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Six Key Conservation Issues that Affect Species and Habitats Statewide

There are some large-scale conservation issues that affect or potentially affect many species and habitats over large landscapes and throughout the state. They also affect people, by reducing land productivity, altering water supplies, or increasing risk of severe wildfires. Invasive species and wildfires do not abide by "No Trespassing" signs, and neither do fish and wildlife. As a result, problems affecting large areas must be considered in a larger context, and across jurisdictional and ownership boundaries.

Oregon Department of Fish and Wildlife, working with the Stakeholder Advisory Committee, identified six key conservation issues. They are presented on pages seven to 10 of the "A Strategy for Action: Overview and Highlights" summary. The Stakeholder Advisory Committee also identified Global Warming as an issue with the potential to impact fish and wildlife in the future. Because there are ongoing statewide and interstate planning efforts for this issue, Oregon Department of Fish and Wildlife did not include it in this Conservation Strategy. Global warming is briefly discussed in Appendix VI on page a48.

In this Chapter, the key conservation issues are addressed in greater detail, with overviews of the issues and information on recommended actions. For all recommended actions, implementation will depend on cooperative efforts by a variety of entities and may be contingent on funding, statutory authority, and other factors. Actions need to be compatible with local priorities, local comprehensive plans and land use ordinances, as well as other local, state, or federal laws. Actions on federal lands must undergo federal planning processes prior to implementation to ensure consistency with existing plans and management objectives for the area.

In many cases, these actions are already occurring and should be continued or expanded. In other cases, new actions are identified. Ideally, new actions should be implemented, monitored and adapted accordingly.

Goals and Actions for all Key Conservation Issues

The Conservation Strategy takes a voluntary, non-regulatory approach to addressing conservation in Oregon. This is the thread that ties together all of the conservation issues. The common theme for all key conservation issues is to foster and support voluntary efforts by Oregonians.

Overall Goals for the Conservation Strategy: maintain healthy fish and wildlife populations by maintaining and restoring functioning habitats, prevent declines of at-risk species, and reverse any declines in these resources where possible. Reducing and reversing the impacts of the key conservation issues can contribute significantly to these goals, while also contributing to healthy human communities.

Overall Recommended Actions for all Key Conservation Issues:

a. Work with community leaders and agency partners to ensure planned, efficient growth, and to preserve fish and wildlife habitats, farmland, forestland and rangeland, open spaces, and recreation areas.

b. Use, expand, and improve financial incentive programs and other voluntary conservation tools to support conservation actions taken by landowners and land managers.

c. Develop new voluntary conservation tools to meet identified needs.

d. Promote collaboration across jurisdictional and land ownership boundaries.

e. Work creatively within the existing regulatory framework, seeking new opportunities to foster win-win solutions.

f. Inform Oregonians of conservation issues and the actions everyone can take that will contribute to Oregon's collective success.

ISSUE 1: Land Use Changes

People's presence on the land has always altered the shape, appearance, and function of ecosystems. Native Americans, European settlers, long-time Oregonians, and today's newcomers have contributed to land use patterns that affect fish and wildlife populations.

Oregon's human population is increasing, which means greater demand for urban, residential, and industrial areas. An estimated 3,541,500 people lived in Oregon in 2003, and Oregon's mild climate, spectacular vistas, and easy access to outdoor recreation will continue to attract new Oregonians. The Willamette Valley is home to 70 percent of Oregon's people and the population is anticipated to nearly double in the next 50 years. Other areas of the state such as Bend-Redmond-Sunriver, Grants Pass, Medford and coastal communities including Brookings and Florence are experiencing population booms. As a result, conversion of natural areas, farmland and forestland to other uses is expected to increase.

Land use change, whether from native vegetation to farmlands or from farmlands to residential neighborhoods, can result in the disruption of natural disturbance regimes (fire and flooding) and can result in habitat loss and fragmentation.

Urbanization poses particular problems. Conversion to more urban uses increases the amount of impervious surfaces, which alter surface and water flow, degrade water quality, and reduce vegetation cover and diversity. The changes made to the landscapes tend to be permanent and restoration to a natural state is difficult if not impossible. However, contained, well-designed urban growth can minimize impacts to surrounding landscapes and conserve habitat values. Conservation within urban areas is discussed further starting on page 65.

Oregon's Land Use Planning Heritage

Oregon has many opportunities today to conserve, restore, and improve fish and wildlife habitat. A major reason is Oregon's statewide land use planning program, which has prevented sprawling development in farm, forest and rangelands.

Prior to the 1960s, population growth was not broadly perceived as a concern in Oregon. However, between 1940 and 1970, Oregon's population grew 109 percent. Subdivisions sprouted next to farms in the Willamette Valley and Oregonians saw their pastoral landscape threatened by sprawl. Governor Tom McCall and farmer-turned-senator Hector MacPherson collaborated on the legislation that created Oregon's land use planning program. (See discussion of Oregon's land use program in Appendix II starting on page a13.) The system's 19 goals include Goal 14 that establishes urban growth boundaries around each city or metropolitan area to separate urban land uses from farm and forest working landscapes. These boundaries are reevaluated periodically to maintain a 20-year supply of buildable land. By concentrating people and associated impacts, compact urban areas reduce the overall footprint on the land.

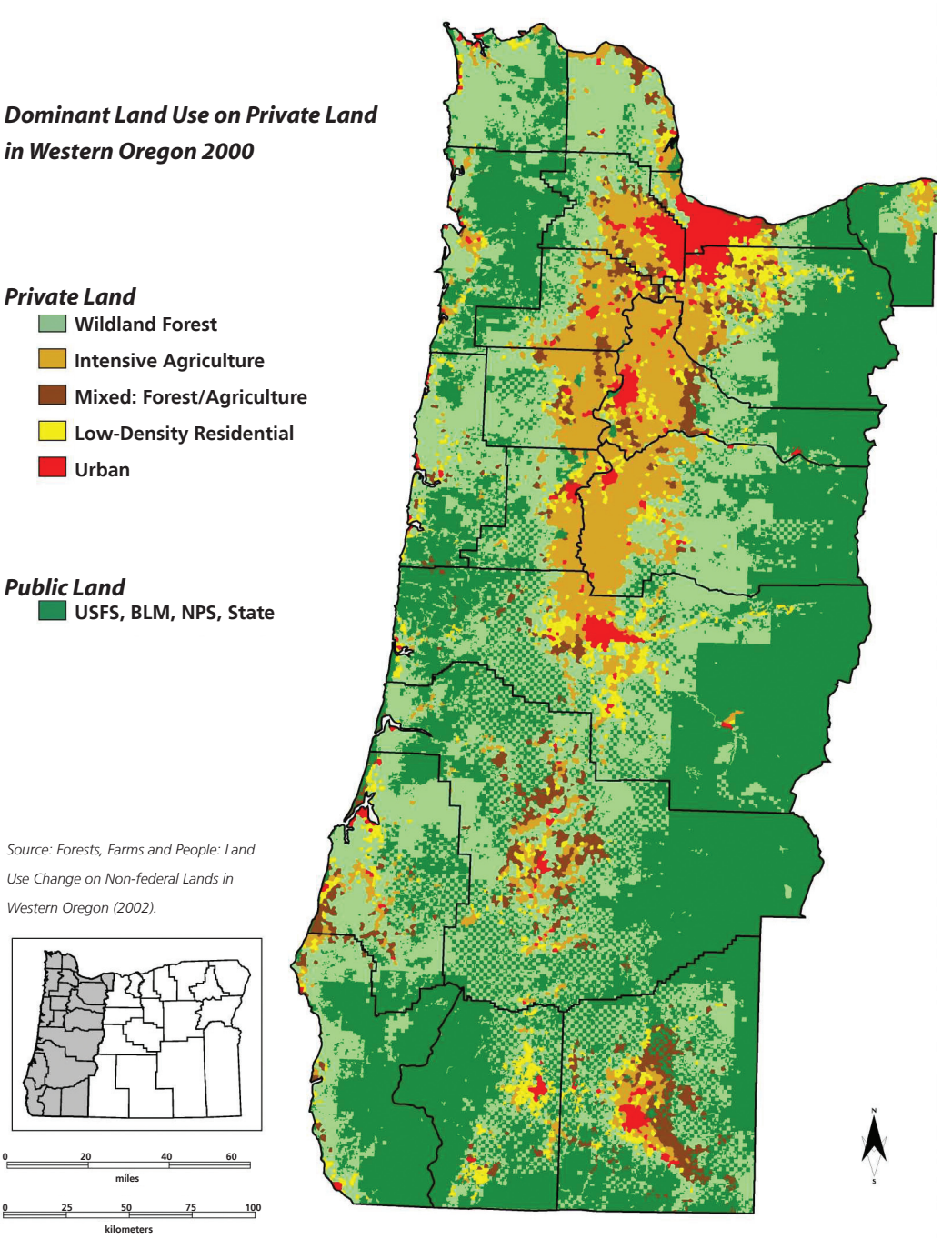
Comprehensive land use plans were in place across Oregon starting in 1982. By most accounts, the land use program has been reasonably successful in containing sprawl, in that "leapfrog" development has been largely curtailed. However, as the population has grown the urban growth boundaries have expanded. Some call this "contained sprawl."

Oregon's land use laws have helped maintain the state's forest and farm lands, which provide habitat for many fish and wildlife species. Although Goal 5 addresses natural resources, scenic and historic areas, and open spaces, Oregon's land use planning system was not intended for conserving native vegetation. In "No Place for Nature," the author Pam Wiley explored the limits of Oregon's land use planning program in conserving fish and wildlife habitats in the Willamette Valley. In her conclusion, Wiley notes that land use planning is best viewed as one part of an integrated, multi-tiered approach to addressing fish and wildlife needs. Such an integrated approach could build on current programs to include broader regional approaches, expanded use of voluntary conservation tools, and restoring ecological processes.

However, there is new uncertainty in Oregon's land use planning system. During the November 2004 elections, Oregon voters passed the voter initiative Ballot Measure 37 by 1,054,589 (61 percent) to 685,079 (39 percent). Ballot Measure 37 provides that the owner of private real property is entitled to receive just compensation when an enacted land use regulation restricts the use of the property and reduces its fair market value. In lieu of compensation, the ballot measure also provides that the government entity responsible for the regulation may choose to "remove, modify or not apply" the regulation. The implications of Ballot Measure 37 on landowners and agencies are not entirely clear due to differing interpretations of the measure, litigation, and possible legislative clarifications. Some local jurisdictions have enacted waiver systems to implement the measure. Passage of Ballot Measure 37 poses significant challenges for effective local planning and increases the need for improved voluntary approaches to conservation.

Recent Patterns in Land Use Changes

The legal and institutional framework for maintaining private forestland in economically viable use is already in place through the Forest Pro-

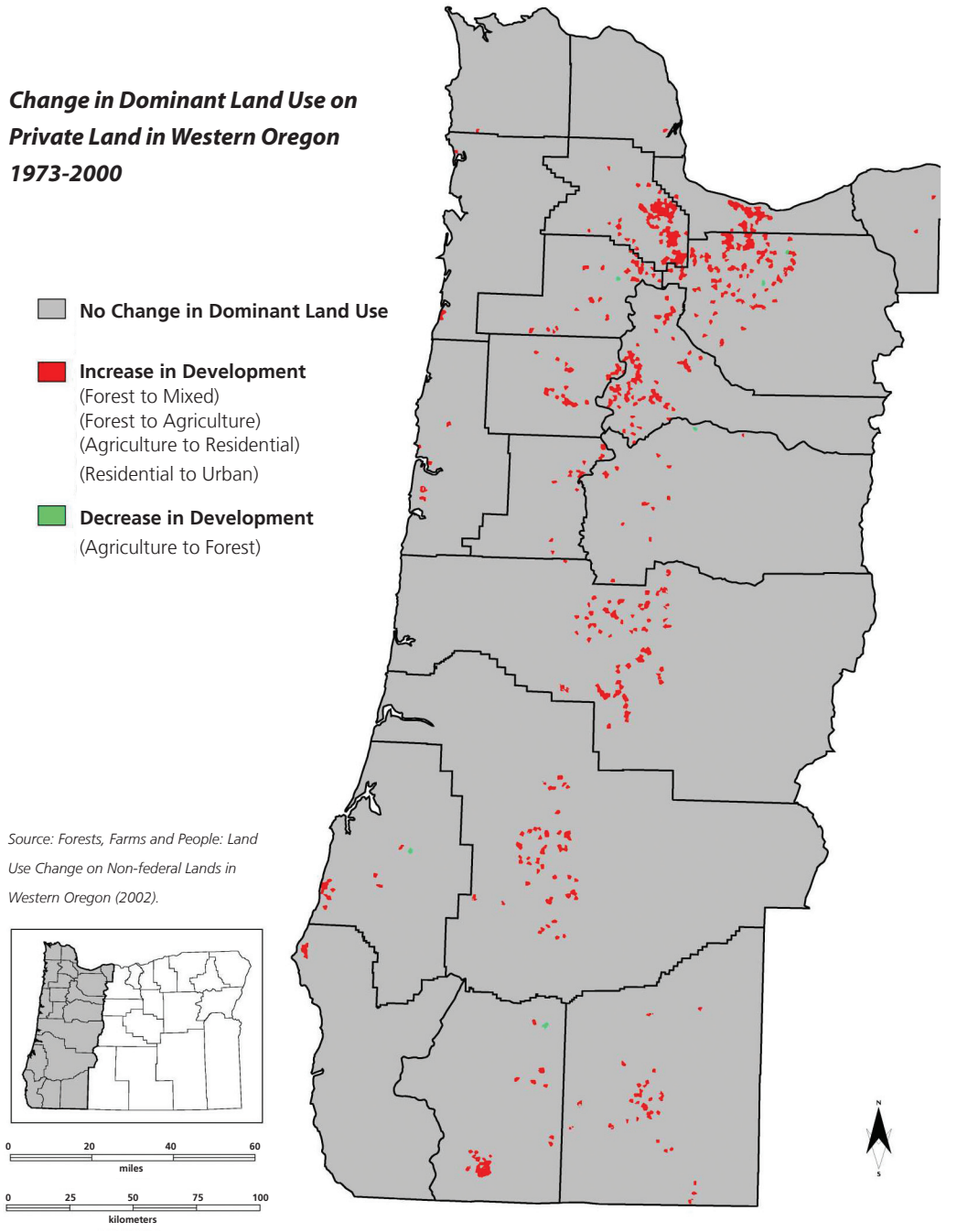


gram for Oregon, the Forest Practices Act, and statewide planning Goal 4, Forest Lands. Oregon's forestlands are extremely important from an economic, social and environmental perspective. Continued support for the existing legal and institutional framework is necessary to maintain forestlands in economically viable forest use. Forestlands developed for other uses will produce less timber, fish and wildlife habitat, and other traditional forest values on a sustainable basis. Maintaining Oregon's forestland base is critical to securing habitat for many forest-obligate fish and wildlife species. Similarly, pastures and rangelands provide habitat for species dependent on more open landscapes. Maintaining these traditional land uses also is extremely important for maintaining rural economies and traditional lifestyles.

The Natural Resource Conservation Service has tracked land conversion in Oregon and estimates that during the period of 1982-1997, the total resource lands converted to rural residential and urban uses was 293,400 acres. That includes loss of crop, pasture, range and forestlands.

In the publication "Forests, Farms and People: Land Use Change on Non-federal Lands in Western Oregon" (2002), the authors noted that population sprawl is cause for concern, even on forest and agricultural lands that have thus far remained intact for their designated use. "While the amounts and uses of western Oregon's forests and farms are stable in areas zoned primarily for agriculture or forest uses,

Change in Dominant Land Use on Private Land in Western Oregon 1973-2000



Source: Forests, Farms and People: Land Use Change on Non-federal Lands in Western Oregon (2002).

dwelling density continues to increase within forest, agriculture and mixed forest/agriculture-dominant land uses within these areas." The report cautions that development could begin to reduce the economic and ecological benefits produced from these lands. Eighty-nine percent of non-federal lands in western Oregon are in forest and agricultural use, but 80 percent of the land use changes between 1973 and 2000 were from agriculture or forest to low-density residential or urban uses.

In 2004, a companion report published for eastern Oregon documented that 97 percent of non-federal land in eastern Oregon was in forest, range, and agricultural land uses. However, between 1975 and 2001 the largest percentage gains in acreage were a 62-percent increase in low-density residential and a 54-percent increase in urban uses.

These documents also state that "Oregon's land use program appears to have been successful in reducing the overall rate of conversion of forest, range, and farmlands to more developed uses and has been demonstrably successful at containing urban expansion within areas zoned for more developed uses. Despite this, dwelling density continued to increase within forest, agriculture, and mixed forest/ range/agriculture dominant uses."

Dominant Land Use on Private Land in Eastern Oregon 2001

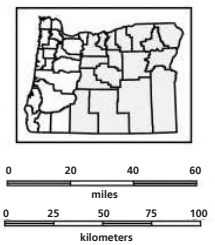
Private Land

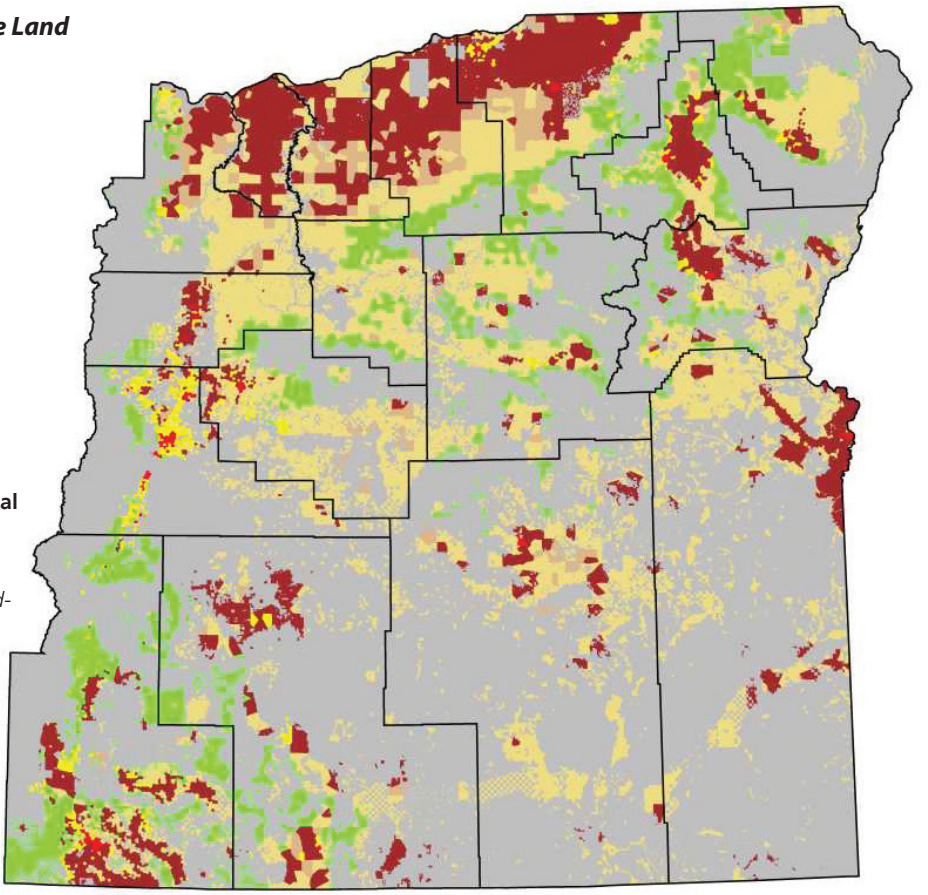
- Wildland Forest
- Wildlife Range
- Agriculture
- Mixed Forest/Range/Agriculture
- Low Density Residential
- Urban

Public Land

- USFS, BLM, NPS, State, Tribal

Source: Land Use Change on Non-federal Lands in Eastern Oregon (2004).

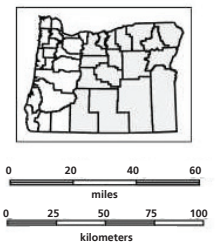


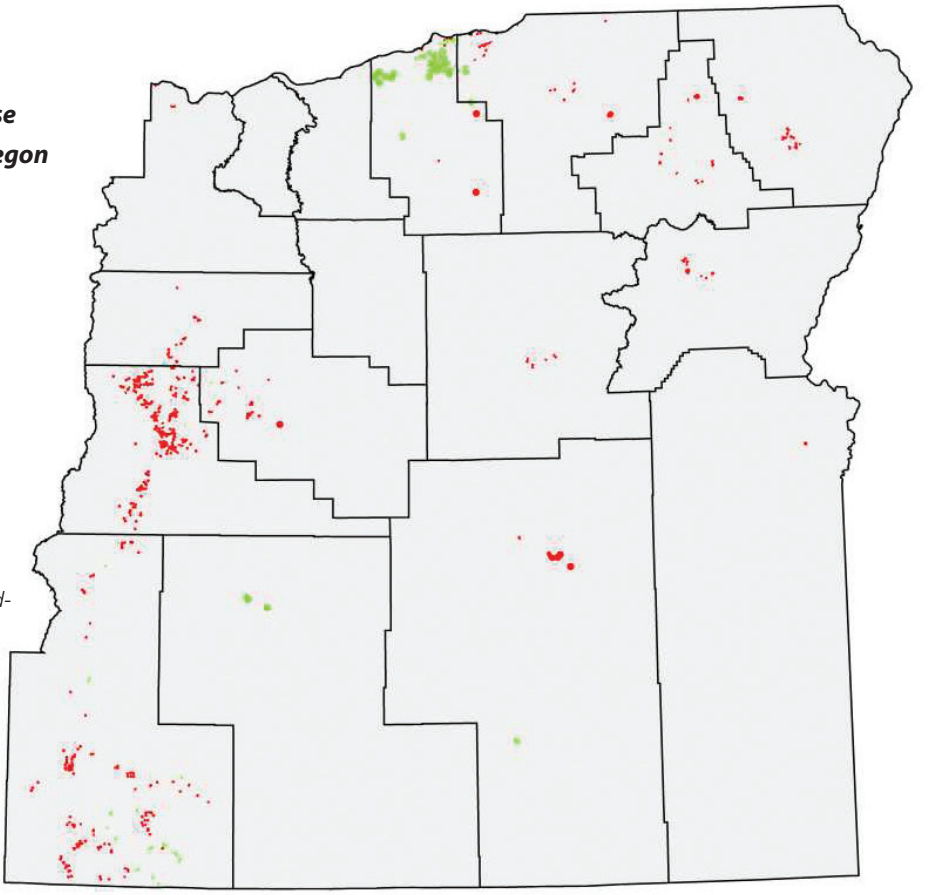


Changes in Dominant Land Use on Private Land in Eastern Oregon 1975-2001

- No Change in Zone Class
- Increase in Development
- Decrease in Development
- Change in Agriculture

Source: Land Use Change on Non-federal Lands in Eastern Oregon (2004).





Though western Oregon's rural forests and farms are holding up in the state's growth spurt, such lands close to centers of development have experienced change. The most significant shifts occurred on private land in the Willamette Valley, particularly in areas close to the Portland Metropolitan Area and other urban areas; in the Bend-Sunriver-Redmond region; and in southern Klamath County.

Oregon is at a crossroads regarding its land use planning heritage. Growth is not incompatible with maintaining fish and wildlife populations, but it must be planned carefully and deliberately. Ideally, Oregonians from across the state will work together to maintain Oregon's ecological integrity while meeting the demands of a growing population.

GOAL AND ACTIONS

Goal: **Manage land use changes to conserve farm, forest and range, open spaces, natural recreation areas, and fish and wildlife habitats.**

Actions:

- **Action 1.1. Conserve Strategy Habitats using voluntary, non-regulatory tools such as financial incentives, conservation easements, landowner agreements and targeted acquisition.**

  People own land for different reasons and need a range of incentives and conservation tools to compliment each landowner's unique circumstances. The Conservation Strategy provides a summary of voluntary, non-regulatory approaches to conserving habitats and recommendations to further assist willing landowners (See Voluntary Conservation Tools starting on page 70). There are several tools available for conserving habitats and preventing changes to other land uses.

  To ensure that limited funds address the greatest conservation need, many of these tools can and should be focused on Strategy Habitats when compatible with individual program purpose and intent. Additionally, a "conservation toolbox" could be developed to provide landowners and organizations with information on developing projects and accomplishing actions while maintaining economic uses.

- **Action 1.2. Encourage strategic land conservation and restoration within Conservation Opportunity Areas.**

  Conservation actions taken across the state will benefit fish and wildlife populations. However, Conservation Opportunity Areas represent priorities for maintaining current land uses and restoring habitats through voluntary approaches. Because these areas are particularly important to certain species, have some of the best remaining habitats, and have fewer limiting factors, conservation focused in these areas is likely to be more efficient and effective at the landscape scale. These areas will be considered priorities for investing conservation dollars to implement Action 1, described above.

- **Action 1.3. Work cooperatively within existing land use planning processes to conserve Strategy Habitats, and optimize use of transferred development rights, conservation banking and other market-based tools to meet land use goals.**

  Land use planning laws are part of the existing regulatory framework. The Conservation Strategy is entirely voluntary and non-regulatory; it does not expand, replace, supersede, or contradict existing regulations. Rather, the Conservation Strategy encourages innovative solutions within the existing regulatory framework. Transfer of development rights and conserva-

Nature in Neighborhoods – A Case Study Worth Watching

In 2004, the Portland area's Metro regional government approved a resolution to provide for incentive-based, voluntary stewardship programs focused on preservation and restoration of habitats, in conjunction with regulatory programs. As proposed, the Nature in Neighborhoods program will rely in part on voluntary, incentive-based approaches such as conservation education, expert assistance, restoration, incentives and willing-seller acquisition. Metro is collaborating with Oregonians, businesses and governments of the region to set and reach mutual goals.

An ordinance proposes to change the way cities and counties allow development to occur for the most valuable streamside habitat areas. Flexible development standards are intended to minimize the impact of development in habitat areas. The Nature in Neighborhoods program has not been implemented yet, but could provide a role model for other communities that want to promote voluntary conservation within local land use planning processes.

tion banking are both market-based approaches that allow local communities to meet local land use goals while allowing landowners and developers to still make a profit. Market-based conservation tools are discussed further under Voluntary Conservation Tools.

- **Action 1.4. Create a system for tracking land use changes over time.**

  Changes in Oregon's forestland and agricultural land have been monitored through two Oregon Progress Board benchmarks. The Natural Resource Conservation Service, Oregon Department of Agriculture, Oregon Department of Forestry, and others collect data regarding conversion of forest and agricultural lands to urban and other uses. However, little information exists pertaining to changes in Oregon's natural vegetation types over time.

  The Oregon Progress Board has conceptually approved and is further developing a new benchmark for detecting changes in natural vegetation across the state. The benchmark will measure the amount and distribution of natural habitats in each of Oregon's eight ecoregions, sub-categorized by four major habitat types: wetlands and riparian areas, forests, shrublands, and grasslands. The Institute for Natural Resources at Oregon State University will consolidate the data and assist with the benchmark development process. This work will complement the existing Oregon Progress Board Benchmarks that measure changes in forestland and agricultural land.

  This benchmark will be useful in measuring the changes in abundance and distribution of Oregon's natural vegetation. In addition, the underlying data can be a helpful aid in setting habitat conservation goals and determining whether they are collectively being met. Agencies can use this data to track long-term changes in the availability of suitable habitat for fish and wildlife on a coarse scale. Also, it can be used to model habitats to help determine which species might be at risk before they are listed as threatened or endangered, so that preventive measures can be taken. The data will be useful for all natural resource agencies, local governments, and development interests to evaluate the impacts of land conversion activities, global warming, and other forces that change Oregon's landscapes. This information on natural vegetation conversions could be combined with the existing data on forest and agricultural land conversion tracked by various agencies in a web-based portal. Such a portal would allow Oregonians and decision-makers to observe where and how land uses were changing.

- **Action 1.5. Support local land use plans and ordinances that protect farm and forestlands and other fish and wildlife habitats in urban and rural areas.**

  Decisions about land use occur at the local level through local comprehensive land use plans, Goal 5 (natural resources) planning, ordinances and other means. These local plans take into account local values, priorities, and needs. To implement this Conservation Strategy, agencies will need to work with local

The Willamette Futures Project and Project 2050 – engaging Oregonians in developing scenarios for the basin's future

In 1996, a five year effort began to look far ahead at land use, growth and conservation opportunities in the Willamette Basin, which expects a population increase of 1.7 million people, bringing the total to nearly 4 million people by the year 2050. The Pacific Northwest Ecosystem Research Consortium was formed to answer four basic questions: how have people altered the land, water and organisms in the last 150 years? How might the landscape change in the next 50 years? What are the environmental consequences of those changes? And what types of management actions are likely to have the greatest effects, and where?

The Consortium synthesized a variety of spatial and other data, and then worked with Oregonians to identify three plausible future scenarios for the basin. Plan/Trend represents a likely future if growth continues with current plans and present trend [before Ballot Measure 37]; Development portrays the landscape if current restrictions are loosened and emphasis is placed on economic gain; Conservation portrays the future if society emphasize ecosystem integrity and restoration in balance with social and economic considerations. The results were analyzed to identify effects on fish and wildlife, water quantity and land use.

The results were documented in the Willamette Basin Planning Atlas, Trajectories of Environmental and Ecological Change in 2002. A companion booklet, Willamette River Basin Challenge of Change, was published in 2005. Both provide insights on balancing environmental, social and economic needs and values. They also provide planning tools and ideas for everyone living and working in the basin, and discuss what was learned in the process.

community leaders and groups to find opportunities to incorporate Strategy Species and Habitats and Conservation Opportunity Area approaches into local plans that conserve farmlands, forestlands, open space, and natural areas.

ISSUE 2: Invasive Species

A biological invasion is underway across the United States and on every other continent. As elsewhere, non-native organisms are arriving and thriving in Oregon, sometimes at the expense of native fish and wildlife and the state's economy. The Conservation Strategy uses the National Invasive Species Council definition of invasive species: species that are not native to ecosystems to which they have been intentionally or accidentally introduced, and whose introduction causes or is likely to cause economic or environmental harm. Invasive plants are often called "noxious weeds." Many non-native species have been introduced to Oregon. While not all non-native species are invasive, some crowd out native plants and animals and become a serious problem.

Invasives: nature's nemesis

When an invasive species colonizes a new environment, it leaves behind the natural enemies such as predators or parasites that controlled its population growth in its original home. It can quickly expand, outcompeting and overwhelming native species. Native species have not evolved the necessary survival strategies to fend off unfamiliar species or diseases.

Invasive species can have many negative consequences for Oregon. Depending on the species and location, invasive plants can affect food chain dynamics, change habitat composition, increase wildfire risk, reduce productivity of commercial forestlands, farmlands and rangelands, modify soil chemistry, accelerate soil erosion, and reduce water quality. Invasive species such as the non-native fish, wildlife, invertebrate and plant species listed in Section B, are the second-largest contributing factor causing native species to become at-risk of extinction in the United States. Invasive species also include disease-causing organisms such as viruses, bacteria, prions, fungi, protozoans, roundworms, flatworms, and external parasites (lice, ticks) that can affect the health of humans, livestock, and pets in addition to fish and wildlife. Invasive species cause significant economic damage to landowners by degrading land productivity or values.

Pathways of introduction

Every year, new non-native invasive species are documented in Oregon, bringing with them the threat of ecological damage. Many invasive species are introduced unwittingly by people, escaping detection until it is too late to control their prolific expansion and devastating effects. As the pace of globalization and cross-border trade increases, the risk of introducing non-native species via numerous pathways rises. Many new species will likely arrive as stowaways in agricultural commodities, seafood, livestock, wood products, packing materials and nursery stock imported into the state by land, air or ship freight.

There are other ways people can unknowingly introduce or increase the spread of invasive species. Mud on the soles of hiking boots or treads of off-road vehicles can contain seeds of noxious weeds. Oregon's rivers and lakes are vulnerable to undesirable aquatic invertebrates such as the highly invasive zebra mussel – an invader from Asia to the Great Lakes – which latches onto boat wells, hulls, motors or trailers in waters infested with its larvae.

People also have intentionally released new species into the environment. People depend on a variety of non-native plants for food, livestock feed, ornamental, medicinal and other uses. While most of these plants have little environmental effect, some -- such as foxglove and Armenian (Himalayan) blackberry -- escape into natural areas. Non-native fish, bullfrogs, and birds have been released to provide new fishing and hunting experiences. Nutria, which cause tremendous damage in agricultural areas, were released after failed attempts at raising them commercially for fur. People release pet amphibians, reptiles and mammals into backyards, and aquarium fish into local streams and ponds. Although perhaps well-intentioned, these releases are illegal in Oregon for many species.

Once introduced, natural pathways help to spread invasive species, especially plants whose seeds are easily dispersed by wind, water and wildlife. Certain land management practices can serve as conduits or create conditions that favor the spread of invasive organisms. Regardless of the pathway or practice implicated in the problem, experts believe that environmental disturbance is often a precursor to invasion by non-native plants. Invasive species are highly adaptable and competitive, using space, water and sunlight of disturbed ground. Following introduction and successful establishment, invasive species will increase their dominance and distribution until they reach the environmental and geographic limits of their expansion. Populations of invasive species will theoretically stabilize eventually but not before inflicting significant damage.

Although accidental or unintentional introductions of invasive species arriving in Oregon is inevitable, preventing invasive species from arriving in the first place is in everyone's best interest.

Assessing risk, prioritizing management

Evaluating the potential danger associated with new species is sometimes a relatively low priority as emphasis and urgency is often placed on control treatments. Natural resource managers and policymakers may not see the purpose or value in ranking introductions of non-native species in terms of risks posed. However, once invasive species are established, controlling them can be difficult, expensive, and in some cases impossible. Priority must be placed on preventing the establishment of new species. Also, not every new non-native species is equally threatening so gauging the level of risk and responding accordingly is important to avoid misallocating limited resources on species of low ecological concern.

This Conservation Strategy uses a systematic approach to assess the level of ecological threat from invasives species currently present in Oregon or likely to appear soon. These priority invasive species are listed in the Ecoregional descriptions starting on page 111. They were determined through an analysis of Oregon Department of Agriculture's Noxious Weed List, Oregon Department of Fish and Wildlife's Wildlife Integrity Rules and Introduced Fish Management Strategies report, Oregon Invasive Species Council's "100 Most Dangerous Invaders" list, information from Portland State University Center for Lakes and Reservoirs and local expert review. In developing these lists, Oregon Department of Fish and Wildlife coordinated with Oregon Department of Agriculture invasive species program staff. The scope was limited to terrestrial and aquatic vascular plants and vertebrates, as information on other organisms is not available.

Building on current planning efforts

Several other planning efforts are underway to protect Oregon from biological invaders. State statutes or agency administrative rules are in place to prohibit the unauthorized entry of undesirable invasive species. Together, the following plans and regulations provide a firm foundation for addressing invasive species and put the issue into clearer context for this Conservation Strategy: the Oregon Invasive Species Council's Invasive Species Action Plan, Invasive Species Report Card, Oregon Nox-

Meeting the Invasives Challenge: A Framework for Action

Invasive species can be effectively managed and their potential ecological and economic impacts mitigated if the right precautions and steps are taken. The National Invasive Species Council has identified a framework of approaches in its plan, Meeting the Invasive Species Challenge: National Invasive Species Management Plan. These actions, or management approaches, are not a cure-all but can give states, counties, private landowners and public land managers a framework for prioritizing efforts to guard Strategy Species and Habitats and working landscapes against invading organisms.

For maximum effectiveness, all approaches in this Framework for Action should be integrated and carried out in a coordinated manner. The approaches need to be implemented at different spatial scales and across all jurisdictional and ownership boundaries. For instance, monitoring in the field aids site-specific management decisions. Reporting these data to a central database also is important for tracking changes in populations and distributions across the state. In another example, weed infestations on federally managed land and on adjacent privately property are more effectively controlled when federal land managers and private landowners join forces at the landscape level, across ownership boundaries.

Management Approach	Reason for Approach
Prevention	Preventing new species introductions is a top priority and most cost-effective approach to protecting native species, ecosystems and productivity of the land from invasive species.
Assessment/Risk Analysis	Defining the level of concern and risk associated with new introductions through an assessment process will help to identify the worst invaders and management priorities.
Monitoring	The importance of surveying cannot be overestimated when looking for first-time infestations of undesirable non-native species or evaluating efforts to control existing occurrences.
Early detection	Early discovery of infestations of previously undocumented non-native species is critical to controlling their spread and achieving complete eradication.
Rapid Response	Immediate treatment of new, isolated infestations will maximize eradication success and decrease the likelihood of populations expanding beyond the initial area of introduction.
Containment	Preventing invasive species from 'hitchhiking' via vulnerable pathways will slow the advance of well-established invasive species into unaffected areas. Some invasive species are tolerable if infestations can be contained and their impacts minimized.
Restoration	A system-wide approach to treating invasive species should consider habitat restoration as part of the ecological healing process. Helping native species and ecosystems recover is an important step following the removal of harmful species.
Adaptive Management	Land managers or landowners should change course on management prescriptions if treatments are not working. Monitoring the results of control actions is an important part of this process.

ious Weed Strategic Plan (Oregon Department of Agriculture), Oregon Aquatic Nuisance Species Management Plan (Portland State University), Ballast Water Management Administrative Rules (Department of Environmental Quality), Wildlife Integrity Administrative Rules (Oregon Department of Fish and Wildlife).

Other ongoing efforts provide information that would be helpful in addressing invasive species. For example, the Forest Inventory and Analysis (FIA) Program of the U.S. Department of Agriculture (USDA) (*http://fia.fs.fed.us*) uses remote sensing imagery or aerial photography to classify land into forest or non-forest. Permanently established field plots are distributed across the landscape and 10 percent of these plots are visited each year to collect forest ecosystem data. A subset of these plots is sampled yearly to measure forest ecosystem function, condition and health, including measurements of native and non-native plants, which can provide information about the spread of invasive species.

In April 2005, the USDA Forest Service released its Final Environmental Impact Statement "Preventing and Managing Invasive Plants." Although the record of decision has not been finalized, the Forest Service proposed action amends all Forest Plans within the Pacific Northwest Region, Region 6, to improve and increase consistency of invasive plant prevention, and allows the use of an expanded set of invasive plant treatment tools. The Proposed Action includes restoration requirements and an inventory and monitoring plan framework.

GOAL AND ACTIONS

***Goal:* Prevent new introductions of species with high potential to become invasive, and reduce the scale and spread of priority invasive species infestations.**

Actions:

- **Action 2.1. Focus on prevention through collaborative efforts and increased public awareness and reporting**

  The cost and difficulty of managing invasive species increases substantially once a species has established self-sustaining populations. Once established and widespread, invasive species are virtually impossible to eliminate and control costs can become prohibitive. Therefore, every effort should be made to prevent first-time introductions of invasive species from becoming established in Oregon. By their very nature, however, states' borders are porous and vulnerable to the entry of non-native organisms. A significant challenge is developing and implementing effective prevention strategies based on the best research of where and how new and potentially invasive organisms are likely to enter Oregon.

  The Oregon Invasive Species Council (http://oregon.gov/OISC) coordinates statewide efforts to prevent biological invasions and seeks to mitigate the ecological, economic and human health impacts of invasive species. Informed Oregonians, landowners, land managers and public officials can take action to further the Council's goals. Businesses, landowners, anglers, hunters, Oregonians and visitors should be reminded of the dangers posed by invasives through targeted outreach and education. People can greatly reduce the accidental introduction or spread of these organisms into and within Oregon if they know which precautions to take. State and federal agencies can work with the Council to promote and raise public awareness of programs for which they have responsibility to reduce or eliminate the risk of introducing invasive species. For example, Oregon Department of Agriculture's noxious weed program provides statewide leadership for coordination and management of state listed noxious weed, and Oregon Department of Fish and Wildlife's wildlife integrity program regulates the importation, possession and transportation of non-native fish and wildlife species. Encouraging Oregonians to report sightings of invaders also is important and can be key to the detection, control and elimination of an invasive species. The Council's toll-free "hotline" is one such tool (1-866-INVADER).

  Elected officials, industries and the conservation community should work together to leverage public and private funding to support the efforts of the Invasive Species Council and its partners to develop effective prevention measures. This investment will help protect the economic and ecological interests of all Oregonians, as well as protect Strategy Species and Habitats from the impacts of harmful invaders.

- **Action 2.2. Develop early response mechanisms to facilitate swift containment of new introductions, using site-appropriate tools.**

  The potential dangers of new invasions to forestlands, agricultural and range lands, natural areas and fish and wildlife should be determined as early as possible so that farmers, ranchers, fish and wildlife managers and conservationists can be warned and are better prepared. One approach would be to form a rapid assessment and response team of state, federal and private experts. Such a team could determine the likely impacts of newly discovered invasive species, predict the spread of new infestations, and decide which steps should be taken to alert the public and bring the problem under control. This approach could do for invasives what interagency fire coordination cen-

ters are established to do for wildfire. Invasive species, like wildfires, ignore ownership boundaries and spread indiscriminately from property to property, underscoring the need to treat invasions wherever they may occur on the landscape. Also like wildfires, invasive infestations are best controlled when small in size. Examples include containment of sudden oak death and control of cordgrass (*Spartina* sp.).

- **Action 2.3. Establish system to track location, size and status of infestations of priority invasives.**

  A number of local, state and federal agencies and private organizations independently gather data on invasive plants, animals and pathogens in Oregon yet the information is decentralized and often not integrated for analysis. The state lacks a comprehensive, coordinated and centralized system for gathering and maintaining data on the location of non-native species on private and public lands. Efforts to institute a reporting system are also hampered in part by landowner privacy and disclosure concerns. Invasive species may not be reported by landowners concerned that disclosure of infestations may lower property values or that they may be held responsible for treatment costs.

  There is a critical need to improve the integration and standardization of data on invasive species derived from independent monitoring efforts. Using existing data housed at the Institute for Natural Resources at Oregon State University, a multi-partner, spatially-explicit database and mapping system non-native plants, animals and diseases could be expanded and enhanced. The data would be used to track changes and trends in invasive populations, better anticipate the spread of invasive organisms within the state, identify vectors or points of entry and high-risk environments for invasion, and evaluate the success of management actions. Voluntary infestation reporting by private landowners should be encouraged by providing confidentiality, nondisclosure of sensitive information, and free technical assistance on control methods to increase landowner participation. The web-based information portals discussed on page 102 could be one tool for invasive data reporting and sharing.

- **Action 2.4. Focus on eradication of invasive species in Strategy Habitats and other high priority areas where there is a clear threat to ecosystems and a high probability of success.**

  Some invasives have spread to the point where it would be impractical or impossible to eliminate them from Oregon. Yet some of these established invasives negatively impact Strategy Species and Habitats and can be contained at the local level. In these situations, control efforts should be focused on those invasives that are limiting factors within Strategy Habitats or to Strategy Species, particularly within Conservation Opportunity Areas. In addition, other priorities may include controlling invasives that disrupt ecological function or impact vulnerable, commercially valuable lands such as rangeland, farmland and timberland.

  Local eradication of invasive species near high priority habitats and lands should be emphasized where practical, with the ultimate goal of restoring these lands to their full ecological or utilitarian potential. Controlling established invasives often requires a long-term commitment. If funding runs out or the management priorities change, invasives can quickly return. Restoration can repair habitats degraded by invasive species and may be necessary if aquatic or terrestrial ecosystems are too damaged to heal on their own. Restoration may be the best prescription for inoculating native plant communities against invasive plants because ecosystems are more resilient to invasion when they are healthy and functioning well. Entities involved in invasive species management should encourage landowners to consider ecologically based restoration as part of any plan to manage invasive species.

  Private landowners are increasingly partnering with watershed councils, Oregon Department of Fish and Wildlife, Soil and Water Conservation Districts, Oregon Department of Agriculture and federal land management agencies to manage invasive species across property lines. Such broad-scale efforts need to continue and be expanded.

- **Action 2.5. Work with the Department of Agriculture, the Oregon Invasive Species Council and other partners to develop an invasive species implementation tool that evaluates the ecological impact and management approaches for invasive species identified as priorities in the Conservation Strategy.**

  As a first step, Oregon Department of Fish and Wildlife is developing an invasive species implementation tool to further evaluate invasive species identified in this document. Building on already-completed assessments, this tool will rank the severity of ecological impact of each invasive species by analyzing four factors: ecological impact, current distribution and abundance, trends in distribution and abundance, and management

difficulty. This information will be used to determine the best management approaches for individual invasive species. Current and potential partners include The Nature Conservancy, Oregon Natural Heritage Information Center, the Oregon Invasive Species Council, county weed boards, federal land management agencies, Oregon Department of Agriculture and other agencies and organizations

- **Action 2.6. Develop and test additional techniques to deal with invasives and share information with landowners and land managers.**

  Landowners and land managers need to know how to treat invasive organisms that lower the productivity and value of land, alter ecosystem processes and threaten native species. They also need to know what level of investment is appropriate and which techniques are most appropriate for their situations. Throughout Oregon, people are using a variety of methods to control individual invasive species with varying degrees of success.

  Multiple site-appropriate control mechanisms (mechanical, chemical and biological) should be evaluated to control individual invasive species. Increased coordination and communication is needed between researchers, agencies, watershed councils and county weed boards and landowners regarding what works under what conditions. In addition, there currently is no known effective way to control some widespread invasive plants such as cheat grass, medusahead, and false brome. Current research needs to be supported and expanded to address these and other invasive species. Outreach materials should be developed to assist landowners and land managers in choosing and using the most appropriate techniques for their sites.

ISSUE 3: Disruption of Disturbance Regimes

Historically, natural disturbance regimes shaped Oregon's landscapes by resetting plant succession, releasing nutrients, moving materials, and creating new habitats. Some ecosystems rely on the natural disturbance regimes for their maintenance. For example, some types of grasslands turn into forests without natural fire.

These natural events have become statewide issues in the past centuries as Oregon's population has grown, placing homes and communities closer to where these disturbances occur. Fires were suppressed to protect valuable timber and towns. The unintended consequences included increased tree density and fuel load of forests, which contributed to insect outbreaks, other forest health issues, and the risk of uncharacteristically severe fires. Dams were constructed to protect towns from flooding, to provide electricity for industries and irrigation for farms. The unintended consequences include loss of floodplain function, loss of fish rearing and spawning areas, and degraded riparian habitats. These changes have all impacted Oregon's fish and wildlife populations. The Conservation Strategy's approach to disturbance regimes is to restore or mimic disturbance regimes to benefit fish and wildlife and reduce risks to people.

GOAL AND ACTIONS

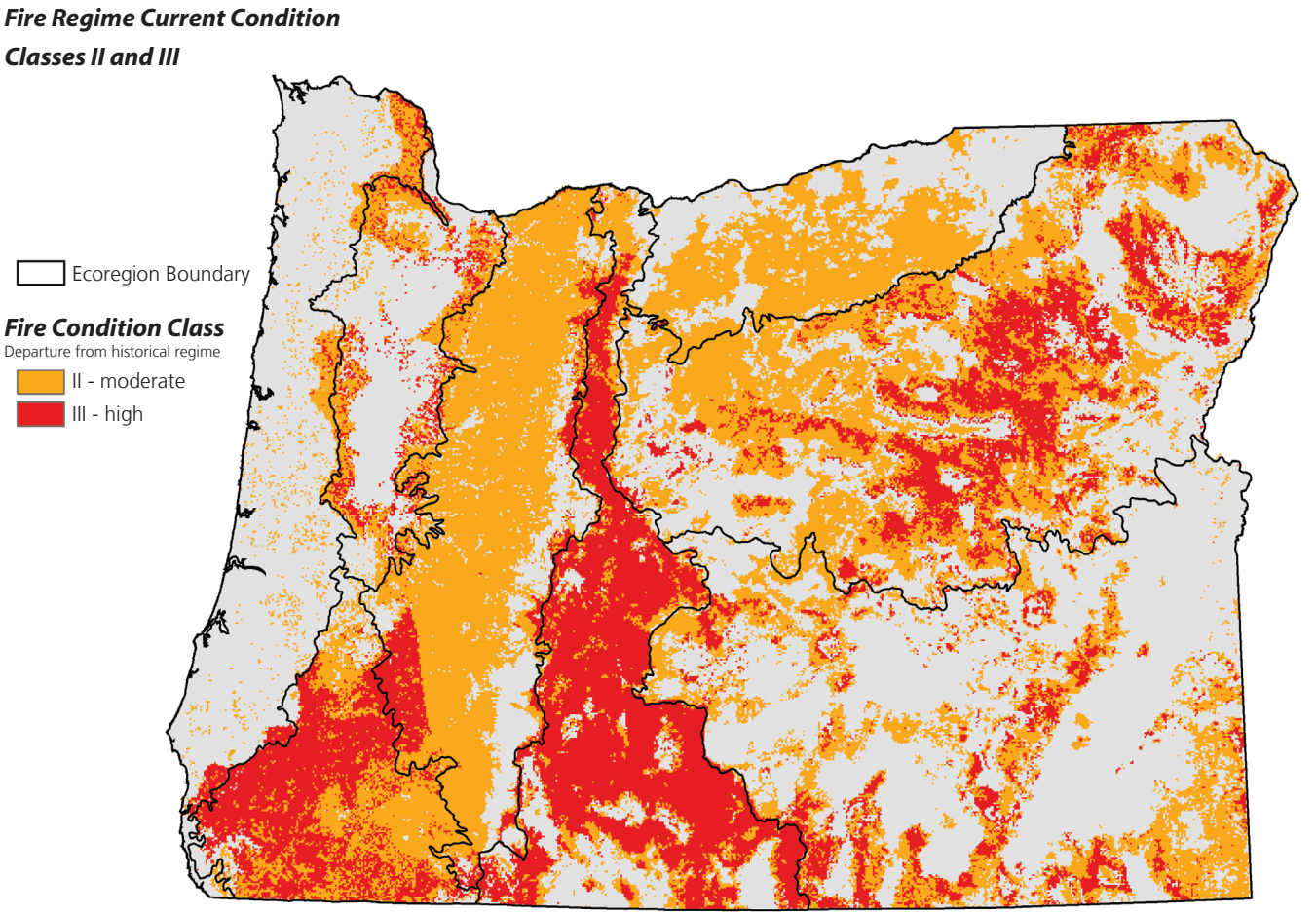
Overall Goals: **Restore natural processes such as fire and flood cycles to sustain and enhance habitat functions in a manner compatible with existing land uses. Encourage efforts to increase understanding of historic natural disturbance regimes.**

Altered fire regimes:

Fire suppression and uncharacteristically severe wildfire

For thousands of years, fire has been one of the most important forces shaping Oregon's landscapes, both forested and unforested. Whether started by lightning or Native Americans, fire strongly influenced wildlife

Fire Regime Condition Class	Description	Potential Risks
Condition Class I	Within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances	Risk of loss of key ecosystem components (e.g., native species, large trees and soil) is low
Condition Class II	Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances	Risk of loss of key ecosystem components (e.g., native species, large trees and soil) is moderate
Condition Class III	High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances	Risk of loss of key ecosystem components (e.g., native species, large trees and soil) is high



Data Source: Fire Modeling Institute, Fire Science Laboratory, Missoula, Montana, 2000.

habitats by altering the structure, composition and landscape pattern of native vegetation.

To understand the natural role of fire and how it should be managed, researchers have determined the "natural" (historical) fire regimes for many of Oregon's habitats. "Natural" fire regimes are classified based on the historic range of fire frequency (the average number of years between fires) and fire severity (the amount of replacement of the dominant overstory vegetation) prior to European settlement. Human intervention over the last hundred years has altered the historic fire regimes in many of Oregon's landscapes. This has resulted in a cascade of unintended consequences for ecological health, wildlife populations, and people.

Forested landscapes

In forested areas, vegetation changes following fire suppression have increased the likelihood of wildfires that are uncharacteristically large, severe or both. "Fire regime condition classes" are used to describe the amount of departure from natural (historic) fire regimes. The following chart contains a simplified description of the fire regime condition classes and associated potential risks to Oregon's forests.

Nationally-developed maps that display coarse-scale fire regime condition class show over one-third (39 percent) of Oregon's 27.5 million acres of forestland in Condition Class III and another 45 percent in Condition Class II. Finer-scale fire regime condition class maps are needed statewide to refine these estimates.

The extent of alteration of natural fire regimes varies considerably among forest types. For the purpose of discussing fire, forests typically are grouped into three broad categories:

- Drier forests that are or were dominated by species such as ponderosa pine, Douglas-fir and larch historically tended to experience frequent fires (average intervals between fires of less than 25 years) that burned small trees and shrubs, but had limited effects on overstory trees with thick, fire-resistant bark. This pattern of frequent, low-severity fires is often referred to as an understory fire regime.

- Forest in moist, cold areas (or at least with cool summers, as in the Coast Range or high elevations in the mountains) tended to experience infrequent fires (average intervals of more than 100 years) that killed most or all of the dominant trees, leading to a stand-replacement fire regime.
- Intermediate environments such as mid-elevation areas supporting forests comprised of a variety of conifer species had average fire return intervals ranging from around 25 to 100 years. The impact of fire on overstory trees could vary from minimal to severe (depending largely on weather and topography). This associated fire regime is often referred to as a mixed fire regime.

The greatest extent of alteration to natural fire regimes has occurred in forests that historically had an understory fire regime. These forests are ponderosa pine and some mixed conifer forest types in the East Cascades, Blue Mountains, and eastern (interior) portion of Klamath Mountains ecoregion. Human intervention, particularly fire suppression and past selective logging of large overstory trees, has shifted the historic fire regime from an understory fire regime with frequent, low-intensity fires to a stand-replacing fire regime with less frequent, high intensity fires.

Fire suppression (particularly on federal lands) eliminated the frequent, low-intensity fires that historically occurred in these forests. The elimination of frequent, low-intensity fires resulted in increased fuel loads in the form of surface fuels, shrubs and smaller trees and increased stand densities. Increased stand densities favored shade-tolerant understory trees like Douglas-fir and grand fir. Dense understory trees served as "ladder fuels" that linked surface fuel and overstory fuels. Selective logging removed the larger, more fire-tolerant trees and opened the canopy, allowing more small fire-sensitive trees to grow in the understory. The increase in fuel loads and stand densities made it more likely that when fire did occur it would reach the forest canopy and spread as a crown fire. As a result of increased stand densities, larger trees became stressed due to competition with other vegetation for water and became more prone to insect infestation and disease.

Because of their large size and intensity, uncharacteristic fires are more likely to cause adverse economic and environmental impacts. Fire has a negative economic impact on rural communities in Oregon whose economy and culture are based on forestry. Fire-fighting activities are a major expense for the state as a whole. In 2002, Oregon spent approximately $47 million on fire suppression efforts.

Uncharacteristically severe wildfire also poses higher risks to species and habitat because such fires can involve large areas and often result in complete mortality of overstory and understory vegetation (stand-replacing events). These stand-replacing fires can impact habitats, soils and watersheds beyond their adaptive limits. Uncharacteristically severe wildfire impacts aquatic habitat by removing riparian vegetation, which results in higher stream temperatures, decreased bank stability, and increased sedimentation in stream channels.

Many Oregon forests in fire regime Condition Class II or III contain Strategy Habitats or other important habitats for Strategy Species. Many of the Late Successional Reserves (LSRs) designated under the Northwest Forest Plan for management to preserve and produce late-successional forests are located in Condition Class II or III forests. These LSRs address the habitat needs of late-successional and old-growth forest related species, such as northern spotted owl or marbled murrelets. Many riparian areas that provide habitat for fish species listed under the Endangered Species Act (ESA), including steelhead, chinook salmon, coho salmon and bull trout also are located in forests in Condition Class II or III. Forests in Condition Class II or III also include many ponderosa pine forests in central and eastern Oregon.

Unforested habitats

Historically, many of Oregon's open structured habitats – those dominated by grasses, forbs, and/or shrubs – were maintained by disturbance. Primarily the disturbance was fire, but also included flooding, wind, storms, and salt spray. In many areas, Native Americans set fire to favor plants with edible bulbs, improve travel, manage for big game, and hunt. Lightening also had a role in historic fire regimes. Altered fire regimes have resulted in vegetation changes in these habitats, affecting wildlife dependent on open landscapes.

Fire historically maintained many grasslands, aspen woodlands, oak woodlands and savannas, and sagebrush steppe habitats by removing competing vegetation and stimulating regeneration of native fire-associated plants. Fire suppression has allowed shrubs and conifers to encroach into grasslands, oak woodlands, and oak savannas. Similarly, it has allowed western juniper to encroach into aspen clones, some riparian areas, and mountain big sagebrush habitats. Maintenance of these habitats over time will require the careful reintroduction of natural fire regimes using site-appropriate prescriptions (accounting for the area size and vegetation characteristics that affect resiliency and resistance to disturbance). In some areas, other techniques such as mowing or controlled grazing can be used to mimic the effects of fire.

The issues of altered fire regimes and invasives species interact to create unnatural fire cycles in eastern Oregon, particularly in the Northern Basin and Range ecoregion. The introduction of invasive annuals, particularly cheatgrass and medusahead, can increase the frequency, intensity, and spread of fires. Breaking this cycle will require proactive

management to prevent introduction of annual invasives, minimizing the spread of cheatgrass, controlling wildfires in invasive-dominated areas, avoiding prescribed fire in cheatgrass-dominated areas, and conducting research on how to better restore areas dominated by invasives.

GOALS AND ACTIONS

Goal: **Reduce uncharacteristically severe wildfire and restore fire or use site-appropriate techniques that mimic effects of fire in fire-dependant ecosystems.**

Actions:

- **Action 3.1. Use wildfire risk classification maps to identify local zones with greatest risk of uncharacteristically severe wildfire and prioritize for further action.**

  Coarse-scale fire condition maps have been developed for Oregon, but further work is needed to determine wildfire risk at finer scales. Specifically, refinement is needed to verify whether site-specific conditions are actually in Condition Class I, II, or III. These maps can then be used to prioritize which local sites need management actions to reduce risks.

  Setting priorities is essential, due to the magnitude of the areas requiring restoration and the limited resources allocated to their treatment. The risk of losing key ecosystem components is a factor that should be considered, with priority given to areas that currently are in fire regime Condition Class III (high risk of losing key ecosystem components) or Class II (moderate risk of losing key ecosystem components).

  In identifying priorities for fuel reduction techniques, consideration should be given to both local site-specific conditions and the broader landscape context. Site-specific considerations should include identification of particular values at risk of loss from uncharacteristically severe wildfire, such as remnant large-diameter ponderosa pine. Larger-scale considerations should include factors such as the extent to which an area's landscape context makes it highly valuable to wildlife (travel corridors, calving grounds, wintering area, etc.) or more likely to be vulnerable to fire or contribute to fire spread. Similarly, proximity to human residences or high-value watersheds needs to be considered.

- **Action 3.2. Collaborate with landowners and other partners in these zones to lower risk of wildfires while maintaining wildlife habitat values, and to choose the sites and landscapes for fuel reduction.**

  Site-by-site decisions must be made on the type and extent of fuel reduction treatments that will be conducted. Fuel reduction treatments must be balanced in relation to other ecological objectives. Oregon forests in fire regime Condition Class II or III contain Strategy Habitats that provide habitat for a number of Strategy Species, including species listed under the Endangered Species Act. If fuel reduction treatments are not undertaken, the long-term risk of losing key ecosystem components to uncharacteristic fire is increased. However, fuel reduction treatments can impact species and habitat by disturbing soil or eliminating key habitat components (such as canopy cover, hiding cover, snags, large woody debris or large live trees). These impacts will vary depending on the extent, pattern and level of fuel reduction treatments. Decisions on the fuel reduction treatments must balance the need to maintain these key ecosystem components with management needed to reduce risk of long-term damage to wildlife from wildfires.

  In high priority zones, use active management techniques to reduce surface, understory and crown fuels. Fuel reduction treatments typically involve mechanical treatments followed by the use of prescribed fire, if appropriate. The most common mechanical treatment is the removal of smaller trees by understory thinning or thinning from below, although other forms of thinning may be employed, as well as mowing and crushing to reduce shrubs and surface fuels. Maintenance treatments will be essential to maintaining desired conditions and successional trajectories. Maintenance of areas in Condition Class I, especially in dry forest types, will also be important. In the absence of maintenance, areas currently in Condition Class I and II will continue to progress into Condition Class III.

- **Action 3.3. Seek and support cost-effective methods for reducing fuels, especially innovative approaches that contribute to local economies.**

  In some areas, carefully removing understory biomass can restore habitats with historically open understories while reducing the risk of uncharacteristically severe wildfire by reducing fuel loads and removing ladder fuels. Developing markets for these small-diameter trees can create jobs, contribute to local economies, and help pay for restoration. The U.S. Forest Service's Stewardship Contracting program offers opportunities to implement and fund certain habitat restoration and management projects. Currently in Oregon there are several innovative projects to develop markets for small-diameter trees. Two of these collaborative efforts are featured in this document:

Community Smallwood Solutions (page 284) and the Lakeview Biomass Project (page 214).

Social acceptance for fuel management and other wildfire reduction efforts is likely to be greatest where various interests and values converge, for instance in an accessible area of dry forest types where restoration would protect residences, restore or conserve habitats of concern, and provide a commercially valuable timber by-product that could be processed in a local mill. Given the great disparity between the extent of areas needing treatment and the limited resources to accomplish necessary treatments, careful consideration of factors related to social acceptance, as well as fire risk and other ecological elements, should help identify areas where projects can both provide substantial benefits and have a high likelihood of being successfully implemented. Thus, collaborative approaches to prioritizing and planning fuel reduction must include diverse public interests. Collaboration between federal land management agencies and a variety of Oregonians, groups and agencies are required for projects undertaken through the Healthy Forest Restoration Act and Stewardship Contracting. Furthermore, the monitoring of fuel reduction techniques discussed above is essential for both refining techniques and building trust and confidence among stakeholders.

A recent book by respected Montana restoration researchers and practitioners Stephen Arno and Carl Fiedler provides both a more complete treatment of the principles discussed above, and many examples of what those authors consider successful forest restoration in different forest types on a variety of land ownerships. Their examples from Oregon include efforts in Wallowa County and central Oregon (US Forest Service, Sisters Ranger District).

- **Action 3.4. Using site-appropriate prescriptions, carefully reintroduce natural fire regimes as part of an overall wildfire risk reduction and habitat restoration program in locations where conflicts such as smoke and safety concerns can be minimized.**

Forested Landscapes

Because of high fuel loads in many areas, the most typical scenario will involve mechanical treatments followed by fire. Prescribed fire typically will involve intentional human ignitions, but strategic use of lightning-caused fires also can be beneficial under well-defined conditions. A program of active fire suppression will continue to be a necessary part of an overall fire-management strategy to protect local communities and private property.

Management actions such as active thinning and prescribed burning in at-risk green stands should eventually reduce the amount of effort and funding needed for fire suppression in those areas. As discussed previously, active maintenance may be needed in some areas. However, the overall goal should be the restoration of conditions where natural fire can perform its historic ecological role across more of the landscape and where compatible with existing land uses. Planning for wildfire risk reduction and habitat restoration should evaluate if it would be feasible, ecologically appropriate and socially desirable to allow the historic fire regime to return once high fuel loads are addressed.

Unforested habitats

Prescribed fire can be a useful tool when tailored to local conditions. However, prescribed fire is not necessarily suitable for all situations. In the Northern Basin and Range and Blue Mountain ecoregions, low productivity communities are extremely slow to recover from disturbance such as prescribed fire. For example, low sagebrush communities have poor, shallow soils and are slow (150-300 years) to recover from significant soil disturbance or fire. Inappropriately managed fire, either prescribed fire or wildfire, can increase dominance by invasive plants. In the Klamath Mountains and Willamette Valley, prescribed fire poses challenges such as conflicts with surrounding land use, smoke management and air quality, and public safety. In the Coast Range, prescribed fire is difficult due to high precipitation and wet conditions. When conditions are dry enough to use prescribed fire in coastal grasslands, there are usually concerns with risk to surrounding forests.

To address these issues, carefully evaluate individual sites to determine if prescribed fire is appropriate. Be particularly cautious in low productivity sites where recovery times are prolonged or in sites with invasive annual grasses. If determined to be ecologically beneficial, reintroduce natural fire regimes using site-appropriate prescriptions and considering conflicts such as smoke and safety concerns. If prescribed fire is not appropriate or feasible, consider alternative methods that mimic the effects of fire (see Action 3.5).

- **Action 3.5. Use site-appropriate tools such as mowing, brush removal, tree cutting, and controlled grazing to mimic effects of fire in fire-dependent habitats.**

  Use multiple site-appropriate tools to maintain open structure habitats. These may include mowing, controlled grazing, hand-removal of encroaching shrubs and trees, or thinning. For all tools, minimize ground disturbance and impacts to native species. Use mechanical treatment methods (e.g., chipping, cutting for firewood) to control encroaching conifers. In aspen habitats, reintroducing a disturbance regime may be necessary to reinvigorate aspen reproduction after mechanical removal of conifers. In areas where western junipers are expanding into sagebrush habitats, maintain older juniper trees, which are very important for wildlife.

- **Action 3.6. Develop tools that evaluate trade-offs between short term loss of wildlife habitat values and long term damage to habitat from wildfires. And,**

- **Action 3.7. Evaluate effects of forest management practices that reduce wildfire risk to wildlife habitat values.**

  Efforts to reduce wildfire risk and restore habitats need to occur within an adaptive management framework in which actions are monitored and modified in response to results and changing conditions.

  In some cases, wildlife habitat elements such as hiding cover and snags will be reduced by fuel reduction activities. However, not taking any action could result in complete habitat loss through severe wildfire. Thus, analytical tools are needed to evaluate and compare the short-term risk of fuel reduction treatments to species and habitats against the long-term risk to species and habitats posed by uncharacteristically severe wildfire. Such tools would assist landowners and land managers in determining appropriate actions for individual sites.

  Fuel reduction techniques need to be monitored to determine the short-term impacts of fuel reduction techniques on species and habitat, and the long-term effectiveness of fuel reduction techniques in reducing the risk of uncharacteristic fire. Furthermore, research is needed to better understand the effects of historic fire regimes, severe wildfire and fire suppression on wildlife. Also, historic disturbance regimes are not well-understood for all habitat types, so research is needed to determine the historic frequency and severity of disturbance that maintained Strategy Habitats. Formulate management approaches, including use of prescribed fire, accordingly.

Floodplain function

The natural cycle of flooding has changed

From time to time Oregon's waterways, filled by rains and snowmelt, overflow their banks and spread across the landscape. Minor floods occur relatively frequently and on most Oregon streams at one time or another. Many streams flood once or more each season. Flooding occurs under different circumstances on the west side of the Cascades than on the east side. Floods on rivers in eastern Oregon are more often the result of spring snowmelt. The central and eastern areas of the state are also subject to summer thunderstorms that drop large amounts of rain in short periods, overwhelming the soil's capacity to absorb the moisture and river systems to transport it. Flash floods result. In western Oregon, winter storms and spring rain-on-snow events contribute to seasonal flooding.

The area of land adjacent to the river that absorbs overflow during floods is the river's floodplain. Rivers often carve new courses during floods. Over time and left to their own ways, rivers move across the landscape creating oxbows and excavating new channels and alcoves. This makes naturally flowing rivers rich habitat for aquatic species and floodplains fertile habitat for terrestrial species.

A River Changes - Story of the Willamette

The Willamette River is a good illustration of how people can change a river and its associated habitats. Although changes have been most dramatic for the Willamette River, this story applies to many of Oregon's streams and rivers.

The Willamette River Basin captures precipitation from the many Pacific Ocean storms that march onshore each winter. This makes the Willamette the 13th largest river by stream flow in the United States, yet it produces more runoff per unit of land area than any of the larger 12 rivers.

Prior to European American settlement, the upper, southern third of the river from today's Eugene to Albany, occupied a wide swath of the valley bottom in a braided network of side channels and wetlands, seven miles wide in places. The middle reach, from today's Albany to Newberg, while constrained by the Salem Hills, meandered across the landscape and seasonally flooded adjacent lowlands. Wide floodplain forests of black cottonwoods, red alder, Oregon ash, big leaf maples

and willows surrounded many of the tributaries as well as the main stem and during large floods, the river expanded into this broad floodplain.

The regular flooding of the valley bottom deposited silt and nutrients from upstream that over time built exceptional agricultural soils and fertile floodplain habitat. The rich soils and abundant rainfall attracted immigrants intent on farming the valley bottoms. The floodplain's proximity to river transportation made these areas all the more appealing. Thus, the Willamette floodplain was one of the first and surely the most completely settled, cultivated and altered of the basin ecosystems.

As settlements grew along the river, floods became a greater threat to life and property. River transportation had also become an essential component of pioneer life. To prevent floods, stop river erosion and improve navigation, the river was significantly altered. Dams were built, and banks were hardened with riprap. The floodplain forests were logged and the land along the river was drained and cultivated. The many braided and shallow channels were filled or merged in to one navigation channel. As a result, there are currently 96 miles of revetments on the Willamette River, most on river bends. Thus the most dynamic sections of the river's course are armored and static, greatly diminishing its capacity to cool, flush out sediment, and accommodate floods.

The riparian forests, wetlands and grasslands that lined the historic 11,000 miles of rivers and streams in the basin provided critical habitat for aquatic and terrestrial species. This habitat has been reduced in scale and value. Studies repeatedly point to the floodplain as the most critical focus of restoration to benefit aquatic, riparian and upland species.

History of modification to Oregon's river systems: dams and channelization

Oregon's first dams were built in the late 1800s to supply electricity to cities. Many "splash dams" were built to transport logs from forest to mill, but they did so much damage to streams they were outlawed in 1958. Major dam building took place between the turn of the last century and the 1960s. Initially the federal government built dams to provide irrigation water to farmers. The first of these projects in Oregon under the 1902 Reclamation Act, and managed by the Bureau of Reclamation, was the Klamath Project, a complex of dams and canals that drained extensive wetlands and diverted lake water to irrigate 225,000 acres of former rangeland. By 1940, over 70 percent of Oregon's current water storage capacity was in place behind eight Bureau of Reclamation dams. While many of these dams may provide a variety of services, flood prevention was not their primary purpose.

As human settlements grew along rivers, buildings, towns and farms were subject to damage by floods as well as erosion from meandering river systems. Dams increasingly became important for flood control. The Flood Control Act of 1936 declared that flood prevention was in the public interest and thus was a responsibility of the federal government. The U.S. Army Corps of Engineers currently operates 20 dams in Oregon, 11 of them west of the Cascades. Those constructed on the Columbia (Bonneville, The Dalles and McNary) were built to generate electricity, rather than provide storage. Today, the greater percentage of dams across the state is operated by cities, local districts or individual landowners for a variety of purposes including flood control. There are 1,100 dams in Oregon that are at least 25 feet high.

In addition to dams, rivers have been modified in a number of other ways. Rivers have been dredged and deepened to improve their use for transportation, flood control, and irrigation needs, as well as to increase the area available for agriculture. Large stone riprap, levees and deflectors harden and stabilize banks and redirect river flow to prevent erosion and channel movement. These structures constrain rivers to a single course, disconnecting them from their floodplains.

Effects on river dynamics, floodplain function and fish and wildlife habitats

While dams and revetments provide valuable services to human communities, they alter river dynamics that affect aquatic and terrestrial communities in significant ways. Floods on wild rivers provide a number of important natural services, renew floodplain soils and aquatic habitat, and are part of the normal pattern of disturbances that shape Oregon ecosystems.

The loss of a river or a stream's connection to its floodplain reduces its ability to absorb floodwaters. When small streams and creeks reach flood stage and overflow onto adjacent lands the pulse of floodwater slows before reaching larger rivers. The speed and severity of modern floods worsens with the loss of this floodplain "sponge effect." In developed areas, modifications have been made throughout river and stream systems. Paved surfaces allow no infiltration into the ground but instead concentrate stormwater into pipes and directly into streams. In rural areas, agricultural ditches move water off the land briskly. Across Oregon, rivers have been channelized. As a result, floodwaters barrel downstream overwhelming the larger rivers instead of spreading across the landscape and gradually infiltrating or evaporating.

Floods move gravel from uplands to bottomlands. Clean gravel is an essential streambed surface for healthy salmon spawning beds. Side channels created by freshly deposited gravel bars provide sheltered

settings outside the strong main river current where young fish and other small aquatic creatures can rest or feed. Water gets cooler when it flows through gravel and changes chemistry, improving conditions for coldwater anadromous species. Unfortunately, dams trap gravel and constrain major floods that would normally move gravel downstream. They also trap silt. Conversely, channelization can contribute to greater streambank scouring and erosion because stream complexity (bends, pools, eddies) have been removed, thereby destabilizing the banks and interfering with the historic pattern of flood-based gravel transport and disposition. Since natural river channels are maintained by a dynamic equilibrium between erosion and deposition of silt, water moving without silt or through straightened channels can cause riverbed erosion.

In natural systems, large floods send logs tumbling into mountain streams and topple trees along riverbanks. The force of floodwater moves submerged logs into new locations. These actions rearrange the river habitat, flushing out sediment and setting up new complex structures necessary for healthy aquatic habitat. Dams temper the force of floodwaters, diminishing the power of streams and rivers to move large wood, thus depriving streams of new structure. Channelization removes the complexity of existing stream structure and straightens and speeds flows, thereby depriving streams of potential locations for large wood debris recruitment and retention.

Water temperature cycles are altered by impounding water behind dams, with resulting disruption of temperature-dependant life cycles of anadromous fish and their food sources. Water in a stream is mixed and full of nutrients and oxygen. Water held behind dams warms in the summer sun. The surface temperatures rise while cold water sinks and suspended material settles to the bottom. Phytoplankton – single celled plants that make up the base of the food chain – proliferate at the top, releasing oxygen. When they die, they sink to the bottom where bacteria consume them and use oxygen. Over the course of the summer, the water at the top of a reservoir is warm and full of oxygen and food. The water at the bottom is cold and low in organic matter and oxygen. This is significant for fish because their life cycles and those of their food sources are triggered by temperature. Dam releases can be controlled to maintain appropriate temperatures for fish. Aquatic insects require a series of temperature cues to produce eggs, hatch, and develop into nymphs. Over time, dammed rivers behave more like lake ecosystems, losing their capacity to support riverine fish species.

The flood prevention modifications also have affected river floodplain habitats. Floods that used to occur every 10 years or so now occur every 100 years or more. Former floodplains no longer receive regular deposits of waterborne sediment. Disconnected from their rivers and drained, they no longer provide wetland and seasonally flooded habitats. In addition, annual high-flow events have become "flashy" (shorter in duration and greater in intensity) in some areas where there has been extensive channelization and loss of floodplain function.

Development intensifies the loss of floodplain habitat on floodplain function. Rather than being absorbed by the ground, water drains off of impervious surfaces into waterways, which can increase stream and river water levels and cause downstream flooding.

GOAL AND ACTIONS

Goal: **Maintain and, where feasible, restore floodplain functions such as aquifer recharge, water quality improvements, soil moistening, natural nutrient and sediment movements, animal and seed dispersal, gravel transport and recruitment, and habitat variation.**

Actions:

- **Action 3.8. Restore floodplain function by: reconnecting rivers and streams to their floodplains, restoring stream channel location and complexity, removing dikes and revetments, allowing seasonal flooding, restoring wetland and riparian habitats, and/or removing priority high-risk structures within floodplains.**

  Maintain functional floodplains and riparian systems. Work with local communities, watershed councils, landowners, and other partners to restore and reconnect natural stream channels and floodplains in rural areas. Explore opportunities for broad scale floodplain restoration on main rivers and their tributaries. The greatest benefits will be achieved where this can be done on large scales. While restoration of entire rivers may not be feasible, seek opportunities to restore critical main-stem or tributary habitats, floodplain function and critical off-channel habitats adjacent to the main channels. Use subbasin plans and similar efforts for key information on floodplain issues and opportunities.

  Reduce head-cutting of streams resulting from storm water discharges by replacing culverts that are not at stream grade, reducing run-off to streams, and replanting and encouraging planting streambank and riverbanks with native vegetation. When re-development is planned, explore opportunities to remove structures or pavement from floodplains and restore native vegetation.

- **Action 3.9. Work with power companies, agencies, irrigation districts and municipalities to time water releases to replicate natural flood cycles.**

  Restore or replicate natural timing where feasible. Work with power companies and municipalities to develop a schedule of releases timed to replicate natural flood cycles, while continuing to provide essential hydroelectric power and water storage services.

- **Action 3.10. Identify and restore important off-channel habitats and oxbows cut-off by previous channel modification.**

  While revetments protect riverside property, they simplify or eliminate the side channels, alcoves and islands that provide essential complex habitat structure for aquatic species. These are critical areas for juvenile salmonids and some amphibians. Reconnect these habitats to rivers where feasible. Use bio-engineering instead of rip-rap on bank stabilization projects.

ISSUE 4: Barriers to Animal Movement: Aquatic Passage and Terrestrial Corridors

Nature is full of cycles that influence fish and wildlife behavior. One of the most dramatic and yet not fully recognized is how wildlife move across the landscape. These movements or migrations happen at different scales. Salmon migrate from mountain streams to the ocean and back to complete a life cycle. Tiny hummingbirds spend winters in Central America, and return to Oregon each spring to nest. Some hummingbirds travel as far north as Alaska to breed – a journey of thousands of miles for an animal that weighs less than a penny. Deer and elk move to higher elevations in spring to raise their young, and move to lower elevations in winter, where weather is milder and food more accessible. Turtles move a few hundred yards or even a few miles in search of a place to lay eggs. Bears will return each year to the same huckleberry patch, to feast on the ripe berries. Migrating waterfowl and shorebirds stop to rest and feed on their long journey north at the same wetlands, mud flats and lakes every year.

As people build structures and alter habitats, the risks to fish and wildlife increase as they encounter barriers, people, vehicles and loss of habitat. These changes in the landscape and vegetation are often difficult adjustments for fish and wildlife, and can affect survival of individual animals and entire populations.

Aquatic passage

Even before Oregon was officially recognized as a state, natural resource managers were concerned with providing stream passage for migratory fish. Barriers such as dams, dikes, road fills and culverts change hydrological conditions and alter natural flow regimes. Many of these artificial obstructions create a drastic change in water surface elevation from one side of the structure to the other. Misaligned culverts that have the downstream end above the water level disconnect stream passage corridors, prevent fish passage and force wildlife to cross roads where they are vulnerable to vehicles and predators. Under-sized or improperly sized culverts alter transport of sediment and wood, creating an uneven distribution of habitat.

Suitable passage should be provided for native migratory fish past artificial obstructions allowing movement both upstream and downstream. As the state agency responsible for sustaining healthy fish populations, Oregon Department of Fish and Wildlife works with owners or operators in several ways to address passage. Recognizing the unique nature of migratory fish in the Pacific Northwest, many other agencies and groups are also interested in ensuring fish passage.

An additional aspect of fish passage is fish screening, which is another important part of the Oregon Plan aimed at the protection, restoration, and recovery of native migratory fish, most specifically salmon and steelhead. Screening efforts go toward reducing juvenile fish mortality at water diversions (e.g., irrigation systems, hydropower systems) by placing screens and by-pass facilities that meet the most recent regulatory criteria to prevent fish from moving with diverted water into locations which are detrimental to their survival. This aspect of downstream passage assures that fish stay within natural waterways and are not harmed by anthropogenic water uses.

Terrestrial corridors

People sometimes think that wildlife occupy the same patch of habitat all their lives. However, wildlife often move through the landscape for a variety of reasons. Some species move seasonally, following food resources. Or, they may move to areas more suitable for laying eggs, raising young or surviving the winter. Other species may move at a more local scale, adjusting their habitat use during parts of the day. For example, wildlife may move to a riparian area for drinking, shade or cover from predators. Still others move through their home range, "patrolling" and marking the boundaries to protect their territory.

Human-caused changes to the landscape can affect the ability of wildlife to move across terrestrial landscapes by adding obstacles, impacting stopover sites, and increasing habitat fragmentation.

Buildings, roads, and other structures can serve as obstacles. Migration is a strong urge in species, and migration routes are often used

over decades or centuries, by generations of wildlife. So, when a new obstacle pops up in the route, like a roadway or a housing development, wildlife may try to find a way through the area, rather than avoid it. This can lead to increased mortality to wildlife on highways and can endanger human safety as well. In residential and urban areas, they are moving through an open landscape of lawns and backyards. Barking dogs and free-roaming cats, lights from houses, security lighting and street lights, vehicle traffic and other features people take for granted can be frightening or even lethal to wildlife. Some wildlife species are not welcome in developed areas, and human-wildlife conflicts results. In rural areas, the impacts of roads on wildlife movement will depend on the type of road and the level of use, with impacts increasing with the amount of traffic.

Some wildlife, especially birds, need staging or stopover areas to rest and refuel during migrations. Habitat conversion or degradation can impact important staging or stopover sites, thus impacting the animals that depend on the sites. Lastly, habitat fragmentation can be a barrier to animal movement for species that require continuous habitat, particularly less mobile ones that cannot fly or swim between habitat patches.

How these barriers affect wildlife depends greatly on the species, the habitat type, the landscape context, and the type of barrier. For example, a two-lane highway may pose an insignificant barrier to elk, but may be impossible for a turtle to cross.

These issues can be addressed through careful planning of transportation facilities and other structures, site-appropriate road management, providing road crossings, maintaining and restoring stopover sites, and addressing habitat connectivity.

GOAL AND ACTIONS

***Goal:* Provide conditions suitable for natural movement of animals across the landscape**

Actions:

- **Action 4.1. Continue working with Oregon Watershed Enhancement Board, Oregon Department of Transportation, U.S. Forest Service, U.S. Bureau of Land Management, and other partners to inventory, prioritize and remove fish passage barriers, leveraging current work done by Oregon Department of Fish and Wildlife's Fish Passage Task Force to expand implementation of fish passage priorities.**

  Time, effort and money could be spent more efficiently if fish passage efforts were clearly prioritized and projects were implemented based on the priorities. In some cases, passage is provided upstream from significant barriers. Given the expense and challenges of this work and the vast number of sites to address, it is critical to work collaboratively and strategically.

  A barriers database currently under development by Oregon Department of Fish and Wildlife, Oregon Watershed Enhancement Board and many other partners presents a good opportunity to fully evaluate barriers across Oregon. To meet statutory requirements and to address the need for prioritizing artificial obstructions, Oregon Department of Fish and Wildlife is seeking funds to complete a statewide inventory of artificial obstructions. The inventory will list information sources held by many different entities. In addition, Oregon Department of Fish and Wildlife already maintains inventories of larger dams and state- and county-owned culverts.

Oregon Department of Fish and Wildlife Fish Passage Task Force

In 2000, a multi-stakeholder group, including state and federal agencies, the Association of Oregon Counties, the League of Oregon Cities, the Oregon Association of Water Utilities and the Water Utility Council, the Oregon Farm Bureau, and other natural resource use and conservation groups, convened to draft legislation designed to focus and combine existing statutes on aquatic passage. The resulting legislation, passed in 2001, requires the owner of an artificial obstruction located in waters where native or migratory fish were currently or historically present to address fish passage. The legislation ensures benefits for native migratory fish while providing flexibility for owner-operators by allowing the Fish and Wildlife Commission to consider circumstances in which passage requirements would not need to be provided at an artificial obstruction These circumstances may include lack of benefit to fish passage, or, an alternative to passage that will provide an overall net benefit to fish, such as increasing habitat quality or quantity within the same basin as the obstruction. The 2001 statute also established a citizen Fish Passage Task Force that currently advises Oregon Department of Fish and Wildlife in matters related to fish passage, including large expenditures from the cost share grant program, new fish passage administrative rules, and waivers and exemptions from providing fish passage.

Oregon Department of Fish and Wildlife also is developing a systematic method to prioritize artificial obstructions based on their value to native migratory fish. This prioritization method will allow artificial obstructions to be ranked and guide agency efforts at improving fish passage. It will be available to others (e.g., watershed councils, counties, Oregon Watershed Enhancement Board) to guide their fish passage work or funding. Oregon Department of Fish and Wildlife intends to provide information and analysis tools via an interactive website. The analysis tools, which will help prioritize structures, will incorporate maps of habitat quality derived from Oregon Department of Environmental Quality information [303(d) list] and fish distribution data. Currently Oregon Department of Fish and Wildlife is seeking funding from the Oregon Watershed Enhancement Board to implement this inventory and prioritization project.

- **Action 4.2. Maintain and restore habitat to ensure aquatic connectivity and terrestrial corridors in priority areas, such as Conservation Opportunity Areas and urban centers.**

Aquatic passage

Of all artificial obstructions that affect aquatic systems, road-stream crossing structures (culverts and bridges) are the most numerous. Many culverts have been placed with the primary goal of moving water past the structure efficiently (rather than impounding it, such as occurs with a dam), without considering the additional goal of ensuring the continuity of stream function across the obstruction so as to provide fish and wildlife access and habitat through and/or within the culvert.

Road-stream crossing structures, including habitat improvement projects or mitigation, should be designed and built with the goal of maintaining natural flow and hydrological regimes. This goal will ensure the best conditions for both fish and wildlife (macroinvertebrate and amphibian) passage. Flow and passage should be maintained as historically available through restoration of aquatic habitat connectively.

Prioritize these efforts based on benefits to aquatic species and location within priority areas, including Conservation Opportunity Areas and urban centers. Use ongoing work on the aquatic barriers database to identify high priority habitat for restoration.

In some situations, coordination among responsible parties and interested partners is required to address the effects of obstructions on the hydrological regime. Coordinating with multiple owners, multiple regulatory levels, and across jurisdictional boundaries, such as with railroads and some hydroelectric projects, can take much more time and negotiation to reach an acceptable outcome, but is critical to long-term success.

Fish passage structures, such as fishways and culverts, must be properly designed. If implemented improperly, these structures will not provide adequate fish passage and can actually become barriers themselves, creating frustration for landowners and land managers.

Oregon Department of Fish and Wildlife has existing criteria and guidelines, which are currently undergoing revision. The National Marine Fisheries Service has criteria and guidelines for fish passage. Agency biologists, consultants, owners and operators of artificial obstructions, and other regulatory entities must be aware of and understand the procedures, criteria, and guidelines in order to assure that the best possible passage and stream function are being provided.

Providing fish passage with a fish ladder or properly sized culvert or bridge is an added expense to the owner or operator of an artificial obstruction. However, there are several financial incentive programs that can be of assistance. Oregon Department of Fish and Wildlife has a cost share grant program to help with these costs. There also is a small tax credit allowed in statute if a fish screening or passage structure is installed. Identifying additional funding sources would be greatly beneficial, as passage projects can be quite expensive.

Terrestrial corridors

When new transportation facility development is proposed, assess the use of an area by fish and wildlife, and look for important crossings and corridors. Leave habitat corridors intact where possible, and if not, provide alternative connecting habitat nearby. If redevelopment opportunities arise in older developments, provide greenways for wildlife in or adjacent to the area. Work with community leaders, planners, and agency partners to identify wildlife movement corridors and to fund and implement site-appropriate mitigation measures such as drift fences to underpasses in priority areas.

When evaluating animal movements, consider avian, subterranean (underground), and sub-nivean (under snow) movements. Some of these might be important to consider when planning wind energy, communications tower, gas pipeline, and other forms of development.

Riparian areas are important corridors, and many species of wildlife use them to move through the landscape. Maintain the riparian areas whenever possible, and plant them with native plants, to provide food and cover. Other less obvious corridors, such as powerline right-of-ways, can play a role, especially in urban areas. Corridors may not be appropriate in all cases, so explore other options for providing connectivity. For example, improve connectivity through habitat restoration by enlarging habitat patches and creating links between isolated habitat patches.

In forested areas, minimize the effects of roads on animal movement by maintaining vegetation to provide screening along open roads, prioritizing roads for closure based on transportation needs and wildlife goals, and/or managing road use during critical periods.

- **Action 4.3. When planning aquatic passage projects, consider the needs of other aquatic species and terrestrial wildlife, as well as fish.**

Most efforts to address aquatic passage have emphasized fish, particularly salmonids, to the exclusion of other types of aquatic life. Some aquatic species may have specific passage needs. For example, the Columbia River Lamprey Technical Workgroup wrote a report on passage considerations for lamprey, which identifies research needs related to lamprey passage. Ensuring fish passage can provide benefits to a broad array of species. Although there are currently no requirements to ensure passage for wildlife, ongoing efforts to replace culverts present opportunities for developing, testing and implementing methods to maximize benefit for a variety of species. Aquatic invertebrates would benefit from making culverts as wide as possible to allow lateral movement of the stream and from keeping the bottoms of culverts at least eight inches below the surface of the stream's substrate. Amphibians benefit from natural substrates. In addition, maintain and restore riparian habitat to provide wildlife passage adjacent to in-water habitats.

- **Action 4.4. Continue to screen ditch and pump water diversions to protect fish using funds from Oregon's Fish Screening and Passage Cost Sharing Program and working with state and federal funding partners.**

Barriers are frequently associated with irrigation, municipal, industrial and hydroelectric water diversions that cause fish loss in the millions. Continue to provide fish screens at water diversions to keep fish in their natural streams and lakes.

- **Action 4.5. Work with Oregon Department of Transportation, county transportation departments, and other partners to identify and address key areas of wildlife mortality on highways and consider animal movements when planning new roads.**

Wildlife cannot avoid roads, railroads and other linear obstructions. The result is sometimes injury or death for wildlife. In the case of vehicle accidents, people are at risk as well.

Ideally, wildlife movement should be considered during the planning phase of new roads to avoid known migratory routes and to design wildlife passage into the project.

Existing roads affect wildlife. Some established migratory routes that intersect roads can be identified by local or state road crews who repeatedly remove carcasses at these spots. In these cases, bridge replacement and routine highway maintenance provide opportunities to address areas where highway mortality is high. For smaller wildlife species, a culvert under the road may help small mammals, reptiles and amphibians cross safely. Install warning signs for drivers about wildlife crossings. Funnel larger species to larger culverts or underpasses. Additional studies may be needed to advance understanding of wildlife-transportation corridor conflicts, as well as design approaches, so that preventative, cost-effective solutions can be incorporated into project designs.

The Oregon Department of Transportation (ODOT) is exploring ways to reduce wildlife-vehicle collisions on state highways. The department is collaborating with Oregon Department of Fish and Wildlife to develop passage designs that are economical as well as practical for wildlife. Also, Metro has worked with road departments in its three-county area to develop a manual for dealing with wildlife crossings on roadways. The Port of Portland designed and installed culverts for turtles to cross beneath a busy transportation corridor.

- **Action 4.6. Identify, maintain and restore important stopover sites for migratory birds.**

The use of stopover sites is often for brief periods in the year, but these are just as essential to wildlife as longer-term homes.

Wildlife crossing long distances during migration expend a great deal of energy each day. These animals must stop to rest and feed one or more times each day and at night in order to refuel for the journey. Many sites, such as wetlands and mudflats, are in lowland areas which are important areas for development. Some areas, such as agricultural fields, can be important for migrating birds, especially shorebirds.

Use existing information on the location and value of known sites when planning for new development. Audubon's Important Bird Area program incorporates key stopover sites. Work with partners to evaluate other potential stopover sites. Maintain and restore priority sites. In particular, look for ways to avoid or minimize impacts or alterations to the sites. If impacts are unavoidable, mitigate for any impacts by providing alternative sites nearby. Also minimize disturbance during critical periods. Look for opportunities to work with landowners to provide and enhance bird habitat.

ISSUE 5: Water Quality and Quantity

The droughts of the early 21st Century have heightened awareness of the issues related to water quality and quantity. Ensuring high quality water supplies is a top environmental challenge for the next century throughout the western United States. Water quantity and quality are inseparable issues. Adequate streamflows and natural hydrology help maintain high water quality in Oregon's rivers and streams. Limited water supply compounds temperature and nutrient problems. Water quality and quantity issues are linked to changes in land uses, increasing intensities of land management, growing demand for water, and uncertainty about the role global warming will play in long-term supply.

In the Pacific Northwest, watershed health also is directly related to healthy populations of migratory salmon. Many measures of ecosystem performance, water quality, and watershed health have been linked to salmonid populations.

Overall Goal: **Maintain and restore water quality and quantity to support fish and wildlife and habitats in balance with economic and social needs of local communities.**

Water quality

Water quality is degraded by many factors, including increased temperature, dissolved oxygen, turbidity (fine suspended sediments), and both point and nonpoint source pollution, including toxic contaminants, bacteria, and nutrients.

A major tool in identifying and prioritizing water quality problems in Oregon is the 303(d) list, required under the federal Clean Water Act. This is a list of water bodies and stream reaches that do not meet water quality standards, and is updated at least every two years. In the Conservation Strategy, the 303(d) list is used in development of Conservation Opportunity Areas to prioritize site selection and to help guide conservation actions.

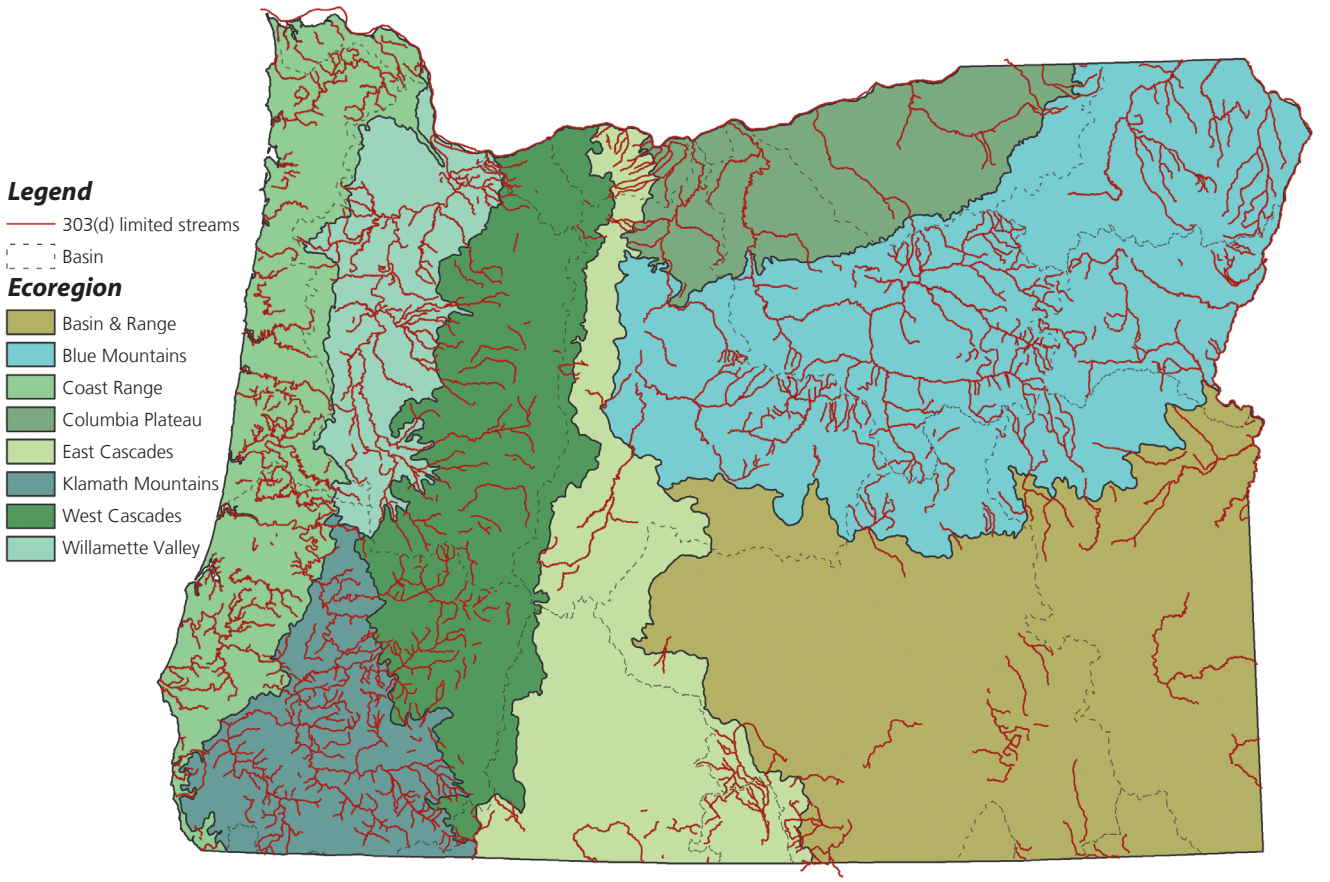
The Oregon Water Quality Index is a method for quantifying water quality throughout the state, considering dissolved oxygen, biological oxygen demand, pH, ammonia and nitrate nitrogen, phosphorous, total solids, and fecal coliform levels. The index is particularly useful as a comparative tool for various regions or reaches. Like most water quality indices and criteria, this index was developed using criteria for human health. Therefore, more information may be required to assess ecological health of aquatic ecosystems and the potential impacts of degraded water quality on fish and wildlife. Moreover, there is a need for further structural and functional criteria to assess the overall success of aquatic restoration projects.

Oregon's existing framework for water quality

- *Oregon Department of Agriculture Water Quality Plans and Rules* - The Oregon Department of Agriculture, working with local stakeholders, recently completed basin-specific agricultural water quality plans and rules (Senate Bill 1010 plans and rules) for the entire state. The plans include goals, objectives, and recommended management practices for agricultural landowners to improve water quality. The rules require certain conditions to be met on all agricultural lands. Basin-specific plans and rules provide for tailoring to local conditions and needs. All plans will be reviewed and updated biennially with input from local stakeholders. Plans and rules address effects of agricultural lands on water quality, including erosion and sediment delivery, animal waste management, nutrient management, irrigation water management, and riparian area management. Plans and rules focus on outcomes and results, allowing landowners to choose the best practices for their operation to comply with the rules. Although compliance with the rules is required, the focus is on voluntary solutions rather than enforcement. To meet the goals of the plans, landowners typically work with local Soil and Water Conservation Districts, the Natural Resources Conservation Service and Farm Service Agency, and Oregon Department of Agriculture to implement a variety of conservation practices.

- *Water Quality programs with Oregon Department of Environmental Quality* - Oregon Department of Environmental Quality

2002 Oregon 303(d) Listed Streams



Data Source: Oregon Department of Environmental Quality

is responsible for protecting the state's surface waters and groundwater to keep these waters safe for a wide range of uses, such as drinking water, recreation, fish habitat, aquatic life, and irrigation. For example, the Department of Environmental Quality develops water quality standards; monitors water quality; regulates sewage, industrial discharge, and injection systems; inspects septic systems; works with public drinking water systems; and works to control nonpoint source pollution.

The DEQ uses standards called Total Maximum Daily Loads (TMDL) as a primary approach to identifying and addressing water quality issues. A TMDL is a pollution analysis to see how much a pollutant must be reduced to meet required Water Quality Criteria. TMDLs are basin-specific and address types of pollutant sources; load allocations (portions of loading capacity to be allocated to existing nonpoint sources or background sources); seasonal variation and reserve capacity of the system. Because they are basin-specific, TMDLs consider individual basin hydrography, climate, streamflow, dam and reservoir operations, land use and ownership, and local fish and wildlife.

Several TMDLs have been completed for Oregon, with the goal of having TMDLs completed for all basins by 2010. Successful implementation of the TMDL is defined as compliance with the implementation plan, Senate Bill 1010 plan, Forest Practices Act rules, or federal Water Quality Restoration Plans. Developing methods for effectiveness monitoring of TMDLs is ongoing.

- *Water Quality programs with Oregon Department of Forestry* - Oregon Department of Forestry manages state-owned forestlands in Oregon and administers the Forest Practices Act on all private, state, and local government forestlands outside of urban growth boundaries to ensure that water quality is maintained during and after commercial forest operations. The 2000 State of the Environment Report stated that instances of good or excellent water quality occur most often in the forested uplands of Oregon.

Additional information relating to these programs can be found in Appendix III.

GOAL AND ACTIONS

***Goal:* Maintain or restore water quality in surface and groundwater to support a healthy ecosystem, support aquatic life and provide fish and wildlife habitat**

Actions:

- **Action 5.1. Reduce runoff from impervious surfaces.**

  In urban areas, runoff from paved areas reduces water quality and can release contaminants into the water.

  Increase cooperation between governments, watershed councils and businesses to reduce impervious surfaces and run-off to storm sewers in urban areas. Promote and permit "green infrastructure," that reduces run-off such as disconnecting downspouts, installing green ("living") roofs, and using permeable paving materials. Manage stormwater to minimize transfer of contaminants to streams. Restore riparian vegetation buffer strips and use native landscaping and bioswales to filter runoff. Continue ongoing water quality assessments and restoration programs (e.g., City of Portland program to filter runoff via fallen leaves).

- **Action 5.2. Restore wetlands and riparian areas to increase filtration of sediments and contaminants.**

  Wetlands often have low or no water flow, which allows sediments to fall out of the water column. Native wetland vegetation such as cattails, rushes and sedges can concentrate certain contaminants in their leaves and roots, thereby removing contaminants from the water. Native riparian vegetation filters sediment before it reaches streams. Riparian vegetation also provides the thermal conditions that are favorable to fish and other aquatic species. Restoring wetlands and riparian areas allows these natural processes to occur.

- **Action 5.3. Implement water quality improvement projects and management frameworks.**

  Minimize run-off of sediment from logging, agriculture, roads, urban and rural construction, and other activities that disturb soil. Some strategies are terracing fields, filtering run-off before it enters aquatic systems, installing sediment control basins to reduce erosion and practicing conservation tillage. When constructing new roads, consider sediment catchment and removal in road design. Use tax credits, pollution credits and other tools to reduce the amount of contaminants entering waterways. In urban areas, continue educational efforts in urban areas such as "Dump no waste, drains to stream" postings at sewer drains.

  Continue implementing Oregon Department of Environmental Quality Total Maximum Daily Load planning and Oregon Department of Agriculture Water Quality Management planning, which address water quality holistically throughout watersheds, including nonpoint sources of contaminants.

- **Action 5.4. Monitor structural, compositional, and functional parameters of aquatic habitats for changes in water quality.**

  National and regional programs use water quantity and quality indicators to assess ecological function (i.e., Heinz Center; Oregon Progress Board; National Research Council). Several indicators of water quality have been well developed and characterized. Use of indicators provides for characterizing status, detecting change, and diagnosing the causes of change. Examples of biological indicators include: benthic community indices (for example, Index of Biotic Integrity); species richness, number of native taxa, relative abundance of sensitive taxa, biomass, productivity; salmonid population (structure, abundance, productivity, diversity); and species interactions (predation, competition, invasive). Examples of physiochemical indicators include water clarity, pH, wetland area, temperature, dissolved oxygen, nutrient levels, chlorophyll A, Total Suspended Solids, or the presence of specific toxic contaminants. Indices can be linked to specific stressors using a weight of evidence approach that combines existing data, literature, and scientific judgment to make predictions about ecological characteristics.

- **Action 5.5. Maintain and restore native vegetation throughout watersheds, including upland areas, riparian corridors and floodplains.**

  In addition to restoring riparian and wetland habitats, restoring vegetation throughout the watershed contributes to water quality by maintaining water infiltration and flow, holding soil, and preventing contaminants from entering aquatic systems.

Water quantity

In some areas of the state, particularly in the summer, water is entirely allocated to out-of-stream uses that reduce the ability of watersheds to provide quality habitat. Diversions are made for agriculture, municipal,

industrial, domestic, and power generation uses. Other physical alterations to water quantity and flow include barriers, wetland drainage, or channelization. Timing of diversions and external factors influence disturbance regimes, sediment transport, and groundwater storage. For example, the timing of water release at dams can have critical implications for water temperature, which can have differential impacts on the timing of salmonid migration. Global processes, including climate change, influence temperature and precipitation patterns, and can potentially affect stream runoff and water supplies.

In Oregon, the Water Resources Department is the state agency with the greatest responsibility for holding instream rights in trust to support the public interest, including uses for recreation, pollution control, navigation, and fish and wildlife habitat (Instream Water Rights Act of 1987). To protect fish populations, Oregon Department of Fish and Wildlife applies for instream flows based on estimated monthly requirements to sustain healthy fish populations. Additionally, Oregon Department of Fish and Wildlife biologists provide advisory comments regarding water right applications' impacts on fish and habitat.

GOAL AND ACTIONS

Goal: **Maintain or restore sufficient stream flows to support aquatic species and Strategy Habitats.**

Actions:

- **Action 5.6. Work with Oregon Water Resources Department and the Oregon Department of Environmental Quality to develop tools to maintain in-stream flow (e.g., water markets and water banks).**

  Economic and environmental assessments into the possibility of including in-stream flow water markets are ongoing. A pilot investigation has been conducted in the Deschutes region. The Northwest Power and Conservation Council is considering results of these assessments, along with subbasin planning, in investigating the feasibility of such markets.

- **Action 5.7. Seek opportunities to restore aquifer recharge and maintain groundwater.**

  Groundwater levels are declining in many areas. Seek opportunities to restore aquifer recharge to restore and maintain groundwater. For example, restore floodplain function and restore wetlands to allow for greater water infiltration. Continue implementation of Oregon's groundwater quality protection act, implemented by Oregon Department of Environmental Quality.

- **Action 5.8. Use established indicators to monitor watershed function and determine thresholds for action.**

  Water quantity and availability need to be monitored, and watershed function and processes need to be better understood to guide restoration.

  Use the existing indicators for watershed health, which have been extensively studied and linked to ecological function. These indicators include: altered hydrology (hydrography); floodplain presence and connectivity; groundwater availability; riparian condition (width, composition and fragmentation); stream connectivity; channel condition and habitat structure (habitat types, bank erosion, channel substrate, off channel habitat, large wood). Integrated hydrologic and water quality models simulate flow and other important characteristics. Habitat equivalency analysis and net environmental benefit analysis models use habitat characteristics to predict ecological changes that might result from proposed hydrological alterations. Continued use of these indicators, when combined with actions to address problems with watershed function, will help ensure that watersheds provide essential ecological services to humans, fish and wildlife. Continue to develop methods of determine if sufficient water exists to maintain ecological function and when conservation actions may be needed.

- **Action 5.9. Work with Water Resources Department and other partners to establish priorities and implement projects to restore stream flow.**

  The Oregon Department of Fish and Wildlife and Water Resources Department have developed stream flow restoration priority maps showing flow restoration needs and priorities. The maps display each river basin, with rankings for stream flow restoration need, feasibility for stream flow restoration, and priorities for restoration. Additional information, including a summary of the prioritization process and the criteria used to establish the priorities is located at http://rainbow.dfw.state.or.us/nrimp/information/streamflowmaps.htm.

  Use these priorities to implement projects that restore stream flows. Collaborate with ongoing water quantity efforts taking place under the Oregon Plan (Oregon Watershed Enhancement Board). Use voluntary conservation tools such as the Conserved Water Program, and purchase and lease of in-stream water rights to restore stream flows.

ISSUE 6: Institutional Barriers to Voluntary Conservation

Across Oregon, landowners are already voluntarily doing work to benefit fish and wildlife, whether by replacing culverts, restoring streamside vegetation, placing large wood in streams, restoring wetlands, or excluding cattle from highly sensitive areas. Evident through participation in Watershed Councils and a history of on-the-ground projects, Oregon's landowners take pride in their land management.

However, in some cases, institutional barriers prevent landowners from completing projects that will benefit fish and wildlife. These barriers include the difficulty of obtaining multiple permits, cumbersome requirements for financial assistance, and rules originally passed for one purpose that block another one. Long-term voluntary participation by Oregonians in conservation can be increased if Oregon can build on successful landowner-assistance programs to address institutional barriers and create a voluntary conservation system that is streamlined, user-friendly, flexible and collaborative.

This section briefly summarizes some key actions to address institutional barriers. These actions and other opportunities are discussed more fully in the Voluntary Conservation Tools section starting on page 70.

GOAL AND ACTIONS

***Goal:* Share information, streamline processes, and seek creative programs that support voluntary conservation actions.**

Actions:

- **Action 6.1. Streamline permitting processes for habitat restoration projects and application processes for financial incentive programs. And,**

- **Action 6.2. Resolve conflicting regulations that hinder conservation and restoration of Strategy Habitats.**

  Permitting processes can be complex and time consuming for landowners and managers. Similarly, conflicting regulations create confusion and uncertainty that hinders conservation and restoration of Strategy Habitats.

  Providing technical assistance to landowners is a short-term solution. For example, personnel from agencies or other groups sometimes complete the permit applications on behalf of landowners. Also, educational materials produced by the Oregon Watershed Enhancement Board help explain the various permits needed for projects in aquatic and riparian habitats.

  However, in the long-term, incentive program providers and regulatory agencies should look for opportunities to streamline the permitting process and address conflicting regulations.

  Some local governments, such as the City of Portland, have been working with state and federal natural resource agencies to streamline regulatory processes. The Governor's Regulatory Streamlining Initiative can serve as a means for addressing some of these issues.

  One example of a current streamlining effort is current work by the Water-Related Permit Process Improvement Team (WRPPIT). The goal of this process is to develop a user-friendly coordinated process for project applicants to obtain permits for all water-related permitting activities conducted by state agencies. As a first step, an inter-agency permitting pamphlet is being created to inform people about the various permitting requirements of the state agencies. Future efforts will include clustered external stakeholder meetings to determine concerns and interagency training sessions.

  Another example of regulatory streamlining is to take programmatic approaches to federal consultation requirements. In 2004, the Natural Resources Conservation Service in Oregon, along with three soil and water conservation districts, developed a Biological Opinion with National Marine Fisheries Service to protect 12 species of federally listed salmonids. The biological opinion covers dry cropland, range, and pastureland in Gilliam, Sherman, and Wasco Counties for landowners who develop and implement a conservation plan for resource sustainability. The biological opinion concludes that these activities are not likely to adversely impact the listed species or their habitats. The opinion meets the requirement for consultation between federal agencies under the Endangered Species Act, streamlining the regulatory process for landowners.

- **Action 6.3. Improve coordination and delivery of incentives programs to more effectively serve landowners and more strategically address needs of Strategy Species and Habitats.**

  There are dozens of assistance and grant programs available to landowners and organizations. However, there also are dozens of different program applications and requirements that can limit the synergy and participation in these conservation opportunities. People face a daunting challenge in order to complete

the paperwork. For complex projects involving multiple partners and funding sources, it can be difficult to receive approval from several agencies or foundations, each of which may have different goals, criteria, and standards for monitoring, completion or success. Opportunities to make incentive programs more coordinated and "user-friendly" include developing common applications and requirements across similar programs, increasing technical assistance, increasing program flexibility where feasible, and involving landowners in program design.

- **Action 6.4. Improve data management, coordination and sharing between various conservation partners to support voluntary conservation.**
  Effective restoration requires collecting, analyzing, and sharing data in order to adapt activities to changing conditions or to better meet goals. Currently, a variety of entities collect data using different protocols and there is a need for greater coordination to improve adaptive management throughout the state. Additionally, agencies need to partner to make most efficient use of limited resources and to reach shared goals. Strengthening data management and sharing is a key recommendation in the Monitoring chapter (see page 102).

  Some approaches include identifying critical data collection activities and associated data management efforts; establishing a consistent data management system; adopting and using standard protocols for database design data collection and metadata development; and developing web portals for information sharing.

- **Action 6.5. Expand technical assistance and delivery of services to landowners through outreach and stakeholder involvement.**
  There are many forms of technical assistance that can benefit landowners. Landowners often want help in designing projects, applying for funds, obtaining permits, and conducting on-the-ground work. There often is not enough technical assistance to fulfill existing need, much less to expand it to cover underserved landowners, geographic areas, and habitats. In some incentive programs, technical support is poorly or not funded at all.

  Some ways to increase technical assistance to landowners include increasing coordination between incentive program staff, providing training for watershed councils and other groups that work with landowners, developing additional technical outreach materials, providing "one-stop shopping" for technical assistance, conducting outreach to let more landowners know about existing assistance, providing web-based information tools, and developing alternative funding sources and pursuing grants to expand technical assistance.