River Power System (FCRPS) has had profound impacts, both direct and indirect, on:

- Habitat:
  - Floodplain and wetland losses
  - Blockage of anadromous and migratory resident fish habitat
  - Inundation of critical fish and wildlife habitat
- Streamflow
- Temperature
- Downstream erosion

These impacts extend well beyond the site-level and have significant subbasin-wide ramifications. Mitigation for some of these impacts is currently being required under the Reasonable and Prudent Alternative of the FCRPS Biological Opinion and through the Basinwide Salmon Strategy (see Salmon Recovery under Existing Goals, Objectives, and Strategies Section).

Priority mitigation needs in the Willamette Subbasin identified in these efforts are described below. Additional and more detailed priorities will result from the in-progress biological opinion on the Willamette Basin Project.

Draft Endangered Species Act Implementation Plan
The Draft Endangered Species Act Implementation Plan is being developed pursuant to the biological opinion on the Federal Columbia River Power System. It is described in more detail under Salmon Recovery in the Existing Management Section of this Summary. Willamette subbasin priorities are shown in Table 49

.Basinwide Salmon Recovery Strategy
For tributary habitats on non-federal lands, the federal agencies propose a "fast start" approach that will first fund action with immediate benefits, including:

- Removing passage barriers
- Screening diversions
- Purchasing in-stream flow rights,
- Restoring water quality, and
- protecting high-quality habitat through conservation easements or land purchase. (Federal Caucus, Conservation of Columbia Basin Fish, Volume 1, December 2000)

For non-federal lands, federal agencies have identified 16 priority subbasins, including:

For Lower Columbia Chinook, Steelhead and Chum ESU stocks:

- the Willamette-Clackamas subbasins

For Upper Willamette Chinook and Steelhead ESU stocks:

- Clackamas subbasin
- North Santiam subbasin
- McKenzie subbasin (Federal Caucus, Conservation of Columbia Basin Fish, Volume 2, December 2000)

Table 49. Willamette Subbasin priorities of the Draft Endangered Species Act Implementation Plan of the Federal Columbia River Power System

Priority Subbasin Enhancement Projects for 4 Priority Subbasins	
Project Area and ID #	**FCRPS Project Description**
Lower-Willamette-Clackamas (#328-330)	Preliminary needs assessment of fish screen, barrier modification, and streamflow opportunities. Initiate NEPA and Consultation. (Habitat - Lower Columbia WILLAMETTE)
Clackamas (#313-315)	Organization and program initiation. Coordinate with NPPC rolling provincial review; evaluate potential actions; coordinate among local, State, and Federal agencies. Implement actions related to fish screens, barrier modifications, and streamflow. (Habitat - Lower Columbia WILLAMETTE)
McKenzie (#298-300) N. Fork Santiam (#316-318)	Continue implementation of multi- year improvements: physically modify instream barriers to permit passage; screen diversions to meet current criteria; purchase available water up to 100% of recommended flow targets. (Habitat - Lower Columbia WILLAMETTE)
Other Priorities	
Project ID #	**FCRPS Project Title/Description/Biological Rationale** (H Sector – Province SUBBASIN)
346	*Enhance flows in the Willamette River and below Bonneville Dam during critical periods:* Enhance flows below Bonneville Dam during critical periods. Provides more consistent water levels required for spawning, rearing, passage, etc. (Habitat - Lower Columbia WILLAMETTE)
348	*Establish a set of sampling reaches that characterize the Columbia, Snake, and Willamette rivers*: Establish a comprehensive set of sampling reaches that characterize the Columbia and Snake rivers. It is essential to establish baseline data, monitor progress, and maintain improvements if salmon recovery goals are to be met. (Habitat - Lower Columbia WILLAMETTE)
270	*Address Passage, Screening and Flow Problems in NMFS identified high priority subbasins*: Fund and manage projects to address passage problems. Improves passage for adults and juveniles. Restores access to blocked habitats. Enhances survival by blocking juveniles from entering irrigation systems. (Habitat - Systemwide COLUMBIA BASIN SYSTEMWIDE)

For tributary habitats on federal land, the federal land managers will protect existing high quality habitat and accelerate restoration in high priority subbasins. (Federal Caucus, Conservation of Columbia Basin Fish, Volume 1, December 2000) For federal lands, the federal agencies have chosen 7 highest priority subbasins for anadromous fish habitat restoration, including one in the Willamette:

- McKenzie subbasin (Federal Caucus, Conservation of Columbia Basin Fish, Volume 2, December 2000)

Furthermore, federal agencies have identified the Willamette River below the Corps dams as one of three critical stream reaches in the Columbia Basin for improving mainstem spawning and rearing habitat. Three sites will be chosen for monitoring (one below Eugene, one below Salem, and one above Multnomah Channel). Habitat improvement objectives, to be achieved in cooperation with state and local governments, will be to:

- create and enhance alcoves, sloughs, marshes, and other shallow water habitats;
- improve water level management;
- acquire/protect shoreline corridors;
- reduce fertilizer use; and
- improve flow management to enhance productivity of wooded wetlands. (Federal Caucus, Conservation of Columbia Basin Fish, Volume 2, December 2000)

The Bureau of Reclamation (BOR) is undertaking one of the largest actions identified in the Columbia River Biological Opinion relating to offsite mitigation, including elimination of fish passage barriers. BOR is targeting three priority subbasins per year (see schedule below). BOR currently lacks construction authority and will therefore need to work with Congress and the state to get it.

- '02 Lemhi, Methow, Upper and Middle John Day
- '03 Upper Salmon, **McKenzie**, Entiat
- '04 Middle Fork Clearwater, NF John Day, Wenatchee
- '05 **N. Santiam,** Cowlitz, **Clackamas**
- '06 Lewis, **Lower Willamette,** Little Salmon [emphasis added]

In addition, the National Marine Fisheries Service has issued guidance for how the needs of threatened salmonid populations may be met in tributary subbasin through the Council's Fish and Wildlife Program. (NMFS 2001) In summary, the guidance asserts it is critical to emphasize the need for ecological context in habitat initiatives and to look for opportunities to produce biological benefits in the short term. Pending completion of sub-basin plans, the Reasonable and Prudent Alternative (RPA) in the biological opinion on the Federal Columbia River Power System includes a series of actions to address tributary habitat issues. NMFS encourages the provincial review process to help implement the RPA by addressing the particular actions listed in the alternative (displayed in relation to the Willamette subbasin in Table 50).

Table 50. NMFS Guidance to the Northwest Power Planning Council in selecting projects solicited through the provincial review process in relation to Willamette Subbasin (actions are those specified in the Biological Opinion on the Federal Columbia River Power System)

Action 149: Identify actions that would lead to a three-year plan for funding projects that complement the evolving BOR program to improve stream flows and address passage and screening problems.
Action 150: Identify opportunities to protect currently productive non-federal habitat at risk of degradation according to the criteria contained in the NMFS crediting paper (or joint NMFS/BPA criteria) as appropriate.
Action 151: Encourage projects that could use transactional approaches to increase stream flows.
Action 152: Prioritize projects ready for implementation based on local agreements that can jointly satisfy CWA and ESA requirements as defined under this RPA item.
Action 153: Encourage opportunities to leverage agricultural incentive programs to protect streamside habitat.

NMFS also encourages the provincial review to consider actions beyond any addressed by the biological opinion. In selecting such projects, NMFS suggests that priority be given to proposals that:

- are based on at least a watershed assessment, and that identify and provide rationale for measurable benefits to specific salmonid life stages in a spatially explicit manner;
- protect and restore land and water habitat in ways that permanently address underlying ecosystem processes, reconnect isolated habitats or improve connections between habitats; and
- include, as appropriate, monitoring and evaluation consistent with the principles outlined in section 9.6.5.3 of the biological opinion and Research, Monitoring and Evaluation RPA Actions 183 and 184.

Subbasin Opportunities for Most Effectively Meeting Fish and Wildlife Needs

The following efforts represent an "opportunity series" of needs identified by recent subbasin-level analyses. These opportunities both provide a context for and should inform the implementation of actions to mitigate fish and wildlife habitat hydropower losses. They represent the latest, spatially explicit thinking about where restoration efforts are likely to produce the "biggest bang for the buck." Some result from collective exercises in best professional judgement; others from rigorous scientific investigation. Taken as a whole, these frameworks hold great promise for mapping the critical path for restoration in the future.

Conservation Conclusions and Recommendations of the Pacific Northwest Ecosystem Research Consortium

The Pacific Northwest Ecosystem Research Consortium (ERC) is a collaboration of regional research programs (including those at the Center for Analysis and Environmental Change, U.S. Forest Service, Oregon State University, University of Oregon, and University of Washington) and U.S. Environmental Protection Agency scientists. It was established to create a core research program and conceptual framework for ecosystem management research in the Pacific Northwest.

The habitat conservation and restoration opportunities map is based on the conservation scenario and reflects ERC discussions with habitat experts and stakeholders. (The future scenarios are described in Joint Cooperative Activities under the Research, Monitoring and Evaluation section of this Summary.) The habitat experts used their best professional judgment to estimate the amount of habitat needed to support self-sustaining populations of certain species. The ERC tested how those estimates fit into the landscape, considering habitat connectivity, natural resource values, and likely urban expansion areas. Stakeholders then suggested changes, based on their sense of what was realistic to expect over a 50-year period.

With active conservation efforts, the ERC work suggests that by 2050, key species would be self-sustaining with roughly an additional 35,000 acres of bottomland forest; 33,000 acres of prairie; 7,000 acres of wetlands; and 33,000 acres of riparian area.

Thus, the Habitat Conservation and Restoration Opportunities map (Figure 9) provides a "first approximation" of areas in the Willamette Basin where native habitat can

be most effectively protected or restored through the year 2050. The map shows both existing habitat that should be conserved and areas where current land uses might be managed to re-establish habitat. Although the map reflects the dominance of opportunities on public lands (especially in the Cascade Mountains and foothills of the eastern basin), it also shows there are opportunities in the lower-elevation lands in the valley floor.

The ERC has developed the recommendations in Table 51 for ecosystem restoration in the Willamette Subbasin--if Oregonians first "choose to enhance protection and restoration of natural resources and biodiversity in the Willamette Basin". (These recommendations will be included in the Willamette River Basin Planning Atlas, Version 2.0, expected to be published in 2002 by Oregon State University Press).

Table 51. Ecosystem restoration recommendations of the Pacific Northwest Ecosystem Research Consortium

Balanced Efforts in Uplands and Lowlands: Efforts will be required across the entire landscape and in all environmental settings. To date, policies and projects have focused disproportionately on upland, forested systems. Because upland and lowland portions of the Basin support distinctly different types of habitats and species, a balanced effort in both areas will be required.
Urban and Rural Residential Expansion. Use available information on basin-wide and local patterns of terrestrial and aquatic native species richness to tailor comprehensive land use plans to minimize urban and rural development in areas with high ecosystem and resource value.
Riparian Buffers in Lowlands. Establish riparian buffers along lowland streams and rivers in agricultural and urban settings. Riparian areas play a disproportionately large role in stream habitat quality and are thus a cost-effective means to enhance both aquatic and terrestrial wildlife in all types of environmental settings.
Rivers and Their Floodplains. Natural flow regimes, periodic flooding, complex channels, and fairly wide buffer widths are required to create the habitat features and dynamics that make riparian areas especially productive and biologically diverse portions of the landscape. Thus, in regulated rivers, manage reservoirs to achieve more natural flow regimes.
Water Availability and Use.. Future changes in crop types are likely to lead to increased water withdrawals for irrigation with subsequent adverse effects on in-stream flows in some locations. Explore ways for voluntarily-retired water rights to convert to in-stream water rights while maintaining their original priority date.
Terrestrial Wildlife: Habitat-based maps of species richness can identify areas where changes in land use/land cover are likely to have the greatest effect on wildlife biodiversity. In addition to the amount of habitat available for a species, the distribution of habitat on the landscape can be a major factor in determining wildlife abundance and viability. To protect wildlife species, consideration should be given to: • Congregating habitat degradation activities rather than dispersing across the entire landscape. • Avoiding surrounding high quality habitats with very poor habitats. It is preferable to place high quality habitat within reach of other good sites, and likewise to cluster poor quality habitats. • Designing habitat to support the spread of individuals from good habitat to good habitat, and avoid movements from good to poor habitat. • Avoiding barriers to movement that separate good habitats.
Natural Processes and Dynamics. Restoring natural processes and dynamics is generally more ecologically and economically effective, over the long term, than attempting to create desirable habitat features by construction, direct manipulation, or other engineering solutions.

[Source: http://www.fsl.orst.edu/pnwerc/wrb/atlas/conclusions.pdf]

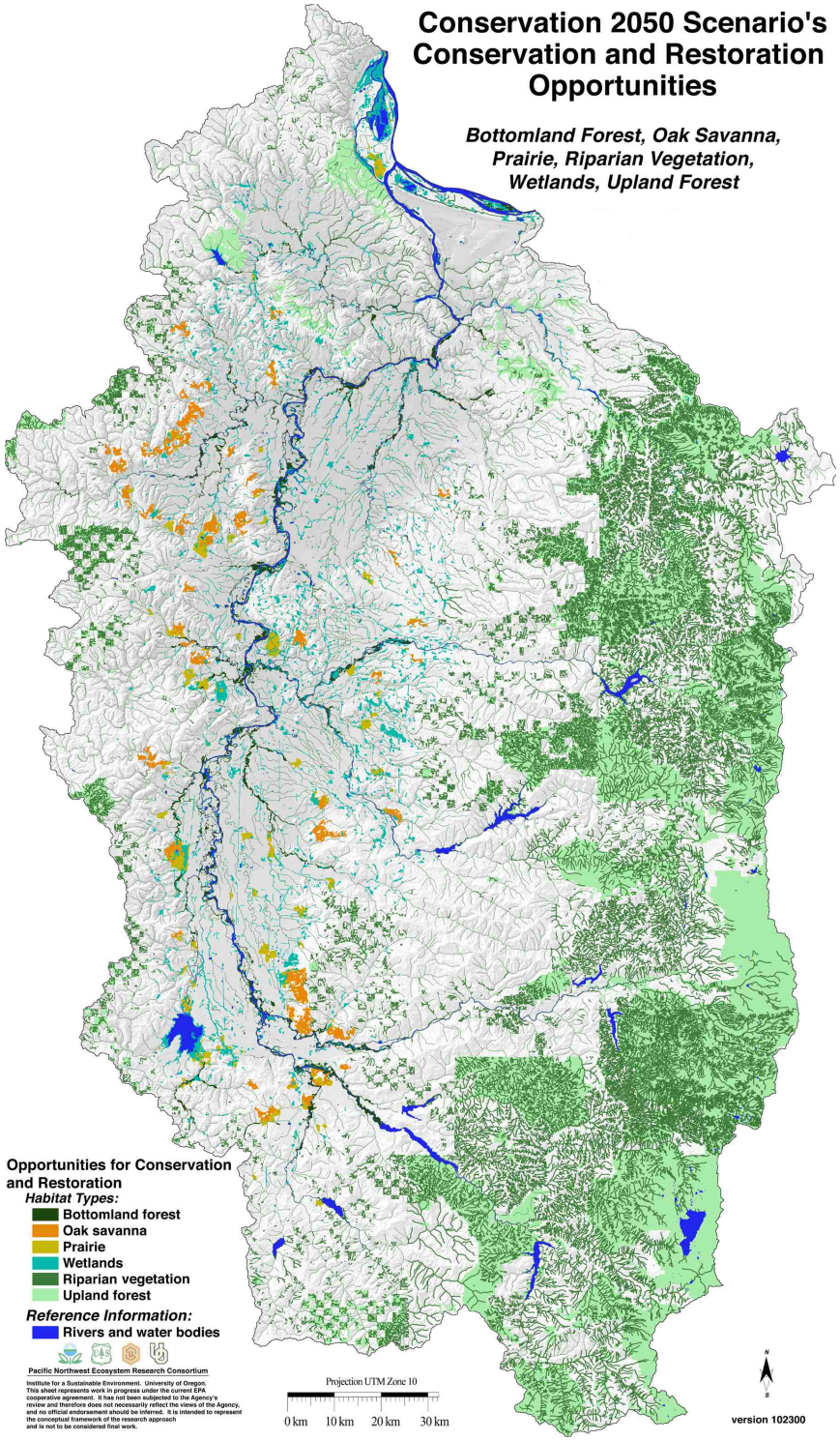


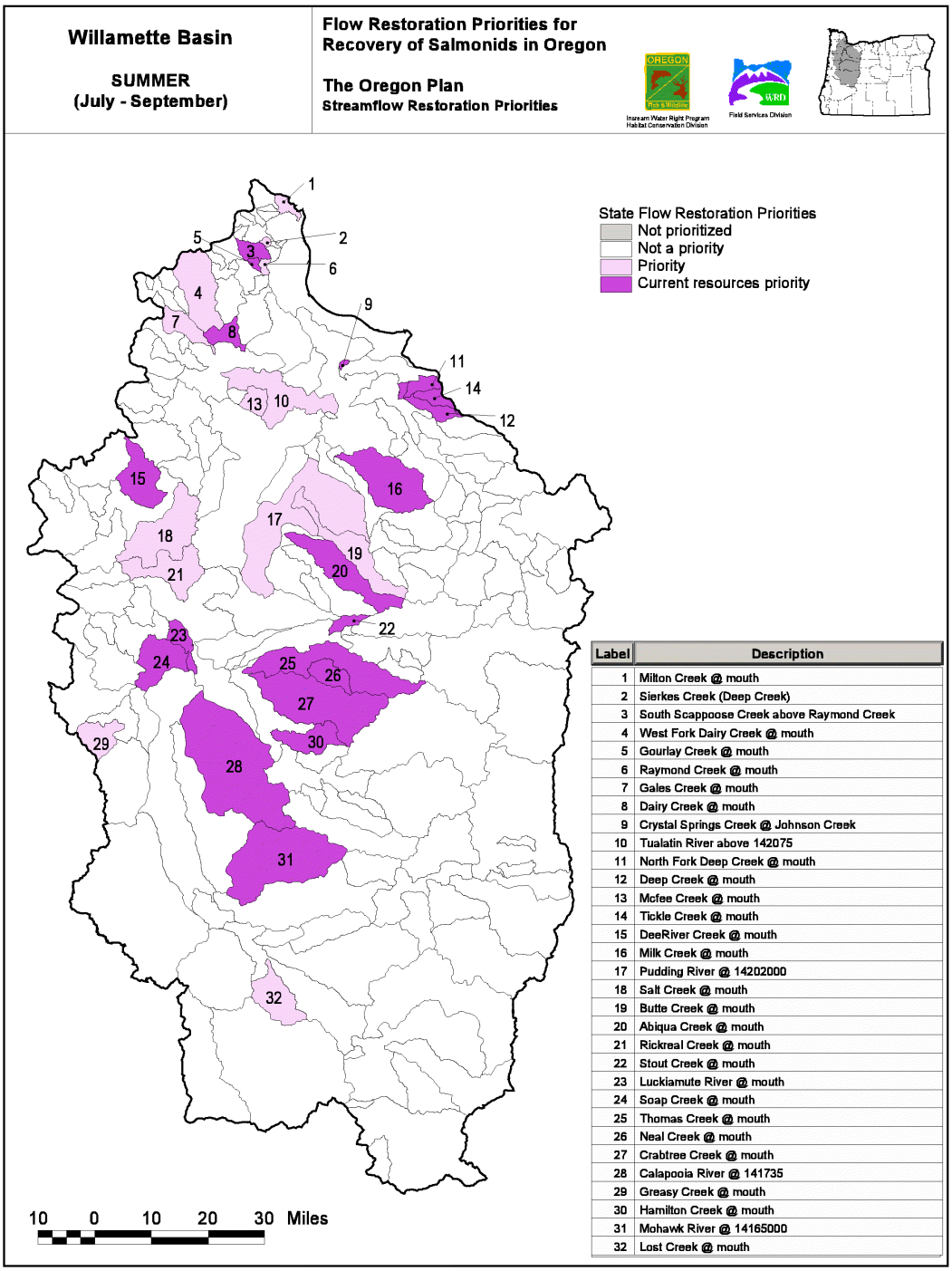
Figure 9. Habitat conservation and restoration opportunities (Pacific Northwest Ecosystem Consortium)

Streamflow Restoration Priorities

As previously described under Existing Goals, Objectives, and Strategies, the State of Oregon has identified streamflow restoration priorities for the Willamette Basin. These are categorized by the extent to which existing resources are sufficient for management and shown below in Table 52 and Figure 10

Table 52. Priority watersheds for streamflow restoration identified by the State of Oregon

Sufficient Resources For Management	Insufficient Resources For Management
Abiqua Creek, trib. to Pudding River	Butte Creek, trib. to Pudding River
Calapooia River, trib. to Willamette River	Gales Creek, trib. to Tualatin River
Crabtree Creek, trib. to South Santiam River	Greasy Creek, trib. to Marys River
Crystal Springs Creek, trib. to Johnson Creek	Lost Creek, trib. to Mid. Frk. Willamette R.
Dairy Creek, trib. to Tualatin River	McFee Creek, trib. to Tualatin River
Deep Creek, trib. to Clackamas River	Milton Creek, trib. to Columbia River
Deer Creek, trib. to South Yamhill River	Mohawk River, trib. to McKenzie River
Gourlay Creek, trib. to South Scappoose Cr.	Pudding River, trib. to Molalla River
Hamilton Creek, trib. to South Santiam River	Raymond Creek, trib. to South Scappoose Cr.
Luckiamute River, trib. to Willamette River	Rickreal Creek, trib. to Willamette River
Milk Creek, trib. to Molalla River	Salt Creek, trib. to South Yamhill River
North Fork Deep Creek, trib. to Deep Creek	Sierkes Creek, trib. to North Scappose Creek
Neal Creek, trib. to Thomas	Soap Creek, trib. to Luckiamute River
South Scappoose Creek, trib. to Scappose Cr.	Tualatin River, trib. to Willamette River
Stout Creek, trib. to North Santiam River	West Fork Dairy Creek, trib. to Dairy Creek
Thomas Creek, trib. to South Santiam River	
Tickle Creek, trib. to Deep Creek	



Label	Description
1	Milton Creek @ mouth
2	Sierkes Creek (Deep Creek)
3	South Scappoose Creek above Raymond Creek
4	West Fork Dairy Creek @ mouth
5	Gourlay Creek @ mouth
6	Raymond Creek @ mouth
7	Gales Creek @ mouth
8	Dairy Creek @ mouth
9	Crystal Springs Creek @ Johnson Creek
10	Tualatin River above 142075
11	North Fork Deep Creek @ mouth
12	Deep Creek @ mouth
13	Mcfee Creek @ mouth
14	Tickle Creek @ mouth
15	DeeRiver Creek @ mouth
16	Milk Creek @ mouth
17	Pudding River @ 14202000
18	Salt Creek @ mouth
19	Butte Creek @ mouth
20	Abiqua Creek @ mouth
21	Rickreal Creek @ mouth
22	Stout Creek @ mouth
23	Luckiamute River @ mouth
24	Soap Creek @ mouth
25	Thomas Creek @ mouth
26	Neal Creek @ mouth
27	Crabtree Creek @ mouth
28	Calapooia River @ 141735
29	Greasy Creek @ mouth
30	Hamilton Creek @ mouth
31	Mohawk River @ 14165000
32	Lost Creek @ mouth

Figure 10 . Streamflow restoration priorities of the State of Oregon

Oregon Biodiversity Project

The Oregon Biodiversity Project, a collaborative effort to develop a statewide strategy to conserve Oregon's natural biological diversity, conducted statewide and ecoregional assessments of conservation needs and opportunities (Oregon Biodiversity Project 1998). It identified 42 "conservation opportunity areas" selected for their potential to address ecoregional and statewide conservation priorities. Particular attention was paid to large blocks of native habitat, habitats showing major declines from historic levels, vegetation types not well-represented in Oregon's current conservation network, at-risk species, and the potential to complement the existing conservation network.

In the Willamette Valley ecoregion, three habitat types—oak savannas and woodlands, wetlands, and bottomland hardwood forests—are conservation priorities. Once-abundant native prairie grasslands are also a conservation priority, but have been reduced to the point where they are currently undetectable in regional mapping. The project identified five conservation opportunity areas described in Table 53.

Table 53. Willamette Valley conservation opportunity areas identified by Oregon Biodiversity Project

1. Willamette River floodplain: Restoration in the historic floodplain would reduce flood hazards and improve water quality, and at the same time, address some of the ecoregion's highest biodiversity conservation priorities — reestablishing the connection between the river and its floodplain, and restoring wetlands and riparian forests.
2. West Eugene wetlands area: The remaining fragments of native habitats in this urbanized area support the greatest concentration of native prairie remnants and associated at-risk species in the Willamette Valley.
3. Muddy Creek area: This area southwest of Corvallis contains some of the best Oregon ash-Oregon white oak forest remaining in the valley, as well as good quality bottomland prairie remnants. Restoration opportunities exist for riparian forests, oak-conifer woodlands, and limited amounts of native wet prairie.
4. North Corvallis area: The area includes habitat for many Willamette Valley endemic plants; excellent examples of oak woodlands, conifer forests, and bottomland wetlands; and some of the best populations of Fender's blue butterfly.
5. Columbia River bottomlands: This area at the mouth of the Willamette supports a stunning diversity of wildlife. With more than 14,000 acres in state and local wildlife areas and natural areas, these bottomlands offer opportunities to restore and manage wetlands and other floodplain habitats on a scale not easily achieved elsewhere in the ecoregion.

*Oregon's Living Landscape*s, Oregon Biodiversity Project 1998

Oregon Wetland Joint Venture (OWJV) Priorities:

In its draft Willamette Valley Focus Area Plan, OWJV, a statewide organization formed to promote wetlands protection, has identified 15 target areas for voluntary wetland conservation and restoration. (Table 54)

The target areas provide important wintering and migrating habitat for waterfowl, neotropical migrants and shorebirds. Many areas also provide habitat for listed species and other species whose numbers are declining such as western pond turtles and red-legged frogs. The mainstem Willamette and the confluence areas provide essential habitat for spring Chinook and steelhead trout.

The plan, which is intended to be an evolving and adaptive document, incorporates habitat goals from companion initiatives such as Partners in Flight, national shorebird and colonial waterbird plans, Pacific Flyway plants, recovery plans for listed species and others working throughout the basin have been incorporated in defining the target areas. The goals are:

1. Over the next 20-years, ensure long-term protection for at least 75,000 acres. Use conservation easements, cooperative agreements, and partnerships or acquisition from willing landowners.
2. Restore 78,500 acres of wetlands and 200 miles of riparian habitat using partnerships with willing landowners, agencies and groups.
3. Ensure all protection and restoration areas are managed to maintain a diversity of wetland and riparian habitats by designing protects to meet a variety of habitat goals, controlling exotic species and establishment of a long-term monitoring and maintenance schedule.

Table 54. Wetland habitat objectives (in acres) for target areas in the Willamette Valley identified by Oregon Wetlands Joint Venture

Target Areas	Protect	Restore
Willamette Forks	2,000	3,000
West Eugene-Long Tom	2,500	4,000
McKenzie Confluence	3,000	3,000
Mid-Willamette Floodplain	30,000	30,000
Coburg Flats	2,000	2,000
Muddy Creek	1,000	1,000
Marys River	1,500	1,500
Calapooia River	2,000	2,000
Buena Vista	3,500	4,500
North Santiam Flats	2,500	2,500
Baskett Slough	2,500	2,500
South Yamhill	5,000	5,000
Lake Labish-Pudding River	1,000	1,000
Mission-Champoeg Bottoms	10,000	10,000
Tualatin Basin	6,000	6,000
Total	**74,500**	**78,000**

Other Areas of Interest:

- Clackamas River – Clear Creek Confluence and Lake Pidgeon, from RM 15-20
- Willamette Narrows
- Jackson Frazier Wetlands and Creeks
- Molalla River State Park
- Oak Creek, southeast of Lebanon in Linn County
- Little Muddy Creek in Linn County

Forest Legacy

The Forest Legacy Program is a federal effort that works in partnership with states, similar to other U.S. Forest Service Cooperative Forestry programs. (Oregon Department of Forestry 2001). FLP supports state efforts to protect privately-owned, environmentally sensitive forest lands through voluntary stewardship and long-term sustainable management. Oregon's Forest Legacy Program will help willing landowners protect forest resources while retaining ownership and facilitate long-term resource management partnerships between local, state and federal governments.

Oregon's Forest Legacy Program addresses privately owned forest lands currently under greatest threat of urbanization and other conversion pressures. In a preliminary analysis of need, the Program has targeted potential Legacy Areas, based on locations of private forest lands as well as ecoregional and county boundaries.

Eleven Legacy Areas have been identified for the Willamette Valley--the only ecoregion needing to be evaluated in its entirety, since it is the only ecoregion which has forests throughout, and which is almost entirely privately owned. For the most part, the forests that remain undeveloped are foothill margin and valley hill Oregon oak and mixed conifer forests. Also, sufficient areas of floodplain forests remain along the Willamette River in Lane, Benton and Linn Counties that this valley bottomland was included and grouped as the Southern Willamette River Riparian area. Additionally, the western and eastern foothill woodlands and forests in Lane County were split, since each contains important biological and natural features, and large acreages of remaining forests. (Figure 11).

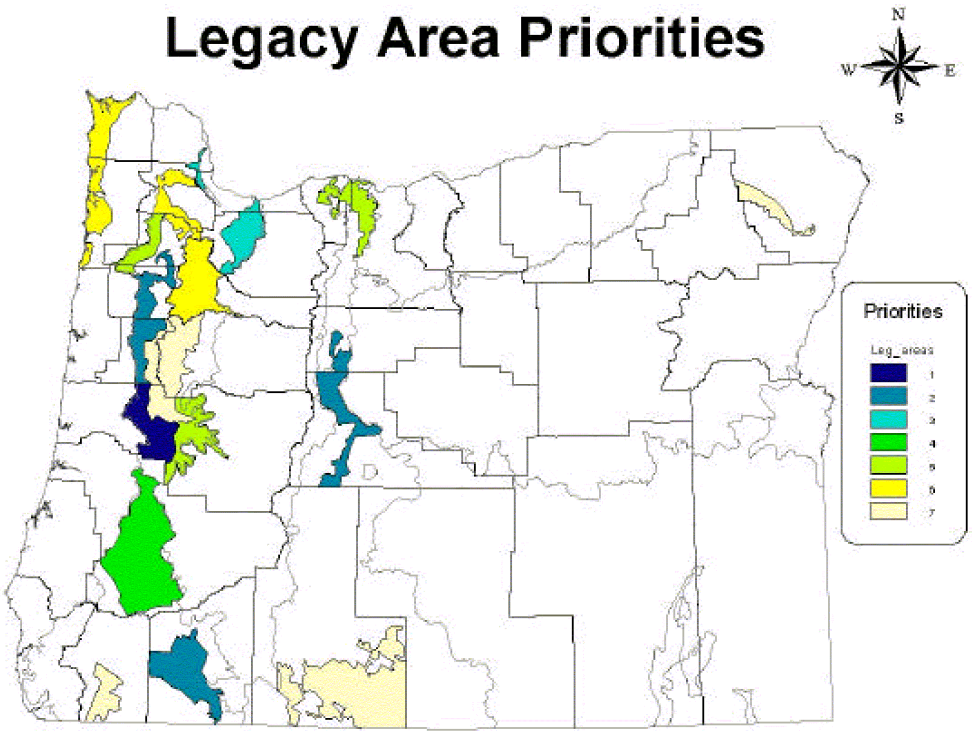


Figure 11. Forest Legacy Program draft priorities

Willamette Subbasin Recommendations

Projects and Budgets

The following subbasin proposals were reviewed by the Lower Columbia and Estuary Province Budget Work Group and are recommended for Bonneville Power Administration project funding for the next three years.

Continuation of Ongoing Projects

Project: 199107800 - Burlington Bottoms Wildlife Mitigation Project

Sponsor: Oregon Department of Fish and Wildlife (ODFW)

Short Description:

This project protects, maintains and enhances a diverse array of wetland habitats for many species of fish and wildlife including the state listed western painted and pond turtles and ESA species including bald eagles and salmon.

Abbreviated Abstract

The Burlington Bottoms mitigation site includes a diverse array of fish and wildlife habitats, including areas of old growth ash bottomlands considered rare along the lower Willamette and Columbia Rivers. In order to protect, maintain and enhance these habitats for the long-term, a five-year habitat management plan has been implemented (starting in 2001) which identifies objectives, tasks, methods, and monitoring and evaluation needed to meet the overall goals and objectives of the site. Objectives include the restoration of native plant communities, using various methods such as moist soil management. Working with various partners including the U.S. Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), Ducks Unlimited (DU), and private individuals, management activities in the next several years will include restoring historic hydrologic flows to the site to the extent possible in order to maintain and enhance the biological diversity of the native flora and fauna.

The expected outcome of the project would be the protection, maintenance and enhancement of fish and wildlife habitat on the site, while also maintaining and increasing associated habitat values for the target and other wildlife species. The 1,319 Habitat Units (HUs) generated by the 1993 HEP would be protected and maintained, while an additional estimated 105+HUs would also be provided through enhancement activities through 2005.

The project goals and objectives identified for this site are consistent with and meet the needs addressed in the Willamette and Lower Columbia River and Columbia River Estuary Subbasin Summaries. Habitat loss and modification, impacts of human activities and growth, and biological integrity were three of the seven priority issues identified as related to the health of the rivers, and which are some of the many needs addressed in this project proposal.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199705900	Securing Wildlife Mitigation Projects-Oregon	Proposal calls for enhancement and management of similar wetland habitats statewide.
199705908	Securing Wildlife Mitigation Sites-Oregon, Multnomah Channel	Adjacent project involving enhancement of similar wildlife habitats, involving coordination of management activities, sharing of information, etc. contributes to mitigation requirements for Willamette Basin.
199705906	Securing Wildlife Mitigation Projects-McKenzie River Islands	Acquisition and enhancement of similar wildlife habitats. Contributes to mitigation requirements for Willamette Basin
199205900	Amazon Basin/Eugene Wetlands, Phase III	Enhancement of similar wildlife habitats, including rare Willamette Valley prairies. Contributes to mitigation requirements for Willamette Basin.
199705916	Securing Wildlife Mitigation Projects, Tualatin River National Wildlife Refuge	Enhancement of similar wildlife habitats. Contributes to mitigation requirements for Willamette Basin.

Budget

FY2003	FY2004	FY2005
Rec: $110,000 Category: High Priority	Rec: $97,540 Category: High Priority	Rec: $100,445 Category: High Priority

Project: 199205900 - Amazon Basin/Eugene Wetlands Phase Two

Sponsor: The Nature Conservancy (TNC)

Short Description:

Continue the restoration and enhancement of existing mitigation lands. Habitats being protected or restored include riparian zones of seasonal streams, wet prairie, upland prairie, forested wetland, oak woodland, and dry coniferous forest.

Abbreviated Abstract

The Nature Conservancy proposes to continue restoration and enhancement activities on the 429-acre Willow Creek Natural Area. These actions will help to mitigate the habitat losses as outlined in the Northwest Planning Council's 1994 Fish and Wildlife Program.

For FY 2003 we propose to continue restoring native wet prairie, enhance oak woodland, reduce non-native species abundance, and apply data from hydrologic monitoring to improve aquatic habitat conditions.

The results of ongoing habitat management will be monitored though vegetation sampling, permanent photo plots, and use of air photos and maps. Quantitative data will be

reported for particular wildlife species under observation or study, and observations related to target species or other noteworthy wildlife species will also be reported.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
9206800	Implementation of Willamette Basin Mitigation Program - Wildlife	Umbrella project
9705900	Securing Wildlife Mitigation sites - Oregon	Umbrella project

Budget

FY2003	FY2004	FY2005
Rec: $60,650 Category: High Priority	Rec: $322,500 Category: High Priority	Rec: $324,600 Category: High Priority

Project: 199206800 - Implement Willamette Basin Mitigation Program

Sponsor: Oregon Department of Fish and Wildlife (ODFW)

Short Description:

Mitigate for impacts caused by hydro-electric facilities through enhancements, easements, acquisitions, restoration, and management of wetlands and other NWPPC target habitat types and species in the Willamette Basin in Oregon.

Abbreviated Abstract

The goal of the Willamette Basin Mitigation Program is to cooperatively develop and implement measures to mitigate for fish and wildlife habitat losses resulting from the construction of the federally licensed hydro-electric dams and facilities. While implementing easements, acquisitions, management plans, and enhancement activities designed to achieve the Council's mitigation goals for target species and habitats maintain and improve water quality and quantity, habitat connectivity, integrity and functionality, biodiversity and overall ecosystem health. Coordination with and sponsoring the U.S. Army Corps of Engineers on the Willamette Basin Ecosystem Restoration Feasibility Study General Investigation will ensure a coordinated approach to restoration and mitigation activities and joint compliance with NEPA, RPAs and ESA undertaken by BPA, the State of Oregon and the USACOE. Through the use of Restoration Ecology, Conservation Biology, Landscape Ecology and passive restoration techniques implement approximately 2-3 mitigation projects with the expected minimum gain of 200 - 300 Habitat Units (HUs) each year. Habitat gains will be applied to each of the hydroelectric facilities based upon habitat type and location. Baseline, actual, and future HUs will be calculated through the use of Habitat Evaluation Procedures (HEP) field sampling, GIS data collection and analysis, and other Monitoring and Evaluation techniques endorsed by the Council, BPA, and CBFWA's Wildlife Working Group. Information, findings, and new techniques about

the Program will be provided by-way-of reports, presentations, digital data and maps, papers, and the Internet.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199506500	Assessing Oregon Trust Agreement Using GAP Analysis	A mitigation planning tool used to analyze and rank potential mitigation projects within the basin
199208400	Oregon Trust Agreement Planning Project	A mitigation planning tool that includes methods for assembling a trust agreement and a list of potential mitigation projects
199107800	Burlington Bottoms Wildlife Mitigation Project	First mitigation site in Willamette basin Implementation, surveys and equipment shared
199205900	Amazon Basin/Eugene Wetlands	Second mitigation site in Willamette basin Implementation, surveys, information, and knowledge shared
200008800	Assess McKenzie Watershed Habitat and Prioritize Projects	Information gathered is shared between projects. Implementation of prioritized needs is implemented in part through the Willamette Program
199607000	McKenzie River Focus Watershed Coordination	Provides coordination, assessment, documentation, and collaboration in McKenzie watershed of project area
199405300	Bull Trout Assessment-Willamette/McKenzie	Baseline data for bull trout which will be applied to acquisition and enhancement actions in McKenzie and upper Willamette systems

Review Comments

A new objective has been included in this proposal.

Budget

FY2003	FY2004	FY2005
Rec: $1,567,500 Category: High Priority	Rec: $1,589,600 Category: High Priority	Rec: $1,673,800 Category: High Priority

Project: 199405300 - Middle Fork Willamette River Bull Trout Re-introduction and Basinwide Monitoring

Sponsor: Oregon Department of Fish and Wildlife (ODFW)

Short Description:

Evaluate protocols for the re-introduction of bull trout into historic habitats in the upper Willamette River subbasin, and employ methods to monitor and evaluate the status and trends of bull trout populations in the Lower Columbia Province.

Abbreviated Abstract

The goal of the project is to provide credible scientific information to the protection and recovery efforts for threatened stocks of bull trout in the Columbia River Basins. Responding to needs identified in the NWPPC Fish and Wildlife Program and Willamette Subbasin summary, the USFWS Bull Trout Recovery Plans and Biological Opinion, and the Oregon Plan for Salmon and Watersheds we propose 1) an experiment to test methods for the reintroduction of bull trout into historic habitats, and 2) a Tier 2 monitoring effort designed to supplement the ODFW statewide bull trout monitoring program. Many of the USFWS recovery plans for the Oregon bull trout recovery units include re-introduction as a significant restoration strategy, however, information regarding effective protocol is severely limited and unavailable. Our study design compares variables of abundance, distribution, and growth between groups of bull trout introduced into historic habitats as fry and as hatchery reared yearlings. Results of this study will help develop successful and low risk bull trout re-introduction programs in Oregon and throughout the distribution of bull trout, including Washington, Montana, Idaho and Canada. In addition, a coordinated approach to the monitoring and evaluation of status and trends in bull trout populations is needed to support restoration in the Oregon portion of the Lower Columbia Province. Our monitoring approach applies a rigorous, Tier-2 sampling design to address key monitoring issues. This effort is designed to continue past monitoring activities and to support collaborative work proposed in other provinces. Information obtained on the project will provide real-time data to guide restoration and adaptive management in the region.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199206800	Assess McKenzie Watershed Habitat And Prioritize Projects	Assesses McKenzie Watershed habitat by synthesizing recent watershed analyses and gathering data to address information gaps. The project will provide a basin-wide context for bull trout habitat protection, restoration and monitoring strategies.
199405400	Bull trout genetics, habitat needs, life history in Central and NE Oregon	Both are Columbia River Basin bull trout studies. 199405300 targets Willamette Subbasin populations 199405400 targets subbasins in Eastern Oregon.
199206800	McKenzie Watershed Council Coordination	Coordinates McKenzie Watershed Council administration, project planning, implementation and monitoring among multiple stakeholders/landowners. The proposed project would be guided by the ongoing McKenzie Watershed Council framework.
199206800	Willamette Basin Mitigation Program, Phase III, Wildlife	Habitat for bull trout
	Cougar Water Temperature Control Project, Fisheries Monitoring	Monitoring work being conducted under this project will add additional data to the monitoring portion of the

Project ID	Title	Nature of Relationship
		proposed project.
	Willamette National Forest	Personnel, Planning, Financial
	US Fish and Wildlife Service	Personnel, Planning, Financial
	Eugene Water and Electric Board	Planning, Financial
	Oregon Department of Transportation	Financial
	Oregon State Police	Personnel
	Oregon Council Federation of Flyfishers	Personnel, Planning, Review, Financial
	McKenzie Flyfishers	Personnel
	National Fish and Wildlife Foundation (Bring Back the Natives Program)	Financial
	Trout Unlimited	Planning, Financial
	Bureau of Land Management	Personnel, Review
	Native Fish Society	Review
	McKenzie Watershed Council	Planning
	Saturday Academy (Apprenticeships in Science and Engineering)	Personnel, Financial
	Oregon Chapter American Fisheries Society	Review
	Salvelinus confluentus Curiosity Society	Personnel, Review
	US Army Corps of Engineers	Planning, Financial
	Oregon Department of Fish and Wildlife	Personnel, Planning, Review, Financial
	Weyerhaeuser Company	Personnel, Review

Review Comments

USFWS has identified that this project is a BiOp project. The proposed project will investigate strategies for reintroduction of bull trout and status and trends of bull trout in the Upper Willamette basin; however, CBFWA believes that the proposed experimental design and data analysis need to be explained in greater detail. Specifically, project sponsors should provide justification for number of release sites chosen and numbers and timing of fish transferred and released. In addition, CBFWA recommends that details of the methods and statistical analyses for Objective 3 need to be defined in greater detail.

Budget

FY2003	FY2004	FY2005
Rec: $159,400 Category: High Priority	Rec: $172,400 Category: High Priority	Rec: $179,600 Category: High Priority

Project: 199607000 - McKenzie River Focus Watershed Program Coordination and Habitat Restoration

Sponsor: McKenzie Focus Watershed Program Coordination (MWC)

Short Description:

Continue McKenzie River Focus Watershed Program Coordination. Develop, coordinate, plan, design, implement and monitor habitat protection, restoration and water quality projects; improve resource stewardship through public outreach and education

Abbreviated Abstract

This proposal requests continued funding for the McKenzie River Focus Watershed Program coordination and habitat restoration. In 1996, the Northwest Power Planning Council selected the McKenzie as one of its focus watersheds. BPA funding, in conjunction with contributions from numerous and diverse partners, supports the McKenzie Watershed Council's (MWC) efforts to coordinate protection, restoration, monitoring and education programs of federal, state, local government, and residents within the watershed. The goal of the Council is to improve watershed stewardship and protect fish, wildlife, and water quality resources. The MWC will always have a baseline program centered on relationship building and information sharing. In 2003, the Council will increase implementation of its protection and restoration program. This increase is due largely to the completion of the following:

- McKenzie Watershed Assessment,
- Willamette Subbasin Summary,
- McKenzie Watershed Conservation Strategy,
- McKenzie Watershed Benchmarks (draft)
- McKenzie Watershed Habitat Acquisition matrix.

These collaborative planning documents provide a biologically solid , spatially explicit prioritized framework supporting proposed protection and restoration projects that will be funded in this proposal. Overall objectives for the McKenzie Focus Watershed Program in FY03 include:

1) Continue to coordinate McKenzie Watershed activities among diverse groups that restore fish and wildlife habitat in the watershed, with a focus on the lower McKenzie, including private lands and the McKenzie-Willamette confluence area;
2) Influence behavior of watershed residents to benefit watershed function through a strategic and comprehensive outreach and education program;
3) Continue to maintain and sustain a highly functional watershed council;
4) Maintain and improve water quality concerns through the continuation of Council-sponsored monitoring and evaluation programs;
5) Implement watershed restoration projects to improve habitat for ESA listed fish species and resident fish and wildlife species, and
6) Continue to secure other funds for watershed restoration projects and Council operations.

The McKenzie Watershed Program specifically addresses RPA's 149, 150, 152 and 154 in the NMFS's Biological Opinion and is also consistent with the NWPPC's Fish and Wildlife Program.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
2000030	Assess McKenzie Watershed condition	subbasin assessment for McKenzie Watershed Council
199607000	McKenzie Focus Coordination - action planning	Conservation Strategy providing prioritized framework for restoration and protection projects
199206800	Willamette Basin Habitat Mitigation	Habitat mitigation process and funds for restoring habitat in the McKenzie Watershed
	ODFW Fish Restoration and Enhancement Program	Providing education regarding chinook and bull trout programs
	ODFW McKenzie Bull Trout Habitat surveys	Population and habitat assessment for bull trout in McKenzie and Willamette Watersheds
	Cougar Dam Temperature Control Tower	New water release tower lowering McKenzie water temperature
	SB1010 for Southern Willamette Valley	Completion of Ag Water Quality management plan, McKenzie WC assists implementing
	McKenzie-Willamette Confluence Planning	MWC lead in planning restoration efforts at confluence, in collaboration with landowners and aggregate folks.
	Willamette Restoration Initiative	Implementation of restoration strategies

Review Comments

The reviewers are concerned about the longevity and certainty of the landowner agreements for habitat protection. New tasks have been added to this ongoing project that modifies it's original scope.

Budget

FY2003	FY2004	FY2005
Rec: $325,000 Category: High Priority	Rec: $357,000 Category: High Priority	Rec: $389,000 Category: High Priority

Project: 200001600 - Protect and Enhance Tualatin River National Wildlife Refuge Additions

Sponsor: U.S. Fish and Wildlife Service (USFWS)
U.S. Geological Survey (USGS)

Short Description:

Provide riparian, forested wetland, and off-channel emergent wetland backwater habitats for salmonid rearing and predator avoidance areas adjacent to the main stem Tualatin River. Acquired and restored lands are protected and maintained in perpetuity.

Abbreviated Abstract

The habitats of the Tualatin River watershed support a vast array of fish and wildlife species including ESA listed salmonids, and other wildlife designated as species of special concern. This proposed project seeks to acquire, restore, monitor, and maintain in perpetuity within Tualatin River National Wildlife Refuge (TRNWR) habitats that have been designated Essential Fish Habitat by the Pacific Fisheries Management Council under the Magnuson-Stevens Act. The project will continue to protect and restore critical habitats as they become available for acquisition. Fiscal year 2003 request is to acquire two parcels totaling 20 acres of intact high-quality riparian forest adjacent to main stem Tualatin River; restore an additional 230 acres of riparian forest, forested wetland, emergent wetland, and associated upland habitat; and conduct an extensive research and monitoring program to determine salmonid use of off-channel habitats among listed species. Acquisition and protection of intact riparian forest that is at risk to logging along the main stem Tualatin River will provide permanent habitat for a number of species such as Vaux's swifts, rufous hummingbirds, pacific slope flycatchers, and red-breasted sapsuckers. Restoration of off-channel habitat will provide salmonid species such as winter run steelhead and spring Chinook shelter, resting, and predator avoidance areas during flood events. In addition, this project will restore wetland and upland habitat vital to myriad wildlife species including bald eagles peregrine falcons, western pond turtles, and red-legged frogs. The hydrology and habitat features of the Tualatin River Valley have been severely impacted the past 100 years by water diversions and floodplain drain tiles, agricultural practices, channelization, and urbanization. This project seeks to restore historic habitat values to benefit fish and wildlife by reversing alterations to historic hydrology. By installing levees and water control structures on off-channel areas we will mimic natural conditions in a highly altered system. Monitoring and research will be conducted on this and other refuge restoration projects to determine how salmonids use these areas. The refuge has in place a "state of the art" water control structure designed in consultation with National Marine Fisheries Service (NMFS). This structure is designed to enhance fish passage from off-channel wetlands to the river while producing high quality backwater habitats. Monitoring and research will determine the effectiveness of this structure and operations to aid in future restoration efforts.

This project is a continuation of acquisition opportunities initiated on behalf of TRNWR by the Oregon Wildlife Coalition (OWC), and restoration previously funded in part by Bonneville Power Administration (Bonneville). Previously OWC represented several partners in Oregon (project # 199705900) for submission of acquisition funding

requests. However, under the new Provincial Rolling Review process it is no longer feasible for acquisition requests across the province to be handled by OWC. Therefore, TRNWR will assume both the roll for acquisition funding requests and restoration funding requests for this and all future projects.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199705900	Securing wildlife mitigation sites - Oregon	Oregon Wildlife Coalition (OWC) project was the umbrella for the first TRNWR acquisitions. While TRNWR applied as a stand-alone project (#200001600) for restoration funding, OWC applied for acquisition funding on behalf of TRNWR and others.
199906600	Multnomah Channel Riparian Habitat Restoration	Focused on habitat restoration and enhancement of various wetlands and degraded riparian habitat along the Multnomah Channel and adjacent creeks.
199205900	Amazon/Willow Creek Wildlife Mitigation Project	Acquired and enhanced land contiguous with the Willow Creek Wildlife project area in Eugene, OR. Restored and enhanced native wet prairie and oak woodland habitat.
199107800	Burlington Bottoms - Phase I	Developed management plan for Burlington Bottoms Wildlife tract to protect, maintain, and enhance habitat for fish and wildlife.
199206800	Willamette Basin Mitigation Program	Mitigate for wildlife habitat losses through the use of easements, acquisitions, management plans, and enhancement activities to benefit fish and wildlife "while maintaining and improving water quality and quantity, habitat connectivity and functionality.

Budget

FY2003	FY2004	FY2005
Rec: $256,000 Category: High Priority	Rec: $345,100 Category: High Priority	Rec: $91,000 Category: High Priority

Project: 31002 - Wildlife Habitat Protection, Lower McKenzie Watershed (Jaqua)

Sponsor: The Nature Conservancy (TNC)

Short Description:

Acquire a wildlife habitat conservation easement over 1240 acres of oak savanna and woodlands, Douglas fir forests, and grasslands to benefit listed and target species in the Lower McKenzie River Watershed.

Abbreviated Abstract

The 1240-acre Jaqua tract is located in the Coburg Hills within the Lower McKenzie watershed. The property includes 670 acres of oak woodlands and prairie habitats and approximately 570 acres of second growth Douglas fir forests.

The Willamette Subbasin Summary identified habitat conversion as the primary factor limiting fish and wildlife habitat in the Willamette Valley. Eighty-seven and eighty-eight percent of the upland forests and foothill savanna/prairie habitats have already been lost through conversion to other land uses. Much of the remaining habitat is fragmented and in degraded condition. Over 80,000 wildlife habitat units were directly impacted from the development of the hydroprojects in the Willamette Basin, the secondary affects from this development were even greater. However, to date little wildlife mitigation has been completed in the Willamette Subbasin.

Protection of this property would benefit 35 species considered at risk or declining in the Willamette including the federally listed Fender's blue butterfly (Endangered) and Kincaid's lupine (Threatened) Valley and 11 species targeted for wildlife mitigation. In addition, protection and enhancement of habitat values on this tract would fulfill wildlife mitigation needs on the Willamette while contributing to habitat and recovery goals identified by the Willamette Restoration Initiative, Oregon Department of Fish and Wildlife, and Partners in Flight.

We are seeking $2,306,025 in FY 03 funds to acquire a wildlife mitigation easement over the property and complete NEPA review, baseline assessments, and a mitigation and management plan for the tract. The proposal briefly describes future opportunities and associated funding needs for enhancing and restoring habitat conditions. Significant cost sharing for the project includes a commitment of $2,000,000 from The Nature Conservancy to a stewardship endowment to cover long-term operations and maintenance and monitoring and evaluation costs estimated to cost $100,000/year, and funds from the USFWS for endangered species monitoring.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
	Assess McKenzie Watershed Planning and Prioritize Projects	Watershed assessment called for protection of oak habitat
199607000	McKenzie River Focus	Project occurs in the lower McKenzie

Project ID	Title	Nature of Relationship
	Watershed Coordination	River Watershed
199205900	Amazon Basin/Eugene Wetlands Phase Two	Both areas are being studied to determine how to best connect protected areas and open space in Lane County to provide for fish and wildlife protection

Review Comments

This is a good property acquisition that may be focusing on a lower priority habitat type relative to the mitigation responsibilities of BPA.

Budget

FY2003	FY2004	FY2005
Rec: $2,321,025 Category: Recommended Action	Rec: $215,000 Category: Recommended Action	Rec: $282,125 Category: Recommended Action

Project: 31004 - Salmon Carcass Enrichment -- Willamette (Clackamas) & Sandy Subbasins

Sponsor: U.S. Forest Service (USFS)

Short Description:

Multi-year salmon carcass enrichment project applied over entire 5th field watersheds (with replicates and controls) aimed at restoring native runs of salmon and steelhead in the Clackamas and Sandy rivers.

Abbreviated Abstract

A multi-year, salmon carcass enrichment project is described for tributaries to the Clackamas (Willamette Subbasin) and Sandy (Sandy Subbasin) rivers. The levels of nutrients (primarily nitrogen and phosphorus) in river systems throughout the Pacific Northwest have been directly linked to the abundance of salmon carcasses. These essential nutrients, in turn, drive the productivity of freshwater ecosystems thus aiding in the production of juvenile (parr and smolt) salmon themselves. With the large loss of naturally spawning salmon as compared to historic levels, many watersheds are believed to be operating far below capacity. Hence, in recent years many projects have been implemented to increase the density of salmon carcasses through supplementation in order to boost productivity. Most of these efforts have been fairly small scale and have not been accompanied by a rigorous monitoring program to evaluate their overall effectiveness. In this project, we propose to treat entire watersheds (i.e., total distance of potential anadromy), including five that coincide with ongoing smolt production evaluations over the last several years. Surplus hatchery salmon will be added to treatment watersheds by helicopter and hand application at a rate of 2,500 lbs. per mile. This project was developed in a randomized block design, utilizing a series of replicate treatments and controls. It is also designed in a before-after-control-impact experimental framework, taking advantage

of eight watersheds for which ongoing smolt production studies are occurring. To our knowledge, this is the first large-scale, salmon carcass enrichment project proposed in a comprehensive manner allowing for a thorough evaluation of overall project effectiveness. A comprehensive, effectiveness monitoring and evaluation component of this project will investigate food web responses. A pilot project was successfully implemented (without BPA funding) in the fall of 2001 to test helicopter applications and evaluate operational protocols. Additionally, baseline monitoring efforts were initiated. This is a joint project between the U.S. Forest Service, Oregon Department of Fish and Wildlife, Portland General Electric, Bureau of Land Management, U.S. Fish and Wildlife Service, Northwest Steelheaders, and Trout Unlimited. This project is intended for a three-year timeframe, at which time continued salmon carcass applications would be re-evaluated based on monitoring results. Should surplus hatchery salmon carcasses be limited in a given year, then additions of salmon carcass analogs or inorganic supplements will be investigated to maintain elevated nutrient levels in treatment watersheds.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
22002	Influences on Stocking Salmon Carcass Analogs on Salmonids in Columbia River Tributaries	Both projects aimed at evaluating food web responses to nutrient enrichment via salmon.

Review Comments

NMFS has identified that this project is a BiOp project.

Budget

FY2003	FY2004	FY2005
Rec: $509,858 Category: Recommended Action	Rec: $535,351 Category: Recommended Action	Rec: $562,118 Category: Recommended Action

Project: 31007 - Distribution and seasonal habitat use of ESA-listed salmonid species in City of Portland tributary streams

Sponsor: City of Portland (COP)

Short Description:

Determine the distribution and seasonal habitat use of listed salmonids in City of Portland watersheds. Use information to guide development of a recovery plan, determine necessary protective measures, and monitor effectiveness of protective measures.

Abbreviated Abstract

This proposal is part of a larger project being conducted by the City of Portland's Endangered Species Program to:
(1) inventory aquatic habitat in Portland watersheds;

(2) determine distribution and seasonal habitat use patterns of ESA-listed salmonids and other fish species in Portland watersheds; and,
(3) guide development of the city's recovery plan for listed salmonids.

This proposal seeks funds to continue seasonal sampling to determine the distribution and habitat use of listed salmonids and other fish species. This activity is an integral and necessary component of the city's recovery plan for listed salmonids, and will fill critical data gaps for the NMFS technical recovery team. Neither the city's nor the ESU's recovery plan can be fully developed until the current distribution, habitat use, and factors limiting distribution are recognized. Findings may also serve as a basis for evaluations of specific recovery actions such as erosion control plans, environmental zoning, culvert replacement, etc.

Portland watersheds currently provide or historically provided habitat for a number of ESA-listed and candidate races of salmonids. Steelhead and chinook salmon utilize a number of streams, and historically utilized many more before access was blocked. Cutthroat trout also occur in many Portland streams.

If this proposal if funded, we plan to continue conducting seasonal electrofishing in approximately 12 tributary watersheds to the lower Willamette River to determine distribution and seasonal use by listed salmonids. We will sample in each "reach" designated during habitat surveys (a new reach is identified when landscape changes significantly, a major tributary enters, or a barrier to fish passage is encountered (stream surveys were conducted by ODFW crews using a protocol based on the OWEB Assessment Manual).

Although the primary focus of the project will be on listed salmonids, all species encountered will be enumerated, and an Index of Biotic Integrity (IBI) will be calculated for each reach. Information about lamprey will be particularly useful for the tribal trustees working on the Superfund listing of Portland Harbor. Findings will be used to guide development of the City of Portland's recovery program for listed salmonids and to develop restoration projects for the Natural Resource Damage Assessment component of the Superfund listing. Information collected will also be useful to the NMFS Technical Recovery Team in its work to establish viable population targets for the Lower Columbia ESU.

Relationship to Other Projects

None.

Review Comments

There is an outstanding question of whether or not this project is a BPA mitigation responsibility relative to impacts of the hydrosystem.

Budget

FY2003	FY2004	FY2005
Rec: $62,000 Category: High Priority	Rec: $62,000 Category: High Priority	Rec: $0 Category:

Project: 31012 - Leveraging Conservation Easements for Fish and Wildlife in the Willamette Basin

Sponsor: Cascade Pacific Resource Conservation and Development, Inc. (CPRC&D)

Short Description:

Leveraging conservation easements for fish and wildlife protection in the Willamette Basin.

Abbreviated Abstract

This project is being initiated by landowners along the Willamette River from the Sam Daws District Improvement Company (SDDIC), in response to the lack of adequate state and federal programs that provide the options and proper incentives for landowners to enroll in conservation easement programs. It is an innovative approach, lead by a non-profit organization, to entice participation by the greatest number of landowners possible. For an investment of $240,000, you will see returns of 10- 20 times that amount in installed easements along the Willamette River.

The SDDIC has been successfully working with Cascade Pacific RC&D, Inc., a 501c3, non-profit corporation, for over two years. CPRC&Ds work is directed from the grassroots level by the needs of our membership which cover a six-county area covering Marion, Polk, Linn, Benton, Lane and Lincoln Counties. We are non-government, and therefore, have developed significant rapport and trust with landowners, not usually found with government entities.

This project will be piloted in the reach from Corvallis to Harrisburg. Its purpose is to develop and implement a conservation easement program for landowners along the Willamette River. It addresses "fish and wildlife habitat needs" identified in the Willamette Subbasin Summary, October 26, 2001 pages 116-129, specifically those tasks associated with floodplain/habitat restoration and compensation for habitat losses caused by hydro power on the Willamette River. It will dedicate 1.0 FTE to provide assistance facilitating a " landowner developed" conservation easement program, organizing and finalizing a conservation easement document, using a public process to obtain landowner input, identifying and securing landowner participation in the easement program, and securing funding.

This program fills a critical need in the upper Willamette Basin. Most of the land along the Willamette River is held by second and third generation large-scale farming families, who are very distrustful of the government, thus creating a lack of participation in USDA programs such as CREP and WRP. In fact, there is a growing fear that government is interested in taking over land that has been traditionally farmed and converting it to other uses. Through work with the Sam Daws District Improvement Company, it became apparent that conservation easements and land acquisitions may be a more economical way to deal with floodplain restoration, erosion control and loss of farmland. Four landowners have agreed, and approximately 10 other landowners have expressed interest in an easement program that is landowner developed and protects their long term interests. A

landowner directed easement program would have the greatest success in reaching our goal of restoring and protecting the riparian corridor of the Willamette River.

A landowner driven program will be different than what is currently being offered through other state and federal programs like CREP. It will operate under a sliding scale where land placed into permanent native vegetation next to the river is most important for easements. As you move farther from the river and allow some farming practices, the easement would be worth less. This approach allows maximum flexibility and can differ from farm to farm, yet, insures that minimum restoration standards are established through a scientific reach analysis. This proposal is a pilot to test the best way to entice the largest number of participants.

Once easements are identified, funding will come from Title 2 and 3 funds (USFS funds from timber receipts), private foundations, and other fund raising efforts. Two of CPRCD Board members are county commissioners. They are working through the Association of Oregon Counties to convince other counties to allocate Title 2 and 3 funds to conservation easements along the Willamette River. All of the counties in the RC&D Area have responded positively. It should be noted that the McKenzie Land Trust raised almost $500,000 in a Conservancy Campaign over a 6- month period that will be used for land acquisition and easements. Steve Gordon, Lane Council of Governments, has shown interest in requesting a congressional allocation, for easements in Lane County along the Willamette River.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
	Willamette River Reach analysis	Will be funded by OWEB to prioritize high value habitat, look at alternatives to dredging, address erosion to roads and other infrastructure
	Willamette River Monitoring Program	National Fish and Wildlife Foundation grant for $150,000 to develop monitoring protocols for restoration work on the Willamette River. Primary investigator, Stan Gregory
	Pacific NW Ecosystem Research Consortium*	Willamette Basin Summary, p. 128

Budget

FY2003	FY2004	FY2005
Rec: $68,090 Category: Recommended Action	Rec: $90,300 Category: Recommended Action	Rec: $80,090 Category: Recommended Action

Project: 31013 - Investigate Re-establishing Anadromous Fish Populations Above Man-made Barriers

Sponsor: Oregon Department of Fish and Wildlife (ODFW)

Short Description:

Investigate the possibilities of re-establishing spring chinook and winter steelhead populations into historic habitat above impassable man-made barriers in the Willamette basin to link them with existing populations below barriers.

Abbreviated Abstract

ODFW proposes to investigate, experimentally stock, monitor and evaluate the re-establishment of spring chinook and winter steelhead above Foster, Cougar, Fall Creek, Dexter/Lookout Point, Dorena, Scoggins, Big Cliff/Detroit, Fern Ridge, Cottage Grove, Hills Creek, and other man-made dams in the Willamette basin without current fish passage or with passage that impedes fish production.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199405300	McKenzie/Willamette Bull Trout Population and Habitat Surveys	
199206800	Willamette Basin Habitat Mitigation	

Review Comments

This project has a very broad scope without clearly defined decision points relative to success or failure of establishing sustainable populations.

Budget

FY2003	FY2004	FY2005
Rec: $221,977 Category: Recommended Action	Rec: $230,690 Category: Recommended Action	Rec: $267,665 Category: Recommended Action

Project: 31016 - Calapooia River Flow Acquisition and Fish Passage Assessment

Sponsor: Oregon Department of Fish and Wildlife (ODFW)

Short Description:

Improve upstream passage for ESA-listed fish on the Calapooia River by reimbursing the owner of Thompsons Mills to not divert flows for power generation. Evaluate the effect of flow manipulation on upstream passage and fish survival.

Abbreviated Abstract

The Oregon Department of Fish and Wildlife (ODFW) is participating in a collaborative effort to seek interim and long term solutions to fish passage and water flow concerns at the Thompson's Mills hydroelectric and hydromechanical project on the Calapooia River. This ad hoc working group, which seeks positive solutions to satisfy numerous interests, is composed of federal and state agencies, water conservation groups and historical societies, and representatives from the Oregon legislature and Governor's office. Because efforts to seek a permanent solution may take some time, the group agreed to identify short term measures that could be implemented in the next 2-3 years to minimize fish passage delays and losses, without causing significant economic hardship to the project owner. In this atmosphere of collaborative problem-solving the ad hoc group is proposing that specific measures be implemented in the short term (2-3 years) to address the fish resource issues while efforts continue toward a permanent solution. It is believed that these measures will reduce existing adverse effects to ESA-listed and other native fish populations, and will serve as an initial step toward improving fish passage conditions during critical passage periods at the project. The primary measures presented in this proposal include:

1) Increasing fish passage and survival opportunities on the Calapooia River by reimbursing the owner of Thompsons Mills to not divert river flows for the purpose of generating power.
2) Operating traps on two Mill-associated fishways to evaluate the effect of flow manipulation on fish passage.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199206800	Willamette Basin Habitat Mitigation	

Review Comments

This proposal is an interim fix to provide flow to listed fish while discussion continues with the landowner to pursue a long term solution. It is anticipated that this temporary action will only be necessary for the next two years.

Budget

FY2003	FY2004	FY2005
Rec: $53,500 Category: High Priority	Rec: $55,500 Category: High Priority	Rec: $1,500 Category: High Priority

Project: 31018 - Willamette Basin Riparian Project

Sponsor: Marion Soil and Water Conservation District

Short Description:

Implement riparian buffering program using cost-share provided by USDA, state of Oregon and private landowners, including urban area trials. Conduct restoration project planning and implementation with watershed councils, landowners and other interests.

Abbreviated Abstract

Riparian areas provide a variety of ecological functions, including filtration of nutrients and sediment, recruitment of large woody debris and other organic material, and moderation of solar heating. In the Willamette Valley, a high percentage of riparian lands have been degraded or altered due to land use change over the past two centuries. A preponderance of the most complex of these stream problems and degraded of aquatic systems exist in the lowland portions of the basin, and the causes are partly rooted in the upstream development of the federal flood control and multiple purpose water projects in the basin.

The applicants, a consortium of the Willamette basin's Soil and Water Conservation Districts (SWCDs) and the basin's Watershed Councils (councils), propose to address several barriers to riparian restoration with urban and rural riparian landowners and provide technical assistance and project delivery to participating landowners. The urban element is proposed as a testable, management-applicable pilot. The primary goal of the riparian restoration part of the project is to establish approximately 500 planting projects along targeted streams over a three-year period. We propose working on a willing-participation basis within all of the watersheds in the basin.

The riparian restoration program will provide a productive vehicle to initiate interest by landowners in other substantial stream restoration activity. Using this, the project will accomplish additional restoration project planning and implementations in lowland settings. These activities will address a suite of resource issues which have been universally prioritized by both local watershed interests and in landscape scale strategic planning efforts within the basin. These projects will address other functional causes of degraded habitat and fish populations above and beyond those remedied by the riparian planting program. The primary goal of this component of the project is to conduct not less than nine planning projects over the three-year period, all of which inform and/or lead to eventual on-ground implementations.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199205900	Amazon and Willow Creeks	compliments proposed project in Long Tom watershed
199206800	Willamette Basin Mitigation Program	compliments mainstem/confluence projects and activities being undertaken by ODFW
199607000	McKenzie River Focus Watershed Coordination	compliments proposed project in McKenzie watershed
199702200	Assess McKenzie Watershed Habitat and Prioritize Projects, and the Mohawk Watershed Planning and Coordination	compliments proposed project in McKenzie watershed

Review Comments

This project should be considered High Priority; however, the budget appears high relative to available funds in this province. Scope and budget should be reduced.

Budget

FY2003	FY2004	FY2005
Rec: $784,765 Category: High Priority	Rec: $767,996 Category: High Priority	Rec: $788,674 Category: High Priority

Project: 31019 - Fish Passage Assessment and Prioritization Program

Sponsor: Washington County Department of Land Use and Transportation (DLUT)

Short Description:

Develop fish passage barrier assessment methodology for road / stream crossings, inventory and assess county owned facilities on a 5th field HUC basis, prioritize passage barriers to core habitat areas for threatened and endangered fish species.

Abbreviated Abstract

Washington County Department of Land Use and Transportation operates and maintains approximately 1,300 centerline miles of roads within the Tualatin River Watershed (HUC 17090010). There are 236.10 miles of major stream corridors within this watershed, of which 217.30 miles are considered productive habitat for threatened and endangered fish species (SteamNet query 11/16/01). It is unknown how many times these roads and streams intersect, but it is likely in the thousands. Each road – stream crossing has the potential to block access to current or historic areas of high quality habitat. Currently, the driving force in culvert replacement is culvert condition; fish passage is a component of project design, not the project selection process. Without a comprehensive road – stream crossing assessment it is impossible to logically prioritize the replacement or remediation of culverts that block fish passage.

This proposal fills that critical need for a comprehensive road – stream crossing assessment that incorporates environmental as well as transportation components into project selection. The approach that Washington County proposes is to evaluate fish passage barriers on a hydrologic unit basis. We have chosen to evaluate and prioritize barriers at the 5th field HUC level. By taking this smaller HUC approach, we can evaluate each barrier in relationship to obtaining access to core areas of productive habitat within the context of the smaller watershed. HUCs will be assessed in descending habitat importance order with data from each individual HUC incorporated into the database until all the crossings within the Tualatin River Watershed (Washington County jurisdiction) are evaluated. Once the assessments are complete we can then assess the 5th field barrier data for each to determine the best removal – retrofit scenario, taking into consideration the value of the smaller fields within the context of the larger Tualatin Basin.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
20088	Assess McKenzie Watershed Habitat & Prioritize Projects	supporting
200001600	Tualatin River National Wildlife Refuge Additions	complimentary
199206800	Willamette Basin Mitigation Program	complimentary
198403600	Willamette River Projects Wildlife and Habitat Loss Assessment	complimentary

Relationship to Existing Goals, Objectives and Strategies

Watershed

Set within a growing and thriving metropolitan area, a productive agricultural landscape, and upland forests, the Tualatin Watershed is in a dynamically changing region of the country. Its lowlands, which predominantly have been agricultural lands, are giving way to increased residential and industrial settlement. Its headwaters in the upland forests are particularly important for water quality and fish and wildlife habitat. As the population and economic base of the region grows, stresses to the watershed are expected to increase. In order to foster a biologically healthy and functional resource, while still supporting the economy of the region, active stewardship of the watershed is essential. A biologically healthy watershed will reduce the likelihood of long-term degradation of the local environment and will maintain public health and the quality of life for which this region is known. (Pinnell, Gries, March 2001)

Tualatin River Watershed Map

The Tualatin River Watershed Council prepared the "Tualatin River Watershed Action Plan" in February, 1999. Two Action Items (1B & 2B) are directly applicable to this proposal. In substance, they state

> "….For areas outside the Urban Growth Boundary (UGB), a general lack of information about in stream habitat including riparian areas exists…..Initial efforts would focus on surveying streams with potential anadromous fish habitat such as Gales Creek, Dairy Creek and McKay Creek. Stream Habitat surveys and mapping would provide information regarding:
> Habitat quality and quantity
> - Riparian characteristics and quality
> - Potential priority enhancement areas
> - Artificial obstructions to fish passage (1B).

Action Item 2B further states

> "The purpose of this action item is to facilitate anadromous fish passage to historic spawning habitat areas in the watershed to the maximum extent possible. This action item will become a high priority with a listing of steelhead or cutthroat under the Endangered Species Act….."

Clean Water Services (formally USA) through their "Watersheds 2000" has initiated a stream health and water quality analysis for the portion of the Tualatin River watershed that falls under USA jurisdiction (primarily urban). The focus is water quality and stream

health; however, limited data may be incorporated about in-stream structures. The Watersheds 2000 website states:

> "…. While the project will provide a wealth of technical information, it will not address the following:

- Policy or programmatic issues (especially those related to ESA response, riparian buffers, Goal 5, and land use design standards)
- Fish-friendly internal audits by local entities in their ESA response efforts
- Social value and economic evaluation regarding ESA response
- Water quality modeling and TMDL development (part of TMDL program)
- Prioritization across the Basin's watersheds (across land type sectors) for fish and water quality improvements"

The project proposal will fill the data gaps for the county owned road – stream crossing barrier analysis and the data will be forwarded to Clean Water Services for inclusion in the Watersheds 2000 project.

Willamette Subbasin

The Willamette Restoration Initiative (WRI) has outlined in their restoration strategy 27 critical actions necessary to restore salmon habitat in the Willamette River Basin. Action item 11 states "Inventory, map, and conserve priority fish and wildlife habitats in the basin." Action item 12 further states "Improve both upstream and downstream fish passage at dams, culverts, and water diversions." http://www.cbfwa.org/files/province/lwrcol/subsum.htm (query Willamette download) prepared for the Northwest Power Planning Council and submitted October 2001 addresses fish passage assessments on page 102:

> "Fish Passage assessments at road / stream crossings have been performed by Oregon Department of Fish and Wildlife, the U.S. Forest Service, Clackamas County, Clean Water Services and other local government and private entities. However, assessment methodologies vary considerable, dependent upon agency focus and need. ….Therefore existing data and reports probably understate the degree to which connectivity limits fish migration and production within the Willamette River subbasin. The lack of a consistent subbasin-wide fish passage barrier inventory inhibits the subbasin's ability to accurately reflect the loss of access to high quality spawning and rearing habitat."

The report continues on page 103:

> "Most local road authorities have begun the remediation process of replacing or retrofitting road / stream crossings within their jurisdictional responsibility that are barriers to either juvenile or adult fish passage. Currently, the driving force for these projects is culvert condition and capacity……Washington County Department of Land Use and Transportation has begun developing its fish passage assessment and prioritization program, but long term funding remains the outstanding limiting factor…."

Columbia Basin

There are 24 major hydroelectric power generation facilities in the Willamette basin. Specific impacts of the Federal Columbia River Power System (FCRPS) are listed within the subbasin summary. Approximately 302.4 lineal miles and 4,751,308 yds^2 of spawning habitat have been lost due to construction of the Willamette Project dams (mainstems, not tributaries). In addition to habitat losses due to passage barriers at the dams, 85.6

miles of river habitat has been inundated by the reservoirs created behind the dams. (Page 50 of the summary). It is highly unlikely that this habitat will be restored within time to benefit the fish species that historically populated these reaches.
The 2000 FCRPS Biological Opinion
http://www.nwr.noaa.gov/1hydrop/hydroweb/docs/Final/2000Biop.html lists offsite mitigation measures in the Reasonable and Prudent Alternatives (RPA) as an option for restoring habitat for species impacted by the FCRPS. The habitat strategy is intended to accelerate efforts to improve survival in priority areas in the short-term, while laying a foundation for long-term strategies through subbasin and watershed assessment and planning. (Section 9.6.2 page 9-135) Section 9.62.1 lists passage and diversion as an objective of tributary habitat efforts.

RPA Action 150 states:

> "In subbasins with listed salmon and steelhead, BPA shall fund protection of currently productive non-Federal habitat, especially if at risk of being degraded, in accordance with criteria and priorities BPA and NMFS will develop by June 1,2001."

Action 152 continues by stating:

> "The Action Agencies shall coordinate their efforts and support offsite habitat enhancement measures undertaken by other Federal agencies, states, Tribes, and local governments by the following:….. Using or building on existing data management structures, so all agencies will share water quality and habitat, data, databases, data management, and quality assurance."

The project proposal combines methodologies, techniques, and data from City, State, Local, Regional, State, and Federal agencies in order to objectively assess and prioritize barriers to fish passage. The prioritization component will balance environmental gains as well as transportation needs to build a decision-making framework to aid in project selection. Although the emphasis in correcting problems is within the public right-of-way, partnerships with private landowners are pursued where priority activities are identified in a watershed. For example, where a priority blockage exists on private lands and there is extensive suitable fish habitat available adjacent to the publicly owned barrier, the county will forward information to the local watershed council and soil and water conservation district to work with landowners to compete for salmon restoration dollars to correct the problem. Lack of cooperative landowners contiguous to the county owned barriers may result in a lower "significant barrier" ranking than the habitat warrants. The final version will be available through StreamNet as well as the BPA.
Action 154 claims:

> "BPA shall work with the NWPPC to ensure development and updating of subbasin assessments and plans; match state and local funding for coordinated development of watershed assessments and plans; and help fund technical support for subbasin and watershed plan implementation from 2001 to 2006. Planning for priority subbasins should be completed by the 2003 check-in. The action agencies will work with other Federal agencies to ensure that subbasin and watershed assessments and

plans are coordinated across non-Federal and Federal land ownerships and programs."

The subbasin and watershed plans are in place as well as the action plans. As mentioned earlier, each assessment and action plan identifies the need to restore habitat connectivity within high and/or historic areas of fish habitat. It is logical that a systematic barrier removal program cannot occur without first identifying where those barriers lay within the watershed and ascertaining adjacent habitat viability. The project proposal implements concurrent goals within the Tualatin River Watershed, The Willamette River Subbasin, Lower Columbia River Province, and the Columbia River basin. In addition, the proposal is consistent with the Council's Fish and Wildlife Program by "pooling" stream scale level data to provide a landscape view of opportunities to restore passage to anadromous and resident fish species within the watershed in order to mitigate habitat losses brought about by the construction and operation of the Willamette Basin dams.

Budget

FY2003	FY2004	FY2005
Rec: $72,432 Category: Recommended Action	Rec: $16,125 Category: Recommended Action	Rec: $29,250 Category: Recommended Action

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