

FOREST ACTION PLAN 2017



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Introduction

The Washington State Department of Natural Resources (DNR) manages an array of State and Private Forestry programs, leveraging federal resources and partnerships in collaboration with private and public stakeholders. These programs are important components of the agency's mission, provide important public service, protect public resources, support all forestland owners and managers in the state in preserving forest health, and prevent the spread of wildfires.

Active for decades, these programs contribute to DNR's efforts to avoid threats, increase the quality of life of all Washingtonians, preserve, manage and restore key landscapes, and prepare communities for wildland fire. Four overarching challenges continue to cause forest disturbance and structural change. All of them have significant ramifications for the programs that this Plan addresses:

- Conversion to non-forestry uses
- Wildfire
- Invasive species
- Climate Change

Collectively, many of the programs for which this document develops strategies fall under the federal Cooperative Forestry Assistance Act (Title 16 U.S. Code, Chapter 41), and are sometimes called U.S. Forest Service "State and Private Forestry" programs. Specifically, these include:

- Private Land Fuels Management and Community Protection
- Cooperative Forest Health Program
- Forest Stewardship Program
- Urban and Community Forestry Program
- Forest Legacy Program
- State Fire Assistance Program
- Volunteer Fire Assistance Program

On the heels of efforts by the Forest Service and State Foresters to redesign State and Private Forestry Programs, Congress added language to the 2008 Farm Bill requiring state forestry agencies to assess Title 16 eligible programs, identify threats to resources managed by those programs, and outline opportunities to meet those threats. DNR's 2010 Statewide Resource Assessment and Strategy accurately forecast a number of issues that have been thrown into higher relief in the intervening years. The 2010 document was framed by final guidance from Forest Service program managers and the National Association of State Foresters.

The 2015 update of the Assessment and Strategy—now known as the Forest Action Plan—concerns itself with many of the same threats and opportunities addressed in the 2010 document. In addition, the updated Plan includes more detailed discussion of threats arising from climate change, invasive species and pathogens, conversion of working forests and fire. Staff in each of the aforementioned program

areas are dealing with these issues daily and in their long term planning. Discussion of these issues in the Forest Action Plan is not designed to set agency strategic direction, but to provide a framework for addressing issues identified by the Commissioner of Public Lands (CPL), agency leadership, and policy makers within the rubric of DNR's State and Private Forestry Programs.

The redesign effort and the Farm Bill language specify three nationally-significant themes that State and Private Forestry programs are to address. This is intended to ensure that the deployment of these programs will contribute to issues of national significance. Subsequent guidance was issued by the U.S. Forest Service on objectives that accompany the statutory themes, and the content and requirements of statewide assessments and strategies (U.S. Forest Service 2008). The statutory themes and objectives from the final guidance are as follows:

- 1. Conserve Working Forest Lands: conserving and managing working forest landscapes for multiple values and uses.
 - 1.1. Identify and conserve high priority forest ecosystems and landscapes.
 - 1.2. Actively and sustainably manage forests.
- 2. Protect Forests from Harm: protect forests from threats, including catastrophic storms, flooding, insect or disease outbreak, and invasive species.
 - 2.1. Restore fire-adapted lands and reduce risk of wildfire impacts.
 - 2.2. Identify, manage and reduce threats to forest and ecosystem health.
- **3.** Enhance Public Benefits from Trees and Forests: including air and water quality, soil conservation, biological diversity, carbon storage, and forest products, forestry-related jobs, production of renewable energy, and wildlife.
 - 3.1. Protect and enhance water quality and quantity.
 - 3.2. Improve air quality and conserve energy.
 - 3.3. Assist communities in planning for and reducing wildfire risks.
 - 3.4. Maintain and enhance the economic benefits and values of trees and forests.
 - 3.5. Protect, conserve, and enhance wildlife and fish habitat.
 - 3.6. Connect people to trees and forests, and engage them in environmental stewardship activities.
 - 3.7. Manage and restore trees and forests to mitigate and adapt to global climate change.

Since these three themes and their sub-guidance do not match perfectly with DNR's Section 16 funded programs, it was necessary to 'cross-walk' these priorities with issues that DNR land managers face and relevant federal State and Private Forestry Programs. The long-term challenges of fire, pathogens and invasive species, conversion and climate change cut across program areas and issues and will be addressed in context many times in this Plan.

Issues for the State of Washington

Washington State Issues	National Themes & Objectives	State & Private Forestry Programs	Agency-Identified Long Term Challenges
Working Forestlands &	1.1, 1.2, 3.1, 3.4, 3.5, 3.6,	Forest Stewardship	Conversion
Conversion	3.7	Forest Legacy	Fire
		Cooperative Forest Health	Invasive Species
Biodiversity & Habitat	1.1, 2.1, 2.2, 3.1, 3.5, 3.6,	Forest Stewardship	Conversion
Conservation	3.7	Forest Legacy	Fire
		Fuels	Climate Change
		Cooperative Forest Health	Invasive Species
		Urban & Community Forestry	
Upland Water Quality,	1.1, 1.2, 2.1, 2.2, 3.1, 3.5,	Forest Stewardship	Conversion
Quantity & Puget Sound	3.6, 3.7	Forest Legacy	Climate Change
Restoration		Fuels	Invasive Species
		Cooperative Forest Health	
		Urban & Community Forestry	
Forest Health Restoration	1.2, 2.2, 3.1, 3.4, 3.6, 3.7	Cooperative Forest Health	Conversion
		Forest Stewardship	Climate Change
		Fuels	Invasive Species
		Urban & Community Forestry	
Wildfire Hazard Reduction	2.1, 2.2, 3.1, 3.3, 3.4, 3.5,	Fuels	Conversion (WUI)
	3.6, 3.7	Forest Stewardship	Climate Change
		Cooperative Forest Health	Invasive Species
		Urban & Community Forestry	Fire
		State Fire Assistance	
		Volunteer Fire Assistance	
Urban & Community	2.2, 3.1, 3.2, 3.3, 3.4, 3.5,	Urban & Community Forestry	Invasive Species
Forestry	3.6, 3.7	Cooperative Forest Health	Climate Change
		Fuels	Conversion

Figure I1. State and Private Forestry "crosswalk"

DNR can make significant headway on these issues by strengthening partnerships with tribes, private foresters, landowners, conservation organizations, communities and local, state and federal agencies. Many organizations can provide assistance through programs, expertise and networks that leverage state and federal program investments.

DNR Strategic Plan 2014-2017

Following up *Strategic Plan 2010-2014: The Goldmark Agenda*, DNR completed an agency-wide process that resulted in the *Strategic Plan 2014-2017: Update to the Goldmark Agenda*. The six Washington State Issues and four Agency-Identified Long Term Challenges can be mapped onto this document.

Working Forestlands and Conversion: DNR has a longstanding commitment to ensuring that forestlands not under agency management are retained as working forest rather than being developed or otherwise converted to other uses. Under **Goal 2(D)** *Build partnerships to retain working forestlands*, the most recent strategic plan describes tactics that the agency will use to slow the rate of conversion to other uses. Additionally DNR will work with the legislature and federal partners to increase the agency's capacity to support family forest landowners through the Small Forest Landowner Office. With adequate resources, the Small Forest Landowner Office could serve more clients and expand its reach by working collaboratively with staff in DNR's transaction section, linking vulnerable landowners with cities, counties, and land trusts invested in preserving working forestland.

Biodiversity and Habitat Conservation: Hand-in-hand with managing its trust land portfolio and regulatory responsibilities, DNR contributes to threatened and endangered species protection and recovery through restoration practices, adaptive management, habitat conservation plans, and the development of natural area preserves and natural resource conservation areas. Elements of this mission are present in Goals 1-5. The Forest Practices Program's Road Maintenance and Abandonment Plan (RMAP) requirements have habitat connectivity benefits, and DNR's interagency and collaborative work on Puget Sound recovery impacts has strong implications for aquatic species habitat. Nearly everything the Department does related to sustainable management of state and private forests has implications in this area.

Upland Water Quality, Quantity and Puget Sound Restoration: DNR manages more than 2.6 million acres of aquatic lands, defined as navigable rivers, lakes and marine waters, including Puget Sound. Upland forests under direct agency management are usually situated in the middle elevations of the watershed. Clean, cold water from snow and glacier melt, usually originating on higher-elevation federal land, passes through DNR-managed lands and industrial forest on its way to lower-watershed small private forest and agricultural lands and urban areas before finally flowing into Puget Sound. DNR is a steward of this essential watershed link, and maintaining water quality from forestlands is essential to the goal of preserving Puget Sound. The importance of DNR's aquatics program shows up in **Goal 1(D)** *Sustainably manage state-owned aquatic lands*; **Goal 2(E)** *Maintain and improve a statewide system of terrestrial and aquatic reserves that protect biodiversity, key habitats, and species*; **Goal 4 (A)** *Undertake resource management actions that protect and restore habitats, water quality and ecological function in Puget Sound*, **(B)** *Advance strategic partnerships for Puget Sound recovery*, and **(C)** *Coordinate delivery of DNR programs to support recovery of Puget Sound*; **Goal 5(B)** *Develop ocean acidification mitigation and adaptation strategies*.

Wildfire Hazard Reduction: As the state's largest on-call fire department and the largest state land management agency, DNR has a unique role and responsibility to preserve forest health, prevent wildfire, reduce the damage that fires cause and mitigate the risk of fighting fires. Fighting wildland fire is one of DNR's most important missions. The Agency has a responsibility to prevent the spread of wildfire and to coordinate with other federal, state, and local bodies entrusted with fighting both wildland and structure fires. Many of the factors that create a severe wildland fire are beyond the agency's control. But laying the groundwork to reduce wildfire severity and spread is within DNR's capacity and mission. **Goal 2** of the 2014 Strategic Plan includes initiatives to **(A)** Protect Washington's communities and natural resources from wildfire and other natural hazards, **(B)** Improve Washington's ability to understand and plan for natural hazards and **(C)** Increase reforestation, forest health, and wildfire hazard reduction treatments across Eastern Washington forests regardless of ownership.

Forest Health Restoration: Eastern Washington is going through a forest health crisis exacerbated by changing rainfall patterns, increasing summer temperatures and overstocked forest conditions. Patches of dead, dying, or defoliated forest exacerbate catastrophic wildfire potential. Insect and disease damage is a challenge shared by many entities. DNR has multiple leadership roles – as a land manager, regulator and source of expertise – and has been designated by the state legislature as the state's lead entity for forest health. Western Washington is sheltered from the worst forest health impacts but still experiences insect and root disease effects. Current climate projections suggest that Western Washington's periods of vapor pressure deficit will be deeper and last longer, which will stress trees and increase their susceptibility to pathogens, insects, defoliation, mortality, growth loss and fire. Forest Health Restoration is addressed in **Goal 2(D)**, *Increase Restoration, Forest Health, and Wildfire Hazard Reduction Treatments across Eastern Washington Forests regardless of Ownership* and **Goal 5(A)**, *Design Climate Adaptation Strategies in Major Areas of DNR Management Responsibility*.

Urban and Community Forests: DNR's Urban and Community Forestry Program constitutes a wideranging effort to preserve, enhance, and encourage urban forests for their ecological, economic, and social benefits. The program works closely with the Urban and Community Forestry Council to partner with cities and towns. Objectives include preservation of urban forestlands, expanding the urban tree canopy and public education. Urban and Community Forestry activities are essential to Strategic Plan **Goal 4**, *Clean up, Restore, and Sustainably Manage Puget Sound* and **Goal 5**, *Mitigate and Adapt to a Changing Environment and Climate.* Preserving urban forests mitigates water quality degradation by reducing impermeable surfaces on the doorstep of Puget Sound.

Agency-Identified Long Term Challenges:

Mitigating the Impacts of Climate Change: No one weather event or natural disaster can be attributed to climate change. But climatologists have observed some trends, including warming average temperatures statewide, changing precipitation patterns in Western Washington, powerful, lightning-laden storms in Eastern Washington, and exceptionally hot and dry summers on both sides of the Cascades. These are the kinds of weather that one would expect as a consequence of climate change, and most climatologists agree that we are under a changing climate regime. The Intergovernmental Panel on Climate Change (IPCC) postulates standard greenhouse gas emission scenarios that would lead to higher or lower levels of warming, with A scenarios describing higher projected temperature changes than B; A2 represents the highest projected level of warming—about +5 °C—and B1 corresponds to a temperature increase of +.8 °C (2014, Peterson, D., et al).

Mitigation includes adapting forests to a changing climate by more aggressively thinning and pruning fire prone stands, monitoring and managing insects and pathogens that are spreading due to expanded

habitat and vulnerable hosts, and planting trees of sufficient resilience to thrive today and into the future. The state and private lands whose owners benefit from our technical assistance programs will be critical carbon sinks. If biofuels utilization from thinning, pruning, and fuel reduction operations expands and develops, it will, over the long term, allow the agency to do more restoration work and produce renewable energy that imposes a lower carbon burden on the atmosphere.

DNR's state and private forestry programs provide the expertise and vision needed to make a significant contribution to the agency's response to climate change. The challenge for cooperative forestry assistance programs will be to plan for the future in the midst of present-day climate, fire, and forest health workload.

Climate Change Strategies

Federal, state and local governments as well as non-governmental organizations and businesses each are wrestling with strategies to address climate change. The 2009 Washington State Legislature passed and the Governor signed E2SSB 5560, which included provisions for the formation of an "integrated climate change response strategy." The Strategy would "better enable state and local agencies, public and private businesses, nongovernmental organizations, and individuals to prepare for, address, and adapt to the impacts of climate change." The legislation directed the state Department of Ecology, in partnership with the state departments of Agriculture, Commerce, Fish and Wildlife, Natural Resources and Transportation to develop an initial state strategy by December of 2011. This built on the 2007 creation of general frameworks for climate change adaptation developed by stakeholder-scientist work groups, including a forestry workgroup.

These six state agencies, along with other representatives from across state government, currently are developing an outline for the draft strategy, along with the details of a stakeholder process that will ensure that we take advantage of the existing expertise in the region. Local governments that will be faced with many front-line challenges in dealing with the negative effects of climate change, will be closely consulted in the development of the strategy. The strategy is being developed in concert with Topic Advisory groups, including a Natural Resources group and an Ecosystems, Species and Habitats group. The scientific input for this effort, and previous climate adaptation work has been largely provided by the University of Washington Climate Impacts Group, for example through *Climate Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers* (Climate Impacts Group 2013), otherwise known as the *State of Knowledge Report*.

Both the U.S. Forest Service and the Department of Interior are working on climate change strategies that will guide adaptation paths for their land management responsibilities that guard against climate-related threats.

Common threads among state and federal strategic efforts include a focus on maintaining forests' carbon sequestration values, and assisting forest ecosystems with adapting to a changed climatic regime. The technical data and resources to develop specific adaptation strategies is largely still in

development.

Ensuring the Health of Washington's Forests: Both Eastern and Western Washington have significant forest health vulnerabilities. Eastern Washington has 2.7 millionacres of forest land facing serious threats to forest health. Decades of fire suppression and past management practices that changed the species and structure of these forests have put them at higher risk of damage by disease, insects and wildfire. Pine bark beetles are important pests of eastern forests, and dwarf mistletoe, a group of parasitic plants, has become more abundant. Small, stressed trees have virtually no economic value, so thinning, pruning, and slash disposal treatments must be entirely subsidized. The possibility exists to monetize some of these treatments by using the material generated by pruning and thinning for biomass energy production, but the biomass industry has to exist in order to meet the need.

Western Washington forests are more resilient at the moment, due to high precipitation. But changing rainfall patterns could lead to longer periods of vapor pressure deficit in the spring and summer months and more tree stress. Trees go through periods of stress and vulnerability to pests when deprived of water. They do not produce as much pitch, which weakens their defenses against beetles and other invaders. Root diseases, such as laminated root rot, have more impact as each functioning root becomes more important. DNR works closely with partner agencies and academics to monitor and evaluate emerging threats to Western Washington Forest Health while encouraging aggressive action to restore degraded forests on the east side of the Cascades.

Slowing the Rate of Conversion: Much of Western Washington's forestland is in small to large private ownership, with parcels ranging from small four- to six-acre plots to larger holdings of 5,000 acres or more. These private landowners are stewards of an important link between public land managers and urbanized Puget Sound. The forests they manage provide wildlife habitat, store carbon, control flooding, and comprise a natural water filtration system. Many of these values are diminished or lost altogether when forestland is converted to developed uses. DNR staff in both Eastern and Western Washington work closely with private landowners to advise them on how to protect their homes and forestlands from fire, avoid impacts from invasive species, provide for fish passage, or improve wildlife habitat. Eastern Washington Landowner Assistance staff are primarily concerned with forest health restoration and fire hazard reduction. In Western Washington, staff address insects, pathogens, fish passage, and road management and abandonment. With additional resources, DNR staff could work with more landowners, land trusts, and other agencies to address an ongoing wave of conversion. Private lands are vulnerable to rapid conversion over the next several decades, a process driven by several factors, including the emergence of the rural real estate market from the shadows of recession, an aging cohort of forestland owners, and strong interest in intensive harvest and subsequent development of forestlands by private investors.

Protecting Forests and Communities from Wildfire: The wildfires of 2014 followed several seasons of steadily mounting wildfire acreage and severity. Summer was dry and hot. Several weeks in the 90s drew moisture out of vegetation and severe storms started several intense blazes that grew into the largest wildfire in Washington state history—the Carlton Complex. Wildland fire releases tons of carbon into the atmosphere, which accelerates climate change. Fires as severe as the Carlton Complex can be

contained and suppressed with a coordinated effort. Managing forests to remove fuels and creating fuel breaks around structures and other assets can reduce damage. Agency managers and residents of fire country must restore the millions of acres of afflicted central and Eastern Washington forests to a state of relative health. That means thinning and pruning, reducing the impacts of insects and diseases, implementing Community Wildfire Protection Plans, and helping landowners develop defensible spaces around their homes.

Washington's Forested Landscapes

The forested environments of Washington State are unique, extensive, diverse and productive. The economic, environmental and social benefits of these forestlands are of national significance. Although it is the smallest of the western states (42.5 million acres), Washington encompasses nearly all of the major biological habitats found in the west. Of Washington's total land area, more than half—22.1 million acres—is forested. Western Washington contains a great diversity of habitats, from rain forests to alpine meadows and dry prairies. For example, while forests on the western side of the Olympic Peninsula receive as much as 175 inches of rain per year, along the northeastern, leeward side of the Olympic Mountains, a rain shadow is formed, parts of which receive only 18 inches of annual precipitation.

Prior to the arrival of Euro-American settlers in the nineteenth century, all of Western Washington was forested with the exception of 8.9 percent of the landscape above the alpine timberline and another 1.4 percent of non-forested prairies or wetlands. The unique confluence of climactic and soil conditions makes Western Washington trees grow quickly, to enormous proportions and to long-lived ages. Some trees are 1,000 to 2,000 years old. Numerous trees in Olympic National Park have been recognized as national champions for their overall size, including a 20-foot diameter, 160 foot tall western redcedar and an 18-foot diameter, 191-foot tall Sitka spruce.

The sharp contrast between the steep mountainous topography of the Cascade Range and the gentle terrain of the Columbia Basin has dramatic effects on precipitation and temperature gradients in Eastern Washington. Accordingly, tree species have become stratified by their competitive abilities and tolerance to both drought and cold.

The dominance of evergreen conifers in the Pacific Northwest makes it unique among the temperate regions of the world. In all other temperate regions, including eastern North America, Europe, Asia, Australia, Chile and New Zealand, conifers are relegated to early successional roles, limited to extreme habitats or share dominance with flowering plants. Here, the opposite is true: flowering plants are relegated to early successional roles, or limited to stressful habitats, as in the case of oaks and madrones.

Washington's forests are some of the most economically productive in the United States, ranked second among all states in softwood lumber production. In fact, more than 5,000 different consumer products are made with trees grown in Washington. These Forests also provide essential habitat for many of the of the wildlife and plant species in Washington that have been federally listed as threatened or endangered, and provide cold, clean water for thousands of miles in streams and rivers that are home to iconic Pacific Northwest salmon species. Many culturally significant edible and medicinal plants, essential for Indian tribal cultures, grow in Washington's forests.

Climate

Washington's climate is controlled by three factors: (I) location on the windward coast of the Pacific Ocean; (2) the Cascade Mountain Range, which runs north and south through the center of the state; and, (3) the semi-permanent high- and low-pressure regions located over the north Pacific Ocean. These factors combine to produce dramatically different conditions within short distances.

The general warm current that circulates around the northern Pacific contributes to a moderate climate along the coast of the Pacific Northwest. Successive moisture-laden storms move into the Pacific Northwest during late fall, winter, and early spring. They are intercepted first by coastal ranges (the Olympic Mountains and Willapa Hills) and then by the Cascade Mountains, leaving much of Eastern Washington in a rain shadow with an almost desert-like climate. From late spring to early fall, the Pacific high pressure ridge moves progressively farther north, weakening storms off the Pacific and limiting rainfall.

Annual precipitation ranges from 75 inches along the coast to 175 inches along the western slopes of the Olympic Mountains and nearly 100 inches in the Willapa Hills to the south. The rain shadow effect of the Olympic Mountains results in only 16-25 inches of rain on the northeast part of the Olympic Peninsula and in parts of the San Juan Islands. From the Puget Sound lowlands south to the Columbia River, the mean annual precipitation is 40-60 inches. Precipitation increases along the west slopes of the Cascades, reaching 120 inches annually in some places. Striking gradations in precipitation totals also are noted on the eastern slopes of the Cascades, decreasing to an annual mean of 12 inches at 40 miles from the crest and down to only 8 inches in the southern part of the central basin.

In Western Washington, the sun typically shines about 24 percent of the time in December and about 61 percent in July. In Eastern Washington, the sun shines 25-30 percent of the time in December and



Figure I2. Forestland Ownerships in Washington State

January, but to 80-85 percent in July and August. Frost-free days in Western Washington begin in late April and continue to early November, while in Eastern Washington the frost-free period begins in late May and ends in early September.

PRIVATE FOREST LAND MANAGEMENT

Private landowners manage 11.6 million acres of forestland in Washington State (Rodgers and Cooke, 2009). This acreage is about equally divided between commercial industrial owners and non-industrial small forestland owners. Their approach and objectives for their forests vary widely. The pattern of forestland ownership also varies significantly between Eastern and Western Washington. In Western Washington, where forest growth productivity is greatest, the area of industrial forestland ownership is more than three times higher than it is in Eastern Washington. Small forestland ownership acreage is roughly the same when comparing Eastern and Western Washington. Due to heavier year-round residential development in Western Washington, small private forests that act as woodland retreats tend to be more frequently visited by their owners on the west side of the Cascades than those on the

East. The higher percentage of "absentee" landowners on the east side of the mountains poses challenges and opportunities to landowner assistance staff in DNR's Northeast and Southeast Regions.

Commercial industrial forestland is managed primarily to produce a sustainable volume of wood. Industrial lands supply 53 percent of the total timber volume harvested, despite the fact that they comprise just 23 percent of the total area of forestland. Beyond a unifying objective among industrial owners to generate economic benefits and wood products, specific management objectives are not monolithic among the many and ever-changing types of corporate structures. In Western Washington, even-aged management systems on 40-year harvest rotations are very common. However, some landowners also choose to manage for larger trees and more complex forest structures over longer rotation periods. Few industrial landowners remain that own timberland, sawmills, manufacturing facilities for panel board, papermaking or other wood products, as well as product marketing. Where this model was prevalent historically, land management and manufacturing typically are owned by different companies today.

Small forestland owners are even more diverse in their characteristics and management objectives. They can range from family tree farms and other enterprises, to forested components of cropland production, multi-purpose working forests and home sites, and small recreation or residential tracts. In many cases, forest management activity is episodic, perhaps motivated by personal or financial circumstances, or in response to the immediacy of a specific concern like insect infestation or wildfire. Some small forest ownerships are run as a business and must generate regular income. Small private forestland supplies about 18 percent of the state's total timber harvested. Overwhelmingly, the sizes of small private parcels are 20 acres or fewer, and an increasing number of these include primary or secondary residences. Because of the sheer number of different owners, no single set of assumptions about economic or social motivations can be applied.

TRIBAL NATURAL RESOURCE MANAGEMENT

Indian tribes always have inhabited the watersheds of Washington State, their cultures based on harvesting fish, wildlife and other natural resources in the region. Inherent tribal sovereignty and tribal rights predate the formation of the United States and State of Washington. In treaties signed during the 1850s, tribes of the Washington Territory ceded millions of acres of land to the federal government. In exchange for the ceded land, the tribes were to receive certain payments, services, and protections from the government. The tribes also reserved certain rights to protect their way of life:

"The right of taking fish and usual and accustomed grounds and stations is further secured to said Indians, in common with all citizens of the United States; and of erecting temporary houses for the purposes of curing; together with the privilege of hunting on open and unclaimed lands." --Treaty of Point No Point, January 26, 1855 The promises of the treaties were not fulfilled, and the struggle to obtain recognition of those rights climaxed in the "Fish Wars" of the late 1960s and early 1970s, when tribal members were arrested and jailed for fishing in defiance of state law.

In 1974, the tribes won a major victory in *United States vs Washington* (known as the Boldt Decision), which reaffirmed their treaty-protected fishing rights. The ruling subsequently upheld by the U.S. Supreme Court, established the tribes as co-managers of Washington's fisheries resources and entitled them to 50 percent of the harvestable number of salmon returning to Washington waters.

Today, Washington's 29 federally recognized Indian tribes are vital government-to-government partners in managing the state's salmon and shellfish stocks, protecting public and cultural resources through the course of forest management practices, and innovators in managing tribal forest resources. The State of Washington, through the Centennial Accord, Millennium Agreement, and other government-togovernment agreements, is committed to working cooperatively and respectfully with sovereign tribes to preserve and protect natural and cultural resources, as well as to meet other mutual goals. The state Department of Natural Resources, specifically through the Commissioner's Order on tribal relations and other policy, procedure, and agreements, has expressed its shared objectives with tribal governments for proper stewardship of public natural resources, and acknowledges and respects the values, culture, and natural resources wisdom accumulated by tribal people over millennia.

Tribal Reservation Forest Management and Enterprises

Tribal governments in Washington manage nearly 1.7 million acres of forestland that is held in federal trust with the U.S. Department of Interior Bureau of Indian Affairs (BIA). Tribal forest enterprises have become increasingly important contributors to forest management in Washington. Tribal forestry programs have transitioned towards great autonomy, with less reliance upon BIA assistance. Rigorous and integrated natural resource management planning, development and diversification of additional tribal enterprises such as forest products manufacturing, and tree genetics and seedling production programs have been initiated by many tribes. Tribal enterprises are operated under the guidance of tribal councils, and as such, are managed to achieve broader socioeconomic goals in addition to meeting economic performance objectives. Indian forests produce timber and revenue as well as a wide variety of non-timber products such as traditional foods and medicines, cultural resources, and firewood. Spiritual use, water, and fish and wildlife habitats are also important. Protection of forests for use by tribal members on an enduring basis is a paramount management emphasis in tribal forest planning.

Tribal Partnerships in Forest Practices

Washington's Indian tribes are essential cooperators in DNR's Forest Practices Program — and this relationship began with the Timber/Fish/Wildlife (TFW) Agreement.

After the adoption of the Washington State Forest Practices Act in 1974, there was continuing contention over the adequacy of forest practices regulations. The situation became increasingly unwieldy and adversarial. In the summer of 1986, representatives of state agencies, Indian tribes, the timber industry and environmental groups met to discuss a better way of doing business. These various

groups held more than sixty meetings in a five month period, which resulted in a final agreement in 1987.

The TFW Agreement is a fluid, changeable, "living" document designed to reshape the way forest-based natural resources are managed in Washington State. This agreement of commitment by all parties supports working together to reach consensus. The TFW process recognizes that many different interest groups and governmental agencies must be involved, together, in order for the best decisions to be made. The decisions take into account the need for a viable timber industry as well as a need for healthy fish and wildlife habitats, the protection of water quality, and respect for tribal archaeological and cultural heritage.

Washington tribes, as well as some tribes in Oregon and Idaho, also are partners in the aspects of the Forest Practices Program that have evolved since the TFW Agreement. Tribes are members of several committees: DNR Forests and Fish Policy; Cooperative Monitoring, Evaluation and Research (CMER); Forest Practices Board's TFW Cultural Resources; and the Small Forest Landowner Advisory Committee. Tribal representatives work with staff from DNR's Forest Practices program and other agencies and organizations to draft forest practices rules and Board Manual guidelines, review individual Forest Practices Applications, notifications and alternate plans, provide technical on-site expertise in DNR's interdisciplinary team reviews, and complete water and wetland typing.

FEDERAL FOREST LAND MANAGEMENT

Federal agencies manage 9.5 million acres of forestland in Washington State (Figure i3), including more than 8 million acres by the U.S. Forest Service and more than 1 million acres by the National Park Service. The Bureau of Land Management is responsible for the management of sixty-nine thousand acres of forestland. The Department of Defense manages 60 thousand acres in several large military reservations. The U.S. Fish and Wildlife Service manages 58 thousand acres of forestland refuges. At the most basic level, these lands are managed for various public benefits and generally not for revenue production.

There are six units of the National Forest System that are wholly or partially within Washington State's boundaries. These include the Olympic, Gifford Pinchot, Mount Baker-Snoqualmie, Okanogan Wenatchee, Colville, and Umatilla National Forests, as well as the Columbia River Gorge National Scenic Area. A significant portion of forestland in the National Forest System is congressionally reserved as Wilderness, Wild and Scenic River corridors, and National Recreation Areas. Together, these designations total 2.7 million acres and are managed for conservation objectives, mostly through custodial methods. Administrative and land-use designations of various kinds are in place for the balance of National Forest System acres, which roughly zone forestland on the basis of primary management objectives. Recent years' decisions generally have allocated more of these designations toward conservation purposes, and away from timber production purposes. Not coincidentally, the National Forest System's share of timber harvested in Washington State has shrunk from 11 percent in the 1990s to 1 percent currently. Watershed and forest ecosystem restoration — along with recreational use —has, tacitly and explicitly, become the prevailing management objective on the National Forests.

Almost all the forest stands in Western Washington that are 150 years and older are on federal lands, indicating a management priority for maintaining mature and old forest structure.

Three units account for the majority of Washington's forestland that is managed within the National Parks System: Olympic National Park, Mount Rainier National Park, and North Cascades National Park (including Lake Chelan and Ross Lake National Recreation Areas). Federal statute and regulations require that National Parks are managed, "to conserve scenery, natural and historic objects, and wildlife, and to provide for the enjoyment of those resources in a manner that will leave them unimpaired for the enjoyment of future generations." In addition to Parks designation, significant shares of Olympic, Mount Rainier and North Cascades units are congressionally designated Wilderness. Mount Rainier National Park, for instance, is 97 percent Wilderness. Individual parks develop management plans to balance their stewardship of natural resources with recreational visitation and specific uses.

STATE FOREST LAND MANAGEMENT

The state Department of Natural Resources manages 2.1 million acres of forested state trust lands and 101 thousand acres of forested conservation areas, the Department of Fish and Wildlife manages nearly 95 thousand acres of forested wildlife areas, and 67 thousand forested acres are managed as Washington State Parks. In total, state-managed forests comprise about 13 percent of all forestlands in Washington (Figure I2). The diversity of forest ecosystem types, management objectives and uses varies widely among these holdings.

DNR State Trust Lands are working forests held in trust and managed to produce revenue for statutorilyprescribed beneficiaries. The revenues generated from timber management and leasing activities are used to provide funding to build the state's public schools and universities, correctional institutions, and State Capitol buildings in Olympia. Some provide funding for county services in which those particular trust lands are located, or contribute to the general fund, earmarked for education. The department must manage trust lands in a manner that will preserve their health and productivity in perpetuity, while providing the greatest return to the beneficiaries, and offering other benefits such as for recreation, where appropriate. As compared to other revenue-generating entities like industrial landowners, forested state trust land management incorporates more public conservation objectives. Management of forested state trust lands in Western Washington includes longer harvest rotations and retention of more legacy forest structures, stronger riparian forest restoration and protections, and includes policies to conserve, manage and protect old-growth forests. Eastern Washington state trust forests are managed to conserve forest health and restore ecologically appropriate mixes of tree species for the dryer conditions, including older forest conditions. Each of these objectives is still achieved within a sustainable harvest and revenue-generating mandate.

The DNR Natural Areas Program manages 101 thousand acres of forestland in two conservation designations: Natural Area Preserves, and Natural Resource Conservation Areas. The Natural Areas were created to protect outstanding examples of the state's extraordinary ecosystem diversity. These lands represent the finest natural, undisturbed ecosystems in state ownership, often protecting one-of-a-kind features which are unique to this region. Preserves protect the best remaining examples of many ecological communities including rare plant and animal habitats. Conservation Areas protect

outstanding examples of native ecosystems, habitat for endangered, threatened and sensitive plants and animals, and scenic landscapes. Management plans are developed for each Natural Area to guide action necessary for the protection of natural features. Management plans for Natural Area Preserves address a range of activities including; prescribed burning to restore ecosystems that are dependent on fire; controlling invasive species that threaten the special features; boundary and interpretive signing; restoring native species if necessary; and fencing to prevent damage from domestic animals.

Since 2011, DNR has had statutory authority to designate DNR lands as Community Forest Trusts (CFT). The Commissioner of Public Lands may designate lands as Community Forest Trusts under certain statutory conditions. Lands within a CFT must be held by the department, and the local community must show commitment to the Community Forest Trust model by providing a contribution of at least fifty percent of the difference between the parcel's appraised fair market value and the parcel's timber and forest land value. Crucially, Community Forests are expected to produce enough revenue to at least reimburse DNR for management costs and ideally to allow for some reinvestment into future landscape management. Community Forests are envisioned as a model that might prevent conversion of working forest lands and build public commitment to public lands through a place-based, community-centered model. To date, the 50,000 acreTeanaway Community Forest is the sole designated landscape in Washington.

State Department of Fish and Wildlife forested wildlife areas are managed to provide habitat for fish and wildlife as well as land for outdoor recreation activities, wildlife viewing, hunting and water access points that are compatible with fish and wildlife stewardship. Management plans developed for each Wildlife Area identify specific management objectives for each complex and strategies for achieving them. Several large wildlife areas in Eastern Washington, such as the Wenas, L.T. Murray, Oak Creek, and Sinlahekin, contain forestland and are intermingled or adjacent to forested DNR and federal public lands. Their management has included active habitat and ecosystem restoration measures such as tree thinning and prescribed fire.

The mission of Washington State Parks is to "acquire, operate, enhance and protect a diverse system of recreational, cultural, historical and natural sites" in an effort to leave a valued legacy to future generations. Most state park units are small and dispersed, containing primarily developed recreation facilities. Forest management objectives include preserving the visual appeal of a natural outdoor setting, and maintaining safety for visitors. Some larger forested parks, such as Mount Spokane and Riverside State Parks, are managed for forest health and wildfire hazard reduction in concert with their recreational uses.

Biodiversity and Habitat Conservation

INTRODUCTION

Forested ecosystems in Washington are diverse, from the rainforests of the Olympic Peninsula to the dry ponderosa pine forests of eastern Washington. These forests support a significant portion of Washington's biodiversity, including many species and ecosystems that are of conservation concern.

The most obvious and significant threat to forested ecosystems and the species that they support is outright loss of forest through conversion to other land uses, including residential, commercial, industrial and agricultural. However, forests also are threatened by fragmentation and degradation. The human footprint (development, transportation corridors, timber harvest, etc.) has fragmented the landscape of remaining forests and altered ecosystem processes (such as the rate, frequency and severity of natural fire and disease), and wildlife movement. With increased 'edges' to forest habitats, and exposure to non-native species, remaining fragments are degraded. Retaining intact, forested ecosystems is critical to the long-term survival of their component species.

CONDITIONS & TRENDS

The following discussion addresses three key components of biodiversity: ecosystems (i.e., assemblages of native species within specific physical environments), ecosystem processes, and species that depend upon the particular habitats within the ecosystem.

Ecosystems & Ecosystem Processes

Many of Washington's ecosystems have undergone significant declines in the last 100-to-150 years, including forested ecosystems. The declines have been primarily the result of direct loss due to conversion to other land uses; habitat fragmentation, which has influenced wildfire, wildlife movement across the landscape and other natural processes; and management practices, such as timber harvest and fire suppression.

Natural processes, including disturbances, are critical for the maintenance of healthy, functioning ecosystems. These ecosystem processes help create the mosaic pattern of early, mid and late-successional stages of individual ecosystem types. As human activities have disrupted these processes, they have affected the current status and future trends of ecosystems and their component plant, fungal, fish and wildlife species. Harvest of old-growth forests, the practice of aggressive fire suppression, and the fragmentation of forests all have impacted these processes.

Old-Growth & Forest Structure

It is estimated that between two-thirds and 87 percent of historical old growth in Washington has been harvested (Booth 1991; Washington State Office of Financial Management [OFM] 1999). Southwestern Washington and the Puget Sound lowlands (collectively, the Puget Trough) experienced the greatest

losses of old growth forest because the trees were easy to access and predominantly on private land. Additionally, harvest of old growth continued on state and federal lands through the 1980s. Finally, more than one million acres of Washington's forestlands, predominantly in the Puget lowlands, has been lost in the last two decades to development (OFM 1999). Modern forest management in the last decade has caused the naturally occurring forest stands with a mix of species to be replaced by singlespecies plantations. Intensive management also has resulted in a significant decrease in important habitat structures such as downed wood and standing snags necessary for wildlife habitat and ecosystem processes (Washington Biodiversity Council 2007a).

About 32 percent of forests in Washington are less than 40-years old, which is currently the optimal economic harvest age for intensively-managed commercial forests in which most trees are of the same age. The vast majority of stands more than 100-years in age are on federal forestland, with only 1 percent on non-federal lands. While some estimates of reference conditions have been made for the age distribution within forest stands in Eastern Washington (Agee 2003), estimates of historical Western Washington forests are not widely established. Prior to Euro-American settlement, stand-replacing windstorms in coastal forests and historical fire regimes during dry periods likely created a mosaic of forest stand ages and structures with a far greater proportion of older, late-successional forests than exist today.

The application of more modern forest management practices, particularly on state trust lands managed by DNR, has retained legacy tree components and snags that serve as important habitat and take a long time to develop. Commercial timber stands are grown beneath these legacy structures, creating a mixed-age stand. Diversity in the composition of tree species replanted after harvest is also gaining favor over single-species plantations. Finally, new forest practices rules were instituted in 2000 that require a more extensive system of riparian forest buffers along waters and wetlands to protect salmon and riparian-dependent species. Studies are underway by the Forest Practices Cooperative Monitoring Evaluation and Research Program to quantify the extent of added benefits for old-forest structure and non-aquatic-dependent biodiversity that are resulting from the Rules.

Dry Forest Structure & Wildfire Disturbance Processes

The disruption of the natural fire regime has had an impact on forested ecosystems. Wildfires have been aggressively fought and suppressed in natural landscapes for many decades. This has shifted the composition of species in these areas away from those that are fire resistant and fire dependent. Forested ecosystems now have stands with more trees per acre, while the species composition of those stands gradually has shifted to include more fire-susceptible species.

Dry forests in Eastern Washington are primarily comprised of ponderosa pine and mixed-conifer ecosystems of ponderosa pine, Douglas-fir, western larch, grand fir and Engelmann spruce. These systems have been significantly changed by timber harvest practices and fire suppression. On the lower elevations of the eastern flank of the Cascades, forests historically were characterized by open stands of large ponderosa pine trees, which are relatively resistant to fire. Douglas-fir, on the other hand, is more susceptible to fire. With diminished fire frequency, Douglas-fir is not eliminated from the stands. Because it is intermediately tolerant of shade, Douglas-fir can persist and grow in the forest understory. Over time, Douglas-fir gains ground, eventually out-competing shade-intolerant pine seedlings. In the last 100 years, overall stand density has increased 307 percent for Douglas-fir, 81 percent for ponderosa pine and 138 percent for Engelmann spruce. Western larch, an important species for its fire, insect, and disease resistance, decreased in density by 48 percent (Ohlson and Schellhaas, unpublished).

Harvest of large ponderosa pine trees exacerbated the effects of fire suppression by leaving firesusceptible trees in place. The end result is that these ecosystems today have a significantly different structure and different species composition. They are affected by different pathogen, insect, and wildfire pressure than historically. One recent study demonstrated that in many regions of Eastern Washington, wildfire-related mortality among large-diameter forests now outpaces their removal through timber harvest.

One way of measuring the interruption of fire as an ecosystem process is Fire Regime Condition Class (FRCC). FRCC measures the degree of "departure" (low, moderate or high) in present-day vegetation from historical reference conditions. Areas with an FRCC value of 1, or low departure, contain conditions that are historically appropriate and ecologically functional. Areas with an FRCC value of 3, or high departure, stand a significant risk of losing key ecosystem components from unnaturally severe wildfire. In Eastern Washington, 6.2 million acres of forestland are at either moderate or high FRCC departure.

See the Wildfire Hazard Reduction section D for a measure of Eastern Washington forest lands that exhibit departure from historical fire regimes and conditions using FRCC.

Urban Growth & Fragmentation

As urban centers expand, forested ecosystems will continue to be subject to residential and urban development. At greater distances from urban centers, forests will be fragmented by suburbanand rural development. The movement of more people to rural landscapes will add complexity to fire suppression issues, particularly in Eastern Washington where fire frequency and size are typically greater than on the state's Westside.

Plant Communities of Conservation Concern

The number of plant community types that are of conservation concern is, in part, a reflection of these changes on the landscape. The *2011 State of Washington Natural Heritage Plan* (DNR 2009c) identifies more than 319 plant community types in Washington as priorities for conservation, of which nearly 180 (>50 percent) are forest types. Of the forest types, nearly 160 are associated with upland forests while 17 are associated with wetland forest. The complete list of plant community priorities maintained by the Washington Natural Heritage Program is available on the DNR website (DNR 2009a).

Biodiversity Conservation Opportunity Framework

The Washington Biodiversity Council, a state-convened group of agency, local government, conservation and industry representatives, generated a framework to guide investment in conservation activities (Washington Biodiversity Council 2007b). The council relied heavily on the data included in work led by

The Nature Conservancy to assess statewide ecological priorities based on ecoregions. Ecoregional assessments – completed as part of a multi-year collaboration between the Washington Department of Fish and Wildlife, Washington State Department of Natural Resources (DNR), The Nature Conservancy, and The Nature Conservancy of Canada – were developed 8 to 15 years ago. While more localized assessments have been conducted since that time, the TNC led ecoregional assessments are the most recent statewide analysis of Washington's biodiversity. (Ecoregional assessments have been completed for seven of the nine ecoregions in Washington, so Conservation Opportunity maps have not been completed for the Canadian Rockies or the Blue Mountains ecoregions, which stretch into the far southeast and northeast corners of the state.)

Ecoregional assessments include state agency and conservation data on three commonly accepted measures of biodiversity significance: richness, rarity, and representation. Together these data were used to create a biodiversity significance score on a scale of 1 to 3. Using projections of future population growth and land use, The Washington Biodiversity Council added a biodiversity "risk" score that was developed on the same scale. Together, these two measures provide a composite score that represents "conservation opportunity," where areas with both high significance and risk of changes in land use rate highest. Figure B2 displays the results of this analysis, referred to as the Conservation Opportunity Framework.

In the forested environment, the Conservation Opportunity Framework identifies approximately 4.3 million acres of high biodiversity significance and 5.5 million acres of moderate significance. In looking at areas with the greatest conservation opportunity, the Conservation Opportunity Framework identifies 6.3 million acres in the forested environment for which *either* biodiversity significance or risk to biodiversity is rated as high (and the other measure as moderate) or where both measures are rated as high.

For a measure of forestland converted over time, see the discussion on Land Ownership Patterns in Working Forestlands and Conversion, section A.

At-Risk Species

The changes in Washington's landscape over the last 100-150 years have resulted in significant declines for many of Washington's native species, including plants and animals in forested environments. Various state and federal agencies and some conservation organizations maintain lists of species that are of conservation concern; all of these lists continue to grow as landscape changes outpace conservation efforts.

One measure of decline is the number of species listed as endangered or threatened under the federal Endangered Species Act (ESA). According to the U.S. Fish and Wildlife Service (USFWS) Endangered Species website (USFWS 2015), there are currently 39 animal species and 11 plant species that occur in

Washington listed under the federal **Endangered Species** Act. The animal species include five mammals and two birds that rely on intact forested environments, as well as 15 fish species whose habitats include rivers and streams that run through forested environments. The northern spotted owl (Strix occidentalis



Figure E1. Occurrences of Rare vascular and nonvascular plant species and high-quality terrestrial and wetland ecosystems of special concern statewide

caurina), marbled murrelet (*Brachyramphus marmoratus*), and 10 evolutionary significant units of salmon (*Oncorhynchus* spp.), five steelhead, and one bull trout are among these federally-listed species. Of the federally listed plant species, three are within forested environments and are potentially affected by the overall health and condition of the forests (*Howellia aquatilis*, *Sidalcea oregana* var. *calva*, and *Hackelia venusta*).

THREATS AND OPPORTUNITIES

As noted above, the primary threats to Washington's forested ecosystems are fragmentation of wildlife habitat caused by conversion, uncharacteristically intense and large wildland fires, declining forest health, and the exacerbating effects of climate change on both fire and forest health.

Threat: Habitat Fragmentation as a result of Conversion to other uses

Since statehood, a significant portion of Washington's forested landscapes have been converted. While large areas of forested and open land remain, they are isolated by cities, towns, roads, and other developments. These fragmented and isolated landscapes are less able to harbor a diverse community of plant and wildlife species, and are more vulnerable to non-native invasive species and native species flourishing outside their historic ranges. The places most vulnerable to development are also some of the most productive ecosystems in the state. Puget Sound lowlands within commuting distance of the greater Seattle-Tacoma-Everett area support an array of common species, and provide prime habitat for a number of species of concern, including threatened and endangered lifeforms. According to the Washington Department of Fish and Wildlife, 30,000 to 80,000 acres of functional habitat for wildlife are lost or altered every year (WDFW 2005).

The most recent data on land use patterns and conversion rates is from 2007. Since then, Washington's economy and housing markets were struck a resounding blow. In the past three years, those markets have rebounded dramatically, accompanied by a commensurate wave of new population. While we

cannot say definitively that in-migration is accelerating the rate of conversion, we can refer to the census and population data compiled by the Office of Financial Management (OFM). Since the 2010 census, the ten most populous counties have grown at a rate of 3.7%, while the remaining 29 counties posted a 2.18% growth rate. The top ten counties added 210,312 residents, while the remaining 29 counties added 33,318 people. With the exception of Yakima, Benton, and Spokane Counties, the most highly populated are on the west side of the Cascades, where the threat of conversion is greatest.

Opportunities

- Work with partners and the legislature to fund new statistical and geospatial data on conversion threats
- Identify and promote a strategic, criteria-based approach to target legacy and habitat lands for preservation
- Educate and assist small forest landowners and agency decision-makers with wildlife habitat conservation and enforcement efforts
- Identify and protect and/or restore critical landscape linkages for species movement

Threat: Increased Frequency and Intensity of Wildland Fire

Fire is a normal feature of Eastern Washington forests, an essential element of species balance and forest health. But more than a hundred years of fire suppression has led to a buildup of forest fuels that threatens standing trees, and may set the stage for invasive non-native and endemic species to expand their ranges. These disruptions affect plants and wildlife that are dependent upon specific forest types, fragment wildlife habitat, and crowd out native species.

Frequent and severe wildfires can lead to increased runoff of gravel, ash, and other materials that increase stream turbidity and temperature, which in turn degrade fish habitat. Allowing fire to perform its ecological function while taking action to prevent large and catastrophic blazes can benefit wildlife and prevent degradation of habitat.

Opportunities

- Partner with multiple landowners and managers to achieve landscape-scale forest restoration objectives
- Use mechanical fuel reduction treatments, prescribed fire and other tools to restore ecological integrity, appropriate density, structure and species composition to Eastern Washington forests
- Maintain stocks of fire adapted tree species
- Reduce fuel loads

Threat: Invasive non-native species and expansion of native plant and insect species range resulting from Climate Change

Invasive, non-native plants and animals are of increasing concern in Washington. They outcompete and displace our native species, profoundly changing natural ecosystems. They evolved in other parts of the world but arrived in Washington without the natural predators or diseases that controlled their growth in their native environments. This is not only a problem for native plants and animals, but for

Washington's agricultural industries as well. Urban forests, in proximity to shipping ports and transportation corridors, tree nurseries and horticultural trade can provide pathways for introduction. Many state and federal agencies have a shared responsibility for invasive non-native species detection and eradication. This should include a recognition that

The spread of invasive species and expansion of range by native species is facilitated by climate change. Changing temperatures and rainfall patterns weaken competing native plants and host species, and make new landscapes hospitable.

Opportunities

- Use best-available information to prioritize restoration activities
- Engage with local landowners to restore forests to ecological function
- Address forest health concerns on DNR lands by using pre-commercial thinning treatments, controlled fire and other tools
- Engage with partners including Washington Invasive Species Council, Washington State Department of Agriculture, and the Pacific Northwest Chapter of the International Society of Arboriculture on invasive species identification and control efforts

RELEVANT NATIONAL THEMES AND STRATEGIC OBJECTIVES

Issues concerning Biodiversity and Habitat Conservation can be addressed by the National Theme "Enhance public benefits from trees and forests" from the State and Private Forestry Redesign structure. Specific to these issues are two Strategic Objectives – "Protect, conserve and enhance wildlife and fish habitat" and "Manage and restore trees and forests to mitigate and adapt to global climate change." There are many linkages between these issues and the other national themes and strategic objectives identified in the State and Private Forestry Redesign.

CURRENT STRATEGIES

A number of different conservation 'strategies' have been implemented in Washington. These strategies include setting statewide priorities for important species, ecosystems, and locations where conservation actions are needed. Many of these strategies, assessments and plans can and will make a direct contribution to the National Themes and their associated management objectives. Some of the higher profile efforts are described below and their contributions to the national themes and associated strategies are identified.

Washington Biodiversity Conservation Strategy

The Washington Biodiversity Council was established by executive order of the Governor in 2004. The Council was charged with developing a biodiversity conservation strategy for the state with a 30year time frame (Washington Biodiversity Council 2007b). The strategy identifies six action recommendations:

- 1. Guide investments on the ground, using the 'conservation opportunity framework, which provides a statewide map of conservation values and future risks (as indicated by projected human population growth).
- 2. Make use of, and expand the availability of, incentive programs and conservation markets to encourage investment in high priority landscapes.
- 3. Incorporate biodiversity conservation priorities into land use planning processes.
- 4. Establish a comprehensive scientific understanding of Washington's biodiversity and effective conservation practices and make available information readily accessible and useful for land managers and decision makers.
- 5. Inform, educate, and engage Washingtonians to create an understanding of biodiversity's importance to our quality of life and to build capacity to take action to conserve, care for, and restore ecosystems.
- 6. Provide leadership, accountability, and funding to ensure successful implementation of the Biodiversity Conservation Strategy.

The Biodiversity Council was disbanded in 2010. Presently, there is no group focused on strategic statewide conservation priorities that has the broad membership and private and public sector representation like that included in the council. Rather, public and private entities concerned with conservation issues coordinate efforts on a more regional or local basis. The State Legislature established the Habitat and Recreation Lands Working Group, also in 2007, which includes several of the state agencies and some private groups that were included in the Biodiversity Council. The focus of that group is more concerned with providing transparency for the state agencies engaged in land acquisition for conservation and recreation purposes and, while agencies share information about their planning and prioritization efforts, the group does not provide specific guidance or develop strategies regarding statewide biodiversity conservation priorities.

The State of Washington Natural Heritage Plan

The *Natural Heritage Plan* (DNR 2011) is updated each biennium. It establishes priorities for species and ecosystems to be targeted for inclusion within the statewide system of natural areas, which includes areas in federal, state and private ownership. The conservation priorities established in the *Natural Heritage Plan* are also widely used outside of the context of natural areas. Conservation organizations, county planning departments and others recognize the Plan's priorities and incorporate them into land-use planning and decision-making. Priorities for species are based on rarity, threats and species' vulnerability. Priorities for ecosystems are based on rarity, size, ecological condition, and landscape context.

Comprehensive Wildlife Conservation Strategy

Washington's *Comprehensive Wildlife Conservation Strategy* (WDFW 2005) was developed by the Washington Department of Fish and Wildlife and approved by the U.S. Fish and Wildlife Service in 2005. It qualifies Washington for an important federal funding source – the State Wildlife Grants program. The strategy identifies six categories of effective conservation action:

- 1. Identify scientific information for local governments and planners.
- 2. Enhance and conserve habitat on public, private, and tribal lands and waterways.

- 3. Implement species conservation strategies and coordinated salmon recovery.
- 4. Expand wildlife information and conservation education programs.
- 5. Conduct biological assessments, research, monitoring and surveys of fish, wildlife and habitat.
- 6. Ensure implementation of local, state, and federal laws to protect fish, wildlife and habitat.

The strategy also identifies three actions to take to implement action plans for each of Washington's nine ecoregions:

- 1. Determine which species, habitats and landscapes represent the greatest conservation opportunities for each ecoregion.
- 2. Identify specific actions needed to realize ecoregional conservation opportunities.
- 3. Activate partnerships; identify conservation roles.

Wildlife Habitat Connectivity Working Group

Habitat connectivity is necessary to meet the needs of wildlife for their daily, seasonal, and dispersal movements. In Washington State a group of state and federal agencies, non-governmental organizations and universities, have joined together to form the Wildlife Habitat Connectivity Working Group to address wildlife connectivity needs; a statewide analysis is the initial task of this organization. The primary product of the statewide analysis will be maps that represent a depiction of landscape features that contribute to unimpeded movements of wildlife throughout Washington and adjacent areas of Idaho, Oregon and British Columbia. Protecting and restoring landscape features that allow animals to move is essential to ensure the long-term viability of many Pacific Northwest wildlife populations.

In Washington State, at least 34 vertebrate Species of Greatest Conservation Need (WDFW 2005), and 22 additional vertebrate species are considered highly vulnerable to loss of habitat connectivity. Of these species, approximately one-third are associated with forested environments.

The connectivity plan is being accomplished with support from the Washington Biodiversity Council, and Washington State Governor's Office, and will have many uses, including use by the Washington State Department of Transportation for safe wildlife passage implementation, by local governments in their comprehensive plans, and by conservation organizations involved in protecting wildlife habitat. The statewide analysis will fulfill a part of Washington State's contribution to the Western Governors' Association Wildlife Corridors and Crucial Habitat Initiative, and is a component of Washington Department of Fish and Wildlife's Wildlife Action Plan. The Working Group has produced research assessing habitat viability in the Columbia plateau ecoregion, and utility of downscaled climate model projections as they relate to habitat connectivity planning.

Washington Wildlife & Recreation Program

The Washington Wildlife and Recreation Program has provided funding for improvement, restoration, and acquisition of 350,000 acres of land since its inception in 1989. In all, \$742 million in state funds and \$475 million in matching local and federal funds have been leveraged to complete over 1,200 projects over the last 25 years. Many of these projects have been for critical habitats, natural areas, parks, riparian protection and recreation in forested environments. In order to be eligible for acquisition in the

Habitat Conservation category, sites must contain species or ecosystems that have been identified as priorities for conservation by either DNR's Natural Heritage Program or the Washington Department of Fish and Wildlife.

Habitat Conservation Plans in Washington State

Habitat Conservation Plans (HCPs) are agreements between a landowner and the U.S. Fish and Wildlife Service in which the landowner agrees to meet specified conservation measures for a federally listed species (or multiple listed species). An HCP gives a landowner a level of certainty regarding which land management activities will be appropriate within the habitat of a listed species. They also put in place terms and conditions for 'incidental taking' of a listed species. Twelve forest-related HCPs are in place in Washington, covering more than 11 million acres. The Forest Practices HCP is the largest at 9.1 million acres, and covers aquatic species (for more information on the Forest Practices HCP, see Existing Strategies in the section C on Upland Water Quality, Quantity and Puget Sound Restoration). Additionally, 1.8 million acres of DNR-managed forest lands are covered by an HCP. A number of private companies have also entered into HCPs. DNR's aquatics program is in the process of finalizing its first HCP.

Forest Certification

Two certification programs have been available in Washington: Sustainable Forestry Initiative (SFI) and Forest Stewardship Council (FSC). Both include standards for biodiversity conservation. DNR has achieved SFI certification for all forested trust lands in the state and FSC certification for forested trust lands within the department's South Puget Planning Unit. This amounts to more than 2 million acres of certified DNR-managed land. In Washington State, there are currently 4.2 million acres of SFI-certified forest land, and 267,000 acres of FSC-certified forest land.

Other Public-Private Partnerships

Private conservation organizations and public agencies have collaborated on various conservation projects in Washington. Two examples are the Mountains to Sound Greenway and the Tapash Sustainable Forest Collaborative. The Greenway seeks to conserve and enhance the landscape along the 100-mile stretch from Seattle across the Cascade Mountains to Central Washington and ensure a long-term balance between people and nature. The organization achieves that goal by promoting land acquisition for wildlife habitat and working forests, recreational access, restoration, trail planning, building and maintenance, advocacy, outreach and education.

The Tapash Sustainable Forest Collaborative **is a formal partnership** of the USDA Forest Service, Washington Department of Fish and Wildlife, DNR, The Nature Conservancy, and Yakama Indian Nation Indian. Other state and federal agencies, conservation groups and entities are also active participants. Formalized in May 2006, the Collaborative's aim is to use a collaborative, cross-ownership approach to restore forest health and protect the forested ecosystems of the eastern Cascades – specifically, thousands of acres in Tieton Canyon — from imminent conversion. For more information on the Tapash Collaborative, see the Existing Strategies in section D of this report on Wildfire Hazard Reduction.

DATA & PROGRAM GAPS

- Rare Species Surveys: Survey and inventory work for rare species is ongoing, but has yet to be completed on much of Washington's forested lands, particularly those that are private, tribal, and state owned.
- Vegetation and Forest Structure: Production of a wall-to-wall statewide vegetation map, including changes to forest structure over time.
- Climate Change: Information about the impacts of climate change and how species will respond to that change.

Urban and Community Forestry

Trees are one of Washington's signature natural resources. Trees are strongly correlated with quality of life measures such as social cohesion, public safety, interactions with neighborhoods, and increased public health among vulnerable populations. Urban trees clean and control stormwater runoff from impermeable surfaces, protecting the water quality of Puget Sound and reducing the severity of floods. Loss of trees due to development and spread of concrete leads to reduced carbon sequestration capacity and declining air quality.

Urban tree loss, caused by development, pollution, invasive species, storms, insects, and pathogens, threatens the essential character of the State and the health and well-being of all who live here. Communities need education, awareness, tools, and capacity to grow and sustain tree canopy, which are provided by comprehensive community forestry programs.

Street and park trees were once the focus of urban forestry programs in cities and towns, seen as a component of community beautification. Recently, community leaders and planners have come to view trees in urban settings —where people live, work, play, and learn — as a major component of municipal infrastructure—assets that must be managed in maintained in order to ensure the continued delivery of their many benefits. Scientific studies done by university and government researchers confirm many environmental, economic, and social benefits of trees.

CONDITIONS AND TRENDS

Population Growth

Washington State's population has increased from 2,853,214 people to 6,986,200 since 1960. If projections hold true, Washington will be home to more than 11 million people by the year 2050. This increase equates to additional population of 29 cities the size of Tacoma (approximately 200,000).

Increasingly, Washington residents live in urban areas. According to 2010 U.S. Census data, 84 percent of the population now lives in urban areas, an increase from 82 percent in 2000 and 76 percent in 1990. Much of the projected population growth is likely to occur within established cities. These cities will therefore face increased urban densities surrounded by sprawling growth that will pressure urban growth boundaries (Washington State Office of Financial Management 2010).

The need for green spaces and environmental services that urban forests provide will also increase. The population will need and demand urban areas with fresh air, clean water and places of respite and beauty as well as places to live, work, and play. At the same time, increasing pressure will be put on urban forests due to development under growth management requirements designed to focus growth in urban centers.

If tree resources are to remain viable enough to provide environmental, economic, and social services, it will be essential to plan for the maintenance of urban trees and forests.

For a discussion of projected population growth for Washington, see the Population/ Demographics portion of Stewardship of Working Forest Lands, Section E.

Forest Fragmentation and Canopy Loss

Broadly speaking, urban areas face declining forest health, with losses in natural areas and biodiversity, and problems associated with invasive non-native species, declining tree species diversity, reduced tree age diversity, and poor soils management. One of the symptoms of declining forest health is loss of urban forest canopy.





Figure C1. Change in tree canopy (in green) between 2001 and 2011 in the Puget Sound Metropolitan Area using satellite imagery

Forest canopy loss is a common result of urbanization. While many cities and counties have ordinances to reduce tree removal due to development, canopy assessments comparing satellite data between 2001 and 2011 show loss in the Puget Sound Metropolitan Area (Figure C1). Areas of high vegetation and tree canopy declined by 37 percent over that time period. One result of that canopy loss was a 35 percent increase in stormwater runoff. The cost of replacing the equivalent lost tree canopy with pipes and ponds and other engineered systems to manage stormwater (between 1974 and 1996) would be more than \$2.4 billion. It is further estimated that the lost tree canopy would have removed about 35 million pounds of pollutants from the air (American Forests 1998). Further study of a smaller urban growth area in Bellevue, Washington showed dramatic change over that same time period, with a loss of more than 50 percent of areas with high levels of tree cover (Table F1).

Ecosystem Services from Trees and Forests in Urban Areas

"Ecosystem services" is a term used to characterize the full range of services and functions that nature provides for people, including environmental, social, and economic benefits. Trees capture both suspended particulates and

gases in the air, and reduce air temperature, which can reduce smog levels (McPherson et al. 2002). Paved surfaces shaded by trees are replaced less frequently, particularly in warmer climates, providing public costs savings-20% shade on a street improves pavement condition by 11%, which is a 60% savings for resurfacing over 30 years

As tree canopy intercepts rain, it reduces the amount of storm water falling on pavement and buffers the duration and intensity of peak stormwater flows. The absorption of precipitation by the trees, and by the ground around the trees, interrupts the runoff and helps reduce its volume. In turn, this may mitigate the need for construction of larger capacity stormwater treatment facilities and result in significant cost savings. With loss of tree canopy,



Audubon Society



stormwater interception diminishes. This stormwater is directed into streams and rivers, and eventually into the Puget Sound, carrying pollutants from urban areas into one of the most imperiled water bodies in the nation (see section G on Upland Water Quantity, Quality and the Puget Sound Restoration for a more detailed discussion of impacts to the Puget Sound).

Tree canopy is important for salmon habitat, as large trees block direct sunlight over stream corridors, helping to maintain cool water temperature and provide cover for fish. Canopy loss directly reduces shade, increasing stream temperatures and degrading water bodies.

The health of Puget Sound is linked to the health of urban forests. Streams that flow into Puget Sound from upper elevations must pass through an urban network of impermeable surfaces that do nothing to filter pollutants before they enter streams and other waterways. Restoring Puget Sound hinges on controlling these discharges, which in turn depends on increasing urban canopy cover and decreasing impermeable surfaces. The Puget Sound Basin "provides benefits worth between \$9.7 billion and \$83 billion every year. This 'natural capital' includes drinking water, food for wildlife, climate regulation, flood protection, recreation, aesthetic value and more" (Earth Economics, 2012). Valuing the Basin as a capital asset places its worth between \$305 billion and \$2.6 trillion.

Human Health and Well-Being Benefits

Trees also contribute to human health and well-being. . Nearly forty years of research reveals how urban greening improves quality of life and productivity for urban residents (Wolf 2008).

Healing and Wellness: City trees may help reduce escalating personal and public spending for health services. Hospital patients who have a view of nature recover faster from surgery and require less medication for pain. Views of nature reduce physiological stress response, including driving and commuting stress. Trees and landscapes



Figure C3. Forest canopy and impaired waterways in the Seattle area

contribute to more 'walkable' cities and increase recreational benefits. More active lifestyles combat obesity, improve cardiovascular health, increase longevity, and enhance physical and psychological development of children.

7.38

Individual Mental Functioning: Nearby nature provides restorative experiences that aid in overcoming the mental fatigue associated with urban lifestyles. Desk workers who have a view of nature report greater job productivity and satisfaction. Children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) show reduced symptoms after spending time in outdoor green spaces. The latest research suggests that students show better academic performance on green campuses.

Community Wellness: Well-managed urban forests can strengthen communities by empowering citizens, improving social ties, and revitalizing neighborhoods. Urban neighborhoods with trees and landscape experience lower crime rates. The urban forest contributes to a sense of place that people value, even cherish.

Community Economics: Trees contribute to the local economy in a variety of ways. Research has shown that residential property values are enhanced up to 20 percent by the presence of trees; rental rates are up to 7 percent higher for commercial office properties having a quality landscape; consumers report being willing to spend up to 12 percent more in central business districts having large trees; desk workers with a view of nature report less illness and greater job satisfaction; and talented workers and firms are drawn to places that have high levels of amenities and environmental quality (Wolf 2006).

Urban Forest Planning and Management

To realize the ecosystem services provided by trees, resource management is essential. Research by the Center for Urban Forest Research (McPherson et al. 2002) showed that for every dollar spent on forest maintenance and management, nearly two dollars in environmental services and increased property values are returned.

In order for cities to manage urban forests with the goal of increasing or maintaining canopy cover, accountability and oversight of trees in a wide variety of circumstances and situations are essential. James Clark and colleagues (1997) proposed a widely used model for evaluating and planning for urban forest sustainability in 2011:

http://www.isa-

arbor.com/events/conference/proceedings/2013/VAN_WASSENAER_article_AUF_%20May_2011.pdf

This model established three necessary components:

- **Vegetation:** The composition, extent, distribution, and health of an urban forest. Sustainable forests have a mix of species, size, and ages.
- **Resource Management:** The policies enacted by a city to protect urban forests, and the staff who provide maintenance. Elements of resource management for sustainable urban forests include management plans, appropriate funding, dedicated, trained staff, tree care standards, and tree protection ordinances.
- **Community Framework:** A shared vision of a sustainable urban forest based in neighborhoods, public spaces, and private lands. The support and cooperation of private landowners is key to maintaining a sustainable urban forest.

Another measure of the emergence of urban forestry efforts in Washington is the increase in participation of communities in the Tree City USA Program. In order to qualify, a community must apply and meet minimum requirements of a viable tree management program and plan. Enrollment in this program has increased from 7 communities in 1991 to 86 communities in 2015 with assistance from Washington's Urban and Community Forestry Program and promotion of Arbor Day Foundation's Tree City USA Program. Nearly 50% of Washington's population lives in a designated Tree City USA.

THREATS AND OPPORTUNITIES

Threat: Declining urban forest and aquatic health due to human disturbance

Trees provide essential environmental services that maintain key functions and benefits important to urban populations. Loss of urban tree canopy will reduce or eliminate these ecosystem services.

Invasive non-native species are a threat to forests, both within and outside urban areas. Direct and disastrous invasive species effects on urban forests have emerged from the introduction of Dutch elm disease, Gypsy moth, emerald ash borer, Asian long-horned beetle, and others. Invasive plants such as English ivy, Norway maple, American holly, Japanese knotweed, bamboo, Himalayan blackberry, scotchbroom, clematis, and morning glory thrive in disturbed and unmanaged urban forests. In the broader forested environment, invasive plants, pests, and diseases can threaten water quality by damaging riparian forests. They disrupt hydrologic processes that supply clean cool water critical for healthy salmon and human populations (see discussion in section G, Upland Water Quality, Quantity, and Puget Sound Restoration). Additionally, they threaten forest health on large landscape scales, damaging productive timberland and habitat, and potentially removing susceptible tree species or groups of species from the ecosystem entirely (see discussion in section D on Forest Health Restoration).

Opportunities

Partner with communities and local entities to monitor urban forests for invasive non-native species

- Formalize DNR's current work with partners to support invasive species removal to restore urban forests, particularly those that promote volunteer participation at the local level
- Improve public awareness of the benefits of urban forests
- Encourage markets for urban wood waste
- Provide technical expertise and training to citizen scientists engaged in urban forest health monitoring

Threat: Urban population growth pressures

Washington State's population grew 1.25 percent between 2013 and 2014. This is the largest increase in population since the state began to emerge from the 2007-2009 recession. In the fastest growing counties, both rural and urban areas added significant population, and policy and regulations adopted to slow the rate of working forest conversion in rural areas is intended to increase the rate of development in urban areas.

Much of that growth will occur in the urban areas of the Puget Sound and Columbia River Basins.

Opportunities

- Partner with city planning departments and the professional land development community to protect urban forests and promote new urban designs that favor healthy growth of urban trees and forests
- Connect the public with their urban forests through education and volunteerism
- Engage non-profit partners to quantify the benefits of urban forests

Threat: Inadequate urban forest planning and management

A survey of communities for management plans and practices was done by the University of Washington, including tree inventories (Corletta 2001), management plans (Studer 2003), and tree codes and ordinances (Dugan 2004). The presence of these elements, combined with Arbor Day celebrations, are good ways to evaluate the sustainability of a community's urban forest (Wolf 2006). There were examples of high quality planning and management efforts across the state. Yet, the studies pointed to the need for consistent practices across all communities. Just 10 percent of communities had up-to-date tree inventories, and 12 percent of communities had management plans. Few cities had clear goals and objectives for tree care that are shared by local government agencies and the public. Reported challenges to tree care were poor pruning practices, hazard trees, pests and disease, and lack of replacement of removed trees.

Opportunities

- Reinvigorate the Evergreen Communities Act
- Encourage and assist city and county planners in developing urban forest plans
- Partner with city foresters and local organizations to conduct tree inventories
- Promote urban trees as components of municipal infrastructure
RELEVANT NATIONAL THEMES AND STRATEGIC OBJECTIVES

The Urban and Community Forests issue area falls into the National Theme "Enhance public benefits from trees and forests" from the State and Private Forestry Redesign structure. It will be addressed through two Strategic Objectives – "Improve air quality and conserve energy" and "Connect people to trees and forests, and engage them in environmental stewardship activities."

EXISTING STRATEGIES

Strategies that currently are in place support and promote Urban and Community Forestry and the benefits it provides.

Washington Urban and Community Forestry Program

Since the establishment of Urban and Community Forestry Program, following the Cooperative Forestry Assistance Act (1978) and major federal funding provided by subsequent Farm Bills (beginning in 1990), Washington has actively sought to establish and grow community forestry programs at the local level with the help of U.S. Forest Service State and Private Forestry. The Program educates citizens and decision-makers about the economic, environmental, psychological and aesthetic benefits of trees and assists local governments, citizen groups and volunteers in planting and sustaining healthy trees and vegetation wherever people live and work in Washington State.

Washington's staff of two certified arborists has been providing technical, financial, and educational urban forestry assistance since 1991. This assistance focuses on achieving the mission of the Urban and Community Forestry program and the Washington Community Forestry Council: To provide leadership to create self-sustaining urban and community forestry programs that preserve, plant and manage forests and trees for public benefits and quality of life.

Evergreen Communities Act

The Evergreen Communities Act (Act) of 2008 is designed to provide assistance to cities, towns, counties and tribes throughout Washington that wish to improve or enhance their urban and community forests in order to reap the many social, ecological, and economic benefits provided by urban trees, including an economically viable, vital and healthy community.

The Act recognizes the many contributions of the state's urban and community forests, stating that the "preservation and enhancement of city trees and urban and community forests is one of the most cost-effective ways to protect and improve water quality, air quality, human well-being, and our quality of life."

The Act provided funding and authority for the Urban and Community Forestry Program in the state Department of Natural Resources and the Department of Commerce (Commerce, formerly the Department of Community, Trade and Economic Development (CTED)) to convene panels of experts to assist in the implementation of the Act.

The interlocking tools developed through the Evergreen Communities Act are intended to help communities establish quality urban forestry programming that provides maximum benefits and ecological services from the urban forestry resource. A key focus of the Act is to assist communities to

develop the solid baseline documentation necessary to position themselves for participation in potential future carbon markets. Programs based on recommendations developed through the Evergreen Communities Act present unique opportunities for communities to achieve goals and objectives associated with climate change and sustainability initiatives in local governments (DNR 2010).

Urban and Community Forestry Strategic Plan

In 2009, the Washington Community Forestry Council and DNR's Urban and Community Forestry staff worked together to revise and update the strategic plan, Forever Green: Urban and Community Forestry in Washington State. This strategic plan sets a course of action for the Washington Urban and Community Forestry Program. It also serves as a tool to communicate that course of action to the program's various stakeholders around the state, the region and the country. In addition to its communication function, this plan will be used as a progress assessment tool for the program itself.

The 'Strategic Action Plan' is the technical action-oriented portion of the strategic plan. It enumerates the activities that ultimately will lead to the attainment of the five major goals.

- **Goal One:** Provide Leadership. Provide leadership to decision makers and agencies on the development and implementation of urban and community related activities.
- **Goal Two:** Promote Education and Outreach. Increase the level of understanding, protection and management of Washington's community trees and native vegetation while increasing the number of people involved in urban and community forestry activities.
- **Goal Three:** Provide Financial and Technical Assistance. Secure sustainable funding sources to provide high quality public service from the Urban and Community Forestry program staff and the best information to our clients.
- **Goal Four:** Build Urban and Community Forestry Program Capacity. Develop additional monetary support for the Urban and Community Forestry program and the people it serves.
- **Goal Five:** Plant Trees. Encourage the planting of more trees and appropriate follow-up management. The ability to achieve this goal is a natural outcome of success in the first four goals.

Arbor Day Celebrations

Arbor Day has been celebrated in Washington since 1917 when Governor Ernest Lister conducted the first official observance recognizing that trees "gladden hearts and promote the well-being of present and future generations" (from the 2002 proclamation by then Washington State Governor Gary Locke). Washington's Arbor Day was designated by the 1957 Washington State Legislature as the second Wednesday in April. Each year communities, non-profit organizations, schools, civic groups, agencies and others plant trees to celebrate. Washington's Tree City USA communities, Tree Line USA utilities, and Tree Campus USA schools must proclaim and celebrate Arbor Day each year to retain their certification.



Tree City USA Program

The Tree City USA program provides direction, technical assistance, public attention, and national recognition for urban and community forestry programs in thousands of towns and cities that more than 135 million Americans call home.

Today, Washington has 86 recognized Tree City USA communities (or 27 percent of Washington's 281 cities and towns). These Tree City USA communities range in size from under 300 residents to more than half a million. The program has experienced steady growth; the technical assistance provided by the Urban and Community Forestry program and grant funding have resulted in consistent annual increases in communities participating. In total, Washington's Tree City USA communities invested more than \$25 million at the local level in their urban forestry programs (based on 2013 reporting data). Without the technical assistance and other support that Urban and Community Forestry funding provides, this investment would decline.

Washington Growth Management Act

Passed in 1990, the Growth Management Act is an effort to reduce urban sprawl and protect valuable natural resources. The parameters placed on growth by the Growth Management Act have led to increased density of available housing within cities and urban communities, creating additional challenges for trees planted or retained forests in urban settings. While the state — through the Department of Commerce — provides a broad range of technical expertise for communities preparing Comprehensive Plans to guide growth and development, urban forestry has not traditionally been identified as supporting the desired outcomes of growth management planning.

Urban Forestry Partnerships

Partnering with other organizations, agencies, universities and non-governmental organizations is an effective way to deliver urban and community forestry messages and assistance. The Urban and Community Forestry program has been very effective in developing these important partnerships. The program works on a regular basis with a spectrum of organizations in Washington, including Forterra and their Green City Partnerships, Washington State University Extension, the University of Washington, the Pacific Northwest Chapter of the International Society of Arboriculture, Plant Amnesty in Seattle, the Association of Washington Cities, the Washington Association of Counties, state agencies, individual municipalities, conservation districts, and public utilities. The program continues to develop partnerships as opportunities arise and new organizations form.

DATA AND PROGRAM GAPS

Urban forestry research in Washington is relatively new and ongoing. In order to better manage this public resource, more data are needed.

- Forest Canopy Assessment: A statewide assessment of urban forest canopy was initiated by the US Forest Service in 2009. The data are based on 60-meter resolution satellite imagery taken in 2000, which provides a rough estimate of state-wide forest canopy coverage a decade ago. This project is not yet completed. In order to assess canopy change over time and quantify existing canopy, this canopy analysis should be repeated, with higher resolution imagery. Ground data should be collected and paired with the spatial analysis in order to assess the structure, condition and function of the state-wide urban and community forest.
- **Ground-Level Threat Inventory:** Ground data are of particular importance to prevent or curb the spread of introduced insects, plants and diseases, similar to the Emerald Ash Borer in the mid-west. It is equally important to monitor research on management of outbreaks threatening urban forests on a national level, since the majority of urban trees are native to other areas of the country. In Washington State, efforts to monitor and respond to the spread of invasive species are underway by the Washington Invasive Species Council and Washington Department of Agriculture. A complete inventory of these threats does not currently exist, though an assessment of invasive species information and programs was identified as a near-term priority in the 2008 Invasive Species Council Strategic Plan (Washington Invasive Species Council 2008).
- Urban Growth Areas: In order to develop management strategies that support sustainable urban and community forestry programs and prepare for naturally occurring events (such as weather

events and insect and disease outbreaks), spatial and ground data on urban forests should be collected within urban growth management area boundaries.

- **Ecosystem Services:** Social science research on trees and their role in human health, particularly in obesity prevention and mitigation, could have direct positive impact to urban forestry, and should be monitored, along with continued economic and environmental research. Collaboration with universities and colleges across the state is important to achieve this research.
- Keeping Assessments Current: The community assessments done in the early 2000s could be repeated every few years to better understand the trends and needs in urban forest planning and management across the state. While many communities reported existing policies and practices that were less than recommended for sustainable urban forestry, others were conducting programs of high quality. Identifying those cities that are developing and using best practices could be the source of innovations and ideas that are best suited to the needs and conditions of Washington State.
- Urban Forestry Professional Services: A periodic survey of the industries that support urban forestry, including the nursery industry and arboriculture consultants, would help determine if there are enough professionals, and people with adequate qualifications to plan, manage and steward urban trees across the state. This analysis could serve to assess services availability and training needs.

Forest Health Restoration

Both Eastern and Western Washington face forest health challenges. East of the Cascades, decades of fire suppression combined with damage from insects and pathogens have set the stage for high levels of tree mortality and defoliation, which increases the occurrence and severity of fire. The wetter west side of the state does not face conspicuous forest mortality, although insect outbreaks, tree diseases, and waterborne pathogens are important. If climate projections hold, Western Washington could see longer and deeper summer vapor pressure deficits, which could increase stress on trees and make them more vulnerable to diseases and insects. Moreover, the presence of high human populations, transportation corridors, and international ports increases the risk of harmful exotic pest introduction.

In Eastern Washington, restoration of overcrowded, diseased and infested forests is essential. Tactics to reduce the impact of disease agents and keep future wildfires from becoming severe include aggressive thinning, pruning, and replanting. In some cases, forests that are adapted to 35-year wildfire return intervals will have to be thinned heavily enough and allowed to grow long enough to mimic those conditions.

Western Washington must be alert to ensure that constantly occurring threats to forest health are detected, analyzed and eradicated in partnership with the Washington State Department of Agriculture and other key stakeholders. Agency staff need to work closely with state and private landowners to address emerging forest health threats, evaluate the presence of diseases or damage detected in aerial and ground surveys, and be vigilant for the presence of *Phytophthora* and exotic pests.

CONDITIONS AND TRENDS

Washington's forests always have been affected by insects, pathogens, wildfire and extremes in weather. In recent decades, some of these disturbances seem to have become more widespread, more intense and of longer duration than occurred previously. Such changes in the forests, particularly in Eastern Washington, are associated with a high density of trees and changes in species composition, stand structure and connectivity. These changes create tree stress and allow disturbance agents to spread easily (Hessburg et al. 1999). Weather and climatological and environmental changes predicted for future decades are likely to make many of these problems worse.

Washington's lands are owned by an array of state, federal, local, and private landholders. Each jurisdiction has separate and sometimes overlapping authorities, interests, and mandates. Protecting, monitoring, and restoring forests under a variety of ownerships poses significant challenges, particularly when there are relatively few highly trained forest entomology and pathology professionals, and when additional front line staff charged with engaging small forest landowners are already stretched thin west of the mountains.

The intersection between poor forest health and fire is well-explored. Heavily overstocked forests and excessive fuel loads due to years of fire suppression, combined with tree mortality or defoliation due to



Figure D1. Western Washington Forest Disturbance, based on 15-year tree mortality indicator





Figure D2. Eastern Washington Forest Disturbance, based on 15-year tree mortality indicator

insects and pathogens create vulnerable conditions for massive wildfires. The Carlton Complex wildfire of summer 2014 started from lightning strikes and spread rapidly in extremely dry Eastern Washington forests. In some places, forest health management activities created stand conditions that were more resilient to damage and provided safe opportunities for firefighting efforts.

Year	Total Area (thousands of acres)	Bear Damage or Root Disease (acres)	Pine Bark Beetles (acres)	Western Spruce Budworm (acres)	Fir Engraver Beetle (acres)
2014	540	161,442	145,956	92,634	30,998
2013	600	182,776	111,700	178,175	9,168
2012	1,080	200,361	171,498	511,659	31,501
2011	950	179,783	116,649	538,694	34,820
2010	940	164,104	242,076	373,303	70,820

Table D1. Total area of forest land in Washington containing new tree mortality or tree defoliation or foliar diseases*

* Identified in the annual cooperative aerial survey major sources of damage conducted by DN R and the U.S. Forest Service Region 6 of (U.S. Forest Service 2010a).

Bear Damage and Root Disease

Tree mortality caused by black bears or fungal root diseases represents the largest forest health damage factor consistently observed in Western Washington forests (Figure D3). Black bears damage trees during the spring by peeling the bark and eating the sugary outer wood. During the aerial survey, groups of scattered, similar, pole-sized, newly dead trees are recorded as "Bear damage." Based on ground checking observations of these records, this damage is actually a combination of bear girdling, root disease, drought stress, porcupine, and mountain beaver girdling. Bear feeding activity is likely still the primary mortality agent even though most areas contain at least some root disease, and sometimes root disease is the sole agent.

Laminated root rot (*Phellinus sulphurascens*, previously *Phellinus weirii*) is the most common root disease in Western Washington. It appears to be widespread throughout the range of Douglas-fir. While most conifers are susceptible to laminated root rot, some species are more susceptible than others. Douglas-fir is one of the most susceptible species, while hardwoods cannot be infected. Laminated root rot often increases water stress, predisposes larger and older trees to Douglas-fir beetle attack, and contributes to windthrow. Laminated root rot infections can kill trees of all sizes and ages. When infected trees die or are cut, the fungus may live saprophytically for decades in colonized stumps. If seedlings of susceptible species are planted near previously infected stumps, they are very likely to get infected. Incidence of root diseases are likely to increase over time if infected sites are naturally seeded or replanted with Douglas-fir or other susceptible species.

Other significant root diseases in Washington include Armillaria root disease (*Armillaria* sp.) and Annosus root and butt rot (*Heterobasidion annosum*).



Figure D3. Trend in bear damage/root disease in Washington State (2005-2014) (based on aerial survey data)

Pine Bark Beetles

Three major kinds of bark beetles affect pine host trees in Washington State. Mountain pine beetles (*Dendroctonus ponderosae* Hopkins), Western pine beetles (*Dendroctonus brevicomis* LeConte) and engraver beetles (*Ips* spp.) are the primary agents of mortality for ponderosa and lodgepole pine in Eastern Washington. Pine bark beetles infest only fresh inner bark tissue in living trees or recently killed or fallen trees. Beetles tunnel beneath the bark, laying eggs along what is called a "gallery." Within a few weeks the eggs hatch and the larvae feed on the nutritious tissue just beneath the bark.

Once beetles find a suitable host tree, they release aggregating pheromones to attract other beetles enabling a "mass attack" that can overwhelm even a healthy tree's defenses. Along with releasing pheromones, the attacking beetles introduce a staining fungus that further weakens the tree by disrupting the trunk's ability to transport water. If enough beetles are attracted to a tree, the feeding of the larvae outward from the gallery can girdle the tree.

Bark beetle populations fluctuate year-to-year depending on the prevalence of stress-causing conditions in the forest. During "normal" years, beetle populations tend to be stable or decline because healthy trees are able to resist beetle attacks. During drought years, beetle populations tend to increase. Competition between trees that are too closely crowded together also has the effect of inducing stress as trees.

Pine bark beetles consistently cause one of the highest amounts of damage among many agents in Washington's forests. Active management that reduces the number and density of weak trees can protect forests from bark beetles and prepare them for future adverse climate and fire.



Figure D4. Trend in pine bark beetle activity in Washington State (2005-2014) (based on aerial survey data)

Western Spruce Budworm

Western spruce budworm (*Choristoneura freemani* Razowski) is a widespread, native defoliating insect in western conifer forests. The insect is a small, mottled rusty-brown moth whose larvae (caterpillars) eat the needles of several western conifers. Douglas-fir and grand fir are the most suitable hosts. Other somewhat suitable hosts include Engelmann spruce, western larch, and subalpine fir. Trees infested by defoliators suffer reduced growth, topkill, and sometimes death. The amount of damage depends on the initial health and vigor of the tree, and on the intensity and duration of attack. Growth losses and topkill are more common than mortality.

Trees weakened by defoliators become vulnerable to subsequent attack by bark beetles. Douglas-fir beetles (*Dendroctonus pseudotsugae* Hopkins) and fir engraver (*Scolytus ventralis* "LeConte") beetles may kill more trees than the defoliator. Smaller trees tend to suffer more direct effects of defoliation, and larger trees tend to suffer more mortality from subsequent bark beetle attack.

Forests most susceptible to attack and vulnerable to damage by spruce budworm contain more than 50 percent of their tree composition in susceptible species, have uneven or layered tree canopies with large host trees in the overstory, and contain trees that are too crowded. Unfortunately, a lack of natural fire or mechanical thinning, and historical forest management practices that reduced the diversity of tree species have contributed to making susceptible forest conditions more and more common throughout Eastern Washington. Over time, as unsusceptible species like ponderosa pine and larch were harvested, leaving susceptible species like Douglas-fir. Stands that once contained a mixture of tree species have shifted in composition. Additionally, periodic fires historically killed susceptible species like grand fir, preventing these trees from growing beneath the canopy of larger and less

susceptible trees. When natural fire became less frequent due to fire suppression, the host species continued growing. Forest density increased and a multi-layered canopy developed, which allows defoliators to thrive. Susceptible conditions are widespread across Eastern Washington and budworm damage has been intense for several years (Figure D5).



Figure D5. Trend in Western spruce budworm defoliation in Washington State (2005-2014) (based on aerial survey data)

Fir Engraver Beetle

In Washington, fir engraver beetles attack primarily grand fir and Pacific silver fir host trees. Fir engravers burrow beneath the bark on the tree trunk, and create damage similar to that of pine bark beetles. Engraver beetle damage can kill individual branches, patches of bark, tree tops, or entire trees. Breeding also occurs in fresh logging slash and recently blown-down trees, allowing populations to build enough that otherwise healthy nearby trees could be attacked.

Fir engraver populations are an important indicator (Figure D6) because beetles often select hosts that are damaged by other agents or are under severe moisture stress. Western spruce budworm defoliation can weaken trees enough to make them susceptible to subsequent mortality by fir engravers. Attacks are also commonly associated with root disease.

Vigorous firs may exude enough pitch to deter or drown the beetles, or contain any introduced fungi. Prolonged and severe drought conditions can lead to outbreaks over larger areas where trees have insufficient moisture to defend themselves.



Figure D6. Trend in fir engraver damage in Washington State (2005-2014) (based on aerial survey data)

Description of Causal Factors of Forest Insect Population Fluctuations

Western spruce budworm

In terms of acreage, the western spruce budworm (WSB) is the most damaging conifer defoliating insect in Washington State. Between 2005 and 2014, the average annual affected area was 382,000 acres. In the last 45 years of annual aerial survey data, the affected acres have varied widely from a few hundred acres to more than one million acres in the late 1970s and early 1990s. There is no predictable duration or return interval for WSB outbreaks. In statewide summaries, WSB defoliated acres may be consistently high for many years, but on that scale it is not considered a single outbreak. Several independent outbreaks may be developing and collapsing simultaneously in different areas of eastern Washington, depending on local conditions.

There are many factors that contribute to the wide range in annual recorded WSB damage. Survival of young dispersing WSB larvae depends on a high proportion of susceptible hosts in dense, multi-layered stands. The continuity of those susceptible stand types is also important for dispersal of egg laying adult WSB. A combination of several different factors may contribute to collapse of WSB outbreak populations. These include a lack of available and nutritious food often due to several years of heavy feeding by WSB; change to less favorable stand conditions; natural enemies, such as diseases, parasites, and predators; and late spring frost events or other adverse weather conditions.

Some annual fluctuations in acres recorded by aerial surveys may also be due to timing and conditions when the survey is flown. Before the survey is flown, ground verification is used to ensure the signature used by observers to identify defoliation is developed. However, smoke, low light and shadows late in

the year, a late flush of new foliage, heavy rains and wind that remove brown needles, or lack of foliage in chronically defoliated areas that obscure visibility of the signature may reduce acres mapped.

Bark beetles

Most fluctuations in bark beetle activity can be explained by changes in local weaterh, especially drought conditions, and large forest disturbance events such as storms or wildfires. Most aggressive bark beetle species that have the potential to develop outbreak populations, such as pine bark beetles, fir engraver, Douglas-fir beetle, and spruce beetle, typically produce more offspring in recently killed or highly stressed host trees that are unable to produce resin and other defensive compounds. High populations of bark beetles may be able to overwhelm the defenses of nearby host trees, especially trees under stress in over-stocked eastside stands.

The red crowns of bark beetle-killed trees usually do not appear in the aerial survey record until year after they were killed, due to the time necessary for a killed tree to dry out under normal conditions. Once initiated, the duration of a bark beetle outbreak depends on the relative aggressiveness of the bark beetle species involved and the condition of the hosts, primarily their size, age, vigor, and environmental stressors. Outbreaks can be as short as a single year in the case of Ips pine engravers or longer than a decade in the case of mountain pine beetle. Fir engraver, mountain pine beetle and western pine beetle outbreaks are often related to drought andhost age, size and stress. Outbreaks of Ips pine engravers, Douglas-fir beetle, and spruce beetle are most often initiated by disturbances that generate ample freshly-killed host material used for breeding.

The red crown signature used in aerial surveys for bark beetle mortality is reliably visible under most conditions. However, mortality due to wildfires may obscure some of the signature. To control for this, observers do not map within fire perimeters until the second year following the fire. In addition, some variability in acres mapped, especially over decades, can be attributed to observer experience, changes in methodology, and changes in aerial survey technology.

Dwarf Mistletoe

Dwarf mistletoes (*Arceuthobium* M. Bieb) are 42 species of native parasitic plants that infect conifer trees across North America. There are seven species of dwarf mistletoe endemic to Washington:

- Fir dwarf mistletoe (Arceuthobium abietinum),
- American Dwarf Mistletoe (Arceuthobium Americanum),
- Larch dwarf mistletoe (Arceuthobium laricis)
- Western dwarf mistletoe (Arceuthobium campylopodum)
- Douglas-fir dwarf mistletoe (Arceuthobium douglasii), and
- Hemlock dwarf mistletoe (Arceuthobium tsugense)

The precise intensity and distribution of *Arceuthobium* in Washington State is unknown, since it is difficult to detect using aerial survey methods. By themselves, *Arceuthobium* species are not always harmful to forests. The heavy "witches broom" branch masses characteristic of *Arceuthobium* infestation are often used by birds and mammals as nesting sites. However, dwarf mistletoes can exacerbate the effects of drought and fire. Dwarf mistletoe brooms are highly flammable, so fire that might ordinarily be limited to the understory can spread easily into tree crowns and burn at high temperatures, adding to the danger and severity of wildland fire.

Dwarf mistletoes explosively discharge their seeds, sending them up to and in some cases further than 15 meters, but contagion can be managed. The most heavily infected trees should be removed and a tree species mix should be encouraged. The tactics usually employed to slow or control insect infestation and to mimic the aftermath of naturally occurring fire—such as aggressive thinning and pruning—are used as a treatment of *Arceuthobium*.

Phytophthora

Phytophthora is a genus of plant damaging water molds that poses serious threats to forested ecosystems and has the potential to cause enormous economic loss and dislocation nationally. There are more than 80 species of *Phytophthora* worldwide. Most are plant pathogens. Among the diseases caused by *Phytophthora* species are sudden oak death and the potato blight that caused the Irish famine.

Phytophthora cause damage by killing plant tissues, such as the roots, stems, or leaves. Blighted leaves, girdled and killed branches, or a variety of root rots can occur as a result of infection. DNR has detected *Phytophthora* in Western Washington waterways, contamination likely resulting from commercial horticultural nurseries. Infected nurseries appear to deliver *Phytophthora* spores into waterways. Infected plants have only been observed outside one nursery one time in Washington. However, once established, *Phytophthora* are extremely difficult to eradicate.

Predictions of Future Mortality

Predicting future disturbances and tree mortality provides useful information to prioritize attention and preventive treatments. Over time, maintaining forests in a healthy condition achieves better outcomes than responding to outbreaks on an emergency basis. Once an outbreak has begun, important forest management objectives like protecting large trees, maintaining the diversity of forest structure, or managing the accumulation of forest fuels may already have been compromised before responsive actions can be initiated. Predictive tools enable forest managers to identify high-risk areas before actual mortality takes place.

Direct insect population monitoring and weather pattern forecasts are two important predictive tools. Insects tend reproduce in boom and bust cycles tied to the availability of food sources, and mediated by weather that contributes to or depresses reproductive success. Although the number of acres currently affected by insects has declined slightly recently, DNR expects to see an increase in defoliation and mortality in coming years because forest conditions remain vulnerable. See *Description of Causal Factors of Forest Insect Population Fluctuations* in this section for more detailed discussion of these cycles as they apply to western spruce budworm and bark beetles.

The prevalence of laminated root rot is not accurately indicated by tree mortality surveys. Heavy rainfall in the region means that trees may not need their full complement of roots to stay vigorous. High rainfall combined with mild winters makes Western Washington ideal tree-growing country, lending forests a vigor and commensurate ability to fend off disease and withstand damage that is not seen in many other regions. An expanding dry trend in Washington's weather exacerbates potential insect and disease outbreaks.

In summer 2015, the Washington State Department of Ecology declared that six state regions were experiencing a drought:

- 1. The east slope of the Central Cascades including the Upper and Lower Yakima, Naches, Wenatchee, Entiat, Rock-Glade, and Alkali-Squilchuck watersheds.
- 2. The Walla Walla River watershed including portions of Walla Walla and Columbia counties.
- 3. The Olympic Peninsula, including the Quilcene-Snow, Elwha-Dungeness, Lyre-Hoko, Sol Duc-Hoh and Queets-Quinault.
- 4. Northwestern Washington, including the Nooksack, Lower Skagit-Samish, Upper Skagit, and Stillaguamish watersheds.
- 5. Southwest Washington, including the Cowlitz, Lewis, Salmon-Washougal, Wind-White Salmon, and Klickitat watersheds.
- 6. The Okanogan Highlands, including the Okanogan watershed.

While 2016 has seen a return to more normal patterns, Washington is expected to become warmer and drier over the next three decades, with more intense rains followed by longer dry periods, resulting in stressed trees and more insect, pathogen and parasite vulnerability. Forest conditions such as tree uniformity, advanced age, tree density, and crown layering (tree branches overlapping or in close proximity) increase the likelihood that trees will be damaged by forest insects and diseases. The most recent iteration of the National Insect and Disease Forest Risk Assessment (NIDRM) map was completed in 2013 and projects risk through 2027.



National Insect and Disease Risk Map: Estimated tree basal area loss 25% or greater 2013 to 2027

Figure D9. Areas projected to lose more than 25% of basal area between 2013 and 2027

Treatment

Strategies to reduce damage, and the risk of damage, from forest insects and pathogens must be specific to the pest or disease, durable, and address as many treatment objectives as possible. In the best of circumstances, a treatment options will halt or significantly slow the spread of damaging agents, increase tree vigor to close off insect or disease pathways, and increase the odds that fire will burn cool enough to leave remaining trees standing and not sterilize soils. For example, some forests are overcrowded with ingrowth of Douglas-fir and grand fir and now are being damaged by the western spruce budworm. The stands may be managed to:

- Increase non-host tree species such as pine and larch
- Thin a stand to expand the distance between trees so each remaining tree has more growing space
- Reduce canopy layering (tree crown overlapping), so caterpillars spreading between trees will be less likely to encounter a host tree and be more likely to fall to the forest floor and get eaten by predators (Shaw et al. 2009).

Strategies such as pesticide use over large areas may still be useful in limited circumstances. Chemical treatments can have impacts on non-target insects, wildlife, and public resources. Biological pesticides that more effectively reach only the target pests are more desirable when available, but do not address underlying forest conditions that favor the pests. Silvicultural treatments are more durable than pesticides and can be repeated until stand health reaches a state of vigor that allows trees to resist insects and pathogens.

The key to deploying closely-targeted, multiple objective treatments is monitoring. On the west side of the Cascades, where disease and pathogen outbreaks occur but are not as severe as on the east side, careful monitoring and early detection is critical, particularly as rainfall amount and timing shifts. On both sides of the Cascades, targeted, area specific fieldwork can enrich aerial survey work and aid in planning and efficiency of treatment options. Additionally, field observations can yield usable data on the spread and severity of infestations by organisms not observable from the air, such as dwarf mistletoe.

Public use of forests has created a sense of ownership and increased awareness of both human impacts and forest health challenges. While some forest users object to and are alarmed by large areas of tree damage or mortality, others perceive insect and disease activity as a natural part of forest ecosystems. These attitudes create an opportunity for DNR to educate the public about the extent to which many forests differ from their historical norms due to human-caused impacts, such as introduction of exotic pests and pathogens, past harvesting practices, and suppression of natural fire. An essential element of success in an outreach and educational program will be the introduction and nurturing of a sense of public responsibility among interested and engaged forest visitors.

Landholder Response

See Section E, Stewardship of Working Forestlands for a more detailed discussion of the small forest landowner categories discussed in the following paragraphs.

Woodland owners' land management priorities and forest health tactics flow from their motivations for owning forested lands. Industrial and large private forest landowners primarily have economic motivations. Most industrial and large private owners are interested in timber revenue, but many have begun to move toward a developed real estate model.

Small forest landowners show more diversity in the values they bring to woodland ownership. Landowners in the **Woodland Retreat** owner category are concerned about forest health threats related to insects, while also being the least likely segment to harvest trees. Less than 1/3 of woodland retreat owners report having consulted with a forestry professional to plan or execute a harvest. In the absence of naturally occurring fire, sustainable harvest activities are an excellent tactic for increasing tree vigor and altering the conditions in which pests and pathogens thrive.

Supplemental income and *Working the land* landowners cite insects and fire as top concerns for their landholdings, and are respectively the first and second most likely of the four landowner categories to report harvesting trees on their land. They are also the first and second most likely to have consulted with a forester to plan harvest activity. Finally, *Uninvolved* landowners are concerned about the same issues—fire, insects, keeping their lands intact for heirs—as other landowners, but at significantly lower levels of intensity than other landowners. They are about as likely to harvest timber as *Supplemental Income* and *Working the Land* owners, and consult with foresters at a similar rate.

Private forest landowners, both industrial and non-industrial, own more than 36% of the forested land in Washington State, just slightly higher than the share managed by the Forest Service, and are an essential component of forest health restoration in Washington State. Treatments emphasizing disease and insect resistance often involve taking out the smallest trees and leaving the largest, most vigorous trees behind. This practice mimics the action of natural wildfire on the landscape without the attendant risks of a controlled burn. These small, stressed trees are worth less money than the cost of transportation to processing facilities. Recent consolidation of many small Western Washington facilities to fewer, larger processors increased transportation costs significantly. In Eastern Washington, mill closures has led to a collapse in the ability to remove and use trees. DNR can counter these forces by working with federal State and Private Forestry managers and local communities to encourage the development of small-scale mill operations as well as mobile pyrolysis units to convert biomass to energy and fuels on site.

THREATS AND OPPORTUNITIES

Threat: Inadequate Capacity for Stewardship Activities

DNR's seedling nursery and seed bank supply genetically-appropriate seedlings for reforestation of treated, burned, or insect/pathogen damaged forests. DNR's wildland seed collection program focuses on procuring seeds from woodlands statewide, most of which are grown as seedlings in the Webster Forest Nursery. Healthy seedlings with a diverse genetic profile are much more likely to survive. Strong nursery stock will be essential in nurturing climate-change adapted woodlands. The seedling nursery and seed bank are partially funded through the Forest Service's Forest Stewardship program. The size of that grant has declined steeply in the past five years, endangering the program and weakening the agency's stewardship efforts.

Further, DNR Landowner Assistance program and Small Forest Landowner Office staff are instrumental in working with landowners to address forest health issues. An educated, engaged, and committed population of private forest landowners is an important bulwark of stewardship efforts. Agency staff provide expertise, knowledge, and a network of professional contacts that allow land owners to monitor their own forests and address threats proactively.

DNR's stewardship funding requests may be hampered because of the measures used to assess program success. The Forest Service views management plans written as a key metric. DNR's Stewardship programs are outcome-based and do not lend themselves to land management planning as a measure.

Opportunities:

- Encourage measurement models for stewardship accomplishments that focus on documentation of actions taken
- Develop dedicated state funding sources for stewardship efforts
- Maintain stocks of genetically appropriate tree species

Threat: Loosely Monitored Avenues for Exotic Pest and Pathogen Introduction

Washington is home to 11 deep-water ports that do substantial business with Asian countries and other trading partners. Products are packed, braced, and palleted on solid wood packing materials, which can host exotic forest pest species. Port facilities are potential introduction points for exotic pests and forest diseases. In recent years, state and federal agencies, have collaborated on pest detection efforts around port facilities and other detection sites. An alder ambrosia beetle *Xyloborinus alni* was initially detected in Washington in the early 1990s and likely arrived through the ports of Tacoma and Olympia. Asian gypsy moth egg masses are easily transported around the world on ships and cargo and have been detected adjacent to Puget Sound several times. In 2001, citrus longhorned beetles escaped from a horticultural nursery facility in Tukwila. WSDA, the USDA Animal and Plant Health Inspection Service, g and the Forest Service undertook a strict quarantine, eradication, and monitoring regime. If additional exotic pests become established, Washington State could face a forestry and agricultural crisis, as key food, forest products and habitat items are directly damaged or face quarantine.

Phytophthora ramorum constitutes another serious potential threat to Washington forests. The water molds can be extraordinarily effective at killing plants. *P. ramorum* has been detected in several streams in Western Washington. We still don't fully understand the dispersal and infection capacity of *Phytophthoras*.

In general, systematic, targeted monitoring efforts are important for early detection of exotic pests. Tree damage reports and insects collected by citizens require examination and evaluation by forest insect and disease experts. Urban forests are the most likely initial recipients of exotic pests because of their diversity, high levels of tree stress, and proximity to human activities. Consistent survey systems can help detect new damage. Climate change threatens to alter rainfall season and intensity, resulting in long dry periods that in turn could increase tree stress and vulnerability to pest invasions.

Opportunities:

- Build Western Washington early detection and forest health monitoring capacity
- Expand education of citizen scientists, arborists, consulting foresters, and forest landowners regarding exotic forest pests and pathogens

Threat: Unhealthy forests in Washington

Decades of fire suppression and past harvesting practices have left heavily stressed, dry forests vulnerable to outbreaks of insects and disease and to wildland fires of increasing size and intensity. Every landowner needs to use all tools available to restore healthy conditions. In 2012, the Commissioner of Public lands identified two Forest Health Hazard Warning Areas to focus existing outreach and assistance resources and seek additional opportunity.

Opportunities:

- Continue to expand resources and capacity to publicize forest health issues and implement remedies through strategic emphasis on Forest Health Hazard Warning Areas
- Support Okanogan-Wenatchee National Forest implementation of Forest Health Restoration Strategy

• Participate in forest health collaboratives to advocate for and increase active forest management on lands across Eastern Washington

• Threat: Downturns and Consolidations in Timber Sector

The number of mills in Washington has been in steady decline for the past twenty years. In the decade between 2002 and 2012, the number of sawmills dropped from 155 to 105. Smaller mills tended to close, while several large new mills were developed in Western Washington, which suggests that the industry is becoming more efficient. Logs in the 5" to 10.9" diameter range account for the steepest declines in sawmill production, while logs in all diameters from 5" to 21+" posted increases in the log export category.

Mill closures are a symptom of the loss of economic viability in the timber industry. A shrinking timber economy may mean that land owners, whether private or public, have fewer options for selling timber products, must transport logs further to processing facilities, and are less likely to be able to offset thinning costs with revenue from timber or biomass production. The problem is especially acute in Eastern Washington, where the need for thinning and biomass utilization options close to the point of harvest is most severe.

Opportunities

- Encourage development of small-scale cooperative mills in Eastern Washington
- Work with federal and private partners to pilot and expand small scale biomass operations, including mobile pyrolysis
- Reinvigorate CTED and work with Department of Commerce and local Chambers of Commerce to encourage mill development in the small, large, and portable categories
- Assess opportunities to connect mills with sources of wood of all diameters, including developing markets for wood from restoration activities

Threat: Overcrowded and Fuel Laden Eastern Washington Forests

Fire is a natural part of Eastern Washington's forest ecology. For decades, firefighting agencies and private landowners managed fire by suppressing it. Removing fire from the forested ecosystems east of the Cascades has resulted massive fuel buildup such as from brush and blowdown, thick acres of lodgepole pine, and tree mortality caused by disease and pests. These impacts result in forests that are much more prone to catastrophic wildfires that clear swathes of forest, leaving behind burned and sterilized soils inhospitable to trees and other plants.

. Healthy fire adapted trees that are growing in open conditions can survive a short-duration blaze. Such trees and forests s are more resilient and able to resist damage from insects, pathogens, and parasites.

Opportunities

- Seek dedicated funding to supplement state and federal landowner assistance programs that help restore fire resistant trees and resilient forests
- Seek new opportunities to pay for Eastern Washington forest health treatments by selling biofuels, biomass-generated energy, and small-wood forest products
- Increase use of best management practices for controlling dwarf mistletoes

RELEVANT NATIONAL THEMES AND STRATEGIC OBJECTIVES

Healthy forests have sound ecological function; are sustainable, resilient, and resistant to insects, diseases, fire and other disturbance; and have the capacity to meet landowner objectives. Effective strategies to increase forest health are reflected in the National Themes, "*Protect Forests from Harm*" and "*Enhance Public Benefits from Trees and Forests*." This is accomplished through the National Strategic Objectives: Identify, manage and reduce threats to forest and ecosystem health, and manage and restore trees and forests to mitigate and adapt to global climatological and environmental change.

EXISTING STRATEGIES

Washington State has excellent strategic infrastructure in place to conduct such actions and meet its forest health challenges.

Washington Forest Health Strategic Plan

In 2004, with the assistance of a diverse stakeholder group called the Forest Health Strategy Work Group, the DNR adopted a *Strategic Plan for Healthy Forests* (<u>DNR</u> 2004). Key principles of this plan include:

- Achieving healthy forests is a shared responsibility between the public and landowners.
- Maintaining landowner options and flexibility is essential.
- Emphasizing that prevention of insect and disease outbreaks by maintaining forest growth in balance with available water resources and climatic conditions is an important forest health strategy across Washington.
- Managing forests in natural resource and developed landscapes to lower fire risk, maintain an acceptable risk of catastrophic fire, and protect public resources is essential..

Success requires the ability to provide landowners and policy makers with timely and accurate assessments of forest health conditions, and requires systems in place to prevent, suppress, or control undesirable insect or disease outbreaks or infestations when necessary. Data and information, an effective legal construct, operational programs and preparation, landowner assistance, public acceptance, a collaborative atmosphere, economics and markets, and special capacity to identify and respond to invasive non-native pests all contribute to an effective program and results.

Forest Health Hazard Warning Areas

Legislation passed in 2007 amended state law governing forest health authorities and policy (RCW 76.06) to give the Commissioner of Public Lands lead authority for implementing a comprehensive plan, coordinated with partner agencies across diverse jurisdictions, to improve forest health. Forest health is defined as: the condition of a forest being sound in ecological function, sustainable, resilient, and resistant to insects, diseases, fire and other disturbance, and having the capacity to meet landowner objectives.

In 2011, DNR undertook a Forest Health technical evaluation process that resulted in significant areas of Okanogan, Ferry, Yakima and Klickitat Counties (Figure D10) being





designated as Forest Health Hazard Warning Areas. The function of a warning area is to give the public and land managers a geographical area in which to focus education, restoration, and landowner outreach efforts.

Forest health in Eastern Washington was recognized as one of four key focus areas of *The Future of Washington Forests* (DNR 2007), a comprehensive report requested by the Legislature in 2005. This report and continued stakeholder discussions and advocacy have heightened awareness of forest health conditions and issues, and aligned forest health proponents. This may achieve improved legislative and industrial collaboration to sustain markets and infrastructure, including increasing innovative utilization options for forest biomass.

2020 Strategic Plan for Wildland Fire Protection

Forest health also is recognized in the state Department of Natural Resources' 2020 Strategic Plan for Wildland Fire Protection (DNR 2006) as a critical element in the future ability to manage wildfire in Washington. The Plan sets out a forest health goal to, "Create landowner capability and public desire to improve or maintain forest health," recognizing the strong connection between forest health conditions

and wildfire risks. As with the 2004 *Strategic Plan for Healthy Forests*, building social recognition and acceptance to establish shared responsibilities between public and private landowners is a central objective. Other objectives include:

- Increasing public understanding that forests change over time and are influenced by human action and inaction.
- Integrating forest health principles with wildfire protection.
- Developing opportunities and incentives to move toward appropriate tree spacing and fuel accumulation levels.
- Taking strategically placed actions that address forest health and extreme fire behavior intersections.
- Examining financial, regulatory and policy challenges that could be better aligned toward increasing the survivability of forest landscapes from fire, insects and disease.

The overall Wildland Fire Protection goal of the Plan also incorporates key forest health considerations, such as maintaining economic, ecological and social values such as viable forest industries, watersheds, community stability, wildlife habitat and a sense of place. Implementing the forest health strategy is anticipated to reduce the number and severity of wildfires and is cited as a key fire protection objective.

Washington Forest Health Law

Washington's Forest Health Law (RCW 76.06) was updated by the 2007 Legislature to ensure that authorities exist to implement an effective statewide forest health program. The specific new authorities were an outgrowth of the Forest Health Strategy Work Group and the 2004 *Strategic Plan for Healthy Forests*.

Emergency authorities were improved to allow rapid response if a new invasive non-native pest is detected and there is high likelihood of successful eradication. Broader forest health program authorities were achieved by establishing a structure and process for implementing a tiered system of actions.

In the first tier, existing monitoring and technical assistance activities to all landowners were expanded. Following the legislation's passage, DNR selected a pilot project area of Stevens County in northeast Washington to test economically effective methods for increased voluntary forest health improvement actions. Expanded Tier 1 actions also included a heightened effort from DNR to engage with and coordinate management actions on federal land.

The law's second tier of authority provides for circumstances in which voluntary efforts have failed to prevent an outbreak from increasing in size where it has the potential to affect many landowners. A broad technical advisory panel may be convened to recommend types and locations of actions, and a forest health hazard warning may be issued by the Commissioner of Public Lands.

The third tier carries the potential to assign landowners liability for future wildfire suppression costs in areas where treatments are not conducted or are not effective and significant amounts of dead trees accumulate.

Washington Invasive Species Plan

The Washington Invasive Species Council has developed an *Invasive Species Plan* (Washington Invasive Species Council 2008) that recognizes the importance of effective prevention, detection, management plans and actions that help reduce the current and future impacts of invasive species. The council supports, coordinates and implements new and existing strategies for addressing invasive species across the state. Existing programs include the state pest and noxious weed programs, both administered through the Washington State Department of Agriculture. For example, the agency conducts ongoing surveillance efforts on high-priority pest species such as the gypsy moth, and has a program with staff and resources to respond quickly when a new infestation is found.

Additionally, the Invasive Species Council implements a strong education and outreach emphasis in its strategic plan to better address forest pests. It has developed a tri-state (Washington, Oregon, and Idaho) public education campaign aimed at reducing risks associated with firewood as a vector for spreading forest pest infestations. The "Don't move firewood" campaign is designed to educate the public to buy local and burn local. Parks at risk of infestation — those most often visited by people coming from highly infested states or areas — have been targeted for surveys and a pilot program to offer visitors free firewood. Finally, the Council maintains a website that facilitates reporting of suspected exotic pest observations: http://www.invasivespecies.wa.gov/report.shtml.

U.S. Forest Service State and Private Forestry Programs

A number of state and federal program assistance options are available for small forest landowners that wish to take action to improve forest health conditions on their land. Traditionally, they have included State and Private Forestry and National Fire Plan funding in the Forest Health and Forest Stewardship Programs. Washington's forest health monitoring and improvement efforts receive major technical and financial support from Forest Health Protection (FHP), and the U.S. Forest Service state and private forestry offices. FHP is DNR's most important partner. The partnership enables excellent entomology and pathology technical assistance, high quality insect and pathogen monitoring, and cost share grants for tree thinning and other treatments to be delivered to landowners and managers.

The 2008 federal Farm Bill also enhanced the eligibility and focus of certain conservation programs administered by the USDA Natural Resources Conservation Service to be applied for by nonindustrial private forestland owners according to program and local priorities. For instance, Environmental Quality Incentives Program (EQIP) funding has been used to conduct thinning to improve forest stand conditions. In addition to EQIP, improved forest health outcomes could be leveraged by combining State and Private Forestry program projects with the Healthy Forests Reserve Program, Conservation Stewardship Program, Cooperative Conservation Partnership Initiative, and Conservation Innovation Grants.

Federal Land Management

Federal land management strategies in Eastern Washington are guided by federal statute, local land management plans, and annually appropriated resources. Much of the U.S. Forest Service land on the east slope of the Cascade Mountains is managed under the direction of the *Northwest Forest Plan*, which zones management emphases among fixed areas for northern spotted owl habitat (Late Successional Reserves) and areas more oriented toward active management (Matrix, Managed Late Successional Areas). There is increasing scientific recognition that new owl-recovery strategies are needed that include active forest management and restoration to assure that important habitat structures, such as large trees, are not lost to uncharacteristically severe disturbances.

Outside the range of the spotted owl, U.S. Forest Service lands are managed under early-1990s-vintage forest plans that were later modified by supplemental direction to the *Northwest Forest Plan*, called the "Eastside Screens." In each case, local forest plans are undergoing a regularly scheduled revision, and these are expected to respond to changed forest conditions and risks, such as forest health. Forest plans provide the long-term strategic direction for the location and design of individual management projects.

In some cases, individual national forests have undertaken supplemental strategic analyses that guide the location and type of projects. One example is the Okanogan Wenatchee National Forest's *Forest Restoration Strategy*, currently under development. The strategy will provide a methodology for analyzing forest conditions within a given landscape to suggest the location and type of restoration most needed for forest health, wildfire, habitat and other important factors.

Recent federal legislation — including the Healthy Forests Restoration Act of 2003 (P.L. 108-148) and the Forest Landscape Restoration Act of 2009 (P.L. 111-11) — have established a heightened national priority for forest health on federal lands. The Forest Landscape Restoration Act created a specific federal policy emphasis on coordinated restoration strategies across land ownership boundaries.

In all cases, individual national forests produce a five-year action plan for project decisions, and these represent the best short-term estimation of where action is intended to take place.

Cross Ownership Efforts

Washington's Forest Health law recognizes that forest health problems may exist on forest land regardless of ownership, and furthermore, that outbreaks originating as a result of unhealthy conditions on one ownership can spread to others. The state is encouraged to collaborate with the federal government to address common forest health deficiencies. Similar collaboration among regional landowners and stakeholders must occur in order to agree on land management objectives, devise superior action plans to implement over large areas, and generate a supportive environment for such actions. In addition to the collaborative framework supported by community wildfire protection planning efforts, cross landowner efforts such as the Tapash Collaborative have the potential to stimulate and support significant forest health improvements across wide areas. For more information on these efforts, see the discussion in section F, Wildfire Hazard Reduction, on Restoring Fire Adapted Lands Across Ownerships.

DATA AND PROGRAM GAPS

Elements of the DNR's Forest Health strategy and activities that still have vulnerable gaps include:

- Fine-Scale Forest Condition Data: Lack of ability to acquire accurate spatially explicit forest inventory data, and apply insect and pathogen risk and hazard models to enable pragmatic, timely prioritization, prescription development, and change measurement. Coarse-scale data are abundant, but lack the detail to inform localized actions.
- Cross-Ownership Data: Lack of cross-ownership data on forest health improvement efforts that would help strategically coordinate efforts and expenditures;
- Communication Methods and Messages: Data on effective methods to influence and develop an economic or moral climate among diverse landowners that would facilitate rapid implementation of forest health improvement treatments.

Stewardship of Working Forest Lands

Of Washington's 45 million acres, 51%, or 23 million acres, are forested. Rich, productive conifer forests stretch west and south from the Cascade Crest to Puget Sound and the Columbia River, and continue across the Olympic Mountains to the Pacific Ocean. Forests run up the east slopes of the Crest, and fan out over the northern third of the state, across the Okanogan and Columbia Highlands to Washington's border with Idaho. Some of the Columbia Basin is lightly forested, but trees begin to grow thickly again in the Blue Mountains of Washington's southeast corner. The State and Federal agencies charged with managing public forests do so under a complex set of laws, rules, regulations, and court orders. In DNR's case, the state Constitution is the framework underlying all land management decisions.

Federal, state, local, and private interests manage Washington's forested lands in a series of roughly concentric bands. National Forests and Parks are situated in the upper watersheds. DNR and private industry manage much of the middle-watershed. Private ownership dominates woodlands in the next level of the watersheds they transition into agricultural land, towns and cities.

The management framework for these lands is a patchwork of state and federal requirements, local ordinances and zoning. Working forests are "sustainably managed for commodity products as well as ecological and social values" and require a "permanent and un-fragmented land base" (NW Environmental Forum, 2008).

In 2014, Washington's Forest Products sector provided 107,000 jobs, paid out \$4.5 billion in wages, and generated \$175 million in tax receipts (WFPA, 2014). The forest products industry plays a significant role in Washington's economy, particularly in rural, timber dependent communities. Timber and resource jobs are often the cornerstones of rural economies, upon which other components, such as tourism and real estate can be laid.

Further, working forests provide benefits that economists are attempting to quantify and understand. High-functioning working forests save counties and municipalities money by naturally filtering water, resulting in lower costs for water purification systems. Relatively intact streamside forests are natural sponges, mitigating the impact of seasonal flooding. And working forests support a fishing and nontraditional forest products industry that supplements the revenue generated by traditional logging operations. These services are a narrow band of the non-industry products provided by intact forests. The relatively new field of ecosystem services accounting is attempting to fully account for the public money saved and earned by intact landscapes. The ecosystem services provided by the Nisqually River Watershed alone have been valued at between \$195 million and \$3.9 billion annually (Earth Economics, 2009).

Small forest parcels are in a key strategic location: Small woodland owners typically own the first band of forest outside of urban growth boundaries. Not only do they experience intense pressure to sell and develop their lands, their presence acts as a shield for forested and agricultural lands beyond them. Development is less likely to "leapfrog" over an undeveloped forested area than to spread from already-developed areas.

Land Ownership Patterns

Roughly 57 percent of the total forestland is in public ownership, and 43 percent is in private ownership. The private forestland subset is comprised of 31 percent industrial and 69 percent non-industrial landowners.

However, land ownership patterns differ between Eastern and Western Washington. Western Washington unreserved timberlands are nearly 40 percent held by industrial private landowners, compared to 14 percent in Eastern Washington. Federal lands comprise a much larger proportion in Eastern Washington as compared to western Washington. Native American tribes also manage a significant amount of the Eastern Washington forest landscape.

Private Ownership Overview

Of privately-owned lands, 3.2 million acres are in small ownerships, leaving 6.2 million acres in large ownerships. Although traditionally the majority of this large private acreage was owned by industrial

companies, those companies now own about 2.9 million acres. The other 3.3 million acres are owned by TIMOs, Real **Estate Investment** Trusts, and other nonindustrial owners including corporations, private individuals or families, Indian tribes, and conservation groups. Given ongoing transactions, these numbers should be expected to continually change to some degree.



Figure A1. Forestland ownership in Washington State

Land use change from forested to non-forested uses are highly regional, with changes in the Puget Sound ecoregion (encompassing the Puget Sound lowlands) amounting to loss of about 0.45 percent a year between 1989 and 2000 (Gray 2009). During that same period, forestland in greater western Washington declined at a lesser rate of 0.11 percent a year. Estimates of more recent land use change show annual forestland loss in the Puget Sound ecoregion exceeding 0.5 percent by the mid-2000s. Further studies suggest that a substantial portion of land use change (0.18 percent for 1992-2006) on non-federal ownership in western Washington is happening in "wildland forest" areas, or those with very low densities of dwellings and roads (Gray 2010). One relatively dominant pattern reflected in these data is the transfer of ownership from forest industry companies to other private owners, followed by the subsequent conversion to non-timberland by the other private owners.

Focus: Small Forest Landowners

Approximately 3.2 million acres of private land in Washington State are considered small forestland parcels, defined generally as less than 5,000 acres in size (DNR 2009b). These parcels are held by an estimated 215,000 individual small forest landowners.

Nearly 75 percent of forestland owners in Washington own holdings of less than 20 acres. This pattern is noticeably less dominant in eastern Washington, where there are significantly fewer owners in the under-20-acre category and significantly more owners with 100 acres and greater. The pattern of these ownerships across the state tends to be concentrated in the lowland forested areas, often along major rivers and streams. Small forest landowners also tend to be situated as the first band of forestland that borders urban growth areas and thus are subjected to significant conversion pressure.

New data released by the Sustaining Family Forests Initiative (SFFI) filters small forest landowners into four categories:

- Woodland Retreat (WR) Landowners: WR owners are primarily interested in the aesthetic and recreation value of their land. They value benefits like beauty, biodiversity, hunting, wildlife habitat, and recreation, and are less interested in financial reasons for owning woodland. They tend to have smaller plots, and about half are retired despite being slightly younger than other owner groups. Their primary concerns are keeping the land intact for heirs; forest health issues; fear of trespassers; and a concern for high property taxes. WR landowners are the largest segment of woodland owners in both eastern and western Washington, at 41% and 62% respectively.
- Working the Land (WTL) Landowners: WTL owners balance their interest in the recreational, aesthetic, and ecological benefits of their land with the financial payoffs of woodland ownership. Their average plot size is 58 acres, higher than the overall sample average of 50 acres. WTL owners are likely to have a cabin or other home on their property. They are concerned with forest health issues, followed by a concern for keeping the land intact for heirs, high property taxes, fear of trespassers, and a fear of fire. They are the second largest segment, constituting 30% of all woodland owners.
- Supplemental Income (SI) Landowners: SI Landowners are primarily interested in the commodity aspects of their land as opposed to the scenic, recreational, and environmental benefits. They are much more likely to cite timber and investment as important reasons for owning lands, and are somewhat older than other woodland owners, with 45% in the 65 or older range. While they own larger parcels of land—averaging 74 acres—they are least likely to have a home or a cabin on their woodlands. They are chiefly concerned with fire and forest health issues, keeping the land intact for heirs, fear of trespassing or poaching, and concern for high property taxes. SI landowners constitute 8% of all woodland owners.
- Uninvolved (UN) Landowners: These landowners are not motivated by finances or the recreational and aesthetic benefit of owning woodlands. They are unlikely to cite any reasons

for owning woodlands. When they do, they typically mention keeping the land intact for heirs, aesthetics, or privacy. UN owners are somewhat older than other woodlands owners. Half are 65 or older. Their average plot size is smaller than others at 44 acres, with 42% owning plot sizes between 10 and 19 acres. Almost half say their landholding includes a farm, suggesting that their woodland acreage is a secondary consideration to their agricultural use of the land. UN landowners constitute 22% of all landowners.

Aggregate data indicate that the majority of small forest landowners in Washington State have plot sizes between 10 and 49 acres (33%). Landowners in that acreage range list fire as their primary concern, followed by insects or plant diseases, and undesirable plants. In sociopolitical terms, this class of landowners is chiefly concerned with high property taxes, followed by trespassing or poaching, and development of nearby lands.

To encourage long-term forestland retention and management, state law provides for reduced "current

use" property tax rates on designated forest lands which meet the definition in Revised Code of Washington (RCW) 84.33.035. In the 10 to 49 acre owner class—the largest class by area and number of owners—only 165 of 2141 respondents (less than one percent) listed harvesting sawlogs or pulpwood among their future plans. Of the 6,318 total respondents in all acreage categories, only 779 (roughly one percent) listed harvest activities among their future plans, which means that these owners will bear the full brunt of property tax. Expressed landowner concern over high property taxes, combined with a rising real estate market and aging landowner cohort, may lead to conversion. These numbers should concern organizations and individuals with an interest in preserving open space, wildlife habitat and working forests. Extending the property tax exemption that accrues to people managing their lands for timber production to all owners who actively manage or restore their woodlands could provide an incentive for landowners or their heirs to conserve their lands and maintain a healthy forest ecosystem.

Focus: Industrial Private Landowners

Industrial Private Landowners are distinguished from Large

RCW 84.33.035

"Forest land" is synonymous with "designated forest land" and means any parcel of land that is five or more acres or multiple parcels of land that are contiguous and total five or more acres that is or are devoted primarily to growing and harvesting timber. Designated forest land means the land only and does not include a residential homesite. The term includes land used for incidental uses that are compatible with the growing and harvesting of timber but no more than ten percent of the land may be used for such incidental uses. It also includes the land on which the appurtenances necessary for the production, preparation, or sale of the timber products exist in conjunction with land producing these products."

Private Landowners not by acreage but by the fact that industrial owners have a mill attached to their property. Industrial landowners operate regularly regardless of fluctuations in the timber market, since the presence of a mill and the attendant infrastructure and workforce require cash flow. Large private parcels can be family-owned, but are often investment properties, since owners can take faster action based on timber price and labor costs. Ownership trends have changed significantly in recent years as

self-sufficient, vertically-integrated forest products companies divested themselves of large portions of their landholdings. Few companies now hold forested properties solely to supply raw materials to their own manufacturing facilities.

Many formerly integrated forest products companies have chosen to restructure by separating ownership of their mills and timberland holdings, rather than selling their timberland outright. Income derived from forestlands of a vertically-integrated company are taxed at the federal corporate income rate while those timberlands held for investment pay a dividend that is taxed at the much lower federal capital gains rate. These corporate structures are known as Real Estate Investment Trusts (REITs) and their shares are traded publicly. The laws governing REITs require that 90 percent of all revenue generated must be distributed to the shareholders annually and thus, can present a different set of management objectives than those within which TIMOs operate.

Industrial landowners, although their corporate structures are changing, continue to hold land in generally large and contiguous blocks. These blocks tend to be positioned as a second concentric ring of forestland outward from developing areas, with small forestland owners the first ring. The fate of industrial and small forest landowners are linked in this way, because conversion to non-forest uses by one category of owners will affect the viability of neighboring land.

Focus: State Forest Landowners

DNR has made a significant investment to consolidate and optimize the state trusts' forestlands. The "checkerboard" ownership pattern of statehood land grant has been blocked into numerous large 'state forests', although many dispersed and isolated parcels remain. The position of trust lands is variable within the landscape. In some cases, forests state trust lands are located between industrial forests and US Forest Service lands at higher elevations. In others, DNR-managed forests are next to population centers. While forested state trust lands are not under pressure to convert to non-forest uses in the same way as private lands, forest management can become prohibitively complicated and expensive when surrounding lands are developed.

In 2011, DNR worked with the State Legislature to create a new class of trust lands—Community Forest Trusts. Local community members will identify potential community forests and recommend them to DNR. Using established criteria, DNR will rank the proposals and submit the list to the Board of Natural Resources for approval, after which the ranked list will be submitted to the legislature for funding. Municipalities requesting that adjacent forestlands be included in the Community Forest Trust system are responsible for a local acquisition match amounting to at least 50 percent of the non-timber real estate value of the proposed forest. Each Community Forest will have a working forest management plan, developed by the local community in conjunction with DNR. The plan will include financial, conservation, and recreation objectives. In 2013, the Washington State Legislature authorized funding for the 46,000-acre Teanaway Community Forest, the first woodland to be designated under this system. The Teanaway Community Forest Advisory Committee was established to develop a management plan for the Forest. Community forests could constitute a bulwark against development if the model is adopted by more communities.

Timber Harvest

Of the 16 million acres of Washington forestlands available for timber harvest, 9.5 million acres are west of the Cascade Crest, and 6.5 million acres are located in Eastern Washington. The coastal region is predominately western hemlock forest, while interior western Washington and the foothills of the Cascades are dominated by Douglas-fir and western hemlock. Red Alder is also an important commercial species. The mild temperate climate and deep soils make western Washington one of the best locations in the US for forest growth. Eastern Washington forests contain primarily true firs, Douglas-fir, lodgepole pine, ponderosa pine and western larch, often in mixed stands. Western red cedar can be found in commercially significant forest stands statewide.

Commercial forests in Washington are managed for the harvest of timber primarily for a North American market, with smaller but important international markets as well. A variety of non-timber co-products and services also are produced from these lands, including clean and abundant water, fish and wildlife habitat, a wide range of public recreational activities, floral greens, and biomass for energy.

According to historical data from DNR's annual mill surveys, between 2005 and 2009, timber harvest on all lands declined from a high of 3.57 billion board feet to 2.22 billion board feet. Since 2009, harvest levels have increased to 3.18 billion board feet in 2013. These numbers are eclipsed by the all-time timber harvest high of 7.6 billion board feet in 1926 and 1990's 5.8 billion board foot harvest. In the period between 2005 and 2013, federal land managers were responsible for as little as 2.26 percent and as much as 4.55 percent of Washington State timber harvest. DNR oversaw 28.93 percent of the timber harvest in 2009 before harvest levels fell to a more normal 16.16 percent in 2013. The vast majority of board feet produced in that period was attributable to private forestland owners. Private woodland owners in all categories harvested 83.83 percent of timber in 2006. These landowner's share of the timber harvest dropped steadily before leveling off at 79.65 percent and 79.41 percent in 2012 and 2013, respectively. In no instance did private landowners' participation in timber harvest drop below 64 percent.

Forest Products Manufacturing Industry

Washington State's timber supply is primarily processed by domestic sawmills producing lumber and other building products. In 2002, sawmills used about 61 percent of Washington's timber harvest from combined ownerships. Veneer and plywood mills consumed another 11 percent. Poles and pilings, shake and



Figure A2. Location and Type of Wood Processing Mills by County, from 2012 DNR Mill Survey

shingle mills, and chipping mills producing chips for pulp mills consume another 6 percent. Pulp and paper mills also consume wood residues from sawmills as well as recycled paper. The remaining 22 percent of the timber supply is exported as logs. These forest industry sectors compete to supply a domestic and global demand for forest products, mainly lumber and newsprint.

The number of timber mills statewide continues to decline. In 2002, Washington had about 150 mills. By 2012, the state had lost nearly 1/3 of those facilities, dropping to 105 mills. Wood processing facilities are necessary if the timber industry is to provide living wage jobs in rural communities. Closures happened in all sectors, including sawlog, shake and shingle, roundwood chipping, veneer and plywood, pulp, and post, pole and piling mills. Only the log export sector was stable, with the number of established export log brokers and forest owners remaining roughly the same. High prices paid by China encouraged a few dozen additional large and small forest owners to ship more than 8,214 containers of logs from the port of Seattle (DNR Mill Survey 2014).

The export market has driven a small boom in log exports. Between 2006 and 2012, log exports increased from about 600 million board feet to just over 1 billion board feet. Pulp production has stayed relatively steady, fluctuating between 3.5 million and 4 million tons annually between 2002 and 2012. Post, pole and piling production has risen from 22,000 board feet in 2004 to 60,000 board feet in 2010, before dropping to 50,000 board feet in 2012. All other sectors, including sawlogs, veneer and plywood,

and shake and shingle have posted declines, with shake and shingle suffering the most severe downturn (DNR Mill Survey 2012).

Forest biomass energy is an emerging forest products industry sector that public and private advocates hope will help the existing industry diversify, and rebuild infrastructure where it has been lost. In 2008, DNR undertook an agency initiative to partner with private industry and help jump-start this emerging sector, including the selection of four biomass pilot projects. DNR selected diverse scales for projects as well as diverse technologies and geographic locations in order to test multiple sets of business models and forest management results. In 2010, DNR sought and received authority from the state legislature to update its contracting statutes in order to conduct biomass supply agreements on forested state trust lands. Biomass has the potential to help offset the costs of forest health treatments, a pressing need in overstocked and stressed Eastern Washington forests.

Forest Practices Program

Forest practices on the 11 million acres of State and private working lands in Washington are regulated by the state's Forest Practices Act [chapter 76.09 Revised Code of Washington (RCW)], Forest Practices Rules [Title 222 Washington Administrative Code (WAC)], and the *Forest Practices Habitat Conservation Plan.* These protections are in place to safeguard "public resources" such as water, soil and wildlife during the course of forestry operations, and represent one of the most comprehensive and protective systems in the United States.

Three state agencies, the Washington State Department of Natural Resources (DNR), the Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Ecology (Ecology) work together to implement the Forest Practices HCP. DNR provides the majority of staff positions that help make sure that landowners fulfill their obligations, due to the authority given the department in the Forest Practices Act and Rules. Because maintaining water quality and quantity in forests has been acknowledged as essential to recovering the Puget Sound ecosystem, a newly-formed state agency the Puget Sound Partnership has identified implementing the Forest Practices HCP an essential element of the state's Action Agenda for restoring the health of the Puget Sound.

The major components of the Forest Practices program include:

- The Cooperative Monitoring Evaluation and Research Committee (CMER),
- The Forests and Fish Policy Working Group,
- The Adaptive Management program,
- The Compliance Monitoring program,
- Small Forest Landowner Office,
- The Family Forest Fish Passage Program (FFFPP),
- Forest Stewardship Program,
- Forestry Riparian Easement Program,
- The review of Road Maintenance and Abandonment Plans (RMAPs),
- The development of Forest Practices Board rules and board manuals,
- The maintenance of a complete and accurate hydrographic data layer,

- The review of forest practices applications, and
- Interdisciplinary teams.

Small Forest Landowner Office

Within DNR, the Small Forest Landowner Office serves as a resource and focal point for small forest landowner concerns and policies. The office has a mission to promote the economic and ecological viability of small forest landowners. The office was established in 1999 when new Forest Practices Rules specified increased sizes of riparian buffers and created further measures to protect water quality and restore habitats that help salmon during different parts of their lifecycle.

The Washington Legislature recognized that the Forest Practices Rules would have a disproportionate burden on small, family-owned forests. In an effort to help owners of small forests to retain their forestland and not convert the land to another land use, the legislature authorized a Small Forest Landowner Office to assist small forest landowners and begin assessing ways in which policies could be crafted to support them.

In addition to its many other functions, the Small Forest landowner Office administers two state-funded incentive programs designed to help small forest landowners remain viable: The Forestry Riparian Easement Program and the Family Forest Fish Passage Program.

The Forestry Riparian Easement Program compensates eligible small forest landowners in exchange for a 50-year easement on those lands with "qualifying timber." These include lands required to be left unharvested adjacent to streams, wetlands, stream adjacent unstable slopes, and other sensitive features on their land associated with requirements to protect aquatic resources under Forest Practices Rules. Landowners cannot cut or remove any qualifying timber during the life of the easement period. The landowner still owns the property and retains full access, but has "leased" the trees and their associated riparian function to the state. DNR does not evaluate the merits of Forestry Riparian Easement Program applications. The applications are processed and purchased in the order received, commensurate with available funding. As of March 2015, the state had purchased 312 Forestry Riparian Easement Program conservation easements on more than 5,200 acres of forest land that is adjacent to over 170 miles of streams.

Because eliminating fish passage barriers can be costly, especially for the family forest landowner, the 2003 Washington Legislature established the Family Forest Fish Passage Program (RCW 76.13.150). The program offers technical assistance and creates a cost-share mechanism that provides 75-to-100 percent of the cost of correcting small forest landowners' fish barriers. A fish passage barrier is a human-made structure, often associated with a road crossing, the removal of which can help restore access to miles of vital habitat for salmon and trout populations in decline. Small forest landowners enrolling in the program are required to fix their barriers only if financial assistance is available from the state. Barriers are prioritized, funded and repaired on a "worst-first" basis in order to provide the greatest benefit to salmon and other identified public resources. Lower priority projects remain in the program, a
landowner is relieved of any forest practices obligation to fix a fish passage barrier until the state determines the barrier is a high priority.

The Family Forest Fish Passage Program has corrected 343 fish passage barriers, reconnecting over 763 miles of stream habitat previously inaccessible to fish (DNR 2009a). Despite these accomplishments, the program currently has a list of more than 670 projects awaiting funding (DNR FFFP Implementation Report 2014).

Road Maintenance and Abandonment Plans

Forest Practices Rules include road maintenance and abandonment provisions to prevent sediment and hydrology-related impacts to public resources such as fish and fish habitat. The rules require large forest landowners to develop and implement a Road Maintenance and Abandonment Plan (RMAP) for roads within their ownership. Large forest landowners were required, by July 1, 2006, to have all roads within their ownership covered under a DNR-approved RMAP (WAC 222-24-051) and to bring all roads into compliance with forest practices standards by July 1, 2016. This includes all roads that were constructed or used for forest practices after 1974. An inventory and assessment of orphaned roads (i.e., forest roads and railroad grades not used for forest practices since 1974) also must be included in the RMAP.

In an effort to minimize the economic hardship on small forest landowners, the 2003 Washington Legislature passed a Road Maintenance and Abandonment Plan bill (HB1095) that modified the definition of "small forest landowner" and clarified how the road requirements applied to small forest landowners. Small forest landowners have the option to submit a "checklist" RMAP with each forest practices application or notification, rather than to provide a plan for their entire ownership.

Population and Demographics

The primary driver of conversion pressure is population growth. From 1990 to 2000, Washington's population grew by 21 percent. The next census, in 2010, reported a statewide population increase of 14 percent. Some of that downturn in population growth may be attributable to the recession that struck in the fourth quarter of 2007. Since 2010, the state's population has grown by 4%, adding 336,870 residents. Between 2014 and 2015, the state's population grew by 1.34%, the largest single-year gain since 2008 (OFM 2015).

Population growth's link to conversion threat is most evident in western Washington, where the state is most urbanized. Eastern Washington grew by 53,000 people between 2010 and 2014. Western Washington added 191,000 residents. In percentage terms, western Washington's growth was only one-tenth of a point higher than Eastern Washington's. But those 191,000 residents were added to a land area that is half that of the eastern counties. Western Washington cities are roughly twice as dense as Eastern Washington cities. Cities west of the Cascades are home to, on average, 2,031 people per square mile, while eastern cities have 1,284 residents per square mile. A significantly larger group of people were added to smaller counties whose cities are already dense. Taken together, those factors make conversion threat, particularly for larger developments, much more significant in counties west of the Cascade Mountains.

Threats and Opportunities

Threat: Forestland Conversion

The 2010 Statewide Forest Resource Assessment and Strategy emphasized the threats offorestland conversion. Since then, conversion threats have become even more severe, and the tools to fight them are harder to access due to poor procedural and evaluative tools. DNR's prediction of a conversion wave is driven by several factors, including:

- Aging Small Forest Landowners: Of the 2,680 landowners surveyed by the Sustaining Family
 Forests Initiative, 87 percent are 45 years or older and 38 percent are 65 years or older. As these
 woodland owners retire and find property taxes more burdensome or become too old to
 manage their property—or both—they will be looking for opportunities to sell that will realize
 some level of profit.
- The rebounding real estate market favors sellers in nearly all sectors. Expected revenue from timber harvest is significantly lower per acre than the price per acre for development, which puts significant pressure on small forest landowners or their heirs to sell property, removing it from the acreage of working forests (Rogers and Cooke, 2009).

Fragmentation is an outcome of forest conversion that compromises resource operations, and biological and economic functionality of working lands. There is decreased availability of land to support the necessary business infrastructure—including the mills to process the lumber. Converted forestland no longer falls within the same set of regulations to protect public environmental resources with which working forestlands must comply. This can mean detrimental changes to riparian forests or their outright removal, and inadequately designed and maintained roads. Negative ecological consequences include increased amounts of hardened impervious surfaces, reducing the water storage and groundwater capability of the land, and increasing pollutants delivered into the state's waterways. Habitat is further degraded by reducing important migration corridors and reducing the amount and quality of wildlife habitat available regionally.

Rates of forestland conversion are highest in western Washington along the I-5 and I-90 transportation corridors. These forestlands are located near the major metropolitan and economic areas where population growth is the strongest. These same lands are highly suitable for forestry. They are situated on gentle slopes with an abundance of rainfall and soils capable of producing 120 cubic feet of volume in tree growth per acre per year. Eastern Washington is also experiencing a loss of forestlands. Spokane County ranks as the eighth most densely populated county in the state and is ranked within the top ten counties for timberland loss.

Opportunities

- Build Small Forest Landowner Office infrastructure to increase the capacity to provide technical assistance to landowners in meeting their specific management objectives
- Leverage State and Private forest funding with existing capacity to connect landowners with easement/fee-simple purchase opportunities

- Working with land trusts, local governments, agency staff, and forest landowners to build a onestop-shop for preservation opportunities
- Work with legislature to adjust RCW to offer tax benefits based on provision of ecosystem services
- Incorporate Asset Management Council mapping

Threat: Loss of Economic Vitality

The erosion of a viable forest products industry diminishes landowners' ability to retain their land in working status, and in turn, forestland conversion reduces the effective timber harvest volume available to maintain infrastructure. A University of Washington study (Bradley et al. 2009) predicts that if conversion trends continue in the South Puget Sound region, within 60 years there will be no timber harvest occurring. Five sawmills currently operate in this region and would be unable to source the material needed to stay in business. By 2080, total western Washington sawlog harvests may be reduced by over 1 billion board-feet as a consequence of conversion, a 43 percent decline.

The costs of meeting environmental protection requirements are an additional aspect of economic viability. DNR and the state legislature dedicate significant resources to assisting forest landowners with compliance, completing RMAP work, and compensation for ecosystem services provided by riparian forests through conservation easements. Section G of this assessment, which addresses Upland Water Quality, Quantity and Puget Sound Restoration, describes how other landowners and managers are making significant road- and riparian forest-related restoration investments. Coordination among these landowners and managers is necessary to achieve the desired improvements in watershed condition, but may also afford opportunities to reduce capital outlay and improve economic viability by avoiding counter-productive expenditures and sharing costs, where possible.

Maintaining economic viability is also related to the continued biological productivity of forestlands. As is discussed in the Forest Health Restoration, section D of the Assessment, native insect, diseases and wildfires can incur the loss of stand productivity, if not the stand in its entirety. For many landowners, this represents a significant loss of revenue-generating capability that threatens their economic viability. Preventing, mitigating, and responding to these events contribute to conserving the working forestland base.

Opportunities

- Maintain and develop forest markets and infrastructure
- Maintain a dependable and non-declining flow of timber from unreserved timberlands
- Restore and rebuild timber-dependent rural communities
- Assist forest landowners with meeting environmental protection requirements
- Remove barriers to fish passage from forest roads and increase aquatic habitat availability
- Compensate forest landowners for ecosystem services
- Enhance coordination among forest landowners and managers toward integrated watershed restoration outcomes

- Protect productivity and function from forest health threats
- Urban wood utilization
- Work with counties and local government to increase the number of very large diameter mills
- Non-timber forest products

Threat: Climate Change

Another form of conversion is predicted to affect Washington forestlands in the form of significant shifts in forest ecosystem types, productivity, and disturbance patterns caused by climatological and environmental change.

The research community dedicated to studying climate change has begun to shift its message from prevention to adaptation, led by the International Panel on Climate Change (IPCC). Current climate projections suggest that between 3.3 and 9.7 degrees of warming degrees of warming will occur by 2070 to 2099. Mid-range warming levels would generate stream flow and forested ecosystem disruptions that would ripple across the natural systems that underpin Washington's economy and public health, and that form the basis of DNR's trust mandates.

Stream Flows

By 2080, the timing of peak stream flows in Washington is projected to shift from mid-June to February (Snover et al. 2013). Moreover, the highest stream levels will drop from about 11,000 cubic feet per second (CFS) to less than 10,000 CFS. While northwest streams that receive most of their inputs from snowmelt runoff may be less sensitive to warming due to the temperature of the snowmelt, declines in snowpack over time will lessen that buffering effect. Such dramatic shifts in water supply and timing may have long-term effects on already stressed fish populations and rural communities.

Forests

Northwest forests will see potentially severe changes caused by climate change. Many impacts will be the result of lengthening and deepening periods of dryness. Long periods of water deprivation increases stress on trees, which makes them vulnerable to insects and diseases. Resulting mortality and defoliation increases the instance and severity of wildfire in the Northwest. In the absence of treatment and adaptation strategies, managing the impacts of fire will consume increasingly greater shares of DNR's resources and impact agency trusts. Predicting the kind and rate of change within complex systems is difficult. But significant increases in temperature, changes in the timing and volume of water delivery, extension of the period when trees are vulnerable to pathogens and insects, and fluctuations in the chilling/forcing cycle necessary to the vigor of many tree species will change the composition of Washington's forest communities. Due to the inexact nature of forest composition projections, DNR will focus its efforts on preserving essential ecosystem functions and services rather than attempting to preserve specific forest types and tree species.

The area burned by wildfires within the interior Columbia River basin in the United States is predicted to double within 10 years, from an average 425,000 acres annually to 800,000 acres annually. Larger

increases are projected for the ensuing decades. This pattern can be anticipated to release more carbon and other pollutants into the atmosphere, as well as reduce the carbon stored in above-ground forest biomass.

Forest health and fire, which are exacerbated by climate change, are key elements of a climate adaptation strategy. Helping a diverse set of landowners treat their landscapes to promote forest health and mitigate the worst impacts of fire has adaptation benefits and increases the likelihood that those landowners will be able to stay on their landscapes. Keeping landscapes in working forest not only preserves long term economic value, but retains ecosystem services that will be increasingly central to the Washington's habitability and quality of life in coming decades.

Further, working forests play several roles to mitigate the impacts of climate change:

- Carbon Sequestration: Healthy Forests, whether working or reserved, use photosynthesis to break down carbon.
- Water Quality Protection: Soil held in place by living tree roots filters water before it enters streams. Heavier-than-normal rains, periods of heavy rain followed by drought, and increasing numbers of rain-on-snow events are all potential products of a changing climate and highlight the need for more reliable water storage and filtration.
- Flood prevention: Surges of water into broad, shallow river valleys cause frequent flooding across Western Washington. Standing forests slow rain delivery into streams, allowing more time to absorb inputs into the system.

Opportunities

- Plan adaptation tactics that focus on key ecosystem function measures: water quality and storage, flooding prevention, air quality, carbon storage, and wildlife habitat/biodiversity potential
- Work with public and private stakeholders to develop biofuels and other alternative energy sources from DNR lands not suitable for trust forestry
- Assist small forest landowners in efforts to adapt to the impacts of climate change
- Seek out and develop new ways to store water for community use and forest health

RELEVANT NATIONAL THEMES AND STRATEGIC OBJECTIVES

The Working Forestlands and Conversion area falls into the National Themes "Conserve working forest lands" and "Enhance public benefits from trees and forests" from the State and Private Forestry Redesign structure. It will be addressed through three strategic objectives—"Identify and conserve high priority forest ecosystems and landscapes," "Actively and sustainably manage forests," and "Maintain and enhance the economic benefits and values of trees and forests."

EXISTING STRATEGIES

The following programs, strategies, and efforts are underway to conserve working forestlands by addressing the multitude of forces that threaten their persistence.

State Trust Lands Working Forest Landscapes

In 1998, the Board of Natural Resources adopted for state trust lands an *Asset Stewardship Plan*, which provided a summary of DNR's process for land asset planning and a recommended strategy for assuring the future value of these assets. This overall approach is reflected in DNR's *Asset Allocation Strategy for Washington Upland Trust Lands* (2003) that, among other things, guides the acquisition and disposal of forested state trust lands. Recent updates to the strategy evaluated region-by-region forestland conversion pressures and the ability to continue effectively generating trust land revenue. A set of asset designations was developed that included long-term forests, interim "hold and manage forests" and conservation areas. From these, long-term "working forest landscape" boundaries were developed around blocks of forested state trust land.

Forestry and environmental leaders in Washington have discussed the concept of how the core of a stable working landscape could form an "anchor" around which efforts to protect lands at risk of conversion may be successfully focused. DNR-managed state trust lands represent a fixture of stable land ownership, and, owing to their sustainable harvest mandate, can be counted upon to continue supplying wood products that support manufacturing infrastructure.

Forest Practices Program

The Forest Practices Program and HCP provide a framework of environmental and economic sustainability for working forestlands in Washington State. The Forest Practices HCP provides certainty in the regulatory environment and allows forest landowners to plan their business operations. An important element of the original 1974 Forest Practices Act that endured through the Forests and Fish discussions and the Forest Practices HCP is to require a balance between protecting public resources and the continued economic viability of forestry in Washington.

In addition to incentive programs like the Family Forest Fish Passage and the Forestry Riparian Easement Program that help ease the costs of regulatory burden on small forest landowners, provisions also were developed in the rules to allow long-term forest practices applications. Normally, the application process can be complex and time consuming and approved applications are valid for two years. As an incentive to keep land in forestry use, the Forest Practices Board authorized a long-term application that is valid for up to 15 years. These can reduce the amount of paperwork over the long term, allow more flexibility to react quickly to changing markets and unforeseen forest health problems or natural disasters, and encourage long-term planning.

Working Forestlands Data and Research

The University of Washington Rural Technology Initiative produced a *Washington State Forestland Database* (Rogers and Cooke 2010) and subsequent report on the *Retention of High-Valued Forest Lands at Risk of Conversion to Non-Forest uses in Washington State* (Bradley et al. 2009).

The Washington State Forestland Database maps quantify the location and features of forestlands at individual parcel levels as small as one acre. Data were assembled from County Assessor's Offices and included attributes in the state's 39 counties, and then were normalized into a common statewide format. These parcels were then compared to satellite imagery to verify forest cover. Knowing the location and distribution of various landowner types informs policy decisions designed to retain working forestlands and enables better targeting of incentives

Both the Washington State Forestland Database and the Retention Report are reaching the end of their usable lives. In order to continue deploying these tools and track changes in land ownership patterns over time, DNR will need to procure resources to refresh data and plan for ongoing updates. There is strong interest in revisiting these data and building a more up-to-date picture of conversion rates and projections, but project funding has not been identified.

USDA Forest Service State and Private Forestry Programs

Forest Stewardship Program

The Forest Stewardship Program provides technical assistance to small forest landowners, including the development and implementation of Forest Stewardship Plans. Stewardship Plans are a prerequisite for many sources of funding for forest management, improvement and conservation programs, and demonstrate a commitment to continued forest use by the landowner. Through the process of plan development and the assistance services provided by the program, landowners become more educated about forest ecosystems and their management, and are able to articulate a set of goals and objectives for their land. Assistance provided by Forest Stewardship Program staff integrates information from several disciplines and programs. For example, the Forest Stewardship Program is the primary source of delivery of forest health, wildfire hazard reduction, wildlife habitat management, forestry information and technical assistance to small forest landowners.

In addition to their technical assistance function, Forest Stewardship Program Staff routinely support Washington State University Extension education programs for small forest landowners across the state. A relatively minor portion of program funds is used annually to support DNR's tree improvement program which helps to ensure the availability of high quality seedlings for state trust lands and small forest landowner properties.

Forest Legacy Program

Since 1993, Washington State has participated in the federal Forest Legacy Program to protect environmentally important forestland from conversion. The program is administered by the USDA Forest Service, and the state's participation in the program is managed by DNR. Each participating state is required to prepare an Assessment of Need. For the purposes of this assessment and strategy, the 2004 Washington Assessment of Need (DNR 2004) is incorporated without modification and remains the basic guidance under which Forest Legacy operates. The Assessment of Need details Washington's need for inclusion in the Forest Legacy Program and defines how the program will be applied in the state. The 2004 assessment revised the eligibility criteria used to identify important forested areas to be included as a Forest Legacy Area (the area in which the Legacy Program is to be applied); proposed boundaries for the Forest Legacy Area; specific goals and objectives to be accomplished by the program in Washington State; and the process that DNR will use to evaluate and prioritize projects to be considered for inclusion in the Forest Legacy Program. The Assessment of Need expresses the following overall program goals:

- 1. Provide present and future timber management opportunities;
- 2. Protect water quality;
- 3. Provide habitat for native fish, wildlife or plants;
- 4. Protect existing landscapes to discourage further fragmentation;
- 5. Incorporate federal program goals when evaluating proposals to ensure Washington's projects meet the intent of the authorizing legislation.

The Assessment of Need also designated a "Forest Legacy Area" that includes all forestlands lying outside designated urban growth areas, but within watersheds containing lands with at least one household unit per 40 acres (with some adjustments for low-risk landscapes). Drawing on all lands within those identified watersheds, Priority A lands were mapped as those with less than one household per 40 acres; Priority B lands contained more than one per 40 acres.

Since 1995, the Forest Legacy Program has permanently protected nearly 50,000 acres of working forestland in Washington State, primarily through the acquisition of conservation easements.

Land Use Planning

Land use planning manages human development on forest lands. This development drives land conversion and the subsequent loss of economic and ecosystem services provided by those forests. In response to Washington's rapid growth, the Growth Management Act (Revised Code of Washington [RCW] 36.70A) was passed in 1990. It requires all cities and counties in the state to conduct growth management planning. In the fastest growing areas, cities and counties are required to plan extensively to reduce sprawl and concentrate urban growth, while planning for open space and recreation, environmental protection, natural resource industries, and shoreline management. Even cities and counties with slower population growth are required to classify and designate resource lands (including forests), and critical areas (including wetlands and habitat conservation areas).

The Growth Management Act is an important way for communities to designate areas where they would like to maintain forests and maintain forestry as a viable part of the natural resource economy.

Designated lands carry zoning and taxing ramifications that may aid in maintaining the economic viability of working forests. Forest resource lands additionally provide crucial ecosystem services (including water quality and carbon sequestration) to those communities – services which are likely to become increasingly valuable in the context of emerging ecosystem services markets.

The Washington Growth Management Act encourages the use of land use management tools to meet the stated goal of conserving productive forests and agricultural lands and discouraging incompatible uses (RCW 36.70A.020(8)). One such innovative tool, known as "transfer of development rights", encourages the voluntary transfer of growth from places where a community would like to see less development (referred to as "sending areas") to places where a community would like to see more development (referred to as "sending areas"). The "Regional Transfer of Development Rights Program", administered by the Washington Department of Commerce, is focused on the development of a regional program for four quickly-growing central Puget Sound Counties (King, Kitsap, Pierce and Snohomish), and the 71 cities within their boundaries. It builds upon existing transfer of development rights programs, pilot projects, and private initiatives through the creation of a market-based regional program. The largest existing transfer of development rights over 92,000 acres of rural, agricultural and forest land since 1998 (Washington State Department of Community, Trade, and Economic Development 2008).

Forest Biomass Markets

Washington's forests have an abundant, renewable supply of woody biomass. Using some of this material for liquid transportation fuel, heating, and electrical power generation will play an important role in Washington's emerging green economy and help to address climate change. Removing biomass from forests in ecologically sustainable ways can provide income for forest landowners while improving forest health, creating jobs in rural parts of the state, and reducing wildfire risk and greenhouse gas emissions.

In 2009, the Washington State Legislature passed HB 2165, authorizing DNR to implement forest biomass-to-energy pilot projects. The goal of the biomass initiative is to fill a void in convening public-private partnerships among forest biomass suppliers, biomass purchasers, energy producers, communities and state agencies to utilize biomass materials for renewable energy generation.

In 2010, DNR requested, and the legislature passed, a forest biomass supply agreement bill (2SHB 2481) that will allow the agency to enter into long-term biomass supply agreements with the emerging biomass energy economy. The ability to secure reliable and predictably priced biomass feedstock supply removes a major obstacle to maximizing the benefits of the emerging biomass energy economy. However, with natural gas priced at \$2.62 per million BTU and oil at its lowest price since 2009, markets for biofuels and renewable energy sources are very soft. While these conditions will not hold permanently, investments are needed now to develop cost-effective, site specific biomass generation technologies.

Ecosystem Services Markets

Forests can provide "ecosystem services" like stabilization of water flows, purification of air, provision of wildlife habitat and biodiversity, and storage of carbon from the atmosphere (see below). Some of these services are necessary to provide basic protection of public resources such as water and air quality and threatened or endangered species. In Washington State these functions are protected through the regulatory authority of the state and federal government, for example through the State Forest Practices Act and Federal Endangered Species Act. Beyond these regulatory protections, society has an interest in restoring and perpetuating ecosystem functions in a way that benefits forest landowners. In some cases, this could entail the creation of market mechanisms that allow society or specific benefiting entities to pay landowners for providing those benefits. Such ecosystem service market payments, or similar payments originating in government incentive programs, could be an important way to retain forest lands in forest uses. Washington State has a history of working to develop ecosystem service markets, including passage of state legislation, non-profit initiatives, and university-based research.

Carbon Sequestration Markets

One forest ecosystem service currently of great relevance is the absorption of carbon dioxide from the atmosphere through tree respiration and growth, and the long-term storage of carbon in plant tissues, especially wood, which continues in long-lived wood products. This forest carbon "sequestration" plays a crucial role in mitigating the atmospheric build-up of carbon dioxide and other greenhouse gasses contributing to climatological and environmental change.

Washington State has been among the leaders in the nation in advancing discussions of market mechanisms for forest carbon sequestration. Significant initiatives include the 2007 State Climate Advisory Team, passage of E2SHB 2815 by the 2008 Washington Legislature, Washington State Leadership of the Western Climate Initiative, leadership in discussions leading to the Western Forestry Leadership Coalition's 2009 adoption of its Position Statement, "A Framework for Forests and Climate Change," and the 2008 consensus stakeholder recommendations to the legislature for forest carbon offsets and incentives. The State currently is re-engaging a broad-based stakeholder group to develop further recommendations, pursuant to a 2009 Governor's Executive Order and 2010 legislation.

DATA AND PROGRAM GAPS

- Drivers for Conversion Decisions: Quantitative economic and social considerations that drive conversion decisions among small forest landowners.
- Economic Viability: Quantitative data and indicators for threshold levels of economic viability of small and large forest landowners. Qualitative information is available. However, there is a low level of decision certainty for specific strategies to maintain economic viability.
- Climate Change: Landscape-scale projected changes in statewide forest vegetation types under varying future climate scenarios.

Wildfire Hazard Reduction

INTRODUCTION

Wildfire threatens the people and resources of Washington State. Since 2005, on average \$18.5 million is spent each year suppressing wildfires on state and private forestland in Washington (Buechel, 2015), excluding the as-yet-uncertain cost to fight 2015's record wildfires. Although final calculations will not be complete until after this Plan's publication, the final cost of fighting wildfires in 2014 will likely reach \$96 million—double the second most expensive year. Millions of acres of productive forestland, and human safety and property are at stake.

History of Wildfire Protection in Washington

A compulsory state fire control law was enacted in 1917. The law required each forest landowner to provide acceptable fire control and prevention for their forestland, or pay an "in lieu" annual per-acre fee for the state to provide this service. Forest landowners also were required to abate slash hazard conditions or be charged for abatements costs. This compulsory fire control law created the first voluntary forest patrol assessment option for

private forest landowners (DNR 2006).

In 2014, an extraordinarily hot, dry summer combined with multiple lightning strikes to ignite the four fires that, strengthened by high winds, combined into the Carlton Complex. Firefighters at the federal, state, county, and municipal levels fought the blaze, but were stretched by other fires across the state. This massive wildfire burned more than 330,000 acres, or more than 550 square miles. Total suppression costs for all 900 fires under DNR protection in 2014 are likely to reach \$96 million.

Fiscal Year	All Funds		
2015	\$96,000,000 ¹		
2014	\$31,058,000		
2013	\$47,220,800		
2012	\$13,281,600		
2011	\$16,361,900		
2010	25,874,200		

Table F1. Total Wildfire Suppression Costs2010-2015¹ Estimated

Wildfire Protection Responsibilities

The Washington State Department of Natural Resources (DNR) is responsible for protecting 12.7 million acres of the roughly 22 million forested acres in the state. Of the forestlands DNR protects from fire, 10 million acres are privately owned, just more than 2 million acres are state-owned forests, and the remainder a portion of tribal lands. The federal government is responsible for protecting roughly the same amount, 12 million acres (both forested and non-forested federal lands).

Washington State law directs that DNR's primary wildfire protection mission is protecting forest resources and suppressing forest fires, second only to saving lives. In addition, it defines the primary mission of rural fire districts and municipal fire departments as protecting and suppressing structural fires (DNR 2006).

Within their jurisdiction, local fire districts are responsible for suppressing all fires. There are many instances in which both DNR and fire districts protect the same acre. In these areas, landowners pay both the fire district levy and the state's forest fire protection assessment. Typically, fire districts do not pay DNR for its assistance; however, under some circumstances DNR may pay fire districts for their assistance. The relationships are defined by a series of bilateral agreements between the fire district and DNR. The lack of a uniform agreement has led to policy and operational complications. As agreements expire, DNR is working to negotiate more uniform agreements.

When local fire districts are overwhelmed and homes are threatened in their protection district, the Washington State Patrol can declare a State Mobilization. By law, the focus of State Mobilization is the protection of structures (buildings). Given the tactical realities of protecting structures that are in a forested setting—the wildland-urban interface and elsewhere—they also may fight the wildland portion. In a State Mobilization, DNR often is involved in suppressing the wildland portion of the overall fire, but not in the actual fighting of structural fires.

Conditions and Trends

Identified Wildfire Risk Areas

Three main categories of forests in Washington are identified as having a high risk of wildfire. Those are the Eastern Washington dry forests, mountain gap wind zones, and the San Juan Islands in the Puget Sound.

Eastern Washington Dry Forests

The majority of fire starts and acres burned occur in the dry forests of Eastern Washington. Since 2010, sixty eight percent of fire starts and ninety nine percent of wildfire acres burned on DNR protected lands occurred in Eastern Washington (DNR 2006). In addition, 1.1 million acres of forest land protected by DNR in Eastern Washington is classified as fire regime I or II (Eisfeldt 2010). These areas historically experienced wildland fires every thirty years or less. Due to forest growth, past forest management practices, and the reduced role of natural fire, a significant part of the Eastern Washington forest landscape is at elevated risk of large, severe wildfires. One method of quantifying increased risk is Fire Regime Condition Class, which combines fire regime data with a metric for present-day conditions in terms of their



Figure F1. Fire Regime Condition Class — departure from historic fire patterns — in Eastern Washington State

degree of departure from historical reference conditions — i.e., how prone to wildfire forestlands are as a result of changes to the natural forest landscape.

From among the nearly 9 million acres of forested land in Eastern Washington, 6.2 million are at moderate or high departure Fire Regime Condition Class (Figure F1). When these areas experience wildfire in the future, fires have a greater potential to be large and severe. Applying prescribed fire or other fuel reduction treatments can restore forest stand conditions to a state of greater resiliency against severe wildfires and moderate wildfire behavior. This is the area of focus for most community wildfire planning efforts and fuel reduction projects.

Mountain Gap Wind Zones

The Cascade Mountain range creates an effective barrier to wind flow across the state. This results in wind funneling through gaps in the mountains at low points. Key areas of concern include the Columbia Gorge, Stampede Gap, Kittitas Valley, and the north and south sides of the Olympic Mountains. Sustained winds in these areas regularly exceed thirty miles per hour. The Enumclaw area in the western Cascade foothills experiences an average of five episodes of 50- to 80-mile per hour winds each year (Mass 2008). These winds can sustain wind-driven fires during any season of the year. Community wildfire planning and fuel reduction efforts in Western Washington focus on these areas.

San Juan Islands

While fire occurrence is low in Washington's San Juan Islands, these areas present significant wildfire risks. The islands lie in the rain shadow of the Olympic Mountain Range. Some of the islands are exposed to gap winds flowing through the Strait of Juan de Fuca, similar to winds in the Cascade Mountains. The need to travel by boat also delays wildfire response when outside resources are needed. Understandably, residents of the islands are very concerned with wildfire and are strong proponents of fire prevention. Many of the recognized 'Firewise Communities' in the state are on the San Juan Islands.

Contributing Factors

Climate Change

NOAA weather data show that Yakima is experiencing a 2.9 ° C deviation from mean temperature and projections suggest a greater likelihood that this summer will be warmer and dryer as opposed to colder and wetter. The historic wildfires of 2014 propagated under similar conditions. While no one weather event or season that deviates from the mean can be attributed to climate change, climatologists have observed a trend toward less frequent precipitation and warmer overall temperatures, particularly in Eastern Washington. DNR Northeast Region Manager Loren Torgerson chronicled some of these effects in the Omak Chronicle:

"By July, our forests were sucked clean of moisture by strong, swirling winds . . . Temperatures rose to 104 degrees July 16 . . . Winds rose to 30 miles per hour and extreme heat continued July 17."

The Climate Impacts Group projects that, even if we curtail our carbon output, climatological and environmental change will continue until excess carbon in the atmosphere is resolved. If that is the case, then the general trend of hotter, drier weather and less-frequent but more-intense storms, laden with freights of lightning in Eastern Washington will continue into the foreseeable future.

Forest Health

The exacerbating effect of forest health on wildfire is discussed in Section G of this document. Once dead or defoliated, crowded small-diameter trees are high-quality fuel, encouraging fire starts from lightning strikes to propagate from the forest floor to the crown, adding intensity and heat as they climb. These very hot blazes, whipped on by fire-created winds, can leap fire breaks, rivers, and highways and can burn intensely through shrub steppe. Again, Loren Torgerson aptly characterizes our current forest health crisis: "The circumstances that created the Carlton Complex began with years of drought in our region. Stressed forests, with their insects and disease, have produced the fuel that makes fires explosive."

Forest health treatments that involve thinning small trees, reduce fuels, and create openings are the same techniques used to decrease the size and intensity of wildland fires.

Conversion

DNR's firefighting responsibilities are limited to private and state forestland, and do not include fighting structure fires. Nor are DNR's firefighters trained or equipped to fight structure fires. Nonetheless, as forestlands are converted to other uses, the area of wildland urban interface (WUI) expands, making firefighting more complicated. According to Torgerson:

"Over the years, homes built in these high-risk environments have added complexity and resource demands for structural and wildland firefighters alike."

DNR reduces the risk of firein the WUI by working with individual landowners, municipalities, and counties to assist the public in preserving their homes through landowner assistance programs, Community Wildfire Protection Plans, and Firewise Community efforts. DNR also assists municipal and local fire departments in obtaining firefighting equipment and training firefighters.

Wildfire Starts and Acres Burned

Table D1 shows the number of fires and acres for calendar years 2009 through 2014 (DNR 2014). The 2014 fire season was characterized by low moisture in forests statewide, very hot temperatures, high winds, and dry lightning.

	DNR Pro	otected Lands	All Lands	
Calendar year	# Wildfires	Acres Burned	# Wildfires	Acres Burned
2009	994	12,785	1,694	89,301
2010	560	25,487	972	28,698
2011	549	7,603	1,634	303,289
2012	791	68,333	1,571	182,192
2013	764	78.373	1,426	126,108
2014	899	77250	1,976	315,036
6 year Average	760	92,559	1,546	126,517

Table F2.	Total annual number	of fires and acres	burned in Washingto	on State, 20	009-2014 (DNR 2010a)



Figure F2. Trend in wildfire starts and acres burned in Washington State on all lands since 2005 (Includes federal, state, local public, tribal and private lands)

This mirrors a national trend wherein large, complex and severe fires have become more common. The objective of much of DNR's work with private landowners and communities is to make them more fire-safe, and less likely to be damaged or destroyed in a wildfire. Tracking the trend in the number of homes damaged or destroyed can provide some insight to the status of efforts to help communities prepare for wildfire.

Population Growth

Population growth will shape the future of wildland fire protection. Nationally, nine percent of the land area of the United States and thirty-one percent of homes are in the interface, and growth rates within the wildland-urban interface are triple the rates elsewhere. Forecasts for Washington show the population increasing by almost 2.4 million between 2006 and 2020. This means that there will be some 600,000 new dwelling units, many of which will be single-family homes located in the wildland-urban interface.

The largest areas of forested wildland-urban interface are concentrated in counties with major population centers in Western Washington. However, Eastern Washington has counties with some of the largest areas of undeveloped forests. When coupled with high rates of population growth and frequent return interval fire regimes, Eastern Washington represents the highest future risk to human safety and property loss in the wildland-urban interface.

Not only is the population growing, more people also are acquiring second homes. As more homes are built in the wildlands, the land becomes less "wild" but still exposed to substantial wildfire risk. The risks often are compounded by the interaction of forest health issues and effects of climate change. Substantially increased fire protection capabilities are necessary to adequately protect life, developed property and forest resources.

See Section E of this assessment for a more detailed discussion of population growth.

Forest Health

Trends in forest health, particularly in Eastern Washington forests, and their role in exacerbating wildfire risk is well documented. For more on the relationship between forest health and wildfire, see section D Forest Health Restoration.

THREATS AND OPPORTUNITIES

Threat: Human Safety and Property Loss/Increased WUI development

Public and firefighter safety is DNR's overriding concern when coordinating wildland fire response and fighting fire. Fires that burn out of control threaten people, structures and forest assets.

The combined resources of firefighting units at all levels of government may not be sufficient to immediately suppress a large wildfire burning out of control. Prevention actions that protect the public, structures, and natural resources and provide strategic options for firefighting make a difference.

Opportunities

- Actively disseminate expertise on clearing defensible spaces around homes in the WUI
- Reduce fuel loads in Eastern Washington forests
- Build DNR's wildland firefighting force
- Improve and enhance force training to protect firefighter and public safety
- Properly equip all wildland firefighters
- Reduce the rate of forest conversion
- Partner with local communities and regional partners to develop and implement Community Wildfire Protection Plans and promote the FireWise program
- Evaluate fire suppression and treatment tactics to ensure resource and property protection without compromising public or firefighter safety

Threat: Deteriorating Forest Health/Reduce Fuel Loads

Fires in overcrowded, stressed, diseased, and dry Eastern Washington forests burn hotter, larger, longer, and more frequently than the fires to which these forests are adapted. Very hot fires can sterilize soils, preventing trees and other plants from growing back. When burns occur on hillsides, bare, damaged soils are slide prone and dangerous to communities and to wildlife species that depend on clean and cold water. These effects may prevail for decades.

For a fuller discussion of the effects of forest health on wildland fire, see Section D of this Document, concerning Forest Health.

Opportunities

- Reduce fuel loads in Eastern Washington forests using best available science to prioritize projects
- Restore ecological integrity, appropriate density, structure and species composition to overstocked Eastern Washington forests
- Integrate fuel reduction activities with forest health improvement actions
- Partner with multiple landowners and managers to achieve landscape-scale forest health restoration objectives
- Use prescribed fire to restore and maintain fire-resistant stand conditions

Threat: Climate Change

Climate change is anticipated to have a significant impact on wildfire occurrence and severity in Washington. The Washington Climate Change Impacts Assessment (Climate Impacts Group 2009) reported that:

Due to increased summer temperature and decreased summer precipitation, the area burned by fire regionally is projected to double by the 2040s and triple by the 2080s (relative to 1916-2006). The probability that more than two million acres will burn in a given year is projected to increase from 5 percent (observed) to 33 percent by the 2080s.

Projected changes in precipitation and temperature patterns will likely put trees under greater moisture stress and cause declines in forest health. For more on climate change impacts to forest health, please see section D.

Opportunities

- Restore and maintain forest productivity and the carbon sequestration value of forests for climate change mitigation
- Manage forest ecosystems to increase resilience to a changing climate

Threat: Loss of Forest Markets

At the same time wildfire hazard and forest health conditions have been worsening in Eastern Washington, landowners' and managers' ability to address the problem has also diminished. Forest manufacturing infrastructure that once could pay for the removal of trees from thinning, harvest and restoration actions has been reduced. Without markets for forest materials, large-scale improvements in forest health and fuels conditions are more difficult.

Opportunities

- Maintain and develop forest markets and infrastructure
- Collaborate with public and private partners to take advantage of non-traditional forest products markets, such as biomass

RELEVANT NATIONAL THEMES AND STRATEGIC OBJECTIVES

The Wildfire Hazard Reduction issue area is reflected in two National Themes "*Protect Forests from Harm*" and "*Enhance Public Benefits from Trees and Forests*" from the State and Private Forestry Redesign structure. Wildfire risks will be addressed through two Strategic Objectives — "*Restore fire-adapted lands and reduce risk of wildfire impacts*" and "*Assist communities in planning for and reducing wildfire risks*."

Existing Strategies

National Cohesive Wildland Fire Management Strategy

Title C, section 503 of the 2010 Interior, Environment and Related Agencies Appropriations Act, cited as the Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME Act of 2009), directed the Secretaries of Interior and Agriculture to submit to Congress a cohesive wildfire management strategy consistent with recommendations described in reports of the Government Accountability Office.

As a result of collaboration by federal, state, local, and tribal governments and nongovernmental partners that incorporated data analysis and geospatial work, the Departments published *The National Strategy: The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy.* The Strategy identifies a vision for the next century:

To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.

National goals that are necessary to achieve the vision are:

Restore and maintain landscapes: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
Fire-adapted communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.
Wildfire response: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

Stakeholders established the following guiding principles and core values for wildland fire management to guide fire and land management activities:

- Reducing risk to firefighters and the public is the first priority in every fire management activity.
- Sound risk management is the foundation for all management activities.
- Actively manage the land to make it more resilient to disturbance, in accordance with management objectives.
- Improve and sustain both community and individual responsibilities to prepare for, respond to, and recover from wildfire through capacity-building activities.
- Rigorous wildfire prevention programs are supported across all jurisdictions.
- Wildland fire, as an essential ecological process and natural change agent, may be incorporated into the planning process and wildfire response.
- Fire management decisions are based on the best available science, knowledge, and experience, and used to evaluate risk versus gain.
- Local, state, tribal, and federal agencies support one another with wildfire response, including engagement in collaborative planning and the decision making process that takes into account all lands and recognizes the interdependence and statutory responsibilities among jurisdictions.
- Where land and resource management objectives differ, prudent and safe actions must be taken through collaborative fire planning and suppression response to keep unwanted wildfires small and costs down.
- Fire management programs and activities are economically viable and commensurate with values to be protected, land and resource management objectives, and social and environmental quality considerations.

2020 Strategic Plan for Wildland Fire Protection

In 2006, DNR completed its first comprehensive review of the agency's Wildfire Protection Program since 1986. Within those two decades, much had changed on the 12.7 million acres of forests protected by DNR. An additional 1.6 million people, a 40 percent increase in population, resulted in more homes in the woods that often don't have any fire protection. Past fire suppression and harvesting methods substantially reduced the health of our forests. The results are increased risks to public and firefighter safety, increased costs of fire suppression, and accelerated losses of productive soils, important habitats, and timber values.

The DNR worked with an internal advisory committee to develop the *2020 Strategic Plan for Wildland Fire Protection* in 2006. The 2007 Legislature directed DNR to create a broad-based, multi-stakeholder group to review previous studies of DNR Fire Programs (including the Strategic Plan); examine the current funding mechanisms of fire programs for appropriateness and adequacy; and look at future challenges and opportunities. This group was called the Forest Fire Prevention and Protection Work Group (Workgroup). The 2006 Strategic Plan and 2008 *Forest Fire Prevention and Protection Work Group Recommendations* (DNR 2008) include the following elements:

 Focus on forest health: Forest health and wildfire are closely connected. Our understanding of the role that fire plays in healthy forests is increasing. Forest health issues cross ownership boundaries, and efforts must be made to address how landscape level forest health improvement efforts can reduce public costs and protect resources.

- Focus on evaluating near-term investments against long-term savings: There are substantial savings to taxpayers and the public when wildfire fuels reduction projects are completed. Substantial costs can be avoided when both market and non-market values are part of wildland fire protection decisions. A "net cost" framework provides a method to evaluate solutions that recognize the various types of risk.
- Focus on personal and institutional responsibilities: Landowners, communities, governmental
 entities and the public each have different responsibilities for wildfire protection. Decisions by
 individual property owners and land-use or other regulatory authorities can reduce or increase
 costs and risks to private property and the public. There is a strategic priority to assist entities
 with understanding and fulfilling their respective roles, so that each may be working toward an
 effective and comprehensive system of wildfire protection.
- Development of a Model Wildfire Protection Ordinance: With more than 600,000 new homes to be built in Washington by 2020, actions taken today can reduce future wildfire protection costs and risks to public safety. The strategic plan calls for collaboratively developing the elements of a model wildfire protection ordinance that can be used throughout the state.
- Create Universal Fire Protection: Current state law does not require fire protection, creating tension for both property owners and those who provide fire protection services. Organized and funded fire protection should be required for all land in Washington.

U.S. Forest Service State and Private Forestry Programs

Community Wildfire Protection Plans

Washington has 58 Community Wildfire Protection Plans (CWPP) in 25 counties. These plans define actions to be taken by communities and landowners, as well as recommendations for state and federal land managers. At a minimum, Community Wildfire Protection Plans must:

- be collaboratively developed by local and state government representatives, in consultation with federal agencies and other interested parties,
- identify and prioritize areas for hazardous fuel reduction, and
- recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan.

Copies of all completed plans are available at the DNR website.

Wildland-Urban Interface Wildfire Fuel Reduction Projects

DNR collaborates with other state and local partners to administer funding received through the Western State Fire Managers' wildland-urban interface grant program and the Community Assistance Grant Program under the Pacific Northwest National Fire Plan. These programs help private forest landowners accomplish hazardous fuel reduction projects identified as priorities in community wildfire protection plans. Since 2001, 727 projects have been completed, and an additional 226 projects are planned and funded. Many more landowners apply for assistance each year for projects identified in Community Wildfire Protection Plans than can be funded (Harris 2010).

Firewise Communities/USA

The Firewise Communities/USA program (National Fire Protection Association 2010) encourages and acknowledges actions by communities that minimize home loss to wildfire. Firewise Communities/USA is a simple, 'three-legged' template that is easily tailored to different size communities and locations. It works in the following way:

- DNR staff or other wildfire specialists provide a community with information about living with the threat of wildfire, including specific ways to mitigate wildfire risks for that particular community.
- The community assesses its own wildfire risk and creates a community network of cooperating homeowners, agencies and organizations.
- The community identifies and implements local solutions.

Washington currently has 136 certified Firewise communities, more than any other western state. The recognized Firewise Communities in San Juan County, WA are shown in Figure F3.

Fire District Assistance

In areas served by fire protection districts, volunteer firefighters frequently are the first responders to wildfires within their boundaries. DNR supports fire districts with this responsibility through administration of the Volunteer Fire Assistance and Federal Personal Property Programs. These U.S. Forest Servicefunded programs provide fire



Figure F3. Recognized Firewise Communities in the San Juan Islands

districts with training, equipment and vehicles needed to suppress fires while they are still small, saving natural resources, money and property. Through these programs, DNR has provided more than 500 firefighting vehicles to fire districts. These programs provide crucial assistance, as 80 percent of replaced vehicles are more than 20 years old and reaching the end of their useful lives for fighting wildfires (DNR 2010b).

Restoring Fire-Adapted Lands across Ownerships

Several collaborative efforts are underway in Washington to restore the health of the fire-adapted lands generally east of the Cascade Range to reduce the risk of uncharacteristic and catastrophic wildfire across these landscapes.

Teanaway Community Forest

The Teanaway is characterized by smaller diameter trees growing close together in heavy understory. These conditions make trees susceptible to insects and disease and more likely to burn catastrophically should they catch fire. The Teanaway Community Forest Advisory Committee suggested that DNR should use forest health goals to guide timber harvest and efforts to restore the landscape for fish and wildlife habitat.

Tapash Sustainable Forest Collaborative

This coalition of public, non-profit and tribal land managers is working cooperatively to overcome land management constraints presented by the checkerboard ownership pattern characteristic of eastern Washington (U.S. Fire Learning Network 2008). The Tapash Collaborative is focused on restoring fire-adapted ecosystems to a core area within the Wenatchee National Forest by exploring new implementation tools and opportunities including stewardship contracting, ecosystem services markets, cellulosic ethanol production from forest biomass and National Fire Plan funding. Using a process developed by The Nature Conservancy called "Conservation Action Planning," the collaborative partners structured the scope, overall project vision and desired ecological outcomes. They then created clear strategies to accomplish the shared vision. The Tapash Collaborative has built a protocol for applying fuels treatment projects across federal and state ownership.

Northeast Washington Forestry Coalition

The Northeast Washington Forestry Coalition (Coalition) was formed in 2002 to demonstrate the full potential of forestry to enhance forest health, public safety, and community economic vitality. The Coalition is a local, citizen-led cooperative effort to bring together mill workers, conservationists, business owners, recreationists, loggers, foresters, ranchers, Tribes and elected officials. Together they are working with the Colville National Forest and other land management agencies to find solutions to forest health, economic, and other land management challenges in northeast Washington. Originally formed to identify common ground between timber and conservation interests, the Coalition has worked together on over twenty forestry projects to reduce fire risk, improve forest health, and enhance wildlife habitat on the Colville National Forest (Northeast Washington Forestry Coalition 2010).

The Coalition's objectives are:

- to design and implement forest restoration and fuels reduction projects that demonstrate innovative approaches to forestry,
- to demonstrate how a diverse coalition of stakeholders can work together to successfully
 promote restoration forestry and community protection from wildfire,
- to use the projects to educate the public about the ecological and socio-economic benefits of restoration forestry and fuels reduction strategies, and

 to develop model forest restoration and fuels reduction projects that can be emulated in other regions of the country.

DATA AND PROGRAM GAPS

- WUI and Population Growth: National projections of population growth (homes to be built) in the wildland-urban interface exist, but state data are unavailable. Projections that reflect differences development rates (by county, for instance) would help with planning for wildland firefighting and prevention.
- Quantifying Avoided Costs: A method to evaluate and estimate the costs and savings that could result from more effective fire prevention activities, including forest management, specifically as they relate to forest health issues.
- Fire Suppression Cost Analysis: A method to estimate costs incurred for fire suppression to protect human built structures in the increasingly developed wildland-urban interface of Washington State.
- **Treatment Optimization:** An optimization model for fire prevention and mitigation activities in the wildland-urban interface.
- Completed Treatment Data: Centralized spatial data for completed fuels reduction and forest health restoration projects. Portions of these data exist for public agencies and governmentfunded actions on private land, but a clearinghouse of information to be shared among land and fire managers is not available.

Upland Water Quality, Quantity, and Puget Sound Restoration

INTRODUCTION

From mountain glaciers to the Pacific Ocean, water from forested streams, wetlands, rivers, lakes, and sounds connects terrestrial and aquatic ecosystems. Washingtonians depend on the forests' streams and groundwater to provide clean, cold and abundant water, fish and wildlife habitat, sources of domestic water supply, and boundless scenic beauty and recreational opportunities.

These waters carry sediments and nutrients to the sea. When they mix with the marine water in coastal or inland estuaries, they feed the Pacific nearshore ecosystem, and they contribute to one of the most fertile fjords in the world, the Salish Sea.

Washington's water resources come from both surface water and groundwater. Washington streams are home to many species of amphibians and fish, and are essential to the area's wildlife, some of which are at risk of extinction. Groundwater plays a critical role in maintaining the health of riparian and wetland ecosystems, sustaining stream and river base flows and stabilizing the temperatures of surface waters.

Based on DNR mapping, Washington State has about 265,000 miles of streams. About 47 percent of the stream miles are in western Washington and 53 percent are in eastern Washington. Sixty-four percent (169,000 miles) of the total stream miles are on forestlands. In western Washington, about 84 percent of the streams are on forestland compared to about 46 percent of the eastern Washington streams (USFWS and NMFS 2005).

Groundwater supplies more than one-quarter of the State's water demand and provides at least 65 percent of the drinking water for the State's residents (Washington Department of Ecology 2002). In large areas east of the Cascade Range, 80-to-100 percent of available drinking water is obtained from groundwater resources. Of the total number of public water supply systems in Washington, over 95 percent use groundwater as their primary water source (U.S. Environmental Protection Agency 1999). Groundwater often is connected directly or indirectly to rivers, streams, lakes, and other surface water bodies, with exchange and mixing occurring between the sources. Contaminants entering groundwater therefore can affect surface waters (and vice versa) and associated aquatic organisms (USFWS and NMFS 2005).

Most of the rivers and streams that flow into Puget Sound have their origin in forested lands. Freshwater, estuary, nearshore, marine, and upland habitats are critical in supporting the health of fish, wildlife and humans. The clean, cool tributaries flowing into Puget Sound provide critical habitat for many important freshwater and marine species. Healthy water systems depend on forests to provide shade, to keep the water cool, filter rain runoff, and provide nutrients and food sources for salmon and other aquatic species. The waterways and riparian forests are migration corridors for fish and wildlife species important to the health of the food web of Puget Sound and the entire watershed.

CONDITIONS AND TRENDS

Land Cover and Impervious Surfaces

Land cover is a key indicator of ecosystem health because of its importance for birds and animals, retention of water runoff, and the function of large trees in forming habitat along the rivers. Loss of forest habitat and forested corridors can dramatically affect river and stream systems and the species that depend on them. When rain falls on a mature forest in the Pacific Northwest, more than 99 percent of the water either evaporates, soaks into the ground, or is taken up by vegetation. Less than 1 percent becomes surface water runoff. When forests are replaced with roads, roofs, and pavement — collectively referred to as "impervious surfaces" — the amount of surface runoff increasess to 30 percent or more (Puget Sound Action Team 2004). The result is a dramatic change in flow patterns in the downstream channel, with the largest flood peaks doubled or more and the frequency of storm discharges increased by as much as ten-fold (Booth and Hartley 2002).

Too much water undercuts stream channels, delivers excessive amounts of sediment to streams and estuaries, and scours stream habitat, such as salmon spawning beds, called redds. The conversion of forestlands also eliminates the role of forests in storing water and slowly releasing it during the dry summer months (Batker undated). Low summer flows and loss of trees that shade the waters can lead to water temperatures too high for salmon, or to stream flows that are inadequate for fish migration from marine waters to the freshwater streams where they spawn.

As forestland is lost due to land use conversion, impervious surfaces increase, and stormwater runoff increases. Permanent forest clearing for agriculture or real estate development is reducing total forest area on private lands in western Washington by about one percent per year. Estimates of the loss of forest cover in the Puget Sound basin are similar to those of greater Western Washington. In areas below 1,000 feet elevation, forest cover was lost at almost 0.4 percent between 1991 and 2001, with some watersheds like the Nisqually losing as much as 1 percent of its forest area a year during this same time period. Impervious surfaces in the Puget Sound lowlands increased by 10.4 percent between 1991 and 2001 (Puget Sound Action Team 2007).

In what were formerly forestlands, stormwaters cross impervious surfaces, picking up oil, grease, metals, chemicals, sediment, bacteria, nutrients, pathogens and other pollutants and carry them untreated into rivers and on to the marine waters. In Puget Sound, these excessive nutrients and pollutants cause the closure of shellfish beds, harm eelgrass meadows and other nearshore habitat that salmon and other fish and wildlife depend on, and create toxic sediment cleanup sites. In their decision to list several salmon species as at risk of extinction under the Endangered Species Act, federal agencies identified habitat loss in Puget Sound nearshore environment caused by stormwater runoff as one of the primary obstacles to salmon recovery.

For more about the loss of timberland in Eastern and Western Washington, see the discussion in the Land Ownership Patterns portion of Working Forestlands and Conversion, section E.

Freshwater and Marine Aquatic Lands

DNR is steward of 2.6 million acres of state-owned aquatic lands. 'Aquatic lands' consist of the submerged lands in the state, such as 2.2 million acres of the marine beds of Puget Sound, Straits, and Pacific Coast, and more than 320,000 acres under freshwater navigable lakes and rivers. State-owned aquatic lands also include about 35 percent of the tidelands (88,500 acres or about 1,000 miles of the 3,026 miles of marine shorelines). Of the freshwaters, DNR manages about 70 percent of the shorelands (33,000 acres) along lakes and rivers. Of the 4,174 lakes and ponds in the state, the beds of about 145 are state-owned. The beds and shores of most of the major rivers are also state-owned. These rivers receive the water, sediments and associated pollutants from small streams that flow into them.

Freshwater Riparian Conditions and Surface Water Quality in Forested Watersheds

Management decisions about forestlands have direct consequences regarding surface water quality. Forest activities carried out near streams or other waterbodies have the greatest potential effect on water temperature, and sediment-related water quality parameters such as turbidity, dissolved oxygen, pesticides and herbicides, and nutrients.

The temperature of stream water is regulated by heat exchange between the stream water and the aerial conditions, such as shade, and subsurface conditions, such as the temperature of groundwater seeping into the streambed. In small- to intermediate-size streams of forested regions, incoming solar radiation represents the dominant form of energy input to streams during the summer, with convection, conduction, evaporation, and advection playing relatively minor roles (Brown 1980; Beschta et al. 1987; Sullivan et al. 1990). Water with high temperatures can contribute to low dissolved oxygen because warm water cannot hold as much oxygen in solution as cold water can. Salmon and other aquatic life need sufficient levels of dissolved oxygen to survive. Also, as temperature increases, salmon metabolism increases and the demand for oxygen also increases. For this reason, to shade and help control the stream temperature, maintenance of riparian vegetation in working forestlands is essential.

Although some sediments are needed downstream to feed the tideland beaches and estuaries, too much sediment in streams can be problematic. Sediments can smother salmon spawning gravel or eggs, and harm other aquatic-dependent species.



Figure G1. 303(d) listed waterways in Western Washington

Clean Water Act Listings

Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses (drinking water, aquatic habitat, recreation, and industrial use) are impaired by pollutants and not expected to improve within the next two years. The Washington State Department of Ecology (Ecology) has the responsibility for listing the impaired surface waters, classified as Category 5 (previously collectively referred to as the 303(d) list). Once a segment is listed, Ecology prepares a Total Maximum Daily Load plan that can direct the remediation of water-quality problems, which puts them into Category 4A. The 2012 Category 5 list shows 3,185 freshwater segments statewide that have been identified as impaired out of 15,991 segments analyzed (query of 2012 Washington State Water Quality Assessment).

Road Maintenance and Abandonment Planning

Two of the most commonly measured and monitored water quality parameters are suspended sediment and turbidity. Both are related to sediment delivery and transport in hydrologic systems. If improperly constructed or unmaintained, forest roads can contribute unwanted sediment to waterways.

Washington's Forest Practices rules include a Road Maintenance and Abandonment Plan (RMAP) program to prevent sediment and hydrology-related impacts to public resources such as fish, and water quality and quantity. The rules regarding road maintenance and abandonment plans are different for large landowners and small landowners. They require large forest landowners (as defined in Washington Administrative Code 222-16-010) to develop and implement an RMAP for roads within their entire ownership. Large landowners are required to bring all roads into compliance with forest practices standards by July 1, 2016. This includes all roads that were constructed or used for forest practices after 1974 (Washington DNR 2009).

Statewide, large landowners have developed RMAPs for 57,442 miles of forest roads, with approximately 22,900 miles of forest road identified as needing improvement to meet Forest Practices standards. As of the end of 2009, approximately 16,195 miles of road, or 71 percent of those identified, had been improved. Of the 5,580 identified fish passage barriers within completed RMAPs, 3,141 or 56 percent were repaired by the end of 2009. This has opened 1,569 miles of stream to fish passage.

In an effort to accomplish the necessary stream protection but minimize the economic hardship of road maintenance and abandonment planning on small forest landowners, the 2003 Washington Legislature passed an RMAP bill (HB1095) that modified the definition of small forest landowner and clarified how requirements applied to small forest landowners. Small forest landowners have the option to submit an RMAP "checklist" with each forest practices application or notification, rather than provide a plan for their entire ownership. The RMAP checklist is a brief assessment of certain road characteristics and is limited to the area described in the forest practices application. This approach does not provide an inventory method for determining the extent and condition of small forest landowner roads or their impact on water quality; and funding is needed to do a sample survey to determine the condition of these roads, and supplement the Forest Practices RMAP checklist strategy, if needed.

The 2003 Legislature also established the Family Forest Fish Passage Program (Revised Code of Washington 76.13.150). The program offers technical assistance and creates a cost-share mechanism that provides 75 to 100 percent of the cost of correcting small forest landowners' fish barriers. Through this program, small forest landowners have removed 180 fish passage barriers, opening up over 400 miles of stream habitat previously inaccessible to fish (DNR 2009).

Federal Land Management

Federal agencies manage 43 percent of Washington State's forestland. By acreage, the U.S. Forest Service (8.2 million) and National Park Service (1.1 million) are the largest among these agencies. Most often, these are the highest-elevation forestlands in the state and therefore occupy the headwater regions of most watersheds. As the missions, land use plans, and management objectives of the agencies differ, so too does their approach to watershed protection.

During the 1960s and 70s, an extensive network of road infrastructure was constructed on National Forest land to support intensive timber management. Reduced timber harvest emphasis has reduced the need for a significant amount of the roads system. At the same time, maintenance funding lagged, and without harvest activity and revenue to support roads upkeep, a significant amount of this system has fallen into disrepair.

In response to these and other restoration needs, the U.S. Forest Service began implementing an Aquatic Restoration Strategy in 2003. Major acceleration of road system restoration began in Fiscal Year 2008, when Congress authorized the Legacy Roads and Trails program and allocated the Forest Service \$40 million to begin implementation. Funds are specifically intended to reduce risks and impacts to watershed health and aquatic ecosystems by removing fish passage barriers, decommissioning unneeded roads and addressing critical repair and deferred maintenance needs. Strong support for this effort was provided by the Washington Watershed Restoration Initiative, a coalition of State agencies and local organizations.

Since its inception in 2008, Washington State has received \$23.4 million in Legacy Roads and Trails funding. As of 2014, those funds have been used to:

- Improve or maintain 2,014 miles of roads;
- Remove 229 miles of unneeded roads; and
- Improve or repair 104 miles of trails.

National Park Service land managers also have watershed management concerns that are legacies of past decisions. One high-profile example is the removal of two dams along the Elwha River in Olympic National Park. Before construction of the dams, 10 native anadromous fish runs used the Elwha River and its diverse habitats for spawning – including Chinook, Coho, Chum, Sockeye, and Pink salmon, native char (bull trout and dolly varden), steelhead, and sea-run cutthroat trout. Sediments released since the removal of the Elwha dams have begun to build up nearshore habitat, and salmon are now entering the upper reaches of the Elwha watershed for the first time in 100 years.

Invasive Non-Native Species

Water quality in the forested environment can also be significantly influenced by invasive non-native species. These may either directly affect aquatic habitat by influencing stream channel morphology and function, or affect surrounding riparian forest conditions. In addition, eradication efforts subsequent to invasive species' establishment that must, for instance, employ the use of additional herbicides and pesticides may, in turn, increase the concentration of these substances in forested rivers and streams, detrimentally affecting water quality. Other control mechanisms may have adverse consequences of their own.

Stream channels, stream riparian areas and adjacent wetlands in western Washington managed forests are threatened by a number of invasive non-native plant species that include reed canarygrass (*Phalaris arundinacea*), Himalayan blackberry (*Rubus armeniacus*), and knotweeds (*Fallapia* spp). Invasive knotweeds, including the Japanese and Bohemian knotweeds, are perennials that establish in riparian areas, and along stream banks that colonize through rhizomes (roots) that can spread up to 60 feet from a plant and to a depth of 10 feet (Invasive Plant Council of British Columbia 2008). Root and stem

fragments as small as a half inch can form new plant colonies. The plant is dispersed primarily from rhizome and stem fragments that are dispersed by human activities or by water to downstream areas. Knotweeds are of particular concern in areas prone to seasonal high water or flooding. Plants emerge in early spring and produce large leaves that can shade out other plant species, and dominate stream banks. They threaten biodiversity by outcompeting native plants and increase soil erosion potential with roots that do not hold soil well. Because of its ease of dispersal, mechanical removal is problematic, and some use of physical barriers (geotextile fabric) has been implemented with high cost and limited effectiveness (Bigley 2010). Chemical control methods are available, but are publically controversial.

Water quality in urban areas is heavily influenced by the presence of urban trees and forests. For a detailed discussion of urban water quality, see section C on Urban and Community Forests.

Surface Water Quantity in Forested Watersheds

Three primary factors affect surface water quantity in forested watersheds (USFWS and NMFS 2005):

- Climate: Precipitation amount and form (snow or rain) determine the rates of water delivery to a watershed. These processes are largely controlled by climate.
- Vegetation: Interception as precipitation falls, condensation, evapotranspiration, and canopy snowmelt influence delivery of water to the forest floor. These processes are controlled mainly by foliage.
- Transport Pathways: Surface and subsurface pathways transport water from the forest floor to the streams. These pathways are controlled by physical and biological factors. The hydrologic functions of a watershed are dependent upon these processes. When these processes are individually or cumulatively altered by road construction, harvesting, or other forest practices, the hydrologic continuity of the watershed is altered (Montgomery 1994; Rashin et al. 1999; U.S. Forest Service 2001).

There are three major areas of hydrologic concern: annual water yields, low flows, and peak flows.

Water yield is the amount of water that is transported from a watershed. In general, forests act to lower average stream flows. Forests also may reduce peak flows and increase flows during dry seasons. This is because forested lands tend to have better infiltration capacity and a higher capacity to retain water than non-forested lands (Jones and Grant 1996; Intergovernmental Panel on Climate Change 2003).

Low flows often are referred to as base flows, dry-weather flows, and groundwater flows. Low flows are the flows provided by groundwater to the streams during the lowest precipitation months of the year in the summer. Though no studies are known in Washington, in western Oregon, increases in low flow are generally short-term (5 years) following clearcut timber harvest (Rothacher 1970). Small volumetric increases may provide improved habitat conditions (lower stream temperature, increased in-stream wetted area and volume) and survivability of aquatic species.

Peak flow is the maximum instantaneous (point-in-time) discharge measured in stream channels during high flow periods. Management activities can affect peak flows based upon their site-specific effect,

elevation location within a watershed, and proportion of basin forest that has been altered by timberrelated activities, such as roads and timber harvest (Bauer and Mastin 1997).

Western Washington (and much of Eastern Washington) receives moderate to high precipitation and is influenced by rain-on-snow events—that is, when rainfall melts snow to add water volume into streams. A significant amount of water can be delivered to the stream system during these events, compared to rainfall alone.

The direct effects of peak flows from these events include stream channel alteration, bank erosion, redistribution of sediment and large organic debris, and flooding. In addition, rain-on-snow events also generate large inputs of water to the soils that can generate unstable conditions on hillslopes by increasing the pore-water pressure, which decreases the strength of the soil (Sidle et al. 1985); a reduction in soil strength increases the potential for slope failure.

The frequency and duration of high and low flows in rivers are perhaps the water quantity trends most relevant to changes in land use, particularly from forestlands in Western Washington.

The conversion of forested and other predominantly undeveloped land to urban and suburban land covers in the Puget Lowland has increased winter peak flows and decreased winter base flows as infiltration of rainfall is reduced and runoff from compacted soils and impervious cover is more quickly routed to receiving streams via engineered conveyance systems. Although the historical flow regime was not without its inter- and intra-annual disturbances, forest clearing and urbanization in the Puget Lowlands over the last 150 years have dramatically altered the historical flow regime, exacerbating disturbances during winter high flows and introducing disturbances during late summer when none typically occurred in the past. (PSP 2009c)

THREATS AND OPPORTUNITIES

Threat: Loss of Surface Water Quality

Ecology's Pre-2008 assessments of marine water and freshwater quality indicate that the primary water quality problems in Washington State were due to temperature and fecal coliform bacteria (303-d list, Washington State Department of Ecology 2010b). Analysis of physical stream conditions (USFWS and NMFS 2005) indicates that common pollutants and impairments include temperature, turbidity, and dissolved oxygen, as well as physical impairments to in-stream flow and fish habitat throughout the state. Past timber harvest practices generally resulted in too little riparian vegetation being retained along streams (Kuttel 2001, 2002; Correa 2002), thereby reducing down woody debris recruitment and shade, which can affect water temperature and fish habitat. After historic Western Washington timber harvest many riparian buffers have regenerated as hardwood-dominated stands (Marshall and Assoc. 2000), with most of this being red alder. Because red alder has a short life span (80 years), limited height (50 to 90 feet) and size potential, and lacks the foliage density and decay resistance of conifers, it is less effective in providing large woody debris or shading to wider channels (Marshall and Assoc. 2000).

Wetlands are areas support vegetation typically adapted for life in saturated soil conditions. Wetlands, like surface waters, provide important habitat and are a critical component in maintaining watershed

function, providing water storage and filtration. A 1989 report completed by the U.S. Fish and Wildlife Service conservatively estimated that activities such as draining and filling wetlands have reduced Washington wetland areas by 33 percent since statehood in 1889 (Canning and Stevens 1990, as cited in *Changing Our Water Ways*, DNR 2000). Washington's Forest Practices Rules provide protection measures that include a wetland 'typing' or categorizing system, require a wetland management zone adjacent to typed wetlands and mandate the use of low-impact harvest systems in forested wetlands (DNR 2005).

Converting forestland to other uses such as homes or other development — or even agriculture to a lesser degree — results in additional impervious surfaces that reduce water storage and infiltration, threatening surface water quality. In addition, forest fragmentation resulting from conversion also affects habitat by reducing important migration corridors between protected areas. Mitigating conversion risk for small forest landowners is especially important because they tend to be located in lowland areas in close proximity to streams that run into Puget Sound. Protecting and expanding urban forest tree canopies, and increasing urban green space can reduce stormwater runoff to partially counteract increased impervious surfaces in developed areas.

Invasive non-native species can have a significant detrimental effect on water quality. In addition to direct effects, eradication efforts and control mechanisms implemented to control invasive species after establishment may have adverse consequences.

Wildfires also have an impact on water quality. High summer temperatures and decreased moisture have exceeded their 100-year historic range since 2000. The potential for large, damaging wildfires poses a significant threat to forest habitats, and in turn, to water quality. Burned-over forest slopes and disturbed soils expose streams to increased sediment delivery as a result of an accelerated risk of surface run-off.

Opportunities

- Conserve riparian forest vegetation and reestablish appropriate species composition
- Conserve forested wetlands
- Conserve, restore and expand the urban tree canopy
- Reduce the rate of forest conversion
- Improve connectivity of ecosystem services between the developed and forested upland environment
- Early detection and eradication of invasive non-native species
- Prepare adequate fire suppression resources
- Reduce forest conditions that contribute to the risk and hazard of large, severe wildfires

Threat: Improper Design, Construction and Maintenance of Forest Roads

The design, construction, and maintenance of forest roads interacts with watershed characteristics soil, topography, and geology—and natural disturbances such as large storms to determine the effects of the roads on the hydrology of a particular watershed. The interception of surface runoff during storms and interception of shallow groundwater flow by a road prism can affect the routing of surface water, and extend the channel network (Wemple et al. 1996). It also can increase the potential for higher peak flows, and increase the potential for mass wasting (Montgomery 1994). Additionally, the process of road building can cause sedimentation of streams. However, one recent study of the Deschutes River watershed in Western Washington suggests that higher standards of road building, increased attention to reducing sediment production from roads, and minimizing the amount of road runoff reaching stream channels have been the primary causes of the declining turbidity levels observed in the watershed (Reiter et al. 2009). Because of the inherent connectivity of hydrologic systems it is essential for road and stream crossing work to be coordinated among landowners and managers within a given watershed. The work of downstream land managers can be rendered moot by a failure to achieve restoration objectives upstream, and vice-versa.

Opportunities

- Reduce negative effects on the hydrology of watersheds from forest roads
- Remove barriers to fish passage and increase aquatic habitat availability
- Enhance coordination among forest landowners and managers toward integrated watershed restoration outcomes

Threat: Climate Change

Small changes in temperature can strongly affect the balance of precipitation falling as rain or snow, depending on a watershed's location, elevation, and aspect. Washington is characterized as having three runoff regimes: snow-melt dominant, rain dominant and transient — where rain-on-snow events are particularly common during winter (Hamlet and Lettenmaier 2007). In future climate scenarios, the water content of Washington's spring snowpack is projected to decrease by an average of about 27-to-29 percent across the state by the 2020s, 37-to-44 percent by the 2040s, and 53-to-65 percent by the 2080s (Elsner et al. 2009).

Seasonal stream-flow timing is projected to shift significantly in watersheds that are both dominated by snowmelt and rain-snow mixed precipitation regimes. Annual runoff across the state is projected to increase by 0-to-2 percent by the 2020s, 2-to-3 percent by the 2040s, and 4-to-6 percent by the 2080s, mainly driven by projected increases in winter precipitation (Elsner et al. 2009).

Opportunities

- Restore and maintain forest productivity and carbon sequestration value of forests for climate change mitigation
- Assist forest ecosystems with adapting to a changed climate
- Prepare for earlier run-off and an increase in rain-on-snow events

RELEVANT NATIONAL THEMES AND STRATEGIC OBJECTIVES

The **Upland Water Quality, Quantity, and Puget Sound Restoration** issue falls into the National Theme *"Enhance public benefits from trees and forests"* from the State and Private Forestry Redesign structure. It will be addressed through two Strategic Objectives — *"Protect and enhance water quality and quantity,"* and *"Manage and restore trees and forests to mitigate and adapt to global climate change."*

EXISTING STRATEGIES

The following describes the current strategies that protect the water quality and water quantity of streams, rivers, and the embayments into which they drain, such as Puget Sound. Areas also are identified in which funding or additional funding would allow the state to take full advantage of strategies currently in place.

Forest Practices Rules and Forest Practices Program

In Washington State, forest practices are regulated through the Forest Practices Act, originally established by the legislature in 1974. The state Forest Practices Board (Board) is charged with creating rules to implement the Forest Practices Act and protect the state's public resources (including water, fish, and wildlife) while maintaining a viable timber industry. The Forest Practices Act and Forest Practices Rules apply to non-Federal and non-tribal forestlands. Among others, activities covered by the Rules include road and skid trail construction, forest road maintenance and abandonment, final and intermediate harvesting, pre-commercial thinning, reforestation, salvage of trees and brush control.

The Act and Rules were designed and adopted, in part, to meet the requirements of the federal Clean Water Act, and the state water quality standards. In October 2009, Ecology "conditionally" extended Clean Water Act assurances for the state's forest practices program. The conditional extension is based on meeting a set of milestones for program improvements and research development. A number of these milestones are related to water-quality-focused research projects within the Forest Practices Adaptive Management Program.

The Forest Practices Program has also developed tools that include the Forest Practices Habitat Conservation Plan, Road Maintenance and Abandonment Plans, the Water Typing System, the Adaptive Management Program, the Forestry Riparian Easement Program, the Family Forest Fish Passage Program, the Riparian Open Space Program, and the Landslide Hazard Zonation Project.

Forest Practices Habitat Conservation Plan

The Forest Practices Habitat Conservation Plan (HCP) covers nearly 9.3 million acres of state and privately owned forestlands, and thousands of forest landowners across the state. In addition to generally protecting public resources such as water, fish and wildlife and soils, it addresses the protection of water-dependent species that have been listed as threatened and endangered. It asserts that the Forest Practices Rules and Program are a way to meet the requirements of the Endangered Species Act (ESA) as well as those of the Federal Clean Water Act. Its protection measures include two

separate but interrelated conservation strategies. *The Riparian Conservation Strategy* measures protect surface waters and wetlands, including wetland and water typing systems, channel migration zones, and wetland and riparian management zones. *The Upland Conservation Strategy* measures protect the habitat of listed species, and are related to unstable slopes, road construction, maintenance, and abandonment and rain-on-snow.

Road Maintenance and Abandonment Plans

The 1999 Salmon Recovery Act required all forest roads on state and private lands to be brought up to new forest roads standards by 2016, as outlined in state Forest Practices Rules. The mechanism established to ensure road standards are met is the RMAP process. A landowner's Road Maintenance and Abandonment Plan (RMAP) contains ownership maps and a schedule for completing necessary road work by 2016. To date, state and large private landowners have brought approximately 71 percent of forest road miles identified for improvements into compliance (DNR 2009).

In 2003, it became clear that the RMAP requirement could cause an unintended disproportionate financial hardship on small forest landowners. As a result, a law established an abbreviated RMAP process (a RMAP checklist) for small forest landowners. The RMAP checklist is a brief assessment of certain characteristics on roads currently being used for forest practice activities only, and does not provide a complete inventory of the landowner's roads. Information is lacking from 'Family Forest' landowners that have not filed an RMAP or Forest Practice Application after 2003. This information is needed to fully understand the status of small forest landowner roads on a statewide basis. Currently, there is no funding available to conduct this survey.

Water Typing System

The Washington Forest Practices Act directs DNR, in cooperation with other state agencies and affected tribes, to classify streams, lakes and ponds using the water typing system. Water types generally are based on three criteria: (1) if a stream or waterbody is designated as 'a significant water', (2) the likelihood that it is potentially used by fish, and/or (3) whether or not a stream flows year-round. This designation determines the amount and pattern of riparian buffer protection required during forest practice activities.

DNR maintains a hydrography geographic information system (GIS) data layer that describes the location and character of the surface waters of the state, and is used to evaluate individual forest practice applications. This database is the best currently available, but contains inaccuracies that include missing, incorrectly located, and incorrectly typed surface waters. These inaccuracies affect DNR's ability to be effective in permitting, compliance, and monitoring. Maintaining an accurate and updated hydrography database is integral to successful implementation of riparian conservation measures contained in the Forest Practices Rules, and is a crucial strategy for protecting water quality and quantity in the forested environment.

DNR's Hydrography GIS data layer currently is updated incrementally on a site-by-site basis, typically addressing one or two streams at a time based on field observation. To systematically address inaccuracies in the hydrography data on a watershed or landscape level, corrections to the data based
on high resolution topography are needed. High-resolution topography data, produced with Light Detection and Ranging (LiDAR) technology, provides a means to generate a more accurate depiction of the number and location of stream channels. Funding to support efforts to produce a complete LiDAR coverage for Washington and correct the hydrography database currently is unavailable.

Adaptive Management Program

The Adaptive Management Program was created to provide science-based recommendations and technical information to assist the Forest Practices Board in determining when it is necessary or advisable to adjust rules and guidance for practices that affect aquatic-dependent species and their habitat. Since Forest Practices rules are complex, and to account for improvements in scientific knowledge, there was a need to provide a framework to:

"... make adjustments as quickly as possible to forest practices that are not achieving the resource objectives ... (and)...incorporate the best available science and information, include protocols and standards, regular monitoring, a scientific and peer review process, and provide recommendations to the board on proposed changes to forest practices rules to meet timber industry viability and salmon recovery" (RCW 76.09.370(7)).

There are three desired outcomes of the Adaptive Management Program:

- 1. Change as needed to protect targeted resources;
- 2. Predictability and stability of the process of change so that landowners, regulators and interested members of the public can anticipate and prepare for change; and
- 3. Quality controls to study design and execution and to the interpreted results.

The program has conducted a rigorous effort of Cooperative Monitoring, Evaluation and Research to improve the scientific underpinnings of the rules. DNR has not as yet secured adequate long-term funding for the Adaptive Management Program that will sustain the state's Forest Practices Habitat Conservation Plan and Clean Water Act assurances.

Forestry Riparian Easement Program for Small Forest Landowners

State legislation passed in 1999 created the Forestry Riparian Easement Program (FREP), managed by the Small Forest Landowner Office within the Forest Practices Program. The riparian easement program acknowledges the importance of small forest landowners and the contributions they make to protect wildlife habitat and water quality. The program also recognizes the disproportionate impact that the forest practices riparian harvest rules have on small forest landowners. In exchange for a 50-year easement on a landowner's riparian forestland, FREP compensates the eligible small forest landowner for those streamside forests that the landowner is required to leave unharvested as a result of forest practices rules. Landowners cannot cut or remove the trees during the life of the easement period. The landowner still owns the property and retains full access, but has leased the trees and their associated riparian function to the state. The applications are processed and purchased commensurate with available funding.

Family Forest Fish Passage Program

Family forest landowners own about a third of the private forestland in the state, with many miles of fish-bearing streams. A key to restoring fish populations is removing barriers to fish passage along those streams. Washington State's Family Forest Fish Passage Program (FFFPP) was created in 2003 to assist owners of small forest land parcels in correcting fish passage barriers on their land. FFFPP is a cost-share program that provides 75-to-100 percent of the cost of correcting fish barriers. The program is managed by three Washington State Agencies (Department of Natural Resources, Department of Fish and Wildlife, and Recreation and Conservation Office).

The Family Forest Fish Passage Program has corrected 343 fish passage barriers, reconnecting over 763 miles of stream habitat previously inaccessible to fish. Despite these accomplishments, the program currently has a list of more than 670 projects awaiting funding (DNR FFFP Implementation Report 2014).

Several hundred more barriers are known to exist on these smaller forest ownerships, in addition to those already waiting for funding. Every year 50-to-100 new landowners enroll in the program. The major factor limiting progress is funding. More than 30 local community conservation organizations around the state provide project oversight and accountability, and work with the small forestland owners to insure projects are installed according to plan. Minimal state agencies staff provide the program structure, accounting, coordination and consistency. In terms of stream habitat opened up per dollar spent, FFFPP has proven to be one of the soundest investments in salmon recovery being made in Washington State.

In order to continue to improve the "worst first" prioritization strategy and accelerate implementation beyond the current pace, a portion of new funds will be dedicated to seeking out the best projects in high priority watersheds. An important step is to walk small sub-watersheds to contact streamside landowners and identify barriers to accelerate the pace of implementation by focusing on priority barriers and willing forest landowners.

Riparian Open Space Program

The Riparian Open Space Program was created as part of the 1999 Forests and Fish law. The program compensates private landowners for lost timber value caused by required harvest restrictions in the forest practices rules. In return, the state acquires a permanent conservation easement on that land which provides for ecological protection and fisheries enhancement.

Since this program was instituted in 2002, 16 projects protecting more than 1,000 acres of habitat have been funded.

Landslide Hazard Zonation Project

Landslides are a major source of sediment that affects water quality and fish and wildlife habitats. Landslides also can threaten public safety. This Landslide Hazard Zonation (LHZ) Project provides standardized methods for conducting landslide inventories and produces unstable slope hazard maps. These maps are used as a screening tool to assess the potential for delivery of sediment or debris into a public resource or to threaten public safety.

Four watershed analysis units have been completed, and four watershed analysis units are in various stages of completion. There are still 37 priority watersheds that have not been inventoried using the LHZ protocols. Funding was cut for the LHZ project in 2009; therefore the remaining 37 watersheds cannot be assessed until funding is obtained.

In March of 2014, a catastrophic landslide occurred in the town of Oso, just west of Darrington in Snohomish County. The Oso landslide claimed 43 lives and engulfed an entire rural neighborhood. In 2015, the Washington State Legislature passed a bill requiring DNR to map landslide hazards and faults with LiDAR technology, which analyses the light return patterns from aircraft-mounted lasers to generate highly-detailed depictions of landforms.

Puget Sound Partnership

In 2007, the Washington Legislature created a new state agency called the Puget Sound Partnership, which includes the involvement of state agency leaders, scientists, and citizens with an interest in the health of Puget Sound. The Puget Sound Action Agenda (Puget Sound Partnership 2009b), developed by the Partnership in 2008, is a strategy to clean up and recover Puget Sound by 2020. The Agenda was adopted and endorsed by the U.S. Environmental Protection Agency (EPA) in May 2009 as the National Estuary Program Comprehensive Conservation and Management Plan for Puget Sound. EPA's adoption allows federal Clean Water Act funds to support implementation of the Action Agenda. The Agenda notes that,

"Habitat alteration consists of activities such as clearing forest, armoring shorelines, diking and draining saltmarshes and freshwater wetlands, dredging, filling, and paving the land. Habitat alteration occurs in Puget Sound marine waters and on the sea floor, along the shoreline, throughout river systems, and in the upland forests, meadows, prairies, and brush. In the nearshore, docks and bulkheads cover beaches that produce the plant life, insects, forage fish, and shellfish that provide food for fish, shorebirds, and marine mammals."

The Puget Sound Action Agenda identifies two areas as the highest priorities to sustain a healthy Puget Sound into the future: alteration and loss of habitat, and the ongoing input of pollutants. In uplands, these priorities are tied heavily to forest management practices. Alteration and loss of habitat can occur with timber harvest, riparian management, and forestland conversion trends. Management of forests adjacent to streams influences water quality and the input of pollutants through sediment delivery, aerial or ground application of pesticides, and nutrient loading (low dissolved oxygen conditions resulting from delivery of excess nutrients). There is an inextricable link between the management of upland forests and the health of the Puget Sound; this link is recognized in the Puget Sound Action Agenda.

The following are "near-term actions" (NTAs) identified in the Action Agenda (Puget Sound Partnership 2009b) that pertain specifically to forest environment and linkages to Puget Sound restoration priorities:

Support state and local partnerships to advance the Action Agenda

- Implement high-priority projects listed in local salmon recovery plans
- Improve shorelines in the South Central Puget Sound Action Area by limiting new residential shoreline armoring and overwater coverage, and promoting "green" shoreline
- Improve floodplains management by creating partnerships of interested parties (especially local governments and business community
- Identify, guide, and fund stormwater retrofits.
- Promote operation and maintenance and improvements to existing stormwater systems
- Increase education of and stewardship by homeowners and businesses to reduce stormwater pollution
- Share information on low impact development /green stormwater infrastructure and facilitate the transition from conventional stormwater management
- Support restoration of the voter approved local Model Toxics Control Account
- Keep toxics and excess nutrients out of the waste stream
- Secure additional funding necessary to implement priority fish and wildlife habitat and highvalue aquatic habitat area enhancement projects
- Complete Regional Alliances Project and share results to increase infill development in urban centers while meeting stormwater requirements and Growth Management Act mandates
- Retain forest canopy cover and soils to attenuate stormwater runoff

For the 2013-2015 Biennium, about \$288 million in state funds and \$28 million in federal funds for fiscal year 2013 were appropriated toward Puget Sound protection and restoration programs, activities, land acquisition, and capital projects.

DNR Aquatic Habitat Conservation Plan

As steward of 2.6 million acres of state-owned aquatic lands, many of which serve as habitat for salmon and other at-risk species, DNR is developing a Habitat Conservation Plan for the state-owned aquatic lands in its care. The draft HCP has been developed, and public comment has been gathered. This science-based plan will help DNR protect species that have been listed as at risk of extinction under the ESA, and help protect Puget Sound, Washington's river systems and all other state-owned aquatic lands by guiding management activities that:

- Avoid or minimize adverse impacts to species that are protected under the ESA
- Provide habitat mitigation (compensation) for unavoidable impacts
- Preserve the navigation, economic and recreation benefits derived from the use of state-owned aquatic lands

The research that DNR has undertaken in developing this Habitat Conservation Plan has shown that specific habitat protection measures need to be incorporated into the leases and other use agreements that DNR issues to those seeking to use state-owned aquatic lands. Achieving the conservation goals will rely in part on reducing pollution and habitat loss in upland areas of the Puget Sound Basin.

U.S. Forest Service Aquatic Restoration Strategy and Legacy Roads and Trails Program

National Forests play a critical role in the long-term maintenance and restoration of watersheds and aquatic ecosystems. In most cases, National Forests are positioned as the highest-elevation forestlands in the watersheds of Washington State, and are therefore responsible for delivering cool, clean water to downstream habitats, landowners and users. The U.S. Forest Service Pacific Northwest Region has developed and is implementing an Aquatic Restoration Strategy (US Forest Service 2007), which strategically guides implementation of its watershed and aquatic resource programs and allocation of associated resources. The Aquatic Restoration Strategy has been fully integrated into the Region's business plans and budget allocation process. It complements and guides near-term execution of the individual Forest Plan strategies for aquatic resources through a more specifically-focused Aquatic and Riparian Conservation Strategy. Through the Aquatic Restoration Strategy the Forest Service has designated the Upper Columbia, Lower Columbia, Washington Coastal and Puget Sound as priority river basins. Individual National Forests, using the Aquatic and Riparian Conservation Strategy, have designated focus watersheds at the sub-basin scale according to aquatic resource condition, watershed sensitivity, and management intensity. Focus watersheds represent areas of concentrated investment for restoration actions on National Forest land in Washington State. Active and passive restoration, community and government partnerships, and education and outreach activities are the primary approaches to attain the strategies' long-term goal of accelerating watershed improvement.

U.S. Forest Service State and Private Forestry Programs

U.S. Forest Service funding from the Forest Stewardship, Forest Health, and National Fire Plan programs is being used to provide technical, educational, and financial assistance for project activities to family forest owners to protect and improve water quality. The Forest Stewardship program provides assistance for landowners to develop and implement multi-resource Forest Stewardship Plans, which include a description and assessment of soil and water resources and specific practices to protect and enhance them. Stewardship Foresters also perform a key delivery mechanism for project implementation funds under National Fire Plan fuels reduction and Forest Health programs. Fuels reduction actions are designed to moderate the severity of fire behavior, which can help avoid harmful erosion from severe fires that may damage water quality. Forest health actions help avoid undesired tree mortality, maintaining forest cover and preventing the accumulation of heavy fuel loading.

DATA AND PROGRAM GAPS

- Impervious surface: Although area of impervious surface is recognized to be a major factor influencing water quality, quantity and the health of Puget Sound, there is not a standard method for measuring or reporting on this trend.
- Groundwater: Groundwater is often connected directly or indirectly to rivers, streams, lakes, and other surface water bodies, with exchange and mixing occurring between the sources.
 Contaminants entering groundwater therefore can affect surface waters (and vice versa) and associated aquatic organism. There is currently little data for the status of groundwater in Washington.

- Surface water quantity: The frequency and duration of high and low flows are relevant to changes in land use, particularly from forestlands in Western Washington. Analyses to better characterize hydrologic changes are not currently available. These include comparing results across watersheds, focusing on volume and duration of winter high and summer low flows (rather than simply extreme flow days), and utilizing approaches such as *Degree of Hydrologic Alteration* to capture the effect of changes resulting from land cover change.
- Forest roads on family forests: Information on location and coverage of forest roads on lands managed by family forest landowners statewide is lacking. As a result it is difficult to determine what the impact of family forest landowner's roads is on water quality and whether they are on track to meet current forest practices standards by 2016.
- Stream barrier inventory: The size of the total workload for Family Forest Fish Passage Program is not known because inventories of barriers have not been completed for most watersheds.
 Without a complete barrier inventory it is impossible to identify small forest landowners who have barriers on their properties but have not yet applied for cost-share funding.
- Marine riparian vegetation: The amount of marine riparian vegetation has not been mapped in Washington, nor has any historical or change analysis been done. Hence the change in the ecological functions provided and the effectiveness of protection provided by Forest Practices or the Shoreline Management Act cannot be assessed.
- Surface water mapping: The DNR Hydrography GIS Data Layer, which serves as the framework for the water-typing system, is missing many streams in the forest environment and depicts many others in the wrong location. Where high resolution topography data from LiDAR exists, it could be used to improve the water typing system. Much of the Puget Sound Basin has been mapped with LiDAR, but this high resolution data is lacking for most other areas of the state.

Strategy

The foregoing assessments of State and Private Forestry Programs built on the 2010 Statewide Resource Assessment and Strategy by:

- Incorporating new data,
- Building in the results of interviews with internal and external program stakeholders,
- Keying program priorities to DNR's 2014-2017 Strategic Plan, and
- Highlighting issues that have taken on greater prominence since 2010, including
 - The growing size and intensity of wildland fire,
 - The projected impacts of climate change,
 - o Deteriorating forest health across Washington State, and
 - The threat of conversion of working forest lands.

Opportunities outlined in the Assessment section of this document are intended to be actionable and measureable at the landscape and programmatic levels. Objectives identified at the level of project implementation are outside the scope of this plan, and are the purview of program and project managers. The Forest Action Plan will articulate a set of strategies keyed to a geographic and programmatic frame that will meet the objectives set forth in the assessments section of this document.

Additionally, this section will propose several pilot projects, contingent upon funding, that are designed to generate institutional knowledge, prove or disprove concepts, engage the public and/or partners, and advance programmatic objectives. Should these projects be funded and approved, DNR will take a lead role in implementation, dissemination of data, and program review.

Descriptions of non-pilot projects will identify DNR's role as a lead, supporting, or non-engaged (relative to other actions or investments) entity. These distinctions will clarify where partnerships will be most productive, will help the agency prioritize limited resources, and will suggest opportunities for DNR to procure more resources to meet an emerging threat. Finally, locating DNR's role within this spectrum will guide decisions regarding statutory or policy enhancements.

Although the 2008 Farm Bill enacted the requirement to complete Statewide Assessments and Strategies and established their baseline requirements, none of the underlying federal statutory language that authorizes and guides specific programs was altered. This means the strategy must achieve the foregoing purposes — ostensibly designed to elicit changes in the way programs are deployed — while retaining certain elements of the status quo that are required in programs' authorizing statutes and policies.

ISSUES, OPPORTUNITIES, OBJECTIVES AND PERFORMANCE MEASURES

Threats and opportunities have been identified for each of the six major issues in the Statewide Assessment, captured in sections under these categories:

- A. Biodiversity and Habitat Conservation
- B. Urban and Community Forestry

- C. Forest Health Restoration
- D. Stewardship of Working Forestlands
- E. Wildfire Hazard Reduction
- F. Upland Water Quality, Quantity, and Puget Sound Restoration

The selected issues are correlated with the national Themes and Objectives as identified in the introductory section of the Assessment. National core performance measures have also been assigned to each objective (USFS and NASF 2010):

4. Conserve Working Forest Lands: conserving and managing working forest landscapes for multiple values and uses.

4.1. Identify and conserve high priority forest ecosystems and landscapes

4.1.1. Performance Measure: High priority forest ecosystems and landscapes are protected from conversion (acres, annual and cumulative).

4.2. Actively and sustainably manage forests

- 4.2.1. Performance Measure: Number of acres in forest areas being managed sustainably as defined by current Forest Stewardship Management Plan (cumulative) through a nationally consistent monitoring program.
- 5. Protect Forests from Harm: protect forests from threats, including catastrophic storms, flooding, insect or disease outbreak, and invasive species.

5.1. Restore fire-adapted lands and reduce risk of wildfire impacts

- 5.1.1. Performance Measure: Number of acres treated to restore fire-adapted ecosystems that are (1) moved toward desired conditions and (2) maintained in desired conditions (annual).
- *5.1.2. Performance Measure:* Total number of acres treated to reduce hazardous fuels on state and private lands through State Fire Assistance (annual, direct federal grant only).
- 5.1.3. Performance Measure: Percentage of at risk communities who report increased local suppression capacity as evidenced by: (1) The increasing number of trained and/or certified fire fighters and crews or (2) Upgraded or new fire suppression equipment obtained or (3) Formation of a new fire department or expansion of an existing department involved in wildland firefighting.

5.2. Identify, manage and reduce threats to forest and ecosystem health

- *5.2.1. Performance Measure:* Number and percent of forest acres restored and/or protected from (1) invasive and (2) native insects, diseases and plants (annual).
- 6. Enhance Public Benefits from Trees and Forests: including air and water quality, soil conservation, biological diversity, carbon storage, and forest products, forestry-related jobs, production of renewable energy, and wildlife.

6.1. Protect and enhance water quality and quantity

6.1.1. Performance Measure: Acres and percent of priority watershed areas where S&PF activities are enhancing or protecting water quality and quantity.

6.2. Improve air quality and conserve energy

- *6.2.1. Performance Measure:* Population of communities benefiting from S&PF activities designed to contribute to an improvement in air quality.
- *6.2.2. Performance Measure:* Population of communities benefiting from S&PF activities that result in energy conservation.

6.3. Assist communities in planning for and reducing wildfire risks

- *6.3.1. Performance Measure:* Number and percent of communities-at-risk covered by a CWPP or equivalent that are reducing their risk of wildland fire (annual).
- *6.3.2. Performance Measure:* Percent of population living in communities developing or managing programs to plant, protect and maintain their urban and community trees and forests.

6.4. Maintain and enhance the economic benefits and values of trees and forests

- *6.4.1. Performance Measure:* Number of communities and percent of population served under an active urban forest management plan.
- *6.4.2. Performance Measure:* Number of total jobs (direct, indirect, and induced) sustained or maintained in the economy annually due to S&PF investments.
- *6.4.3. Performance Measure:* Total value of resources leveraged through partnerships with states and others partners.

6.5. Protect, conserve, and enhance wildlife and fish habitat

- *6.5.1. Performance Measure:* Acres and percent of priority habitat areas where S&PF activities are protecting, conserving, and enhancing wildlife and fish habitat.
- 6.5.2. Performance Measure: Acres of connected forest resulting from S&PF investments.

6.6. Connect people to trees and forests, and engage them in environmental stewardship activities

- *6.6.1. Performance Measure:* Number of people who annually participate in FS and state forestry agency environmental literacy programs and activities.
- *6.6.2. Performance Measure:* Number of people (measured in person-days) engaged in environmental stewardship activities as part of an S&PF program.

6.7. Manage and restore trees and forests to mitigate and adapt to global climatological and environmental change

6.7.1. Performance Measure: Acres and percent of priority areas vulnerable to climate change where S&PF activities are contributing to resilient forests able to adapt to climate change.

6.7.2. Performance Measure: Potential carbon sequestered through implementation of forest management practices that result from S&PF investments on private forest lands.

DNR identified 76 distinct opportunities through the program assessment process. In many cases, State and Private Forestry program may have a shared lead role with other state and federal programs, or private entities to take advantage of these opportunities. These distinctions are not an expression of potential, but rather of current status. This section will address areas where DNR's status might change from a lower to a higher level of responsibility, as well as situations in which DNR might walk away from a leading role due to duplicative efforts or the existence of a potential lead entity in a better position to succeed with DNR assistance. Appendix C compiles threats and opportunities and correlates them with national themes and identified agency challenges. Further, Appendix C contains the current roles of State and Private Forestry programs in relation to responsibility for outcomes.

PRIORITIZATION MECHANISMS

A key function of this strategy is to invest State and Private Forestry program funds and leveraged resources in the following ways:

Geographic Distribution

Many elements of DNR's State and Private Forestry programs are necessarily geographically delimited. For example, fuels reduction funds are best used to deploy treatments in areas with heavy fuel loading. Urban and Community Forestry funds will be most efficacious in areas where urban forests have the best opportunity to provide ecosystem services and protect Puget Sound. And efforts to slow the rate of conversion will have their greatest impact in select counties of Western Washington that experience very grave conversion threat.

Categorical Efforts

Still other programs outlined in this document are statewide or programmatic in nature. For instance, DNR's long-standing and effective aerial survey efforts cover the entire state, with the exception of urban areas where they would not be effective. Strategies and tactics to assist forests in adapting to climatological and environmental change will be deployed statewide, although the contours will vary geographically.

Emergency/On Call

A subset of otherwise geographically targeted actions must continue to be on-call functions of State and Private Forestry programs that respond to emergency situations and timely opportunities. These include response to the detection and spread of new invasive non-native insects and diseases, outbreaks of native forest pests, the development of new urban forestry policies, champions or partnership opportunities in a municipal area, or the occurrence of large, severe, and damaging wildfire incidents.

Current Mechanisms

One of the key functions of this Plan is to address prioritization of State and Private Forestry resources. Many activities are geographically based. For example, fuels treatments are necessarily deployed in areas that have excess fuels. Others are statewide in nature, including the aerial survey program. Both of these programs, though, are essential to understanding the state of forest health and preparing for wildfire, which is an emergency/on call program, and is one of DNR's most central responsibilities. Further, on-call responsibilities like landowner assistance for disease or insect identification add significant nuance and allows the agency to observe conditions on the ground, adding detail to aerial surveys and confirming or debunking projections.

There is more tension between geographic and categorical priorities within disciplines. For instance, within wildland fire hazard reduction programs there may be projects that lend themselves to both categorical and geographic activities. By definition, geographic activities respond to observed conditions within a specific area, so are construed as a more pressing concern. In these circumstances, when resources decline, they move from categorical into geographic programs. That tension does not define the relationship between fire and fuels programs and urban forestry, for instance.

Finally, partnerships are essential to program delivery in State and Private Forestry work. Partnership opportunities do not always conform to high priority geographic areas, which means that some partners are prioritized over others. Complicating this imbalance is the fact that most funding sources available to State and Private Forestry efforts are, at least in part, contingent upon support from partners.

The strategy seeks to strike a balance with this tension, augmenting Assessment-identified priority landscapes with considerations for where the strongest partnerships and greatest need for core program functions exist, as well as partnership growth.

As discussed in the purpose statement for this strategy, there is a need to simultaneously meet the statutory requirements of the Farm Bill and subsequent guidance, while maintaining fidelity to the unaltered authorizing requirements of individual programs.

As an example, a core requirement and priority for some types of funding for wildfire fuel reduction and fire prevention actions is to protect areas with the most significant values at risk—in other words, developed areas with a concentration of people and homes in the wildland-urban interface. The Assessment, based on Congressional directions and subsequent content guidance, included these considerations but also is required to evaluate all forested lands. Paradoxically, other funding sources for wildfire fuel reduction and fire prevention actions require projects to be adjacent to federal lands. That these two kinds of priority coexist in the same landscape is rare in Washington State, and therefore no single way of evaluating priorities would identify areas that meet the statutory and policy requirements for both the programs and the Assessment, but also involve strategic decisions that are rooted in program-specific federal statute and policy.

CORE AND INTEGRATED PROGRAM LANDSCAPES

To achieve the purpose of this strategy, a performance goal is established to direct at least 60 percent of project implementation funding through State and Private Forestry programs to "core landscapes" defined by this strategy, measured for Fiscal Years 2016-2020. Core landscapes are delineated for the following program areas: Working Forestlands and Conversion, Upland Water Quality, Quantity, and Puget Sound Restoration, Wildfire Hazard Reduction, Forest Health Restoration, and Urban and Community Forest Enhancement. An additional map based on precipitation and surface temperature changes related to carbon inputs has been developed to guide funds in program areas affected by a changing climate, namely Forest Health Restoration and Wildfire Hazard Reduction.

While the remaining 40 percent of resources can be applied statewide in areas of high opportunity, program managers should prioritize grants that serve complementary purposes. For example, since Fuels Reduction and Forest Health Restoration activities share similar tactics, Opportunity funds in Fuels Reduction programs should first flow fuels projects in the Forest Health Restoration Core Areas.

Further, program managers should direct program resources to landscapes that may see lower precipitation and higher surface temperatures related to climate change. A supplemental map of areas likely to experience a mix of both effects has been developed to inform the delivery of Opportunity funds in categories affected by climate change impacts. The allocation formulae are as follows:

Program Resource Allocation

Fuels Reduction and Community Protection Programs

Forest Health Restoration Programs

≥60 percent Core Area Funding Forest Health Restoration Core Areas

≤40 percent Opportunity Funding

Remaining funds will be available for opportunity projects statewide, with special emphasis placed on those projects that fall within Fuels Reduction and Community Protection Core Area and Climate Change Impacts Areas of Concern

Working Forestlands Stewardship Programs

≥60 percent Core Area Funding

Forest Stewardship Core Areas

≤40 percent 40 percent Opportunity Funding

Remaining funds will be available for opportunity projects statewide, with special emphasis placed on those projects that fall within Forest Health Restoration Core Areas and Climate Change Impacts Areas of Concern

Urban Forestry Core Areas

≥60 percent Core Area Funding

Urban Forestry Core Areas

≤40 percent Opportunity Funding

Remaining funds will be available for opportunity projects statewide, with special emphasis placed on those projects that fall within Working Forestlands Stewardship Core Areas

Datasets Analyzed for Core Area Determination

Fuels Reduction and Community Protection Core Areas



Figure S1. Fuels Reduction and Community Protection Areas

- Fire Regime Condition Class (FRCC)—The Forest Service and other agencies contribute to and maintain a database of wildfire –related data called LANDFIRE. FRCC is among the available LANDFIRE data products, and combines measures of historic regimes along with the degree of departure from historical vegetation reference conditions. For the core area determination, acres with FRCC 2 and FRCC 3 (moderate to high departure, respectively, from historical conditions) were chosen and clipped to NLCD forestland.
- Westwide Wildfire Risk Assessment—Specifically, the Fire Risk Index (FRI), is a combination of the Fire Threat Index (a determination of the probability of an acre burning) and the Fire Effects Index (FEI), which identifies areas that have important values at risk due to wildfire and/or are costly areas to suppress wildfire.
- 3. Northeast Region Wildfire Risk Assessment—Consisting of a point dataset compiled in the Northeast Region from completed Residential Wildfire Hazard Assessment forms, these data provide a snapshot of the number of homes that are at risk of damage from wildfire due to aspect, slope, and vegetation factors. Since surveys are not conducted on every home in the Region, this dataset is primarily useful as a confirmation of work with more scientific validity.

Forest Health Restoration Core Areas



Figure S2. Forest Health Restoration Core Areas

- NIDRM (National Insect and Disease Risk Map) layers for selected pests and pathogens—The US Forest Service's Forest Health Protection program has produced a National Insect and Disease Risk Map (NIDRM) based on data from the Forest Inventory and Analysis (FIA) system to predict stand mortality and damage over the 15 year period from 2013-2027. Data can be viewed by pest code. In this case, we used data depicting mortality due to dwarf mistletoe, pine bark beetles, western spruce budworm, and Douglas fir beetle.
- 2. USFS Region 6 mean precipitation level estimates under ensemble mean carbon Increase projections 2070-2099 and mean surface temperature estimates under ensemble mean carbon Increase projections 2070-2099.

Stewardship of Working Forestlands Core Areas



Figure S3. Stewardship of Working Forestland Core Areas

- DNR Asset Management Strategy ("Working Forest Landscapes")—Completed in 2008, the Asset Management Strategy identified long-term working forest landscapes, developed around blocks of forested state trust land. Two areas, East Jefferson County and the Starbird Region in Snohomish County were given more weight in the analysis due to rapid local population growth combined with key conservation and trust land assets.
- 2. Forest Legacy Program Assessment of Need (AON)—The Washington State AON guides deployment of the US Forest Service Forest Legacy program. The most current AON (2004) designates priority A and B proposed acquisition areas based on forestlands lying outside the designated urban growth areas, but within Watershed Administrative Units that contain land populated with at least one household unit per 40 acres.
- Washington Natural Heritage Program GIS Dataset—This dataset currently represents more than 7,000 site-specific records of Washington's most significant elements of biodiversity, including rare vascular and non-vascular plant species and high-quality terrestrial and wetland ecosystems of special concern. Forested areas were weighted over other terrestrial ecosystems.





Urban and Community Forestry

- 1. Tree City USA—This data layer shows the location of current Tree Cities in Washington State.
- 2. United States Census Block Data combined with recent past and projected population increase data from the Washington State Office of Financial Management.
- 3. Percent Canopy Cover: 2011 dataset showing statewide canopy cover.



Figure S5. Climate Change Adaptation Core Areas

Climate Change Adaptation Core Areas

- 1. USFS Region 6 Ensemble Mean Precipitation level projection 2070-2099—Dataset reflects projected precipitation expressed as the mean of several potential "carbon futures", overlaid with the same dataset's estimate of mean surface temperature.
- 2. USGS NLCD Landcover Data 2011—The foregoing precipitation and surface temperature datasets were clipped to forest cover statewide.

Forested areas that were expected to experience significant increases over normal surface temperature and significant decreases in normal precipitation were classified as "areas of concern".

Opportunities

The foregoing assessments identified 78 opportunities in six key program areas. The following discussion will determine lead, shared, and secondary responsibilities, propose opportunities to share resources and competencies, and close with a discussion of potential pilot projects for consideration by program managers. Opportunities are classified as either geographically delimited (tied to core and opportunity area assessments) or categorical in nature.

Fuels Reduction Opportunities

Geographic

- Increase landowner assistance work to clear defensible spaces around homes in the WUI. *Coleads:* DNR Fire Protection and Prevention, DNR Regional and Statewide Landowner Assistance staff, landowners and managers
- **Reduce fuel loads in Eastern Washington forests.** *Co-leads:* DNR Fire Protection and Prevention, Conservation Districts, land owners and managers
- Broaden reach of CWPP program. Co-leads: DNR Fire Protection and Prevention, DNR Regions
- Restore ecological integrity, appropriate density, structure, and species composition to overstocked Eastern Washington forests. *Co-leads:* DNR Fire Protection and Prevention, DNR and S&PF Forest Health, DNR Region Landowner Assistance staff, land owners and managers
- Integrate fuel reduction activities with forest health improvement actions. *Co-leads:* DNR Fire Protection and Prevention, DNR and S&PF Forest Health
- Partner with multiple landowners and managers to achieve landscape-scale forest health restoration objectives. *Co-leads:* DNR and S&PF Forest Health, partner agencies, land owners and managers, local prescribed fire councils
- Restore and maintain forest productivity and carbon sequestration value of forests for climatological and environmental change mitigation and adopt strategies for adapting forests to a changed climate: *Co-leads*: DNR S&PF Forest Health, DNR Policy staff
- Collaborate with public and private partners to take advantage of non-traditional forest markets, such as biofuels and edible products. *Co-leads*: DNR Forest Practices program, DNR and S&PF Forest Health, NGO partners, and partner agencies

Categorical

- Build DNR's wildland firefighting force. Leads: DNR Fire Protection and Prevention
- Maintain and develop forest markets and infrastructure: *Co-leads:* DNR Uplands, local governments, NGO partners
- Increase use of prescribed fire without compromising human life or property. *Co-leads:* DNR Fire Protection and Prevention, DNR and S&PF Forest Health, local prescribed fire councils
- Improve and enhance force training. *Leads:* DNR Fire Protection and Prevention
- **Properly equip all wildland firefighters.** *Leads:* DNR Fire Protection and Prevention
- **Reduce the rate of forest conversion.** *Co-leads:* DNR Small Forest Landowner Office, DNR Region Technical Assistance staff, agency and NGO partners
- Record climatological and firefighter action data for after-action assessment of treatment/attack strategies. *Leads:* DNR Fire Protection and prevention, DNR and S&PF Forest Health

National core performance measures (see ISSUES, OPPORTUNITIES, OBJECTIVES AND PERFORMANCE MEASURES section) applicable to addressing these opportunities include: 1.2.1., 2.1.1., 2.1.2, 2.1.3, 2.2.1, 3.1.1., 3.3.1, 3.4.2, 3.4.3., 3.5.1., 3.6.1., 3.6.2., 3.7.1., and 3.7.2.

Forest Health Opportunities

Geographic

- **Build Western Washington monitoring capacity.** *Co-leads*: DNR and S&PF Forest Health, Washington State Department of Agriculture, NGO Partners
- Participate in forest health collaboratives to advocate for and increase active forest management
- Encourage development of small-scale cooperative mills in Eastern Washington. *Co-leads*: DNR Policy, DNR Uplands, local government entities, NGO and Agency partners
- Seek new ways to pay for Eastern Washington forest health treatments by selling biofuels, biomass-generated energy, and small-wood forest products. *Co-leads*: DNR Uplands, DNR Policy, DNR and S&PF Forest Health, NGO partners
- Create and implement a set of best management practices for controlling dwarf mistletoes that dovetails with pest management efforts. *Co-leads:* DNR and S&PF Forest Health
- Work with federal and private partners to pilot and expand small scale biomass operations, including mobile pyrolysis. *Co-leads*: DNR Policy, DNR and S&PF Forest Health
- Manage DNR/USFS boundary as defensible space vis-à-vis forest health hazards. *Co-leads*: DNR and S&PF Forest Health, Federal Agency partners
- Assist/Advise Okanogan-Wenatchee National Forest on implementation of Forest Health Restoration Strategy. *Lead*: DNR and S&PF Forest Health

Categorical

- Encourage measurement models for stewardship accomplishments that focus on documentation of actions taken. *Co-leads*: State Forester, DNR Policy staff, Small Forest Landowner Office, NGO Partners
- **Develop dedicated state funding sources for stewardship efforts.** *Lead*: DNR Governmental Relations staff
- Expand education of citizen scientists, arborists, consulting foresters, and forest landowners regarding exotic pests and dangerous pathogens. *Co-leads*: DNR and S&PF Forest Health, DNR Landowner Technical Assistance, DNR Urban and Community Forestry, NGO partners, Federal Agency partners,
- Reinvigorate CTED, work with Department of Commerce and local Chambers of Commerce to encourage mill development in the small, large, and portable categories. *Co-leads*: DNR Governmental Relations staff, Chambers of Commerce and other NGO partners
- Seek dedicated funding to supplement state and federal funds in landowner assistance programs. *Co-leads*: DNR Governmental Relations staff

National core performance measures (see ISSUES, OPPORTUNITIES, OBJECTIVES AND PERFORMANCE MEASURES section) applicable to addressing these opportunities include: 1.2.1, 2.1.1, 2.1.2, 2.2.1, 3.1.1, 3.3.2, 3.5.1, 3.5.2, 3.6.1, 3.6.2, 3.7.1, 3.7.2

Forest Stewardship Opportunities

Geographic

- Leverage state and federal funding with existing capacity to connect landowners with easement/fee-simple purchase opportunities. Co-leads: DNR Small Forest Landowner office, DNR Transactions section, land owners
- Working with land trusts, local governments, agency staff, and forest landowners to build a onestop-shop for preservation opportunities. Co-leads: DNR Small Forest Landowner office, DNR Transactions section, Legacy Program staff, land trusts, land owners
- Work with legislature to adjust RCW to offer tax benefits based on provision of ecosystem services. Co-leads: DNR Policy staff, DNR Governmental Relations staff
- Deliver DNR education and technical expertise programs to a broader swathe of public. Coleads: DNR Small Forest Landowner office, DNR Region Landowner Technical Assistance, DNR and S&PF Forest Health
- Maintain a dependable and non-declining flow of timber from unreserved timberlands. Coleads: DNR Uplands, DNR Governmental Relations, local community partners, NGO partners
- Assist forest landowners with meeting environmental protection requirements. Co-leads: DNR Small Forest Landowner office, DNR Region Landowner Technical Assistance staff
- Remove barriers to fish passage from forest roads and increase aquatic habitat availability. Lead: DNR Small Forest Landowner Office
- Work with partners and communities to invigorate development of mobile mills. Co-leads: DNR Uplands, DNR Governmental Relations, NGO partners, industry partners, Chambers of Commerce.
- Work with public and private stakeholders to develop biofuels and other alternative energy sources from DNR lands not suitable for trust forestry. Co-leads: DNR Policy, DNR and S&PF Forest Health
- Plan adaptation tactics that focus on key ecosystem function measures: water quality and storage, flooding prevention, air quality, carbon storage, and wildlife habitat/biodiversity potential. Co-leads: DNR Policy, DNR Uplands, DNR Natural Heritage Program
- Promote management strategies that increase water storage and retention an all forested environments, including urban forests. Co-leads: DNR Uplands, DNR Aquatics, DNR Natural Heritage Program

Categorical

- **Build Small Forest Landowner Office infrastructure to serve more landowners.** *Co-Leads*: DNR Governmental Relations, DNR Small Forest Landowner Office
- **Compensate forest landowners for ecosystem services.** *Co-Leads*: DNR Governmental Relations, elected officials
- Enhance coordination among forest landowners and managers toward integrated watershed restoration outcomes. *Co-Leads*: DNR Uplands, DNR Forest Practices, DNR Small Forest Landowner Office, Federal Agency Partners, NGO Partners
- **Protect productivity and function from forest health threats.** *Co-Leads*: DNR and S&PF Forest Health
- Develop markets for non-timber forest products and identify and encourage economic viability of very-large-diameter mills. *Lead: DNR Uplands*

• Assist small forest landowners in efforts to adapt to the impacts of climatological and environmental change. *Co-Leads*: DNR Small Forest Landowner Office, DNR Region Landowner Technical Assistance

National core performance measures (see ISSUES, OPPORTUNITIES, OBJECTIVES and PERFORMANCE MEASURES section) applicable to addressing these opportunities include: 1.1.1, 1.2.1, 2.1.2, 2.2.1, 3.1.1, 3.3.2, 3.4.3, 3.5.1, 3.5.2, 3.6.2, 3.7.1, 3.7.2

Urban and Community Forestry Opportunities

Geographic

- Cultivate local partnerships to monitor urban forests for invasive non-native species. *Co-Leads*: DNR Urban and Community Forestry, DNR and S&PF Forest Health, NGO Partners, city governments, academic institutions
- Formalize DNR's current work with partners to restore urban forests and support volunteerism. *Co-Leads*: DNR Urban and Community Forestry, Washington Conservation Corp, Local NGO partners
- Partner with the Invasive Species Council and ports to ensure early detection of non-native tree pest and pathogen introductions. *Co-Leads*: DNR Urban and Community Forestry, DNR and S&PF Forest Health, Washington State Department of Agriculture, Port Districts, NGO Partners
- Improve public awareness of the benefits of urban forests. *Co-Leads*: DNR Urban and Community Forestry, academic institutions, local governments
- Provide technical expertise and training to citizen scientists engaged in urban forest health monitoring. *Co-Leads*: DNR Urban and Community Forestry, DNR and S&PF Forest Health, local governments, academic institutions
- **Partner with city planning departments and developers to protect urban forests.** *Co-Leads*: DNR Urban and Community Forestry, city forestry programs, building industry trade associations
- **Connect the public with their urban forests through education and volunteerism.** *Co-Leads*: DNR Urban and Community Forestry, local NGO partners, city governments, school districts
- Engage non-profit partners to quantify the benefits of urban forests. *Co-Leads*: DNR Urban and Community Forestry, local and statewide NGO partners
- Encourage and assist city and county planners in developing urban forest plans. *Co-Leads*: DNR Urban and Community Forestry, city and county planning and development departments, county natural resource and forestry programs
- **Partner with city foresters and local organizations to conduct tree inventories.** *Co-Leads*: DNR Urban and Community Forestry, school districts, local NGOs
- Promote urban wood waste utilization as a wood source and detection point for urban pests. *Co-Leads*: DNR Urban and Community Forestry, city forestry departments, arboriculturists, correctional institutions

Categorical

• **Reinvigorate the Evergreen Communities Act.** *Co-Leads*: DNR Policy and Governmental Relations staff, DNR Urban and Community Forestry

National core performance measures (see ISSUES, OPPORTUNITIES, OBJECTIVES and PERFORMANCE MEASURES section) applicable to addressing these opportunities include: 1.1.1, 2.2.1, 3.2.1, 3.4.1, 3.4.2, 3.4.4, 3.5.1, 3.5.2, 3.6.1, 3.6.2, 3.7.1, 3.7.2

Shared Opportunities

To encourage interdisciplinary efforts, DNR will assemble cross-program teams to assess the potential for shared efforts or the state of knowledge in the following areas:

Fuels Reduction and Forest Health Restoration

- Potential Shared Effort: Geographic areas with shared management opportunities
- Potential Shared Effort: Shared future projects in areas projected to be drier and hotter
- State of Knowledge Assessment: Forest health impacts on wildland fire frequency and intensity, and vice-versa

Urban and Community Forestry and Upland Water Quality

- State of Knowledge Assessment: Assess need for updated canopy percentage data
- State of Knowledge Assessment: Urban tree loss/impermeable surface impacts on sound
- State of Knowledge Assessment: Nexus between urban development and retention of working forest

Legacy/Transactions and Small Forest Landowner Office

- State of Knowledge Assessment: Legacy Assessment of Need Update
- Potential Shared Effort: Emerging potential known legacy projects
- Potential Shared Effort: Small Forest Landowner Office/Legacy Program/Land Trust partnership (see Pilot Projects section)

Pilot Projects

Contingent upon resources, DNR will assess and potentially implement the following pilot projects to encourage cross-program work and address significant impinging issues, including surface temperature and precipitation impacts related to climatological and environmental change and increasing threat of working forestland conversion.

Douglas Fir Climatic Zone Study

Problem: The impacts of alteration to statewide precipitation level, timing, and form, coupled with probably increases in surface temperature are poorly understood. The viable ranges of many tree species are likely to change, and ideal conditions for a number of Washington's iconic species may not exist in the state by mid-century. Conceptual adaptation strategies have focused on introduction of non-native heat and drought tolerant tree species to Washington's forested lands. The unknown

consequences of these strategies include potential introductions of new pests and pathogens, economic dislocation in the forest products industry, and as-yet-unknown harmful interactions between introduces species and native flora and fauna. Finally, species like Douglas fir, Sitka spruce, and western hemlock are important to the public's sense of place in Washington. The social implications of widespread forest species composition change must be considered in adaptation strategies.

Solution: Explore using native species or very close relatives to adapt landscapes to climatological and environmental change.

Model: Douglas fir ranges from Vancouver, BC to Central California, thriving in both semi-dry and wet zones. There is some likelihood that Douglas fir specimens that grow in hotter, drier environments are genetically distinct from Western Washington varieties in ways that allow them to survive and reproduce in a significantly warmer and drier environment.

This project will increase the agency's knowledge of potential sources of seed and seedling stock for climate adaptation purposes. Working with small and large forest landowners and industrial foresters, DNR will establish 100 plots of five trees each in Western Washington. The plots will be planted at a variety of elevations, aspects, soil types, and temperature and precipitation zones. Seedlings will be chosen from a range of precipitation and temperature zones from Western Washington to Oregon and planted in plots in both in and out of their typical climatic ranges. Agency staff and landowners will monitor the trees regularly, recording all important life-cycle hallmarks, including bud formation and bud break, growth patterns and rate, and resistance to pests and pathogens. These data will be recorded coterminous with on-site weather data to provide the clearest possible picture of potential native species adaptation strategies. Every effort will be taken to ensure that each plot receives the same treatment in order to ensure validity. True rigor will be derived from the scope of the project rather than from the treatment of any one plot.

Project Timeframe: 40-80 years. Progress will be recorded in each successive Forest Action Plan update.

Working Forestlands Preservation Clearinghouse

Problem: An increasing population, combined with an accelerating real estate market and an ageing landowner base, threatens to instigate a conversion wave in Washington's most productive forestland. State and Federal resources to address conversion rates are not matched to the threat of mass conversion, and staffing levels are not high enough to work in a criteria-based and strategic fashion, and necessary connections between program areas have not been cultivated due to inadequate resources. Finally, the large base of land trusts statewide is not well-organized or coordinated around a unified set of landscapes or landscape types.

Solution: Establish DNR as a front-line contact point for and middle-ground clearinghouse between vulnerable small forest landowners in key landscapes and the NGOs and agencies that might help them keep their property in forest.

Model: Working in Snohomish, King, Clark, and Kittitas Counties, DNR's Stewardship Foresters will undertake an outreach project, supported by additional demographic and administrative resources, to identify landowners who may have

• Trouble paying their property taxes

- Recently suffered the loss of a family matriarch or patriarch,
- Be encountering significant forest health problems that threaten to take their landscapes of out forest, or
- Be otherwise vulnerable to selling or developing their land.

Upon identification, staff will meet with landowners to begin discussing options for procuring needed forest health improvement resources, conservation easements, harvest technical assistance, or, in very limited cases, fee-simple purchase. DNR staff would gather as much information landowners are willing to share about the landowner's financial situation, property condition, and relevant authorities. If landowners are willing to move through the process, staff will discuss the landowner's situation and the relative importance of the landscape for conservation purposes with relevant land trusts and state or federal agency partners to assess the viability of an easement or other action. Within one month, staff will report the results of their assessment back to the landowner.

If staff are reasonably certain that they can procure a mix of resources to enable the landowner to stay on his or her land, and the landowner wishes to take the next step, DNR will spend the next six months working with NGO partners and agency partners to prepare all necessary documents, complete negotiations, and procure resources. The aim of the process is to finalize projects within one year.

Project Timeline: Pilot will not commence unless sufficient resources are available for, at minimum, a two-year test. Success of the pilot will be assessed in the next Forest Action Plan update.

PROGRAM RESOURCES

Guidance for Statewide Forest Resource Strategies requires a description of the resources needed by the State Forester in order to address strategic components (U.S. Forest Service 2008). This section provides a quantitative gauge of baseline program viability-level resources, current program funding levels, and the potential for meeting additional strategic priorities with increased resources. Figure S6 shows the current funding levels for



Figure S6: State and Private Forestry Allotments, FY 2009-2015

State and Private Forestry programs to Washington State, averaged from Fiscal Years 2009 to 2015. Most one-time funds, such as supplemental congressional appropriations and American Recovery and Reinvestment Act projects, have been removed from the averages to reflect more normalized program levels. For each program, the current funding levels are qualified below with a discussion of observed program funding trends.

State and **Volunteer Fire** Assistance

The current State and Volunteer Fire Assistance programs' respective funding levels of approximately \$1.2 million and \$500 thousand annually are sufficient to meet baseline viability requirements. Funds for both program areas entered a period of decline in 2011, and have steadily move upward in the years since, although State Fire Assistance funds



Figure S7. State Fire Assistance seven year funding history

have yet to attain their historic high.

Federal funding comprises 12 percent of Washington State expenditures on wildland fire preparedness

and suppression. Reductions from current levels would significantly diminish federal, state and local coordination and resource sharing. In turn, this would result in lost efficiencies, likely increasing overall fire suppression costs for all jurisdictions as well as risking additional human safety, property and forest resource damage. Local fire districts play an increasingly critical role in the coordinated emergency response



Figure S8. Volunteer Fire Assistance seven year funding history

system in Washington State. State and Private Forestry funding is important to assuring their continued ability to meet these demands. DNR performs a crucial role as a bridge between the federal wildland

fire system and local fire districts. Communities would be less prepared, and at the same time, more wildfires would be likely to escape containment goals due to lack of timely mobilization, clear communication, and advanced planning.

The record fire season of 2014, combined with deep drought in the winter and spring of 2015 suggests that the upcoming fire season may again be severe. Simultaneously, federal partners have produced the National Cohesive Wildland Fire Management Strategy and the Westwide Wildfire Risk Assessment, which, respectively, charts national strategy for managing wildlife fire and provides new datasets to assist wildland fire managers in assessing risk and prescribing treatments and actions.

Based on these opportunities and the need for program growth that accommodates increasing wildland fire complexity, an additional annual program allocation of \$500 thousand (total \$1.7 million) in State Fire Assistance and \$500 thousand in Volunteer Fire Assistance (total \$1 million) would attain the next increment of meaningfully enhanced accomplishments.



Wildfire Fuels Reduction

and competitive program funding sources and not a State and Private Forestry program unto itself per se. These sources have been aggregated for the purposes of this strategy. The current average annual fuels reduction funding level of \$2 million

Fuels reduction



is sufficient to meet baseline viability requirements. The trend in recent years' allocation has been declining, although significant one-time funding has allowed the rate of implementation for Community Wildfire Protection Plan treatments to increase.

Based on the rate at which needs outpace current resources, doubling the average annual program allocation to a \$4 million level would achieve the next meaningful increment in meeting the identified opportunities. The trajectory of fuel reduction accomplishments can be expected to increase as forest biomass industry infrastructure grows, provided that existing traditional infrastructure does not suffer significant additional losses. Increased material utilization will reduce per-acre treatment costs and effectively stretch limited funding further.

Forest Health

The current annual average Forest Health program funding level of \$380 thousand is sufficient to meet baseline viability requirements. These include the annual aerial survey of insect and disease damage, field surveys and monitoring of native and non-native invasive insects and diseases, basic entomology and pathology expertise for technical assistance, and a modest amount of treatment. Expanded forest

health efforts in Northeast Washington were funded under the Recovery Act, and the program has secured additional funds through the Western Landscape Scale Restoration (LSR) grant process. Overall, forest health resources are in a state of decline for Washington National Forests.



Should it continue, the downward trend bodes

ill for the health of Washington's forests. The National Insect and Disease Risk Map projects elevated mortality levels will occur on 33 percent of the forestland in eastern Washington within the next 15 years, which seems likely to be a substantial underestimation when compounded by projected climatological and environmental change impacts. While much of northeast Washington's lodgepole pine has escaped the stand-replacing mortality levels that have been experienced only miles north in British Columbia, large areas are reaching a stage of heightened susceptibility at the same time. Recent years insect and disease damage and wildfire trends also bear witness to worsening, compounding interactions between these two elements of forest disturbance regimes that have vastly departed from historical norms.

The DNR Forest Health

Figure S10. Forest Health Program seven year funding history

Program is arguably the most advanced and best equipped for effective action compared with any other western state. There is a strong statutory underpinning for responses to forest health emergencies and for taking systematic preventive measures. An "all-lands" approach has already been adopted by DNR, its constituents and partners, and endorsed by the State Legislature.

As is the case with fuels reduction, the need for additional action vastly outpaces current resources. Implementation of the Recovery Act project will test several new methods of fine-scale risk evaluation and targeted landowner response with the aim of further increasing program efficacy. Using these improvements, a potential increased State and Private Forestry funding level that would realize the next increment of accomplishment toward identified opportunities is \$1.3 million annually. Principally this would be used to implement additional forest health restoration treatments. A current lack of capacity to deliver targeted outreach that will elicit timely landowner action would also be remedied, extending the efficacy of treatment efforts.

Forest Stewardship

The current average Forest Stewardship program funding level of approximately \$218 thousand annually is not sufficient to meet baseline viability requirements. After a slight increase in 2010, Stewardship funds have been on a steady decline to their current record low. As a result, Forest



Figure S11. Forest Stewardship Program seven year funding history

Stewardship does

not serve a leading role in any of the Assessment-identified opportunities. Other state-funded and State and Private Forestry-funded program resources are currently required to meet the basic demand for forest stewardship planning. There is also a complete lack of Stewardship funds for project implementation.

A minimum program viability level is estimated to be \$550 thousand annually. This funding level would sustain the following assets:

- Three Western Washington field foresters to assist landowners with projects to address "alllands" priority landscapes for Water Quality, Quantity and Puget Sound Restoration, Working Forestlands and Conversion, and Biodiversity and Habitat Conservation issues and their opportunities identified in the Assessment;
- A forest roads engineering specialist to assist with projects to reduce watershed impacts and attain "all-lands" watershed restoration objectives; and
- One outreach specialist who would:
 - Contribute to current broad-reach education strategies, like field days and coached planning courses currently led by Washington State University Extension;
 - Organize and leverage Forest Stewardship actions with the lead-role entities and project funding sources for identified opportunities.

An enhanced program level that would achieve the next meaningful increment toward realizing identified opportunities would require \$1 million annually. Personnel expenditures would remain the same as minimum viability levels, but \$150 thousand annually would be sub-granted for project implementation within each of the three NRCS Local Working Groups in Western Washington (\$450 thousand in total). These project funds could then be leveraged against investments by the NRCS Environmental Quality Incentives Program and other NRCS conservation programs, along with Puget Sound Partnership, Salmon Recovery Funding Board, Washington Wildlife and Recreation Program, and DNR Small Forest Landowner Office projects. A relatively small State and Private Forestry investment in Forest Stewardship project implementation funding would tremendously increase working forest, watershed restoration and biodiversity outcomes by bringing some resources to coordination efforts among ongoing investments. Although a truly collaborative spirit prevails among the entities central to forestland management and conservation efforts in Washington State, collaboration is difficult to sustain when the partnership is essentially one-way. The enhanced program level would have the added benefit of greatly increasing reportable program contributions toward the applicable national performance measures by virtue of the huge leveraged fund contribution opportunities.



longstanding MOU among the U.S. Forest

Figure S12. Urban and Community Forestry seven year funding history

Service and State Foresters, \$200 thousand annually is the established baseline viability level. Costs have increased substantially since this agreement was signed, and the actual inflation-adjusted amount for Washington's baseline program should be approximately \$248 thousand. This provides the essential program staff to deploy the program development, education and outreach strategies outlined earlier in this strategy (see STATEWIDE and CATEGORICALLY PRIORITIZED ACTIONS section). Funding that is supplemental to the baseline program amount is sub-granted to communities and applicants for purposes also outlined earlier, which notably lack categories for urban tree planting, re-greening and ecosystem services connectivity projects.

Based on the Assessment-identified opportunities expansion of urban forestry programs, Puget Sound water quality improvement, and expanded partnership efforts, an enhanced program level that would

begin realizing these opportunities requires an additional \$1.1 million annually (\$1.5 million total). Program funding growth of that level is attainable over ten years, rather than the five-year life of this plan. These investments would be tied to the following specific assessment opportunities and corresponding performance measures

- Cultivate local partnerships to monitor urban forests for invasive non-native species;
- Meet the program requirements of a reinvigorated Evergreen Communities Act;
- Provide technical assistance to urban forest landowners;
- Reconnect urban people, especially youths, with the forested and outdoors environments;
- Maintain and improve air quality and energy conservation;
- Restore urban forests and individual trees in urban riparian areas; and
- Detect and eradicate invasive non-native species.

Forest Legacy

Forest Legacy program projects compete for funding in a national selection process, and therefore "average" levels do not appear in Figure S13. Annual funding requests depend on the ripeness of projects with willing landowners and partners, so yearto-year figures vary widely. Washington State's program has



Figure S13. Forest Legacy Program Funding, nationally

focused on conservation easement acquisitions as opposed to more expensive fee simple interest transactions (DNR 2004b). This, coupled with excellent leveraged partner resources, has earned the program a leading role in the opportunity to reduce the rate of forestland conversion identified in the Assessment. Significant acreage of permanent working forest conservation has been achieved while minimizing per-acre costs. While the FY 11 President's budget called for a 32% increase over FY 10 funding levels, funding has since returned to normal levels, measured nationally.

One recent study estimates that nearly one million private forestland acres are at risk of conversion in western Washington alone (Bradley et al. 2009). Threats of this magnitude are simply too great for a single program to wholly guard against, making it of the utmost importance to employ leveraged partnerships and close coordination with other conservation investments. Strategic considerations in the Legacy Assessment of Need (DNR 2004b) like focusing on working forestlands that are well outside

urban growth areas and positioning acquisitions adjacent to forestland in a stable ownership status are the most effective means of reducing conversion trends. Effectively this strategy uses conservation investments to establish a buffer between developed and working lands uses before extreme development pressures are brought to bear that would drive property prices too high. One key precursor of more effective Forest Legacy requests is an updated assessment of need that takes into account new geospatial data produced by DNR and partners. In particular, the High Resolution Change Detection (HRCD) developed by the Washington Department of Fish and Wildlife (WDFW), with funding be the Washington Department of Ecology, the Salmon Recovery Funding Board (SRFB), and the United States Environmental Protection Agency (EPA) provides a potential new framework for analysis of rate, type, and impact of landscape change.

National program rules cap the value of any given Forest Legacy project at \$7 million. No state may submit more than three projects annually, and the combined project values may not exceed \$10 million. By a wide margin, Washington State has the capability and wealth of opportunities to perform \$10 million in Forest Legacy projects annually on a sustained basis. Per-acre costs for the Forest Legacy program's share of completed acquisitions has ranged from around \$300 to over \$2000. Several recent large projects have been in the low end of this range but per-acre costs will always depend on site-specific values and considerations. At an average Legacy share of acquisition costs in the \$500 per acre range, \$10 million annually over the five-year life of this strategy could permanently conserve 100,000 acres and make a significant impact on the predicted conversion rates.

AGENCY IDENTIFIED CHALLENGES

Conversion of Working Forestland Strategies

Conversion, driven as it is by a multiplicity of factors, is one of State and Private Forestry's most serious challenges. Like wildland fire and forest health, the conversion crisis is imminent and driven primarily by direct change of land use from forest to pavement.

The lingering effects to the recession that ended in 2010 have held the rural housing market back. But as the state's population grows rapidly, and as current landowners age, working forestlands are poised to convert. The following strategies are necessary elements of any effort to stem the rate of conversion:

- Increase coordination on landowner identification and landscape integrity protection efforts (see Working Forestlands Preservation pilot project, page 132)
- Reinvigorate Small Forest Landowner Office to support landowners who are trying to keep their holdings in working forest
- Support increased Forest Legacy funding and build Legacy Program staff to enable more strategic and criteria based approach on applications
- Address information gaps regarding small forest landowner demographics, land cover and canopy assessments, and Forest Legacy Program Assessment of Need

Climate Change Adaption Strategies

The scientific basis for climate adaptation strategies has been largely provided by the University of Washington Climate Impacts Group, for example through *Climate Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers* (Climate Impacts Group 2013), otherwise known as the *State of Knowledge Report*.

Both the U.S. Forest Service and the Department of Interior are working on adaptation strategies that will guide adaptation paths for their land management responsibilities that guard against climate-related threats.

Common threads among state and federal strategic efforts include a focus on maintaining forests' carbon sequestration values, and assisting forest ecosystems with adapting to a changed climatic regime. The technical data and resources to develop specific adaptation strategies is largely still in development. Some approaches to climate change adaptation that might bear fruit include:

- Emphasis on ecosystem services: In the face of stochastic events and an uncertain climate future, land managers should focus on preserving essential ecosystem services rather than extant biological communities.
- Link urban areas to upland ecosystems: To reduce energy use, protect waterways and Puget Sound, and store carbon, land managers should focus on watershed-wide approaches to restoration and management activities, linking urban and traditionally rural forestlands.
- Experiments in adaptation: Assess the resilience of species representatives adapted to microclimates across a range of ecological niches (see Douglas fir Climactic Zone Study, page 131).

WESTERN LANDSCAPE SCALE RESTORATION GRANTS

Each year, DNR programs develop project proposals that compete with other states for a subset of the overall State & Private Forestry funding. In recent years, 15 percent of the national State & Private Forestry program allocations have been dedicated to funding competitively selected projects. The information in the Statewide Assessment and Strategy will enhance the quality of all future competitive proposals by quantifying priorities and identifying opportunities that address state and national issues and threats. Western Landscape Scale Restoration (LSR) grants are a specific subset of competitive funds that will be the subject of performance improvement over the duration of this strategy.

While DNR's application for LSR resources may contain funding for categorical needs, such as gathering statewide data to enrich outreach or restoration efforts, this strategy sets a standard that each LSR request will be tied to an applicable Core Area landscape. For example, should DNR request funds to develop landscape scale stewardship plans, a portion of the planning area must be in one of the Stewardship of Working Forestlands Core Areas.

The following is a list of proposals that are consistent with Western Landscape Scale Restoration priorities and the strategies and tactics outlined in this Plan.

Washington e-book

Comprehensive one-stop online shop for education on: Tree selection, sustainability, business and taxes, wildfire, harvesting, non-timber forest products, succession planning, insects and pathogens, and ecosystem services.

High Priority Landscape-Scale Stewardship Plans (Multiple proposals over a long planning horizon)

Provide a master plan to guide and supplement agency and private stewardship plans in the following WRIAs:

- Southwest Washington: Cowlitz, Lewis, Salmon-Washougal, Wind-White Salmon, Nisqually, Upper and Lower Chehalis
- Northwest Washington: Snohomish, Stillaguamish, Lower Skagit-Samish
- Eastern Olympic Peninsula: Quilcene-Snow, Kitsap, Kennedy-Goldsworth

Sub-Watershed Scale Fish Passage and Habitat Restoration

Assessment and restoration of important upstream waters emphasizing instream structures and riparian planting and restoration. Focus on salmonid populations primarily in SW Washington.

Invasives and Pathogens Mapping Fieldwork

Increase capacity to better understand the extent, severity and impact of existing and potential pathogens, parasites, and insects related to their impacts on forest health and the intensity and size of wildland fire.

Urban Forestry Data Gaps

Project could include:

- New canopy assessments, complemented by
- *fine-scale ground-level resource inventories to identify function, structure and value of community trees,*

Urban Forestry Assisted Planning

Add capacity to use the foregoing assessment and data to assist cities and municipalities in developing urban forest plans that emphasize sustainable tree management; including identifying potential risk factors and threats in and to the existing forest, and identifying adaptive management strategies to avoid risk and threats.

Sustaining Family Forestlands: Database and Outreach Project

Link demographic data from the Sustaining Family Forest Initiative with updated geospatial ownership data from the Washington State Forestland Database. The project will increase the efficacy of outreach efforts and project implementation for multiple State and Private Forestry programs. Improvements will be piloted in two demonstration projects in core FAP priority landscapes.

Urban and Rural Small Forest Landowners: The Next Generation

Add capacity to identify and work with current small forest landowners on succession planning, and build ties with recent heirs to assist them in retaining family property through the use of land management and harvest planning, and easement procurement.

Coached Landowner Planning—SFL and Urban

Add capacity to work with local governments and private landowners in core program area to maximize forest acreage managed by a planning document.

Small Forest Landowner-Urban Forest Connectivity Project

Provide a set of services tiered to landowner interest and landholding size with the goal of keeping land in a forested condition. Services would include direct technical and regulatory assistance, online services, financial incentive programs, and succession planning. Model would focus on summit-to-sound connectivity.

Collaborative Support and Leadership

Focus on seeding the collaborative model in appropriate areas of high need and would provide leadership to existing and potential collaboratives via a leadership council.

Root Disease Management

Project has two components:

- Assess the distribution of root disease as distinct from animal damage via field surveys, and
- Provide technical assistance and education to landowners whose trees show signs of root disease.

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Following are the references for all sections of the Washington State *Forest Assessment and Strategy*. Web links to the information are included where possible.

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URBAN AND COMMUNITY FORESTS

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