5 Management Plan

5.1 Vision

The Willamette Subbasin Plan Oversight Group (see Chapter 2) developed the vision statement for this *Willamette Subbasin Plan*. The group's discussions emphasized that effective conservation and restoration in the Willamette Basin must be guided by an understanding of the systemic nature of ecosystem processes, functions, and dynamics. Long-term effectiveness will require enabling the natural process and dynamics that form and maintain diverse habitats to occur. The group stressed that restoration actions should be sequenced for maximum effectiveness, considering the importance of hydrology, habitat creation and maintenance, and biological communities. The group agreed that, overall, the Willamette Basin needs to be seen as a string of connected habitats. Accordingly, the group drafted the following vision:

> *Willamette Basin citizens from all walks of life prize and enjoy a quilt-work of natural areas, working landscapes, and distinctive communities, from the crest of the Coast Range to the crest of the Cascades—a place characterized by dynamic natural processes that create and sustain abundant and diverse communities of native fish and wildlife and the aquatic and terrestrial habitats on which they depend, thereby assuring substantial ecological, cultural, and economic benefits.*

5.2 Key Findings: Basinwide Priorities

5.2.1 Key Findings

As described in Section 3.6, Willamette Basin ecosystem functions and processes have been disrupted, creating an interwoven array of environmental challenges. The ecosystem processes that have undergone the most disruptive change are flow, channel form, and connectivity. Disruptions in these processes, in turn, have created a host of negative habitat changes, including temperature problems, low streamflows, and habitat fragmentation. The ability to stop additional habitat loss and reverse species declines is, in part, a function of institutional effectiveness.

This Management Plan identifies strategies that will effectively address these key process disruptions and the environmental symptoms they produce. Because the identified strategies are ecosystem-based, they tend to be mutually beneficial to both fish and wildlife species. It is also clear that how the strategies are applied—that is, how they are anchored on the ground—requires locally led processes that employ common analytical frameworks.

However, this Management Plan does not attempt to isolate, elevate, or preselect the single most important strategy or strategies, for several reasons: because there is no single cause for these disruptions, because the multiple causes act in concert, and because a rich, local dialogue about these systemwide problems has not yet taken place. To regain viable populations of fish and wildlife species in the basin, we will have to do many things simultaneously for a long time.

Because we live within human time-scales and act within social budgets of time, money, and public permissions, there is a dynamic tension between the need to be true to principles of holistic ecosystem management over decades and the urgent need to make choices today with limited funds and imperfect—but growing—knowledge.

In recognition of that urgent need, the following basinwide priorities are recommended as productive focal areas for conservation efforts in the next 10 to 15 years.

5.2.2 Basinwide Priorities

5.2.2.1 Deal with the Dams

Salmon, steelhead, and some other species have been cut off from some of the highest quality aquatic habitat in the Willamette Basin. Getting adult fish above the dams once again, and juveniles back below, represents one of the clearest opportunities in the next 10 to15 years to dramatically increase the abundance, capacity, and diversity of listed salmonids. In addition, learning new ways to manage dams to meet competing demands—including providing for alternative flow releases to emulate more natural flow regimes—will have substantial impacts on both fish and wildlife populations. Therefore, the development and public airing of the Willamette River Basin Project biological opinion will warrant the attention and participation of all stakeholders.

5.2.2.2 Fix Culverts and Diversions to Allow Fish Passage

The density of roads, especially in lowlands, poses significant impediments to the migration of fish to better upland habitat. The database of known road-stream crossings has recently been improved, allowing more ready access to information on their location and ownership, the severity of the problems they cause, and their relation to upstream habitats. This, coupled with state programs to promote fish screening for diversions, also represents a near-term opportunity for conservation success.

5.2.2.3 Focus on Valley and Foothills Wildlife*

As described in this plan and illustrated in the *Willamette River Basin Planning Atlas*, the Willamette Basin has lost 80 percent of its bottomland forests, 97 percent of its natural grasslands, and nearly100 percent of its oak savanna. Conservation attention has been focused for decades on upland forests. Restoration efforts should now focus on these valley and hillside habitats to benefit the unique and sometimes rare wildlife species that live there. The information and approaches developed in this plan should provide a new capacity to aid this effort.

5.2.2.4 Restore Lowland Riparian Areas*

Riparian vegetation along lowland streams and rivers in agricultural and urban areas needs to be reestablished. Riparian areas are important for both wildlife and aquatic species. Planting native vegetation along streams is a cost-effective way to improve habitat for both aquatic and terrestrial species, in all settings: forested, agricultural, urban, and rural residential. While any natural vegetation is good, forested riparian areas are best for shading and adding logs and nutrients to the stream. Vegetation nearest the stream has the greatest influence, so it is most important to plant the full length of the stream. One long zone is more useful than several shorter, disconnected zones.

* Paraphrased from the *Willamette River Basin Planning Atlas* (PNERC 2002), whose authors suggest these recommendations "if Oregonians choose to enhance protection and restoration of natural resources and biodiversity in the Willamette Basin."

5.2.2.5 Restore Low-Cost, High-Return Areas of the Willamette River Floodplain*

Natural flow regimes, periodic flooding, complex channels, and functioning riparian areas are required to create and maintain the habitat features and dynamics that make floodplains especially productive and biologically diverse. The best areas of the river and its floodplain to restore are those that have the highest potential for recovery of complex, biologically diverse habitats and those areas where local people are likely to be supportive. The Willamette Basin is unique in having both the detailed information and active citizenry to make this feasible.

5.2.2.6 Let the River Cool Itself*

When the river flows through gravel, important chemical changes take place and the water temperature drops. Encouraging the river to flow more freely through more islands, alcoves and gravel bars will both increase habitat for aquatic species and improve water quality. This sets the stage for what could be a powerful interaction between urban interests that are being required to meet new water standards and rural areas that can help them do this through enhanced stewardship of the working landscape.

5.2.2.7 Ensure That All of the Priority Themes Above Are Taken Up in an Organized Way at the Local Level

This plan cannot succeed unless grass-roots conservation organizations, local governments, state and federal agency local units, and watershed groups understand and agree with the identification of system-level needs—and then agree to identify how local contributions can help meet those needs. This subbasin plan is intended to provide useful and credentialed information—as well as new tools—for use by conservation practitioners. The information and tools would be best disseminated if there were a continuing commitment to sponsoring local dialogue and refining this plan.

5.3 Aquatic and Terrestrial Biological Objectives

According to the Northwest Power and Conservation Council, biological objectives describe physical and biological changes needed to achieve the subbasin vision. Objectives have two components: (1) biological performance, which describes the responses of focal species to habitat conditions in terms of capacity, abundance, productivity, and life history diversity, and (2) environmental characteristics, which describe the environmental conditions needed to achieve the desired biological performance. Where possible, biological objectives are intended to be empirically measurable and based on an explicit scientific rationale.

In general and as described further below, WRI relied on already-articulated biological performance measures, such as population objectives developed by ODFW and the U.S. Fish and Wildlife Service for threatened or endangered fish species. In terms of environmental conditions, or “habitat objectives,” WRI proposes a number of objectives developed by previous studies, as well as some that were identified during the development of this subbasin plan.

5.3.1 Aquatic Biological Objectives

5.3.1.1 Biological Performance Objectives

Fish management agencies have established quantifiable performance targets for all focal species in the Willamette Basin. Performance objectives articulated by interested agencies and organizations are not always the same and are not always measured in the same way (ODFW 1998, WLCTRT 2003; NPCC 2002). Regardless of consistency among the variety of the performance targets or the metrics used to measure success, no focal species in the Willamette Basin has sustained performance levels near any numerically stated target.

It is important to note that cyclical spikes and drops in fish species abundance have occurred since people have been counting fish in the Willamette Basin—especially in populations of returning salmon. One of those spikes is occurring at the moment. At the time of this writing, the projected run size of spring Chinook salmon passing Willamette Falls is 109,400 fish—more than 9,000 more than the ODFW objective of 100,000. The vast majority of these fish are thought to be of hatchery origin. Relationships between hatchery production, ocean conditions, habitat, and wild and hatchery returns of Pacific salmon are not fully understood. This uncertainty must be considered when developing biological objectives. In other words, biological objectives should address trends, not cycles.

EDT is one model that attempts to capture the relationship between habitat potential and species performance. This model is useful in helping to establish more realistic performance objectives. In its fully developed form, EDT can help planners estimate the potential effectiveness of conservation and restoration activities on species performance—essentially, EDT can help planners compare the effectiveness of a variety of scenarios to accomplish performance targets. EDT has not yet been fully developed in the Willamette Basin. In the McKenzie and Clackamas subbasins, draft diagnosis portions of EDT have been developed, but time and resources did not permit development of any local objectives or scenarios.

Spring Chinook and Winter Steelhead

This planning process revealed what many others before it have: that current information on the many variables that determine the status of spring Chinook and winter steelhead are limited (ODFW's *Willamette Basin Fish Management Plan,* March, 1998). The scarcity of tested knowledge limits the ability of scientists to clearly define measurable population objectives that have a scientifically justified relationship to a stated goals of persistence. The Oregon Department of Fish and Wildlife, the Willamette Lower Columbia Technical Recovery Team, the Pacific Northwest Fisheries Science Center, and NOAA Fisheries are working together to establish population viability curves based on the best available information, to guide recovery efforts. The analysis and development of the viability curves are still underway as of this writing. The population viability curves will be the most rigorous identification to date of population abundance targets and will go a long way toward establishing scientifically justified goals and objectives for the many efforts currently underway and planned for salmon recovery.

On May 19, 2004, the Technical Outreach Assistance Team delivered a tool to subbasin planners to help established species productivity targets for anadromous salmonids. No reliable and technically reviewed productivity figures for Willamette Basin salmon stocks are available that would enable use of the tool. The Willamette/ Lower Columbia Technical Recovery Team is actively drafting a status report for the Willamette Basin ESUs based on a workshop with ODFW biologists in January 2004. That report (which is expected to be publicly available soon) will enable the use of a tool created by TOAST that will be valuable for building scenarios within the developing EDT framework.

Throughout this planning process, the many partners involved in creating this subbasin plan, including technical experts developing the conservation curves within the agencies responsible for salmon and steelhead management, agreed that biological objectives for this plan at this time are best stated as improved trajectories of population abundance targeted at previously stated goals. It is understood that development of species viability curves, combined with ongoing efforts to build EDT capacity in the Willamette Basin, will provide context, meaning, and credibility to abundance and productivity objectives in the near future.

The Willamette Lower Columbia Technical Recovery Team has established draft viability criteria (Appendix A) but no abundance or productivity numbers. The Oregon Department of Fish and Wildlife has articulated a goal of 100,000 mixed hatchery and wild spring Chinook returning to the mouth of the Willamette. In its 2000 Fish and Wildlife Program, the Northwest Power and Conservation Council established an interim goal of "healthy populations as defined as having an 80 percent probability of maintaining themselves for 200 years at a level that can support harvest rates of at least 30 percent"

The available status and performance data that have been collected and documented in Chapter 3 of this plan indicate that the population performance trends throughout the Willamette ESUs are unlikely to sustain achievement of any of the previously articulated goals. Figure 5-1 and Figure 5-2 are examples of abundance performance of upper Willamette River spring Chinook relative to targets established by ODFW and for which data exist. The purpose of the example is simply to demonstrate that the gap between existing targets and current trends in average abundance is significant. Given the anticipated near-future release of much more detailed and scientifically grounded performance objectives, this draft subbasin plan will stick to the advice of fisheries managers and state objectives in trends.

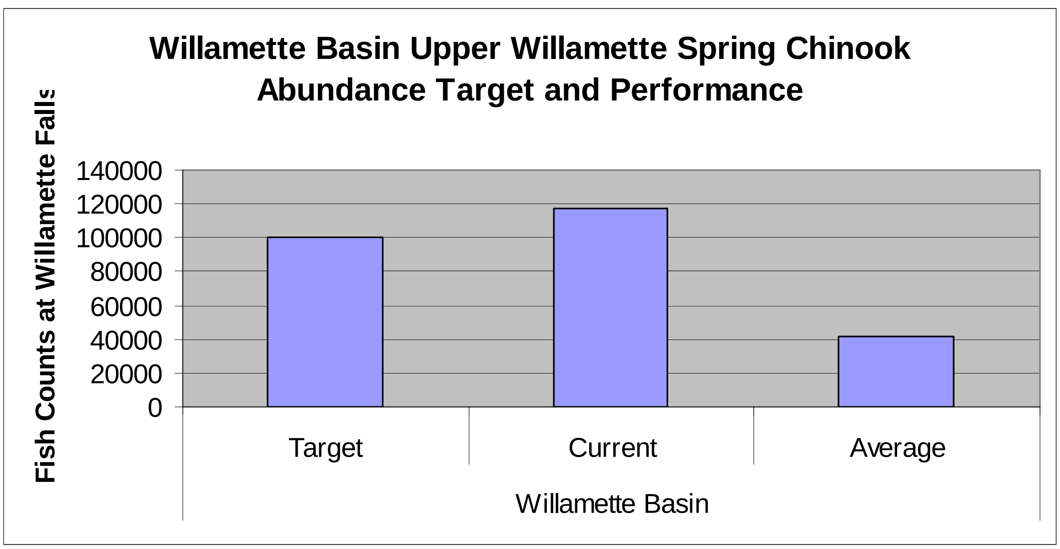

Figure 5-1: Fish Abundance Relative to Targets Articulated by Oregon Department of Fish and Wildlife

Source: ODFW, 1998; WLCTRT, 2003.

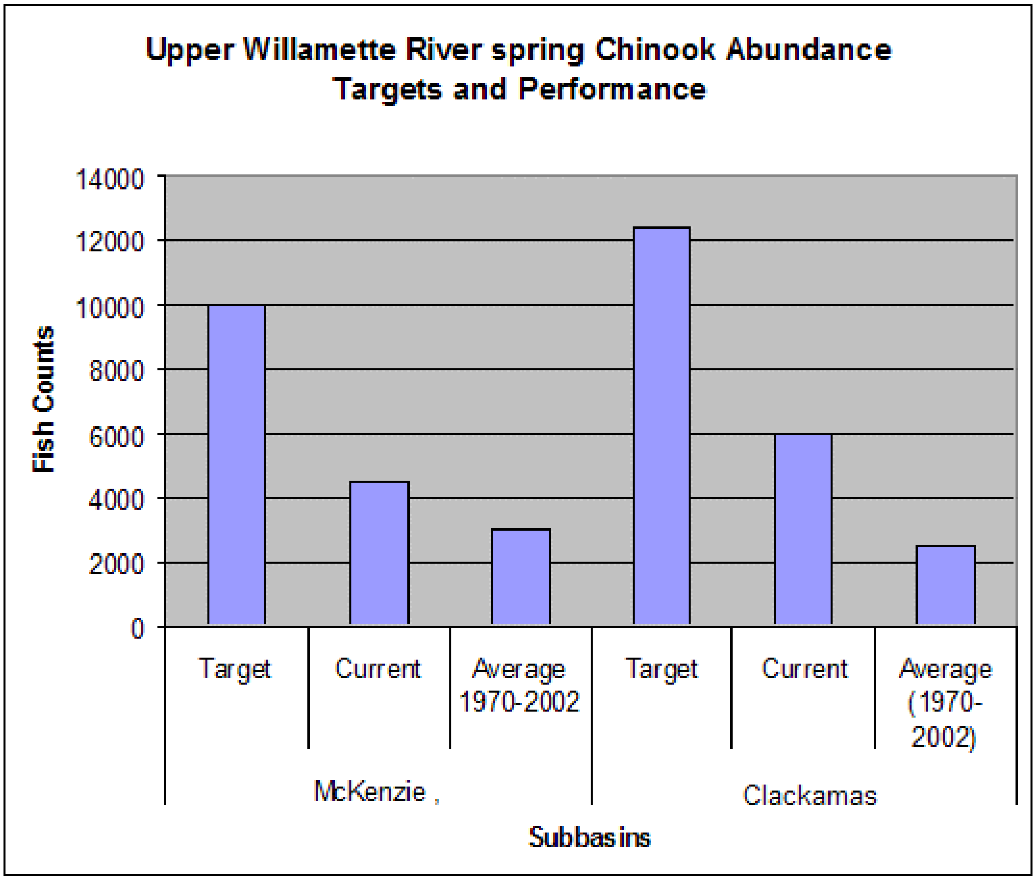

Figure 5-2: Fish Abundance Relative to Targets Articulated by Oregon Department of Fish and Wildlife

Source: ODFW, 1998; WLCTRT, 2003.

***Population Performance Objective for Spring Chinook and Winter Steelhead**:* Increasing trends in the abundance, distribution, and genetic preservation of naturally spawning Chinook and steelhead salmon in the Willamette Basin within the next 15 years, as measured by counts at all available facilities, presence above barriers, and the presence of marked fish on spawning grounds.

Bull Trout

The Willamette Basin is a designated bull trout recovery unit. A draft recovery plan exists for bull trout populations in the Willamette Basin. The biological objective for bull trout performance in the Willamette Basin is adopted from the draft USFWS recovery plan.

The goal of the bull trout recovery plan is to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range so that the species can be delisted. To achieve this goal, the following objectives have been identified for bull trout in the Willamette recovery unit:

- Maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Willamette recovery unit.
- Maintain stable or increasing trends in the abundance of adult bull trout.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and forms.
- Conserve genetic diversity and provide opportunity for genetic exchange.

Distribution criteria will be met when bull trout are distributed among five or more local populations in the recovery unit: four in the Upper Willamette core area and one in the Clackamas River core habitat. In a recovered condition, the Upper Willamette core area would include local populations in the mainstem McKenzie River (connectivity with the Trail Bridge local population would need to be established), South Fork McKenzie River, upper Middle Fork Willamette River, and Salt Creek/Salmon Creek/North Fork Middle Fork Willamette River complex.

***Population Performance Objective for Bull Trout**:* 900 to 1,500 or more individuals in the recovery unit, distributed in each core area as follows: 600 to 1,000 in the upper Willamette River core area and 300 to 500 in the Clackamas River core habitat with stable or increasing trends for minimum of 10 years.

Connectivity criteria will be met when migratory forms are present in all local populations and when intact migratory corridors among all local populations in core areas provide the opportunity for genetic exchange and diversity. For the upper Willamette River core area, meeting connectivity criteria would require establishing fish passage at Cougar, Trail Bridge, Dexter, Lookout, and Hills Creek dams. In the future, establishing fish passage at dams in the Clackamas and Santiam river basins may be necessary, but currently there is insufficient information to make that determination.

Cutthroat Trout

Population Performance Objective for Cutthroat Trout: Increasing trend in numbers of naturally produced adult cutthroat trout in their historical range in the Willamette River and its tributaries as measured by average density of adults per square meter in samples of randomly selected reaches in streams (ODFW, 1998).

Oregon Chub

USFWS adopted a recovery plan for Oregon Chub in 1998. The ultimate object of the U.S. Fish and Wildlife Service is to delist Oregon chub. The biological objective for this subbasin plan is adopted from the Oregon chub recovery plan.

Population Performance Objective for Oregon Chub: 20 populations, with at least 500 adults in each population with a stable or increasing trend for 7 years. At least four populations must be located in each of three subbasins: Willamette River mainstem, Middle Fork Willamette River, Santiam River.

5.3.1.2 Aquatic Habitat Objectives

The data and tools to definitively link the effectiveness of habitat modification with biological performance objectives are not fully developed in the Willamette Basin. The assessment of current conditions (Chapter 3) and inventory of existing programs and activities (Chapter 4) enabled the development of working hypotheses to inform the development of habitat objectives. The essential element of the working hypotheses in Section 3.6 is that the quantity and quality of key habitats and habitat diversity needed for aquatic species in the Willamette Basin depend on the natural processes, functions, and dynamics that form and maintain them.

According to NOAA Fisheries, properly functioning conditions (PFCs) are “the sustained presence of natural habitat-forming processes in a watershed (e.g., riparian community succession, bedload transport, precipitation runoff pattern, channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation. PFC, then, constitutes the habitat component of a species’ biological requirements. The PFC concept includes a recognition that natural patterns of habitat disturbance will continue to occur. For example, floods, landslides, wind damage, and wildfires will result in spatial and temporal variability in habitat characteristics, as will anthropogenic perturbations” (National Marine Fisheries Service, 1999).

As a guiding reference point, WRI proposes the use of the PFC construct recommended by NOAA Fisheries as a way of bounding anadromous salmonid habitat objectives. The use of PFC creates a future reference against which additional alternatives can be measured and objectives can be modified and linked to achieve a vision of sustainable, naturally functioning and reproducing biological communities.

In its EDT-based analyses in the Clackamas Subbasin, Mobrand Biometrics modeled likely responses of anadromous fish to moving the current habitat condition in the system to a properly functioning condition, using EDT ratings developed by the Washington Department of Fish and Wildlife to approximate such conditions (see Appendix P, which presents hypotheses, reach strategies, and PCF EDT results). In reviewing the results of these PFC-based alternatives, it is clear there is significant potential for large increases in both capacity and production compared to current conditions.

WRI proposes that similar results be obtained for PFC-based EDTs conducted in the remainder of the Willamette Subbasin, including the Willamette River mainstem. As described in WRI’s NPCC scope of work, these analyses have not yet been conducted. However, WRI recommends additional EDT analyses as a high priority (see Section 5.7).

Furthermore, WRI’s working hypothesis is that as systems approach properly functioning conditions, the likelihood of achieving the NPCC’s salmonid biological performance objective increases. In other words, the most direct and effective way of meeting the NPCC salmon goals, as applied in the Willamette, is through the promotion of and investment in natural processes. This working hypothesis is proposed for further testing, including by varying EDT ratings in future PFC-related modeling to incorporate protection of life and property—a provision not yet brought into current EDT analyses in the subbasin.

5.3.2 Terrestrial Biological Objectives

The overall objective is to significantly increase population trends of focal species, especially those listed under the Endangered Species Act, and the quantity and quality of connected habitats on which they depend.

5.3.2.1 Biological Performance Objectives

Biological objectives for the *Willamette Subbasin Plan* focal terrestrial species are displayed in Table 5-1.

5.3.2.2 Habitat Objectives

Habitat objectives are displayed in Table 5-1. In addition, habitat objectives have been identified in many previous studies (Table 5-2). For purposes of this subbasin plan, these objectives serve to bracket the likely extent and distribution of habitat needed to achieve the vision. The objectives have been identified for varying purposes and areas, and through studies with different assumptions. Overall, on the order of 50,000 acres of oak woodland are identified, along with roughly 60,000 to 200,000 acres of wetland and riparian areas.

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

Acorn woodpecker	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain a mean oak tree diameter of at least 15 inches, with >20% of the trees larger than 22 inches. • Maintain canopy cover of Douglas-fir at less than 5% • Maintain or create a deciduous (predominantly oak) canopy cover of less than 75% and a subcanopy cover of less than 50%
Chipping Sparrow	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain or create multiple patches of native shrub cover (e.g., snowberry, poison oak) and herbaceous openings within oak woodlands such that cover of native shrubs is 10-40%, cover of blackberries is <10%, and cover of herbaceous plants is 30-70% And the following population objectives: • Reverse declining BBS trends to achieve stable populations (trends of <2%/year) or increasing trends by 2020. Maintain cowbird parasitism rates below 5% within specific woodlands.
Western Wood-Pewee	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain canopy cover of Douglas-fir at less than 5% • Maintain or create a deciduous canopy cover of 40-85% of which more than 80% is oak And the following population objective: • Reverse declining BBS trends to achieve stable populations (trends of <2%/year) or increasing trends by 2020.
White-breasted Nuthatch	As adapted from the *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), habitat objectives should include the following, applied mainly to areas where oak woodland predominated historically, i.e., where elevation, soil, and other factors can support oak woodland: • Oak canopy cover within woodlands of 40-80% • Non-oak canopy cover within woodlands of less than 10% • Mean oak tree diameter of >22 inches with 20% of the oaks larger than 28 inches • At a landscape scale, oak woodland patches should be at least 100 ac in size, with at least one patch per watershed (fifth-field HUC) being larger than 300 acres if soil and elevation conditions are suitable for this And the following population objective: • achieve stable or increasing populations within 10 years

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

Sharptail Snake	• Maintain or increase downed wood (especially large-diameter logs) within oak woodlands • Survey and maintain or increase present population in the subbasin.
Southern Alligator Lizard	• Maintain or increase semi-open oak woodlands, especially near rocky areas. • Maintain or increase present population in the subbasin.
Western Gray Squirrel	• Maintain or increase conditions supportive of sustaining a supply of large oaks within woodlands • Survey and maintain (or increase) the present population in the subbasin.
Golden Paintbrush	Maintain and increase current numbers and distribution through habitat protection, restoration, and management. The species recovery plan (USFWS 2000) describes objectives and identifies population reintroduction and development of propagation methods as high priority actions to meet the recovery objectives.
White Rock Larkspur	Maintain and increase current numbers and distribution through habitat protection, restoration, and management.
White-topped (Curtus's) Aster	Maintain and increase current numbers and distribution through habitat protection, restoration, and management.
Kincaid's Lupine	Maintain and increase current numbers and distribution through habitat protection, restoration, and management.
Fender's Blue Butterfly	Maintain and increase current numbers and distribution through habitat protection, restoration, and management.
Taylor's Checkerspot Butterfly	Maintain and increase current numbers and distribution through habitat protection, restoration, and management.
American Kestrel	Manage woodlands to provide a sustained supply of cavities (especially in oaks) in trees of at least 24-inch diameter and located either along forest edges that adjoin open areas or within the open areas themselves, i.e., areas with <30% canopy. Population objectives should include: • Achieve stable populations (negative trends of less than 2% per year) or increasing trends by 2010.
Horned Lark	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain or create patches of suitable habitat (individually less than an acre in extent) throughout native and agricultural grasslands; the patches should have these characteristics: • Vegetation shorter than 1 ft • 20-50% bare or sparsely vegetated • Located where disturbance from people, animals, and vehicles is minimal

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

	Population objectives should include: • Maintain more than 20 distinct breeding populations in the subbasin by 2010
Vesper Sparrow	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain or provide patches of suitable habitat individually greater than 20 acres and having these characteristics, which apply mainly to pasture, native prairie, and fallow fields: • Grass of variable heights, generally less than 18 inches tall • Some areas of bare or sparsely vegetated ground • Shrub cover of 5 to 15% • Located where disturbance from people, animals, and vehicles is minimal Population objectives should include: • Maintain more than 20 distinct breeding populations in the subbasin by 2010
Western Meadowlark	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain or create patches of suitable habitat (individually less than 200 acres in extent) throughout native and agricultural grasslands; the patches should have these characteristics: ▪ Variable grass heights, generally shorter than 30 inches ▪ Containing some shrubs, trees, or other perches, but over less than 10% of area ▪ Located where disturbance from people, animals, and vehicles is minimal Guidance on Willamette grassland management for this species is provided in ODFW (2001). Population objectives should include: • Reverse the declining BBS trends to achieve stable populations (negative trends of less than 2% per year) or increasing trends by 2010.
Western Bluebird	Habitat objectives should include: • Manage woodlands to provide a sustained supply of snags (at least 10 ft tall and 15 inch diameter) located along edges that adjoin open areas, i.e., areas with fewer than 5 trees/ac (Hansen et al. 1995) • Following forest fires, leave larger snags whenever feasible. Population objectives should include: • Achieve stable populations (negative trends of less than 2% per year) or increasing trends by 2010.

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

Black-tailed Jackrabbit	Survey, then maintain or increase present densities and distribution in the subbasin, consistent with minimizing potential damage to nearby crops.
Western Rattlesnake	Survey present densities in the subbasin and then formulate biological objectives.
Bradshaw's Lomatium	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Nelson's Checkermallow	Maintain or expand existing numbers and geographic distribution of this plant through protection, restoration, and management of suitable habitat.
Willamette Valley Daisy	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Peacock Larkspur	Maintain and increase current numbers and distribution through habitat protection, restoration, and management.
Water Howellia	Determine limiting factors through research and seek opportunities to reintroduce if and where suitable habitat is found.
Red-legged Frog	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Common Yellowthroat	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Dunlin	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Northern Harrier	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain a mosaic of non-managed grasslands in blocks of larger than 400 ac located at least one-quarter mile from human development or recreational activities • Where nests are located, provide a no-activity buffer of at least 400 ft radius around nests
Sora	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Western Pond Turtle	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. Specific suggestions for habitat enhancement techniques and conservation strategies are provided by Adamus (2003b) and ODFW (www.dfw.state.or.us/ODFWhtml/springfield/W_Pond_Turtle.htm).
Cascades Frog	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Oregon Spotted Frog	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Purple Martin	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Green Heron	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Wood Duck	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Yellow Warbler	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), the habitat objectives should include: • Maintain or create at least 70% deciduous shrub cover, of which at least 40% is beneath a forest canopy

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

	• Maintain or create a mosaic of shrub or wetland patches amid a larger landscape of forest or other land devoid of cattle The ultimate objective is to expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
American Dipper	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. Stream restoration actions that benefit salmon and trout are likely to benefit this species.
Harlequin Duck	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Bald Eagle	See the species Recovery Plan (USFWS 1986).
Red-eyed Vireo	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat
Willow Flycatcher	As proposed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000), habitat objectives should include the following: • Maintain or provide a patchy deciduous shrub layer with several scattered herbaceous openings (i.e., 30-80% shrub cover) • Do not allow tree canopy cover to exceed 20% • Provide the above at a distance of no less than 0.6 mi from residential areas and not less than 3 mi from areas with livestock (due to cowbird threat) And the following population objective: • Reverse declining BBS trends to achieve stable populations (trends of <2%/year) or increasing trends by 2020.
Coastal Tailed Frog	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
American Beaver	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat, consistent with minimizing ecological and economic damages.
River Otter	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.

Pileated Woodpecker	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. The density of breeding pairs should be an average of one pair per 1500 acres within the percent of the landscape that is suitable habitat (Altman 1999). As proposed in *Conservation Strategy for Landbirds in Coniferous Forests of Western Oregon and Washington* habitat objectives should include the following in managed stands older than 60 years:
	• Maintain >70% canopy closure and >70% conifer species canopy trees
	• Maintain 2 nest snags per 10 ac, each being >30 inches in diameter
	• Retained snags should be spatially well distributed and mostly hard snags, but some may be defective live trees.
	• Provide an average of 12 foraging snags per acre (mix of hard and soft snags) in the following size classes:
	  ▪ 10-20 in dbh = 7/ac
	  ▪ 20-30 in dbh = 3/ac

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

	▪ >30 in dbh = 2/ac (may include the nest snags) • Maintain a 5-acre no-harvest buffer around known nest or roost sites. • Extend rotation ages to >80 years to provide potential snags of sufficient size, and retain these snags and recruit replacement snags (large live trees) at each harvest entry. • Retain large live trees with defective or dying conditions such as broken tops, fungal conks, and insect infestations. • If snags have not been retained (or are insufficient in number), create snags through blasting tops or inoculation with heart rot if size of trees meets species requirements. • Retain known or suitable nesting and roosting snags from all harvest and salvage activities and restrict access for fuelwood cutters. • During harvest operations, retain large logs and stumps in various stages of decay for foraging sites. • Avoid use of pesticides near retained snags
Olive-sided Flycatcher	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. The density of breeding pairs should be an average of one pair per 50 acres within the percent of the landscape that is suitable habitat (early successional with conditions described below or old growth with large canopy gaps) (Altman 1999). As proposed in *Conservation Strategy for Landbirds in Coniferous Forests of Western Oregon and Washington* habitat objectives should include the following, applied within harvest units larger than 50 acres: • Retain >2.5 ac areas (aggregate clumps) with 4-12 trees/ac) that are >40 ft high and are within the harvest unit, not adjacent to the forest edge. • The remainder of the harvest unit should average 1-2 trees/ac that are >40 ft high, dispersed relatively equally throughout the harvest unit • Retained trees should be >50% hemlocks or true firs to provide preferred nest trees, and have at least 25% foliage volume (canopy lift) for nesting substrate. • Retain or provide suppressed or plantation trees throughout the harvest unit (>5/ac) that are 10-40 ft high. In addition to green-tree retention, seed tree, shelterwood, or group selection cuts may be used to meet the biological objectives. • In reforestation units, include at least 10% hemlock or true fir seedlings, and retain these trees through thinnings and harvest. • Retain residual clumps of older forest in association with retained green-trees to increase edge and reduce effects of wind-throw on retained green-trees. • Retain large trees in association with retained large snags where snags can serve as guard and foraging perches. • Maintain retained large canopy trees through stand development and recruit replacement green-trees at each harvest entry.

Table 5-1: Biological and Habitat Objectives for Willamette Subbasin Terrestrial Focal Species*

Vaux's Swift	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. To accomplish this, the *Conservation Strategy for Landbirds in Coniferous Forests of Western Oregon and Washington* (Altman 1999) recommends the following habitat objectives for managed forests: • Increase the length of harvest rotations to greater than 100 years; • Retain or create nest structures with diameter greater than 27 inches and height greater than 82 ft, that are in different stages of decay and in stands with less than 60% canopy closure (e.g., canopy gaps) so they are accessible to flying swifts; • Provide an average of 5 of these potential nest/roost structures per square mile at any point in time, with up to 30% being live trees with broken tops (created or natural), and up to 20% being snags; • Maintain a 5-acre no-harvest buffer around known nest or roost sites.
Marbled Murrelet	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Spotted Owl	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat.
Great Gray Owl	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. Lengthen the usual harvest rotation period to sustain the supply of old growth trees.
Oregon Slender Salamander	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. Lengthen the usual harvest rotation period to sustain the supply of old growth trees.
American (Pine) Marten	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat, particularly as: • Tracts of greater than 640 acres that contain >45% mature and old growth forest. • Riparian areas or other corridors wider than 600 ft wide • Lengthen the usual harvest rotation period to sustain the supply of old growth trees and create and maintain uneven-aged stands of timber • Retain downed dead wood to the maximum extent (ideally covering >20% of the ground) consistent with fuel reduction needs and in a spatially dispersed pattern
Red Tree Vole	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. Lengthen the usual harvest rotation period to sustain a supply of old growth trees.
Townsend's (Pacific Western) Big-eared Bat	Maintain or expand existing numbers and geographic distribution through protection, restoration, and management of suitable habitat. Lengthen the usual harvest rotation period to sustain a supply of old growth trees.

* Ordered by habitat type; where unattributed, objectives developed by WRI during development of subbasin plan.

Table 5-2: Examples of Objectives for Focal Habitat Types (or Their Approximate Equivalents) Identified in Other Assessments

	Oak Woodland	Upland Prairie & Savanna	Wetland Prairie	Ponds & Sloughs	Stream Riparian	Old Growth Conifer Forest
Willamette Restoration Strategy (ODFW; Nov. 2000 draft)[1]	50,000 ac	50,000 ac ["grasslands"]	93,000 ac ["wetlands"]; 50,000 ac ["grasslands"]	93,000 ac ["wetlands"]; 200,000 ac ["riparian"]	200,000 ac ["riparian"]	100,000 ac ['conifer forest']
Ecoregional Assessment (TNC; Floberg et al. 2004)	all remaining viable (~48,346 ac)	all remaining viable	all remaining viable prairie; 8 marshes	N/A	55,192 ac	N/A
Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington (Altman 2000)	all tracts >100 ac	all tracts >200 ac ["grassland-savanna"]	N/A	N/A	all tracts >50 ac and/or 30% of historical area	
Joint Venture Implementation Plan: Willamette Valley(Roth et al. 2002)	14,000		58,000			
Hulse et al. 2002 [2]	55,200	37,900		N/A	N/A	N/A
Payne 2002 [3]	38,136	8319	3184	2394 ["wetlands"]	1229	N/A

5.4 Aquatic and Terrestrial Strategies

A list of all aquatic and terrestrial strategies is presented in Table 5-3. The assessment of conditions in the Willamette Basin showed, at a basic level, that the factors limiting the life stages of focal species are primarily the loss of key habitat quantity, quality, and diversity. The strategies presented below are intended to address the causes of these deficiencies. The findings of the assessment showed that the processes, functions, and dynamics needed to form and maintain the quantity and quality of the diverse habitat types essential for the full range of life history stages for focal species are not working properly.

5.4.1 Principles and Approaches

The strategies identified in this Management Plan result from the use of the scientific principles described in the Scientific Foundation section of the assessment (Chapter 3.2.2.) In applying these principles, the Willamette Restoration Initiative encountered and employed the conservation guidelines shown in Figure 5-3, which were developed by the City of Portland in its *Framework for Integrated Management of Watershed Health* (City of Portland, 2004.)

Table 5-3: Strategies

Aquatic Strategies	
Restore Processes That Maintain Watershed Health	
Achieve more natural flow regimes	• Create more floodplain-connecting flows by improving management of releases from major dams. • Increase low season flows through water conservation and instream water rights acquisition and leasing, and reducing impervious surfaces to increase subsurface storage. • Decrease flashiness by reducing impervious surfaces and improving subsurface storage.
Restore physical habitats	• Increase interaction of rivers and floodplains by removing or altering: – selected revetments and – selected off-channel blockages • Move toward more natural pattern and duration of peak flows • Increase supply and recruitment of large wood by improving riparian composition and extent and providing for flows to capture wood. • Improve low season flows • Increase gravel recruitment and transport. • Improve water quality, especially temperature problems, by – Controlling releases of unnaturally cold water from dams during winter by altering intake/release structures at major dams – Controlling releases of unnaturally warm water from major dams during summer – Increasing water volumes at key times – Improve riparian shading – Increasing extent and duration of flow interaction with hyporheic zone.
Conserve and restore biological communities	• Control the most damaging terrestrial and aquatic invasive species • Control temperatures which favor nonnative species • Improve hatchery management through the funding and implementation of Hatchery-Genetics Management Plans. • Continue freshwater and ocean harvest controls that favor survival of wild anadromous and resident fish.

Table 5-3: Strategies

Connect favorable habitats	• Get fish past dams (especially those operated by the U.S. Army Corps of Engineers in its Willamette River Basin Project) by determining and then aggressively applying the best methods, such as through: – Trapping and hauling – Constructing and/or improving fish ladders and fish-ways. • Get fish past other barriers by identifying and remedying: – Road-stream crossings that increase access to the most high quality habitat – Screening or otherwise assuring fish are not misdirected by water diversions • Connect fish to off-channel habitat by reconnecting rivers with floodplains and improved flow management (see strategies under a1 and a2, above)
Terrestrial Strategies	
Restore Processes That Maintain Watershed Health	
Restore physical habitats	• Increase extent and distribution of focal habitats as guided by the terrestrial utility described in section VI, below (the Applying the Strategy section), including by: – Increase interaction of rivers and floodplains by removing or altering: ▪ selected revetments and ▪ selected off-channel blockages – Improve extent and composition of riparian areas – Restoring more natural fire regimes where feasible and consistent with the protection of life and property. – Achieve an adequate and sustainable supply of standing and downed dead wood in upland and streamside environments
Conserve and restore biological communities	• Protect existing high quality habitats and consider restoration by: – Investigating potential for lands identified in Priority Conservation Areas of the Nature Conservancy, or Conservation – Restoration Opportunity Areas of the Pacific Northwest Ecosystem Consortium, as guided by the approaches and the terrestrial utility described in section VI, below (the Applying the Strategy section), – Maintaining or improving existing land use and forest practice laws, mitigation requirements, and landowner conservation incentives – Remove and control the most harmful invasive species, including by responding rapidly to new plant pathogens.
Achieve more natural flow and water regimes	• Move toward more natural pattern and duration of peak flows by: – Improving management of releases from major dams. – Increase low season flows through water conservation and instream water rights acquisition and leasing, and reducing impervious surfaces to increase subsurface storage. • Increase supply and recruitment of large wood by improving riparian composition and extent and providing for flows to capture wood. • Maintain natural water level and soil moisture regimes

Table 5-3: Strategies

Connect Favorable Habitats	• Avoid barriers to wildlife movement. Manage habitat to encourage individuals to move from good habitat to good habitat, not from good to bad. (PNERC 2002) • Minimize extent of new road construction; • Promote clustering of human activities that reduce habitat value by using comprehensive plans and zoning ordinances, as well as economic incentives, to manage rural residential area build-out and/or expansion. • Expand the habitat value of refuge areas. Lands adjacent to established refuge areas should be managed with increased attention to conservation practices.
Institutional Strategies	
	• Improve habitat on private lands, consistent with their inherent objectives to produce revenue, including by: – Expanding and improving voluntary incentives programs, and, – Increasing the capacity of local groups (especially watershed councils and districts) and agencies to market and help implement incentives programs. • Improve coordination among all those working to manage Willamette subbasin habitats at site, watershed, subbasin, and regional scales by: – Promoting frequent communication among landowners, local governments, watershed groups, agencies, and non-governmental organizations. • Promote more strategic targeting of restoration investments throughout all scales of management by increasing consultation among stakeholders, community leaders, and public and private conservation organizations. • Promote improved regulatory coordination especially with regard to the federal Endangered Species and Clean Water Acts. • Increase effective communication and outreach to stakeholders, decision-makers and the public. • Improve management of environmental data and information, including establishing improved means to coordinate in its collection and dissemination. • Improve understanding of conservation economics by establishing a conservation and restoration investment strategy that accounts for existing assets and forecasts future needs; and developing improved metrics for the economic contributions from natural environmental services (e.g., provision of clean water), from functioning habitats, and quality-of-life aspects of natural areas. • Recognize the benefits of a regional coordinating body for facilitating the effective implementation of Willamette strategies. • Increase the diversity, amount and effective use of conservation resources, including through improved efficiencies or enhanced funding, to assist with strategy implementation, including: – Protecting lands through conservation easements or acquisition, through agreements with willing landowners and consultation with communities. – Establishing more natural flows where appropriate – Effective communication, outreach and education

1. View the whole picture: Watershed restoration efforts need to be placed within the context of the entire watershed; species recovery efforts must be placed within the context of complete life cycles.
   1.1 Define watershed health holistically, by addressing the entire system in four dimensions: longitudinal, lateral, vertical and temporal.
   1.2 Understand the role of the watershed in the landscape.
2. Characterize existing conditions and use the results to inform the entire restoration planning process.
3. Prioritize and sequence actions to maximize long-term success in meeting restoration objectives.
   3.1 Begin recovery efforts by protecting and restoring existing populations, functions and habitats.
   3.2 Build outward from existing populations, functions and high-quality habitats.
   3.3 Place priority on controlling sources of degradation before attempting to address the impacts of those sources.
   3.4 In prioritizing restoration actions, first understand how watershed processes affect watershed health. Focus initial restoration actions on the processes that create and maintain healthy watershed conditions and functions.
4. To the maximum extent practicable, use natural processes to achieve ecological functions and societal goals.

Figure 5-3: Conservation Guidelines

Source: Adapted from the City of Portland's Framework for Integrated Management of Watershed Health *(City of Portland, 2004).*

WRI also endorses the following approach developed by the City of Portland as a guide for local implementation, especially of the aquatic strategies recommended later in this chapter (City of Portland 2004):

1. **The highest quality habitats should be protected.** Fish access to these habitats should be evaluated and, wherever possible, restored or improved. Opportunities for protection and even expansion of these habitats (such as by improving species' access to adjacent high-quality habitats or restoring nearby habitats) should be investigated.

2. **Intermediate-quality habitats should be evaluated for restoration.** Intermediate-quality habitats are those that have been degraded by human activities but have the potential to recover characteristics that would make them functionally equivalent to high-quality habitats. Habitats in this category that are contiguous with or along migratory routes to high-quality habitats should be given additional priority.

3. **The lowest quality habitats should be evaluated for their potential to create "bottlenecks" and to fragment habitat.** Areas that are highly degraded (such as through toxic contamination, habitat destruction, high temperatures, or excessive or inadequate flows) may impede or prevent species from reaching higher quality habitats, increase mortality or decrease individuals' fitness as they pass through these degraded areas. Degraded areas that are near or between high-quality areas, or along migratory routes to high-quality areas, should be given additional priority.

As a guide for local implementation of terrestrial strategies identified later in this chapter, WRI recommends the following:

1. **Consider focal species and habitat first:** For both conservation and restoration, first consider opportunities for this plan's focal habitat types and species. Among the focal species, highest priority should be accorded to those that are federally listed. The next highest priorities should be species listed as sensitive by ODFW and species extirpated from the subbasin but for which recovery is feasible.
2. **Employ multi-species approaches:** In planning for wildlife and rare plant habitat, a consciously and comprehensively multi-species approach, with emphasis on (but not limited to) this report's focal habitat types and species, should be used. This approach would be useful, for example, in calculating mitigation credits, analyzing the consequences of alternative landscape patterns and practices, prioritizing land acquisitions, or managing watersheds for fish, rare plants, and wildlife.

5.4.2 Aquatic Strategies

5.4.2.1 Restore Processes That Maintain Watershed Health

Achieve More Natural Flow Regimes

Rationale. Hydrology is one of the most basic forces determining the structure, dynamics, and function of stream ecosystems. Flow affects nearly every aspect of ecosystem function, including habitat formation and maintenance, the flow of energy and materials, temperature, pollutant transport and the makeup of biological communities (Stanford et al., 1996; Poff et al., 1997). The extent and composition of riparian vegetation, water qualit, and the structure of instream habitats and communities are all strongly influenced by flow regimes. Protecting and restoring fish and wildlife populations ultimately means providing for the range of natural conditions under which they evolved. Because of flow's critical importance, failing to take it into account when conducting watershed restoration activities also may risk the success of these efforts (Beschta 1996, Kauffman et al. 1997). For example, restored physical habitat may be eliminated by peak flows or rendered inaccessible to fish by low flows.

Strategy Components

- Create more floodplain-connecting flows by improving management of releases from major dams.
- Increase low season flows through water conservation and instream water rights acquisition and leasing, and reducing impervious surfaces to increase subsurface storage.
- Decrease flashiness by reducing impervious surfaces and improving subsurface storage.

Restore Physical Habitats

Rationale. In addition to the provision of more natural flow regimes, fish and wildlife species require a diversity of physical habitat. Frissell et al., 1986) emphasize the importance of physical habitat in the structure and function of stream ecosystems. Aquatic habitats are created by the interaction of flow, wood, and substrate material (gravel, sediments, bedrock, etc.). Achieving more normal flow regimes, improving connection to riparian and floodplain areas, and restoring more natural sediment processes are key to restoring habitat. Restoring flow and habitat also will provide many of the processes that maintain water quality.

Strategy Components

- Increase interaction of rivers and floodplains by removing or altering:
  - Selected revetments
  - Selected off-channel blockages
- Move toward more natural pattern and duration of peak flows.
- Increase supply and recruitment of large wood by improving riparian composition and extent and providing for flows to capture wood.
- Improve low season flows.
- Increase gravel recruitment and transport.
- Improve water quality, especially temperature problems, by:
  - Controlling releases of unnaturally warm water from dams in the fall and summer and controlling releases of unnaturally cold water from dams in the winter by altering intake/release structures at major dams
  - Increasing water volumes at key times
  - Improving riparian shading
  - Increasing the extent and duration of flow interaction with hyporheic zone.

Conserve and Restore Biological Communities

Rationale. As previously noted, natural biological communities both result from and influence their environment. Actions that attempt to direct positive manipulation of biological communities (invasive species control, hatchery introductions, etc.) should assess the extent to which degraded flow, habitat, and water quality conditions can put the success of these efforts at risk. Attempts to reestablish native species or reduce the populations of introduced species may fail if the habitat conditions which native species need are not present (National Research Council, 1996). One of the highest priorities in restoring biological communities is addressing the flow, habitat, and water quality conditions that currently limit these communities.

Strategy Components

- Control the most damaging terrestrial and aquatic invasive species.
- Control temperatures which favor nonnative species.
- Improve hatchery management through the funding and implementation of Hatchery-Genetics Management Plans.
- Continue freshwater and ocean harvest controls that favor survival of wild anadromous and resident fish.

5.4.2.2 Connect Favorable Habitats

***Rationale*:** Fragmentation and disconnection of aquatic habitat represents both a major limiting factor and a key opportunity for near-term conservation success, especially for Pacific salmon. Salmon and steelhead migrate great distances through the ocean and river systems, and are therefore seasonally distributed across a vast ecosystem composed of what has been called “a chain of favorable geographic habitats" (Thompson, 1959). A major ecological impact of land management and development in riparian areas and floodplains has been the simplification and fragmentation of salmon habitat (Reeves and Sedell, 1992). Simplification reduces the number of habitat types, and fragmentation makes it hard for salmon and other species to migrate at key times between links in the habitat chain (Lichatowich et al., 1995).

Disconnection and fragmentation can, and often does, occur as a result of inappropriately placed or badly designed culverts or other structures that block or impede fish passage. Impeding fish passage at road crossings, especially, can have many adverse effects, including:

- Loss of spawning habitat available to adult anadromous salmonids
- Loss of habitat available to juvenile anadromous and resident fish for feeding and predator avoidance
- Loss of genetic diversity in resident fish in upstream reaches
- Loss of nutrients from anadromous spawning adult carcasses
- Changes in fish community assemblages upstream of blockages
- Preventing recolonization of headwater areas by resident fish after periodic losses caused by flood or drought events

In addition, improperly sized or placed culverts can cause catastrophic or chronic sediment inputs into streams (OWEB, 1999).

The most significant fish passage problems in the Willamette Subbasin stem from the flood-control dams operated by the U.S. Army Corps of Engineers. Measured in the loss of spring Chinook habitat alone, these dams had dramatic impacts: 71 percent of the Santiam River's Chinook production occurred above Detroit Dam, but all access to upstream spawning habitat was lost because the dam was built without fish passage facilities; Dexter and Fall Creek dams blocked access to about 80 percent of the Middle Fork Willamette Subbasin's Chinook habitat; and the McKenzie River formerly produced roughly 40 percent of the spring Chinook run above Willamette Falls, but Cougar Dam has blocked off 25 miles of some of the most productive spawning habitat historically available (WRI's *Willamette Subbasin Summary*, 2002).

Strategy Components

- Get fish past dams (especially those operated by the U.S. Army Corps of Engineers in its Willamette River Basin Project) by determining and then aggressively applying the best methods, such as through:
  - Trapping and hauling
  - Constructing and/or improving fish ladders and fishways
- Get fish past other barriers by identifying and remedying:
  - Road-stream crossings that increase access to the most high quality habitat
  - Screening or otherwise assuring fish are not misdirected by water diversions

- Connect fish to off-channel habitat by reconnecting rivers with floodplains and improving flow management (see the strategies “Restore processes that maintain watershed health” and “Restore physical habitats,” above)

EDT diagnosis of habitat conditions for anadromous fish in the Clackamas and McKenzie enables the development of more place-specific strategies associated with specific life stages in the in those places. Examples of how aquatic strategies can be applied at the local level are included in Appendixes K and P. It is important to note that the strategies in these appendixes are sample, draft strategies. They are grounded in EDT analyses but have not been reviewed locally and have not been evaluated for their impact on PFC or biological performance.

5.4.3 Terrestrial Strategies

5.4.3.1 Restore Processes That Maintain Watershed Health

Restore Physical Habitats

Rationale. Land and water uses over the past 150 years have dramatically changed the patterns and composition of natural vegetation and of species dependent on them. More than 60 percent of the basin’s older conifer forests have been converted to other land cover types or land uses. Natural grasslands have almost entirely been eradicated, shrubland has been halved, and hardwood forests diminished by three-quarters. About 75 percent of what formerly was wet and dry prairie, and about 60 percent of what was wetland, is now in agricultural production. The Willamette Basin has lost about 97 percent of the original area of bottomland prairie grasslands, 80 percent of its bottomland forests, and nearly 100 percent of its oak savannas. By 1990, more than half of the Willamette Valley area had been converted from natural vegetation to agriculture or development. It is estimated that, historically, there was approximately 40 percent more native terrestrial wildlife habitat than there was in 1990 and a nearly 80 percent greater abundance of native wildlife (PNWERC 2002). Given the widespread effects of its loss and degradation, restoring physical habitat is of critical importance.

Strategy Components

- Increase the extent and distribution of focal habitats as guided by the terrestrial utility described in Section 5.6, including by:
  - Increasing interaction of rivers and floodplains by removing or altering:
    - Selected revetments
    - Selected off-channel blockages
  - Improving extent and composition of riparian areas
  - Restoring more natural fire regimes where feasible and consistent with the protection of life and property.
  - Achieving an adequate and sustainable supply of standing and downed dead wood in upland and streamside environments

Conserve and Restore Biological Communities

Rationale. A number of studies have identified areas where biological communities may benefit most from habitat conservation or restoration (Floberg, 2004; PNWERC, 2002). Invasion of exotic species has greatly altered the composition of riparian plant communities, with introduced plants increasing from 10 percent in the headwaters to more than 50 percent of the number of species in the mainstem Willamette. Nonnative plant and animal species–such as bullfrogs, Scots broom, and Himalayan blackberry– threaten the health of native species (Oregon Progress Board 2000).

Strategy Components

- Protect existing high-quality habitats and consider restoration by:
  - Investigating potential for lands identified in Priority Conservation Areas of the Nature Conservancy, or Conservation – Restoration Opportunity Areas of the Pacific Northwest Ecosystem Consortium, as guided by the approaches and the terrestrial utility described in Section 5.6.
  - Maintaining or improving existing land use and forest practice laws, mitigation requirements, and landowner conservation incentives
- Remove and control the most harmful invasive species, including by responding rapidly to new plant pathogens.

Achieve More Natural Flow and Water Regimes

Rationale: The density and diversity of terrestrial species is often correlated with the presence of flowing, ponded, or subsurface water. Naturally occurring high flows that over-top banks can create channels or seasonal water bodies that are critically important to plant and animal species alike. Strategies that ensure more natural flows and water regimes are important for meeting terrestrial biological objectives.

Strategy Components

- Move toward more natural pattern and duration of peak flows by:
  - Improving management of releases from major dams
  - Increasing low season flows through water conservation and instream water rights acquisition and leasing, and reducing impervious surfaces to increase subsurface storage
- Increase the supply and recruitment of large wood by improving riparian composition and extent and providing for flows to capture wood.
- Maintain natural water level and soil moisture regimes.

5.4.3.2 Connect Favorable Habitats

Rationale. The future viability of plant and animal populations depends not just on the quality and quantity of habitat, but on its distribution. A favorable distribution of habitats increases the capacity of different species and life stages functioning across a greater geographic range, and it minimizes the risk of species loss. For terrestrial species, some of the greatest sources of habitat fragmentation are roads, urban development, and conversion of large blocks of previously diverse habitat for other economic uses.

Strategy Components

- Avoid barriers to wildlife movement. Manage habitat to encourage individuals to move from good habitat to good habitat, not from good to bad (PNERC 2002).
- Minimize the extent of new road construction.

- Promote clustering of human activities that reduce habitat value by using comprehensive plans and zoning ordinances, as well as economic incentives, to manage rural residential area build-out and/or expansion.
- Expand the habitat value of refuge areas. Lands adjacent to established refuge areas should be managed with increased attention to conservation practices.

5.5 Institutional Strategies

These institutional strategies respond to the gap analysis in Chapter 4, Inventory and Assessment of Conservation Efforts.

In a stakeholder subbasin workshop convened in April 2004 by WRI, the 60-plus participants indicated a predominating interest in discussing institutional issues identified as limiting success in conserving and restoring fish and wildlife habitat. As shown in Figure 5-4, the factors thought to have the highest potential for constructive change if addressed in the next 10 to 15 years were as follows:

- Coordination and integration
- Communication
- Support for on-the-ground restoration
- Incorporating true economic costs of activities affecting the environment
- The need for a common vision

Addressing a lack of regulation (i.e., establishing additional regulations) was identified as having the least potential.

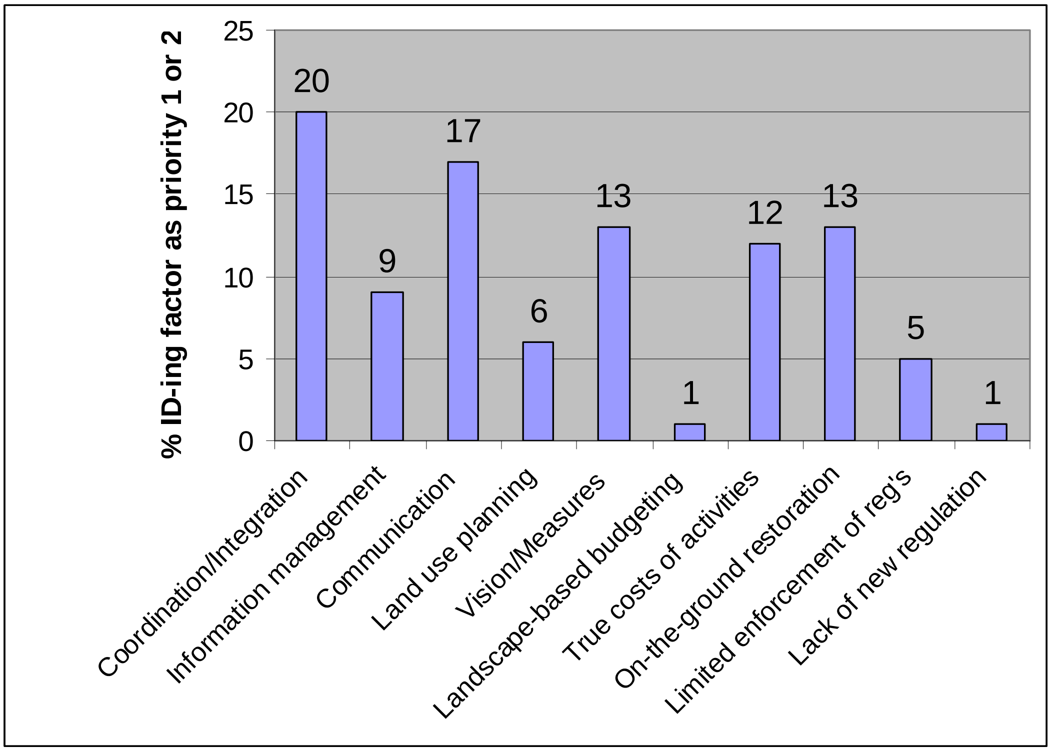

Figure 5-4: Institutional Limiting Factors Identified as Having Highest Constructive Potential

Source: April 2004 Willamette Subbasin Plan Workshop.

Many of these factors were also identified in the *Willamette Subbasin Summary* (Willamette Restoration Initiative, 2002), which identified the need for the following strategies:

- Improve habitat on private lands, consistent with their inherent objectives to produce revenue, including by:
  - Expanding and improving voluntary incentives programs
  - Increasing the capacity of local groups (especially watershed councils and districts) and agencies to market and help implement incentives programs
- Improve coordination among all those working to manage Willamette subbasin habitats at site, watershed, subbasin, and regional scales by:
  - Promoting frequent communication among landowners, local governments, watershed groups, agencies, and non-governmental organizations.
- Promote more strategic targeting of restoration investments throughout all scales of management by increasing consultation among stakeholders, community leaders, and public and private conservation organizations.
- Promote improved regulatory coordination especially with regard to the federal Endangered Species and Clean Water Acts.

In addition, participants in the Willamette Subbasin Workshop identified additional strategies, including:

- Increase effective communication and outreach to stakeholders, decision-makers and the public.
- Improve management of environmental data and information, including establishing improved means to coordinate in its collection and dissemination.
- Improve understanding of conservation economics by establishing a conservation and restoration investment strategy that accounts for existing assets and forecasts future needs; and developing improved metrics for the economic contributions from natural environmental services (e.g., provision of clean water), from functioning habitats, and quality-of-life aspects of natural areas.
- Recognize the benefits of a regional coordinating body for facilitating the effective implementation of Willamette strategies.
- Increase the diversity, amount and effective use of conservation resources, including through improved efficiencies or enhanced funding, to assist with strategy implementation, including:
  - Protecting lands through conservation easements or acquisition, through agreements with willing landowners and consultation with communities.
  - Establishing more natural flows where appropriate
  - Effective communication, outreach and education

5.6 Applying the Strategies Locally

As previously noted, this *Willamette Subbasin Plan* seeks to identify and offer solutions for system-wide factors that are currently limiting fish and wildlife habitats and populations. Consistent with that objective, this Management Plan has articulated ecosystem-based principles for identifying basinwide strategies and has developed recommendations regarding basinwide priorities (Section 5.2).

In other words, the goal of this plan has been to identify limiting factors in a manner that distinguishes symptom from cause, and localized problems from systemic dysfunction. That is, the plan focuses on the functional background of systemic solutions, rather than on the productive foreground of local action. It is not intended to provide a “cookbook” for conservation decisions, but neither is it intended only to describe conservation theory or summarize the available science.

But the Willamette Basin has so much environmental information available and so many interests ready, willing and able to use it, that the processes for implementing the strategies are as important as the strategies themselves. In other words, the plan’s visions and objectives are not likely to be met simply with a list of strategies, no matter how needed or well-stated. The logic of the plan needs to extend past the strategies to inform, but not dictate, local action. The information and databases developed for this plan can be used to assist—but not dictate—specific conservation and restoration decisions.

The information is based on an approach that is systematic and relatively comprehensive with regard both to species (addressing all wildlife species, all federally-listed plants, and all listed fish) and to geography (covering the entire Willamette subbasin, at multiple scales). While not all parts of the basin have the same level of analytical detail, the assessment shows clear patterns and consistency with regard to factors that limit success of life stages that occur in the Willamette.

Information in this report has been drawn from more than 500 published references. Local experts have reviewed drafts of the report and their suggestions have generally been incorporated. In addition, both biologists and local stakeholders were involved in the development of conservation recommendations developed in earlier studies, many of which are used in this report and its databases.

This section has been developed to suggest a way to connect basinwide needs with local action. That is, how strategies might be anchored on-the-ground through local processes that employ common analytical frameworks. To be most effective, conservation and restoration decisions and actions should be done in consultation with local biologists, conservation groups and stakeholders. Identification of specific places to implement conservation and restoration activities to make efficient use of scarce resources need to emerge from a careful process that considers ecological process and potential, capitalizes on opportunity, and builds relationships with the people who will responsible for putting conservation on the ground. The limitations of the species and habitat data currently available make this report and the following processes excellent tools in the in the toolkits of practitioners, but on the ground work, requires on the ground knowledge and adaptability guided by lived experience.

The following approaches are offered as guidance for implementing *Willamette Subbasin Plan* strategies by prioritizing actions at more local levels.

5.6.1.1 Use EDT or Other Modeling

In a significant portion of the Willamette Subbasin, great amounts of data have been prepared for use in the Ecosystem Diagnosis and Treatment model (http://www.mobrand.com/MBI/edt.html), which is designed to associate changes in habitat with changes in fish populations. In addition, significantly more watersheds in the Willamette are expected to receive the same treatment over next one to two years. This represents a new resource for local conservation interests. It should allow more affordable evaluations of local conservation scenarios to identify effective action. A number of other watershed groups have made use of alternative models, such as RESTORE (http://biosys.bre.orst.edu/restore/) that may also prove useful at the local level.

5.6.1.2 Terrestrial Utility Tool

All databases referenced for use in this tool can be found at www.oregonwri.org.

Example 1: Land Protection Choices. Suppose you live near Corvallis, Oregon. You and some friends are interested in identifying and protecting the most ecologically important land parcels in your area. Working through your watershed council and public agencies, you’ve become aware of some funding sources that could support land purchases or easement agreements with willing sellers. But everyone has a different idea of where the “best habitats” are, depending perhaps on where they live and which species or habitat type they’re thinking of. How might you and your friends efficiently account for the needs of the most species, or at least the needs of species that are most imperiled? Here's how you might proceed:

1. Identify which watershed(s) you're interested in. To do this, find your approximate location on the watershed map (MapFile:HUC6 available at www.oregonwri.org), zooming in on the computer image until you can read the 12-digit "HUC6" codes. For the area you're interested in, the watershed (HUC6) code is 170900030602.

2. Load MapFile PCA_CROA on your computer and zoom into your watershed. Locate any Priority Conservation Areas (PCAs) or Conservation-Restoration Opportunity Areas (CROAs) in this watershed. You'll note there are three PCAs; their identification numbers are 321, 322, and 327.

   - From Table 6 in Appendix D, note that the overlap between CROAs and PCAs is small (24 percent) for PCA#321, large (72 percent) for PCA#322, and none for PCA#327. This means that the Ecoregional Assessment conducted by TNC, and the Willamette Alternative Futures project conducted by the PNW-ERC, both identified lands within PCAs 321 and 322 as being of high conservation importance.

   - From the same table, note that PCA#322 was considered to have no remaining buildable land, whereas PCA#321 has 9 percent and PCA#327 has 13 percent. Other factors being equal, this suggests that protection of #321 and 327 may be more urgent, but may also result in greater social and economic impacts.

3. Don't limit yourselves to considering just the PCAs and CROAs. Where available, consult other sources that have prioritized areas for conservation, such as some published watershed assessments, Goal 5 natural features inventories, and other documents listed in section 6.3 of Appendix D. In this particular case (Corvallis), local government has completed a natural features inventory (http://www.inforain.org/corvallis/) that contains maps showing "Wildlife Habitat Areas," with ratings of these areas shown in tables accompanying the inventory. Examine overlap between these areas and the PCAs and CROAs, but don't eliminate areas from consideration just because there is no overlap.

4. Purchasing or arranging easements for such extensive areas is unlikely to be practical. Even considering just these PCAs alone, their cumulative area in this watershed is 25,351 acres (40 square miles). Thus, further prioritization is required. Beyond this point the map files accompanying this report, due to their spatial coarseness, cannot provide information of direct usefulness to prioritizing parcels within the PCAs or other units. However, one or more of the following approaches can be taken to inform (but not dictate) area selection at finer scales:

   - Contact ORNHIC (http://oregonstate.edu/ornhic/) and ask to obtain, from their EOR database, locations of sensitive species documented to occur within the areas you're considering. Other factors being equal, accord higher priority to parcels containing such occurrences. Be aware that ORNHIC does not have locations for all sensitive species, and even for those that it tracks, the list of locations is nearly always incomplete.

   - If you know how to use MS Access or a similar computer application, query the DetailFiles that accompany the report, specifically, the one called SPHABHUC6. Query it to generate a complete list of wildlife species projected to occur within elevation zones of interest within the HUC6. This can be accomplished in just a few minutes.

- Ask local biologists which specific areas within the PCAs and CROAs (and other areas in the watershed designated as important to fish and wildlife) are most likely to contain any of the six focal habitats described in this report. If maps of any of the focal habitat types are available for even part of the local area, that will be a big help. Then ask *where* (within the focal habitats within the PCAs and CROAs) they believe focal species associated with that focal habitat type (Table 9 in Appendix D) are most likely to occur. Holding other factors equal, assign higher priority to land parcels containing both the focal habitats and the focal species. Also assign greater weight to species that have little or no suitable habitat on public lands in this watershed. Determine this by querying the SPHABHUC6 file.
- Consider the sustainability of individual parcels containing focal habitats and species within the PCAs, CROAs, or other priority areas. To evaluate sustainability, begin by considering factors TNC considered to pose potential threats (see Table 7 of Appendix D) and discuss these and other sustainability factors with local biologists. Also consider the diversity of functional roles fulfilled by the species projected to be present in each parcel.
- Consider the connectivity of individual parcels containing focal habitats and species within the PCAs, CROAs, or other priority areas. Evaluating connectivity requires that you first recognize which focal habitat types are present. This is because connectivity between forested areas involves corridors that are forested, whereas connectivity among upland prairies means evaluating corridors (or “stepping stones”) according to the degree that they are *not* forested. To minimize barrier effects, assign higher priority to parcels in which the bulk of the focal habitat is located several hundred feet from roads and development.

5. Once you have narrowed the potential selection to several parcels, consider the willingness of the owners of each of these parcels to sell their land to a conservation entity or to enter into long term conservation agreements. Also consider local zoning and other legal, social, and economic factors before making a final selection.

Example 2: Habitat Restoration Decisions. Suppose you belong to a group whose mission is to do volunteer work to improve your community’s social and environmental conditions. You and other members are trying to envision a project that will restore habitat for fish or wildlife. Unlike the preceding example which considered an entire watershed, in this case your group’s approach is largely opportunistic. That is, you know of only three landowners who are willing to allow habitat on their land to be restored. You have only limited time and resources. Whose restoration project should be undertaken first? Here’s how you might proceed:

1. Repeat steps 1 through 3 as described in Example 1 above.
2. Determine which mapped vegetation types predominated historically in the watersheds (HUC6s) in which these 3 parcels are located. Look this up in Table 49 of Appendix D. Also note which mapped vegetation types have experienced the largest declines in your watershed (negative numbers in Table 46 of Appendix D). If any of the parcels you’re considering still contain these types, assign them higher priority for restoration, other factors being equal.

3. If you determined during #1 that any of the parcels is located within a PCA, review Table 44 of Appendix D for additional information about historical vegetation. This information is much more detailed and geographically-specific. Again, if any of the parcels you're considering still contain these types, assign them higher priority for restoration, other factors being equal.

4. Use the information from #2 and #3 to establish *preliminary* restoration objectives for each parcel, that is, the vegetation or habitat types that were once present but have declined the most.

5. If #2 and #3 reveal that none of the parcels you're considering has remnants of the vegetation types that once predominated, focus your restoration efforts instead on creating conditions that will sustain one or more of the six focal habitat types. In section 2 of Appendix D, read carefully the general requirements of each focal habitat type, because not all parcels can sustain all types. For example, if your historical analysis indicates that wetland prairie restoration should be a priority in the watershed, but if the only parcels available for restoration are on rocky slopes, you obviously should modify your objectives. Local biologists also can advise you in determining which sites will be most geotechnically suitable for restoring particular vegetation or habitat types.

6. Suppose oak woodland restoration appears to be highly feasible in one parcel, whereas restoration of a different focal habitat type (say, stream riparian) is equally feasible in another parcel. Which project should receive preference? Other factors being equal, consider which *focal habitat type* is currently least-well represented and managed on public lands or other conservation lands within this watershed, and assign higher priority to that type and the parcels in which it occurs. You may also want to consider which *species* are currently the least-well protected by public and conservation lands in this watershed. You can determine that by querying the DetailFile: SPHABHUC6 that accompanies this report, as described in Example 1. You may then give preference to restoration projects (and associated land parcels) that will do the most to benefit those species, especially if they are focal species.

7. As in Example 1, consider the *sustainability and connectivity* of habitats that will be restored, in arriving at priorities.

8. Once you're ready to begin the restoration, consult local biologists and the guidebook, *Restoring Rare Native Habitats in the Willamette Valley* (Campbell 2004) for useful guidance.

5.6.1.3 Fish-Floodplain Connectivity

The assessment conducted under this subbasin plan reinforces the importance of connectivity and interaction between rivers and streams and their floodplains. The Pacific Northwest Ecosystem Research Consortium (2002) recently developed a strategic framework and process to identify and prioritize appropriate places for restoration activities. The foundation of the process is an understanding of ecological potential and consideration of patterns of human activity and development.

A fundamental premise of this process is to understand ecological potential based on the estimated change from historic to current conditions and the social and economic costs associated with reversing or modifying those conditions. It is important to assure that expenditure and effort will have the desired outcomes and minimize risk to life and property.

Practitioners interested in improving floodplain connectivity and channel complexity—the two most important factors limiting natural processes and habitat formation and maintenance in the Willamette Basin—should consult the *Willamette Basin Planning Atlas 2002* for further detail. Table 5-4 is an example of steps conservation practitioners should consider when evaluating areas of potential floodplain and channel complexity restoration.

Table 5-4: Example of Steps for Evaluating Floodplain Restoration Opportunities

At the River Network Level: • Consider current conditions and identify those places where the river channel is relatively unconstrained and opportunities for floodplain connectivity and channel complexity exist and areas where the change from historic conditions is the greatest. • Identify areas with low population density and few development structures • Identify potential for natural flood storage where historic channels and oxbows are no longer connected to the river system.
At the Reach Level: • After identifying high probability areas at the River extent level, identify willing landowners at the reach extent level. • Among the potential areas where there is landowner support, identify those areas with low densities of capital intensive improvements; low population densities; and public land ownership. • Identify those areas with high probability for recovery of native floodplain forests and channel complexity; and those areas with the fewest revetments and highest flood storage potential.
At the Site Specific Level: • Determine the ratio of predicted forest area and channel complexity increase to the cost of restoration • Determine availability for incentives for stewardship of private land.

Note: Selection criteria are adapted from the *Willamette Basin Planning Atlas*.
Source: PNWERC, 2002:146.

5.6.1.4 Riparian Areas

In evaluating potential conservation and restoration opportunities for riparian areas consider the following strategic approach to conservation and restoration efforts:

Conservation

1. Concentrate efforts in the lowlands of the Willamette Valley.
2. Preserve the liner connectivity and extent of existing riparian areas. Riparian areas closest to the a river or stream have the greatest net benefit (PNWERC 2002).
3. Place a priority on riparian areas that have the highest probability of inundation under current flow regimes. Consider topography, bank hardening structures, and current or potential flow regimes when choosing between conservation opportunities.

Restoration

1. Concentrate efforts in the lowlands of the Willamette Valley.
2. Fill the gaps in vegetation closest to the river or stream

3. Improve vegetative age classes and composition (more variety of bigger trees including closer range of historic conifers).

4. Expand riparian areas in those places with the highest probability of inundation during high flood events.

5.6.1.5 Steps in Restoring Fish Passage

These steps are adapted from the more detailed 1999 Oregon Road/Stream Crossing Restoration Guide by Robison, Mirati, and Allen (available on the web from: http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/orfishps.htm)

1. Find and prioritize problem road/stream crossings. Identify areas with the highest potential quality and quantity of inaccessible habitat.
2. Identify barriers that limit access to the habitat and prioritize sequential restoration. (use and confirm newly created fish barrier (Appendix G)
3. Get information about stream and other conditions at crossings to be restored
4. Decide if installation can be repaired or improved or must be replaced
5. Decide on design strategy based on information collected
6. Prepare a design
7. Install new road/stream crossing structure
8. Monitor and Maintain road/stream crossing structure.

5.7 Research, Monitoring, and Evaluation

There is an extraordinary amount of ongoing fish and wildlife population and ecosystem research and monitoring in the Willamette Basin. State and federal agencies, universities, municipalities, watershed councils, soil and water conservation districts, landowners, and numerous other organizations are engaged in some form of aquatic and terrestrial research, monitoring, and evaluation (RM&E). We have not completed a comprehensive inventory of all research and monitoring activities in the Basin. Table 5-5 outlines selected ongoing monitoring and research activities.

Table 5-5: Selected Willamette Basin Monitoring and Research Projects And Programs

Organization	Example of Activities
Federal agencies	USFS and BLM: Aquatic and Riparian Effectiveness Monitoring Program for the Northwest Forest Plan; aquatic habitat inventories; fish populations and distribution; and other monitoring actions. USFS Research: Investigating how land use, natural disturbances, and climate change affect carbon dynamics, biodiversity, and hydrology. EPA: Environmental Assessment and Monitoring Program (EMAP); and other studies. USGS: Stream flow gages; ongoing water quality and other research. NRCS: Implementation monitoring of projects.
State agencies	ODFW: Fish population status and trends; habitat inventories; and other studies. WRD: Stream flows and water use.

Table 5-5: Selected Willamette Basin Monitoring and Research Projects And Programs

Organization	Example of Activities
	DEQ: Basinwide ambient monitoring networks; monitoring studies in support of TMDLs. ODF: Forest practices regulation implementation effectiveness monitoring. OWEB: Monitoring protocols; Oregon Plan coordination; restoration database for OWEB-funded actions. Other agencies: Implementation monitoring.
Land owners	Timber industry: Water temperatures; effectiveness of road sediment control; upper distribution of fish use; habitat inventories; and other studies. Agricultural: Assessing noxious weeds; and other studies. Other private: Cooperation with watershed council and SWCD monitoring efforts.
Watershed councils and Soil and Water Conservation Districts	Implementation and effectiveness monitoring of restoration projects (physical and biological indicators). Watershed-scale water temperature monitoring. Site-specific and watershed scale water quality monitoring.
Municipalities	Stormwater monitoring. Effluent monitoring. Restoration project effectiveness monitoring.
Universities	H.J. Andrews Experimental Forest: Controlled watershed studies; ecosystem processes; and other studies. Pacific Northwest Ecosystem Research Consortium (OSU, U of O, and EPA): Current and status conditions for terrestrial, riparian and aquatic habitat; fish population studies. Other ongoing research: Fish and amphibian dynamics in Willamette Valley lowland seasonal streams; development of models linking water quality to land use activities; studies of nutrient budgets; aquatic ecosystem dynamics; lowland habitat and wildlife dynamics; studies of amphibian population declines in the Cascade Mountains; and other studies.

Designing a comprehensive research and monitoring program in the socially, economically and ecologically diverse Willamette Basin is an extraordinarily complex undertaking. Through the subbasin planning process, there was not the time nor resources to devote to the coordinated development of the RM&E plan. As a consequence, this is a description the key issues and a strategic framework for the development of a Willamette Basin RM&E plan. The final RM&E plan will provide detailed descriptions of data collection protocols, coordinated monitoring at various scales (watershed, subbasin, and basinwide), and mechanisms for information sharing and reporting. At this time, organizations involved in the subbasin plan will maintain ongoing monitoring and evaluation efforts until a more structured and coordinated monitoring and evaluation framework and plan is developed and approved.

5.7.1 A Strategic Monitoring and Evaluation Framework for the Willamette Basin

Currently, most monitoring data in the Willamette Basin is collected through separate projects and programs with very little coordination between organizations and integration of data collection protocols, information management, or reporting. For the most part, monitoring efforts focus on the site, reach, or subbasin scales (local scale). There is need to collect local-scale monitoring data in a fashion that can be "tiered" into the broader scales of the ESU and the Willamette Basin. Ultimately, monitoring data collected within the Willamette Basin should be compatible with other regional date protocols and evaluation frameworks, allowing for evaluation across the Columbia system. This hierarchical approach to RM&E necessitates a higher level of coordination and creates a new set of challenges at each level of involvement.

As identified by the Pacific Northwest Aquatic Monitoring Partnership (PNAMP 2004), one of the key tasks of the Willamette Basin planning effort will be to work with regional, basinwide and local entities to identify the common metrics and monitoring designs necessary to address questions at and across the basin and the region. This plan will include a terrestrial and aquatic component and address the questions needed to meet the fish and wildlife vision, goals and objectives of Willamette Subbasin Plan. The plan will also outline a process to evaluate the economic efficiency of the different ecosystem restoration and protection approaches that incorporates both cost and benefits of ecological services and protections.

The monitoring program will integrate with the Oregon Plan for Salmon and Watersheds Monitoring Strategy (OWEB 2002). The Willamette Basin is an Oregon Plan for Salmon and Watersheds "Report Basin." Accordingly, the Willamette Basin component of the broader Columbia Basin RM&E plan will develop an implementation framework to address the following OWEB monitoring strategies:

- Strategy 1: Assess general status and trend for physical habitat, fish and wildlife populations, and terrestrial and aquatic conditions in Willamette subbasins at appropriate scales.
- Strategy 2: Monitor habitat capacity, focal species survival and productivity, and biotic processes in selected watersheds within the Willamette Basin.
- Strategy 3: Analyze habitat trends and focal species populations in the context of basin and subbasin effects.
- Strategy 4: Document implementation of restoration projects, conservation activities, and agency programs.
- Strategy 5: Evaluate the local effectiveness of site-specific restoration efforts by monitoring representative samples of specific restoration project types.
- Strategy 6: Evaluate the combined effectiveness of site-specific restoration projects by monitoring habitat and focal species population response in a structured sample of watersheds.
- Strategy 7: Standardize monitoring designs, assessment protocols, and methods to manage, analyze data, and report findings.
- Strategy 8: Coordinate and support local and basinwide monitoring efforts and develop a framework for public-private partnerships.
- Strategy 9: Manage and integrate information from multiple sources to produce data products and reports that assess restoration efforts and evaluate progress toward recovery goals.

The monitoring program will build on existing studies and programs. For example, the Pacific Northwest Ecosystem Research Consortium has completed detailed information on historic and current fish and wildlife habitats and populations throughout the Willamette Valley; DEQ has an extensive network of water quality monitoring sites; and the EPA's EMAP structure provides a flexible sampling design that allows site-specific data to tier up to a range of scales – watershed, subbasin, basin and region. The Oregon Plan for Salmon and Watershed's *Indicators of Basin Condition* will be used to help guide the development indicators for assessing status and trends in the basin's aquatic and riparian systems (see Appendix Q).

While there is an abundance of ongoing monitoring and research activities within the Willamette Basin they are not linked within a strategic framework. The extraordinary level of coordination and integration required for collecting common data sets across sites, watersheds, and subbasins within the Willamette Basin will require leveraging exiting information and managing new data gathering efforts within a cooperative framework. Fortunately the components are in place. The EMAP sampling framework, for example, could be used to assess the status and trends for terrestrial and aquatic habitat, water quality, and spawning fish. This will require careful planning to identify and allocate resources and responsibility among those currently engaged in RM&E activities and programs in the basin. To create efficiencies and to develop a cooperative framework the program will:

- Rely as much as possible upon work conducted under existing RM&E programs, such as EMAP (state and federal agency monitoring programs, municipalities, watershed councils, and other entities).
- Develop new cooperators within an existing monitoring programs.
- As needed develop new projects and programs.
- Identify mechanisms for sharing resources for data collection, information management and evaluation.

To complement exiting monitoring and research actions, the RM&E planning effort will examine the feasibility of establishing a hierarchical network of sites that will provide information across scales. This monitoring network could include the following:

- Status monitoring of watershed conditions and terrestrial wildlife and fish populations.
- Intensively monitored watersheds to assess the effectiveness of different categories of actions on fish and wildlife at watershed scales.
- Linkages among an identified restoration effectiveness studies.

5.7.2 Framework for Implementation

It is important to first identify the management questions that the monitoring and research program is intended to address. Because resources are limited, these key questions will be prioritized in consultation with the monitoring and research community. Environment and fish and wildlife population indicators will be identified to address the highest priority monitoring and research questions. Table 5-6 illustrates the spatial and temporal scale considerations and provides examples monitoring types and indicators.

The are a number of issues that will need to be resolved for successful implementation of a comprehensive and coordinated RM&E program in the Willamette Basin. It will be necessary to define responsibilities, identify priorities, rigorously document protocols and procedures, and describe how information will compiled, archived, shared and reported. Table 5-7 summarizes the key implementation issues for each of the monitoring strategies.

5.7.3 Key Aquatic and Terrestrial Monitoring and Research Issues

Most of the fish and wildlife population and habitat data collection within the Willamette Basin focuses on the upland portions of the basin, particularly on federal, state and private forestlands. There are critical data gaps on the aquatic and terrestrial environment and populations in the lowland portion of the valley. Significantly, the lowland areas of the basin are where many of the important conservation gains are to be made. Table 5-8 outlines some of the key data gaps for the aquatic system in the lowland areas within the Willamette Basin.

For most focal terrestrial species and habitats, technical data are currently inadequate for adopting quantitative biological objectives or standards that represent desired conditions and could be used to evaluate progress towards meeting ecological goals. Over the longer term, data needed to support sound biological objectives will be developed using four strategies:

1. Research to measure key demographic characteristics of terrestrial focal species, e.g., home range size, reproductive success, and survival. Such research should emphasize the focal habitats, and select research sites stratified by landscape configuration and geomorphic settings, so as to ultimately allow estimation of minimum viable population sizes and population viability;

2. Research to prioritize the relative importance of each terrestrial focal species' limiting factors, from among the possibilities listed generally in this report;

3. Monitoring of terrestrial species populations, especially species that are suspected – based on paucity of recent reports — of having recently become (or are about to become) extirpated from the Willamette subbasin. These might include, for example, breeding populations of short-eared owl, Wilson's snipe, black-tailed jackrabbit, Baird's shrew (endemic to this subbasin), and several species of bats, plants, and invertebrates.

Table 5-6: Sample Strategic Framework for Monitoring and Evaluation Within the Willamette Basin

Spatial Scale	Frequency	Monitoring Type	Key Indicators	Protocols to Consider
Subbasin ESU Willamette Basin (Oregon Plan Report Area)	Annual and/or Seasonal: Ongoing Duration	Status and Trend Spatially explicit, Rigorous, statistical sampling designs and protocols	Population Abundance, Distribution, Diversity Watershed Condition Riparian & Channel Habitat, Water Quality & Biotic Indicators	EMAP Based Sample Site Selection: Site specific activities (Upper Columbia Monitoring Strategy, AREMP, PIBO, Habitat, Water Qual., Fish Populations, etc)
Watersheds 5th -6th Field (USGS HUC)	Seasonal and Continuous: Long Term Duration (10-40+ yrs)	Intensively Monitored Watersheds Limiting Factors, BMP Evaluation & Compliance, Effectiveness	Landscape Assessment Watershed Condition and Processes, Salmonid Freshwater Survival & Productivity Management Actions	Upper Columbia Monitoring Strategy, CLAMS, AREMP, Current WA and OR IMW's. Paired-watersheds and/or sample-based watersheds
Stream Reaches	Annual and Seasonal: Med. Duration (5-10 yrs)	Project Effectiveness Desired physical and biotic responses.	Channel and Riparian Habitat Response Fish Use / Productivity Water Quality	Upper Columbia Monitoring Strategy, OPSW Water Quality and Riparian Guides, WA-SRFB Protocols, Ongoing PNAMP Process, etc.
Sites	Seasonal Short Term (1-5 yrs)	Validation Testing Restoration Methods	Expected vs. Response Conditions. What works, why, and where?	See Washington State for Example; SRFB Draft Protocols, Upper Columbia Monitoring Strategy
Projects	Before/After Project Completion	Implementation	Location, Description of Activity, Target Species, Ecosystem Function or Habitat Condition	Documentation & Reporting via BiOp Implementation Plans, PRISM, OWEB, NOAA

Note: Most of this framework focuses on the aquatic system.
Source: PNAMP, 2004.

Table 5-7: Implementation Issues Related to the Key Willamette Basin Monitoring Strategies

Strategy	Description	Implementation Issues
1. Assess general status and trend for physical habitat, populations, and terrestrial / aquatic conditions in Willamette subbasins at appropriate scales.	Status and trend monitoring for fish and wildlife populations, terrestrial and aquatic habitat, water quality, and conditions of watersheds requires collecting information that has statistical rigor and comparability both year to year and between subbasins within the Willamette Basin and other portions of the Columbia system.	• Defining and reaching consensus on appropriate indicators of watershed health and aquatic focal species population status and trends. • Reaching agreement on the appropriate scales to evaluate watershed health and focal species population indicators. • Determining the appropriate and affordable level of precision to measure watershed health and focal species indicators.
2. Monitor habitat capacity, focal species survival and productivity, and biotic processes in selected watersheds within the Willamette Basin.	Detailed assessments and monitoring in selected watersheds within the Basin will provide information to track progress. This intensive monitoring at the watershed-scale will complement work done by state and federal agencies, watershed councils, and other local entities. Specific studies that test hypotheses on the relationship between terrestrial and aquatic focal species populations and environmental conditions will link environmental trend data to fish and wildlife population data at the watershed scale. This information will help to understand the functional relationships between watershed and landscape process, habitats, and populations.	• Determining what information is needed to investigate cause-and-effect relationships at specified scales. • Reaching agreement on watersheds selected for study, study design, and reporting methods.
3. Analyze habitat trends and focal species populations in the context of basin and subbasin effects.	Understanding the relationships between environmental changes and fish and wildlife populations is necessary to develop confidence in restoration project strategies and adjust strategies accordingly.	• Agreeing on a consistent way to report on indicators and supporting information at the subbasin level. • Develop methods for synthesizing information at appropriate scales.

Table 5-7: Implementation Issues Related to the Key Willamette Basin Monitoring Strategies

Strategy	Description	Implementation Issues
4. Document implementation of restoration projects, conservation activities, and agency programs.	While OWEB and other organizations do collect information on the implementation of restoration projects, there is not a comprehensive database of activities for the Willamette Basin. Implementation of a comprehensive restoration project reporting framework will require cooperation with landowners, industry organizations and agencies that are engaged in restoration activities.	• Developing a framework for ensuring that all restoration actions are reported. • Agreeing on a reporting framework to document the range of restoration and conservation activities.
5. Evaluate the local effectiveness of site-specific restoration efforts by monitoring representative samples of specific restoration project types.	There are very limited application of standardized protocols for measuring and evaluating the effectiveness of site and reach-specific restoration efforts. Implementation of a restoration effectiveness monitoring strategy will require the development and training in the use of protocols and a commitment to long-term funding of monitoring actions.	• Developing testable hypotheses embodied in different restoration strategies. • Agreeing on a subset of restoration activities for effectiveness monitoring. • Defining and reaching consensus on appropriate indicators restoration project effectiveness. • Determining the appropriate and affordable level of precision to measure restoration effectiveness indicators.
6. Evaluate the combined effectiveness of site-specific restoration projects by monitoring habitat and focal species population response in a structured sample of watersheds.	The link between watershed restoration actions, other management activities and watershed processes is complex. Watershed-scale monitoring will provide the most complete evaluation of restoration efforts. “Validation watersheds”, small watersheds where there is a full accounting of the factors that influence habitat and populations can be combined with comprehensive monitoring of cause-and-effect relationships and trends. This level of monitoring will be closely linked to research studies of ecosystem function at the watershed-scale (e.g., H.J. Andrews Experimental Forest watershed studies).	• Determining what information is needed to investigate cause-and-effect relationships at specified scales. • Reaching agreement on watersheds selected for evaluating cumulative restoration responses.

Table 5-7: Implementation Issues Related to the Key Willamette Basin Monitoring Strategies

Strategy	Description	Implementation Issues
7. Standardize monitoring designs, assessment protocols, and methods to manage, analyze data, and report findings.	Standardized field data collection protocols and a common monitoring design create a framework for comparing information from watershed to watershed across the Willamette Basin and Columbia Basin. A common monitoring strategy (for example a random sampling design) and data standards will create the ability to evaluate data at a variety of scales and promote the sharing of information.	• Determining responsibility for developing and documenting standardized monitoring designs and data collection protocols. • Providing training and quality control / assurance mechanisms to all participants.
8. Coordinate and support local and basinwide monitoring efforts and develop a framework for public-private partnerships.	The complexity and scope of monitoring needed to assess watershed restoration across the Willamette Basin is too great to be the responsibility of any one agency or organization. It is necessary to develop and coordinated and cooperative monitoring framework among state and federal agencies, municipalities, watershed councils and other local entities.	• Developing a coordination framework and assigning responsibilities for data collection, integration, and reporting. • Developing mechanisms to assure long-term participation and funding for all local and regional organizations and agencies that participate in monitoring.
9. Manage and integrate information from multiple sources to produce data products and reports that assess restoration efforts and evaluate progress toward recovery goals.	Data from various spatial scales and sources needs to be linked and synthesized in order to provide information and evaluation of progress toward goals and objectives. The public and funding organizations require timely reporting of progress. This effort will require mechanisms for coordination, data sharing and archiving, and reporting.	• Creating effective forums and mechanisms for sharing research, monitoring, and evaluation information and results. • Develop a framework and mechanisms for archiving and retrieving information.

Source: OWEB, 2002.

Table 5-8: Selected Monitoring and Research Issues for the Willamette Basin's Lowland Aquatic Systems

Development and implementation of consistent channel and riparian habitat measures for large river systems. These habitat measures should be in a format that is compatible with the EDT Stream Reach Editor parameters and ratings.
Defining the range of high flows below the dam system that are adequate to maintain and create aquatic and floodplain habitats.
Studying how the retention of bedload within reservoirs below the dams has modified the spatial distribution and dynamics of channel substrate.
Identifying the factors that are contributing to fish and egg mortality below the dams.
Defining winter steelhead, spring Chinook salmon, and cutthroat trout use and population status within the Willamette River and the lower portions of tributaries.
The contribution of slow-water habitats (side channels, alcoves, and sloughs) to focal aquatic species survival and life history diversity.
Evaluating the effectiveness of restored slow-water habitats (alcoves, side channels, etc.) in maintaining important habitats and contributing to increased fish populations.
Determining the status, trends and habitat use for lamprey species.
Further defining the role of the hyporheic zone determining the status of water quality.

4. Measurement of both typical and desired structural characteristics of each terrestrial focal species' habitat from a statistical sample (probabilistic frequency distribution) stratified by geomorphic setting, e.g., mean patch size of oaks in south-facing slopes between 500 and 1,000 ft elevation, expected cover of non-native shrubs in wetland prairies on Bashaw clay soils. A field and GIS-based inventory of such characteristics is necessary to add realism to biological objectives.

In addition, existing species-habitat models and demographic models, upon which many of the recommendations of this plan are based, should be updated and refined using:

- New or supplemental spatial data layers;
- Results of research studies published since 1999 (when the models were drafted);
- Field validation and improvement of land cover (habitat) spatial data used in model predictions;
- Incorporation of data from federal agency species observation databases (e.g., ISMS); and
- Local biologist review of the watershed species lists generated by existing models.

The models should then be re-run for the entire subbasin with results again subtotaled by watershed (HUC6) and for specific conservation opportunity areas. If feasible, assumptions made earlier about the frequency of habitat elements within each map class (e.g., relative extent of snags in 40-60 year-old closed-canopy conifer forest; see pages A-12 through A-15 in Payne 2002) should be field-verified. This will allow for improved assessments of the consequences of adopting alternative biological objectives for particular species, as well as improved identification and prioritization of lands for restoration or conservation within individual watersheds.

Over the long term the needs of species, genetic groups, habitat types, and ecosystem functions not considered by this or other Willamette reports should be determined, taken into account, and monitored. Only then can we be assured that ecological integrity – not simply wildlife diversity – is being maintained in the Willamette Basin.

5.8 ESA-CWA Requirements

The Clean Water Act and Endangered Species Act are having profound impacts in Oregon and the Willamette River Basin by significantly increasing stream protections (Oregon's 2000 Water Quality Status Assessment Report; Section 305(b) Report; Oregon Department of Environmental Quality).

There are two major drivers of the Acts: listings of species under the Endangered Species Act and listings of waters as water-quality limited. Species listings require recovery plans; water-quality limited listings result in the development of Total Maximum Daily Load and implementation plans. Listed species and waters are described in the Subbasin Overview in Chapter 3.

Both laws are complex and far-reaching, and therefore there is a growing interest in integrating responses to both (Nolan, 1999). The Willamette Basin is especially noteworthy in terms of efforts that strive to meet requirements of both Acts. (Note that many of these are also described in Chapter 4, Inventory and Assessment of Conservation Efforts.

The Aquatic Conservation Strategy of the Northwest Forest Plan does not represent a formal integration response to the two laws, but it does operate to achieve practical integration. One of the Strategy's primary objectives is: "Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain in the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities" (BLM Roseburg District at http://www.or.blm.gov/roseburg/ROD_RMP/roseburg/aquastrategy.html). The Environmental Protection Agency indicates it advocates through the Northwest Forest Plan for compliance with the Clean Water Act through watershed analysis, restoration project identification, monitoring, ecosystem management research, geographic information system development, and coordination with non-federal land managers (Environmental Protection Agency; http://www.epa.gov/ecoplaces/part1/site20.html).

In 2000 and 2003, the governors of Oregon, Washington, Idaho, and Montana released their "Recommendation for the Protection and Restoration of Fish in the Columbia River Basin," with the a goal of "protection and restoration of salmonids and other aquatic species to sustainable and harvestable levels meeting the requirements of the Endangered Species Act, the Clean Water Act, the Northwest Power Act and tribal rights under treaties and executive orders while taking into account the need to preserve a sound economy in the Pacific Northwest." The Governors recommended that federal, state, and regional planning processes be integrated with the NWPPC's amended Fish and Wildlife Program. (NOAA Fisheries, 2000).

Another important integration effort is the Oregon Plan for Salmon and Watersheds. According to the Oregon Watershed Enhancement Board, "the Oregon Plan rests on a framework of state laws, rules, and executive orders designed to enhance and protect watershed health, at risk species, and water quality by governing forest and agricultural practices, water diversions, wetlands, water quality, and fish and wildlife protection. This foundation of environmental laws is consistent with the federal Clean Water Act (CWA) and Endangered Species Act (ESA), giving Oregonians greater control over Oregon's natural resources while still meeting standards and obligations at the federal level." The Willamette Restoration Strategy is the Willamette "chapter" of the Oregon Plan and serves as a major coordinating framework for improving water quality and habitat (Oregon Watershed Enhancement Board, 2003).

The Oregon Department of Environmental Quality is nearing completion in developing about 150 separate reach-based TMDLs for most of the Willamette Basin. Listings for temperature and bacteria make up about 2/3's of the listings. Some sections of the mainstem Willamette are listed for biological criteria, based on observed skeletal deformities in fish. There are also seven listings for habitat and flow modification, but which do not require TMDL's based upon direction from the U.S. Environmental Protection Agency (Oregon's 2000 Water Quality Status Assessment Report; Section 305(b) Report; Oregon Department of Environmental Quality).

The City of Portland is currently developing a powerful program to integrate environmental protection activities—the Framework for Integrated Management of Watershed Health. The Framework is detailed response to the City's challenges of complying with requirements of the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), the ESA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In addition, Title 3 of Metro's *Urban Growth Management Functional Plan* specifically requires implementation of several Oregon statewide land use goals through the avoidance, limitation or mitigation of development's impact on streams, rivers, wetlands and floodplains. By integrating these efforts, the *Framework* seeks to advance the City's compliance with each of these obligations. In addition, the City is playing an active role in a number of collaborative regional efforts to restore fish and wildlife and improve water quality and watershed conditions. These efforts include Northwest Power and Conservation Council subbasin planning, the Oregon Plan for Salmon and Watersheds, the Willamette Restoration Initiative and coordination with other regional governments and stakeholders on ESA and water quality planning and activities. (Framework for Integrated Management of Watershed Health; City of Portland, Oregon. March 2004)

Clean Water Services, a Washington County special district, has developed the Healthy Streams Plan—a coordinated strategy for protecting water resources and meeting the requirements of the Clean Water Act (and Endangered Species Act. The plan identifies and prioritizes specific projects, policies, and programmatic changes needed to further improve water quality, manage flooding and floodplains, and protect aquatic species in the Tualatin River Basin.

There are a number of other efforts that address both ESA and CWA provisions. For example, the U.S. Army Corps of Engineer's Willamette Temperature Control project in the McKenzie subbasin is building new outlet structures for Cougar Reservoir. This outlet tower will remedy downstream temperature problems that affect salmon spawning success. The project is being conducted to also serve the interests of upstream bull trout and to protect Oregon chub and nearby spotted owls (U.S. Army Corps of Engineers, Portland District). Metro, the Portland area regional government, is developing water quality, fish and wildlife protections through its Title

II and Title III efforts. These protections are being established to comply with state land use regulations, but will also help meet Clean Water Act and Endangered Species Act objectives. In addition, NOAA Fisheries has developed a number of recommendations to the Northwest Power Conservation Council regarding implementation of the Federal Columbia River Power System biological opinion in the Willamette basin, including: "Action 152: Prioritize projects ready for implementation based on local agreements that can jointly satisfy CWA and ESA requirements." (Willamette Restoration Initiative, 2002).

This *Willamette Subbasin Plan*, then, becomes the latest Willamette effort to integrate the requirements of both Acts. Its integrative character is expressed primarily through its ecosystem-based approach to improving fish and wildlife habitat. By promoting the role of natural processes for conservation and restoration, the plan advances both water quality and species protections. The plan's emphasis on floodplain and channel restoration, for example, is designed to yield important benefits in terms of water temperature reductions, Chinook salmon habitat, and floodplain-dependent wildlife, such as the pond turtle. Further, the plan's strategies for increased coordination and integration set the stage for substantially increased collaboration between urban and rural interests in developing new economic mechanisms for providing environmental services (land and water management that maintain or improve water quality and habitat). In addition, the plan's riparian strategies will result in improved water quality (both in terms of temperature and non-point source control) and increased habitat for species (both aquatic—for example, by diversifying salmon habitat through large wood inputs—and terrestrial, for example bald eagle habitat). Finally, the plan's interest in returning to more natural flow regimes not only creates more physical habitat for listed species, it also should produce seasonal temperature benefits.