Draft Umatilla/Willow Subbasin Plan

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Prepared for the Northwest Power and Conservation Council

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Umatilla/Willow Subbasin Plan

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1. Executive Summary

1.1 Purpose and Process

This draft of the Umatilla/Willow subbasin plan was developed in response to the Northwest Power and Conservation Council's (Council) new review and selection process. Subbasin plans that are ultimately adopted by the Council will serve multiple purposes. Their primary purpose is to guide Bonneville Power Administration (BPA) funding of projects that protect, mitigate and enhance fish and wildlife that have been adversely impacted by the development and operation of the Columbia River hydropower system. Plans will also be used by the Council, BPA, the National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the U.S. Fish and Wildlife Service (USFWS) to help meet requirements of the 2000 Federal Columbia River Power System Biological Opinion. In addition, NOAA Fisheries and USFWS will use subbasin plans as a foundation for recovery planning for threatened and endangered species.

The formal planning process for this draft began with the formation of the Umatilla/Willow Core Partnership in 2002. The Core Partnership is the lead entity for the subbasin planning process in the subbasin, and consists of representatives from six major stakeholder groups in the Umatilla/Willow subbasin: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Morrow Soil and Water Conservation District (SWCD), Oregon Department of Fish and Wildlife (ODFW), Umatilla Basin Irrigation Districts Association (UBIDA), Umatilla Basin Watershed Council (UBWC), and Umatilla County SWCD. Members of the Core Partnership had the greatest role in the subbasin planning effort, and were responsible for taking the lead in coordinating among groups, developing the vision and biological objectives, and prioritizing subbasin strategies.

Members of a larger Stakeholder Group also played a vital role in the process by participating in reviews of early drafts and by attending five public meetings. The Stakeholder Group was composed of individuals or entities which reside in, derive their livelihood from, or are involved with business, research, or regulatory processes within the Umatilla/Willow subbasin, and members represented over 60 organizations, watershed councils, cities, counties, irrigation districts, state agencies, and federal and resource management agencies. In addition, three technical teams provided their expertise in the development and review of the plan. The General Technical Team was an interdisciplinary team that worked under the direction of the Core Partnership and was composed of specialists from various subbasin agencies and entities, as well as members of the Core Partnership. Members of this team reviewed the general information presented in the overview portion of the subbasin plan. Two more specialized teams, the Aquatic Workgroup and the Terrestrial Wildlife Workgroup, were responsible for providing the technical expertise for the development of the aquatic and terrestrial wildlife portion of the assessment and management plan. The Core Partnership hired a Project Manager to help compile, edit, and write various sections of the plan, and to facilitate technical team meetings and take the lead in compiling data contributed by agency staff. Two technical writers were also hired to work as principal authors of the

plan. CTUIR was responsible for the fiscal management and contract administration involved with planning in the Umatilla/Willow subbasin.

Several sets of guidance documents were followed by subbasin planners to maximize the likelihood that the plan would meet the requirements set forth by the Council. One of these documents, the *Technical Guide for Subbasin Planners* (Council 2001), describes three necessary components of subbasin plans: the assessment, the inventory, and the management plan. The assessment forms the scientific and technical foundation for developing the subbasin management plan; it not only describes the status and limiting factors of aquatic and terrestrial wildlife species and their habitats, but it also provides relevant information about the context in which fish and wildlife management takes place, including information on the social, economic, and cultural realities of the subbasin. The inventory summarizes and synthesizes fish and wildlife protection, restoration, and artificial production activities and programs within the subbasin that have occurred within the last five years, with the goal of demonstrating 1) current management directions, 2) existing protections, and 3) current strategies implemented through specific projects. These activities are related to limiting factors identified in the assessment. Another component of the inventory is a "gap analysis", which seeks to identify gaps between actions taken and actions needed. In combination with results from the assessment, the inventory should indicate the value and efficacy of current activities. The third component, the management plan, is described as the "heart" of the subbasin planning process (Council 2001). The primary goal of the management plan is to define the environmental and biological vision, objectives, and strategies specific to fish and wildlife in the subbasin. The planning horizon for the management plan is suggested to range from 10 to 15 years.

Another planning document that played an important role in guiding this draft of the Umatilla/Willow subbasin plan is the *Oregon Specific Guidance* (Oregon Subbasin Planning Coordination Group 2003). This document augments the guidance provided by the *Technical Guide for Subbasin Planners* (Council 2001) for Oregon subbasins. One guideline in this document that had a major effect on the organization and content of this draft plan is the stipulation that Oregon subbasin planners use a standardized outline[1]. Umatilla/Willow subbasin planners attempted to follow the outline provided by this document to the degree possible.

Once the draft Umatilla/Willow subbasin plan has been received by the Council on May 28, 2004, it will undergo an initial review by Council staff from May 29 through June 4, 2004 to determine if all the required components of the plan are included. On June 4, 2004, the plan will be sent to the Independent Scientific Review Panel (ISRP) and posted for public review on the Council's website at http://www.nwppc.org/. At that point, three simultaneous processes will take place between June 4 and August 12, 2004. The three reviews will be: 1) a scientific review by an expanded ISRP, which will include presentations by the subbasin planners on July 21 and 22, 2004 in Pendleton, 2) an

[1] This stipulation reads as follows on p. 9 of the *Oregon Specific Guidance* "Oregon subbasin plans are required to use this outline for at least the first two levels (i.e., *[sic]* level 2.1, 4.1) for all sections except Section 3, which should include the first three levels (i.e., *[sic]* 3.1.1, 3.2.1, etc.)."

adoptability review by Council staff to determine the adequacy of the plan under the Northwest Power Act (NWPA), and 3) a general review by NOAA, BPA, USFW, the states, public, and others. The comment period ends on August 12, 2004. With additional funding available through BPA, local subbasin planners will begin editing and re-writing the plan to incorporate review comments from all contributors. These changes will be completed by November 1, 2004, when the Council staff will compile all plans into a draft Fish and Wildlife Program Amendment. On November 18, 2004, the Council will propose the Draft Amendment of Subbasin Plans, with another public comment period occurring from November 10 to mid-December, 2004. The process will end during December 2004 and January 2005, when Council staff will meet again and adopt the plans.

1.2 Summary of the Assessment

As described above, the assessment forms the scientific and technical foundation for developing the subbasin management plan; it not only describes the status and limiting factors of aquatic and terrestrial wildlife species and their habitats, but it also provides relevant information about the context in which fish and wildlife management takes place, including information on the social, economic, and cultural realities of the subbasin. The assessment in this plan is organized in two major sections. The first section is an overview section, which describes the size, location, geology, economy, land ownership, influences of human activities on the aquatic and terrestrial environment, water resources, hydrologic and ecologic trends, and the greater regional context in which the subbasin falls. The rest of the assessment describes the status of aquatic and terrestrial wildlife species and their habitats, the limiting factors that negatively impact these species inside and outside the subbasin, the desired future conditions, and the working hypotheses, which describe how actions that address limiting factors will influence focal species populations. The main points of each of these sections are outlined below.

1.2.1 Location, Size, Geology, and Climate

The Umatilla/Willow subbasin is a 3,714 square mile area in northeastern Oregon and occurs primarily in Umatilla and Morrow Counties, with a small portion located in Union County. The Umatilla/Willow subbasin is composed of four drainages: the Umatilla subbasin, the Willow Creek subbasin, the Six-Mile Canyon drainage, and the Juniper Canyon drainage. The mainstem Umatilla River is 89 miles long and the river and its tributaries drain an area of nearly 2,290 square miles. Willow Creek is 79 miles long and drains an area of about 880 square miles. The Six-Mile Canyon area, which contains intermittent streams that rarely drain into the Columbia River, is 472 square miles. The mainstem of Juniper Canyon Creek is 19 miles long and drains 72 square miles.

The Umatilla/Willow subbasin consists of two geologic provinces: the Blue Mountains and the lower basin. The Umatilla River and its tributaries begin in the Blue Mountains, which are characterized by deeply incised upland surfaces and a ramp-like slope called the Blue Mountain slope or foothills. The flat-topped ridges and steep stair-stepped valley walls of the Blue Mountains were formed by thousands of feet of Miocene basalt flows. Streams leaving the canyons of the Blue Mountains cross a wide expanse of plains

and terraces making up the lower basin, which is comprised of tertiary and quaternary loess, alluvium, glacio-fluvial, and lacustrine sediment deposits which mantle the Columbia River basalts across much of the lower elevations.

The entire Umatilla/Willow subbasin falls within Oregon's North Central Climatic Zone (Zone 6). The major influence on the regional climate is the Cascade Mountains to the west, which form a barrier against warm moist fronts from the Pacific Ocean. The Columbia Gorge provides a break in the curtain of the Cascade Mountains and occasionally allows moisture laden marine air to penetrate into the northern Blue Mountains. This induces light to moderate precipitation (depending on elevation), and results in vegetation common to the west slopes of the Cascades. The subbasin experiences strong seasonal fluctuations in both temperature and precipitation. In the summer the subbasin experiences a continental climate with warm days, cool nights and little precipitation. Winters are much colder, with average temperatures often only slightly above freezing. Precipitation also changes dramatically with the seasons, with most precipitation in the subbasin falling during the fall, winter and spring.

1.2.2 Land Cover and Use, Population, and Land Ownership

General types of land cover found in the Umatilla/Willow subbasin, in order of prevalence, include agricultural areas, shrub-steppe, grasslands, forested communities, urban areas, and riparian areas and other wetlands. Forested communities are associated with higher elevations and agricultural lands, grassland, and shrub-steppe are more common at lower elevations. The majority of land in Umatilla and Morrow Counties is used for agricultural purposes, as defined by the proportion of the total area designated as cropland, pasture, and rangeland. Cropland, both dryland and irrigated, comprise about 39% of the Umatilla/Willow subbasin. Approximately 73% of the cropland in the subbasin is dryland and 27% is irrigated. Rangeland and range-forest transition areas account for 42% of land cover, forest accounts for approximately 14%, and urban and developed areas account for approximately 1%.

Approximately 70,548 people lived in Umatilla County in 2000, resulting in a density of 21.9 people per square mile. The majority of these people (51.2%) live in rural areas and in towns of less than 2,000 people; the remaining population lives in Pendleton, Hermiston, and Umatilla, which are all found along the mainstem of the Umatilla River. Morrow County had a population of 10,995 in 2000, resulting in a density of only 5.4 people per square mile. Only one town in Morrow County, Boardman, has a population larger than 2000. The total resident Native American population on or near the Umatilla Indian Reservation was more than 2,400 in 1998 (including Native Americans enrolled with other Tribes). CTUIR membership numbered 2,140 members living on and off Reservation lands. The Reservation is also home to about 1,700 non-Native Americans.

The economies of Umatilla/Willow subbasin have risen steadily from 1990 to 2000. Major components of the economy include agriculture, government sources, manufacturing, service industries, and wildland recreation. Agriculture, in particular, plays a major role in the economy, both directly and through its influence on other industries such as transportation, manufacturing, and government. In 2001, Umatilla

County farmers and ranchers employed 5,750 workers involved in the production of agricultural commodities, and the total value of agriculture to the economy of Umatilla County was estimated at $685 million in 2001. In 2003, Umatilla County ranked fifth in the state in agricultural commodity sales at $200 million and Morrow County ranked eighth at $180 million. Wheat, irrigated crops, and livestock are the most important agricultural products of the subbasin.

The majority of land in the Umatilla/Willow subbasin is privately owned. Approximately 11% of the drainage is managed by federal agencies, including the United States Forest Service (USFS), which manages over 70% of federally owned lands. Other landowners in the subbasin include the State of Oregon, counties, cities, and the CTUIR.

1.2.3 Human Influences on the Aquatic and Terrestrial Environment

Humans exert both positive and negative effects on the aquatic and terrestrial environment in the subbasin. Some of the most prevalent human influences in the subbasin are associated with agriculture, exotic weed introduction, forest practices, livestock grazing, transportation, urbanization, and water development. All of these human activities, except for exotic weed introduction, provide widespread and well-recognized benefits to Oregon's citizens, communities, and economies. However, because of the scope of this plan, these activities are discussed in terms of their influence on aquatic and terrestrial environments that are important to fish and wildlife in the subbasin. Negative impacts of these activities include stream channelization, reduced instream water volume, high water temperatures, riparian vegetation loss, increased erosion and sedimentation into streams, and land conversion and degradation. The ecological effect of these negative impacts include increased flood frequency, reduced water quality, separation of stream channels from floodplains, loss of exchanges between the hyporheic zone and river flow, and loss and degradation of habitat for aquatic and terrestrial wildlife species. Although the Umatilla/Willow subbasin is not unique in experiencing negative effects on fish and wildlife habitat associated with human activity, it is unique in the sense that stakeholders with different interests have a strong history in working together to solve the most pressing of these problems. Progress has been substantial, and has resulted in major improvements, especially with respect to improving water quality and quantity issues facing anadromous fish.

1.2.4 Existing Water Resources

Two major river systems occur in the subbasin: the Umatilla River and Willow Creek. The Umatilla River headwaters are in the Blue Mountains, where the North and South Fork join to form the mainstem, an 89 mile reach of river that flows through a series of broad valleys that drain low rolling lands. The mainstem Umatilla River has eight main tributaries: the North and South Forks of the Umatilla River and Meacham Creek in the upper subbasin; Wildhorse, Tutuilla, McKay and Birch Creeks in the mid subbasin; and Butter Creek in the lower subbasin. Like the Umatilla River, the headwaters of Willow Creek and Juniper Canyon Creek are also found in the Blue Mountains. The primary tributaries of Willow Creek are Eightmile Creek and Rhea Creek, and the primary tributaries of Juniper Canyon Creek are the North and South Forks of Juniper Canyon.

Flows in the Umatilla/Willow subbasin are characterized by high peaks during the early spring and often extremely low flows in the summer. The patterns in flow observed in the Umatilla/Willow subbasin are the result of snow melt and rain in late winter and early spring which cause peaks in flow. Water runoff peaks in April, while the lowest flows, or baseflows, generally occur in September.

Another significant component of the subbasin's hydrology that is often overlooked is the exchange of ground and surface water in rivers. In alluvial rivers such as the Umatilla River, ground- and surface-waters circulate continuously and bidirectionally between the river channel and alluvial aquifer, which underlies the river and flood plain. This bidirectional exchange creates a shallow ground-water flow network known as the hyporheic zone. Because hyporheic flow circulates continuously, the potential for ground-water to influence stream temperature may be much higher in streams and rivers with substantial hyporheic flow. Research on the exchange of ground and surface water on the Umatilla River has shown that 1) high rates of hyporheic exchange are associated with cooler stream temperatures, and 2) channel engineering in the subbasin has resulted in substantially simplified channel and flood-plain morphology, and modeled rates of hyporheic exchange are noticeably reduced from similar areas where dredging and diking have not occurred. Therefore, reduced hyporheic exchange associated with channel engineering provides a likely mechanism to explain the tendency for the river to warm rapidly as it flows through engineered reaches.

Water quality issues in the subbasin are being actively addressed. A Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) were completed for the Umatilla subbasin in 2001. A TMDL is currently being developed for the Willow Creek subbasin and a WQMP was recently completed. In addition, the CTUIR have requested to be treated as a state and have coordinated with the Environmental Protection Agency (EPA) to develop water quality standards pertaining specifically to reservation lands.

Throughout the Umatilla/Willow subbasin, three important beneficial uses -- domestic water supply, salmonid life cycles, and water contact recreation -- are not fully supported as a result of water quality impairments. Water quality impairments arise from a variety of variables and have resulted in many reaches in the Umatilla/Willow subbasin listed in accord with Section 303(d) of the Clean Water Act of 1972 as being water quality-limited water bodies. The most important of these variables are water temperature, sedimentation, and habitat modification. Other variables include turbidity, pH, nitrates, ammonia, bacteria, aquatic weeds and algae, and flow modification.

The current condition of the riparian vegetation varies considerably throughout the Umatilla/Willow subbasin. The majority of the riparian vegetation in the upper tributaries is composed of narrow bands of hardwood and conifer species, while galleries of large mature cottonwoods exist in some areas of CTUIR land as well as in a few areas along the mainstem Umatilla River below Pendleton. Lower mainstem and tributary reaches have riparian vegetation types primarily composed of shrubs and grasses, with some scattered hardwood trees. In some cases where crop cultivation extends to the

stream banks or where grazing pressure is high, woody or shade-producing riparian vegetation is sparse. Much of the lower mainstem is diked, and trees are actively prevented from growing on the dikes. Riparian vegetation on the mainstem Umatilla River and many tributaries is in poor condition, with approximately 70% of 422 miles inventoried identified as needing riparian improvements. Losses of riparian vegetation are particularly high in the lower subbasin; one study estimated those losses at greater than 95% as compared to pre-settlement conditions (c. 1850).

Wetlands are another important resource in the Umatilla/Willow subbasin. Based on a limited analysis conducted by the CTUIR, wetland losses in the upper Umatilla River range from 30 to 35%, while wetland losses in the Umatilla/Echo Meadows area are estimated to be as high as 90%. Three important wetland areas remain in the Umatilla subbasin: Minthorn Springs on the Umatilla Indian Reservation, a braided portion of the Umatilla River downstream of Pendleton, and the Echo/Umatilla Meadows complex.

1.2.5 Effects of Climate and Humans on Hydrologic and Ecologic Trends

Effects of Climate

Hydrology and ecology are influenced to a great degree by a region's climate. Thus, year-to-year variation in climate can result in year-to-year variability in the hydrologic regime and fish and wildlife populations. However, no obvious trends in climate over the last 100 years are evident in the subbasin, suggesting the absence of climate-induced trends in either hydrology or ecology in the subbasin. However, the ecology of the subbasin is likely influenced by trends in climate outside of the subbasin. An important weather pattern in the Pacific Northwest that appears to have a strong influence on salmon survival in the ocean is the Pacific Decadal Oscillation (PDO). The PDO pattern is of a period of cool, wet years followed by a period of warm, dry years. PDO patterns can influence the abundances of adult salmon and steelhead returning to the Columbia River and to the Umatilla/Willow subbasin.

Effect of Human Activities - Agriculture

Hydrology and ecology have also been influenced by human activities through time. Intensive dryland agriculture began in the subbasin in the 1880s, and resulted in large amounts of native grassland being converted to dry cropland. The completion of several irrigation systems in the early 20th century allowed for the conversion of arid areas in the lower basin into irrigated croplands. Since the advent of modern irrigation systems, approximately 480,000 acres of land have been developed for crop production. Other than through water development, trends in agriculture have had two important impacts on the subbasin's fish and wildlife resources: the conversion of native grasslands and shrub-steppe plant communities to croplands and an increase of erosion and sediment input into streams. Agricultural impacts on wildlife have not all been negative, however. Agricultural areas support many small birds and mammals, important predators such as coyotes and red-tailed hawks, and game species such as Ring-necked Pheasants and Wild Turkey. In addition, negative impacts of agriculture on fish and wildlife resources in the subbasin have been mitigated to a degree by conservation incentive programs, such as the Conservation Reserve Program (CRP) and Direct Seeding Program. As of 2003, the

Umatilla/Willow subbasin had more than 200,000 acres enrolled in CRP and more than 50,000 acres in which growers used direct seeding.

Effect of Human Activities – Exotic Weeds
The ecology of the subbasin has also been affected by the spread of exotic weeds. Problems with exotic weeds were identified as early as 1902 and have increased dramatically in recent times. The spread of exotic weeds not only reduces the abundance and diversity of native vegetation, but can also negatively affect fish and terrestrial wildlife and natural ecological processes, such as fire regimes in shrub-steppe habitats.

Effect of Human Activities – Forestry Practices
Hydrological and ecological trends in the subbasin have also been impacted by forestry practices. Although commercial forestry began in the Umatilla/Willow subbasin in the 1920s, large amounts of timber were not cut until the 1950s. Data on harvest rates indicate that harvest peaked in the subbasin in the 1970s and declined substantially by the 1990s, although extensive logging still occurs in the subbasin, especially on private property. Fire suppression has also had a major effect on the structure and composition of the forest vegetation within the subbasin. The result of these vegetation changes has been an increase in fuel loads to the extent that forested areas are at significantly higher risk of experiencing stand replacing wildfires as compared to historic conditions.

Effect of Human Activities – Livestock Grazing
Livestock grazing has also influenced the hydrology and ecology of the subbasin since pre-European settlement times. The local tribes, particularly the Cayuse, owned large numbers of horses, which likely impacted the native grasses of the region. White settlers also raised livestock and livestock grazing continues to be an economically important activity in the subbasin. Although sheep were originally the most common livestock raised, by the late 1950s cattle had become the predominant livestock. The total number of livestock in Umatilla and Morrow counties was quite large in the early 1900s, often totaling over 250,000 head of sheep. However, in the early 1930s the numbers began to decline and currently there is approximately 90,000 head of livestock in each county. Negative effects of improper grazing practices include 1) the reduction of the total amount of native vegetation, 2) replacement of native vegetation with plants of low forage value and/or exotic species and 3) reduction of surface cover, resulting in increased surface and wind erosion. These effects can negatively impact both aquatic and terrestrial wildlife species.

Effect of Human Activities – Settlement and Urbanization
Trends in settlement and urbanization have also affected the hydrology and ecology of the subbasin. The first human inhabitants of the Umatilla/Willow subbasin were Native Americans of the Walla Walla, Cayuse, and Umatilla Indian Tribes. Historically, Native-Americans relied heavily on hunting, fishing, and gathering. This lifestyle changed as large numbers of white settlers moved into the Umatilla/Willow subbasin in the mid 1800s. Conflict arose when the federal government gave Native American lands in the Oregon Territory to settlers. This conflict ended, for the most part, with the Treaty of 1855. Under the Treaty, the Tribes ceded 6.4 million acres of their lands in northeast

Oregon and southeast Washington to the United States and reserved rights for fishing, hunting, gathering foods and medicines, and pasturing livestock. The Tribes also reserved 510,000 acres on which to live. Today, there are over 2,400 tribal members, and the lands of the CTUIR encompass 172,000 acres. Approximately 75,500 acres of the reservation are privately owned.

The population of the Umatilla/Willow subbasin has grown steadily over the last 100 years, with much of the growth occurring in the three largest cities, all of which were established before 1910. The subbasin is expected to continue to grow by about 10,000 people in the next 10 years. Urbanization has affected about 1% of the land in the Umatilla/Willow subbasin, and the impacts of urbanization include effects on water flow and water quality, and the construction of dikes, levees, and rip-rapped banks. Several efforts are underway in the Umatilla/Willow subbasin to reduce negative impacts of urbanization on stream water quality and water flow conditions, including hazardous materials training for public works employees and water supply development programs being developed and implemented by the City of Pendleton.

Effect of Human Activities – Transportation Corridors

The earliest routes of transportation in northeastern Oregon were formed by Native Americans of the Columbia Plateau, as they traded goods with tribes west of the Cascades and east of the Bitteroot Mountains. Later, early white settlers established major transportation routes in the Umatilla/Willow subbasin, including the Oregon Trail, as they moved to the western United States in wagon trains. Estimates from 1842 to 1849 indicate a total of 12,287 immigrants moved through CTUIR tribal homelands during that time. The movement of large numbers of settlers into the area had a devastating effect on Native Americans. Diseases introduced by settlers killed up to 50% of area Native Americans; resources, including fish and wildlife, were degraded and depleted; and, eventually, most tribal lands were lost.

Further development of transportation corridors in the Umatilla/Willow subbasin continued with the coming of the railroad in 1881, which opened the area to the development of dryland wheat farming. Many past and current railroad routes follow the Umatilla River and its tributaries and Willow Creek. Roads and highways have also continued to increase in the Umatilla/Willow subbasin. Although first used by horse drawn vehicles, roads became more common with the widespread use of the automobile, and with the development of urban areas, such as the cities of Pendleton, Umatilla, and Hermiston. In addition, the timbering industry resulted in a high density of roads in many of the forested areas in the subbasin. Both paved and gravel roads are often constructed along waterways in the Umatilla and Willow Creek subbasin.

Transportation corridors can significantly impact hydrology and ecology by increasing 1) the loss of riparian vegetation, 2) stream water temperatures, 3) surface water run-off into stream channels, and 4) flashiness in stream flow.

Effects of Human Activity – Water Development

Water development for irrigation has had a large impact on both the hydrology and ecology of the Umatilla/Willow subbasin. Irrigated agriculture is served by six diversion dams found in the lower Umatilla River and two reservoirs, Cold Springs and McKay Reservoirs. In Umatilla County, the first large irrigation canal, the Hinkle Ditch, was constructed in 1903. In 1905, the Secretary of the Interior authorized the Umatilla Basin Project, for the purpose of irrigating 60,000 acres of land and building a reservoir. By 1916 three major irrigation systems, including diversion dams and canals, and one reservoir, Cold Springs, had been completed as part of the project. In 1927, a second reservoir, McKay Reservoir on McKay Creek, was completed.

During the same period, private irrigation ventures were started. These included a project by the Furnish Ditch Company, which began in 1903. By 1907 the company had built a diversion dam east of the town of Echo, which is currently operated by the Stanfield Irrigation District. The other private venture, Western Land Irrigation Company, was started in the 1890s. It is currently the Westland Irrigation District and operates the Westland Diversion Dam.

These irrigation diversion projects and McKay Reservoir have had important impacts on the hydrology of the Umatilla subbasin. During the summer months, discharge in the lower Umatilla River decreases with water withdrawals and shows slight increases with irrigation return water. Water is released from McKay Reservoir during peak irrigation periods. The impact of storage of water in McKay Reservoir and releases of water during the summer months is to lower mean monthly instream flows during the winter when water is stored and increase flows during the summer when stored water is used for irrigation.

The hydrology of Willow Creek is also greatly influenced by irrigated agriculture as well as the construction of the Willow Creek Dam. Irrigated agriculture began in the late part of the 19th century. Currently, total annual flows are reduced by approximately 23% due to extensive irrigation withdrawals. The Willow Creek Dam was constructed mainly as a flood control structure, and not for irrigation (although a permit issued by OWRD does allow the storage of 3,500 acre-feet for irrigation purposes). As such, its influence on downstream hydrology is different than diversions built for irrigation purposes. This hydrology is characterized by no natural floods, a regular fall peak in flow during reservoir draw-down, and constant high winter and spring flows.

In the Umatilla River, the dewatering of reaches and the creation of passage barriers that were necessary for irrigation activities resulted in the extirpation of Chinook and coho salmon stocks and the endangerment of the steelhead stock in the 1920s. In response to the need for continued irrigation and the desire to restore steelhead and salmon populations a unique coalition formed in the 1980s between the CTUIR and local irrigators. With the help of the BOR, BPA, Oregon Water Resources Department (OWRD), and ODFW, this coalition has made substantial progress in recovering salmon populations in the subbasin without harming irrigated agriculture. The coalition led to

the development of the Umatilla Basin Project Act, which was passed by Congress on October 28, 1988.

The Act allows irrigators to exchange Umatilla River water for Columbia River water. This allows water historically appropriated for irrigation to remain in the Umatilla River during times when flows are critical for steelhead and salmon. Two phases of the Act have been completed and a third phase has been proposed. Phase I of the project involves pumping water (up to 140 cfs) from the Columbia River into the West Extension Irrigation District system to offset diversion of Umatilla River water when flows in that river drop below target values. Phase II involves exchanging up to 240 cfs of Umatilla River and McKay Reservoir water for Columbia River water for use by the Stanfield and Hermiston Irrigation Districts. This results in water that had historically been diverted from live flow and from McKay Reservoir releases being retained for instream uses. As a result of Phase II, approximately one half of the storage in McKay Reservoir is now used to maintain instream flow in the Umatilla River below McKay Creek.

While the water exchanges associated with the Umatilla Basin Project do not increase flows year-round, they do increase flows during critical times for salmon and steelhead adult returns and juvenile outmigration. In addition, releases of water from McKay Reservoir during summer generally positively impact temperatures of reaches of the Umatilla River below the McKay Creek confluence. However, McKay Reservoir releases for fish are not continuous during the summer, and water temperatures in the river can become extreme at times. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion and can contribute to unsuitable habitat conditions for salmonids.

While these phases have helped the recovery of the steelhead population and assisted the reintroduction of Chinook and coho populations in the Umatilla River, irrigation still removes approximately half of the instream flows during the summer months. The proposed Phase III of the Umatilla Basin Project would involve a complete exchange of water in the Umatilla River used by Westland Irrigation District with Columbia River. This proposed exchange of water coupled with already completed Phases I and II would allow a substantial portion of the Umatilla River surface water to remain instream.

Another negative effect of the construction of diversion dams was problems with passage, entrainment, and injuries to fish at points of diversion. In an effort to address these problems, outdated juvenile and adult fish passage facilities were reconstructed between 1988 and 1994 at five major irrigation dams on the lower Umatilla River.

In addition, water development might also have had an important impact on non-salmonid fish species in the subbasin. Summer fish communities in the lower Umatilla mainstem include exotics whose abundance in the river may be aided by low discharge and high temperatures. These species include smallmouth bass, largemouth bass, carp, bluegill, yellow perch, black crappie, channel catfish, and mosquitofish. It is unclear what impact these exotic fish have on the ecology of the river system including the abundance of native species.

Finally, while little work exists on the impacts of water development on wildlife, waterfowl numbers have increased recently in the subbasin. While this has been attributed to the construction of the John Day and McNary dams and their reservoirs, the Cold Springs and McKay Reservoirs most likely contribute to the increase in these species within the Umatilla/Willow subbasin as well.

1.2.6 Regional Context

The Umatilla/Willow subbasin is located near the center of the Columbia basin and accounts for approximately 1.7% of the total area of the Columbia basin in the United States. The Umatilla River flows into the Columbia River at RM 289 and Willow Creek enters at RM 253. Three major Columbia River dams (the John Day, The Dalles, and Bonneville dams) are downstream of these confluences.

The Umatilla/Willow subbasin is one of ten subbasins grouped in the Columbian Plateau ecological province, which is the largest of the 11 ecological provinces. Because subbasins in the Columbia Plateau province are grouped together based on similarities in climate and geology, the Umatilla/Willow subbasin and most other subbasins in the province were historically dominated by interior grasslands and/or shrub-steppe habitats, are currently dominated by agricultural lands, have low human population densities, and have large portions of land in private ownership. The importance of agriculture and the arid nature of the area also results in a problem common in most other subbasins in the province: water is over-appropriated and is required for multiple, sometimes competing purposes. Like most other subbasins in the province wildland recreation, including fishing, hunting, boating, and hiking, is also an important component of the economy and culture of the Umatilla/Willow subbasin.

The fish and wildlife of the Umatilla/Willow subbasin are also related to other subbasins in the province. For example, bull trout of the Walla Walla, John Day, and Umatilla/Willow subbasins belong to the same gene conservation group. In addition, the Umatilla/Willow, John Day, Yakima, and Walla Walla subbasins share the same Middle Columbia River Steelhead evolutionarily significant unit (ESU). Many of the terrestrial wildlife species found in the Umatilla/Willow subbasin are also found in other subbasins in the province, with mobile species often moving between subbasins in the province. Fish and wildlife in the Umatilla/Willow subbasin face many of the same problems that threaten species in other subbasins of the province, both from within and outside of the subbasin.

Although the Umatilla/Willow subbasin is similar in many ways with the other subbasins in the province, it is unique in other ways. Perhaps most notable is the way in which stakeholders in the Umatilla/Willow subbasin with different interests have worked together to improve fish habitat in the Umatilla River through the Umatilla Basin Project, as describe above. The subbasin is also unique in other ways related to water resources and the presence of salmonid species. Extirpated Chinook and coho salmon have been reintroduced to the subbasin, and their production, as well as steelhead production, has been increased through hatchery supplementation. Natural production of steelhead is

increasing as well; returns of Middle Columbia River ESU natural summer steelhead adults are increasing more rapidly in the Umatilla River than in the Walla Walla or John Day subbasins. The Umatilla/Willow subbasin also provides important habitat for many salmonids. Although the subbasin contains only about 1.5% of all the river miles in the U.S. portion of the Columbia basin and 6% of all the river miles in the Columbia Plateau province, it provides a disproportionate amount of salmonid habitat.

The terrestrial environment in the Umatilla/Willow subbasin is also unique in that it contains some of the largest remaining tracts of shrub-steppe habitat in the Columbia Plateau in Oregon.

Environmental conditions external to the Umatilla/Willow subbasin impact both fish and wildlife species in the subbasin. Anadromous fish leaving the subbasin as juveniles and returning as adults are affected by multiple aspects of the aquatic environments they encounter in that journey, including three major dams on the Columbia River, and variable estuary and ocean conditions. Passage barriers, poor water quality, flow issues, and predation are some of the obstacles facing these fish outside the subbasin. In addition, salmon and steelhead abundances are influenced strongly by ocean conditions including the PDO. Likewise, highly mobile terrestrial wildlife species are also affected by out-of-subbasin conditions. These may range from problems such as loss of habitat connectivity in adjacent subbasins to deforestation of wintering habitat in South America.

1.2.7 Fish, Wildlife, Plants, and Invertebrates of Ecological Importance

The Umatilla/Willow subbasin is home to a multitude of fish, wildlife, plants, and invertebrates of ecological importance and/or conservation concern. Species of conservation concern in the subbasin include two fish and five terrestrial wildlife species that are currently listed as threatened or endangered by Oregon and/or the federal government. In addition, three wildlife species in the subbasin are federal candidate species and three plant species in the subbasin are state candidate species. Three fish species, 22 wildlife species, and five plant species also fall into the USFWS “species of concern” category and two fish species and 10 wildlife species in the subbasin are listed as sensitive species by the USFS. USFS has also established a list of 30 sensitive plant species found in the Umatilla National Forest. At the state level, the subbasin has three fish species and 43 wildlife species found on Oregon’s sensitive species list, including 15 wildlife species that are considered “critical sensitive species”. Other important species in the subbasin include species that are rare or significant to the local area, Partner in Flight species, critically linked species, functional specialists, and managed game species.

1.2.8 Aquatic Assessment

Focal Species and Rationale

Five aquatic focal species were selected for the subbasin: bull trout, summer steelhead/redband trout, spring Chinook, fall Chinook, and coho. The focal species are used to develop management strategies that should enhance the quality of the environment for all aquatic species. Focal species were selected based on three criteria: 1) the degree to which they have special ecological, cultural or legal status, 2) the extent

to which they "represent" certain habitat types and the aquatic communities found in those habitats and 3) the availability of adequate knowledge of the species' biology in the subbasin for use in the Ecosystem Diagnosis and Treatment Model (EDT) and the Qualitative Habitat Assessment Model (QHA). Steelhead and bull trout are both federally listed as threatened species. Redband trout were chosen with steelhead because current genetic information suggests there is little difference between the two and redband trout are found in Willow Creek and its tributaries, whereas, all anadromous species have been extirpated from that area. Spring Chinook and coho were selected as focal species because each species has unique distributions, habitat requirements and life history characteristics. Fall Chinook were selected as a focal species based primarily on their cultural, social, and political importance in the subbasin.

In addition, two "taxa of interest" were identified because of their cultural and ecological importance in the subbasin. These taxa are mussels and Pacific lamprey.

Status of focal species population and distributions

Two populations of bull trout are found in the subbasin. One population inhabits the north and south forks of the Umatilla River; however, the important center for this population is a section of the North Fork where the highest density of spawning occurs. The other population inhabits North Fork Meacham Creek. Adult abundance in the North Fork Umatilla has been estimated over the past decade using redd counts. The number of spawning adults has averaged 165 over this period with a general increasing trend. Despite this, the population is considered "of special concern" regarding extinction by the ODFW. The population in Meacham Creek is in worse shape and is considered "at high risk" of extinction, mainly because the habitat is of lower quality and the population size is smaller. Little information exists regarding the historical distribution of bull trout in the subbasin. Recent sightings of bull trout in the mid- and lower Umatilla River and in lower McKay Creek suggest that, in addition to the current distribution, these reaches might have had important historical use and are used only infrequently now and are not considered viable bull trout habitat as a result of degraded stream conditions. Because of their threatened status, there is no current harvest of bull trout; however, before 1994 there was a limited amount of tribal and sport harvest in the subbasin.

An annual average of 2,412 returning adult steelhead entered the subbasin between 1988 and 2003, with a peak of 5,520 adults returning in 2002. Naturally produced adults have averaged 68.9% of the return during this time. Estimates of productivity based on female escapement and number of redds suggests that there has been a trend of increasing productivity in the subbasin from the early 1990s to 2002. However, estimates of the number or returning adults per spawner do not support this trend. These estimates indicate that the population has been below replacement (i.e., the number of returning adults is less than the number of spawners) for most of the years during this same period with no obvious increasing trend. The current spawning distribution of steelhead is much below that of the estimated historic distribution. Spawning currently occurs in the upper mainstem, North and South Forks, Meacham Creek, and the upper Birch Creek watershed. Historic spawning occurred throughout the subbasin and included the majority of the mainstem and McKay, Butter, and Wildhorse Creeks. Causes of this

reduced range include increased sediment load, high water temperatures, and habitat loss mainly through loss of riparian vegetation. The steelhead population is supplemented with hatchery stock. This supplementation began in 1967 with Skamania and Oxbow stocks, but has been from endemic stocks every year since 1975. Returning hatchery adults form an important opportunity for both tribal and sports harvest. Between the years 1993 and 2001 from 8 to 20% of the hatchery returns have been harvested by both tribal and sports fishermen, with an increasing trend from 1998 to 2001.

Spring Chinook were extirpated from the subbasin in the 1920s and were reintroduced to the Umatilla River in 1986 with Carson stock. Adult returns to the subbasin have been counted since 1988. The average number of adult returns between 1988 and 2002 was 1,968 with an increasing trend from 1999 to 2002. In 1996 the first naturally produced adults returned to the Umatilla River and they have returned in small numbers (from 22 to 348) since then. Hatchery returns form the great bulk of the returns (84 to 98.8%). The productivity of the spring Chinook population appears to be increasing over the years 1991 to 2002 based on the number of redds and the number of spawned out female carcasses. However, during the period from 1992 to 1997 the population was below replacement every year except one (1992) based on the number of adults returning per spawner. As with steelhead, the current spawning distribution is much smaller than the estimated historic distribution for the same reasons. The current distribution is limited to the upper mainstem, the North Fork Umatilla, and Meacham Creek. The historic distribution included the middle mainstem and McKay, Birch, and Butter Creeks. In 1986 the population was reintroduced with Carson Stock from the Little White Salmon Hatchery. Beginning in 1998 the majority of the broodstock has come from adults returning to the Umatilla River. As a result of the hatchery program, returns of spring Chinook have been large enough to support a sport and tribal harvest in 10 of the last 13 years. An average of 13.4% of the returns have been harvested by sport and tribal fisheries during this period.

Fall Chinook were reintroduced into the Umatilla River in 1982 with Spring Creek tule stock (in 1982) and upriver bright stock (1983 on). However, the first adults did not return to the river until 1988. Between 1988 and 2001 the average number of adults returning was 493; jacks also make up an important part of the return and their numbers have averaged 275 during the same period. A strong increase in the number of adults returning to the Umatilla River was evident from 1998 to 2001. In 1995 the first naturally produced adults returned to the Umatilla River. The numbers of naturally produced adults has been very small and hatchery returns represent the great portion of total returns. Productivity of fall Chinook in the subbasin is very low based both on female spawning escapement and the number of returning adults per spawner. To supplement natural production, annual outplanting of several hundred adult females from Priest Rapids and Ringold Springs Hatcheries started in 1996. The historic distribution of fall Chinook in the subbasin is unclear because traditionally fall and spring Chinook were recognized as one species and it is unknown where divisions between their spawning habitats occurred. Because of the low number of returning adults there is no tribal or sports harvest of adults; however, there is a small harvest of returning jacks.

Coho were reintroduced into the subassin in 1966 with Tanner Creek stock. The hatchery program stopped in 1969 and did not pick up again until 1987 (using the same stock). Adult returns to the Umatilla River have been enumerated since 1988. Between 1988 and 2003 the number of adults returning has varied widely, from 356 (in 1992) to 22,792 (in 2001) and averaged 3,669 adults. Jack numbers have also varied during this time from 16 (in 1993) to 1,276 (in 2000) and averaged 361 jacks. As with steelhead and spring Chinook the number of adults returning shows an increasing trend from 1998 on. For all species, this increasing trend might reflect positive changes in ocean conditions resulting from a PDO phase shift. Productivity, based on spawning escapement, has also seen an increase from 1998 to 2003. It is difficult to compare the current vs. the historic distribution of coho in the subbasin because the historic distribution is unclear. Records specifically stating that coho were in the Umatilla River or Willow Creek are not available. The coho hatchery program supports a sports fishery and from the years 1992 to 2001 an average number of 240 adults and 62 jacks were harvested, representing 5% of the adult run and 33% of the jack run.

Determination of Limiting Factors and Priority Areas

To determine the limiting factors and priority areas for restoration and protection for the natural production of each focal species, two modeling methods were used. EDT was used for the anadromous species and QHA was used for bull trout in the Umatilla River subbasin and redband trout in the Willow Creek subbasin. Both modeling approaches identify limiting factors and prioritize geographic areas for restoration and protection. Results of the models revealed that the primary limiting factors were sediment load, high water temperatures, habitat complexity, and habitat quantity. These factors can be addressed by improvements to specific attributes of the environment through restoration techniques.

The EDT results presented in this draft of the plan represent only a preliminary attempt at using EDT for the Umatilla subbasin. Several problems were encountered with how the model had been developed for the subbasin at a time when it was too late to change the model before the May 28, 2004 deadline. Therefore, the results presented here should be viewed as preliminary and there are plans to update and finalize the model during the summer of 2004.

EDT modeling was also used to examine the impact of three restoration scenarios on anadromous focal species populations:

1) Habitat restoration of the top priority geographic areas singly plus the implementation of Phase III of the Umatilla Basin Project.
2) Habitat restoration of the top 19 geographic areas plus implementation of Phase III.
3) Habitat restoration of the top 19 geographic areas with no implementation of Phase III.

Results of these scenario runs were used to develop working hypotheses regarding the impact of the restoration actions on the abundance of naturally produced adults and the productivity of the population.

Aquatic Working Hypotheses

The following working hypotheses were developed for each anadromous focal species from the results of the EDT modeling.

Steelhead – EDT estimate of current abundance = 2,650 adults and productivity = 4.9

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in no impact on productivity and an increase in returning adult abundance by approximately 2% (adult abundance = 2,705).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 43% (a value of 7.0) and an increase in returning adult abundance by approximately 36% (an abundance of 3,610 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 37% (a value of 6.7) and an increase in returning adult abundance by approximately 30% (an abundance of 3,443 adults).

Spring Chinook – EDT estimate of current abundance = 440 adults and productivity= 2.3

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 42% (a value of 3.4) and an increase in returning adult abundance by approximately 152% (adult abundance = 1,108).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 100% (a value of 4.6) and an increase in returning adult abundance by approximately 287% (an abundance of 1,702 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 83% (a value of 4.2) and an increase in abundance of returning adults by approximately 127% (an abundance of 998 adults).

Fall Chinook – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 200% (a value of 1.2) and an increase in returning adult abundance to approximately 1,457 fish.

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 350% (a value of 1.8) and an increase in returning adult abundance to approximately 4,192 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 275% (a value of 1.5) and an increase in abundance of returning adults to approximately 3,005 fish.

Coho – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 25% (a value of 0.5); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 150% (a value of 1.0) and an increase in returning adult abundance to approximately 69 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 125% (a value of 0.9); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

Not surprisingly, these results suggest that the greatest amount of action (restoring all 19 geographic areas and implementing Phase III) has the greatest impact on steelhead and salmon productivity and abundance. However, the relative benefit of different actions varies among the species. For example, implementation of Phase III has a relatively small impact on steelhead, while restoring all 19 areas has a large impact. In contrast, implementing Phase III and restoring only the most important geographic area has a greater impact on spring Chinook than restoring all 19 areas and not implementing Phase III. A future challenge will be to examine the economic cost effectiveness, cultural, social, and political ramifications of each restoration scenario.

1.2.9 Terrestrial Wildlife Assessment

General Approach

The terrestrial wildlife assessment is based on an approach that not only considers focal species but also the habitats on which they depend. By combining a "coarse filter" (focal habitats) with a "fine filter" (focal wildlife species assemblage) approach, subbasin planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for terrestrial wildlife. This approach not only identifies priority focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. These habitat attributes are termed "key environmental correlates". Subbasin planners assume that conservation and management directed towards focal species will establish conditions that will also benefit a wider group of species with similar habitat requirements.

The use of focal species also has the additional benefit of drawing immediate attention to habitat features and conditions most in need of conservation or most important in a properly functioning ecosystem. These focal species can serve as "poster" species for a given habitat type, helping stakeholders and the public to better relate to the somewhat abstract notion that habitats are often the primary target of management actions, not species.

Umatilla/Willow subbasin planners selected ten focal species from a list of focal candidates that met one or more of the categories indicating ecological importance. These species were associated with eight focal habitats and have life requirements representative of habitat conditions or features that are important within properly functioning focal habitats. Planners also looked for species to provide a focus for describing desired habitat conditions, attributes, and needed management strategies and/or actions. The ten focal species and eight focal habitats are described below.

The terrestrial assessment was conducted using existing data on the Umatilla/Willow subbasin in combination with a new product, the Interactive Biodiversity Information System (IBIS), which was made available through the subbasin planning effort. In most cases, IBIS was relied on for providing information on 1) wildlife species occurrences in the subbasin, 2) the ecological and conservation status of those species, 3) historic and current distribution of habitat types found in the subbasin, 4) general information about focal habitats, 5) information on the ownership and protection status for each habitat, and 6) functional redundancy analyses. However, in some cases data generated from IBIS were clearly inaccurate; in these cases, other sources were used if possible. In other cases, the data seemed questionable; in these cases, caveats are expressed in the text. Another limitation of the database, and of current knowledge in the subbasin, is a lack of quantitative information on habitat quality, especially in regards to the key environmental correlates of focal species.

Terrestrial Wildlife Assessment Results

Results specific to each focal habitat type, including status, limiting factors, focal species selected, working hypothesis, and current protection and ownership, are presented below. A general discussion of opportunities and data gaps and uncertainties follows.

Mixed Conifer Forest: Mixed conifer forest in the subbasin is estimated to have doubled in area since c. 1850. However, the quality of mixed conifer forest is believed to have decreased primarily because of timber harvest and altered fire regimes. Other factors that negatively impact mixed conifer forest habitat quality are ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasions. Mature mixed conifer stands (dominated by trees 150-300 years old) are believed to be rare. The Pileated Woodpecker was selected as a focal species for mixed conifer forest because mature conifer forest provides the necessary key environmental correlates required by the Pileated Woodpecker. Pileated Woodpeckers are believed to have declined in the subbasin because of the limited amount of high quality mixed conifer habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Pileated Woodpecker and other wildlife species strongly associated with mature conifer habitat. Most (>90%) of the mixed conifer habitat in the Umatilla/Willow subbasin is under no or low protected status and most (67%) is federally owned, suggesting that strategies aimed at increasing protection and enhancement by working with federal agencies should be emphasized.

Ponderosa Pine Forest: Ponderosa pine forest in the subbasin is estimated to have increased in area by 10% since c. 1850. However, the quality of ponderosa pine forest is believed to have decreased primarily because of timber harvest, altered fire regimes and stand replacing fires, and mixed conifer encroachment. Other factors that negatively impact ponderosa pine forest habitat quality are exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities. Old growth ponderosa pine stands (dominated by trees > 150 years old) are believed to be rare. The White-headed Woodpecker was selected as a focal species for ponderosa pine forest because old growth ponderosa pine provides the necessary key environmental correlates required by the White-headed Woodpecker.

White-headed Woodpeckers are believed to have declined in the subbasin because of the limited amount of high quality ponderosa pine habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the White-headed Woodpecker and other wildlife species strongly associated with old growth ponderosa pine. Most (>90%) of the ponderosa pine habitat in the Umatilla/Willow subbasin is under no or low protected status and most (61%) is privately owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

Quaking Aspen: An estimated 94% of quaking aspen forest in the Umatilla/Willow subbasin has been lost since historic times (c. 1850). Although good data on current distribution of quaking aspen are lacking for most of the subbasin, less than 100 acres are estimated to remain. In addition, subbasin planners believe that much of the remaining habitat is degraded primarily by intensive grazing of livestock and native ungulates, fire suppression, and the invasion of coniferous species. The Red-naped Sapsucker was selected as a focal species for quaking aspen because the habitat provides the necessary key environmental correlates required by the Red-naped Sapsucker. Red-naped Sapsuckers are believed to have declined in the subbasin because of the limited amount of high quality quaking aspen habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Red-naped Sapsucker and other obligate quaking aspen species. Although no data are available from IBIS on the ownership or protected status of the limited amount of quaking aspen habitat in the subbasin, subbasin planners believe that most of it is on CTUIR or federal lands with an uncertain protected status. Thus, strategies aimed at increasing protection and enhancement by working with federal and tribal agencies should be emphasized.

Western Juniper: Data provided by IBIS concerning the present and historic distribution of juniper in the Umatilla/Willow subbasin are questionable. An alternative source suggests that juniper habitat associated with grassland and shrub-steppe is believed to have decreased by 50-65% since historic times. In contrast, the current distribution of mid-elevation transitional zone juniper woodland is believed to have remained relatively constant. Regardless of the amount currently in existence in the subbasin, subbasin planners believe the quality of this habitat has declined because of agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions. Mature juniper trees and stands are believed to be particularly rare. The Ferruginous Hawk was selected as a focal species for western juniper because mature juniper trees and stands provide the necessary key environmental correlates required by the Ferruginous Hawk. Ferruginous Hawks are believed to have declined in the subbasin because of the limited amount of high quality western juniper habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Ferruginous Hawk and other obligate western juniper species. Most (99%) of the western juniper habitat in the Umatilla/Willow subbasin is believed to be unprotected and most (99%) is privately owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

Shrub-Steppe: Data provided by IBIS concerning the present and historic distribution of shrub-steppe in the subbasin are questionable. An alternative source suggests that certain types of shrub-steppe habitat, primarily low-elevation shrub-steppe types, have decreased dramatically since historic times; big sagebrush steppe has declined by an estimated 86% and bitterbrush habitat has declined by an estimated 55%. In addition, the remaining remnants of these types of sagebrush habitats are believed to be heavily degraded. Major factors affecting shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing. The Sage Sparrow was selected as a focal species for shrub-steppe because the habitat provides the necessary key environmental correlates required by the Sage Sparrow. Sage Sparrows are believed to have declined because of limited high quality shrub-steppe habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Sage Sparrow and other obligate shrub-steppe species. Five areas identified in the assessment contain not only a large portion of the existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. These areas are also significant because many of them have large portions of land that are owned or controlled by the federal government and TNC. Thus, these five areas represent an excellent opportunity to protect and enhance some of the best existing low-elevation shrub-steppe in the Umatilla/Willow subbasin through cooperation with the federal government, TNC, and private landowners.

Interior Grasslands: Interior grasslands in the Umatilla/Willow subbasin are estimated to have declined by 74% since historic times (c. 1850). In addition, subbasin planners believe that the quality of remaining grassland habitat has also decreased. Major factors affecting interior grasslands in the subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. The Grasshopper Sparrow was selected as a focal species for grassland habitat because high quality grasslands provide the necessary key environmental correlates required by the Grasshopper Sparrow. Grasshopper Sparrows are believed to have declined because of limited high quality grassland habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Grasshopper Sparrow and other wildlife species strongly associated with high quality grassland habitat. Most (99%) grassland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (82%) is privately-owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

Herbaceous Wetlands: The area of herbaceous wetland habitat in the Umatilla/Willow subbasin is estimated to have declined by 75% since historic times (c. 1850), with only 4,670 acres estimated to occur in the subbasin presently. In addition, the quality of remaining herbaceous wetlands is believed to have decreased. Major factors that have led to the destruction and degradation of herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal

invasions, and livestock grazing. The Columbia spotted frog was selected as a focal species for herbaceous wetlands because good quality habitat provides the necessary key environmental correlates required by Columbia spotted frog. Columbia spotted frogs are believed to have declined because of limited high quality herbaceous wetland habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Columbia spotted frog and other obligate herbaceous wetland species. Most (86%) herbaceous wetland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (74%) is privately owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners, especially through cooperative programs and education, should be emphasized.

Riparian Wetlands: The amount of riparian wetland habitat presently occurring in the Umatilla/Willow subbasin is uncertain. Estimates suggest that from 86% to 99% of riparian wetlands have been lost in the subbasin since historic times (c. 1850). In addition, the quality of remaining riparian wetlands is believed to have declined. Major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. The Great Blue Heron, the Yellow Warbler, and the American beaver were selected as focal species for riparian wetlands because high quality riparian wetlands provide the necessary key environmental correlates required by these species. All three species are believed to have declined because of limited high quality riparian habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit all three species and other wildlife species strongly associated with high quality riparian habitat. Most (>94%) of the riparian wetland habitat in the Umatilla/Willow subbasin is estimated to be under no or low protected status. However, the ownership status of riparian wetlands is unclear, with estimates differing over whether most riparian wetland habitat is found on private land or CTUIR land. Regardless, strategies aimed at increasing protection and enhancement by working with either CTUIR and/or private landowners should be emphasized.

General Considerations: Although opportunities for protection and enhancement of each focal habitat are dictated by its protected status and ownership, and thus vary by habitat, a general opportunity to protect and enhance wildlife habitat and populations applies to all habitat types. As discussed above, a large portion of the subbasin's economy is related to agriculture, which is often pitted against fish and wildlife interests in other areas. The Umatilla/Willow subbasin is unique in that agricultural, tribal, and governmental groups, as well as other stakeholders, have worked together to form mutually acceptable solutions to fisheries and wildlife problems in the past. This past history of success is an opportunity in the sense that it has developed a foundation of trust and cooperation that can be capitalized on in the future. Thus, subbasin planners are committed to continuing with this cooperative model as they develop and implement terrestrial wildlife objectives and strategies.

Finally, data gaps and uncertainties became obvious during the terrestrial wildlife assessment. Although the magnitude of uncertainty varies by habitat, the following

actions are needed to fill those gaps: 1) obtain data on the quality of focal habitats in the Umatilla/Willow subbasin, including data on ecological function as related to the focal and other obligate species, 2) refine or gather information on habitat suitability for focal species in the subbasin, 3) refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of focal habitats, 4) identify areas in the subbasin that could be converted to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches, 5) generate population and distribution data for focal and other obligate species in the Umatilla/Willow subbasin, and 6) determine the amount of high quality habitat needed to support viable populations of focal species in the subbasin.

1.3 Summary of the Inventory

The inventory presents a brief summary of the important legal protections, management plans, management programs, and projects in the subbasin. Legal protections are laws and legal agreements that protect both species and habitats (e.g., the Wilderness Act, conservation leases). Management plans are existing plans that guide conservation and restoration practices, development, and land use practices. Management programs are programs designed to assist governmental bodies or private individuals in the management of their lands (e.g., CRP and EQIP programs in the federal Farm Bill). The project inventory is a listing of restoration projects that have been conducted in the subbasin and designed to restore fish and wildlife habitat.

The final section of the inventory is a gap analysis designed to determine whether existing projects have been addressing the limiting factors identified in the assessment and if those projects have been conducted in the appropriate geographic areas as identified in the assessment. The gap analysis revealed that, in general, existing projects have been addressing the appropriate limiting factors. However, the gap analysis suggests there are some priority areas that have received little attention in terms of projects. These conclusions need to be interpreted with great caution. Many projects were started 5 to 10 years ago, and some are older than that, and our identification of limiting factors and priority geographic areas is based on data that ranges from 10 years old to less than one year old. Therefore, we do not know what conditions were like when projects began and it is erroneous to conclude that projects have been misplaced (either geographically or in terms of the limiting factor they address). In addition, the gap analysis cannot be used to determine the success of projects because managers do not know the conditions of limiting factors before the projects began and how they changed after project implementation. This issue identified one of the major data gaps in the subbasin: good data on the effectiveness of projects. This gap does not result from a lack of desire by local biologists and managers, but a lack of funding being made available for rigorous monitoring and evaluation of projects. Therefore, the gap analysis is of limited usefulness and can only provide a very general guide on whether future actions should follow past actions.

1.4 Summary of the Management Plan

The management plan for the Umatilla/Willow subbasin begins with a vision statement, which describes the desired future condition of the subbasin and reflects the current

conditions, values, and priorities of the subbasin in a manner that is consistent with the Council's vision described for the Columbia basin. The following vision statement for the Umatilla/Willow subbasin was adopted by the Core Partnership on November 6, 2003 and was presented and approved at a public meeting on November 12, 2003.

> The vision for the Umatilla/Willow subbasin is a healthy ecosystem with abundant, productive, viable, and diverse populations of aquatic and terrestrial species, which will support sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin and the Pacific Northwest.
>
> This vision entails several broad goals for the subbasin that can be categorized as human use; habitat; population; and research, monitoring, and evaluation goals.
>
> **Human Use**
> - Provide for non-consumptive recreational, educational, aesthetic, scientific, economic, cultural, and religious uses of the subbasin's diverse fish and wildlife resources.
> - Provide for sustainable consumptive, ceremonial, subsistence, and recreational uses of the subbasin's diverse fish and wildlife resources.
> - Provide for sustainable resource-based activities to support the economies and cultures of the communities within the subbasin.
>
> **Habitat**
> - Protect existing high quality fish and wildlife habitat and strongholds.
> - Restore and enhance degraded and diminished fish and wildlife habitats to support population restoration goals and to mitigate impacts from the construction and operation of the Columbia basin hydropower system and other anthropogenic impacts.
> - Restore the health and function of ecosystems in the Umatilla/Willow subbasin to ensure continued viability of their natural resources.
>
> **Population**
> - Maintain and enhance the diversity, abundance and productivity of existing fish and wildlife populations within the subbasin.
> - Strive for de-listing and avoidance of future listings of native fish and wildlife species in the subbasin under state and federal Endangered Species Acts.
> - Restore and maintain self-sustaining populations of extirpated species consistent with habitat availability, public acceptance, and other uses of the lands and waters of the state.
>
> **Research, Monitoring, and Evaluation**
> - Develop a research, monitoring, and evaluation plan for the ecosystems of the subbasin that is consistent with and complements the larger regional efforts to track the status of fish and wildlife populations and their habitats as needed for appraising management actions, the results of these actions, and for evaluating other environmental changes.

The development of objectives and strategies for the subbasin's aquatic and terrestrial wildlife management plan was driven by the vision, the current biological and ecological

conditions in the subbasin, and the economic and social realities described in the assessment. The biological objectives describe the physical and biological changes within the subbasin needed to achieve the vision. When forming aquatic and wildlife biological objectives and strategies, subbasin planners worked to satisfy the criteria set forth by the Council (2001) in its *Technical Guide to Subbasin Planners* and to ensure consistency of the plan with the requirements of the Endangered Species Act and the Clean Water Act.

1.4.1 Aquatic Management Plan

A general objective for aquatic focal species is to enhance natural productivity and to develop strategies to produce enough returning adults to support both tribal and sports fisheries and to support a large enough escapement to increase natural productivity. This objective will be met through both enhancing natural production and continuing to supplement populations through artificial production.

Natural Production -- Objectives and Strategies
In the Umatilla River subbasin the main objective is to improve habitat of the focal species to increase productivity and abundance. In addition, another objective is to improve access to many areas of the subbasin.

In the Willow Creek subbasin the main objective is the same: improve habitat for focal species to increase productivity and abundance. Another objective in this subbasin is to improve passage barriers to a degree that will allow summer steelhead to re-populate the subbasin.

To address these objectives, 14 strategies were developed by the Umatilla/Willow Creek Subbasin Aquatic Working Group. These strategies, with a brief explanation, are not listed in order of priority here, but are prioritized by geographic area as related to primary limiting factors in the management plan.

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects. Under Phase III, summer flows in the Umatilla River will be enhanced (and water temperatures decreased) from Thornhollow Springs to the mouth.
2) Purchase water rights from willing sellers. Purchased water rights can come from water directly removed from the Umatilla or Willow mainstems and tributaries or from McKay and/or Willow Creek reservoirs. This water can then be left instream or released from McKay or Willow Creek reservoirs to enhance flows and decrease temperatures.
3) Depending on return flows and impacts to water temperature, water conservation and irrigation efficiency projects can be a tool. This strategy will aid in improving streamflow by reducing the quantity of water withdrawn for agricultural, industrial or municipal purposes. Typical conservation projects include conversion of flood irrigation systems to sprinklers, piping and lining of irrigation ditch systems, irrigation scheduling and water management, and decreased watering of lawns by municipalities.

4) Modify zoning and flood control planning through regulatory actions. By working to improve zoning ordinances to prevent development of riparian areas and floodplains, better riparian function and channel-floodplain connection can be attained and/or maintained.
5) Place large woody debris and large boulders. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve instream habitat. Placing large woody debris and large boulders directly increases habitat complexity and can improve habitat quantity by increasing the number of pools.
6) Fence and plant riparian zones. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve riparian habitat. Fencing is installed to manage use of the riparian zone by livestock and planting of native vegetation is done to speed the recovery process once grazing or other land uses have been modified. Riparian habitat improvements can directly impact stream temperatures and sediment inputs (through stabilizing streambanks and filtering runoff).
7) Modify channel and floodplain function. Where opportunities exist, work on public, federal, state, tribal, and private lands will be conducted to improve form and function of stream channels. This work involves directly or indirectly returning stream channels to a functional state that is determined by the valley form, geology, soils, vegetation and climate. Specific parameters often targeted by this type of work include channel width and depth, sinuosity, slope, flood prone area, and ratio of channel features.
8) Construct pool and riffle habitat using in-stream modifications. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to increase the quantity of pools and gravel dominated riffles (as opposed to cobble). Straightening and entrenchment of stream channel is a common problem in the Umatilla Basin that leads to the reduction of pool habitat and gravel dominated riffles. Pools will be constructed by direct intervention, often concurrently with work to restore channel form and function, and the quantity of gravel dominated riffles will be improved by decreasing channel slope, reducing entrenchment and confinement, and restoring pool/riffle sequencing.
9) Maintain, relocate, or eliminate forest, public, and private roads in riparian and sensitive areas. Where opportunities exist, work on public, federal, state, tribal, and private lands will be conducted to address problems caused by roads. Roads are a source of sediment and a means of rapidly routing sediment to streams, occupy historic riparian zones, and often result in stream confinement. Maintenance, relocation or removal of roads are the primary tools for addressing the problems.
10) Increase protective status of priority habitats. Where habitats have high value due to their current productive capacity or general importance to particular species, they should be protected to maintain their value. This can be accomplished by easements and other kinds of natural resource protection agreements, or on public lands by varying kinds of protections authorized by statute or rule.

11) Modify detrimental land use activities. Change land use activities leading to degradation of habitat, thereby allowing stream attributes impacted by these activities to recover without intervention. A common example of this kind of work is riparian buffers where streamside areas are protected from uses such as livestock grazing or agricultural crops.
12) Restore upstream or headwater attributes to improve downstream conditions. In particular, water quality problems are cumulative in a downstream direction. Sources of water quality problems at a particular location can often be sourced to areas upstream. This is also true of large wood debris. The source of large woody debris for some reaches can be primarily from upstream reaches. Limiting factors such as fine sediment, water temperature and large wood debris should be addressed at the watershed scale as well as the reach/geographic area scale. Understanding of these problems at the watershed scale is necessary, however, to effectively work at this scale. Actions such as restoration of riparian vegetation and channel function upstream of areas limited by temperature, sediment and/or large wood should be particularly effective.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions. Correction of passage deficiencies should be corrected wherever they exist.
14) Maintain passage efficiency. Structural fixes installed to provide fish passage over irrigation dams require maintenance to operate within design criteria. All fish passage facilities should be maintained to provide optimal passage conditions.

Artificial Production – Objectives and Strategies
The main objective of artificial production in the subbasin is to supplement natural production to support tribal and sport fisheries and to provide an abundance of returning adults to augment spawning escapement.

The strategies to achieve this objective are:
1) Continue to supplement the recently reintroduced spring Chinook population with a hatchery program using Carson stock brood returning to the Umatilla River to provide for natural production and harvest.
2) Continue to supplement the recently reintroduced fall Chinook population with a hatchery program using upriver bright stock brood returning to the Umatilla River and Priest Rapids Hatchery to provide for natural production and harvest.
3) Continue to supplement the recently reintroduced coho population with a hatchery program using early run stock brood from Bonneville Hatchery to provide for natural production and harvest.
4) Continue to supplement the indigenous summer steelhead population with a hatchery program using native stock brood returning to the Umatilla River to enhance natural production and provide harvest opportunities.

1.4.2 Terrestrial Wildlife Management Plan

The development of 26 objectives and 90 strategies for the terrestrial wildlife management plan was driven by the vision for the subbasin, the current biological and

ecological conditions, and the economic and social realities described in the assessment. The biological objectives for wildlife describe the physical and biological changes within the subbasin needed to achieve the vision. For wildlife, these objectives (and their associated strategies) are primarily described in terms of changes needed in focal habitats, rather than in population-related attributes of focal or obligate species. Focal species-centered objectives and strategies are not appropriate for wildlife because of the lack of adequate information available on focal species needed to form biological objectives. Instead, the wildlife plan is composed primarily of habitat-centered objectives and strategies that focus on the ecological function of the habitat (i.e., its ability to provide the key environmental correlates identified for the focal and other obligate species). Thus, the primary role of focal species in forming the management plan is in the use of their needs to define functional habitat and, in some cases, in the research, monitoring, and evaluation component of this plan.

Wildlife objectives and strategies were developed by the Umatilla/Willow Subbasin Terrestrial Wildlife Workgroup. An early draft set of objectives and strategies for three habitat types was presented at a public meeting on May 6, 2004 and suggestions provided at that meeting were used to revise the objectives and strategies. Objectives and associated strategies were developed for each habitat, with the exception of a general objective which applies to all eight focal habitats. This objective, which is not strictly a biological objective, was developed in response to data gaps that became apparent when conducting the subbasin assessment. Addressing these data gaps was deemed to be a high priority because the lack of knowledge presented a substantial obstacle in developing firm quantitative biological objectives for many habitats. Thus, completing this objective will be instrumental in implementing effective adaptive management in the subbasin for terrestrial wildlife species.

Biological objectives for each focal habitat type generally fall into one of three categories: protection, enhancement, and conversion. Protection objectives relate to increasing the legal or administrative protection of the habitat, although they do not preclude active management. In fact, the higher the protection, the more likely it is that management would prohibit activities that degrade or destroy habitat and would encourage practices that would mimic natural disturbances. Thus, there may be some overlap between objectives related to protection and those that address enhancement. However, enhancement objectives focus exclusively on maintaining or increasing the ecological function of focal habitats, especially with respect to focal and other obligate species. Finally, objectives related to conversion or restoration, seek to increase the amount of focal habitat in the subbasin by converting it or restoring it from some other habitat type. In general, for each habitat subbasin planners sought to protect a realistic amount of the best quality habitat, to enhance protected habitat, and to increase connectivity or size of existing habitat or create new reservoirs of habitat through conversion/restoration.

Where possible, objectives within each habitat type were prioritized. In addition, each set of strategies associated with an objective was also prioritized to the extent possible. Although multiple alternative strategies were considered for every objective, strategies

rejected are not specifically listed under each objective because they generally fell into three categories: 1) strategies that were not consistent with the economic, political, or social realities of the subbasin, 2) strategies that were believed to have a low chance of success, and/or 3) strategies that were not as efficient at producing results as the strategies eventually selected.

Adaptive management plays a central role in the Umatilla/Willow wildlife plan, and is, in fact, built into the objectives. The completion of the first general objective will provide important information that can be used to refine and modify the biological objectives and strategies for each focal habitat, as needed. Additional information gained though research, monitoring, and evaluation will also be used to continually update the plan throughout its life.

1.4.3 Research, Monitoring and Evaluation

Research, monitoring, and evaluation (RM&E) plans were developed for both fish and wildlife programs. The goals of these plans are to monitor trends in focal species and habitats, evaluate the efficacy of management strategies in accomplishing objectives, and to conduct research to address critical uncertainties in the understanding of the biological and ecological systems in the subbasin and their management. A variety of methodologies for RM&E are presented both for fish and wildlife programs.

The enhanced RM&E plans currently under development address local management information needs. The draft plans will incorporate regional RM&E programs and protocols as they are developed. For the aquatic plan these protocols will come from the Collaborative System-wide Monitoring and Evaluation Project (CSMEP), the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), and regional genetics monitoring. For the terrestrial plan these protocols will come from coordination among terrestrial wildlife managers who are currently working to develop standard protocols across the ecoregion. The draft RM&E plan reflects much of this coordination effort to date. The draft plans in Appendix H are working documents that will be finalized during the review process (to ensure regional and ISRP oversight is incorporated into the plans).

The RM&E plans support Independent Scientific Review Panel (ISRP), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and Oregon Fish and Wildlife (ODFW) recommendations, beyond current funding levels, to monitor fish and wildlife populations, status, distributions, and productivities and the habitats they require.

Literature Cited:

Council (Northwest Power Planning Council) (2001) *Technical Guide to Subbasin Planners*. Northwest Power Planning Council Document #2000-20, Portland, Oregon.

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