PORTLAND PARKS & RECREATION

Courtesy Phyllis Reynolds

PORTLAND URBAN FORESTRY MANAGEMENT PLAN 2004

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and the
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Executive Summary

The Urban Forest

The urban forest is the complex system of trees and smaller plants, wildlife, associated organisms, soil, water, air and people in and around our city. The urban forest surrounds us and contributes to the quality of our daily lives. It provides environmental, psychological, and economic benefits ranging from improved air and water quality to savings from decreased heating and cooling costs to aesthetically pleasing neighborhoods and increased resale values. It is vital to our efforts to restore fish and wildlife habitat and it provides countless opportunities for recreation and refreshment.

One large residential tree is estimated to produce $4,000 of total economic benefits over its first fifty years,[1] and to increase resale values by 6 to 9%.[2] Other benefits are less easily measured, but no less valuable. The aesthetic and inspirational value of the hundreds of thousands of trees in Portland's urban forest is incalculable. We must manage and care for this resource to ensure that current and future residents will enjoy its benefits.

Purpose

The Urban Forestry Management Plan is being updated to improve and coordinate the management and administration of Portland's urban forest. The new plan responds to recent environmental mandates, clarifies confusion about resource management and authority, better coordinates the roles of the different agencies and bureaus, and addresses problems that remain from the 1995 plan. This new plan provides direction for the maintenance and improvement of this important resource and makes recommendations to enhance and improve our city's urban forest now and for the future.

Goals

Protect, preserve, restore and expand Portland's urban forest. A healthy urban forest contributes to the economic vitality of the city, provides environmental stability, and ensures a better quality of life.

Promote stewardship of the urban forest. Care of the urban forest by many knowledgeable people improves and enhances the quality of the urban forest.

Courtesy Phyllis Reynolds

Oregon oak (Quercus garryana)

[1] *Personal communication (email) with McPherson, 8/13/2002.*
[2] *Morales (1980), p. 308.*

The decisions we make now determine how well or poorly the urban forest functions in the future.

Provide equitable urban forest benefits for all residents of the city. All residents deserve the benefits of a healthy urban forest.

Meeting these goals not only ensures a healthy and functioning urban forest but also advances and promotes other City plans and programs including River Renaissance, the Framework for Integrated Management of Watershed and River Health, the City's watershed plans, Parks 2020 Vision and more.

RECOMMENDATIONS

The following recommendations apply to all areas of the urban forest. Actions for each recommendation are listed in Chapter Three.

Coordinate the roles, responsibilities, policies and projects of City bureaus, agencies and partners for planning and managing the urban forest.

Document the health and condition of Portland's urban forest.

Preserve, maintain and restore the existing urban forest and ensure the safety of the public.

Increase the quality and quantity of appropriate trees and vegetation, especially large canopy trees in appropriate areas.

Fund and provide adequate staff and resources to maintain, preserve, restore and increase all aspects of the urban forest.

Regulate where necessary to ensure the health, quality and benefits of the urban forest.

IMPLEMENTATION

Portland Parks & Recreation, assisted by the Urban Forestry Commission, is charged with developing and maintaining the Urban Forest Management Plan. Many City bureaus implement the plan as they work to fulfill their own charges.

The plan proposes working groups made up of representatives of those bureaus and groups who manage the City's natural resources to coordinate the management of the urban forest and ensure its health — an Urban Forestry Policy Group to work on the overall management, and standing committees to work on particular areas of the urban forest. Representatives of those groups collaborated in preparing this plan and their continued cooperation is necessary to realize its vision, goals and recommendations.

A healthy urban forest is an enormously valuable resource — one that affects our physical, emotional and economic well-being and our quality of life. Without care and attention, a healthy urban forest cannot exist. The decisions we make now and the consequences of our actions determine how well or poorly the urban forest will function in ten, twenty and fifty years.

Mt Tabor park

PORTLAND'S URBAN FOREST IN 2020

The view from the eastern foothills of Mt. Hood to the ridgelines of the West Hills is a panorama of a healthy and diverse forest with groves of tall native evergreens that identify Portland as a Pacific Northwest city. The health of this urban forest, a mosaic of the planted landscape and the remnant native forest, is a reflection of the city's health, well-being and livability. These trees and other plants are a vital part of Portland's character, giving it a special sense of place.

The urban forest canopy is cohesive, not fragmented, because development includes trees as part of the total vision for sustainable development. The air and water are cleaner because the trees and other plants remove pollution from the air and reduce runoff. Fish and wildlife have healthy habitats. Open spaces and urban stream corridors define a sense of space in our communities while providing a quiet respite from hectic urban life. Tree-lined streets offer shade and protect us from inclement weather. Shoppers frequent shaded business districts where trees help save energy, reduce noise and soften the hard edges of structures and paved areas.

Coordinated management of the urban forest occurs because city agencies, businesses, civic organizations and residents have formed partnerships to make a place for trees in the city. Portlanders recognize trees as a vital, functioning part of the city's infrastructure and ecosystem and provide adequate, stable funding to maintain and enhance the urban forest.

We have achieved a healthy, sustained urban forest, carefully managed and cared for, which contributes to the economic and environmental well-being of the city. Portland has made room for trees.

Cathedral of trees

Introduction

The Urban Forest

While many people think of street trees when they think of the urban forest, it is much more than that. The urban forest is the complex system of trees and smaller plants, wildlife, associated organisms, soil, water and air in and around our city. It is the trees along our streets, the landscaping around our homes and institutions, the vegetation in commercial and industrial areas, the multi-layered forests in our natural areas and the plants in our parks.

The urban forest is managed by many agencies for many reasons — healthy watersheds, prime wildlife habitat, excellent outdoor recreation and exceptional trees. A healthy urban forest is essential to our quality of life and increasingly important in the City's coordinated efforts to restore the quality of its rivers and streams and improve the environment of the city. A healthy urban forest is an asset that increases in value over time — one that provides service as well as beauty to Portland residents.

This plan addresses all the vegetation of the urban forest as a whole, but it places more emphasis on trees since they provide the most benefits, are required most often and are regulated to a greater degree than other elements of the urban forest.

Updating the Urban Forestry Management Plan

The adoption of the first Urban Forestry Management Plan (UFMP) in 1995 was an important step in raising awareness about the value of the urban forest and the roles of the many City bureaus, agencies and organizations that manage it. Since 1995 there have been many changes that necessitate revising and updating the plan. Among them are:

New environmental mandates. The Endangered Species Act, the Clean Water Act and the Superfund Law have resulted in new mandates that affect and guide Portland's resource management. Trees and vegetation are increasingly used to reduce the negative environmental impacts of urbanization and to mitigate for past actions that have harmed water quality, fish and wildlife habitat.

More organizations responsible for urban forest management. Many bureaus and agencies with different visions, missions, goals and objectives are responsible for meeting the new mandates. Bureau and agency roles and responsibilities are not always clear. Management of the urban forest is sometimes fragmented, overlapping and bureaucratic.

Park Blocks

Increasingly complex rules and regulations. Meeting the new mandates has resulted in new rules and regulations, which are becoming more numerous, complicated and difficult to coordinate. The permit process is confusing, and there is little coordination on site development issues — different bureaus require trees and vegetation for different reasons. While the City is currently establishing central review for site development requirements, and improving regulatory requirements, much remains to be done.

Courtesy Phyllis Reynolds

Oregon oak (Quercus garryana)

Culture shift from "gray" to "green." The urban forest — the "green" infrastructure — is increasingly used to perform the functions of the built — or "gray" infrastructure. Trees and vegetation take up stormwater from streets and developed areas, reducing the need for pipes and treatment plants. They reduce the need for air conditioning, lessening the need for generating plants. This cultural shift is reflected by the plans and projects of many bureaus and agencies. Among these are Metro's Green Streets guidelines that integrate transportation systems with resource protection and Environmental Services' Stormwater Management requirements that use trees and vegetation to mitigate for impervious surfaces. Portland's Sustainable City Principles,[3] adopted in 1994, promote sustainable development and efficient use of resources to protect the environment.

Growth and Infill. Oregonians have chosen to protect farm and forest land by limiting the expansion of the Urban Growth Boundary (UGB). While this results in more efficient use of urban land for development, it reduces the space available in the city for trees and vegetation. As cities become denser, there is a greater need to maintain, protect and manage the urban forest.

Global warming. Predicted climate changes for the Northwest indicate significant threats to the urban forest. At the same time, the urban forest can play an important role by mitigating the impacts of global warming and reducing the effects of the greenhouse gas emissions that cause global warming.

PROGRESS SINCE 1995

Since Portland's first Urban Forestry Management Plan was prepared and adopted in 1995, progress has been made by many local and regional agencies to improve the urban forest.[4] Accomplishments include:

- Hiring an Urban Forestry Coordinator in 1996.
- Creating the Neighborhood Tree Liaison Program in 1997 and hiring a Neighborhood Tree Liaison Coordinator.
- Developing and amending the City Code as follows to support the urban forest: Tree Cutting (1997), New Land Division (1999), Plant

[3] *See Chapter Four and the Appendix.*
[4] *Further information about many of these programs is found in the Appendix.*

ing of Trees (1999), Tree Preservation (2001) and improved landscaping requirements in parking lots (2001).
- Expanding and improving information, outreach and education efforts including informational brochures and Arbor Day celebrations.
- Completing a park tree canopy assessment, as well as selected street tree inventories, throughout the city.
- Developing Metro's Green Streets program.
- Hiring ecologists to manage Portland Parks & Recreation's natural areas.
- Expanding Portland Parks & Recreation's native plant nursery for city revegetation programs.
- Completing Friends of Trees' five-year Seed the Future Campaign.[5]
- Creating the Bureau of Environmental Services' revegetation program, which is responsible for planting thousands of trees, shrubs and plants.
- Using trees as mitigation for development in the Stormwater Management Manual.
- Adopting the LEED Green Building certification program, which includes sustainable site development and encourages planting and retaining trees and vegetation.
- Completing a citywide tree canopy cover analysis in 2003.

Problems that Remain

Although much valuable work has been done, many problems remain. Among them are:
- Increased density that threatens the urban forest with increased impervious surfaces and loss of vegetation and habitat.
- Uneven distribution of urban forest canopy throughout the city.
- Infrequent and reactionary maintenance of street, public and private trees.
- Lack of diversity in age and species of trees in some established neighborhoods and parks.
- Invasive non-native plants that continue to devalue and destroy the natural habitat.
- Incomplete inventories of trees and vegetation that limit proactive management.
- Lack of funds to improve and expand the urban forest.

Principles

The following principles guide the management of Portland's urban forest:

The green infrastructure is as important as the gray infrastructure. A healthy urban forest is critical to a high quality of life in the city. It is a living part of the urban infrastructure, an element as necessary for the sustainability of the city as the highways, utilities and sewers. Like the

[5] *Friends of Trees (FOT) planted over 157,000 trees during the Seed the Future campaign and plans to plant and/or distribute another 18,000 in neighborhoods and schoolyards by 2004.*

The urban forest is a living part of the urban infrastructure.

built part of the infrastructure, the urban forest or 'green-frastructure' requires care and maintenance to maximize the benefits it provides. With appropriate care the green-frastructure increases in value over time, and its benefits become more important. Without care and maintenance, it loses value and may pose safety hazards.

Successful urban forest management improves the environment and accommodates development. The urban forest provides water and air quality benefits, improves the local climate by providing cooling and shading and improves the ecological health of the urban environment. Managing the urban forest for these benefits is sometimes difficult in the urban environment — housing, commerce, transportation, public safety and recreation must be accommodated. Successful urban forest management accommodates these uses, provides environmental benefits and improves the quality of life for residents.

Education is as important as regulation. Informing and educating people in a positive way about the value and benefits of the urban forest is often more effective in achieving compliance than regulation. Explaining the reasons for certain requirements often brings better results than monitoring, inspecting and regulating.

GOALS

The Urban Forestry Management Plan seeks to achieve the following goals:

Protect, preserve, restore and expand Portland's urban forest. A healthy urban forest contributes to the economic vitality of the city, provides environmental stability and ensures a better quality of life.

Promote stewardship of the urban forest. Care of the urban forest by many knowledgeable people improves and enhances the quality of the urban forest.

Provide equitable urban forest benefits for all residents of the city. All residents deserve the benefits of a healthy urban forest.

These goals not only ensure a healthy and functioning urban forest, they advance and promote other City plans and programs including River Renaissance, the Framework for Integrated Management of Watershed and River Health, the City's watershed plans, Parks 2020 Vision and more.

ORGANIZATION OF THE PLAN

Information in this plan is presented in four chapters.

Chapter 1: Portland's Urban Forest describes the current conditions of Portland's urban forest, its physical setting and the benefits of the urban forest.

Chapter 2: Mandates and Current Urban Forest Management explains the federal, state and local mandates that affect the urban forest and the variety of bureaus and agencies that manage the urban forest.

Chapter 3: Analysis and Recommendations describes the strengths, weaknesses, opportunities and threats to the urban forest and makes recommendations for improving it that apply to all areas of the urban forest.

Chapter 4: Urban Land Environments provides specific information and additional recommendations for the five major land environments that make up the urban forest.

The plan includes sources of information about the urban forest, a glossary and appendices with more detailed information about the urban forest.

Vine maple (Acer circinatum)

Chapter 1
Portland's Urban Forest

Introduction

Portland's urban forest is a significant part of the environment and one that residents interact with directly and indirectly as part of their daily lives. This section describes Portland's setting, the urban forest and the many environmental, psychological and economic benefits that it provides to the community.

The Setting

Location. Portland is located in the northern portion of the Willamette Valley in Northwest Oregon near the confluence of the Willamette and Columbia Rivers. Tributaries of the Willamette course through the city above ground in streams and below ground in pipes. Lakes and wetlands associated with the Columbia River are located in the northern part of the city. Portland's physical landscape has been shaped by a spectacular geological history of volcanic activity involving massive basalt flows, the folding of the west hills, and catastrophic floods.

Downtown Portland is located on the Willamette River and is framed by the Tualatin Range to the west. To the east are forested terraces with low volcanic peaks rising out of the residential neighborhoods. On clear days, the Cascade Range and its foothills are seen in the distance. Mt. Hood and Mt. St. Helens ascend into the skyline. Neighborhood parks and open areas are scattered throughout the city.

Originally much of the area was heavily forested with Douglas firs, bigleaf maples and other species of deciduous trees. There were extensive wetlands associated with the streams and rivers, and large oak savannas. Most of these original habitats are gone or severely altered, but many natural areas have regenerated or been restored. These natural areas provide valuable habitat and important recreation resources for Portland's residents.

Downtown Portland

Climate. Portland climate is determined by its location between the Pacific Ocean and the high desert just above the 45th parallel. The Coast Range to the west buffers the effects of the marine air, and the Cascade Range to the east shelters the Willamette Valley from extreme summer and winter continental air masses.

Portland has a 'Mediterranean' climate with typically mild wet winters and clear dry summers. The average annual precipitation of 36.3 inches falls mostly as rain between October and May. The average January

mean temperature is 39.6 degrees F., while the average mean temperature for August, typically the warmest month, is only 68.5 degrees F.[6] The mild temperatures and moderate rainfall result in a long growing season that favors a diversity of vegetation and many Portland residents are avid gardeners.

Courtesy Phyllis Reynolds

This climate will change over time, although how much and when are unknown. According to the Climate Impacts Group at the University of Washington "nearly all the climate models show wetter winters and drier summers in the future." Possible impacts from climate change include reduced growth rates of the urban forest, greater fire risks, and changes in the kinds of species that thrive in the Northwest. If those models are correct, there will be more need for the moderating effects and increases to human comfort that the urban forest provides.[7]

Soils. Little information is available on urban soils in the central city's developed areas because most of the downtown area is covered by buildings and pavement and remaining areas have been graded, filled and compacted.[8] This downtown area is on the flood plain of the Willamette River where the slope is less than 3%. Street trees and other vegetation in these areas must be able to withstand poor or compacted soils.

Land east of the Willamette River is composed of several different soil complexes. Although much of the land has been disturbed, some areas retain the original qualities of a moderately well-drained loam soil. Elevations range from 50 to 400 feet. These soils can support a wide variety of vegetation although some species need summer irrigation to thrive in the dry summer conditions.

The soils in the West Hills are composed of deep silt mixed with volcanic ash deposits. A silty clay fragipan overlays basalt bedrock. Slopes are steep in many places and the potential for erosion and landslides is high. These soils underlie the mixed coniferous forest in the 5,000-acre Forest Park that serves as an impressive backdrop for the city and reminds Portlanders of the characteristic Northwest forest from which the city was carved.

Wetlands, Streams and Watersheds. The once numerous wetlands along the Willamette and Columbia Rivers have been greatly reduced but those that remain have great value for habitat, as well as some limited recreation. The sloughs along the Columbia and the Oaks Bottom area near the Willamette are being preserved and restored.

[6]*National Weather Service data (2002).*
[7]*University of Washington Climate Impacts Group (1999).*
[8]*According to the Soil Survey of Multnomah County (USDA Soil Conservation Service, 1983), most of the land in central Portland is classified only as "Urban Land." Original soils were gravelly loam, silt loam or silty clay loam with sandy materials.*

In addition to the Willamette River flowing through the heart of the city, there are numerous important tributaries. The most notable are Fanno, Johnson and Tryon Creeks. Development and activities in these streams and their watersheds have significant impacts on water quality and on fish and wildlife habitat. Smaller creeks and riparian corridors in the forested ravines of the West Hills provide additional habitat and environmental benefits. Watershed planning is being developed to preserve and restore the valuable functions of these areas.

Fish and Wildlife. Urbanization has had a dramatic impact on fish and wildlife through the loss of habitat. As wetlands are drained and filled, forests cleared and fertile valleys cultivated and built upon, habitat for many species has been and continues to be eliminated. Wetlands are especially critical for migrating waterfowl and shorebirds. They provide resting, breeding and feeding places for many bird species and for reptiles, amphibians and aquatic mammals, as well as fish. Coniferous forests provide important habitat for amphibians, mammals and many species of birds. Riparian trees and vegetation shade streams, providing important habitat for cool-water fish such as the federally-listed salmonids and other species.

Appropriate vegetation in parks, residential yards and community open spaces contributes to the food source and habitat of songbirds, butterflies and small animals. The quality and quantity of the urban forest also affects the fish and other aquatic species in our streams and rivers by cleaning and cooling water before it reaches the streams.

PORTLAND'S URBAN FOREST

Native Vegetation. At the time of European settlement, heavy forests covered most of the region. Stands of Douglas fir, western hemlock, and western red cedar dominated the landscape. Deciduous bigleaf maple and red alder were intermixed. Wetlands and flood plains along the river supported Oregon ash, willows, and black cottonwood. Oregon white oak and Pacific madrone grew in drier uplands. Understory upland vegetation included vine maple, western hazel, oceanspray, snowberry, thimbleberry, Oregon grape, salal, red huckleberry, ferns and forbs. Wetland species included elderberry, Douglas spirea, dogwood, sedges and rushes.[9]

As early settlers cleared the forest to build the city, the result was acres of stumps — and Portland's nickname of "Stump Town." Although most native trees and vegetation were removed, some native conifers still stand in small groups and as single specimens in parks and lawns. Native vegetation is being restored in many areas.

[9]*The "Portland Plant List," published by the Bureau of Planning, lists the trees, shrubs and ground covers native to the region. See Appendix for further information.*

Introduced Vegetation. In addition to supporting lush native forests, Portland's moderate climate nourishes vegetation from many other parts of the world including the Eastern United States, Europe and Asia. Early settlers to this area brought seeds and seedlings of plants native to their homelands. Nurserymen arrived soon after with stock to supply orchards and private pleasure gardens. By the turn of the century, a wide selection of ornamental plants was available.

While most introduced species fit well with the native landscape, some non-native species have very undesirable qualities. Plants such as Himalayan blackberry, Scot's broom, wild clematis and English ivy have invaded many natural areas and displaced more diverse and beneficial native plant communities. English ivy in particular is a problem in natural areas, as it smothers the native plants and creates a monoculture that has no value for wildlife. It has recently been listed as a Noxious Weed by the Oregon Department of Agriculture, and its transport, purchase, sale or propagation are prohibited.[10]

Most of the street trees in the city today are cultivars of introduced species.[11] Cultivars offer predictability in form and behavior for given situations. They are bred for certain features such as fall color, flower quality, disease resistance, or the ability to withstand difficult growing conditions.

"Trees reduce the temperatures of the heat islands that form in urban centers by shading pavement and structures. The larger the trees and the bigger the size of the green spaces, the greater the effect on climate."

In some areas, natives are appropriate for use as street trees, but they require adequate room and good growing conditions. The needs of different species must be carefully matched with the planting areas to ensure the success of each planting.

Urban Land Environments. As noted earlier, street trees are only one part of the urban forest. Five basic categories called Urban Land Environments (ULEs) make up Portland's urban forest. They are Residential; Commercial/Industrial/Institutional; Natural Areas and Stream Corridors; Transportation Corridors and Rights-of-Way; and Developed Parks and Open Spaces. The urban forest in each of these areas has similar characteristics and management needs. Chapter Four addresses these ULEs in detail.

Inventories and Studies. A number of inventories and studies have been done for various parts of the urban forest, beginning with street tree inventories in 1938 and 1976. More extensive city and regional canopy cover inventories have been undertaken recently, including one in 2003 by PSU professor Dr. Joe Poracsky and Mike Lackner. Their study looked at the current state of Portland's urban forest canopy, the changes in the amount and composition of the canopy over time, and the relationship of canopy cover to geography (neighborhood and land-use).

[10] *Oregon Department of Agriculture.*
[11] *Cultivar - Cultivated variety.*

Current total canopy cover in Portland is estimated to be 26.3% with Forest Park included and 23.6% with Forest Park excluded. This is an *increase* of 1.2% from 1972 when the first data was collected. The greatest increases in canopy occurred in inner-east Portland, which can be attributed to Friends of Trees tree-planting efforts, and the greatest loss occurred in Forest Heights where many wooded areas have been cleared for development.

This study and others are described in greater detail in the Appendix. Current efforts are to coordinate data collection and make it available to bureaus and groups throughout the city for a variety of inventory and analysis needs.

BENEFITS OF THE URBAN FOREST

The urban forest provides numerous environmental, psychological and economic benefits. It is critical in providing a healthy environment for people, fish and wildlife. It affects our health and sense of well-being. It provides economic benefits by reducing the need for power generating plants and for water treatment plants. Most benefits can be measured, some cannot, all are significant.

ENVIRONMENTAL BENEFITS

Water Quality. Clean water is vital to the health of our environment. In every area of the city, the urban forest helps to provide clean water. The urban forest intercepts rain — eliminating runoff before it can occur. It absorbs and stores water which reduces the impacts of stormwater pulses, especially in developed areas, along streets and highways and in parking lots. It helps remove pollution from the water and reduces excess sedimentation. Riparian vegetation shades and cools the water surface and the air in riparian areas, providing better habitat for fish and wildlife.

Courtesy Phyllis Reynolds

Bigleaf maple (Acer macrophyllum)

Erosion Control. The hard surfaces common to urban areas are impervious to water infiltration, thereby increasing stormwater runoff volume and flow rate. The rapidly moving water erodes the soil, increases siltation in vital urban waterways and creates serious water pollution problems. Trees and other plants play a vital role in stabilizing soils and preventing erosion. Their roots slow runoff by holding the soil in place and absorbing water. Leaves diminish the impact of raindrops on bare land and mitigate stormwater volume.[12]

Energy Efficiency and Temperature Control. The role of vegetation in temperature control may become more important as hotter summers are expected for the Northwest because of global warming.[13] Well-placed vegetation can significantly reduce energy needs and increase

[12] *McPherson, et al. (2002), p. 9.*

[13] *Global warming refers to increased global temperatures resulting from increased carbon dioxide (CO_2) emissions produced by burning fossil fuels. The urban forest can reduce energy needs and consequently reduces CO_2 emissions.*

The USDA Forest Service states, "Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20-50 percent in energy used for heating," and the US Department of Agriculture states, "The net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day."
(The National Arbor Day Foundation).

energy efficiency by reducing heat loss in winter and increasing cooling in summer.

In winter, evergreen vegetation can reduce wind velocity that pulls heat out of buildings and provide an insulating effect by trapping air close to buildings. Deciduous vegetation around buildings allows for solar gain in the winter months, reducing heating costs. In summer, well-placed trees can intercept up to 90% of the solar energy, reducing the need for air-conditioning.[14] Since different tree species provide different effects, local conditions must be known to obtain the best results.

Trees reduce the temperatures of the heat islands that form in urban centers by shading pavement and structures. The larger the trees and the bigger the size of the green spaces, the greater the effect on climate.[15]

Plants can be used to manipulate air movement by strategically placing them to block undesirable prevailing winds and to provide effective barriers. Walls of vegetation can be used to direct air to sites where cooling is wanted.

Improved Air Quality. Many plants of the urban forest can reduce the effects of air pollution by removing pollution, both particulates and gases, from the air. This occurs because plants reduce winds, causing particulates to settle out of the atmosphere onto plants or the ground where precipitation washes the particulates into the soil below. Certain gases such as nitrogen oxides, carbon monoxide, chlorine and fluorine halogens, ammonia, and ozone are removed by absorption and stored in the leaves and needles of some woody vegetation. Trees also sequester and reduce atmospheric carbon dioxide (CO_2).[16] Portland's Friends of Trees estimates that a mature tree will sequester 223 pounds of CO_2 annually.[17] Trees improve air quality as they release oxygen through photosynthesis and they reduce ozone levels by reducing urban temperatures.[18]

While some plants in the urban forest can tolerate a degree of pollution, many others have a low tolerance for pollutants and suffer from its effects. While trees take up and store pollutants, it is desirable to plant trees that emit low levels of biogenic volatile organic compounds since under certain conditions, this can contribute to ozone formation.

[14]*The USDA Forest Service states, "Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20-50 percent in energy used for heating," and the US Department of Agriculture states, "The net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day." (The National Arbor Day Foundation).*
[15]*McPherson, et al. (2002), pp. 5-6.*
[16]*The US Department of Agriculture estimates that "one acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the annual needs of 18 people." (The National Arbor Day Foundation).*
[17]*McPherson et al. (2002) pp. 7-8.*
[18]*McPherson et al. (2002) p. 8.*

Sound Control. The leaves, twigs and branches on vegetation absorb sound energy, as do grasses and other low growing plants, especially sounds in the higher frequencies which are the most bothersome to people. Plants dissipate sound energy by refraction that occurs when sound passes through vegetative barriers and bends around plant structures. Barriers of trees and vegetation in conjunction with walls and landforms can reduce highway noise by 6 to 15 decibels.[19]

Vegetation also masks unwanted sound by providing sounds of nature — rustling leaves and singing birds — to cover unwanted noise. People can focus on those natural sounds that are more pleasing than the noise of the city.

Fish and Wildlife Habitat. The urban forest provides habitat for many species of birds, mammals, fish, insects and amphibians that enrich urban life and offer opportunities for study. The larger the area, the greater the possibility for diversity of habitat and wildlife. While forested natural areas with native understory offer more biological diversity than other parts of the urban forest, all provide some habitat. Squirrels (mostly non-native) and chipmunks live in and around the trees; numerous species of birds abound in the vegetation; bats dwell in the secret places; fish inhabit the creeks, streams, and rivers. Wetlands, riparian areas, connected natural areas and urban landscapes provide important biodiversity.

PSYCHOLOGICAL BENEFITS

Mental and Emotional Benefits. While people have always felt that the urban forest increases the enjoyment of everyday life and provides a meaningful connection between people and the natural environment, research now provides the scientific basis to support those feelings. Urban forests have a clear role to play in reducing stress-related impacts on health such as lowering blood pressure, easing headaches and calming upset digestive systems.[20]

Studies show that exposure to nature and the urban forest reduces stress and provides significant restorative benefits. Various studies using slides of different subjects show that those of natural scenes and urban nature settings hold the viewer's attention more effectively than urban scenes without nature. Even slides of unspectacular natural scenes produce more positive emotional states than urban scenes without trees.

Douglas fir (Pseudotsuga menziesii)

[19] *McPherson et al. (2002) p.11.*

[20] *Examination of acutely stressed patients in pre-surgical holding rooms indicates that patients exposed to "serene" views (primarily displaying trees, water or other natural elements) have systolic blood pressure levels 10-15 points lower than patients exposed either to "exciting" pictures (e.g., a sail boarder leaning into the wind) or to no picture at all. Prison research suggests that views of nature from cell windows are associated with lower frequencies of prisoner stress symptoms, such as digestive illness and headaches (Hull and Ulrich, 1991).*

Significance and Symbolism. Trees have deep significance to people, especially in an urban setting that may offer little of the natural world. Trees and forests provide beauty and serenity that we can experience in the sensory realm. The constantly changing sights, sounds and smells of plants fascinate and delight us.

Following the devastation of Hurricane Hugo in Charleston, South Carolina, 185 residents talked about the special physical features of the city that were damaged by the storm. Thirty percent responded that some aspect of the urban forest was the most significant thing damaged. More than 10% of the respondents remarked that they had previously taken the urban forest for granted.

Trees have deep symbolic meaning. Many cultures associate trees with strength and wisdom, and we remember loved ones with memorial tree plantings.[21] Planting trees shows a commitment to the future and a desire to improve the places where we live. While the economic benefits of the urban forest are important to the well-being of the city, to many people they are insignificant compared to the positive experiences that trees and natural areas offer.

Aesthetics. Positive emotional states are also associated with being in or looking at things that are pleasing. Trees and vegetation provide much of the color, variety, texture, shape and sound that are pleasing in all seasons of the year. The Visual Preference Survey, conducted in Portland in 1993, showed that small parks and open spaces were uniformly desirable in all settings of the city. Other studies have shown that people prefer scenes that show well-maintained trees and vegetation. Research substantiates what people have known intuitively — trees and natural areas bring pleasure and provide benefits beyond their economic values.[22]

BENEFITS AND COSTS

As shown above, a healthy urban forest improves water quality, prevents erosion, reduces heating and cooling costs, converts carbon dioxide into oxygen and has positive effects on our health and well-being.

Trees provide benefits in their immediate location and to the surrounding community. From the individual property owner who has a more comfortable environment and increased resale value to community members who have better water and air quality to the fish and wildlife who have better habitats — all benefit from healthy trees and vegetation.

Cost Benefit Ratios. For all sizes of trees, the total benefits greatly outweigh the total costs. Generally, the larger the tree, the greater the benefits, but both benefits and costs increase with the size of the tree. A large tree, such as a red oak, is estimated to provide $50 worth of ben-

[21] *Dwyer (1994), pp.143-144.*
[22] *McPherson et al. (2002), p. 12.*

efits annually for the first 20 years of its life and around $100 per year for the next 30 years — effectively producing around $4,000 worth of benefits over a 50-year life span.[23]

It is critical to note that maximum benefits are gained from planting the right trees in the right places. Many conflicts can be reduced or avoided by careful planning and by matching tree characteristics to site conditions.

Increased Resale Values. Studies have shown that landscaping with trees is associated with an increase of 6 to 9%[24] in the sales price of residential properties. A study done in 1988 showed that a 1% increase in sales price was associated with each large front yard tree.[25] Intermediate and large sized trees, regardless of species, have a greater effect on resale values than small trees.[26] Typically, properties with trees show better and sell faster. Increased property values increase the community's tax base.

Northern red oaks (Quercus rubra)

Stormwater Benefits. In addition to increased resale value, trees and vegetation provide cost savings to developers and property owners. Trees and vegetation mitigate stormwater runoff from new construction, reducing or eliminating the need for more costly piped systems. Reduced stormwater volume allows the City to address water quality regulations and infrastructure needs more effectively.

Economic Stimulus. Trees make the city more attractive to both residents and businesses. The National Arbor Day Foundation explains that "trees can be a stimulus to economic development, attracting new business and tourism. Commercial retail areas are more attractive to shoppers, apartments rent more quickly, tenants stay longer, and space in a wooded setting is more valuable to sell or rent."[27] In a survey conducted by the University of Washington, consumers indicated that they would be willing to pay 12% more for goods purchased in well-landscaped districts. The study also indicated 15% higher interaction between consumers and merchants, and tree-lined sidewalks were rated 80% higher for amenities and comfort.[28]

Recreational Value. Portland's urban forest includes wonderful recreation areas, ranging from the urban wilderness of Forest Park to the

[23] *McPherson et al. (2002), p. 28, and personal communication with McPherson, 8/13/2002.*
[24] *Morales (1980), p. 308. The International City/County Management Association states, "landscaping, especially with trees, can increase property values as much as 20 percent," and the USDA Forest Service states, "Healthy, mature trees add an average of 10 percent to a property's value." (The National Arbor Day Foundation).*
[25] *McPherson et al. (2002), p. 10.*
[26] *Average annual benefits associated with property values range from $8 to $10 for a small tree, $20 to 23 for an average tree and $35 to 41 for a large tree. (McPherson et al. (2002), p. 31.*
[27] *Cool Communities.*
[28] *Wolf (1999), p. 4.*

Specimen tree in park

cool and refreshing local parks found in most of our neighborhoods. While it is important to provide ample open areas for active recreation, it is equally important to provide places for passive recreation. The urban forest provides places to observe wildlife, commune with nature and escape the stresses of daily life. Having recreation areas nearby reduces the need to drive fuel-consuming and carbon dioxide-producing vehicles to reach recreation areas.

Traffic Management. Trees function as "traffic calming" devices — effectively slowing speeding drivers while also adding to the aesthetics of the urban landscape. Vertical elements, including trees, reduce the "optical width" of a narrowed street, thereby discouraging speeding.[29] Trees and other plants may be used to direct not only vehicular traffic, but pedestrian traffic as well.[30]

Having a healthy urban forest has some costs, including establishing and maintaining trees and vegetation, repairing parts of the built infrastructure (sidewalks and utilities) due to conflicts with tree roots and canopies and replacing the urban forest as it ages.

The following information is based on average costs for the open-grown trees found in residential yards, along the streets and in developed parks, not the trees and vegetation in our natural areas.[31]

Establishment and Maintenance Costs. All plants need some level of care, especially to get established. Survival is greatly enhanced by selecting the right plants for the right places and by watering.[32] For residential trees, that cost averages less than a $1/year.[33]After the trees are established, the largest single cost is for pruning. Property owners may need to prune or remove trees and vegetation as wildfire prevention measures, as well as for regular maintenance of trees on private property and in street rights-of-way.

There are clean-up costs after storms, and there are costs to remove and dispose of trees when they die. Other costs come from regular street cleaning of leaf litter and other debris from trees that can clog drain inlets and, on occasion, cause localized flooding.

Urban Interface Costs. Trees in urban environments often occupy the same areas as sidewalks, streets and utilities, with resultant conflicts in some cases. Sidewalks and streets occasionally need repair because of

[29] *Project for Public Spaces.*
[30] *Grey & Deneke (1992) p.91.*
[31] *See Appendix for cost and benefit estimates for various elements of the urban forest.*
[32] *The best time to establish trees is in the fall, when the soil is warm and the rains are soon to come.*
[33] *McPherson et al. (2002), p.12.*

damage from street trees. Additional costs can come from repairs to sewer lines, building foundations and other built infrastructure elements. Costs to maintain trees in and around power lines are reflected in electric rates.

Trees function as "traffic calming" devices — effectively slowing speeding drivers while also adding to the aesthetics of the urban landscape.

ESTIMATING THE VALUE OF THE URBAN FOREST

Recent studies provide some information about the value of the urban forest on a regional basis. It is estimated that by reducing the amount of water that needs to be treated, the stormwater retention value of the trees in the Willamette/Lower Columbia region is $20.2 billion.[34] Tree shade saves $1.8 million annually in residential energy savings, and reduced energy needs results in lower pollutant emissions. Trees in this region remove 178 million pounds of pollutants annually, saving $419 million.[35]

As noted earlier, inventories of the numbers of trees in Portland are incomplete. While we believe that Portland is comparatively well-treed compared to other cities, we don't know the exact number of trees in the city. The Appendix includes a description of the inventories that have been done to date. The following values are based on estimated replacement costs in areas where we have good estimates of the quantity of trees.

Street Trees. Using the general rule of thumb that a typical tree in good condition is worth $150 per inch of trunk diameter, measured at 4.5' from the ground, and assuming that an average street tree is 5" in diameter, Portland's estimated 200,000 street trees are worth $150 million.

Trees in Developed Parks. A recent survey placed the value of the trees in Portland's developed parks at $250-270 million.[36] Since developed and open spaces are not necessarily heavily treed and only account for 5% of the city's land base, it can be assumed that the city has trees worth 2 to 3 billion dollars, and perhaps more that are in the yards of Portland residents and in the thousands of acres of natural resource land in the city. This is an asset that must be carefully managed to maximize its benefits into the future.

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[34] *American Forests (2001) p. 3*
[35] *American Forests (2001) p. 7*
[36] *This is estimated replacement cost.*

Chapter 2
Mandates and Current Urban Forest Management

Federal, State and Metro Mandates

In recent years, new mandates have been handed down that have a considerable effect on City planning, programs and regulations. The Endangered Species Act, the Clean Water Act and the Superfund Law have resulted in extensive changes in how development occurs and how natural resources are managed. Portland's decision to exceed the requirements of the mandates in an effort to restore the natural environment to the best possible condition has resulted in more rules, regulations and City involvement than ever before.

The primary mandates affecting urban forestry are listed below, followed by descriptions of the agencies and groups who manage the urban forest, their responsibilities, plans and projects.

FEDERAL MANDATES

The following federal mandates have implications for urban forestry in Portland. Agencies at all levels of government are involved in complying with these mandates.

Endangered Species Act (ESA). This act lists steelhead trout and Chinook salmon as threatened species. The City's proactive response is as follows:

1. Work collaboratively with National Oceanic and Atmospheric Administration (NOAA) Fisheries to prepare a program for salmonid recovery.
2. Collaborate with the region and state to restore affected watersheds which cross political boundaries.
3. Enlist the help of citizens to develop the City's response to the listing.

The City is developing a coordinated Framework for Integrated Management of Watershed and River Health (the Framework) to respond to the ESA requirements. The Framework informs and guides multiple existing City programs that contribute to improving the Willamette River. These programs are explained later in this chapter.

Clean Water Act (CWA): National Pollution Discharge Elimination System (NPDES). The CWA established the basic structure for regulating discharges of pollutants into the waters of the U.S. It also established the National Pollution Discharge Elimination System (NPDES)

Courtesy Bureau of Environmental Services

Roof drainage to vegetation

which regulates point and non-point sources of pollution including wastewater treatment plants, permits, combined sewer overflows (CSOs) and stormwater. The Oregon Department of Environmental Quality (DEQ) enforces these regulations and issues permits for approved plans such as Portland's Stormwater Management Plan which includes increased tree planting and vegetation management to improve the environment and mitigate for certain activities.[37]

Clean Water Act: Total Maximum Daily Load (TMDL) Program. Under section 303(d) of the Clean Water Act, states are required to develop lists of impaired waters that do not meet water quality standards set by the state. Rivers and streams listed as water-quality impaired include: Tryon Creek, Johnson Creek, Fanno Creek, the Columbia Slough and the mainstem of the Willamette River and Columbia River. This requires Oregon DEQ to develop total maximum daily loads (TMDLs) for the listed parameter(s) — specifying the maximum amount of the parameter that a waterbody can receive from all point and non-point sources and still meet water quality standards. Affected jurisdictions must then develop management plans to achieve the identified requirements. Urban stormwater runoff contributes to a number of 303(d)/TMDL parameters.

Safe Drinking Water Act: Underground Injection Control (UIC) Program. The Safe Drinking Water Act (SDWA), established in 1974 and amended in 1986 and 1996, protects the quality of drinking water in the U.S. It requires a number of actions to protect waters actually or potentially designed for drinking use, as well as their sources including rivers, lakes, reservoirs, springs and groundwater wells. The Underground Injection Control (UIC) program is a permit program under the SDWA that protects underground sources of drinking water by regulating five classes of injection wells.[38] EPA has authorized DEQ to enforce the UIC program in Oregon. Trees and vegetation can affect the quality of surface and ground water and reduce the need for dry wells, sumps or artificial injection.

Courtesy Pat Breen, OSU

Oregon ash (Fraxinus latifolia)

Superfund Law (Comprehensive Environmental Response, Compensation and Liability Act — CERCLA). The Superfund Law authorizes the Environmental Protection Agency (EPA) to take remedial response actions to reduce the dangers associated with hazardous waste. In 2000, the Portland Harbor area of the Willamette River was listed on EPA's National Priorities List as a site that must be cleaned of toxic contaminants. Harbor sediments contain pesticides, polychlorinated biphenyls (PCBs), heavy metals and carcinogenic compounds found in petroleum products, which pose a serious risk to people who use the river for re-

[37] *City of Portland Bureau of Environmental Services.*

[38] *An underground injection is any system, structure or activity created to place fluid below the ground or subsurface. This includes stormwater systems such as sumps, drywells and trench drains, which DEQ classifies as "Class V Injection Wells" under the UIC program.*

creation, to the Native American tribes who use the river as a natural and cultural resource and to wildlife — including threatened salmonids.[39] The urban forest affects the water quality of the upland areas above the harbor.

STATE MANDATES

The State of Oregon has 19 Statewide Planning Goals and Guidelines.[40] The City of Portland's Comprehensive Plan addresses these goals. The following goals are particularly relevant to the urban forest:

Trees improve living conditions

Goal 5. "To protect natural resources and conserve scenic and historic areas and open spaces." The goal requires local governments to develop programs to protect these resources for present and future generations to promote livability in the State. This includes the protection of fish and wildlife habitats, stream flow and water levels, and natural areas – all areas where a healthy urban forest is an important component.

Goal 6. "To maintain and improve the quality of the air, water and land resources of the state." The vegetation of the urban forest affects air and water quality. Increasing the quality and quantity of the vegetative cover can improve these resources.

Goal 7. "To protect life and property from natural disasters and hazards." This goal requires planning that considers the benefits of maintaining and protecting natural hazard areas as open space, avoids development in hazard areas and manages potential hazards such as floods and landslides through stormwater management and erosion control — all of which use vegetation management to accomplish these objectives.

Goal 15. "To protect, conserve, enhance and maintain the natural, scenic, historical, agricultural, economic and recreational qualities of lands along the Willamette River as the Willamette River Greenway." This goal sets forth provisions for recreation, fish and wildlife habitat, vegetative fringe and development away from the river.

METRO MANDATES

2040 Growth Concept. Metro's 2040 Growth Concept, adopted in 1995, is the blueprint for future growth in the Portland metropolitan region. The unifying theme is to preserve the region's livability while planning for expected growth by developing a compact urban form to be achieved in 2040. The 2040 Growth Concept complies with statewide land use goals and is the foundation of Metro's 1997 Regional Framework Plan.

[39] *U.S. Environmental Protection Agency (2000).*
[40] *Oregon Department of Land Conservation and Development.*

The 2040 Growth Concept has the following components:

- Centers and corridors with an emphasis on higher development densities, mixed land uses, ease of traveling by transit, bicycling and walking and streets designed for people, not just cars.
- Neighborhoods that will remain largely residential in nature, and change very little from today.
- Industrial areas and marine, rail and air cargo terminals that serve as the hub for regional commerce.
- Environmentally sensitive areas that need special protections.

Regional Transportation Plan. The 2000 Regional Transportation Plan (RTP) is a 20-year blueprint for the region's transportation system that supports the land uses in the 2040 Growth Concept and serves all forms of travel. The plan deals with how best to move people and goods in and through the region and sets the direction for regional investments in a mix of transportation options, including roadways, light rail, freight, transit, pedestrian access and bicycles. It is updated and adopted by the Metro Council every three years.[41]

Street Design Guidelines. Metro has developed guidelines for incorporating the RTP concepts into local design codes and individual projects. The following documents integrate transportation planning, land use and natural resources:

- *Creating Livable Streets* handbook.
- *Green Streets* document, a companion guide with designs for multimodal transportation systems that protect the quality of the region's streams and rivers.
- *Trees for Green Streets*, which suggests tree species and strategies to implement the Green Streets plan. Street trees are a key component of green streets.

These documents are available from Metro or can be downloaded from Metro's web site (*www.metro-region.org*).

Urban Growth Management Functional Plan. Metro's Urban Growth Management Functional Plan provides a framework for growth in the region and includes the following mandates that affect the urban forest. "Title 3: Water Quality, Flood Management, and Fish and Wildlife Conservation" is the regional implementation of State Goals 5, 6, and 7. It has two elements; both relate to the urban forest.

- *Part 1 Natural Resource Protection— Stream and Flood Plain Protection Plan*
  This plan describes regional performance standards for new development and large redevelopments and designates riparian areas to be regulated.

[41]*The 2000 Regional Transportation Plan was adopted by the Metro Council on August 10, 2000.*

- *Part 2 Natural Resource Protection — Fish and Wildlife Habitat Protection Plan*
  This plan, currently in development, will conserve, protect and restore a continuous ecologically viable streamside corridor system, from headwaters to the floodplains, in a way that is integrated with the surrounding urban landscape.

CITY CODE REQUIREMENTS

The following city codes, standards, guidelines and regulations relate to urban forestry:

City Code Title 10: Erosion and Sediment Control. Title 10 requires the prevention and control of sediment at the source during construction and development. All new and redevelopment projects with ground-disturbing activities with over 500 square feet of impervious surface or projects of any size that are classified as high risk because of site characteristics or activities are required to have an erosion control plan and a site inspection. This title includes a requirement to plant replacement vegetation.

City Code Title 17: Public Improvements: Drainage and Water Quality (17.38). This chapter provides for the effective management of stormwater and drainage, and maintains and improves water quality in the watercourses and water bodies within the city. It sets forth policies for stormwater management to avoid a net negative impact on nearby streams, wetlands, groundwater and other water bodies, and requires that the quality of stormwater leaving the site after development to be of equal or better quality than the stormwater leaving the site before development. This chapter affects landscaping and environmental zone regulations. The urban forest is a key component in reducing stormwater runoff and enhancing water quality.

City Code Title 17: Public Improvements: Trees (17.52). This chapter sets forth provisions for tree trimming, cleanup and removal to prevent interference by trees with wires, sidewalks and sewers.

City Code Title 20: Parks and Recreation: Street and Other Public Trees (20.40). The purpose of this chapter is to manage, conserve and enhance the existing trees located in the parks and public areas so as to preserve the wooded character of the city, enhance the appearance of the city and protect the urban forest as an important environmental and economic resource. It establishes the Urban Forestry Commission, and mandates the creation of this plan. Section 20.42 regulates tree cutting in order to preserve the wooded character of the city and protect the urban forest.

City Code Title 24: Building Regulations: Clearing, Grading, and Erosion Control (24.70). This chapter requires a permit for cutting trees or clearing vegetation under specified circumstances. This chapter is primarily aimed at proposals to cut trees or clear vegetation on slopes and/or areas greater than 5,000 square feet.

City Code Title 24: Building Regulations: Flood Hazard Management (24.50). This chapter's protects public health, safety and welfare by restricting or prohibiting uses which are dangerous to health, safety or property in times of flood or which increase vulnerability to flooding. It regulates development and construction in identified flood hazard areas. As with stormwater management, the urban forest can help reduce flooding problems.

Sweetgum (Liquidambar styraciflua)

City Code Title 33: Zoning Code: Landscaping and Screening Standards (33.248). This chapter recognizes the aesthetic, ecological and economic value of landscaping and requires its use for many purposes, including: to preserve and enhance Portland's urban forest, promote water quality, enhance the city's visual appearance, provide wildlife habitat, promote the retention of existing vegetation and aid in energy conservation. The chapter establishes landscaping and tree planting or preservation requirements for a variety of settings.

City Code Title 33: Zoning Code: Environmental Overlay Zones (33.430). The purpose of this code chapter is to protect and conserve significant natural resources in Portland. Currently, the environmental overlay zones apply to approximately 19,000 acres including streams, wetlands, trees and vegetation. The regulations guide where and how development may occur in environmental zones, and include standards for removal and replacement of trees and vegetation. Development proposals must meet standards and/or approval criteria to ensure that adverse impacts on natural resources are avoided, limited and mitigated.

City Code Title 33: Zoning Code: Scenic Resource Zone (33.480). The Scenic Resource Zone protects Portland's significant scenic resources as identified in the Scenic Resources Protection Plan and enhances the appearance of Portland to make it a better place to live and work. The Scenic Resource Zone establishes height limits within view corridors to protect significant views and may require additional landscaping and screening to preserve and enhance identified scenic resources. This chapter regulates tree removal to enhance the character along corridors.

City Code Title 33: Zoning Code: Land Division Regulations (33.600). These regulations cover all land divisions and involve preservation of significant trees, stormwater management, installation of other utilities, rights-of-way, clearing and grading, landscaping, development in land-

slide and floodplain hazard areas, and other site development factors.

Other chapters of City Code Title 33 that apply to specific areas and protect trees include:

33.508	Cascade Station/Portland International Center Plan District
33.515	Columbia South Shore Plan District
33.535	Johnson Creek Basin Plan District
33.570	Rocky Butte Plan District
33.563	Northwest Hills Plan District
33.580	South Auditorium Plan District

Titles 1-32 are found at www.portlandonline.com/auditor.
Title 33 is found at www.planning.ci.portland.or.us

Natural Resources Management Plans. Natural Resources Management Plans (NRMPs) provide guidance for the protection and management of natural resources within a given area. NRMPs are alternatives to case-by-case environmental reviews. These plans provide the means to evaluate the cumulative effects of development and mitigation proposed at different times and in different places within the same large ecosystem. NRMPs are of particular value in areas of multiple ownership. The plans also present opportunities for coordination with, or joint adoption by, other local governments, special districts and regional, state and federal agencies.

NRMPs have been prepared for East Columbia Neighborhood, Smith & Bybee Lakes, Forest Park and Peninsula One Drainage District.

CITY PROGRAMS AND GUIDELINES

A key element in the City's response to the federal mandates is its "Framework for Integrated Management of Watershed and River Health"[42] (the Framework Plan), which coordinates and implements the plans and programs that affect and impact the City's natural resources. The chart at the end of this City of Portland section shows the general relationship between the mandates, the Framework Plan and City plans and programs. Improving the urban forest and managing vegetation for mitigation and environmental improvement are important elements in all these plans.[43] The bureaus, commissions and programs that manage and affect the City's natural resources are as follows:

Courtesy Phyllis Reynolds

Tulip tree leaf and flower (Heritage tree)

Endangered Species Act (ESA) Program. The City of Portland's Endangered Species Act Program was established in 1998 in response to federal listings of steelhead trout and Chinook salmon as threatened.

[42]*City of Portland. Framework for Integrated Management of Watershed and River Health – Internal and 1st Review Draft, Portland, OR. (November 2002).*
[43]*The ESA program is partially funding the preparation of this updated Urban Forestry Management Plan.*

Courtesy Endangered Species Act

Salmon

The ESA Program is involved with developing a comprehensive, integrated citywide strategy to carry out City Council's resolution to assist with recovery of listed salmonids, and its "Clean and Healthy River" River Renaissance Vision theme. The ESA Program provides guidance to City bureaus and programs to avoid "take" and reduce the City's liability under the federal ESA by establishing strategies, criteria and procedures on ESA-related matters.

ESA Program staff participate in the development and implementation of watershed plans following processes described in the City's Framework Plan. This includes assessing the health of each City watershed, establishing watershed and reach-specific objectives, identifying, evaluating and selecting actions, developing watershed plans, implementing approved watershed plans and monitoring actions.

River Renaissance Program. This program is the foundation for river-related activities. It sets forth visions and guides the community-wide effort to revitalize the Willamette River by integrating plans and future actions for the Willamette and its tributaries. The program is directed by the River Renaissance Team — an inter-bureau team led by Bureau of Planning, Bureau of Environmental Services and Portland Development Commission staff with assistance from PP&R, Superfund and Endangered Species Act staff. This team coordinates City river-related work plans and projects to protect the Willamette River and important Portland streams so they play an integral role in the natural, economic, urban and recreational life of the city.

Sustainable City Principles. In 1994, the City of Portland adopted ten Sustainable City Principles.[44] Led by the Sustainable Portland Commission, the City periodically conducts an environmental review to assess its progress. The overarching goal is to "promote a sustainable future that meets today's needs without compromising the ability of future generations to meet their needs."

The City supports activities that:

- Support a stable, diverse and equitable economy.
- Protect the quality of the air, water, land and other natural resources.
- Conserve native vegetation, fish, wildlife habitat and other ecosystems.
- Minimize human impacts on local and worldwide ecosystems.[45]

[44]*See Appendix for Sustainable City Principles.*
[45]*City of Portland Office of Sustainable Development (1994).*

PORTLAND'S CURRENT URBAN FOREST MANAGEMENT

Actively managing the different areas of the urban forest is a fairly recent activity. For many years, only the trees in the City's parks were managed and maintained. Problems with Portland's street trees —planted when the city was first developed — began to emerge in the 1940s. Trees were too closely spaced, sidewalks and curbs were rupturing and conflicts occurred between trees and utility wires. In 1944, Parks Superintendent C. P. Keyser urged the City to assume the administration of street trees. But not until 1972 did City Council give Portland Parks & Recreation responsibility over the trees on City property and in the public rights-of-way. Two years later, the first City Forester was hired to manage those trees. Now many bureaus, agencies, utilities and nonprofit agencies manage and care for various elements of the urban forest.

The following section identifies those agencies and their roles, responsibilities, programs and plans. These have evolved in response to the numerous mandates noted previously — particularly the Clean Water Act and the ESA listing of Chinook salmon and steelhead trout as threatened species.

PORTLAND PARKS & RECREATION (PP&R)

The City Code charges the PP&R Director (Superintendent), assisted by the City Forester and the Urban Forestry Commission, with developing and maintaining the Urban Forest Management Plan and with implementing portions of it. The following PP&R programs manage, plan and coordinate the care of various parts of the urban forest: Urban Forestry, Natural Resources, Horticultural Services, Planning and Development and Districts.

Trees add to beauty of parks

By City Code, the duties of PP&R's Superintendent include:[46]

- Preserve and enhance the Urban Forest.
- Develop and maintain the Urban Forestry Master Plan.
- Administer and monitor the implementation of the Master Plan.

Urban Forestry Commission (UFC). The eleven-member Commission has the following duties:[47]

- Provide assistance in the development of the UFMP, submit the plan to City Council for approval and review and update the plan periodically.
- Advise the City Forester, the Superintendent and the Parks Budget Advisory Committee on the preparation and contents of the Annual Urban Forestry Division budget request.

[46] *Portland City Code Chapter 20.40 Street Tree and Other Public Tree Regulations.*
[47] *Portland City Code Chapter 20.40 Street Tree and Other Public Tree Regulations.*

- Review plans and policies developed pursuant to other City Code provisions which contain elements or which affect matters related to urban forestry and arboricultural concerns in the city and other matters brought forward by the City Forester and others.
- Prepare and submit to the Commissioner of Parks & Recreation an annual report containing a section dealing specifically with the relations with and concerns of the various City bureaus.
- Serve as an appeal board for citizens with tree issues.
- Support the Urban Forestry Program's public outreach and education efforts.

Heritage Tree Program. This program promotes and educates the public about unique trees in Portland. A subcommittee of the UFC evaluates, inspects and recommends trees to be added to the Heritage Tree Program to City Council. See Appendix for further information on the Heritage Tree Program.

PP&R Urban Forestry Program. Over the years, the Urban Forestry Program has grown or shrunk depending on the economy and funding. At its maximum in 1983-84, a full-time crew of 29 did large-scale tree planting projects — planting, pruning and spraying individual street trees at the request of property owners. When funding reductions forced layoffs, Urban Forestry discontinued most of these activities.

Although the City regulates public trees, the care and maintenance of the street trees is the responsibility of the adjacent property owners. Urban Forestry currently employs 25 full-time staff with responsibility for the public trees in parks, along streets and around public buildings as mandated by City Code. Their responsibilities include:

- Coordinating the planning, planting and maintenance of public trees.
- Maintaining, planting and replacing trees in parks and on City property.
- Advising and educating property owners about the planting, care and preservation of street trees.
- Permitting and inspecting all street tree plantings, pruning and removals.
- Providing 24-hour emergency response services for storm and tree-related emergencies.
- Enforcing City Code to preserve significant trees.
- Working with other City bureaus on tree-related issues.

Installing new trees

By City Code, the City Forester supervises all tree maintenance services including cutting, pruning, spraying, planting and tree removal required by or performed by City bureaus. The Forester may plant or cause trees to be planted in the streets, parks and other property of the City.

Other responsibilities include:

- Reviewing development plans to preserve trees.
- Working with the Urban Forestry Commission to resolve conflicts related to trees.
- Providing information and clerical support to the Urban Forestry Commission.
- Providing support to Friends of Trees and other nonprofit organizations to promote tree planting and enhance the urban forest.
- Maintaining an experimental planting of ornamental trees for possible use on streets and in parks.
- Educating the public through the Neighborhood Tree Liaison Program, Arbor Day Celebration, brochures, flyers, workshops and other presentations.
- Educating park employees and recreation leaders about hazard trees and tree care in parks.
- Assisting neighborhoods in their efforts to save mature elms in neighborhoods.
- Developing and updating recommended street tree lists.

Neighborhood Tree Liaison Program. Urban Forestry Program staff train community volunteers to serve as neighborhood-based resources for information and education about urban forestry issues and to organize community tree-related projects, including planting and pruning street trees. They also lead educational walks through the community. To date, 120 people have completed training.

PP&R Horticultural Services. Horticultural Services staff operate greenhouses and nurseries where they specialize in growing native plants for habitat restoration for PP&R, BES and other City bureaus as well as growing other plants for PP&R grounds. They provide Integrated Pest Management services (see below) including organizing regional efforts to control invasive weeds and providing training and consultation to multiple public agencies.

Community gardens bring people together

Horticultural Services manages the Community Gardens program that includes 900 garden plots at 27 sites, and conducts numerous education programs. Staff act as liaisons for the Classical Chinese Garden and the Portland Memory Garden, and provide citywide landscape construction services, installing landscapes and plantings in parks, on transportation sites and on other city-owned landscapes, as well as restoration and enhancement of native plantings.

Integrated Pest Management. The Integrated Pest Management (IPM) program includes the NOAA Fisheries approved 4d exemption, which meets the stringent requirements of Portland's ESA listing. IPM controls pests that are harmful to the health or aesthetic value of park plantings in a manner that is cost-effective, safe and environmentally responsible.

To accomplish this, the principles of Integrated Pest Management (IPM) are endorsed.[48] This approach uses multi-faceted strategies that minimize negative
impacts on the environment and on human health.

PP&R Natural Resources Program. The Natural Resources Program staff manages 6,700 acres in 30 natural areas including over 5,000 acres at Forest Park, over 600 acres at Powell Butte and 220 acres at Hoyt Arboretum. Other significant areas include Oaks Bottom Wildlife Refuge, Elk Rock Island, Marquam Nature Park, Springwater Corridor and many of the larger natural resource areas in other parks. They also manage over 100 miles of trails.

An integrated approach to management provides the greatest benefits.

Other responsibilities include:

- Forming cooperative agreements with Metro and other organizations for special projects such as ivy pulling and natural area restoration.
- Assisting with preservation and restoration projects at other sites.
- Assisting with 15 Friends groups, citizen-led committees, numerous watershed councils, schools and many *ad hoc* volunteer activities.
- Providing educational programs at Hoyt Arboretum that interpret the large collection of native and exotic species for visitors and Hoyt Arboretum Friends.
- Working closely on natural resource issues with City and Metro staff.

- **Ecosystem Management Planning.** Ecosystem Management Planning is based on an adaptive management cycle of inventory, statement of desired future condition, assessment, prescription, intervention and monitoring, which is similar to the resource planning used in the City's Framework Plan. Natural Resources' staff ecologists use this method of collecting scientific information to track and improve the condition of the City's natural areas.

- **Riparian Assessments.** PP&R's Natural Resources Program is conducting an ESA-funded project to assess vegetation in riparian areas in the city. This will contribute to the information that is available about the urban forest.

[48] *PP&R uses the following definition of Integrated Pest Management: "Integrated Pest Management (IPM) attempts to lower pest populations below levels that cause economic damage by using a balance of biological, cultural, chemical, genetic or other control methods. Control may be aimed at one or more pests depending upon the scope and complexity of the management system. IPM takes into account interactions among pests, environment and commodity. IPM differs from traditional control approaches in which each pest was considered and controlled individually, with emphasis often being placed on a single measure." (Portland Parks & Recreation (2001), p. 3).*

In addition to those programs, PP&R staff members are involved in the following activties:

OTHER PP&R ACTIVITIES

Environmental Education and Stewardship. PP&R offers many environmental education opportunities through classes, outdoor excursions, volunteer programs and community events. There are also community stewardship programs for many individual parks. Representatives from the Natural Resources, Urban Forestry and Outdoor Education programs coordinate their environmental education offerings.

Salmon-Safe Park Certification Program. Salmon-Safe park certification is a new program that evaluates overall park management policies and operations that are related to the protection and restoration of water quality and fish habitat. This system-wide evaluation will be backed by field assessment of individual park sites against objective standards to evaluate whether the management of candidate parks is consistent with best management practices for avoiding harm to stream ecosystems.

A healthy stream corridor

Restoration and enhancement projects will be assessed in the field to determine if significant system-wide progress is being made to address existing habitat deficiencies. This assessment will occur with consideration for the public use mandate for the particular site and recognizing the financial constraints of PP&R.

PORTLAND BUREAU OF PLANNING (BOP)

The Bureau of Planning is responsible for the development of plans, policies, strategies and regulations that guide Portland's future.[49] BOP coordinates changes to Portland's Comprehensive Plan, which directs long-range future needs in transportation, parks, stormwater management and support infrastructure with other City bureaus, regional and state agencies and the public.

BOP staff work on citywide projects related to housing, design for all types of development, environmental protection and other issues of concern to Portland. Staff also maintain and update Portland's Zoning Code, which implements the Comprehensive Plan Map and contains, in part, environmental and Land Division regulations to ensure that development regulations support the adopted goals. Much of their work directs the plans, policies and procedures that affect the urban forest.

River Renaissance Program. This citywide program strives to integrate plans and activities to advance the River Renaissance Vision: A Clean and Healthy River; a Prosperous Working Harbor; Vibrant Waterfront Districts; Portland's Front Yard; and, Partnerships, Leadership and Edu-

[49]*The Bureau of Development Services is a separate Bureau that is responsible for the implementation of those plans, policies, and regulations.*

cation. The program is directed by the River Renaissance Management Team — an inter-bureau team led by the Director of the Bureau of Planning.

Healthy Portland Streams (River Renaissance project). The goal of the Healthy Portland Streams project is to evaluate and recommend regulations and voluntary efforts to help protect and restore Portland's creeks, sloughs and other riparian areas to ensure clean water, prevent erosion, manage floods and preserve the natural spaces for wildlife, fish and people to enjoy.

A major component of Healthy Portland Streams involves updating the city's natural resource inventories and environmental overlay zoning program to address new scientific information and city watershed health goals and to address regional, state and federal mandates. This project will amend the City's existing environmental requirements to make them clearer and simpler to implement and enforce. The project will also involve recommending amendments to Portland's Comprehensive Plan Goal 8 to update city policies relating to streams and water bodies and watershed health.

The River Plan (River Renaissance project). The BOP will be revising and expanding the Willamette River Greenway Plan to implement the River Renaissance Vision and River Renaissance Plan and to address emerging issues, challenges and opportunities in and along the Willamette River. The River Plan will guide future land use decisions and investments in the quarter-mile wide area on each side of the Willamette River.

Planning and protection result in clean streams and rivers

BUREAU OF DEVELOPMENT SERVICES (BDS)

BDS is responsible for implementing national, state and local building codes, conducting plan reviews and inspecting and enforcing many of the City Code titles that pertain to building and site development. Of particular interest to urban forestry are Title 33 — Planning and Zoning, and Title 10 — Erosion and Sediment Control.

Code Enforcement. BDS ensures that requirements for landscaping and trees on private property are met under development permits. Code Compliance and Housing Maintenance sections enforce these requirements.

Other bureaus also perform reviews and enforce sections of the City Code that relate to urban forestry. The chart at the end of this City of Portland section summarizes the roles of various city bureaus.

Environmental Zones. BDS implements Portland's Environmental Zones — the overlay zones that apply to various natural resource sites throughout the city. The Environmental Conservation ("c") Overlay Zone con-

serves important resources and the functions they perform. Environmentally sensitive development is allowed in the "c" zone if the resource can be protected. The Environmental Protection ("p") Overlay Zone provides the highest level of protection to the most important resources and the functions they perform. Development is approved in the "p" zone only in rare and unusual circumstances.

Planting 63,000 trees along 350 miles of bare curb will increase tree canopy by 100 acres.

Review of Site Development Processes. BDS reviews development related to the environment such as landscaping, erosion control and stormwater management codes to define the problems and identify improvements in administering and enforcing site development regulations.

BUREAU OF ENVIRONMENTAL SERVICES (BES)

BES is responsible for developing and implementing programs to protect Portland's rivers and streams. Their responsibilities include wastewater collection and treatment, providing stormwater drainage, preventing and reducing stormwater pollution, restoring native vegetation and improving watershed health in general. The following BES planning, implementation and regulatory activities are of particular importance to Portland's natural areas and urban forest.

Combined Sewer Overflow (CSO) Program: Clean River Plan. The CSO program separates the combined storm and sanitary sewers that overflow into the Willamette River and Columbia Slough during times of heavy rain to eliminate the resulting pollution.

The Clean River Plan addresses the combined sewers as well as protection and improvements to important urban watersheds through its "Ten Actions for Success." It aims to reduce stream flow, restore floodplains and foster environmental education and stewardship. Action 2 reads, "Plant trees, native vegetation and create buffers and shade along streams." The plan calls for the City to develop partnerships with agencies, neighborhoods, schools, organizations and businesses for restoration and planting projects. It also mandates that the City adopt and enforce development standards that protect vegetation, respond to the requirements of the ESA, increase the in-stream structures in creeks and create slow-moving backwater areas and braided channels. The plan calls for planting 63,000 trees along 350 miles of bare curb to increase tree canopy by 100 acres.[50]

[50] *Holladay/Sullivan/Stark Predesign Project Draft (12/01).*

Comprehensive Watershed Planning and Management. Watershed plans being developed for Portland include four sub-watersheds: the Columbia Slough, Fanno/Tryon Creek, Johnson Creek, and the mainstem of the Willamette River.[51] Each sub-watershed plan addresses the particular problems of that watershed and provides ways to protect, enhance and restore the watershed. Healthy tributaries and watersheds will contribute to the improved health of the Willamette. BES actively works with other agencies and jurisdictions and the public to protect and restore the beneficial functions and health of the watershed. These plans comply with State Goal 5, the Endangered Species Act, the River Plan and the Clean Water Act.

Environmental Education and Stewardship. This program informs, educates and involves businesses and residents in water quality and natural resources activities and projects to build a long-term advocacy for watershed health and improved water quality. BES sponsors events, provides educational materials and distributes stewardship grants that involve the public in the preservation and restoration of ecosystem functions.

Erosion Control Manual. The Erosion Control Manual details site specific requirements for any ground-disturbing activity. It requires trees and vegetation for mitigation. It provides guidance for complying with the City Code Title 10, which requires no visible or measurable sediment or pollutant to leave the site.

Property Acquisition Program. BES acquires properties from willing sellers in targeted areas to restore floodplain functions and protect water quality critical lands.

Superfund Response. BES is responding to the Superfund listing of the Portland Harbor with its Sustainable Stormwater Program — which calls for use of trees and vegetation to retain stormwater inflows. It also addresses conflicts between trees and sewer systems (roots, pipe damage, access and interference).

Stormwater Management Manual. The BES Stormwater Management Manual (SWMM) outlines stormwater management requirements and identifies who is required to comply with them. This manual provides guidance and detailed requirements for complying with City Code 17.38. The revised SWMM includes requirements for onsite vegetative mitigation measures such as tree planting.

Stormwater Management Program. The Stormwater Management Program responds to both federal regulations and the City's desire to protect and enhance its valuable water resources. BES coordinates the

[51] *A watershed is the land area that drains into a stream. An area of land that contributes runoff to one specific delivery point; large watersheds may be composed of several smaller "subsheds," each of which contributes runoff to different locations that ultimately combine at a common delivery point.*

program, which involves a number of other City bureaus and local jurisdictions. The success of the program depends on partnerships with public and private groups and Portland's residents.

Street Trees and Canopy Assessment Program. BES is currently using GIS data and field work to identify the canopy coverage provided by street trees in the Holladay/Sullivan/Stark sub-area of Portland. This assessment also quantifies potentially plantable areas.

Watershed Revegetation Program. This program restores native vegetation in Portland's watersheds along degraded stream banks and upland areas to improve water quality, control erosion, reduce stormwater pollution, aid in long-term salmon recovery and enhance wildlife habitat. The program covers the entire Portland area. Projects include upland and riparian zone plantings.

Willamette River Design Notebook. BES and PDC created a "Willamette River Design Notebook" that contains innovative design options for the Willamette riverbank for both public and private developers. Development models show urban riverfront projects that also protect threatened fish species. The notebook illustrates bank designs to protect and improve fish and wildlife habitat, water quality and access and bank stabilization — designs that often use trees and vegetation.

Stormwater Advisory Committee. BES provides staff support for the Stormwater Advisory Committee (SAC), which makes recommendations for stormwater management issues in development areas. Planting trees and revegetating sites are among their recommendations.

OFFICE OF TRANSPORTATION (PDOT)

PDOT is responsible for Portland's Transportation System Plan (TSP) which is the City's 20-year plan for transportation improvements and investments, and helps Portland comply with federal requirements, including the Transportation Equity Act, Clean Air Act, Clean Water Act and Americans with Disabilities Act. It complies with State and regional goals, policies, and regulations.

Trees beautify transportation corridors

The TSP addresses local transportation needs for cost-effective street, transit, freight, bicycle and pedestrian improvements. The plan provides transportation choices for residents, employees, visitors and firms doing business in Portland, making it more convenient to walk, bicycle, take transit and drive less to meet their daily needs. The TSP provides a balanced transportation system to support neighborhood livability and economic development.

The following Office of Transportation bureaus are involved with street trees:

PDOT Bureau of Engineering and Development is responsible for the design and construction of the transportation infrastructure which includes street trees.

- Coordinates with the City Forester to assure that street trees are included in the design stage of new construction projects.[52]
- Plants approximately 2,000 street trees per year as part of transportation corridor improvements.

PDOT Bureau of Maintenance (BOM) is concerned with interactions between trees and sidewalks, cutouts, curbs and streets.

- Manages the maintenance of sidewalks, curbs and driveways in a way that protects street trees and other desirable vegetation whenever possible.[53] Property owners are responsible for the maintenance of the sidewalk and the street trees adjacent to their property.
- Routinely coordinates with the City Forester to reduce damage to trees because of pavement repair and damage to pavement because of trees.
- Cleans streets of leaves and other tree debris.
- Contracts with PP&R to maintain landscaping on certain arterial projects. (This work is currently not funded due to reduced revenue from gas taxes.)

The urban forest reduces greenhouse gases and provides stormwater benefits.

PDOT Bureau of Transportation System Management is concerned with street trees or trees on private property if they obstruct the visibility of traffic signals, street lights and oncoming traffic at intersections and curves. Proper selection of tree species, proper location of trees and lights, pruning and flexible lighting designs reduce conflicts.

- Works with neighborhood groups to identify traffic problems and to devise solutions to those problems. Use of landscaped traffic circles and diverters is one of several approaches.
- Contracts annually with Urban Forestry Program to prune trees to maintain clearance for lights. Pruning occurs primarily in response to citizen requests. (This work is currently not funded due to reduced revenue from gas taxes.)

OFFICE OF SUSTAINABLE DEVELOPMENT (OSD)

OSD develops programs and policies that promote recycling and reduce solid waste, improve energy efficiency and support the use of renewable energy resources, promote green building practices and en-

[52] *The Portland Pedestrian Design Guide, developed by an inter-bureau Technical Advisory Committee, defines and assigns the available space in the public right-of-way for public improvements including street trees.*

[53] *This objective is from Sidewalk Maintenance Program, Policy and Operating Guidelines. Property owners are responsible for the maintenance of the sidewalk and the street trees adjacent to their property.*

hance sustainability throughout the community. Work that relates to urban forestry includes:

- Supporting, planting and maintaining trees to improve local air quality, sequester carbon and reduce greenhouse gases, thereby slowing climate change.
- Promoting use of those trees that allow year-round solar access while providing summer shade, and reducing energy needs for cooling.
- Working with developers to implement green building standards.[54]

Local Action Plan on Global Warming. This plan recognizes the role of the urban forest in reducing greenhouse gases and providing stormwater control benefits. It promotes tree planting, maintenance of existing vegetation as a greenhouse gas reduction strategy and working to ensure that the community understands the role of the urban forest as a vital part of Portland's character that improves the environment.

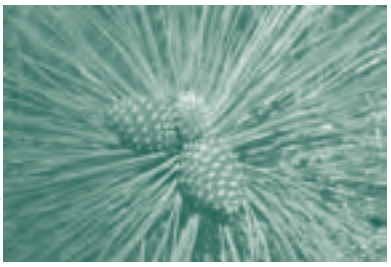
Green Building Policy. The City's adopted Green Building Policy (January 2001) states that Portland will promote green building standards in its own buildings and in private sector development. Standards related to urban forestry encourage reducing urban heat islands, minimizing site disturbance and using water-efficient landscaping.

PORTLAND FIRE AND RESCUE

Fire and Rescue is concerned with the interface of the urban forest with human habitations, especially where structures are located in or near natural areas. Increased fire hazards result from increased development in forested areas. The Fire Bureau is currently developing recommendations to alleviate risks from urban wildfires in certain areas.

PORTLAND DEVELOPMENT COMMISSION (PDC)

PDC develops and redevelops areas in the city that are physically deteriorated, unsafe or poorly planned. PDC uses urban renewal funds to carry out capital projects such as parks, streetscape improvements and community centers that would not happen on their own. Parks and street improvements are the primary areas where PDC projects affect the urban forest.



Courtesy Pat Breen, OSU

Ponderosa pine (Pinus ponderosa)

THE PORT OF PORTLAND

The Port owns and manages about 10,000 acres of land and 12 miles of riverfront on the Willamette and Columbia Rivers. Port staff use ecosystem-based planning and natural resources management strategies, and share data with the City and regional planning agencies.

[54]*In July 2002, the Office of Sustainable Development introduced Portland LEED, a supplement to the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) rating system. Portland LEED tailors the national standard to local building and development requirements while maintaining third party verification and official certification by the USGBC. It is the first local adaptation of LEED accepted by the USGBC in the U.S.*

RELATIONSHIPS CHARTS

The following charts provide:

1. A general summary of the current relationships among Portland's City bureaus regarding planning and regulating of the urban forest.
2. The relationship between the mandates listed in Chapter Two, the bureaus and agencies, their plans and projects, and the City's Framework Plan. The Framework Plan coordinates the City's responses to the ESA listing for salmonids and relates to many other city plans.

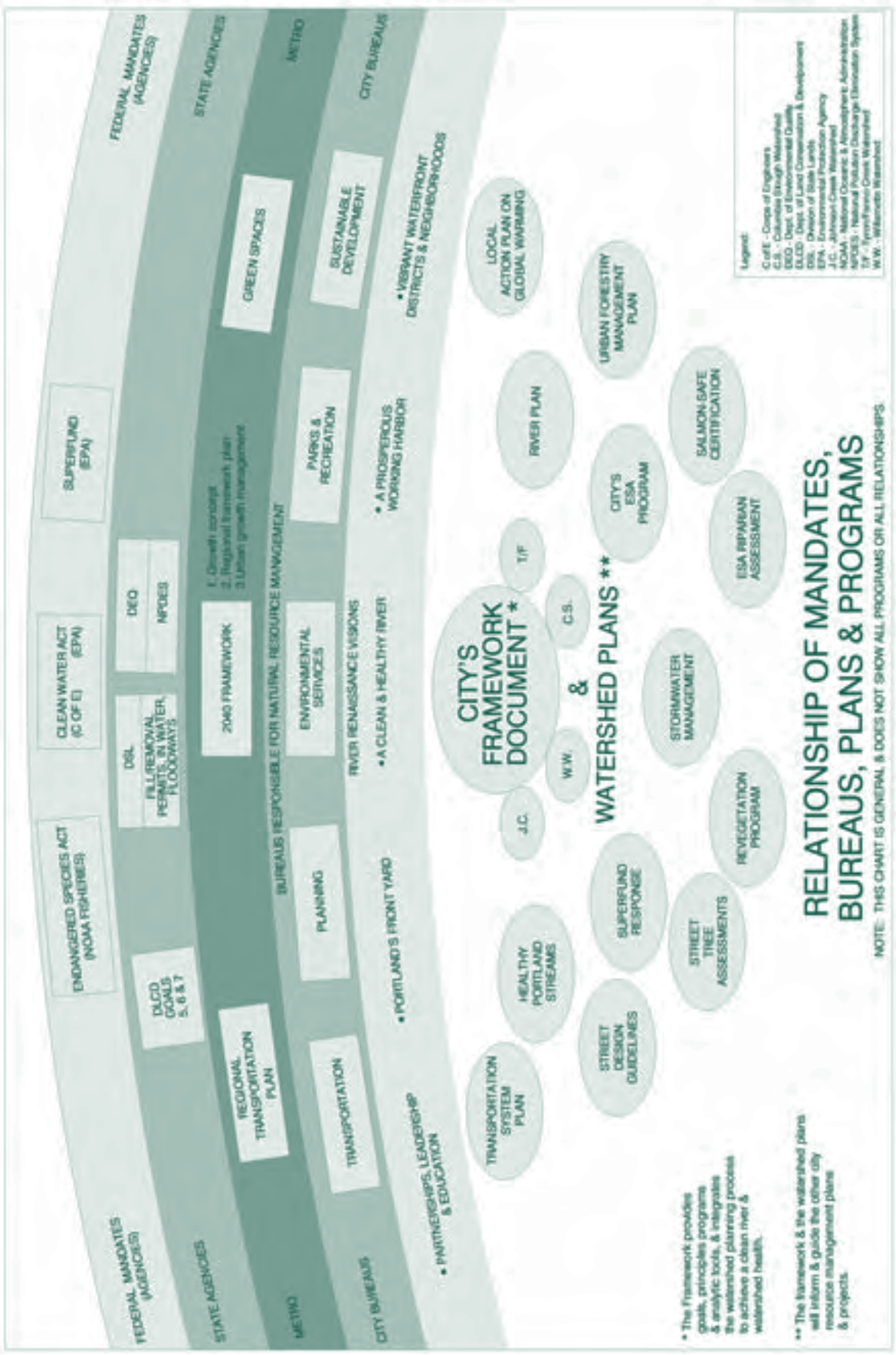
ROLES OF VARIOUS CITY BUREAUS & ORGANIZATIONS IN URBAN FORESTRY

Note: These are broad and general definitions. There are many exceptions and refinements.

Public Trees – Parks & other City-owned property	**Planned or Proposed by**	**Reviewed by**	**Implemented by**	**Regulated or Enforced by**
Trees in Developed Parks and Open Spaces	UF / other PP&R unit	UF/BDS	UF / other PP&R unit/BDS	UF/BDS
Trees in Publicly-owned Natural Areas	NR (PP&R) Ecosystem MP/ BES/Metro/OSP	UF/BDS	NR/BDS	UF/BDS in e-zones, etc.
Private Trees in Public Rights-of-Way[55]	**Planned or Proposed by**	**Reviewed by**	**Implemented by**	**Regulated or Enforced by**
Street Trees – Neighborhoods	FOT/ UF/ BES	UF	FOT, Neighbors, UF	UF – Title 20/BDS
Street Trees – Individual Lots	PPO/ BES	UF	PPO	UF – Title 20[56]/BDS
Street Trees – Transportation Improvements	PDOT Engineering	UF	PDOT	UF – Title 20/BDS
Street Trees – Subdivisions (public or private streets)	PPO/ BES	UF/BDS	PO/BDS	UF – Title 20/BDS
Private Trees – Developed Areas	**Planned or Proposed by**	**Reviewed by**	**Implemented by**	**Regulated or Enforced by**
Trees in Parking Lots	PO/ BES	BDS (BES for SWMM)	PO	BDS – Title 33
Required Landscaping	PO	BDS	PO	BDS – Title 33
Erosion Control	PO	BDS	PO	BDS – Title 10
Stormwater Management Facilities	PO/ BES	BES	PO	BES – Title 17
Heritage Trees		UF		UF
Removal of trees over 12" in diameter (except on SF residential)	PO	UF/BDS	PO	UF - Title 20.42/BDS
Other Trees on private property (generally)	PPO	BDS	PPO	BDS
Private Trees in Overlay Zones	**Planned or Proposed by**	**Reviewed by**	**Implemented by**	**Regulated or Enforced by**
Environmental zones	PO	BDS	PO	BDS
Willamette Greenway	PO	BDS	PO	BDS
Scenic Resources	PO	BDS	PO	BDS
Private Trees – Under or Undeveloped Areas	**Planned or Proposed by**	**Reviewed by**	**Implemented by**	**Regulated or Enforced by**
Trees on Dividable Lots – cutting[57] & preservation	PO	UF/BDS	PO	UF – Title 20/BDS
Cutting of regulated trees w/ clearing & grading[58]	PO	BDS	PO	BDS
Subdivisions – tree preservation	PO	BDS	PO	BDS

BES = Bureau of Environmental Services
BDS = Bureau of Development Services
FOT = Friends of Trees
NR = PP&R Natural Resources Program
PDOT = Portland Office of Transportation
PO = Property Owner (public or private)
PPO = Private Property Owner
PP&R = Portland Parks & Recreation
SF = Single Family
SWMM = Stormwater Management Manual
UF = Urban Forestry Program

[55]*Property owners are required to maintain and care for street trees.*
[56]*The City Forester can require street trees on private property.*
[57]*For trees 12" in diameter and over.*
[58]*BDS handles clearing and grading under Title 24.*


FEDERAL MANDATES (AGENCIES)
STATE AGENCIES
METRO
CITY BUREAUS
ENDANGERED SPECIES ACT (NOAA FISHERIES)
DLCD GOALS 5, 6 & 7
REGIONAL TRANSPORTATION PLAN
TRANSPORTATION
PLANNING
• PARTNERSHIPS, LEADERSHIP & EDUCATION
CLEAN WATER ACT (C OF E)
DSL
FILL REMOVAL PERMITS, IN WATER, FLOODWAYS
DEQ
NPDES
2040 FRAMEWORK
1. Growth concept
2. Regional framework plan
3 Urban growth management
BUREAUS RESPONSIBLE FOR NATURAL RESOURCE MANAGEMENT
ENVIRONMENTAL SERVICES
RIVER RENAISSANCE VISIONS
• A CLEAN & HEALTHY RIVER
• PORTLAND'S FRONT YARD
SUPERFUND (EPA)
PARKS & RECREATION
• A PROSPEROUS WORKING HARBOR
GREEN SPACES
SUSTAINABLE DEVELOPMENT
• VIBRANT WATERFRONT DISTRICTS & NEIGHBORHOODS
CITY'S FRAMEWORK DOCUMENT *
WATERSHED PLANS **
W.W.
&
C.S.
T/F
J.C.
TRANSPORTATION SYSTEM PLAN
HEALTHY PORTLAND STREAMS
STREET DESIGN GUIDELINES
SUPERFUND RESPONSE
STREET TREE ASSESSMENTS
REVEGETATION PROGRAM
STORMWATER MANAGEMENT
CITY'S ESA PROGRAM
ESA RIPARIAN ASSESSMENT
RIVER PLAN
SALMON-SAFE CERTIFICATION
LOCAL ACTION PLAN ON GLOBAL WARMING
URBAN FORESTRY MANAGEMENT PLAN
RELATIONSHIP OF MANDATES, BUREAUS, PLANS & PROGRAMS
NOTE: THIS CHART IS GENERAL & DOES NOT SHOW ALL PROGRAMS OR ALL RELATIONSHIPS
* The Framework provides goals, principles programs & analytic tools, & integrates the watershed planning process to achieve a clean river & watershed health.
** The framework & the watershed plans will inform & guide the other city resource management plans & projects.
Legend
C of E - Corps of Engineers
C.S. - Columbia Slough Watershed
DEQ - Dept. of Environmental Quality
DLCD - Dept. of Land Conservation & Development
DSL - Division of State Lands
EPA - Environmental Protection Agency
J.C. - Johnson Creek Watershed
NOAA - National Oceanic & Atmospheric Administration
NPDES - National Pollution Discharge Elimination System
T/F - Tryon/Stevens Creek Watershed
W.W. - Willamette Watershed

Tree planting and habitat storation

NONPROFIT ORGANIZATIONS

Friends of Trees (FOT) is dedicated exclusively to planting urban trees, assuring their survival, and inspiring public stewardship of the urban forest. FOT uses a community-building model to work with willing partners in three planting programs:

- Neighborhood Trees – plants street and yard trees in neighborhoods and business districts.
- Natural Area Restoration – restores urban natural areas.
- School Trees – plants trees on school grounds.

Each of these programs has a tree care and monitoring component.

FOT currently plants about 25,000 trees and seedlings each year, utilizing current scientific and strategic data about what and where to plant. Target areas include those with fewest trees, those that are losing trees, low-income areas, those that provide habitat connectivity, and those that lend themselves to community outreach and education. FOT works closely with Urban Forestry, local nurseries and many agencies, community groups and volunteers to assure that the right trees are planted in the right places.

Since its founding in 1989, FOT has involved over 23,000 volunteers in planting more than 200,000 trees. This volunteer infrastructure builds community and improves the urban forest. FOT provides environmental education in schools and emphasizes public education about the importance of the urban forest and how residents can become involved in its conservation, protection and restoration.

Save Our Elms. This community elm inoculation program is dedicated to protecting Portland's American Elm trees from Dutch Elm Disease – a devastating and incurable disease.

- Reinforces Urban Forestry's elm inoculation program.
- Educates residents about urban forestry issues and disease prevention.

Other Nonprofit Organizations. Numerous nonprofit organizations play important roles in preserving and protecting the urban forest and providing environmental education opportunities. Among them are:

- Portland Audubon Society
- Three Rivers Land Conservancy
- The Urban Streams Council
- Watershed Councils
- Wetlands Conservancy
- Friends Groups
- World Forestry Center
- Community Development Organizations (e.g. REACH)

EDUCATIONAL INSTITUTIONS

Portland State University (PSU) provides classes about the urban forest and has mapping and inventory services.

- Coordinates and interprets satellite and aerial mapping data.
- Assists in developing Geographic Information Systems (GIS) for various groups.
- Performs tree inventories in various parts of the city.
- Develops displays and presentations relating to urban forest issues.

Portland Public Schools (PPS) land around public schools buildings contributes to the city's supply of open space and recreation areas. Many of these areas include a variety of trees, ranging from mature large canopy trees to recent revegetation and restoration plantings. These areas provide opportunities for additional plantings and for environmental education.

Portland schools also provide environmental education to their students and work with not-for-profit groups – including Friends of Trees and Save Our Elms – to supplement their curriculum.

"The healthier the urban forest, the greater the benefit it provides to the community."

Municipal Tree Management in the United States

PRIVATE UTILITIES

Portland General Electric (PGE) provides electric power to most of the Portland area. Their Forestry Division employs seven professional foresters that maintain all trees around power lines on a two or three-year cycle on a contract basis.

- Maintains landscaping around substations.
- Provides funds and technical assistance through their tree replacement program to remove and replace incompatible trees under power lines.
- Provides educational materials including a brochure on planting appropriate tree species under power lines, notices in newsletters to customers, and information in bill inserts.
- Has provided funding for several of PP&R Urban Forestry Program's brochures.

Pacific Power provides power to a portion of Northeast Portland.

- Maintains trees under power lines.
- Assists property owners in removing hazardous trees and replacing them with suitable species through their tree replacement program.
- Sponsors the "Green Corps" grant program for tree planting projects.
- Distributes tree care information through tree crews. Educational materials are also distributed through nurseries and at special events.

REGIONAL AGENCIES

Metro owns over 10,000 acres in Clackamas, Multnomah and Washington counties, and coordinates with 26 park providers in those coun-

Wetlands provide valuable habitat

ties to "ensure a vital green heritage" and to provide nature-based recreation, education, and volunteer opportunities as part of a regional greenspaces system. This includes environmental education programs at Oxbow Park and at Smith and Bybee Lakes.

The Metro Greenspaces Master Plan (adopted by Metro in July 1992) is a policy document that outlines goals and specific tasks to establish a framework to prioritize acquisition, and/or preservation and restoration of natural areas, open spaces, trails and greenways for wildlife and people.[59] Metro and other park providers in the region are currently updating the Regional System Green Spaces Master Plan.

STATE AGENCIES

Oregon Parks and Recreation Department. OPRD owns and manages the 650-acre Tryon Creek State Natural Area located in Southwest Portland.

- Provides environmental education programs at Tryon Creek.

Oregon Department of Forestry, Urban and Community Forestry Assistance Program. This ODF program provides technical assistance to communities throughout Oregon.

- Administers several grant programs that fund many community forestry activities.
- Develops and provides a newsletter and topical brochures.
- Sponsors conferences and seminars.
- Provides environmental education.

Oregon Community Trees. The council promotes urban forestry issues on statewide basis. Representatives from around the state work cooperatively on educational programs and special projects.

- Provides forum for networking between communities.
- Lobbies for urban forests and greenspaces.
- Reviews grant proposals for urban forestry projects.

Oregon Department of Fish and Wildlife. ODF&W promotes the "Naturescaping" program that encourages homeowners to plant native materials in their yards.

OTHERS

Numerous other organizations and individuals have a strong interest in the urban forest, including professional societies and associations, nursery growers and retail nurseries, arborists, landscape architects and contractors, gardeners, wildlife biologists, urban forestry academicians, consultants and planners.

[59]*Local city and county recreation agencies are responsible for developing and providing active recreation facilities for their residents.*

Chapter 3
Analysis and Recommendations

Analysis of Portland's Urban Forest

While Portland's urban forest is diverse and varied, there are common elements throughout all parts of the urban forest. They are addressed in this chapter. The following strengths, weaknesses, opportunities and threats are found in all areas of the city. The next chapter addresses the specific needs of the five different categories of the urban forest known as Urban Land Environments (ULEs).

STRENGTHS

- Portland has an excellent climate for trees and other plants.
- There is an active Urban Forestry Commission.
- Numerous bureaus and agencies have expertise in resource management and are involved in the planning and management of the urban forest.
- The city has many effective revegetation programs.
- Ordinances and environmental zones provide some protection to the urban forest.
- Residents are involved and provide stewardship through organizations such as Neighborhood Tree Liaisons, Save Our Elms and Friends of Trees.
- Residents appreciate natural resources, trees and vegetation and value the abundant opportunities to enjoy them.

WEAKNESSES

- Many bureaus are involved in the management of the urban forest, but their reasons for doing so are not necessarily compatible and the desired outcomes may be at odds with each other; consequences and side effects are not always anticipated.
- The urban forest is unevenly distributed. Economically disadvantaged neighborhoods often have fewer trees than more wealthy areas. People in poorer areas have fewer resources to care for trees and vegetation.[60] This often results in fewer street and yard trees or trees that are in poor condition in certain areas.
- Information about the overall quality and quantity of the urban forest is not coordinated, although there are some surveys of trees in several neighborhoods and of the forest canopy.[61]

Streets without trees are less inviting and provide fewer benefits

[60] *All residents are required to maintain street trees in their right-of-way, which may be more difficult for those in poorer areas.*
[61] *See Appendix.*

- Finding places with enough room for large canopy trees is challenging even though those trees provide greater environmental and psychological benefits.
- There is an increasing trend to plant small trees instead of large canopy trees.
- Some developers and property owners do not comply with regulations and ordinances.
- Trees in rights-of-way are often removed and not replaced.
- Funding for the urban forest comes from a variety of sources, and little of it is stable.[62]
- There is not enough staff to enforce regulations.

OPPORTUNITIES

- There are areas available for additional trees in all parts of the city.
- There is increasing public interest in improving natural resources and the urban forest.
- Many remnant stands of large Douglas fir trees exist in Portland's parks. With active management these stands can survive into the future.

THREATS

- Increased density in the city results in more impervious surfaces and less tree and vegetation cover.
- The need to accommodate increased density puts pressure to develop on hillsides and in stream corridors — areas that are often treed.
- Invasive non-native plants — especially English ivy (*Hedera helix*) and wild clematis (*Clematis vitalba*) — are a major problem in public and private natural areas, and seriously threaten the health of the urban forest.
- Pests and disease can have sudden and devastating effects, especially in areas that lack species diversity.
- Wildfires threaten the urban forest as well as homes and businesses in certain areas.

As this analysis shows, there are many strengths to build on, and opportunities to take advantage of. There are also numerous weaknesses and threats to overcome.

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[62]*Urban Forestry's budget accounts for only about 0.50% of the City budget, and only provides for care of trees in parks. Most tree work is reactive and involves removal of hazards, not health care or preventive maintenance. Compared to cities of comparable size across the country, Portland's Urban Forestry program spends $2.65 per capita on the urban forest while other cities spend $3.61 per capita on average. On a per-acre basis PP&R's Natural Resources program is funded at 10% to 50% of similar programs across the country.*

RECOMMENDATIONS AND ACTIONS

This section gives recommendations for improving all portions of the urban forest. The intent is to move from reactive, fragmented management to proactive, integrated and coordinated management. The involvement and cooperation of all of the bureaus and agencies that manage the urban forest is key to success.

COORDINATE. *Coordinate the roles, responsibilities, policies and projects of City bureaus, agencies and partners for planning and managing the urban forest.*

- Urban Forestry will convene a permanent Urban Forestry Policy Group to coordinate management of the urban forest with representation by all major partners and the Urban Forestry Commission. Management tasks will be based on expertise, available resources and mandated responsibilities to assist in carrying out the following recommendations. The purpose of the group is not to replicate existing process, code, administrative rule and committee provisions but to coordinate efforts between bureaus and to help those bureaus with primary responsibility to carry out their tasks.

- Coordinate citywide plans and revegetation and restoration activities for wildfires, floods, stormwater, view preservation and global warming to ensure that urban forest goals for different bureaus and agencies are compatible.

- Prepare an annual report on activities and accomplishments for affected bureau directors, the commissioner in charge of Parks and the Urban Forestry Commission for use in City regulatory compliance documents and for the general public.[63]

- Develop standing committees to coordinate the projects and activities in each ULE. Assess and report annually on progress toward meeting objectives for each ULE.

- Encourage all City bureaus and agencies to make tree planting and vegetation management a priority in their developments, capital improvements and operation programs and long-range plans.

- Work with Metro and cooperate with other municipalities to manage and maintain the regional urban forest.

- Maintain strong partnerships with groups such as Friends of Trees and Save Our Elms, and develop new alliances that expand and improve the urban forest.

Courtesy Pat Breen, OSU

Paperbark maple (Acer griseum)

[63] *BES reports on similar activities to DEQ in the NPDES Stormwater Annual Compliance Report.*

Encourage all city bureaus to make tree planting a priority.

DOCUMENT. ***Characterize, inventory, and document the health and condition of Portland's urban forest.***

- Determine the economic benefits of canopy and use the information to educate the public and city policy makers.
- Quantify the relationship between canopy cover, stormwater reduction and water quality. Some areas, such as the Columbia Slough, could experience great water quality gains with increased canopy.
- Coordinate data gathering, inventories and mapping projects with other City bureaus and agencies to gather and interpret information about canopy cover.
- Determine information needs for the city as a whole and for each ULE.
- Establish baselines and monitoring procedures to assess, quantify and track trends and changes in the urban forest on a periodic basis. Repeat satellite canopy cover studies every 5 to 8 years.
- Identify areas of greatest opportunity and need as priorities for improving the urban forest.
- Analyze and evaluate the effectiveness of the performance measures outlined for each ULE.

PRESERVE. ***Develop and coordinate effective maintenance and stewardship programs to maintain, restore and preserve the existing urban forest and ensure the safety of the public.***

- Encourage City bureaus to make tree preservation a priority in their development projects and operations.
- Identify, preserve and protect healthy trees and plants in the urban forest.
- Establish cost-effective preventive maintenance programs to improve the health and safety of park, public and street trees.
- Develop and adopt appropriate maintenance standards and practices for each ULE.
- Prepare plans and educate staff and the public on how to address outbreaks of pests and diseases that may threaten the urban forest.

- Utilize new technology such as structural soils and pervious pavement to improve growing conditions for trees in harsh environments such as urban streets and industrial areas.

- Remove invasive non-natives and other unsuitable vegetation where appropriate.

- Promote the use of fire-resistant trees and vegetation in appropriate places.

- Replace trees and vegetation lost due to development, redevelopment and disease, and mitigate impacts to the environment from development and human uses.

INCREASE. ***Identify and utilize areas where additional trees and vegetation can be added to improve and enhance the urban forest, especially large canopy trees in appropriate areas.***

- Focus planting efforts in tree deficient areas in order to distribute the urban forest equitably throughout the city. Develop criteria and prioritize planting areas.

- Identify all planting opportunities. Identify and utilize non-traditional planting areas such as curb extensions, rooftops and others.

- Acquire or establish areas where trees can be planted as mitigation for tree cutting that occurs in other areas of the city.

- Promote the use of a diversity of large canopy trees that provide maximum benefits in appropriate areas.

- Encourage plantings that are long-lived and sustainable over time.

- Plant appropriate trees and vegetation in appropriate places.

- Consider overall species and age diversity when adding new trees.[64]

- Encourage planting of evergreens in appropriate areas.

Courtesy Pat Breen, Oregon State University

Noble fir (Abies procera)

EDUCATE. ***Increase awareness and understanding about the value and benefits of the urban forest and promote proper care for the urban forest.***

- Develop education plans that raise awareness of the urban forest, promote the planting of trees and vegetation, improve the care of urban forest and explain the benefits of the urban forest.

[64]*This does not apply to natural areas.*

Tree Neighborhood Liaisons are champions for local tree issues.

- Coordinate education and outreach programs and materials internally with City bureaus, and externally with partner agencies, neighborhood associations and coalitions.

- Initiate multi-media awareness campaigns about the benefits of the urban forest for target audiences and provide them with appropriate and easy to understand information.

- Educate the public about the serious threat posed by English ivy (*Hedera helix*) and wild clematis (*Clematis vitalba*).

- Encourage each Neighborhood Association to have two Tree Liaisons[65] to be the champions for local tree issues. Establish local neighborhood 'Tree Boards' to deal with local urban forest issues. Involve youth in the Neighborhood Tree Liaison program.

- Provide ample volunteer opportunities for citizen involvement in urban forestry projects and events. Maintain or increase the Urban Forestry Program's annual number of volunteer hours.[66]

- Promote Arbor Day, the Urban Forestry Commission's Heritage Tree Program and awards and other bureaus' programs that celebrate the urban forest.

- Partner with the Office of Sustainable Development's Green Building program to educate the development community about the importance of the urban forest and its economic value.

- Develop and adopt appropriate planting and design standards that provide clear information about allowed urban forest activities in each ULE.

- Link education programs with incentives. (See next item.)

ENCOURAGE. ***Develop and implement incentives that provide tangible benefits for the planting, care and permanent protection of the urban forest.***

- Identify and promote actions that should be rewarded such as:
  - Voluntary upgrading of existing commercial/industrial developments to meet current landscape codes.

[65]*The Urban Forestry Program trains volunteers to be Neighborhood Tree Liaisons.*
[66]*The Urban Forestry Program's current target is 3,000 volunteer hours per year. UF also aims to have information tables at 20 events per year.*

- Preservation of wooded ridgelines, riparian corridors and wildlife areas.
- Use of sustainable management practices.
- Integrated pest management (IPM) practices.
- Conservation easements.
- Planting large maturing trees when feasible.

- Develop a variety of attractive incentives such as, but not limited to:
  - Land use density bonuses.
  - Transfer of development rights in sensitive areas.
  - Property tax incentives.
  - Rebates and discounts that encourage planting trees and vegetation.[67]
  - Voucher/coupon systems.

FUND. ***Establish stable funding and adequate resources and staff to maintain, preserve, restore and increase all aspects of the urban forest.***

Adequate staff and resources are needed to manage all areas of the urban forest.

- Ensure that bureaus, organizations and agencies have adequate funds to manage those areas of the urban forest for which they are responsible. In doing this, establish a logical connection between the funding source and the expenditure.

- Explore and develop alternate funding mechanisms such as:
  - Bond measures.
  - Endowments, using the interest for operations and expenses.
  - Front foot assessment for street trees.[68]
  - Permit fees.
  - Gas taxes/road taxes for street trees.
  - Trust funds with funds coming from tax-exempt donations or proceeds from sale of unused City-owned properties.
  - Surcharges that relate to the urban forest, e.g., a tax on lumber.
  - Carbon Dioxide offset program.

- Coordinate and prioritize funding among bureaus for projects and to support the Urban Forestry Coordinator position.

[67] *Bureau of Environmental Services does this through Friends of Trees and the Downspout Disconnect program. See Appendix.*

[68] *A Front Foot Assessment would assess everyone whose property abuts a public street for a certain amount of money per linear foot of the abutment per year. This money would allow the City to take care of street trees — removal, pruning, etc., that is now the responsibility of the property owner (in some cases a major expense). It could also include seasonal leaf removal. (It would probably not include sidewalk maintenance.) FFA is done successfully in many cities in Ohio, in Vancouver, B.C., and in a suburb of Denver.*

REGULATE. ***Develop and enforce effective regulations and planting and design standards that ensure the health, quality and benefits of the urban forest.***

- Coordinate, consolidate and enforce all regulations and standards that relate to the urban forest and to site development.[69]

- Develop and implement enforceable regulations with effective penalties.
  - Identify, develop and implement inspection and enforcement needs for tree preservation and tree-related development re view activities. Provide training to inspectors on urban forest and tree issues.
  - Continue to evaluate the effectiveness of regulations.

A healthy urban forest brings beauty and benefits

MAKING THE VISION A REALITY

It will take the coordinated efforts of all the managing bureaus and agencies to implement these policies and actions and the commitment and involvement of all of Portland's residents to achieve the far-reaching vision presented at the beginning of this plan. To learn more about the urban forest and to get involved in this effort, contact any of the sources of information listed in the Appendix.

Working together, we will have "a healthy, sustained urban forest, carefully managed and cared for, which contributes to the economic and environmental well-being of the city."

[69] *The City is currently considering revising and consolidating many regulations, including tree caliper size and tree/landscape requirements.*

Chapter 4
Urban Land Environments

Introduction

This plan divides Portland's urban forest into five basic categories called Urban Land Environments (ULEs). Each ULE has particular physical characteristics and issues, provides various benefits and serves different needs. Each is managed by different bureaus, agencies or individuals to achieve different results. The health and quality of the urban forest in each ULE depends on the knowledge, skills and involvement of the owners and managers.

This chapter provides a description of each ULE, management goals, information about property owners, managers, and an analysis of the strengths, weaknesses, opportunities, threats and issues for the ULE. This is followed by specific objectives, recommended actions and specific performance measures when possible.

The chart below shows the approximate number of acres in each ULE and its percent of the city land base. Excluding the area of the Willamette and Columbia River, Portland's land base is 87,040 acres (136 square miles). The ULE percentages shown below are based on the land portion only. Creeks and other waterways are included.

Urban Land Environments	Acres	% of city land
Residential	50,000	57%
Commercial/Industrial/Institutional	20,000	23%
Natural Areas and Stream Corridors[70]	14,500	16%
Transportation Corridors and R-of-W	8,700 (paved portion)[71]	10%[72]
Developed Parks and Open Spaces[73]	4,000	05%

Areas shown do not add up to 100% because of overlap and duplications, particularly between the Natural Areas, Transportation Corridors and Residential ULEs. Much of the land in these ULEs is designated for

"In managing the urban forest, we are playing a long-term chess game, with both living and non-living pieces. Some of our moves are direct, many are strategic. All must be planned toward a designed future."

R.N. Sampson and R. Rowntree
The Living City

[70] *Includes the islands in the Willamette River.*
[71] *ODOT and PDOT provided information on the amount of pavement in their respective systems from which the following estimates were made for areas within Portland: ODOT - 1,210 acres of roadway, PDOT - 6,480 acres of streets and 1,020 acres of sidewalk for a total of 8,710 acres of impervious surface. There is no information on the amounts of unpaved ROW.*
[72] *The city's Stormwater Advisory Committee estimates that city streets make up18% of city land.*
[73] *Developed Parks and Open Spaces includes areas that have structures or built facilities, or are designated and programmed for specific recreation activities; e.g., sports fields, as well as open and unprogrammed areas with no structures that are set aside for low intensity uses and passive recreation.*

particular uses like environmental conservation and protection or transportation, but since it is privately owned and, it also shows up in the Residential ULE.

Since it is difficult to determine the percent of each ULE that is paved, in rights-of-way or zoned for environmental protection, these numbers are *very rough estimates*. They are gleaned from a variety of sources, and are only *general indications* of the distribution of land in each ULE.

RESIDENTIAL

All residential development, from traditional single family to multi-family dwellings.

DESCRIPTION

Residential.

Over half of the city's land base is dedicated to residential use. Single family homes on 5,000 - 7,000 sq. ft. lots comprise most of this Urban Land Environment, although some single-family homes are on larger lots and multi-family dwellings are located throughout the city. By 2020, Portland is expected to include another 113,000 people, an increase of about 20%.[74] The density and design of future residential development to accommodate these new residents will impact the urban forest throughout this ULE.

The quantity and quality of the urban forest in this ULE varies greatly. Generally speaking, residential areas have more trees and vegetation than other privately owned property, but this varies by area. Affluent areas often have generous tree canopy cover and landscaping that is in good condition, while other areas lack canopy cover entirely and landscaping may be non-existent or in poor condition.

Most trees and vegetation on single-family residential property are unregulated, with the following exceptions:

- Situations which represent a hazard to the general public.
- Trees afflicted with or susceptible to Dutch Elm disease.
- Situations involving power line clearance.
- Areas within environmental zones.
- Trees used for stormwater mitigation.
- Trees subject to the Tree Preservation Ordinance.
- Heritage trees.

There are additional regulations for multi-family residential lots that can be subdivided.

Note: All property owners are responsible for street trees in the ROW for their properties. This is covered in the Transportation Corridors and Rights-of-Way ULE.

[74] *Metro (1995).*

Property Owners, Managers and Principal Partners

Owner/Manager	**Acres***	**Primary Activities**
Private Property Owners	50,000	Private yard and garden care (some more than other)

Additional Partners	**Role**
BES	Water quality improvement, stormwater mitigation, naturescaping and erosion control
BDS	Erosion control, regulations and enforcement
BOP	Healthy Portland Streams and environmental zones
PP&R - Urban Forestry	Oversight of trees in select circumstances and education
Fire and Rescue	Maintaining safe zones around homes
FOT	Education

*This is a *very rough estimate*, gleaned from a variety of sources, and only a *general indication* of the amount of land in this ULE.

ANALYSIS

Strengths

- There are many areas of mature trees and abundant vegetation in good condition.
- Portland has a great climate for growing vegetation.
- Many residents take great pride in their yards and gardens.

Weaknesses

- The urban forest is unequally distributed in this ULE.
- Some people lack the resources needed to maintain trees and vegetation.
- Management of trees on private property, except for rights-of-way and trees that are specified for stormwater mitigation when development occurs, is unregulated.

Opportunities

- Property owners can be effective stewards for the vegetation in this ULE.
- Partnerships with volunteers can help to plant trees in low-income areas.
- Trees and vegetation can establish regional and neighborhood character and community identity.

Threats

- New development and increased density reduces existing canopy.
- Trees are cut or topped to create private views or to reduce maintenance costs.
- Disease or pests may quickly wipe out large segments of the urban forest.
- Some property owners provide poor or inappropriate maintenance of trees.

ISSUES

- Some low-income property owners find care and maintenance of trees to be an economic burden. Poorer areas of the city lack abundant amounts of the urban forest.

- Developing the amount of "defensible space" needed around buildings to reduce the risk of wildfires in urban/wildland interface areas may conflict with the need to retain canopy cover, as well as the need to protect the vegetation in environmental zones.

GOALS, OBJECTIVES AND PERFORMANCE MEASURES

Urban forest management in this ULE focuses on encouraging private property owners to maintain and enhance the urban forest on their property. Note: Not every objective has a specific performance measure.

Mature street tree

Goal - Provide the benefits of the urban forest to all residents.
A healthy urban forest improves the quality of life for residents, increases property resale values and enhances comfort.

> ***Objective: Increase tree canopy.***
> Tree canopies offers multiple benefits to residents. Recommendations for residential canopy cover range from 10-60%.[75]

Performance Measure - Canopy Cover
35-40% canopy cover
Canopy cover of 35-40% requires 1-2 large trees or 2-3 medium trees or 5-6 small trees for a 6,200 square foot lot.[76] Trees should be selected based on specific site conditions and needs.

For development in single and multi-dwelling zones, City Code dictates "at least 2 inches of tree per 1,000 square feet of site area must be preserved [or planted]. On lots that are 3,000 square feet or smaller, at least 3 inches of tree must be preserved [or planted]." (Chapter 33.248.020) While this is a good standard, it is difficult to enforce, and does not necessarily translate into canopy cover.

Goal - Educate residents about the management and care of the urban forest.
Knowledgeable residents provide better care and act as stewards for the urban forest.

> ***Objective: Provide information about best management practices for tree planting, preservation and care.***
> Develop a variety of resources to educate homeowners about the urban forest.

[75] *See Appendix for information on recommendations.*
[76] *Calculated using information from Head, Fisher, and O'Brien (2001), p. 57.*

- Expand partnerships with other bureaus and agencies to educate homeowners about the benefits of trees and vegetation including water quality management, erosion control and energy savings.
- Encourage the use of large canopy trees in appropriate areas.
- Encourage the use of native trees and vegetation in appropriate areas.
- Expand the Neighborhood Tree Liaison Program to provide two Neighborhood Tree Liaisons in every neighborhood.
- Develop a community assistance program to encourage low-income property owners to plant and care for trees and vegetation.

Goal - Ensure public safety from potential wildfires.
Wildfires are a threat in some areas of the city.

Objective*: *Reduce fire hazards near homes and structures.
Under certain conditions, some residential areas are at risk for wildfires.

- Adopt an Urban Wildfire Hazard Plan.
- Encourage the use of fire-resistant native plants in areas near structures and habitation.

Goal - Protect the urban forest from pests and diseases. (This goal and its objectives apply to all ULEs, except Natural Areas.)
Lower the risk of catastrophic loss from pests and diseases.

Objective*: *Provide a diversity of tree species.
A diversity of species is a risk-prevention measurement since an area with many species of trees is less likely to suffer catastrophic loss from diseases such as Dutch elm disease that can wipe out an entire species of trees in a geographic area. A diversity of species provides greater variety of habitat and food for fish and wildlife.

Note that this objective does not encourage the cutting of any existing trees, but rather encourages planting a diversity of new trees.

Performance Measures - Species Diversity
This should be measured on a large area basis, not by individual sites.

- No more than 10% of a single species. (Recommendations range from 5-15% for a single species. 10% is the general "rule of thumb.")
- No more than 30% of a single genus (e.g., maple).
- No more than 30% of any genus should be a single species (e.g., red maple).

Objective*: *Ensure diversity of ages among trees in the urban forest.

Since Portland's urban forest is already fairly diverse in overall age composition, this is not a goal that needs to be actively managed. As long as trees are continually planted, the general age diversity of the urban forest will be perpetuated. Information on ages should be collected when trees are inventoried.

"Plant the right tree in the right place."

Like species diversity, this is also a risk-prevention measurement. Having a variety of ages among the trees of the urban forest reduces the likelihood that all of the trees will begin to die at the same time. A healthy mixture of young, medium and old trees provides a constant turnover of generations that ensures that the urban forest will remain in a fairly steady state as new trees replace those that die. A forest with a diverse age composition has more complexity that offers greater habitat for fish and wildlife.

COMMERCIAL/INDUSTRIAL/INSTITUTIONAL

Urban and neighborhood commercial areas, malls, manufacturing and warehousing areas, industrial and wholesale sales, industrial parks, quasi public areas such as schools, religious institutions, cemeteries, and government facilities.

Commercial/Industrial/Institutional

DESCRIPTION

Areas in this ULE are generally highly developed but have a wide variety of urban forest conditions. While many have a low percentage of vegetative cover, some areas such as campuses are well-vegetated.

When these properties are developed, they are often cleared and graded, which reduces the potential to protect existing vegetation. Any urban forest on these properties is usually a result of the City's landscaping requirements. New developments are required to have 15% landscaping, but some older developments have few trees, especially older parking lots, and little landscaping. Code requirements include street trees, parking lot and landscaping, buffer plantings and landscape coverage. City Code also regulates the cutting of trees in this ULE.

Note: All property owners are responsible for street trees in the ROW for their properties. This is covered in the Transportation Corridors and Rights-of-Way ULE.

Property Owners, Managers and Principal Partners

Owner/Manager	**Acres***	**Primary Activities**
Private and Public Property Owners	20,000	Vegetation management

Additional Partners	**Role**
BDS	Erosion control, regulations and enforcement
BOP	Healthy Portland Streams — environmental zones
BES	Water quality improvement and stormwater mitigation
FOT	Tree plantings on school and church properties
PP&R - Urban Forestry	Administer tree cutting ordinance

*This is a *very rough estimate*, gleaned from a variety of sources, and is only a *general indication* of the distribution of land in this ULE.

ANALYSIS

Strengths

- Ample vegetation and green spaces exists on some industrial parks and institutional campuses.

- Existing parking lots that lack trees and vegetation are gradually being upgraded and planted.
- The Stormwater Management Manual (SWMM) requires trees and vegetation for development projects.
- Trees provide significant amenities in retail districts.[77] On average, consumers are willing to pay 12% more for products of all kinds in districts with trees.

Weaknesses

- Growing conditions are often harsh due to compacted soils, extensive paving and heavy use of many sites.
- There are some overlapping and confusing regulations for developers and property owners. At present BDS, Urban Forestry, BES and sometimes PDOT administer three different codes with different requirements and procedures. There are multiple plant lists and multiple fees are required.
- Overlapping regulations address the same vegetation, e.g., mitigation for impervious surfaces, parking lots, and landscape requirements.
- Code enforcement is lax in some areas.

Opportunities

- Trees and vegetation can be added to improve water quality, improve the comfort of employees and the public and improve the visual characteristics of an area.
- Canopy cover inventories can be used to identify planting opportunities.

Threats

- Urban forest maintenance and improvement is not a priority for all property owners.

ISSUES

Heavy use of these sites makes it difficult to provide a healthy urban forest.

GOALS, OBJECTIVES AND PERFORMANCE MEASURES

Urban forest management in this ULE focuses primarily on improving the health of individual trees, and adding to the urban forest in appropriate places. Note: Not every objective has a specific performance measure.

Goal - Provide the benefits of the urban forest in a highly developed environment.

Healthy trees and vegetation can improve the functional use of these sites, while accommodating the needs of the businesses.

[77] *Wolf, Kathleen (1999).*

Objective: Provide urban forest elements, especially canopy cover, to improve site conditions.

Increased canopy cover provides multiple benefits. Recommendations range from 0-40% with most around 10-15%.[78]

Performance Measure - Canopy Cover

15% canopy cover

There are some areas — such as downtown commercial areas — where it may not be possible to attain this level of coverage. Other areas may be able to achieve a much higher canopy cover.

Portland's City Code landscape standards generally call for 15% landscape coverage of these areas.[79] While this is not the same as canopy cover, it is a measurable requirement.

- Select trees and vegetation appropriate to specific sites.
- Identify areas, such as parking lots, where canopy cover can be increased.
- Develop incentives to encourage development of a healthy urban forest and retention of existing healthy trees and vegetation, especially large trees that provide maximum benefits.

Trees offer interest in all seasons

Goal - Educate property owners about the management and care of the urban forest.

Knowledgeable property owners provide better care and maintenance and act as stewards for the urban forest.

Objective: Provide information about best management practices for tree planting, preservation and care.

Develop a variety of resources to educate property owners about the urban forest.

- Expand partnerships with other bureaus and agencies to inform property owners about the benefits of trees and vegetation including water quality management, erosion control and energy savings.
- Encourage the use of large canopy trees in appropriate areas.
- Encourage the use of native trees and vegetation in appropriate areas.

Goal - Improve growing conditions.

Growing conditions in this ULE can be particularly difficult.

[78] *See Appendix for information on recommendations.*

[79] *City Code dictates the following landscaping standards as minimum requirements: Institutional: 25% of site landscaped; Commercial: 15% of site landscaped (for most zones); Industrial: 15% of site landscaped (for most zones); Parking lots: one tree for every 120 square feet of required landscaping. Chapters 33.248.020 and 33.266.130.*

Objective: Investigate and develop new techniques that provide better growing conditions.

- Use structural soils to improve growing conditions.
- Provide extra protection for newly planted trees including curbs or protective barriers where necessary.

Goal - Protect the urban forest from pests and diseases.

The objectives and performance measures listed in the Residential ULE apply to this ULE.

NATURAL AREAS AND STREAM CORRIDORS

Undeveloped public and private natural areas, includes environmental zones.

Natural areas and stream corridors

DESCRIPTION

For purposes of this document, a natural area is defined as "a landscape unit composed of plant and animal communities, water bodies, soil and rock, largely devoid of human-made structures." Lands in this ULE are publicly or privately owned and include significant natural resources. Environmental overlay zones cover many of these areas.[80] This ULE includes wetlands and meadows as well as a variety of forested areas. Understory plants are as important as overall tree canopy in this ULE.

Very few, if any, of these areas are remnants of the pre-settlement landscape. Most are disturbed lands that have grown back over time, or that have been revegetated. All provide important wildlife refuges or fisheries habitat. Many natural areas and parks are linked by the 40-Mile Loop, a 140-mile trail system in and around the city.

In the other ULEs, trees are considered as individual specimen trees. In this ULE, they are elements of an interrelated ecosystem and need to be managed accordingly.

Property Owners, Managers and Principal Partners

Owner/Manager	Acres*	Primary Activities
PP&R - Natural Resources	7,300	Habitat protection and enhancement of natural areas
BES	500	Water quality improvement; stormwater mitigation; revegetation program on public and private land, flood management and storage; partners for PP&R's natural areas
Metro	2,000	Habitat protection and enhancement
Oregon State Parks (Tryon Creek)	650	Habitat protection and enhancement
Private Property Owners	4,050	Protecting environmental zones

[80] *Environmental Zones are overlay zones that protect more than 19,000 acres of environmentally sensitive areas in Portland — including wetlands, upland forests, steep slopes and areas along streams. Development is regulated in these zones.*

Additional Partners Role	
ESA Program	Ensures that City activities comply with ESA obligations and regulations
FOT	Habitat restoration on public and private lands
Fire and Rescue	Reduce fire threats in areas of urban/ wildland interface
BOP	Healthy Portland Streams — environmental zones
BDS	Regulations, enforcement of environmental zoning code
PP&R - Urban Forestry Program	Regulates trees planted or removed on public lands and in rights-of-way; places large wood in restoration stream sites
Watershed Councils	Advise on management of particular watersheds
PP&R - Horticulture Services	Restoration activities
Land Trusts	Assist in acquiring and protecting natural resources
Friends Groups	Assist in acquiring and protecting natural resources

*These numbers are *very rough estimates*, gleaned from a variety of sources, and are only *general indications* of the distribution of land in this ULE.

ANALYSIS

Strengths

- Many of the City's natural areas are in public ownership, where it is often easier for government agencies to restore natural functions than on private lands.
- Much of Portland's urban forest canopy is in the forested natural resource areas.[81]
- Resource agencies have high levels of awareness of the ecological value of natural areas.
- Public interest in participating in restoration efforts is increasing. Organizations like Friends of Trees and others organize and coordinate volunteer projects and stewardship activities.
- Planting in natural areas is relatively inexpensive and has a high benefit- to-cost ratio.[82]

Weaknesses

- There is lack of clarity about the different roles and responsibilities of various bureaus.
- Follow-up maintenance for planting and revegetation projects is inconsistent or lacking.
- Management techniques for natural areas are not standardized.

Courtesy Pat Breen, OSU

Common ninebark (Physocarpus opulifolius)

[81] *McPherson et al. (1993), p. 25.*
[82] *McPherson et al. (1993), p. 85.*

- It is difficult to evaluate progress over time because of lack of performance measures, as well as lack of staff to monitor and measure change.

Opportunities

- Providing better information to private property owners may help restore natural areas on their property.
- Volunteers are available and eager to improve or restore publicly owned natural areas.
- Active management such as eliminating non-natives, and planting and maintaining appropriate natives can restore natural areas.
- Some ecosystem interventions such as thinning dense stands, changing plant communities or altering hydrology can restore ecosystems and improve habitat and overall urban forest health.

Threats

- Invasive non-native species seriously threaten most natural areas. Species such as English ivy, wild clematis, blackberries, and Scot's broom have out-competed native plant species in many areas.
- Some natural areas are at high-risk for wildfires (caused naturally and by humans), threatening resources and nearby residential areas.
- Inappropriate uses such as illegal camping, dumping and disposing of yard debris in and around natural areas threatens and disturbs both flora and fauna.
- Some privately owned open spaces function as natural areas but are not protected from development or invasive non-native species.

English ivy smothering native plants

ISSUES

- The need for people to have access to publicly owned natural areas often conflicts with the need to protect natural areas from human disturbance.

- Differences of opinion exist about the desired future condition and appropriate management of natural areas, e.g. thinning of trees in dense stands.

- Some identified City regulations and goals are in conflict with each other, e.g. increasing tree canopy competes with clearing for scenic view protection. Title 33 environmental zone regulations do not always recognize other Bureau of Planning regulations and goals.

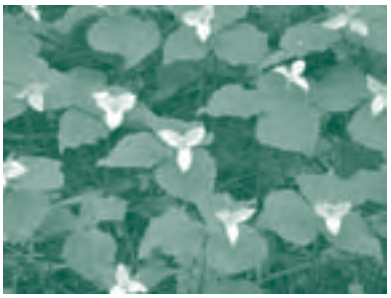
- Best management practices (BMP's) for street trees and individual public trees differ from BMP's for trees in natural areas. Regulations

that were developed for street trees and specimen trees in parks and other public areas are applied to trees in publicly-owned environmental zones.[83] The result is duplication of permits and occasional conflicts in code requirements.

- Changing or modifying established active uses in order to restore or protect the resource is sometimes difficult.

GOALS, OBJECTIVES AND PERFORMANCE MEASURES

Urban forest management in this ULE focuses on the health of systems rather than on individual trees. Note: Not every objective has a specific performance measure.[84]



Trillium

Goal - Maintain and restore healthy habitats.
Protect and enhance healthy natural areas dominated by native species and restore areas that are primarily dominated by non-natives.

Objective: Control invasive non-native plants.
Non-native species such as English ivy, Himalayan blackberry, wild clematis and Scot's broom are highly invasive, and a rapidly growing problem. Since control of non-native species is a developing management regime, it is difficult to set a specific target for this objective. However, the following actions are important.

- Map the extent and severity of the problem to develop benchmarks for future evaluations and to prioritize removal and restoration projects.
- Determine target percentages of cover of non-native species that will be managed in selected habitat areas.
- Protect areas without invasive species from encroachment.

Objective: Increase structural and species diversity.
Greater structural diversity — multiple layers of canopy, shrubs and groundcover — provides more habitat opportunities for wildlife. Structural diversity is achieved through species and age diversity.

- Assess areas where multiple layers are appropriate and plant accordingly.

Objective: Leave as much dead wood and large wood in place as possible.
Large wood is beneficial for habitat restoration in streams and along stream banks and in healthy forests. The role and management of large wood may vary from one area to another.

[83] *Chapter 20.40 of the City Code regulates street trees and other public trees. Chapter 33.430 regulates environmental overlay zones.*
[84] *The City of Portland's Framework for Integrated Watershed Management Plan (the Framework) has goals, indicators, and targets that are applicable to portions of this ULE.*

- Leave all dead wood in place unless it poses hazards such as increased flooding or fuel loading for fire. Monitor effects to prevent unwanted flooding or hazards.
- Place large wood where recruitment is not sufficient or in areas where it has been removed.
- Stockpile large wood for use in appropriate areas.

Courtesy Pat Breen, Oregon State University

Salal (Gualtheria shallon)

Objective: Use ecosystem management principles to manage natural areas and stream corridors.

Ecosystem management principles[85] provide best management practices for this ULE. This management allows these areas to be self-sustaining and to perpetuate their natural conditions as much as possible.

- Develop ecosystem management plans and monitoring for all city-owned natural areas.
- Work with other natural resource management groups to ensure consistent plans and policies.

Objective: Establish a Natural Areas Work Group to coordinate projects.

Include representatives of appropriate bureaus, agencies and groups to meet regularly to discuss and agree on appropriate projects and methods to expedite work and results.

- Develop long-term, follow-up maintenance plans for each planting and revegetation project.
- Evaluate structure, threats, human impacts, presence of invasive non-natives, species that are regenerating and overall functional level for each habitat type.
- Work with Metro in the development of their Fish and Wildlife Habitat Protection Plan.
- Look at ways to eliminate duplication of permits and conflicts in code requirements that govern trees and vegetation in environmental overlay zones.

Objective: Increase the effective size and stability of natural areas.

Larger ecosystems can sustain larger and more diverse populations of plants and wildlife.

- Acquire important privately-owned lands or enter into permanent conservation easements with property owners.
- Connect small natural areas to form larger ecological units.

Objective: Educate the general public about the values, benefits and management of natural areas.

Education is an effective tool to promote stewardship and assist property owners in restoring natural areas.

[85]*Ecosystem Management is based on an adaptive management cycle of inventory, statement of desired future condition, assessment, prescription, intervention and monitoring.*

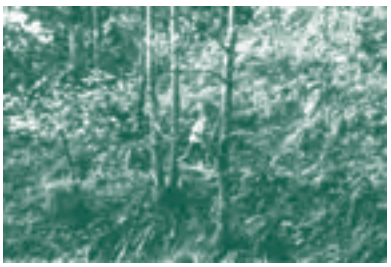
- Build on existing programs to develop better information about the value of natural areas for property owners, and ways to maintain and restore natural areas.
- Expand and develop new public and private partnerships with schools and friends groups to enhance stewardship of natural areas.

Goal - Improve water quality and provide flow control in streams.
Natural areas provide important natural filtering and infiltration, cooling of surface water and recharge of ground water. Management activities that improve ecological health also improve water quality.

Objective: Provide canopy cover throughout Portland's watersheds.
Chinook and steelhead require cold water to survive. The urban forest helps to mitigate the "urban heat island" effect that results from solar energy absorbed by pavement and roofing and transferred to streams by stormwater runoff.[86] Shade in all parts of the watershed helps to lower water temperatures and provides better habitat that aids in the recovery of the ESA-listed salmonids.

Performance Measure - Use targets set by the City's Framework Plan and watershed plans.
- Provide shade along streams and in other critical areas.

Objective: Increase riparian[87] vegetation.
Riparian vegetation provides food and habitat while preventing erosion and sedimentation of the stream. The amount of shade that should be provided will vary between streams and between watersheds. (See specific BES watershed plans for additional guidelines.) Trees also help filter pollutants and reduce stormwater runoff — further enhancing water quality and the livability of streams.[88]


Nature-based recreation

Performance Measure - Use targets set by the City's Framework Plan and watershed plans.
- Continue to plant and restore riparian areas.

Goal - Ensure public safety from potential wildfires.
Under certain conditions, some natural areas are at risk for fire — both natural and human caused. Management can improve the condition of the natural area and improve public safety.

[86] *These heat islands are generally six to eight degrees hotter than the rural areas surrounding them.*
[87] *Riparian: Areas adjacent to rivers, streams, lakes, ponds, and other water bodies. They are transitional between aquatic and upland zones, and as such, contain elements of both aquatic and terrestrial ecosystems.*
[88] *"Portland's Urban Forestry Program: Endangered Species" brochure has information on the relationship between endangered species and the urban forest.*

Objective: Reduce fire hazards near homes and structures.

- Adopt an Urban Wildfire Hazard Plan.
- Encourage the use of fire-resistant native plants in areas near structures and habitation.

Goal - Provide appropriate nature-based recreation.

Natural areas provide opportunities for hiking, wildlife watching and environmental education.

Objective: Include appropriate recreation that is compatible with restoring and improving water and air quality and providing healthy fish and wildlife habitat.

- Protect the resource and its functions while allowing compatible recreation opportunities and facilities.
- Establish appropriate levels of recreation for specific areas. Limit use to designated areas.

TRANSPORTATION CORRIDORS AND RIGHTS-OF-WAY

Major highways, local commercial streets, light rail rights-of-way, median strips and large interchanges, neighborhood and residential streets, bike paths and pedestrian trails.

DESCRIPTION

Transportation corridors

This ULE includes transportation uses from major highways to pedestrian paths. These public rights-of-way (ROW) accommodate automobiles, trucks, transit, pedestrians and bicycles, and include utility corridors. Increasingly, these areas are planted and modified to perform stormwater management and water quality functions to reduce the volume of water in pipes and cool water before it reaches the streams and rivers.

It is difficult to obtain definitive numbers on the size of this ULE, but estimates can be made based on the following information. Portland's Office of Transportation is responsible for 3,686 lane miles of improved public roads, 132 lane miles of gravel roads and 2,100 miles of sidewalk. Using 14' for a lane width and assuming 4' for an average sidewalk, those add up to approximately 6,480 acres of paved streets and 1,020 acres of sidewalks. The Oregon Department of Transportation is responsible for about 1,210 acres of freeways and major roads in the city. This adds up to at least 8,700 acres of impervious surface or 10% of the city land base and is probably a conservative number. The Stormwater Advisory Committee estimates that 18% of the city is covered by street surfaces.[89] Hundreds of acres of impervious surface exist in other areas of the city — from large parking lots to the thousands of buildings.

The street trees and other landscaping in these rights-of-way are key elements of the city's green infrastructure and a highly visible and valuable component of the urban forest. Trees along the transportation corridors are vital to maintaining attractive neighborhoods and livable communities. Presently, there are estimated to be 200,000 street trees on the streets of Portland, with room for 150,000 more. There are no estimates available for the amount of unpaved right-of-way that is or could be planted.

Property Owners, Managers and Principal Partners

Owner/Manager	Primary Activities
Private Property Owners	Street tree care and maintenance
PDOT/ODOT	Planting street trees
PDOT Bureau of Maintenance	Street and rights-of-way maintenance
Private utilities	Tree canopy pruning for line clearance

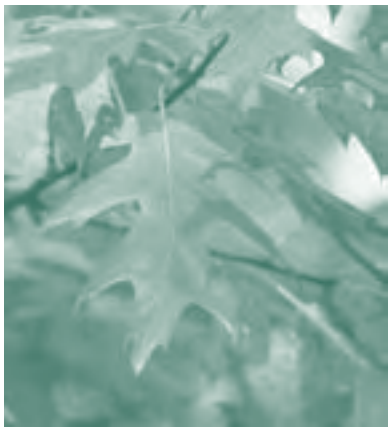
[89]*Status Report to Council, June, 2002.*

Additional Partners	Role
OSD	Air quality
BES	Water quality improvement; stormwater mitigation, pipeline mitigation
FOT	Tree planting
PP&R - Urban Forestry Program	Regulations and enforcement (permitting of street trees)
Metro	Green Streets Program

ANALYSIS

Strengths

- Many streets are well-treed, and the trees are well cared for.
- Utility companies provide consistent, high-quality care for the trees under their power lines.
- Street trees create desirable environments and contribute to the character of neighborhoods.[90]
- PDOT's Bureau of Maintenance produces compost certified for use in organic gardens at their leaf composting facility.
- Metro's Green Streets guidelines provide information that links land use, transportation and natural resource protection.



Courtesy Pat Breen, Oregon State University

Northern Red Oak (Quercus rubra)

Weaknesses

- Some areas have little species or age diversity among their street trees.
- Some trees are over mature or have outgrown their planting spaces.
- Many street trees receive minimal care because private property owners are unaware that they are responsible for them.
- Some contractors have problems finding trees of the size and species to meet the development standards for street trees.
- Leaf removal is considered a nuisance by many property owners and is costly for the City. The City only assists in leaf removal in those neighborhoods with a high concentration of mature street trees.
- Street trees often need to be replaced more frequently because they endure harsher growing conditions and do not usually live as long as trees in other areas.
- Tree roots can damage sidewalks and may affect drain pipes. The City is responsible for repairs to the street and the curb. Property owners are responsible for repairs from the curb to the house side of the sidewalk.

Opportunities

- Coordinate the use of street trees for multiple purposes — shading, stormwater management, traffic control and others.

[90] *Portland Pedestrian Design Guidelines, June 1998. Plantings and street trees should create desirable microclimates and contribute to psychological and visual comfort of sidewalk users.*

- Street trees and vegetation in rights-of-way can reduce the need for major capital projects, e.g., trees retain water so sewer pipelines may be reduced in size.
- New technology such as structural soils can provide larger root zones and better growing conditions.
- Many large areas such as interchanges and large medians are available to be planted.

Threats

- Room for street trees in the ROW is limited by the need to accommodate other elements.[91]
- Vandalism, including topping or girdling of trees, can be a problem.
- Reduced gas taxes have severely reduced care for over 400 publicly owned Transportation Landscapes.[92] Many of these areas provide significant canopy and landscaping and are important neighborhood assets.
- The requirement for planting street trees as a condition of development is often avoided due to limited inspection and enforcement abilities, especially in residential areas.

ISSUES

"Develop incentives for good urban forest care."

- Native tree species are desirable but not necessarily appropriate as street trees. Although they are adapted to the local climate, they are not necessarily adapted to the harsh conditions found along city streets.

- Some non-native street trees may naturalize and displace natives in natural areas.

- The cost of street area landscape maintenance is increasing and funds are decreasing, or non-existent. Since funding for a proactive program is not available, maintenance is largely reactive.

- The cost of maintaining street trees and repairing unintended damage to sidewalks and drain pipes is a burden for many property owners.

GOALS, OBJECTIVES AND PERFORMANCE MEASURES

Urban forest management in this ULE focuses on improving the health of individual trees, adding street tree canopy and educating property owners about street tree care and maintenance. Note: Not every objective has a specific performance measure.

[91] *Other ROW elements include pavement, sidewalks, furnishings, traffic signals and lights, meters, driveways, utility poles, signs, shelters, vaults and utilities.*
[92] *These include boulevards, traffic islands and other elements.*

Goal - Provide the benefits of street trees to all residents.
Healthy and abundant street trees improve the quality of life for residents and visitors.

Objective: Increase street tree canopy in all areas.
Increased tree canopy offers multiple benefits to residents and travelers. Greg McPherson (Researcher, USDA Forest Service) concludes that 25% street tree canopy cover is a reasonable standard once the first generation of street trees begins to die and be replaced. Fifty-percent coverage by the first generation of street trees at maturity is a desirable goal.[93]

Performance Measure - Canopy Cover
35% canopy cover

- Plant trees that are long-lived and have large canopies at maturity where possible.
- Use native trees as street trees in appropriate areas, especially in larger planting areas near natural areas and stream corridors.
- Work with growers to obtain desired size and species of trees for particular street improvements.
- Plant appropriate numbers and species of trees in all available street tree spaces.

Objective: Increase the stocking level for street trees.
Stocking level is the percent of available planting spaces for street trees. The available spaces are limited to areas where street trees will not interfere with driveways, signs or intersections.[94]

Portland's present stocking level is estimated to be from 40%-60%.[95] Recommendations for stocking level range from 60%-90% of available locations.[96]

[93]*USDA Northeastern Area (1993), p. 31, also recommends 50% coverage.*
[94]*PP&R Urban Forestry Tree Location Guidelines specify the following: 20' or more from other trees; 25' from intersection; 20' from stop/yield signs; 5' from fire hydrants; 7' from driveways and alleys; 10' from directional traffic signs; 2' from property lines; 15'-25' from street lights; 5' above sewers or other utilities.*
[95]*Portland's Urban Forestry Coordinator and City Forester estimate that 3,200-3,700 street trees are planted annually from a variety of sources. Friends of Trees has been a major contributor to the planting of street trees, and it is estimated that this group planted 7,500 street trees between 1996 and 2000 as part of the "Seed the Future Campaign."*
[96]*Syracuse, NY's Master Plan calls for a stocking level of 60%; Phil Hoefer, retired Urban and Community Forestry Coordinator for Colorado, recommends 75%; Davey Resource Group recommends 97-98%.*

Performance Measure - Stocking Level

Increase the stocking level of street trees to 100% of available locations.[97]

- Plant long-lived trees.
- Increase stocking levels by 10% in the next 10 years and 20% within the next 20 years.
- Plant appropriate species in all available street tree locations. Since planting strip widths vary from 2.5 to more than 10 feet, they can accommodate a wide variety of species.
- Develop covenants that require street trees to be planted as conditions of approval for development.

Performance Measure - Planting versus Removal of Street Trees

Maintain a planting to removal ratio of at least 2:1.[98]

- Plant two trees for every tree removed.

Objective: Provide adequate rights-of-way that have sufficient room for street trees.

Rights-of-way must accommodate many functions — vehicular traffic, cyclists, pedestrians, stormwater functions, street furnishings and trees.

- Create a Transportation Corridor Work Group to coordinate and address different bureaus' needs and concerns.
- Use PDOT's Transportation System Plan recommendations to redesign or enlarge some ROWs to better accommodate all needs and uses.[99]
- Increase minimum planting strip sizes to at least 4 feet to better accommodate tree needs. Provide large tree wells and 'bulb out' areas where feasible.
- Use structural soils[100] to improve growing conditions for street trees.
- Manage street trees to ensure good sight lines and clearance for traffic, street lights, traffic signals and signs.
- In areas of new construction or large redevelopment, encourage utility companies to install underground lines, as long as

Courtesy Pat Breen, Oregon State University

Sargent cherry (Prunus sargentii 'Columnaris')

[97] *The Northwest Industrial Area has a stocking level of approximately 46%, Cathedral Park is approximately 49% stocked and Irvington's stocking level is about 72%. These inventories have also shown that overplanting (40-50%) of Acer and Prunus species is common. (Poracsky (1999) and Poracsky and Scott (1999)). Phyllis Reynolds, author of "Trees of Greater Portland" has conducted an inventory of the "significant" trees in Irvington.*

[98] *With the goal of increasing the stocking level, this ratio needs to be greater than 1:1. The City of Salem has a policy of planting two trees per one removed. Portland's City Forester feels that this is a reasonable goal.*

[99] *The Stormwater Advisory Committee will be discussing stormwater management approaches for transportation ROWs starting in September 2002 and providing recommendations to City Council.*

[100] *Structural Soil/Engineered Soil: Specially mixed and graded fill soil intended to serve a particular purpose such as combining structural support for vehicles with a favorable root zone for street trees. Dell, Owen, "The New Watershed: Section 6. Glossary." County Landscape and Design. http://www.owendell.com/watershed6.html#engin*

they are not in the planting strip. In all areas, whether underground or overhead, encourage utility companies to bundle utility lines to leave as much room as possible for trees above and below ground.

Well maintained street trees

Objective: Maintain healthy street trees that are appropriate for their location.

Healthy trees are less likely to pose hazards from breakage due to weak limbs and poor condition.

- Select tree species that are appropriate for particular locations. Consider branching height, possible litter from leaves, seed and fruit and other elements that can affect the safety of the general public. Contact the City Forester for the required permit and assistance in selecting an appropriate tree(s).
- Replace over-mature trees with appropriate species for the size of planting area.
- Educate the public about reporting possible tree hazards to the appropriate agencies.

Goal - Provide the benefits of the urban forest in a highly developed environment.

Street trees are very important elements of this ULE. They reduce the heat island effect from large amounts of pavement, reduce volumes of stormwater and improve water and air quality.

Objective: Provide equitable distribution of street trees throughout the city.

Street trees provide important benefits to residents and give neighborhoods a sense of place.

- Inventory the location, species, size and health of street trees and available planting spaces.
- Ensure that developers plant required street trees.

Goal - Comprehensive and consistent care of street trees throughout the city.

Street trees in some areas are well cared for, but good care in other areas is limited or non-existent. Street trees in poor condition or in the wrong location can be hazardous.

Objective: Educate property owners about their responsibilities for the care of street trees.

Knowledgeable property owners provide better care and maintenance and act as stewards for trees in their neighborhood.

- Provide information about best management practices for tree planting, preservation and care.
- Expand partnerships with other bureaus and agencies to educate property owners about their responsibilities for the planting, care and maintenance of street trees.
- Encourage the use of large canopy trees in appropriate areas.

- Educate the public about the choices available for trees.
- Encourage the use of native trees and vegetation in appropriate areas.
- Provide stable funding for the Neighborhood Tree Liaison program.

Objective: Explore the possibilities of the City managing all street trees.

City management and care of street trees would ensure equitable distribution and better health of street trees. Since trees are a benefit to all, costs to maintain them should be shared by all.

- Evaluate the pros and cons of the City taking over the care and management of all street trees. Investigate funding options for this.
- Look into various funding strategies, including a front foot assessment that would allow the City to contract the care of street trees. Care would include installation, inspection, pruning, removal and leaf pickup.
- Develop adequate funding to maintain city-owned street landscapes.

Goal - Protect the urban forest from pests and diseases.

The objectives and performance measures listed in the Residential ULE apply to this ULE.

DEVELOPED PARKS AND OPEN SPACES

Public parks and open spaces with developed recreation, highly structured or programmed areas, public and private golf courses, common open spaces — excluding natural areas. (See Natural Areas and Stream Corridors ULE).

Developed park

DESCRIPTION

This ULE includes the active recreation and developed areas in Portland's parks, gardens and open spaces, as well as passive recreation areas that are *outside* the natural areas (see Natural Areas ULE). These areas include a wide variety of trees and vegetation — garden areas with a wealth of plants, passive use areas with lawns and large mature trees and open grassed sports fields. Lands in this ULE are generally publicly owned and may require high maintenance.

Property Owners, Managers and Principal Partners

Owner/Manager	**Acres***	**Primary Activities**
PP&R - Districts & Operations and Urban Forestry Program	2,800	General vegetation maintenance; tree care; planting of additional trees and management activities
Private and Metro Golf Courses	1,200	General vegetation maintenance
Additional Partners	**Role**	
BES	Water quality improvement; stormwater mitigation	
FOT	Tree planting	
BOP	Healthy Portland Streams — environmental zones	
BDS/UF	Regulations and enforcement	
ESA Program	Limited assistance in habitat restoration	

*These numbers are *very rough estimates*, gleaned from a variety of sources, and are only *general indications* of the distribution of land in this ULE.

ANALYSIS

Strengths

- Many park and open space areas have beautiful, large, mature trees.
- Many areas are well landscaped with a wide variety of plants.
- A rich variety of public gardens showcases a diversity of plants.
- Developed parks are generally well-stocked with trees.[101]

Weaknesses

- Some trees in older parks are over-mature and in declining health. Without adequate staff and resources they may not be discovered and remedied.

[101] *McPherson et al. (1993), p. 84.*

- Tree maintenance is done on a reactive basis, often crisis-based and limited to the most actively used areas.
- Tree replacement is not keeping up with tree removal.
- Pre-existing conditions in some areas include large parking lots in parks without trees or vegetation.

Opportunities
- Some areas presently maintained as rough grass could be planted with trees and vegetation.
- There are many planting areas suitable for trees that reach large sizes at maturity.
- Many areas are available to showcase the wide variety of plants that can be grown in Portland's climate.

Threats
- Funding to maintain developed parks is limited and declining.
- Disease threatens older stands of trees.
- Some people top or kill trees on private and public properties to achieve scenic views.

ISSUES

Balancing the different roles of trees in these limited areas can be difficult, e.g., aesthetics versus functions, natives versus ornamentals, and maintaining open areas for active recreation versus planting additional trees.

GOALS, OBJECTIVES AND PERFORMANCE MEASURES

Urban forest management in this ULE focuses primarily on providing trees to enhance human comfort, improving the health of individual trees and adding to the urban forest in appropriate places. Note: Not every objective has a specific performance measure.

Trees enhance developed parks

Goal - Provide urban forest benefits that enhance high quality recreation experiences.

Use trees and vegetation to add beauty, shade, cooling and shelter near programmed/active and unprogrammed/passive recreation areas.

Objective: Provide canopied areas around large open recreational spaces in developed parks.

Canopy cover will vary greatly in developed parks since each developed park has very different conditions and needs.

This objective takes into account the need for active recreation areas such as sports fields and courts, community centers and pools — all of which inhibit canopy cover. In some highly developed areas, a goal of 15%-25% canopy cover, similar to industrial/institutional areas is probably appropriate. In other developed parks such

as the Park Blocks, a much higher canopy cover — probably over 50% in many cases — is appropriate.

Performance Measure - Canopy cover[102]
30% overall canopy cover

Objective: Maintain existing canopy cover and increase it in appropriate areas.
To maintain the current canopy level, each tree removed should be replaced. To increase the canopy cover level, increase the ratio or replace with species that are larger at maturity. If a tree is removed to make room for a new facility during the tree's prime years, it should be replaced on an inch-per-inch basis to attempt to achieve the same benefits. It may be necessary to find planting opportunities in other ULEs to meet the overall goal.

Performance Measure - Planting versus Removal of Trees
Maintain a planting-to-removal ratio of at least 1:1 and replace trees on an inch-per-inch basis when a tree is removed.

- Develop a plan to maintain stands of large trees — particularly stands of Douglas fir and other evergreens.
- Use large native trees in appropriate areas.

Objective: Maintain the history, design, integrity and functional use of developed parks.
Most of Portland's parks have been professionally designed and many — like the Park Blocks and Laurelhurst Park — have historically significant plantings and features.

- Preserve these features and plantings when replacing trees or redesigning elements of the parks.

***Objective*: Improve parking lots in this ULE to meet current standards.**
Added vegetation will improve water quality, stormwater management and the aesthetics of all parking lots.

- Bring all parking lots up to current landscape and stormwater management standards. [103]

[102] *Canopy cover is the proportion of an area, when viewed from above, that is occupied by tree crowns. Canopy cover is a good overall indicator of the quantity and health of the urban forest. It includes both public and private trees and provides a general picture of the urban forest. Canopy cover can be estimated using satellite images, aerial photographs and ground sampling. Canopy cover goals were derived from research on recommendations and existing canopy assessments (see Chapter Two and the Appendix).*

[103] *The new Parking Lot ordinance allows the planting of smaller trees to satisfy the landscape requirement if the trees are included on the Parking Lot Tree List. See Appendix for information.*

Goal - Ensure public safety.
Dead and/or decaying trees can pose hazards to the general public, especially in high use areas and along trails.

Objective: Organize and coordinate tree maintenance.
Systematic maintenance will reduce hazardous situations.

- Develop a plan for each developed park that includes tree replacement and additional tree plantings. Include residents in the preparation of these plans.
- Ensure adequate staff and resources to inspect and maintain trees in high use areas.

Goal - Protect the urban forest from pests and diseases.
The objectives and performance measures listed in the Residential ULE apply to this ULE.

Acronyms

Following are acronyms used throughout this document.

BDS	Bureau of Development Services
BES	Bureau of Environmental Services
BOP	Bureau of Planning
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CO_2	Carbon Dioxide
CSO	Combined Sewer Overflows
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Oregon)
EPA	Environmental Protection Agency (U.S.)
ESA	Endangered Species Act
FOT	Friends of Trees
IPM	Integrated Pest Management
LEED	Leadership in Energy and Environmental Design (Green Building Rating System)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NR	Natural Resources Program (Portland Parks & Recreation)
ODOT	Oregon Department of Transportation
OSD	Office of Sustainable Development
PDC	Portland Development Commission
PDOT	Portland Department of Transportation
PGE	Portland General Electric
PP&L	Pacific Power and Light
PP&R	Portland Parks & Recreation
PPS	Portland Public Schools
PSU	Portland State University
ROW	Right-of-Way
SWMM	Stormwater Management Manual
TMDL	Total Maximum Daily Load
TSP	Transportation Systems Plan
UF	Urban Forestry Program (Portland Parks & Recreation)
UFC	Urban Forestry Commission
UFMP	Urban Forestry Management Plan
UGB	Urban Growth Boundary
ULE	Urban Land Environment
USDA	U.S. Department of Agriculture

Glossary

Following are definitions of terms used throughout this document.

Canopy Cover: The area directly beneath the crown and within the dripline of a tree or shrub. The crown consists of the above ground branches, stems and leaves.[104] Canopy cover is a good overall indicator of the quantity and health of the urban forest. It includes both public and private trees and provides a general picture of the urban forest. Canopy cover can be estimated using satellite images, aerial photographs and/or ground sampling.

Commercial/Industrial/Institutional Urban Land Environment: Landscape unit that includes urban and neighborhood commercial areas, malls, manufacturing and warehousing areas, industrial and wholesale sales, industrial parks, quasi-public areas such as schools and colleges, religious institutions and government facilities.

Cultivar: A cultivated variety of strain of a plant produced by horticultural techniques that is clearly distinguishable from others by one or more characteristics and that when reproduced retains its distinguishing characteristics. In the United States, *variety* is considered to be synonymous with *cultivar* (derived from 'cultivated variety'). A cultivar name is written after the Latin name, usually marked by single quotation marks, as in *Zinnia elegans* 'Tom Thumb.'[105]

Developed Parks and Open Spaces Urban Land Environment: Landscape unit that includes public parks and open spaces with developed recreation, highly structured or programmed areas, golf courses and common open spaces — excluding natural areas.

Environmental Zones: Overlay zones that protect more than 19,000 acres of environmentally sensitive areas in Portland. These areas are typically wetlands, upland forests, steep slopes and areas along streams. Development is regulated in these zones.[106]

Fish and Wildlife Habitat Areas: Lands that contain significant food, water or cover for native terrestrial and aquatic species of animals. Examples include forests, fields, riparian areas, wetlands and water bodies.

Flood Plain: A level, low-lying area adjacent to streams or rivers that is periodically flooded by stream water. It includes lands at the same elevation as areas with evidence of moving water, such as active or inactive flood channels, recent fluvial soils, sediment on the ground surface or in tree bark, rafted debris and tree scarring.[107]

Functional Values: Benefits provided by resources. The functional value may be physical, aesthetic, scenic, educational or some other nonphysical function, or a combination of these. For example, the functional values of a wetland could be its ability to provide stormwater detention and its ability to provide food and shelter for migrating waterfowl. An unusual native species of

[104] *Portland City Code Chapter 33.900.010.*
[105] *UNEP World Conservation Forest Monitoring Centre, "Glossary of Biodiversity Terms." http://www.unep-wcmc.org/reception/glossaryA-E.htm and The Chicago Botanic Garden, "Illinois Best Plants: Glossary." http://bestplants.chicagobotanic.org/glossary.htm*
[106] *City of Portland Bureau of Planning, "Healthy Portland Streams: What are Environmental Overlay Zones?" http://www.planning.ci.portland.or.us/cp_hps_regs.html*
[107] *British Columbia Ministry of Forests, "Glossary of Forest Terms." http://www.for.gov.bc.ca/pab/publctns/glossary/glossary.htm*

plant in a natural resource area could have educational, heritage and scientific functional values. Most natural resources have many functional values.[108]

Green-frastructure: An interconnected system of urban forest, streams, rivers, wetlands, natural areas and neighborhood parks inside urban areas.

Green Streets: Streets that integrate land uses, transportation and natural resources to improve the region's water quality by incorporating stormwater treatment within the right-of-way.

Greenways: Corridors of protected public and private land established along rivers, stream valleys, ridges, abandoned railroad corridors, utility rights-of-way, canals, scenic roads or other linear features. Greenways link recreational, cultural and natural features, provide pathways for people and wildlife, protect forests, wetlands and grasslands and improve the quality of life for everyone.[109]

Hazard Tree: A tree that is in an area frequented by people or is located adjacent to valuable facilities and has defects in roots, stem or branches that may cause a failure resulting in property damage or personal injury.[110]

Heritage Trees: Trees within the City which, because of their age, size, type, historical association or horticultural value, are of special importance to the City. No tree standing on private property shall be designated a "Heritage Tree" without the consent of the property owner; however, the consent of a property owner shall bind all successors, heirs and assigns.

Invasive Species: An alien plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health.[111]

Naturescaping: Landscaping that allows people and nature to coexist by incorporating native plants into landscape design to attract insects, birds and other creatures and to help keep rivers and streams healthy.[112]

Natural Area: A landscape unit composed of plant and animal communities, water bodies, soil and rock, and which is largely devoid of human-made structures.

Natural Areas Urban Land Environment: A landscape unit composed of plant and animal communities, water bodies, soil and rock, largely devoid of human-made structures. Lands in this ULE are publicly or privately owned and include significant natural resources. Environmental overlay zones cover many of these areas.[113] This ULE includes wetlands and meadows as well as a variety of forested areas.

[108] *Portland City Code Chapter 33.900.010.*
[109] *The Conservation Fund, "American Greenways Program: Creating Conservation Connections." http://www.conservationfund.org/?article=2471&back=true*
[110] *USDA Forest Service Northeastern Area, "Hazard Tree Definitions." http://www.na.fs.fed.us/spfo/hazard/defin.htm*
[111] *US Department of Transportation Federal Highway Administration, "What are Invasive Plant Species?" http://www.fhwa.dot.gov/environment/greenerroadsides/fal01p2.htm*
[112] *Portland Bureau of Environmental Services, "What is Naturescaping?" http://www.cleanrivers-pdx.org/get_involved/naturescaping.htm*
[113] *Environmental Zones are overlay zones that protect more than 19,000 acres of environmentally sensitive areas in Portland — including wetlands, upland forests, steep slopes and areas along streams. Development is regulated in these zones.*

Glossary

Planting Strip: The area between the roadway and the edge of a detached sidewalk. Planting strips can be continuous or individual tree wells within the right-of-way's furnishing zone — the area where elements such as street trees, poles, parking meters and street furniture are found and which buffers pedestrians from the roadway.

Right-of-Way (ROW): An area that allows for the passage of people or goods including freeways, pedestrian connections, alleys and all streets; that portion of land that is dedicated for public use including pedestrians, bicycles, vehicles and transit, utility placement and signage.[114] In the case of street trees, the City maintains the street, the property owner maintains the area behind the curb including the sidewalk and street trees.

Riparian Areas: Lands which are adjacent to rivers, streams, lakes, ponds and other water bodies. They are transitional between aquatic and upland zones, and as such, contain elements of both aquatic and terrestrial ecosystems. They have high water tables because of their close proximity to aquatic systems, soils that are usually made up largely of water-carried sediments and some vegetation that requires free (unbound) water or conditions that are more moist than normal.[115]

Street Trees: Trees growing in the public rights-of-way usually within the planting strip or in tree wells between the curb and sidewalk.

Stocking Level: The percent of available spaces for street trees that are currently planted. The available spaces do not include spaces where street trees would interfere with driveways, signs, intersections, etc.

Stormwater: Water runoff, originating as precipitation on a particular site, basin or watershed.[116]

Structural Soil: Specially mixed and graded fill soil intended to serve a particular purpose such as combining structural support for vehicles with a favorable root zone for street trees.[117]

Transportation Corridors and Rights-of-Way Urban Land Environment: Land used as major highways, local commercial streets, light rail rights-of-way, median strips and large interchanges, neighborhood and residential streets, bike paths and pedestrian trails.

Understory: Plants growing under the canopy formed by other plants, particularly herbaceous and shrub vegetation under a tree canopy.[118]

Uplands: Lands not characterized by the presence of riparian areas, water bodies, or wetlands.

Urban Forest: The complex system of trees and smaller plants, associated organisms, soil, water, air and people in and around human settlements ranging from rural communities to densely populated metropolitan areas.

[114] *Portland City Code Chapter 33.900.010.*
[115] *Portland City Code Chapter 33.900.010.*
[116] *Portland Bureau of Environmental Services, "Stormwater Management Manual."*
[117] *Dell, Owen, "The New Watershed: Section 6. Glossary." County Landscape and Design. http://www.owendell.com/watershed6.html#engin*
[118] *British Columbia Ministry of Forests, "Glossary of Forest Terms." http://www.for.gov.bc.ca/pab/publctns/glossary/glossary.htm*

Glossary

Urban Land Environment (**ULE**)**:** A specified type of land use with particular physical characteristics and issues. The urban forest in each of the five ULEs defined in this plan provides a variety of benefits and serves different needs.

Watershed: The land area that drains into a stream, an area of land that contributes runoff to one specific delivery point. Large watersheds may be composed of several smaller "subsheds," each of which contributes runoff to different locations that ultimately combine at a common delivery point.[119]

Watershed Management: The process of planning, establishing measurable objectives, characterizing watershed conditions and analyzing, selecting, implementing and monitoring projects, programs and activities to achieve the following citywide watershed health goals:

- Protect and improve stream flow and hydrology.
- Protect, enhance and restore aquatic and terrestrial habitat.
- Protect and improve surface water and groundwater quality.
- Protect, enhance and restore target aquatic and terrestrial species and biological communi ties.[120]

Wetland: An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs and similar areas.[121]

[119]*Cumberland River Compact, "Glossary of Watershed Terms." http://www.cumberlandrivercompact.org/glossary.htm*
[120]*City of Portland. Framework for Integrated Management of Watershed and River Health, Internal and 1st Draft Review, November 2002.*
[121]*Portland City Code Chapter 33.900.010*

Appendices

1. **Additional Sources of Information**
   - Frequent Contacts
   - City Code
   - Metro's Livable Streets Program
   - Parking Lot Tree List
   - Recommended Street Tree Lists
   - Heritage Trees
   - Portland Plant List
   - Green Building Program and LEED Certification
2. **Urban Forestry Brochures**
3. **Community Education, Outreach Programs and Volunteer Opportunities**
4. **Past and Current Urban Forest Inventories**
5. **Performance Measurement and Canopy Cover Targets**
6. **Estimated Annual Costs and Benefits of Trees**
7. **Sustainable City Principles**
8. **Environmental Zoning Summary**
9. **Planning for Development in the Urban Forest**
10. **Landscaping for Wildlife Habitat**
11. **Planning Process for the UFMP**

Appendix 1: Additional Sources of Information

Frequent Contacts

Portland Parks & Recreation	503-823-2223	http://www.portlandparks.org
Urban Forestry	503-823-4489	http://www.portlandparks.org
Community Gardens	503-823-1612	http://www.portlandparks.org
Hoyt Arboretum	503-823-8733	http://www.hoytarboretum.org
Bureau of Maintenance	503-823-1700	http://trans.ci.portland.or.us
Bureau of Environmental Services	503-823-7740	http://cleanrivers~pdx.org
Portland General Electric	503-590-1454	http://portlandgeneral.com
Pacific Power & Light	888-221-7070	http://pacificpower.net

City Code

Portland's City Code is accessible online at: http://www.ordlink.com/codes/portland/index.htm or by contacting the City Auditor's office at: 503-823-4078.

Ordinances related to urban forestry include:

- Chapter 33.630 TREE PRESERVATION
  (Added by Ordinance 175965 and 176333, effective 7/1/02)
- Chapter 20.40 STREET TREE AND OTHER PUBLIC TREE REGULATIONS
  (Added by Ordinance 134330; New Chapter substituted by 159490; Mar. 12, 1987)
- Chapter 20.42 TREE CUTTING
  (Replaced by Ordinance No. 170775, effective Jan. 10, 1997)

Metro's Livable Streets Program

Streets are an important key to community livability. Metro's regional street design policies support implementation of the 2040 Growth Concept by linking the way a street is designed to the land uses it serves. A well-planned street system can help prevent congestion while encouraging walking, transit and bicycling. Good street design can promote community livability by emphasizing local travel needs and creating a safe, inviting space for community activity. Street design elements such as sidewalks, crosswalks, landscaped sidewalk buffers, bikeways, on-street parking, street trees, landscaping, street lighting, bus shelters, benches and corner curb extensions provide an environment that is not only attractive, but can slow traffic and encourage alternate forms of transportation.

Streets also can be designed to be "green." Features such as street trees, landscaped swales and special paving materials can be used to limit stormwater runoff. Limiting runoff helps protect stream habitat. Metro has developed a series of three handbooks to guide the development of green and livable streets. *Creating Livable Streets*, *Trees for Green Streets*, and *Green Streets* are available from Metro by calling (503) 797-1839. For more information see: http://www.metro-region.org/transpo/greenstreets/green_streets.html

Parking Lot Tree List

List of tree species and common names adopted by Ordinance 175341, February 14, 2001

Specific types of trees are recommended for use in parking lots. The recommended minimum clearance from the pavement provides guidance on the amount of planting space each tree needs

for good results. Comments included in the list provide guidance as to best applications of the different trees and additional information that may help in tree selection. Some species of trees are well suited to landscaped areas that will receive stormwater runoff, while others will not tolerate the additional moisture from runoff. This list is available from Urban Forestry at 503-823-4489.

Recommended Street Tree Lists
The Urban Forestry Program has lists of recommended street trees for developed planting strips by size and the presence of overhead wires and for undeveloped planting strips. These lists are available by calling the Urban Forestry Program at 503-823-4489, as are the free permits required for planting trees in the right-of-way.

Heritage Trees
Between 1973 and 1993, six trees were declared Historic Landmarks by City Council. In May of 1993 a Heritage Tree Ordinance was adopted to facilitate designating historic trees. The Urban Forestry Commission (UFC) has primary responsibility for this. Trees are recommended for Heritage Tree status based upon their condition, age, size, type, historical association and horticultural value. Those that meet the established criteria are presented to City Council for adoption. Nominations can be referred to PP&R's Urban Forestry program.

As of December 1, 2003, there were 251 Heritage Trees. They represent public trees (on the streets or in parks) and private trees. There is a link to the Heritage Tree Web Site with color photographs, maps and descriptions.[122] The *Portland Heritage Trees Through December 31, 2001 Second Edition* booklet, available from Portland Parks & Recreation, has a comprehensive list of these trees and tree tours in neighborhoods with particularly good specimens.

Portland Plant List
The Portland Plant List is an integral component of the City's natural resource protection program. Native plants on the list are required within the Environmental and Willamette River Greenway Zones; invasive or harmful plants (identified on the "Nuisance" or "Prohibited" Plant Lists) are prohibited.

Healthy native plant communities provide habitat for native wildlife and preserve critical habitat for rare, threatened and endangered animals and plants. They enhance air and water quality by trapping airborne particulates and by filtering sediments and pollutants from runoff before they enter streams and aquifers. They stabilize stream banks and hillside slopes, dissipate erosive forces, ameliorate the local microclimate and reduce water and energy needs. They enhance Portland's livability by providing scenic, recreational and educational values. Native plants are part of the region's natural heritage.[123]

[122] http://www.portlandparks.org/urbanforestry/index.html
[123] http://www.planning.ci.portland.or.us/lib_plantlist.html

Appendix 2: Urban Forestry Brochures

The Urban Forestry Program has many helpful and informative brochures. These include:

- Dutch Elm Disease: A City and Community Elm Survival Guide
- Guidelines for Mature Tree Care
- Guidelines for Pruning Young Shade Trees
- Neighborhood Tree Liaison Program and Application
- Portland's Urban Forest and Oregon's Endangered Species
- Providing a Foundation for a community working toward a fully functional Urban Forest
- Street Tree Planting and Establishment Guidelines
- Tree Cutting Guidelines

Many of these brochures are available online at http://www.portlandparks.org/urbanforestry.htm or by calling the Urban Forestry Program at 503-823-4489.

Appendix 3: Community Education, Outreach Programs & Volunteer Opportunities

Community Watershed Stewardship Program **503-823-5740**
The Stewardship program provides opportunities for Portland community groups and residents to be involved in watershed issues by promoting community-initiated restoration projects that improve watershed health.
http://www.cleanriver-pdx.org/get_involved/stewardship.htm

Downspout Disconnect Program **503-823-5858**
This Environmental Services Program pays homeowners or neighborhood groups to disconnect their downspouts from the combined sewer system and allow their roof water to drain to gardens and lawns, or disconnects them for homeowners free of charge.
http://www.cleanrivers-pdx.org/get_involved/downspout_disconnection.htm

Friends of Trees **503-284-8846**
Friends of Trees (FOT) is a non-profit organization that organizes tree planting and tree care projects along city streets, in urban natural areas and on school grounds. They also educate the public about the urban forest and make tree planting in yards affordable through their Branching Out program.
http://www.friendsoftrees.org

The executive summary of the FOT Strategic Vision is available at:
http://www.friendsoftrees.org/pdfImages/Exec_Summary.pdf

Green Building Program and LEED Certification
Information about the Office of Sustainable Development's Green Building Program and LEED Certification is available at: http://www.green-rated.org/g_rated/grated.html

Ivy Removal Project **503-823-3681**
The No Ivy League project provides education about English ivy and other invasive species and uses volunteers for ivy control, removal and habitat restoration.
http://www.noivyleague.com

Naturescaping for Clean Rivers **503-823-2862**
Naturescaping uses native plants, natural landscapes, and water-friendly gardening practices. Call to find out about naturescaping workshops scheduled for your area or to help organize one in the Portland area.
http://www.cleanrivers-pdx.org/get_involved/naturescaping.htm

Neighborhood Tree Liaisons **503-823-1650**
Neighborhood Tree Liaisons are local leaders that serve as neighborhood resources for proper tree care. Call Urban Forestry to find out about the next training session.
www.PortlandParks.org/trees

Pollution Prevention Outreach/Education **503-823-7623**
The Pollution Prevention Program trains business representatives, residents and city workers to identify pollution and prevent it at the source.
http://www.cleanrivers-pdx.org/pollution_prevention/index.asp

Southwest Watershed Resource Center **503-823-2862**
The Center, located at Gabriel Park, lends tools and provides other resources to help keep our rivers and streams clean. The Center's goal is to help residents improve the health of their watershed.

Appendix 4: Past and Current Urban Forest Inventories

Street Tree Inventories

In the past, information about the urban forest consisted primarily of street tree inventories. The first census of street trees was completed with the aid of a Works Progress Administration grant in 1938. The result of the inventory was a list of 78,886 trees composed of 173 species. Seven genera accounted for 71% of the trees with conifers making up 15% of the total. Other deciduous tree species accounted for less than 1% each.

Maple	18,074	23%
Walnut	12,060	15%
Elm	6,719	9%
Hawthorn	6,366	8%
Birch	5,616	7%
Buckeye	4,803	6%
Mountain Ash	3,278	4%
Conifers (all species)	11,833	15%
Other	10,137	13%
Total	78,886	100%

A second inventory of street trees done in 1976 covered 57% of the city and estimated an approximate total of 69,564 street trees for the entire city – 9,322 fewer street trees than in 1938. This survey counted 197 varieties of trees. Though the species composition changed significantly since the 1938 survey, several genera still dominated the population. By 1976, conifers accounted for only 4% of the total.

Cherry and Plum	8,349	21%
Maple	7,759	20%
Birch	3,701	9%
Hawthorn	2,946	7%
Walnut	1,891	5%
Sweetgum	1,879	5%
Elm	1,768	4%
Oak	1,065	3%
Conifers (all species)	2,783	4%
Others	15,304	22%
Total	69,564	100%

The 1976 survey also provided important information about the health of street trees. Forty-one percent were in excellent or good condition with 56% in fair or poor condition. Thirteen percent needed pruning, 10% had been topped and 1% needed to be removed.

That survey sampled twenty-six neighborhood areas and showed that some neighborhoods had far more street trees per street mile than others. Irvington, Eastmoreland, and Laurelhurst were well above average. Eliot, Corbett-Terwilliger, Brooklyn and Buckman were below the average. These trends continue today in many parts of the city.

STREET TREE COMPARISONS

In 1989, Kielbaso and Cotrone produced a report titled "The State of the Urban Forest" that included data on street trees in 320 cities across the country, including Portland. The inventory looked at numbers, sizes and conditions of street trees. In many respects, Portland was at or somewhat below the national average. In terms of tree sizes, Portland had many more sapling size trees (less than 3" diameter) and fewer trees in the small, medium and large sizes. The numbers of trees in excellent, good, fair, or poor condition were similar to the national average. However, Portland had nearly 50% more empty tree spaces than the national average. According to this study, there were three empty spaces for every tree. It should be noted that many areas that were surveyed included industrial areas and residential areas that have very narrow tree planting spaces. For reference, the street trees in Salem and Corvallis were much better than Portland's, while street trees in Eugene were about the same as Portland's. It should be noted that since 1989, FOT has planted thousands of street trees, so this information is probably not accurate.

CANOPY COVER INVENTORIES

A variety of aerial photos and satellite imagery provides information about the urban forest in the city and surrounding region. They include the following:

PSU Study of Portland's Urban Forest Canopy, 2003

Dr. Joe Poracsky and Mike Lackner collaborated on a satellite imagery study to determine the current state of Portland's urban forest canopy, how the canopy has changed over time in amount and composition and how canopy cover relates to geography (neighborhood and land-use). Their report also recommends canopy cover targets for the city as a whole and for specific land uses.

Poracsky and Lackner analyzed satellite imagery from 1972, 1991 and 2002, along with digital 2002 aerial photos and RLIS GIS data. Using an unsupervised classification process, pixels were grouped into eight categories, which were each given a relative canopy weight from 0 to 100. Areas with vegetation cover were grouped into four classes, which were each given a relative canopy weight from 0 to 100. A total canopy score for each pixel was produced by multiplying the canopy score for vegetation type by the canopy score for the cover class.

Four land-use categories were recognized:

- Parks / Greenspaces
- Residential
- Commercial / Industrial
- Right-of-way

Results

Current total canopy cover in Portland was estimated to be 26.3% with Forest Park included and 23.6% with Forest Park excluded. This is an *increase* of 1.2% from 1972. Accuracy of results was estimated to be 61-72% by category; overall accuracy was 69.2%.

Greatest increases occurred in many established neighborhoods. Often these areas of canopy increase correlated to areas where Friends of Trees has led tree-planting efforts. As expected, parks and greenspaces had the highest canopy cover and commercial / industrial areas had very low canopy cover.

Recommended Canopy Cover Targets

Parks / Greenspaces: Tree planting depends on the uses of the park. Some areas such as sports fields, playgrounds and parking lots will never have trees, while other areas may be heavily wooded. Park managers should increase tree stocking levels where appropriate and replace aging trees.
Residential: A "high but achievable" target is 47% canopy cover (75th percentile). Many areas are available for large increases.
Commercial / Industrial: 12% is a realistic target.
Right-of-way: Use stocking levels rather than canopy cover since satellite analysis does not lend itself to individual trees. This will require ground surveys.

General Recommendations

- Educate citizens in all neighborhoods about the benefits of trees to stimulate tree planting.
- Encourage and support tree planting efforts.
- Quantify the relationship between canopy and water quality. Some areas, such as the Columbia Slough, could experience great water quality gains with increased canopy.
- Use information about economic benefits of trees to educate public and inform policy makers.
- Focus planting in areas with relatively little canopy, rather than increasing canopy in areas with relatively good canopy cover.
- Repeat satellite canopy cover study in 5 to 8 years.

Modeling Benefits and Costs of Community Tree Plantings. In 1993, Gregory McPherson Ph.D., Paul Sacamano and Steve Wensman of the USDA Forest Service conducted a study of twelve cities in the US — including Portland. They used aerial photographs of each city to estimate existing land cover and opportunities for new tree planting. Using 1990 photographs for this interpretation, Portland had a 42% tree/shrub cover overall — higher than any of the other eleven cities studied. The study also identified that Portland's overall stocking level is at 64.9% — also higher than that of any other city studied.[124]

Master's Thesis for Tree Crown Density. A master's thesis project by Paul Newman of the Portland State University Geography Department in 1994 used satellite imagery to measure tree crown density within the city. This information could be coordinated with other information in a geographic system to correlate urban forest density with other features such as population density and zoning, as well as to show relative densities among neighborhoods or other land uses.

Portland Parks & Recreation Tree Canopy Assessment. The Urban Forestry Program completed a park tree canopy assessment in 2001 that showed approximately 60% canopy cover over the 2,800 acres of Portland Park and Recreation's developed parks. The replacement value for these trees is estimated at $250 million, and the total replacement cost is estimated to be $270 million.

Regional Ecosystem Analysis for the Willamette/Lower Columbia Region of Northwestern Oregon and Southwestern Washington State. In 2001, American Forests partnered with nine municipalities from Vancouver, WA to Eugene, OR. The study area covered more than 7 million acres and utilized data from Landstat satellite images to assess the changes to the landcover for a 28-year period from 1972 to 2000.[125] As expected, that study showed reductions in the urban forest as development has occurred. It should be noted that the information gathered and compared in that report came from sources that used different resolutions than earlier studies, so it is difficult to provide certainty about the degree of change.

[124] *McPherson,Sacamano, and Wensman (1993).*
[125] *American Forests (2001).*

Metro's Habitat Inventory. Metro is currently developing a region-wide inventory of riparian and wildlife habitat. This includes stream corridors and patches of the urban forest that are at least one acre in size. Most of the patches recognized in this inventory are "closed forest canopy" with at least a 75% canopy coverage. This inventory will continue to be updated using aerial photographs. Metro's recognition of these patches of urban forest as "regionally significant" will eventually lead to a regional management and protection plan that will include recommendations for incentives, acquisition, public education, stewardship opportunities and regulations (tentatively in late 2003).

BES Street Tree Canopy Assessment. BES is currently doing a street tree canopy assessment for the Holladay/Sullivan/Stark Street area. It will examine the canopy coverage provided by street trees in this study area and identify potential planting areas.

Green City Data Projects. Other assessments have been done for various neighborhoods including the Green City Data street tree project done by 8th grade students in 1998, and other inventories done by other students in subsequent years.[126]

In 2000, Kim Wilson wrote *"Common Street Trees of Portland."* This report was developed to assist participants in the Youth Tree Inventory Project by providing guidance to identifying street trees throughout Portland.

[126] *Poracsky et al. (1999).*

Appendix 5: Performance Measurement and Canopy Cover Targets

Performance Measurement

Urban forestry is considered by many to be a new and evolving science and there are no widely accepted standards or performance measures that assess the condition of the urban forest. Performance measurement will be increasingly important for urban forestry managers to evaluate their progress and rate of change.

Suggestions for assessing the urban forest health and condition include:

- Canopy cover
- Leaf surface area
- Species diversity
- Age diversity
- Condition assessment (using ISA standards for example)
- Stocking level
- Ratio of planting to removal

Other suggestions for performance measures include the number of volunteer hours, the number of education/outreach contacts and funding. Although these do not directly assess the condition of the urban forest, they address the management of urban forestry programs.

Canopy Cover

Canopy cover is defined as the proportion of an area, when viewed from above, that is occupied by tree crowns. Canopy cover is an overall indicator of forest health and quantity. It is measured using aerial photographs, satellite images and ground surveys. This is less complex than evaluating leaf surface area — although this may be a future tool. Performance measures with specific targets for canopy cover have been developed for the Urban Land Environments (ULEs) in this plan.

The specific targets set forth in this plan are based on research of the recommendations and/or code requirements of other cities, counties and states, as well as scientific literature and conversations with several urban forestry researchers. The table is at the end of this section.

Although several cities have adopted specific targets, so far there seems to be little scientific evidence that shows that any of these targets are necessarily correlated with a healthy, functioning urban forest. This may be an area for future urban forestry research.

The following table shows the wide range of performance targets or code requirements for residential areas and commercial/industrial/institutional areas. It is important to consider that these targets may reflect different growing conditions and climates. In addition, those figures that are code requirements may not reflect overall city or county canopy goals.

The following canopy cover targets in this plan are based on current research (see Sources at end of this section), the knowledge and experience of Portland's urban forest managers and information from existing canopy analyses, although these are limited.

Canopy Cover Targets for Portland ULEs

The canopy cover targets set forth in this plan are as follows:

Residential	35-40%
Commercial/Industrial/Institutional	15%
Natural Areas and Stream Corridors	Targets set by City Framework Plan
Transportation Corridors and Rights-of-Way	35%
Developed Parks and Open Spaces	30%

Sources - Performance Measures and Canopy Cover Targets

American Forests. "Regional Ecosystem Analysis for the Willamette/Lower Columbia Region of Northwestern Oregon and Southwestern Washington State: Calculating the Value of Nature." October 2001. http://www.americanforests.org/download.php?file=/rea/AF_Portland.pdf

American Forests. "National Urban Tree Deficit." http://www.americanforests.org/graytogreen/treedeficit/

Botetourt County, Virgina. "Municipal Code: Chapter 25." http://www.co.botetourt.va.us/code/ch025.htm

Cascadia Consulting Group. "Seattle Urban Forest Assessment: Sustainability Matrix." July 31, 2001. http://www.cityofseattle.net/environment/documents/sustainability%20matrix.pdf

City of Chesapeake, Virginia. "City Code: Section 19-602."

City of Georgetown, Texas. "Unified Development Code: Chapter 8: Landscaping and Buffering." Draft, March 17, 2002, pp. 130-132.

City of Manassas, Virginia. "Zoning Ordinance: Chapter 34.1 of the Code of Manassas." p. 135.

City of Suffolk, Virginia. "Unified Development Ordinance." pp. 6-25 and 6-26. http://www.suffolk.va.us/citygovt/udo/a6/section31603_design_standards.pdf

Fauquier County, Virginia. "Article 7: Off-Street Parking and Loading, Streets, Water and Sewer, Tree Canopy, Landscape and Buffer Requirements." pp. VII-17 and VII-18. http://www.fauquiercounty.gov/documents/departments/commdev/pdf/zoningordinance/ART_07.PDF

Gamstetter, Dave. City of Cincinnati. Personal communication (email) 7/5/02.

Georgia Department of Community Affairs. "Model Code: Alternatives to Conventional Zoning." April 2002.

Head, Constance P., Robinson Fisher, and Maureen O'Brien. "Best Management Practices for Community Trees: A Technical Guide to Tree Conservation in Athens-Clarke County, Georgia." 2001.

Hoefer, Phil. Retired Urban and Community Forest Coordinator for Colorado. Personal communication (email) 6/26/02.

Jefferson County, Kentucky. "Land Development Code: Chapter 10." Draft, March 2002, pp. 10.1-1 to 10.1-6. http://www.co.jefferson.ky.us/PlanDev/CodeSections/TreeCanopy.pdf

McPherson, E. Gregory. USDA Forest Service. Personal communication (email) 6/26/02.

Mead, Mark. City of Seattle. Personal communication (email) 7/1/02.

Miller, Robert W. *Urban forestry: Planning and Managing Urban Greenspaces 2nd Edition*. Upper Saddle River, N.J.: Prentice Hall, 1997.

Nowak, David and Paul O'Connor. *Syracuse Urban Forest Master Plan: Guiding the City's Forest Resource Into the 21st Century*. USDA Forest Service, Northeastern Research Station, March 2001.

Nowak, David. USDA Forest Service. Personal communication (phone) 6/26/02.

Pauleit, Stephen and Friedrich Duhme. "GIS Assessment of Munich's Urban Forest Structure for Urban Planning." *Journal of Arboriculture* 26(3): May 2000, pp. 133-141.

Prince William County, Virginia. "Design and Construction Manual: Chapter 8." p. TBL-2.

Smithfield County, Virginia. "Smithfield Zoning Ordinance: Article 9." September 1998. http://www.co.smithfield.va.us/zoart9.pdf

USDA Forest Service, Northeastern Area. *An Ecosystem Approach to Urban and Community Forestry: A Resource Guide 2nd Edition,* 1993.

Canopy Cover Recommendations and/or Code of Requirements

	American Forests (for Portland area)	Athens-Clarke County, GA, *BMPs for Community Trees**	Botetourt County, VA *Municipal Code*	Chesapeake, VA *City Code*	Cincinnati, OH (American Forests' Standards)	Fauquier County, VA *Zoning Ordinance*	Georgetown, TX *Draft Development Code*	Georgia Dept of Community Affairs *Model Code*	Phil Hoefer, Retired U&CF Coordinator for CO	Jefferson County, KY *Land Development Code*	Manassas, VA *City Code*	Maryland's 1991 Forest Conservation Act (from Miller 1997)	Greg McPherson, USDA Forest Service	Mark Mead, Seattle Dept of Transportation	Munich, Germany	Prince William County, VA *Design Construction Standards Manual*	Seattle, WA *Urban Forest Assessment: Sustainability Matrix* (American Forests' Standards)	Smithfield County, VA *Zoning Ordinance*	Suffolk, VA *Development Ordinance*	Syracuse, NY *Urban Forest Master Plan*	*USDA NE Area Resource Guide* (1993)
Urban Residential	25%	40-60%	15%	15-20%	25%	15%		20%	60%	10-20%	15-20%	15-25%			20%	10-20%	25%	10-20%	10-20%		
Single Family		*60%*		*20%*						*10-20%*											
Mixed Density/ Multi-Family		*40-50%*		*15%*			*30%*			*10-20%*											
Commercial/ Industrial/ Institutional	15%	0-40%	10%	10%	15%	10%	10-25%	15%		0-15%	10%	15-25%				10%	15%	10%	10%		
Commercial		*0-40%*					*15-30%*			*0-15%*		*15%*									
Industrial		*20%*					*10%*			*0-15%*		*15%*									
Institutional		*30%*								*5-20%*		*25%*									
Streets & ROW													25%**								50%
Natural Areas & Stream Corridors		70% for riparian zones & drainage areas																			
Developed Parks & Open Spaces																					
Overall	40%				40%?									25-35%						30%	50%

Notes:

*These are all included in their site design standards (section 9 of code) except for single-family residential & riparian areas

**After 1st generation has begun to be replaced--50% for 1st planting

Appendix 6: Estimated Annual Costs & Benefits of Trees

Estimated annual costs for a small-, medium-, and large-sized public and private, residential yard tree located opposite a west-facing wall 20 years after planting.

	Small Tree 28 ft tall 25 ft spread LSA=1,891 ft²		Medium Tree 38 ft tall 31 ft spread LSA=4,770 ft²		Large Tree 46 ft tall 41 ft spread LSA=6,911 ft²	
Costs ($/yr/tree)	Private	Public tree	Private	Public tree	Private	Public tree
Tree & Planting	$0.00	$ 0.00	$0.00	$ 0.00	$ 0.00	$ 0.00
Pruning[127]	$4.79	$ 7.59	$4.79	$ 7.59	$11.00	$13.73
Remove & Dispose	$0.28	$ 1.45	$0.34	$ 1.79	$ 0.42	$ 2.22
Pest & Disease	$0.31	$ 0.08	$0.38	$ 0.10	$ 0.47	$ 0.12
Infrastructure	$0.28	$ 1.13	$0.35	$ 1.39	$ 0.43	$ 1.73
Irrigation	$0.24	$ 0.00	$0.60	$ 0.00	$ 0.86	$ 0.00
Clean-Up	$0.28	$ 1.11	$0.34	$ 1.37	$ 0.43	$ 1.71
Liability & Legal	$0.06	$ 0.25	$0.08	$ 0.31	$ 0.10	$ 0.38
Admin & Other	$0.00	$ 1.29	$0.00	$ 1.39	$ 0.00	$ 2.21
Total Costs	**$6.23**	**$12.90**	**$6.87**	**$13.94**	**$13.72**	**$22.10**
Total Benefits (see below)	$17.96	$18.12	$36.04	$37.24	$65.18	$68.92
Net Benefits	**$11.73**	**$ 5.22**	**$29.16**	**$23.30**	**$51.46**	**$46.82**

Estimated value of net annual benefits from a small-, medium- and large-sized residential yard tree opposite a west-facing wall 20 years after planting.

	Small Tree 28 ft tall 25 ft spread LSA = 1,891 ft²		Medium Tree 38 ft tall 31 ft spread LSA = 4,770 ft²		Large Tree 46 ft tall 41 ft spread LSA = 6,911 ft²	
Benefit Category						
ElectriCity savings ($0.06/kWh	62 kWh	$3.89	93 kWh	$5.87	125 kWh	$ 7.85
Natural gas savings ($0.92/therm)	-150 kBtu	-$1.38	-80 kBtu	-$0.73	133 kBtu	$ 1.22
Carbon dioxide ($0.015/lb)	28 lb	$0.42	76 lb	$1.14	263 lb	$ 3.95
Ozone ($2.40/lb)	0.13 lb	$0.32	0.21 lb	$0.51	0.35 lb	$ 0.84
NO2 ($2.40/lb)	0.07 lb	$0.18	0.14 lb	$0.34	0.24 lb	$ 0.58
SO2 ($1.00/lb)	0.04 lb	$0.04	0.07 lb	$0.07	0.10 lb	$ 0.10
PM10 ($2.72/lb)	0.15 lb	$0.41	0.24 lb	$0.66	0.40 lb	$ 1.09
VOC's ($6.65/lb	0.001lb	$0.018	0.002 lb	$0.063	0.005 lb	$ 0.030
BVOC's ($6.65/lb)	-0.004lb	-$0.024	-0.012 lb	-$0.081	-0.034 lb	-$ 0.224
Rainfall Interception ($0.028/gal)	169 gal	$4.70	288 gal	$8.01	449 gal	$12.47
Environmental Subtotal		**$8.58**		**$15.85**		**$27.91**
Other Benefits		$ 9.38		$20.19		$37.27
Total Benefits		**$17.96**		**$36.04**		**$65.18**
Total Costs		$ 6.23		$ 6.87		$13.72
Net Benefits		**$11.73**		**$29.16**		**$51.46**

Source: McPherson, E. Gregory et al. Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategic Planting. Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station, 2002, pp. 28 & 30.

[127] *Portland Parks & Recreation staff feel that these pruning costs may be underestimated.*

Appendix 7: Sustainable City Principles

November 1994

Goal: City of Portland will promote a sustainable future that meets today's needs without compromising the ability of future generations to meet their needs, and accepts its responsibility to:

- Support a stable, diverse and equitable economy
- Protect the quality of the air, water, land and other natural resources
- Conserve native vegetation, fish, wildlife habitat and other ecosystems
- Minimize human impacts on local and worldwide ecosystems

City elected officials and staff will:

1. Encourage and develop connections between environmental quality and economic vitality. Promote development that reduces adverse effects on ecology and the natural resource capital base and supports employment opportunities for our citizens.

2. Include cumulative and long-term impacts in decision making and work to protect the natural beauty and diversity of Portland for future generations.

3. Ensure commitment to equity so environmental impacts and the costs of protecting the environment do not unfairly burden any one geographic or socioeconomic sector of the City.

4. Ensure environmental quality and understand environmental linkages when decisions are made and regarding growth management, land use, transportation, energy, water, affordable housing, indoor and outdoor air quality and economic development.

5. Use resources efficiently and reduce demand for natural resources, like energy, land and water, rather than expanding supply.

6. Prevent additional pollution through planned, proactive measures rather than only corrective action. Enlist the community to focus on solutions rather than symptoms.

7. Act locally to reduce adverse global impacts of rapid growth population and consumption, such as ozone depletion and global warming, and support and implement innovative programs that maintain and promote Portland's leadership as a sustainable city.

8. Purchase products based on long-term environmental and operating costs and find ways to include environmental and social costs in short-term prices. Purchase products that are durable, reusable, made of recycled materials and non-toxic.

9. Educate citizens and businesses about Portland's Sustainable City Principles and take advantage of community resources. Facilitate citizen participation in City policy decisions and encourage everyone to take responsibility for their actions that otherwise adversely impact the environment.

10. Report annually on the health and quality of Portland's environment and economy.

From: Portland Office of Sustainable Development, http://www.sustainableportland.org/Sustainable%20City%20Principles.pdf

Appendix 8: Environmental Zoning Summary

Existing zoning to protect Portland's natural areas
Portland's Zoning Code regulates land use and development in the city and assigns each parcel of land a "base zone," such as residential, industrial or commercial.

To meet special needs, the City Council has adopted a second kind of zoning that overlays the base zones. These overlay zones address specific city goals — such as design or scenic resources — that apply to properties within them, whether it's a store, office or home.

Since 1989, the city has used environmental overlay zoning to protect more than 19,000 acres of environmentally sensitive areas in Portland. These areas are typically wetlands, upland forests, steep slopes and areas along streams — including many of the streams being considered under Healthy Portland Streams.

The environmental overlay zones regulate the way development can take place because paving, removing trees and adding to a building's size can increase erosion, noise or pollution and add to the flood threat.

The City's goal is for development to take place with greater sensitivity to our environment. The regulations don't seek to stop development, but rather to guide it to better protect and enhance the natural areas we value.

Under the current zoning code, there are two environmental overlay zones: the protection, or p-zone, and the conservation, or c-zone.

Environmental protection zone.
Offering the highest level of protection, this zone includes a regional network of urban natural areas and stream corridors. In the long-term, these lands will be shaped by healthy streams, wetlands, meadows and forests. Almost three-quarters of the land in the p-zone is publicly owned, such as Forest Park, Tryon Creek State Park, Powell Butte, and the Smith and Bybee Lakes.

The protection zone allows new development only when there is a public need and benefit, such as trails or interpretive facilities. Existing buildings and other structures (bridges, driveways) can be maintained without restriction.

Environmental conservation zone.
Less restrictive than the p-zone, this zone can allow limited urban development. Homes and other buildings may be built as long as all alternatives are considered and the development is designed to be sensitive to the natural environment. For example, the c-zone limits the amount of land area that may be disturbed during development, limits the number of trees that may be removed, and establishes minimum setbacks from streams, lakes, wetlands, and other water bodies. The zone also requires native plants for new landscaped areas.

Development proposals in the c-zone may be approved in one of two ways. They may be approved through an Environmental Plan Check that compares the proposal to strict, objective development standards with no flexibility. Or they can undergo an Environmental Review that allows considerably more flexibility and creativity tailored to the specific property, while still meeting conservation goals. For example, enhanced natural landscaping could compensate for the potential harm of paving a driveway.

Appendix 8 cont.

Currently the environmental overlay zones also include a 25-foot transition area that is located just inside the environmental overlay zone boundary, but it is not shown on official zoning maps. The current transition area has fewer restrictions than the rest of the environmental overlay zone.

Source: Portland Bureau of Planning, "Healthy Portland Streams: Summary of Discussion Draft Proposal." October 2001, http://www.planning.ci.portland.or.us/pdf/hps_summary.pdf, pp. 3-4.

Appendix 9: Planning for Development in the Urban Forest

New development in any of the Urban Land Environments potentially threatens the condition and extent of the urban forest. Inadequate attention is typically given to the presence of existing vegetation during site planning and throughout the development phase. However, retention and protection of some of the existing vegetation on a site has important environmental and economic benefits.

This appendix outlines steps involved in tree preservation, summarizes common methods to minimize damage to trees during construction and lists available resources to obtain more information. Some Certified Arborists are specially trained and experienced in tree preservation. The use of such qualified professionals during all aspects of site planning and development is highly recommended.

Designing Development with the Landscape in Mind

Site Survey

A qualified professional should be retained to review proposed site changes for potential impacts to the existing landscape. A site map should include: existing vegetation, elevation and proposed grade changes, existing utilities and proposed structures to be built.

Assessment

A qualified professional can assist in determining which individual trees and areas of vegetation should be retained depending on individual tree species, location and condition. Erosion control, slope stability and esthetic impacts are factors to be measured.

Conservation Plan

Individual and groups of trees to be protected need to be marked on construction plans. Delineation of effective root zones is especially critical. Several methods exist to reduce construction impacts to trees. Plans for preservation must be developed in advance of construction and effectively communicated to all appropriate parties.

Preservation Techniques

A certified arborist, not the general contractor, should do the tree work during construction. Examples of arborist work includes root inspections and tree and root pruning.

Monitoring during Construction

Vigilant monitoring by qualified professionals is needed to protect trees during construction. Protection zones must be maintained to guard trees from fill, bark damage, compaction, root loss during grading, etc. Additional landscaping must consider the requirements of the existing vegetation. Landscape professionals can assist with this work.

Post Construction Care

Mature trees will need to be monitored on a continual basis for signs of stress and treated accordingly.

Construction Impacts and Tree Preservation Techniques

Impact to Tree	Construction Activity	Methods and Treatments to Minimize Damage
Root Loss	Stripping site of organic surface soil during mass grading	Restrict stripping of topsoil around trees. Any woody vegetation to be removed adjacent to trees to remain should be cut at ground level and not pulled out by equipment; root injury to remaining trees may result.
	Lowering grade, scarifying, preparing subgrade for fills, structures	Use retaining walls with discontinuous footings to maintain natural grade as far as possible from trees. Excavate to finish grade by hand and cut exposed roots with a saw to avoid root wrenching and shattering by equipment, or cut with root pruning equipment. Spoil beyond cut face can be removed by equipment sitting outside the drip line of the tree.
	Subgrade preparation for pavement	Use paving materials requiring a minimum amount of excavation (e.g. reinforced concrete instead of asphalt). Design traffic patterns to avoid heavy loads adjacent to trees (heavy load bearing pavements require thicker base material and subgrade compaction). Specify minimum subgrade compaction under pavement within drip line.
	Excavation for footings, walls foundations	Design walls and structures with discontinuous footings, pier foundations. Excavate by hand. Avoid slab foundations, post and beam footings.
	Trenching for utilities, drainage	Coordinate utility trench locations with contractors. Consolidate utility trenches. Excavate trenches by hand in areas with roots larger than 11″ diameter. Tunnel under woody roots rather than cutting them.
Wounding Top of Tree	Injury from equipment	Fence trees to enclose low branches and protect trunk. Report all damage promptly so arborist can treat appropriately.
	Pruning for vertical clearance for building and construction equipment	Prune to minimum height required prior to construction. Consider minimum height requirements of construction equipment and emergency vehicles over roads. All pruning should be performed by an arborist, not by construction personnel.
Damage to Roots, Stress From Reduced Root Systems	Compacted soils	Fence trees to keep traffic and storage out of root area. In areas of engineered fills, specify minimum compaction (usually 85) if fill will not support a structure. Provide a storage yard and traffic areas for construction activity well away from trees. Protect soil surface from traffic compaction with thick mulch. Following construction, vertical mulch compacted areas.
	Spills, waste disposal (e.g. paint, oil, fuel)	Post notices on fences prohibiting dumping and disposal of waste around trees. Require immediate cleanup of accidental spills.

Construction Impacts and Tree Preservation Techniques

	Soil sterilants (herbicides) applied under pavement	Use herbicides safe for use around existing vegetation and follow directions on the label.
	Impervious pavement over soil surface	Utilize pervious paving materials. Install aeration vents in impervious paving.
Inadequate Soil Moisture	Rechannelization of stream flow, redirecting runoff, lowering water table, lower grade	In some cases it may be possible to design systems to allow low flows through normal stream alignments and provide bypass into storm drains for peak flow conditions. Provide supplemental irrigation in similar volumes and seasonal distribution as would occur.
Excess Soil Moisture	Underground flow backup, raising water table	Fills placed across drainage courses must have culverts placed at the bottom of the low flow so that water is not backed up before rising to the elevation of the culvert. Study the geotechnical report for ground water characteristics to see that walls and fills will not intercept underground flow.
	Lack of surface drainage away from	Where surface grades are to be modified, make sure that water will flow away from the trunk, i.e. that the trunk is not at the lowest point. If the tree is placed in a well, drainage must be provided from the bottom of the well.
	Compacted soils, irrigation of exotic landscapes	Compacted soils have few macropores and many micropores. Core vent to improve drainage. Some species cannot tolerate frequent irrigation required to maintain lawns, flowers and other shallow-rooted plants. Avoid landscaping under those trees, or utilize plants that do not require irrigation.
Increased Exposure	Thinning stands, removal of undergrowth	Preserve species that perform poorly in single stands as groups or clusters of trees. Maintain the natural undergrowth.
	Reflected heat from surrounding hard surfaces	Minimize use of hard surfaces around trees. Monitor soil moisture needs where water use is expected to increase.
	Pruning	Avoid severe pruning where previously shaded bark would be exposed to sun. Where pruning is unavoid able, provide protection to bark from sun.

Source: *A Technical Guide to Urban and Community Forestry in Washington, Oregon, and California.* World Forestry Center, Portland, Oregon and Robin Morgan, 1993.

Appendix 10: Landscaping for Wildlife Habitat

The presence of wildlife in the city depends largely on the availability of habitat. All species require sources of food, water and cover. In addition to parks and refuges, landscaping in residential yards and other areas such as institutional campuses can be designed to provide for wildlife. Habitat can be enhanced by providing for the animals' needs as follows:

Food. Plant species that provide a food source. Many native plants are particularly useful and are quite beautiful as well. Some introduced plants provide food sources as well. Entire books are dedicated to plants that attract hummingbirds, butterflies and songbirds. Some of these resources are listed below.

Diversity. Vegetation patterns that include a variety of trees, shrubs and ground covers and a mix of plant species are more useful at providing habitat and wildlife cover than lawns with single trees.

Water. Water is essential to all life. If possible, incorporate pools or bird baths in the landscape. Provide water throughout the year and keep it clean.

Pest and Weed Control. Eliminate the use of harmful chemicals for pest and weed control. Indiscriminate use of pesticides can kill beneficial insects and reduce food sources for other species. Explore alternative methods of biological control if pests are a problem.

Domestic Pets. Keep domestic pets, especially cats, indoors. Cats kill songbirds and dogs can be disruptive to wildlife.

Resources for more information:

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APPENDIX 11: The Planning Process for the UFMP

Work on the revised Urban Forestry Management Plan began in early 2002 with review of the 1995 UFMP to determine how to revise the plan. A series of individual meetings with current partners who manage and have responsibility for various aspects of the urban forest was held to gather initial information. A Technical Advisory Committee was formed. The members are listed on the inside cover of the document. The TAC received an initial information package that included:

- Reasons for updating the UFMP.
- Summary of current UF management by various bureaus and organizations.
- Issues and concerns raised during preliminary meetings with current partners.

Summary of UFMP TAC Meetings

Meeting 1 — May 17, 2002
Introductions
Reviewed 1995 Urban Forestry Management Plan — sections to be updated.
Discussed mutual goals and areas of common interest.
Identified and prioritized issues and concerns.

Meeting 2 — May 31, 2002
Determined goals of plan and primary responsibility of principal partners.

Meeting 3 — June 14, 2002
Discussed management, worked on definitions and management responsibilities for each Urban Land Environment.

Meeting 4 — June 28, 2002
Discussed Draft document.

Meeting 5 — August 9, 2002
Took final comments on Draft document.

Presentations
Urban Forestry Commission – May 16, 2002 and September 19, 2002
River Renaissance Natural Resource Team – August 30, 2002
Portland Park Board – October 1, 2002
Friends of Trees Staff – November 5, 2002
Friends of Trees Board – November 20, 2002

Public Review
Notice about the plan was sent to interested parties and it was available for review online at Portland Parks & Recreation's web site, or in hard copy, if requested. About a dozen comments and suggestions were received and responded to. Comments were for clarification of some points and suggestions for additional information. The document was revised as appropriate.

Approvals
The UFMP was adopted by the Urban Forestry Commission January 16, 2003.

Adoption
The UFMP was adopted by Resolution 36189 December 10, 2003.

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