City of Seattle

Urban Forest Management Plan

Vision

Seattle's urban forest is a thriving and sustainable mix of tree species and ages that creates a contiguous and healthy ecosystem that is valued and cared for by the City and all of its citizens as an essential environmental, economic, and community asset.

City of Seattle

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a city among the trees
EXECUTIVE SUMMARY

The Urban Forest Management Plan is a 30-year plan that recommends steps that the City of Seattle should take to preserve its trees and the cherished environment that has come to be called "a city among the trees." Seattle's urban forest touches the lives of its citizens every day. It consists of all trees in the city on both public as well as private property, including street trees, park trees, forested parklands, trees on institutional campuses and trees in many private ownership settings ranging from parking lots to back yards.

Unfortunately, Seattle's urban forest has significantly declined over the last few decades as the City has grown. Today, about 18% of the city is covered by tree canopy as compared with 40% just 35 years ago. Accommodating growth is important in order to preserve open spaces outside of the city. However, the loss of treed relief in our built environment reduces livability and further motivates sprawl. Balancing urban goals that include managing growth, enhancing livability, protecting the environment, fostering economic growth, maintaining vibrant public spaces, and creating recreational opportunities is challenging and trees contribute to all of these goals.
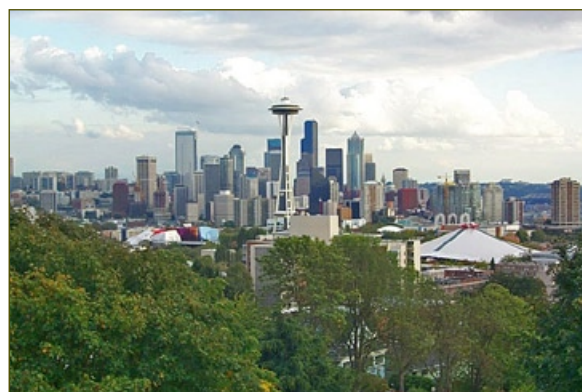
To curb the loss of tree cover, the City has planted thousands of trees during restoration projects, as part of Capital Improvement Program (CIP) projects, and as replacements for trees that were removed. The City also creates incentives for private tree planting through programs like the Neighborhood Matching Fund as well as requirements for preservation through our development regulations.

To encourage tree preservation and planting across the city, the Urban Forest Management Plan lays out actions ranging from improving tree care on City of Seattle property to enhancing community outreach to strengthening incentives and regulations during development. The plan also establishes goals for different land-use types and identifies the challenges and opportunities for enhancing the tree canopy coverage within each type.

1. Urban Forest Sustainability

Although efforts of City of Seattle and committed community members have had a positive impact, they have not been enough to preserve Seattle's urban forest. The Urban Forest Management Plan, therefore, was developed as a roadmap for the long-term management of Seattle's trees. The primary goal of the Urban Forest Management Plan is to increase the city's tree canopy cover to 30% in 30 years by identifying goals, recommendations and actions that will preserve, restore, enhance and sustain the urban forest over the long term.

Urban Forest Sustainability Model

To assist in this rigorous task, the City employed a nationally recognized Model of Urban Forest Sustainability. Careful consideration was also given to how the resource has been managed in the past, what its value is, how the resource can be sustained over time, and what set of actions will move the City toward its goals.

Seattle's urban forest management strategy is built around four principles from the model:

- Sustainability is a broad, general goal that results in the maintenance of environmental, economic and social functions and benefits over time.
- Urban forests primarily provide services rather than goods.
- Sustainable urban forests require human intervention.
- Trees growing on private lands compose the majority of urban forests.

Seattle's Urban Forest Management Plan adapted the sustainability model to provide a structure that organizes its goals and the actions needed to achieve them. It incorporates the following three management elements of the model:

1. **Tree Resource**: the trees themselves, as individuals or in forest stands

2. **Management Framework**: the policy, planning and resources— including staff, funding, and tools — brought to bear on the tree re- source

3. **Community Framework**: the way residents are engaged in planning and caring for trees. Because most trees in the urban forest are on pri- vate property, a successful program requires that the community plant and maintain trees on their property.

Seattle's Urban Forest History Highlights

The first European settlers to this region were awed by what appeared to be unending, magnificent old-growth forests. Trees became the business of the new city, with millions of board feet of lumber milled for local use or shipped to San Francisco and other ports to feed the needs of a growing nation.

Over time, native soils were significantly disturbed, streams and the life they supported were altered, and many acres of forest lands were covered by the building footprints of the new city. Early logging operations left no seed source to repopulate second-growth conifer forests, causing more than 70% of Seattle's new forest to be seeded with short-lived native maples and alders. Today, in a city land-base that once enjoyed more than 53,000 acres of old-growth conifers, only slightly more than 200 acres of true old-growth forest remain. These 200 acres are part of the mere 3,200 acres of actual forest lands left within the city limits.

Environmental, Economic, and Social Value of the Urban Forest

This section of the Urban Forest Management Plan describes the benefits of healthy, well managed forests in terms of environmental, economic and social value, the challenges the City faces to maintain or restore its urban forests, and what is lost when forests are poorly maintained and less healthy.

In addition to making the city more livable for a growing population, Seattle's urban forest provides habitat to a variety of wildlife and native and migratory songbirds. The urban forest, which offers shade that cools streams, intercepts rainwater and lessens the impacts from storm events, is home to more than 250 terrestrial vertebrate species and valuable terrestrial and aquatic habitat. Trees also improve air and water quality, and sequester global warming pollution.

The dollar value of the ecological services attributed to healthy urban forests can be into the many millions of dollars annually, particularly for the Pacific Northwest where stormwater control, for example, requires substantial investments in built infrastructure. By applying cost/benefit modeling provided by the *Western Washington and Oregon Tree Guide: Benefits, Costs and Strategic Planting,* E. Greg McPherson, et al. it has been determined that an increase in Seattle's tree canopy coverage from the present 18% to 36% would more than double current environmental and economic benefits.

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2. Seattle's Urban Forest Today

Beginning with an assessment of the current state of the resource, this section of the Urban Forest Management Plan highlights both the challenges and opportunities for future resource management. Discussion focuses on the following three key elements of the sustainability model to provide the framework for this assessment:

- Tree resource assessment
- Management framework assessment
- Community framework assessment

Tree Resource Assessment

Factors used to evaluate an urban forest include the extent of tree canopy, species diversity, age and health of trees. As previously discussed, canopy cover in Seattle has declined to about 18%. About 70% of the trees in Seattle's forested lands are aged deciduous maples and alders and about 30% conifers. About 40% of the trees in developed locations across the city are small flowering deciduous trees without expansive canopies. A primary goal of the Urban Forest Management Plan is to reverse both of these conditions over time.

Urban trees are under pressures not present in native forests and require active management intervention to sustain them. They lack some of the natural buffers and protection found in wildlands, where the combination of soil micro-organisms, understory plants, an ample seed source, number of trees, variance in topography, and stable hydrology all contribute to healthy trees able to ward off early destruction due to diseases, insects, and invasive plants.

Furthermore, tree selection in the urban environment is usually driven by site conditions that have been shaped by previous development and current land use more than on natural conditions that sustain native northwest forests.

Management Framework Assessment

Effective interdepartmental coordination is essential for consistent delivery of urban forestry programs. To that end, the City of Seattle formed an Urban Forest Coalition in 1994 to provide a common base for coordinating development of policy, programs, and budget that need citywide direction. The Urban Forest Coalition is represented by all city departments that have urban forest management responsibilities. As important as it is for good communi-

cation between city departments on urban forestry matters, it is equally important that similar communication exist between the City and other agencies such as the Port of Seattle, Army Corps of Engineers, King County, Washington State Department of Transportation (WSDOT), and even commercial entities such as the railroads.

The City needs better information and tools to evaluate the conditions, values, benefits, needs and opportunities associated with its urban forest including:

1. More complete and current tree inventory

2. Better maintenance records with records linked to inventory data

3. Better tools/models for determining the value and benefits of the urban forest.

Certainly, as the pressure to redevelop land within Seattle continues and the region's population increases, density goals and development pressures need to be balanced with tree protection and planting goals. Finding the right balance is crucial to maintaining the city's livability and encouraging new development within already developed areas rather than pushing it to the metropolitan fringe.

A summary of Seattle's existing regulations, policies and programs that protect and increase the urban forest can be found in Appendix B, Tree Policies and Regulations.

Community Framework Assessment

Community appreciation for the benefits and needs of trees and engagement in planning, planting and caring for trees is essential to the long-term health of the asset. Citizen input and volunteer participation are critical to City programs. Without this support and involvement, urban forestry programs cannot succeed. This section of the Urban Forest Management Plan describes the ways the community is currently informed about and participates in stewardship of the urban forest through various programs, including the following:

- Outreach
- Volunteer opportunities
- Planning and policy development
- Partnerships
- Regional cooperation

4. Goals and Actions by Management Unit

Seattle's urban forest covers all 53,000+ acres of publicly- and privately-owned land within the city limits. The obvious differences between urban spaces, streetscapes, parklands, remnant forests and other land-use types create a collection of management units that together form Seattle's urban forest eco-system. This section defines the following nine of these management units and describes specific issues, opportunities, goals, and actions associated with each unit.

The following are the nine management units for the Urban Forest Management Plan:

1. Single-Family Residential
2. Multi-Family Residential
3. Commercial/Mixed Use Areas
4. Downtown Seattle
5. Transportation Corridors/Street Trees
6. Industrial Property
7. Major Institutional Property
8. Developed Parks and Boulevards
9. Parks Natural Areas

Canopy cover is a major indicator not only of the breadth of the urban for-est but also of its overall health and vitality. The table below is a citywide snapshot that identifies current canopy cover percentages by land-use type or what this study refers to as a 'management unit.' It also estimates the num-ber of trees to be found within each management unit as well as our 30-year canopy cover goals.

Canopy Cover Goals for Seattle by Management Unit

Land-use category	Current cover	Current trees	30-year goal	Estimated # of new trees to meet goal
Single-Family	18%	473,300	31%	350,200
Multi-Family	13%	103,400	20%	56,000
Commercial/Mixed Use	8%	49,700	15%	44,400
Downtown	9%	9,700	12%	3,800
Manufacturing/Industrial	8%	68,100	10%	18,100
Institutional Properties	15%	14,600	20%	5,000
Parks: developed sites	19%	90,000	25%	28,400
Parks: natural areas	64%	568,700	80%	143,200
Citywide	18%	1,377,500	30%	649,100
Transportation Corridors/ Street ROW*	16%		24%	

Acres representing transportation corridors are included in the other management units

Once existing and future canopy cover goals are known and an estimate of the number of trees associated with each are known, the costs and benefits for managing the urban forest can be quantified. The table below shows this data at a citywide level. The Urban Forest Management Plan also provides this level of data by management unit.

Citywide Management Unit (MU) Data*

Statistic	Citywide	
	Current	*30-year Goal*
Acres in MU	54,324	
MU as % of City land base	100%	
Canopy coverage	18%	30%
Number of trees	1,377,500	2,026,600
Plantings needed		**649,100**
One-time cost of plantings		**$114,200,000**
Maintenance Costs (yr)	$14,054,300	$21,116,300
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$20,643,000**	**$30,215,000**
Air Cleaning Value (yr)	**$4,894,000**	**$7,047,000**
Carbon Sequestration (Tons CO_2)	**52,400**	**77,066**
Carbon Sequestration (Value $)	**$1,584,000**	**$2,331,000**
Other Benefits (Energy, Aesthetics, & etc)	**$17,237,300**	**$26,342,300**
Net Benefit (All Benefits - All Costs) (yr)	$30,304,000	$44,585,000

All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

5. Moving Forward: Implementing the Plan

This Urban Forest Management Plan provides a roadmap for City staff and the community to move forward together to work toward a common set of ambitious goals. For the plan to be implemented, it needs to be institutionalized as a document requiring implementation. It also will require a stewarding group and a sense of urgency to get things started.

A broad range of actions that will forward the goal of a sustainable urban forest in Seattle over the next 30 years are presented throughout this document.

This first ever comprehensive plan for the managing and improving the condition of the urban forest is an exciting milestone. There is much to be done over time to improve the condition of Seattle's urban forest. The plan should be revisited every 5 years to celebrate accomplishments, validate assumptions, adjust goals and actions and revise data as new information is made available.

Purpose of the Plan

The purpose of the Urban Forest Management Plan is to guide a broad range of actions that will achieve a sustainable urban forest in Seattle. This is a 30-year plan that recommends the steps the City of Seattle must take to preserve Seattle's trees and the cherished environment we have come to call "a city among the trees."

What is the Urban Forest?

Stated simply, Seattle's urban forest consists of all trees in the city on both public as well as private property. This forest includes street trees, park trees, forested parklands, trees on institutional campuses, and trees in many private ownership settings. The urban forest touches the lives of Seattle's citizens every day. Whether it's enjoying a hike through old-growth forest in Seward Park or the fall colors on a drive along Lake Washington Boulevard, it is trees that comprise the urban forest and trees that make the experience magical.

Why is it Important?

Trees located throughout Seattle on public and private property affect our lives and the local economy in ways that aren't always obvious. Trees provide community, environmental, and economic benefits that range from reducing the effects of density to increasing property values to providing ecological services such as stormwater mitigation, air toxics removal, and greenhouse gas sequestration.
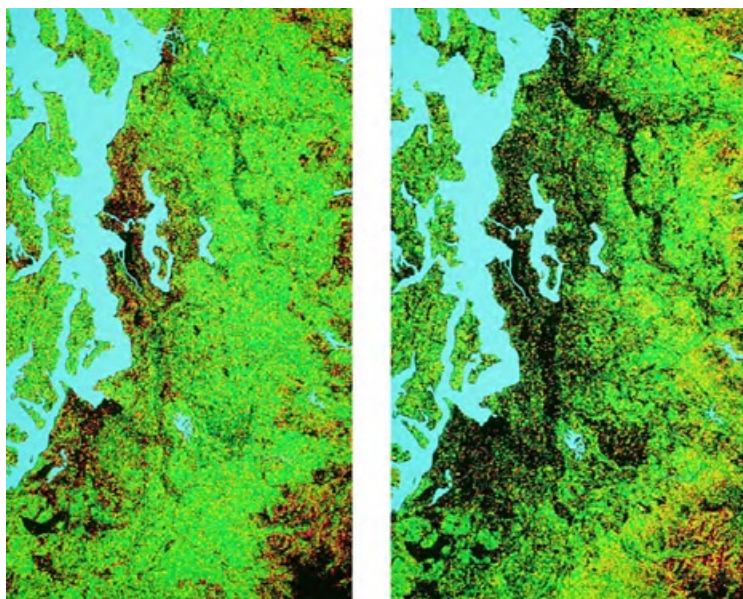
1972   1996

Tree cover loss since 1972 has cost Seattle $1.3 million each year in stormwater mitigation benefits and $226,000 per year in air cleaning value.

Seattle's First Comprehensive Urban Forest Plan

While having a positive impact, these efforts have not been enough to pre-serve Seattle's urban forest. A resource of this magnitude requires careful man-agement to ensure its preservation, restoration, and enhancement. For that reason, the Urban Forest Management Plan has been developed as a roadmap for the long-term management of Seattle's trees.

Managing trees in a city differs from managing forests in natural settings. Urban forest management goals such as increasing tree canopy, improving public safety, and providing native habitat and recreational and educational opportunities must be balanced with other goals such as accommodating growth and facilitating transportation. The Urban Forest Management Plan is the City of Seattle's plan to integrate management of the many issues and op-portunities posed by Seattle's tree resource.

Additionally, all natural systems change over time. If we want these changes to enhance the urban forest, they must be actively managed. Nationally-based studies repeatedly support the fact that the resource deteriorates when hu-man intervention is not a proactive part of urban forest management. This de-cline can be seen in many of Seattle's greenbelts where ivy is strangling trees and preventing native species from growing because historically these areas were considered 'natural' and did not require maintenance. It is also evident where trees are planted in places that either don't allow for growth or that conflict with power lines. Proactive management is needed to keep our trees sustainable and in balance with other urban priorities.
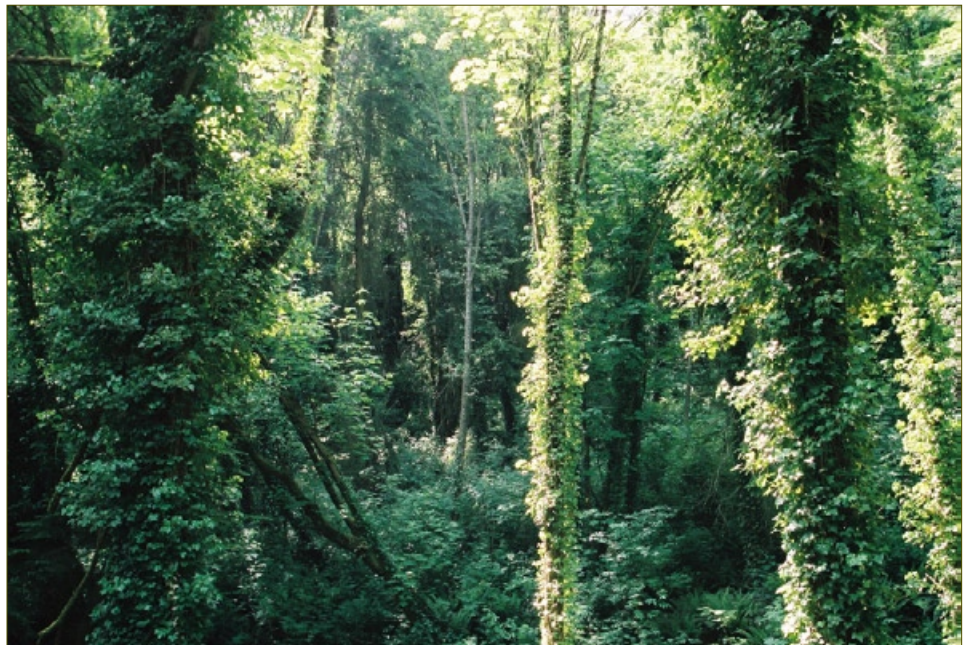
1. Urban Forest Sustainability

The primary goal of the Urban Forest Management Plan is to identify goals, recommendations, and actions that will preserve, restore, enhance, and sustain the urban forest over the long term. To assist in this rigorous task a nationally recognized Model of Urban Forest Sustainability was employed. Careful consideration was also given to how the resource has been managed in the past, what its value is today, how the resource can be sustained over time, and what set of actions will move us toward our goals. In this section, we discuss the model used to shape this plan, the history and value of the city's trees and the outcomes we expect to achieve.

1.1. An Urban Forest Sustainability Model

Unlike timber forests that are grown primarily to produce forest **products**, urban forests provide **services** such as air and water quality improvement. Urban forests are directly affected most notably by the pressures of their location in developed areas. Given this fact, management intervention is necessary to keep city trees and forest lands within cities sustainable and healthy in perpetuity. To that end, the Urban Forest Management Plan uses a planning model framework built around a basic understanding of the unique characteristics of urban forests.

Seattle's Urban Forest Management Plan is informed by "A Model of Urban Forest Sustainability" (Clark et al. 1997). This model recognizes the challenges, benefits, and opportunities unique to city trees. Seattle's sustainable urban forest model is built around four principles from this model:

- Sustainability is a broad, general goal that results in the maintenance of environmental, economic, and social functions and benefits over time.
- Urban forests primarily provide services rather than goods.
- Sustainable urban forests require human intervention.
- Trees growing on private lands compose the majority of urban forests.

Seattle's Urban Forest Management Plan has adapted the sustainability model to provide a structure that organizes our goals and the actions needed to achieve them. Although we've altered the main titles, we use the same three primary management elements as those of the model:

- **Tree Resource**: an understanding of the trees themselves, as individuals or in forest stands
- **Management Framework**: assignment of responsibility, resources, and best practices for the care of trees

Organization of the Plan

The Urban Forest Management Plan is organized into the following sections:

- Urban Forest Sustainability
- Seattle's Urban Forest Today
- Recommended Goals and Actions
- Goals and Actions by Management Units
- Moving Forward: Implementing the Plan

- **Community Framework**: the way residents are engaged in planning and caring for trees. Because most trees in the urban forest are on private property, a successful program requires that the community plant and maintain trees on their property.

1.2. Seattle's Urban Forestry History Highlights

From a Land of Giant Trees to an Urban Forest

In the 1820s David Douglas observed,

"The Douglas fir wilderness of Western Washington and Oregon, covering 55,000 square miles, was one of the treasure chests of the nation. Mile on mile, county on county, it stretched from level bay to high-hipped mountain, from river canyon to lava ridge, carpeting shoreland flat, valley and peak with an almost unbroken mantle of green".

The first European settlers to our region were awed by magnificent old-growth forests that seemed unending. Trees soon became the business of the new city with millions of board feet of lumber milled for local use or shipped to San Francisco and other ports to feed the needs of a growing nation.

The ecological impact of logging over time was enormous. Native soils were significantly disturbed, streams and the life they supported were also significantly altered, and many acres of forest lands were incrementally covered by the building footprints of the new city. Perhaps the most significant impact of early logging operations was that no seed source remained to allow second-growth forests to be repopulated with conifers. Instead, over 70% of Seattle's new forest seeded in with short-lived native maples and alders. Today, the City of Seattle owns more than 3,200 acres of these second-growth forests and most are in serious decline. In a city land-base that once enjoyed more than 53,000 acres of old-growth conifers, only slightly more than 200 acres of true old-growth forest remain today.

The urban forest contains all the trees in the city. Over time, many trees have been planted within the built environment as well as in forested parklands. The following are highlights:

- In 1884, Seattle dedicated Denny Park as its first City park. Since then, the park system has expanded to over 6,300 acres—12% of the city's land base. Today, Seattle's developed parks and boulevards contain an estimated 90,000 trees. Seattle's remaining forested parklands contain an estimated 550,000 to 600,000 trees.

- In 1903, an ordinance was passed that authorized the Superintendent of the Board of Public Works to improve the parking strips along Seattle's streets. Local Area Improvement Districts were formed to build, plant, and maintain street medians in many neighborhoods. As a result of these actions, Seattle now has over 135,000 street trees, 35,000 of which are directly maintained by the city.

- Also in 1903, the Board of Park Commissioners hired the Olmsted Brothers Landscape Architecture firm to develop a plan for a citywide park and boulevard system. The Olmsted proposal recognized existing

parks, recommended areas for future acquisition as either a developed park or natural area, and designated a system of connected boulevards and scenic roads. In 1908, the City received their "A Comprehensive System of Parks and Parkways" report: now commonly referred to as the "Olmsted Plan."

- Following the Alaska-Yukon-Pacific Exhibition in 1909, a new Municipal Plans Commission was formed to work with the board to consider land acquisition. The commission hired Virgil Bogue, a world-renown engineer who had worked previously on projects directed by Frederick Law Olmsted. Bogue proposed creating a civic center at Fourth and Blanchard. In 1927, the first phase of construction began on what would become the 87-acre Seattle Center campus.

- In 1959, a Citizen Advisory Group planning for the 1962 Seattle World's Fair proposed planting street trees along Third, Fourth, and Fifth Avenues with trees from the Central Business District to the Seattle Center fairgrounds. Weyerhaeuser donated the trees to the City, who charged the City Engineer with their planting and maintenance.

- In 1967 "Operation Green Triangle" was approved as part of the King County Forward Thrust Bond measure. This led to street beautification, including over 50 triangles throughout the city. Since then, street trees plantings have been funded by federal block grants, state grants, and City initiatives. City efforts include the Urban Tree Replacement Program at Seattle City Light, the Millennium Woods Legacy Project, and the Department of Neighborhoods Fall Tree Fund.

- In 1989 Seattle voters passed the $41 million "Open Space Bond Measure." By 1998 the original $41 million had been leveraged with other fund sources to about $100 million allowing Seattle Parks and Recreation to acquire nearly 600 acres of openspace properties, to be maintained in a natural state in perpetuity.

- In 1994 the City of Seattle allocated funds from the Cumulative Reserve Fund (CRF) for the purpose of restoring forested parklands. This action was important for several reasons. For the first time trees were identified as City infrastructure assets. This made forest restoration eligible for CRF funding. This action resulted in Park's successful Forest Restoration Program which is vastly expanded today.

- In 1994 Seattle's first Heritage Tree, a Japanese Umbrella Pine, was recognized by the City Council at the Curry Temple, 172 – 23rd Avenue.

- In 1999/2000 Seattle implemented the Millennium Woods Legacy Project, which resulted in the planting of nearly 26,000 new trees throughout the city on both public and private property.

- In 2000 the Pro Parks Levy was passed by Seattle voters. The levy contained funding for a third tree crew in Parks, creation of an Urban Forest Crew Chief position to supervise all parks tree crews, and a 3-person Natural Area Crew dedicated to maintenance work within forested parklands.

- In 2001 the Seattle City Council passed, and the Mayor signed into law, a Tree Protection Ordinance number 120410, which applies to trees on undeveloped land and allows for the added protection of trees during development.

- In 2001 Dutch Elm disease was discovered in Seattle. The City responded quickly by providing emergency funding for control of the spread of the disease.

- In 2004 the Green Seattle Partnership was formed. The partnership is a collaboration between the City and the Cascade Land Conservancy with the single goal of restoring 2,500 acres of forested parklands by the year 2025.

- In 2005 Mayor Greg Nickels issued an Executive Order directing City departments to replace every tree removed from city property with two new trees, a step that will help ensure Seattle remains a truly 'green' city (this order does not pertain to City park forested lands, which are part of a separate reforestation program or to trees that are lost to wind storms or similar natural causes).

- In 2006 the draft Urban Forest Management Plan was released for public comment by Mayor Nickels. The mayor set a goal of increasing Seattle's tree coverage from its current 18% to 30% over the next 30 years—or by about 650,000 new trees. To help launch the effort, the mayor announced the City of Seattle will give away 2,000 coupons for free trees in the fall of 2006.

- In 2006 Mayor Nickels launched the Seattle Climate Action Plan, the cornerstone of the effort to reduce the city's greenhouse gas emissions by 680,000 metric tons and meet the 2012 international goals of the Kyoto Protocol. The plan builds on a strong environmental foundation in Seattle. The mayor's 2007-2008 proposed budget calls for a $37 million investment over the next two years to reduce emissions. Thirty-four million dollars of this amount is part of the Bridging the Gap proposal. Bridging the Gap (passed by voters in 2006) contains funding for an additional SDOT tree crew as well as bicycle and pedestrian safety improvements, including new and extended bikeways, sidewalks, and trails.

1.3. Environmental, Economic and Social Value of the Urban Forest

Sustainable urban forests result when ". . . naturally occurring and planted trees in cities are managed to provide the inhabitants with a continuing level of economic, social, environmental, and ecological benefits today and into the future" (Clark et al. 1997). As can be expected, healthy, well-managed forests provide greater amounts of these benefits than forests that are poorly maintained and less healthy.

Environmental Values

We know that Seattle's urban forest is home to wildlife. Within Park-owned properties alone, more than 250 terrestrial vertebrate species (8 amphibian, 7 reptilian, 225 avian, 21 terrestrial mammalian, and 10 marine) are known to occur. The trees found in Seattle's forested areas and watersheds provide valuable terrestrial and aquatic habitat. At the same time, trees provide shade that cools streams, intercepts rainwater and lessens the impacts from storm events. As a result, fluctuations in stream flows are reduced and stream water quality is improved, which positively affects fish and other aquatic life. An aerial view of a typical Seattle residential neighborhood reveals another interesting environmental benefit. Homeowners tend to plant the back of their property more heavily than the front. When viewed from above, these trees grow together often forming substantial linear forested stretches that provide added habitat and forest connectivity.

In addition to making our city more livable for a growing population, Seattle's urban forest provides habitat to a variety of wildlife and native and migratory songbirds. Specific programs like the Backyard Wildlife Sanctuary Program administered through Washington State Fish and Wildlife encourage urban stewards to create habitat that supports dwindling urban wildlife populations. Typically this involves an emphasis on planting native plants. In general, there has been a trend in the Seattle area for a number of years to favor native plants over ornamentals when possible for a variety of environmental reasons.

Economic Values

Have you ever thought of a tree as a stormwater conveyance system? Probably not. When thinking of public infrastructure such as stormwater drainage systems, we typically think of the highly engineered systems of pipes and pumping stations, built of steel and concrete and requiring major capital investments to develop and maintain. However, 'Green infrastructure,' notably trees,

Green Infrastructure vs. Global Warming

When seen from space, Seattle is quilted with streets, building roofs, parking lots, patches of trees, boulevards, parks, and waterbodies. Collectively, the planted ('green') component of our city influences air and water temperatures, air and water quality, and surface water runoff. Our green infrastructure is an important means of reducing global warming.

also provides 'ecological services' that include the ability to capture rainwater to reduce stormwater runoff and flooding. The real dollar value of these ecological services can be many millions of dollars annually, particularly for the Pacific Northwest where stormwater control is a very important issue.

Trees also improve air and water quality, and sequester global warming pollution. Many recent studies estimate a dollar value for these benefits as well. The extent of economic value attributable to the urban forest is directly related to the amount and condition of existing tree canopy. If we manage Seattle's urban forest well, we can maximize the ecological services that these trees provide at substantially less cost than the concrete and steel alternatives. It's a bargain that brings with it many companion benefits.

Just as we do for engineered infrastructure, it is important to consider the value of these ecological services when budgeting for the management of the city's green infrastructure. Seattle's innovative pilot Street Edge Alternatives project (SEA Streets) is a great example.

Value of Seattle's Urban Forest

The city's trees provide an economic benefit of $20,643,000 in stormwater retention and $4,894,000 in air cleaning each year.

These projects are designed to provide drainage that more closely mimics the natural landscape before development. Two years of monitoring show that SEA Street projects reduce by 98% the total volume of stormwater leaving the street during a 2-year storm event. In 1999, the City of Seattle asked American Forests, a leader in the science and practice of urban forestry, to conduct an 'Urban Ecosystem Analysis' using their CITY Green software combined with Global Information System (GIS) technology. Based on satellite imagery from 1972 to 1996, the study found the following (Figure 1):

- The average tree canopy coverage for Seattle is 18%, too low by national standards.
- Canopy Loss is Expensive

The American Forest group's 1999 analysis concluded that between 1972 and 1996, Seattle lost 46% of its heavy tree cover and 67% of its medium tree cover.

That loss costs Seattle an estimated $1.3 million *per year* in rainwater storage and management capacity and $226,000 per year in air pollution-related health care costs.

- In 1972, areas with heavy tree canopy coverage (50% or greater) comprised 10% of Seattle's 54,000 square acres, or 5,400 acres.
- By 1996, areas with heavy tree canopy coverage (50% or greater) had decreased by half, to 5% of Seattle's 54,000 acres, or about 2,800 acres.

Figure1. Tree Canopy Cover in Seattle
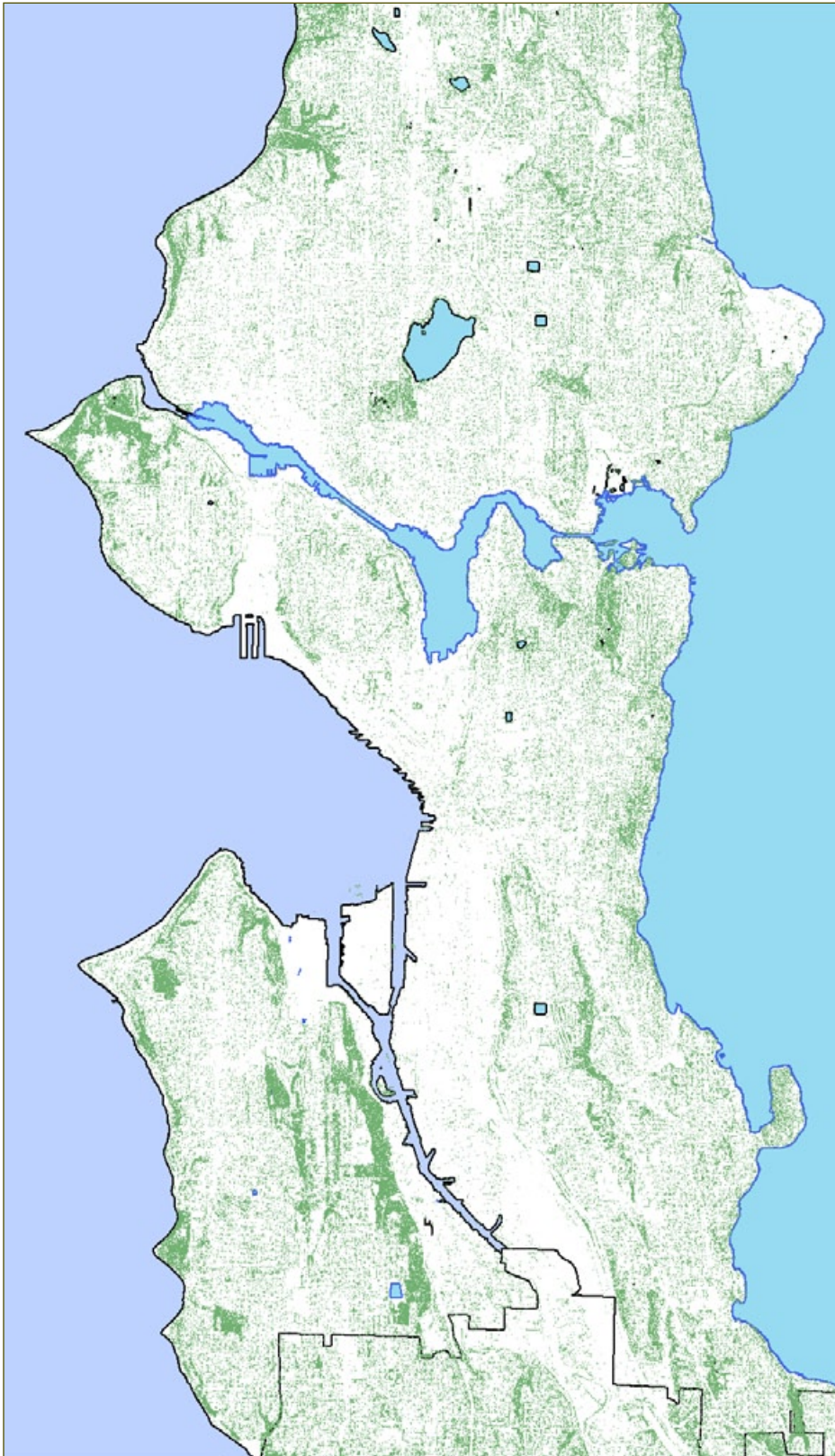
Economic implications of canopy loss for stormwater management and clean air were clear:

- The total stormwater retention capacity of Seattle's urban forest cover was reduced by 27% from 1972 to 1996.

- This tree loss in Seattle from 1972 to 1996 resulted in an estimated 7.5 million cubic feet (cf) of additional stormwater runoff.

The lost tree canopy would also have removed many thousands of pounds of the pollutants sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and particulate matter of 10 microns or less from the atmosphere annually. The net result— which also carries a cost— is dirtier air in Seattle.

Based upon the above, one would assume that restoring and enhancing Seattle's tree canopy coverage would reverse these trends and would increase the stormwater and air cleaning values of the urban forest, and such is the case. By applying cost/benefit modeling provided by the *Western Washington and Oregon Tree Guide: Benefits, Costs and Strategic Planting* (McPherson et al. 2002), it has been determined that an increase in Seattle's tree canopy coverage from the present 18% to 36% would more than double current environmental and economic benefits. The values are based upon the assumption all current canopy is retained and continues to grow, while new canopy will be added and will grow. Two other assumptions were made:

- The tree canopy lost over time would also have removed many thousands of pounds of the pollutants sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and particulate matter of 10 microns or less

- The additional tree canopy would remove air pollutants annually, at a total value of about $9.8 million per year.

The stormwater retention capacity of the urban forest would also more than double at an annual value of $41,300,000 million per year.

Many other cities have undertaken similar urban forest ecosystem analyses. A 2002 San Antonio study showed that a 20% canopy cover provides a one-time savings of $1.35 billion in construction costs for flood control systems and sewers. The San Antonio study estimates a 25% canopy cover would avoid having to pay for an additional stormwater storage capacity of 65 million cf (valued at $129 million). In 2003, a New York City pilot study of urban trees placed a value of $9.5 million/year in anti-pollution benefits. The study concluded an average cumulative lifetime value of $3,225 per tree. See Appendix A for the methodology for deriving ecological services data.

In addition to their widely recognized aesthetic worth in an urban setting, trees provide other significant economic value that can be measured. Recent studies from the University of Washington's Center for Urban Horticulture, and other universities, have shown that trees positively affect the economic vitality of communities in the following ways:

- Higher property values
- Lower crime rates
- Higher shopping frequency
- Higher office occupancy rates
- Reduced health care costs

Social Values

Street trees keep streets and sidewalks cool in the summer and provide scale and interest in the winter. They also calm traffic and separate pedestrians and vehicles. Seattle's system of tree-lined bike and pedestrian trails are well used and valued as a resource to promote exercise and a healthier lifestyle. Trees have been shown to improve hospital recovery times, reduce air pollution and stress on children with asthma, and improve children's performance in school. Trees are often the primary 'architectural' element in our developed parklands and, as such, define functional use areas, and add significant aesthetic character. Natural areas in City parks give urban residents access to trails and environmental learning opportunities that help keep us connected to the needs of fish and wildlife and the experience of being in nature while in the city. The presence of many trees can often define a neighborhood, and conversely, the absence of trees can do the same.

As mentioned earlier, many studies show that people enjoy trees and are more comfortable in the presence of trees than they are without them in a landscape. The fact that many people plant a tree in memory of a loved one is a strong indication that we see trees as symbols of life and longevity.

1.4. Goals of the Plan

Defining specific goals within each of the three elements of the plan will help guide development and prioritization of the broad range of actions necessary to achieve our vision of a sustainable forest in Seattle. Some of the overarching considerations that have heavily influenced the direction of the plan include the following:

- **Increased environmental and engineering benefits from trees**. In cities, trees and their understory perform as green infrastructure, slowing and holding stormwater, reducing erosion, buffering waterbodies from polluting runoff, and cleaning the air of airborne pollutants. As the extent and health of an urban forest increases, so does its capacity to provide these green infrastructure benefits in greater amounts.

- **Improved condition of the urban forest**. An urban forest that is managed sustainably is healthier—allowing more trees to mature and more species to thrive. Healthy forests ultimately increase the ecological, social, and economic benefits of the forest and improve forest management efficiency.

- **Standardized maintenance practices**. Each of the City departments with responsibility for the urban forest will share standardized maintenance practices. Standardized practices increase overall consistency in how trees are maintained, resulting in better tree health and longevity.

- **Equitable urban forest resource allocation citywide**. It's important that the City and its partners allocate urban forest management resources in a manner that recognizes geographic, racial, and social equity.

- **Optimized opportunity for partnerships in urban forest preservation and enhancement**. A community—residents and businesses alike—that is provided a clear picture of the priorities, scope, timing, and resources for achieving a thriving urban forest is more likely to invest their energy and resources to help achieve that vision.

- **Policy direction or recommendations for Seattle's trees**. Issues like private views versus public trees are commonplace in Seattle. Another continuing policy discussion point is the role that trees do or do not play in the behavior of transients.

- **A document for community education and action**. City trees need to be actively cared for and managed to be healthy, safe, and coexist with homes, streets, businesses, parks, and natural areas. An urban forest management plan that provides the public with a vision for a healthy and sustainable urban forest—as well as a roadmap for getting there—will inspire more people to become informed and involved as stewards to guide and support future sustainable tree practices and policies. The specific goals of this plan are shown in Table 1:

Table 1. Seattle's Urban Forest Framework and Goals

Tree Resource	Management Framework	Community Framework
Understand the characteristics and complexity of Seattle's urban forest Maintain trees to promote health and longevity Maximize canopy cover and optimize age and species diversity Maximize the ecological and environmental benefits of the urban forest	Facilitate interdepartmental communication and cooperation to provide decision-makers the information they need to implement the UFMP Develop and implement resource management tools Preserve and protect existing trees, and encourage new tree planting throughout the city by improving management of trees on private property Model good stewardship in City practices	Enhance public awareness of the urban forest as a community resource Engage the community in active stewardship of the urban forest Promote citizen-government-business partnerships

Achieving these goals will result in the following outcomes:

- Improved condition of the urban forest in terms of increased canopy, health, and diversity
- Increased ecological service benefits such as stormwater mitigation benefits
- Clear policy framework to guide City actions
- Consistent approach to urban forest management and public outreach among City departments
- Improved management and accountability within City government
- Equitable distribution of urban forest resources across the city
- Engaged and informed community

2. Seattle's Urban Forest Today

A comprehensive resource management plan must begin with a thorough understanding of the resource itself. This is accomplished through an inventory and assessment process. This process identifies the current state or condition of the resource and highlights both challenges and opportunities for future resource management. For the purposes of the UFMP, the three key elements of the sustainability model provide the framework for this inventory and assessment. Some of the specific challenges facing Seattle's urban forest are listed below. An expanded assessment of Seattle's Tree Resource, Management Framework, and Community Framework, found later in this section, describes how Seattle's urban forest has held up after decades of these pressures as reflected in current conditions. The following are the current challenges to Seattle's urban forest:

Tree Resource:

- The loss of trees due to development
- Competition and damage from invasive plants
- Nuisance pests and diseases: tent caterpillars, aphids, fall web worm, anthracnose, other leaf spots
- Serious pests and diseases: gypsy moth, cherry bark tortrix, armallaria, honey locust pod gall, Dutch elm disease, anthracnose.
- The introduction of pathogens that directly impact natives: madrona trees and Western red cedars
- Inadequate age and species diversity
- Trees sensitive to the compaction and root disturbance common in almost all urban areas: big-leaf maple and Western hemlock
- Constrained settings like narrow planting strips, tree pits and grates
- Impacts from traffic including air pollution, accidents, breaking low hanging limbs

Management Framework:

- Limited maintenance budgets to care for City-owned trees
- Inadequate tools for monitoring and managing City-owned trees
- Insufficient incentives and regulations to preserve and encourage planting of trees on private property
- Lack of a plan that defines critical importance of green infrastructure and establishes goals and sets priorities to inform management and budgets for trees

Community Framework:

- Lack of broad-based community appreciation of the benefits of professional tree management
- Lack of understanding of proper tree care requirements and practices
- Competition for space lost to development
- Residents' desire for views and light on their property

2.1. Tree Resource Assessment

The urban forest can be evaluated using many factors, including extent of tree canopy, species diversity, age, and health of trees. As previously discussed, canopy cover in Seattle has declined to 18%. Shrinking canopy cover, necessarily has the companion effect of reducing the value of environmental and ecological services of the urban forest. These facts underpin the importance of preserving Seattle's existing trees, particularly the badly out-numbered large conifers.

Urban trees are under pressures not present in native forests and require active management intervention to sustain them. Urban trees lack some of the natural buffers and protection found in wildlands. In native forests, the correct combination of soil micro-organisms, understory plants, an ample seed source, number of trees, and variance in topography, and stable hydrology all contribute to impede or stop extensive destruction due to diseases, insects, and invasive plants.

Diverse tree composition reduces the risk of major losses to virulent pathogens such as chestnut blight or Dutch elm disease. While experts debate the recommended maximum percentage of a single species in the tree population to be either 5% or 10% (Barker 1975, Miller 1991), the number of genera (subdivisions) and species that thrive in Seattle allows for increased diversity to safeguard against disease.

Tree selection in the urban environment is usually driven by site conditions that have been shaped by previous development and current land use much more so than to the natural conditions that sustain native northwest forests.

Sites within the city that are well suited to the protection, planting, and long-term management of native species common to our native forests are important to identify and to preserve.

Sites that have been significantly altered and constrained by development provide uniquely challenging opportunities for protection, planting, and long-term management of species biologically adapted—either by nature or by the horticultural industry—to thrive under the conditions presented.

What is a Tree?

A tree is a single or multi-trunked plant capable of attaining a height of at least 15 feet and traditionally referred to as a 'tree' in common reference materials such as the Sunset Western Garden Book or similar publications.

Forests are not static—native forests undergo change through succession and urban forests undergo change in reaction to impacts by humans with species selection requiring ongoing adaptation to optimize the potential of the site. Factors to consider beyond the visually obvious (size, shape, and aesthetic appeal) include:

- Horticultural requirements for drainage, soil conditions and solar exposure
- Community interests and priorities
- Habitat value for urban wildlife
- Size of available space and location of buildings, paved surfaces and utilities

Other pressures on trees in the urban environment are from development. These threats include land clearing to accommodate growth and views and tree removal to reduce conflicts between trees, power lines, and street signs and to provide sight lines along roadways.

Street Trees

Seattle's estimated 130,000 street trees have a broad range of sizes. Some of our older trees were planted as part of coordinated projects in the 1920s and 1930s and others in the late 1960s and early 1970s. In the past 20 years, there have been several focused tree plantings that have created more tree-lined streets organized by the Seattle Department of Transportation (SDOT), the Department of Neighborhoods, Seattle City Light, nonprofits, neighborhood and individual residents. Seattle street trees range in size, but, overall, tend to be much smaller when compared with other cities with longer histories of street tree planting and with wider planting strips.

Based on inventory data from 1992 and visual observations, the size distribution of street trees in residential areas has not changed much in the last 10 years. Nearly 50% of residential street trees have diameters of 5 inches or less and are relatively young. Many others are larger, with diameters of 6 to 20 inches, yet are young enough to provide benefits for many more years. With the exception of a few streets with mature plantings, private yards provide space and support the growth of many of the larger trees in residential neighborhoods.

Seattle's current tree inventory includes 105 different genera (subdivisions) and over 310 species. Diversity, however, is a problem because 67% of the street tree population is made up of just 7 genera (Table 2). Prunus (cherries, plums and laurel) are most widely planted at 24%. The maples (Acer) rank sec-

ond at 18%. Together, Prunus and Acer comprise 42% of Seattle's street trees, a number that violates the general recommendation that no more than 10% of any one genus predominate the urban forest.

Table 2. Seattle Street Tree Genera Mix (2006)

Genera	Common Name	Percent
Prunus	Cherry/Plum/Laurel	24%
Acer	Maple	18%
Crataegus	Hawthorn	7%
Malus	Apple	6%
Quercus	Oak	4%
Fraxinus	Ash	4%
Tilia	Linden	4%
Other	Pear, Sweet Gum, etc.	33%

A number of issues threaten the viability of Seattle's street trees. In the downtown core and other commercial zones, small tree pits and failure to maintain tree grates or prune surface roots can cause root/trunk girdling, shortening the tree's lifespan. Soil compaction and bike and vending machine locks also stress these trees and damage their roots and trunks. Vandalism and car crashes also cause some damage and loss. In the mid-1970s in residential areas and along arterials many trees were planted in substandard planting strips and inappropriately under power lines. A number of these trees are now outgrowing their planting strip or tree pit. Those under wires have been repeatedly topped, which is no longer an acceptable management practice. Tree topping results in poorly attached quickly growing sprouts that require frequent pruning and weaken the tree structure. When street trees are removed, replacement may not be an option, due to incompatibility with current planting standards. Seattle's street tree locations are shown on Figure 2.

Although large trees are a rather small part of Seattle's total street tree population, people consider them highly important and resent the aesthetic impact of their loss. For example, a 40-year-old tree is perceived to be a large tree according to a study on the benefits of trees in business districts (Wolf 1998). Outreach, public notification, and education provide information about why trees are being removed, but public response can be emotional and focused on saving individual trees regardless of their condition.

Figure 2. Street Trees and Parks Owned by the City of Seattle
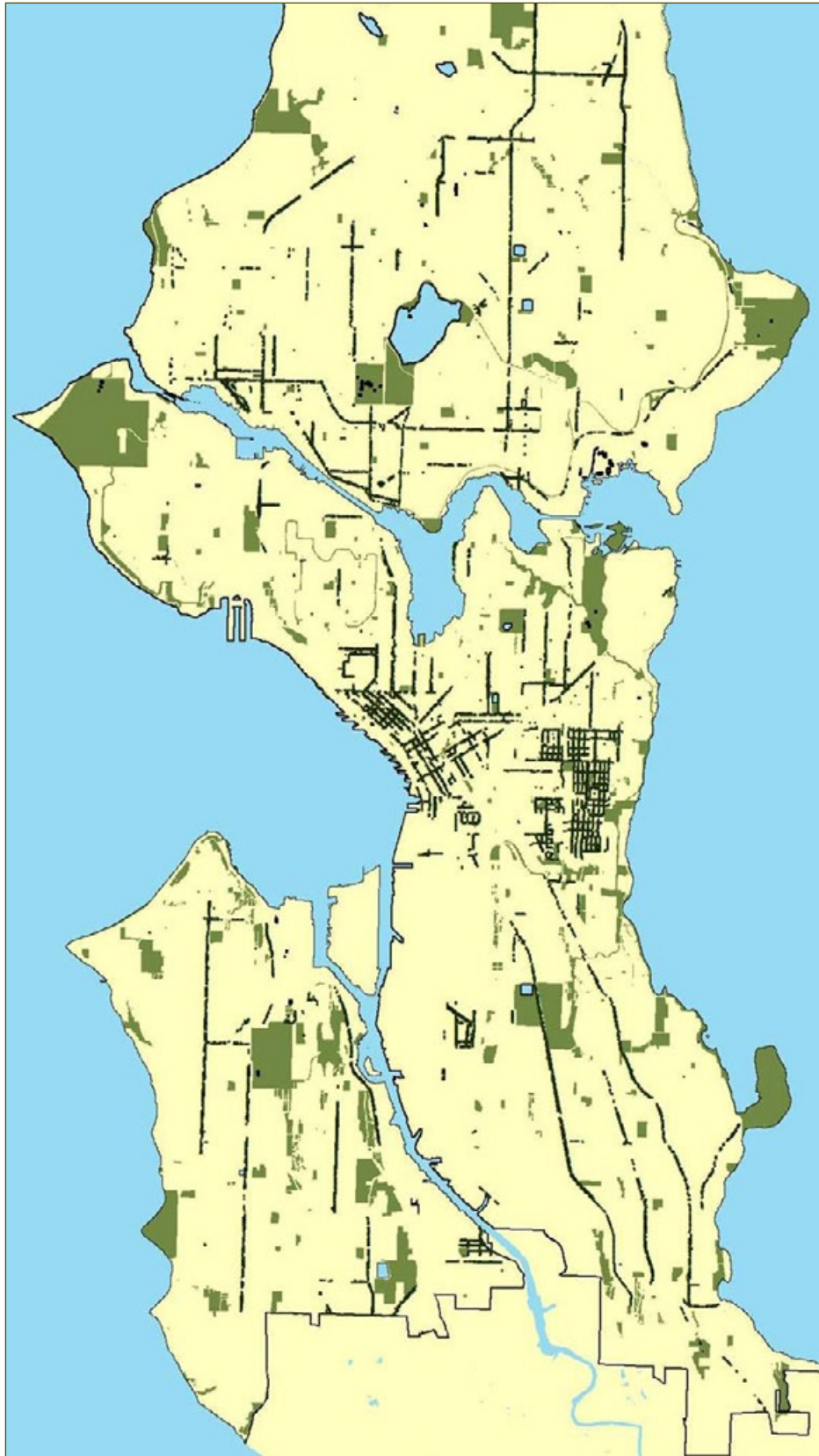
SDOT requires developers to preserve healthy street trees with an extended useful life when they are compatible with projects. Redevelopment may require tree removal when preservation is not an option. With new construction, however, stressed or ill-suited trees get replaced with trees better suited to site conditions and new construction allows for introductions of new species.

Parklands

Trees in Seattle's parks are found in two types of areas: developed parks or forested parklands.

Developed Parklands

The approximately 90,000 trees in Seattle's developed parks have great species diversity as well as size distribution. This distribution is a result of the staged growth of the park system. In addition, the older and larger trees of Seattle are typically found in parks across the City. Parks typically offer large areas free of the buildings and paved surfaces associated with developed properties. These parks provide trees with the space to grow and fully mature.

Over time, tree replacement in City parks has been uneven. Trees in high visibility park locations, such as Parks-owned boulevards, have been replaced more quickly than trees in less visible areas. In recent years, the construction of new parks has allowed additional trees to be planted. Historically, the net effect has been to plant at least one tree for every three trees removed in developed parks. New tree replacement funding in the 2007/2008 biennium will allow parks to increase its tree replacement ratio to about 1:5 new trees for every tree removed.

Forested Parklands

Seattle's forested parklands have too few conifers, too many deciduous trees, and too many non-native invasive plants when compared with native ecosystems. As discussed earlier, this condition is a result of clear-cutting decades ago. With no conifer seed source, the forests reseeded to alder and big-leaf maple, both relatively short-lived species. Forest restoration projects are working to combat this situation. Thousands of seedlings are planted during restoration activities each year with support from thousands of citizen volunteers.

The understory diversity depends on the structure and climate provided by the conifers of the Northwest. Additionally, the mature height of native trees (200 to 300 feet in deep forests) allows a larger volume of leaf area in a smaller footprint, vastly increasing the production of ecological benefits such as air cleaning and stormwater retention and interception.

What's A Tree Worth?

The number of trees in Seattle's urban forest is conservatively estimated at 550,000 to 600,000 trees, with a monetary value of over $1 billion.

This estimate encompasses both street and off-street trees, including trees in parks and greenbelts.

The Green Seattle Partnership formed in 2004 is focused on park forest lands with the goal of restoring 2,500 acres of these properties to a sustainable state by the year 2025.

Private Trees

About 74% of Seattle's land base is privately owned and includes a wide spectrum of land-use types ranging from single-family to industrial and institutional. Although there is no inventory, it is apparent from looking at trees on private property, that there is a wide spectrum of tree density, age, and sizes throughout Seattle's neighborhoods. While some areas of the city enjoy proximity to nearby greenbelts, ravines, and parks, there are other neighborhoods that are defined by towering stately street trees with welcoming green archways. Some neighborhoods to the north still have scattered stands of remnant second- or third-growth conifers. Conversely, some neighborhoods have little mature canopy cover. Throughout the city, there are opportunities to plant new trees.

The greatest loss of Seattle's tree canopy has been from private property. While most Seattle residents value and enjoy trees, there are situations where trees are regarded as troublesome and either removed or topped (a very poor maintenance practice) for blocking views and sunlight or dropping leaves or fruit. While trees in business districts may be appreciated by shoppers, business owners may have concerns with their signs being visible and with maintenance. Trees in parking lots offer shade but may reduce the number of stalls. On institutional and industrial campuses trees soften buildings, absorb noise and dust, and provide outdoor space for employees and visitors to enjoy, but trees require an investment in maintenance.

Improper maintenance impairs tree health and shortens tree lifespan. Being the owner of healthy trees requires an investment in proper maintenance. Seattle has many good arborists and PlantAmnesty, a local not-for-profit, has done much to teach people how to correctly prune. They have also worked hard to foster public awareness that tree topping is bad for tree health and creates ugly and unsafe trees. Education is an ongoing process, but even for people who know how to prune, it is difficult and sometimes costly to prune mature trees that require climbing, large equipment, and specialized skills. These challenges have lead to relatively poor tree maintenance practices on private property overall.

Tree Removal

As part of any comprehensive forest management plan, sometimes trees need to be removed. The conditions that require such action include hazard tree reduction, changes in facility use, new development, trees that have outgrown their space due to poor initial tree selection and for similar reasons. The removal of trees can cause substantial community concern and even litigation. Even the removal of trees at designated public viewpoints can be controversial. The City takes these community concerns quite seriously and seeks to do its best in demonstrating to the public sufficient justification for the removal of trees.

Trees and Climate Change

The debate may still be underway regarding how human actions may influence and impact the scope and timing of potential global warming and companion climate change. However, one thing we do know with greater certainty is that many plant species do not require a substantial change in their environmental conditions to be greatly effected. It is entirely possible that the species composition of Seattle's urban forest 50 or 100 years from now will include species that we currently do not or cannot grow. The city's urban foresters, landscape architects, and horticulturists will need to be particularly attentive to changes and trends in the environment that may require them to make adjustments to our planting palettes. As well, changes in climate may also make it easier for invasive non-native species, flora and fauna, to find a new home in the Pacific Northwest to the detriment of our indigenous species.

Invasive Species:

Over the years many tree and shrub/ground cover plant species have been introduced to the Seattle region only to see them become invasive, threatening the native species. Trees like Norway maple, hawthorn, English holly and others now flourish in our forests in place of more desirable native species. Likewise, shrubs and ground covers like English ivy, Himalayan blackberry and Japanese knotweed threaten our forest floors and riparian corridors. Not only should we avoid planting these species, we should also support programs that will remove these invasive plants over time.

Trees and Views:

Private views, or the potential for private views, often include publicly-owned trees. For some, there is value in seeing distant panoramas and for others their view out to the street is an important value that contributes to quality of life. For many, neighboring trees either frame a 'territorial' view or are the view. Views are subjective and are defined by changing landscapes that often involve other property ownership. Being situated on a set of hills, Seattle is a city of views. To ensure that all residents can enjoy the opportunity the Seattle landscape provides, over 85 sites throughout the city are protected by state environmental law for their public view. For each of these sites, the view or view corridor has been carefully mapped.

Because of the amount of land it manages, Parks typically deals with more view issues than the other City of Seattle departments. It would be fair to say that Parks and the City's perspective on providing private view relief have changed over time. Until the late 1980s, the City still allowed publicly-owned trees to be topped to retain or create private views. By 1990 that practice was no longer allowed.

Current City of Seattle policy on private views and public trees is best represented in Seattle Parks and Recreation's tree policy. That policy, revised in 2001, clearly states that public trees cannot be topped or removed for the purposes of retaining or creating a private view. Park's policy is to permit view relief only if it can be accomplished through pruning that meets the City of Seattle's arboricultural standards, and is performed by certified arboricultural contractors under the direction of Park's Senior Urban Forester.

2.2. Management Framework Assessment

This section describes the current City of Seattle framework for managing the urban forest resource.

Interdepartmental Coordination

Effective interdepartmental coordination is essential for consistent delivery of urban forestry programs. "A Model of Urban Forest Sustainability" (Clark et al. 1997) describes this ability as the ". . . degree to which all city departments operate with common goals and objectives."

Urban Forest Coalition

The Urban Forest Coalition was formed in 1994 to provide a venue for coordinating development of tree-related policy, programs, and budget initiatives that need Citywide direction. It is a cooperative effort of nine City departments that have tree management responsibilities (Table 3).

By providing an opportunity for representatives to meet regularly, the coalition allows members to keep each other informed of actions that will impact the urban forest and that are either undertaken or proposed within their departments. As needed, coalition members also consider matters of urban forest management philosophy and policy and recommend action.

Beginning in 2007, it is anticipated that the primary role of the Urban Forest Coalition, as reflected in its annual work plan, will be the phased implementation of the Urban Forest Management Plan.

Interdepartmental Programs

Additionally, City departments have collaborated on several individual programs. the Green Seattle Initiative was launched on Earthday 2004 by Mayor Nickels and has three goals:

- Save Seattle's public forests
- Make Seattle's Neighborhoods greener
- Promote 'green' urban development

Seattle's Clean and Green Seattle program includes a Parks and SDOT 'green' element in each of the monthly litter and graffiti control projects undertaken in a selected Seattle neighborhood. On a larger scale, the Green Seattle Partnership brings Parks, SPU and the Office of Sustainability and Environment together with the Cascade Land Conservancy to restore 2,500 acres of forested parkland by 2025. This 20-year project leverages extensive volunteer support to remove invasive plants and restore the forest in a staged, multi-year effort.

Many Trees — Many Missions

Trees are managed within departments to meet differing functional goals that match each department's mission:

• Seattle Department of Transportation plants and maintains 35,000 street trees and regulates planting and maintenance of another 90,000 street trees. They must balance canopy cover goals with the need to minimize tree conflicts with surrounding infrastructure and transportation safety requirements.

• Seattle City Light prunes trees in the utility corridor to maintain electrical safety and, when necessary, replaces trees. City Light is challenged by the planting of inappropriate trees that grow into utility lines.

• Seattle Parks and Recreation manages 90,000 trees in developed parks and over 500,000 trees in the forested areas of parks. Parks must balance a wide range of recreational goals including the desire for picnic, sports, and play areas.

• Seattle Center manages trees in a campus-like setting designed for neighborhood use and as a festival space where large crowds impact trees. Trees at the Center strongly influence use and character of the site. A few disease-prone species were widely planted in the 1960s. Many of these trees are reaching the end of their natural lifespan.

• Seattle Public Utilities as part of its stormwater, flood control, and aquatic resources protection programs, SPU manages trees along creeks in the City to maintain healthy riparian and fish habitat.

• Department of Planning and Development regulates tree preservation and planting during design and construction to protect special trees and critical areas while allowing development.

• Office of Sustainability and the Environment leads the City's Urban Forest Coalition and manages and tracks the Mayor's Environmental Action Agenda. Enhancing the urban forest is a top priority.

Table 3. City of Seattle Urban Forest Responsibilities by Department

Department	Responsibilities
Seattle Parks and Recreation (Parks)	Parks manages trees distributed over 6,000 acres of developed parks, boulevards, natural areas, and other publicly-owned open spaces. The staff consists of a Senior Urban Forester, a Forestry Crew Chief and three 3-person tree crews. Staff is responsible for tree maintenance and response to citizens and City staff on tree-related issues: view pruning, hazard trees, and damaged trees and sidewalks. An urban forester heads the Forest Restoration Program (CRF-funded). Begun in 1994, the program is designed to plan for the restoration and long-term health and integrity of forested parklands. A 3-person Pro Parks Levy-funded Natural Area Crew is focused on forest restoration and trail maintenance work. Parks Trails Restoration Program is the Forestry Unit's CRF-funded program. It's focused on the re-building and restoration of existing park trail systems. Two full-time positions are assigned to this program.
Contact	Horticulture & Forestry Manager, 206-684-4108 Senior Urban Forester, 206-684-4113 Parks tree maintenance: http://www.ci.seattle.wa.us/parks/Horticulture/treemaintenance.htm Forest restoration: http://www.ci.seattle.wa.us/parks/Horticulture/forestrestoration.htm
Seattle Department of Transportation (SDOT)	SDOT Urban Forestry is responsible for design, installation, and stewardship of trees and landscapes associated with public ROW. Seattle has over 130,000 street trees. SDOT is responsible for maintaining 35,000 of these. The remaining 90,000 are the responsibility of adjacent property owners. SDOT-owned street trees have an estimated, conservative value of over $100 million. The Urban Forestry Manager, plus two administrative support positions provide overall program direction and management support. The City arborist regulates planting, pruning, and removal of street trees through SDOT's permitting process A Senior Landscape Architect is responsible for incorporating trees in new street projects and for the preservation of trees along SDOT rights of way. Six arboriculturists coordinate with private property owners on tree work permits, coordinate with contractors on tree planting and preservation issues, and assist with coordination of neighborhood projects and volunteers who maintain traffic circles and other streetside plantings throughout Seattle. Two, 3-person tree crews maintain the 35,000 trees under SDOT jurisdiction. In addition, 11.5 gardeners and two Irrigation Specialists are supervised by one Landscape Supervisor. A portion of the work of this crew also directly supports trees on SDOT properties.
Contact	Urban Forest Manager, 206-233-7829 City Arborist 206-615-0957 http://www.cityofseattle.net/transportation/forestry.htm
Seattle Center	Seattle Center is a unique 74-acre campus. It hosts hundreds of community events and three major festivals each year. There is constant pressure on the trees and landscape from resident organizations, promoters, and citizens. Seattle Center landscape staff must diligently protect trees from a wide variety of potential abuses. Landscape staff is responsible for health and maintenance of about 750 trees (excluding street trees). This work includes protecting trees during construction (a frequent site condition over the past several years) and identifying and removing hazard trees. As in any widely used civic space, there is pressure to remove trees to increase visibility for signage, clearances, art work, and public safety.
Contact	Landscape Supervisor, 206-615-0364

Department	Responsibilities
Seattle City Light (City Light)	City Light's primary urban forest responsibility is tree pruning and trimming for electric line clearance. By law, only electrically qualified journeymen tree trimmers who are certified annually to do line clearance work are allowed to prune trees within a 10-foot radius of energized electric wires. Electrical lineworkers may trim trees in an emergency. Pruning is contracted out. In 2005, 8 contract crews performed work for all City Light territory compared with 15 or 16 crews in the late 1990s. Other City Light responsibilities include emergency tree removal when a line is down, an urban tree replacement program, notification of the public before routine pruning, and substation landscape maintenance.
Contact	Arboriculturist, 206-386-1902
Seattle Public Utilities (SPU)	Urban forest health has recently become an area of interest for SPU, primarily as a component of the Urban Creeks Legacy Program. This program focuses on the relationship between a healthy urban forest and a natural drainage system of streams, lakes, and Puget Sound capable of supporting protected fisheries populations. Increasingly, SPU partners with SDOT and Parks to enhance neighborhoods and parks in rebuilding habitat for fish. SPU's role in the urban forest also extends to its Natural Landscape Program (aimed at the public) and its construction practices/specifications associated with installing water and sewer lines under ROW planting strips.
Contact	206-733-9157
Office of Sustainability and Environment (OSE)	OSE is a member of the Urban Forest Coalition and specifically tasked with helping to do the following: Provide interdepartmental coordination Support policy/program consistency with the Mayor's Environmental Action Agenda Achieve broader awareness in City government of the economic, social and environmental value of a healthy urban forest. OSE led development of the Urban Forest Strategic Plan, chaired the UFC for several years, and provides a leadership role in the Green Seattle Partnership along with Parks and SPU.
Contact	206-386-4595 http://www.seattle.gov/environment/
Department of Neighborhoods	Since 1996, the Neighborhood Matching Fund's Tree Fund program has provided over 17,200 trees to over 600 neighborhood groups for Seattle's streets and parks. Groups of five or more households on residential streets with planting strips and sidewalks can apply for 10 to 40 trees. Neighbors are responsible for planting and maintaining their trees. Current funding remains stable at about $50,000 per year.
Contact	206-684 0320
Department of Planning and Development (DPD)	DPD enforces regulations relating to trees on private properties. Relevant regulations and plans include the following: City of Seattle *Comprehensive Plan* includes goals and policies for trees on private property and City-owned land. *Environmentally Critically Areas Ordinances* regulates vegetation and tree removal within wetlands, wetland buffers, riparian corridors, landslide prone areas and wildlife habitat areas (ordinances 116253 and 116976). *Land Use Code* includes provisions that provide an option for preserving trees in single- and multi-family zoned properties undergoing development (ordinance 119792). Chapter 25.11 of the Land Use Code (*Tree Protection Ordinance,* #120410) generally protects trees greater than 6 inches in diameter on undeveloped land and it protects exceptional trees on private properties during development whenever practical. Director's Rule 13-92 addresses landscape standards.
Contact	206-684-0432

Department	Responsibilities
Fleets and Facilities	The Fleets and Facilities Department manages properties and facilities owned or leased by the City. This includes vacant property, as well as buildings serving the Seattle Fire Department, Seattle Police Department, downtown office buildings, campuses housing construction and heavy maintenance vehicles and various buildings throughout the community. Their goal is to preserve as many trees as possible on all sites, and to create landscaped areas around buildings/properties.

Communication with other Agencies

As important as it is for good communication between city departments on urban forestry matters, it is equally important that similar communication exist between the City and other agencies such as the Port of Seattle, Army Corps of Engineers, King County, WSDOT, and even commercial entities such as the railroads. These organizations are often engaged in activities that can or do impact Seattle's urban forest. The City of Seattle and the Urban Forest Coalition in particular have demonstrated an effectiveness for internal as well as external collaboration. This has resulted in historically good interagency coordination, particularly between the City of Seattle and the United States Forest Service and Washington State Department of Natural Resources community and urban forestry programs

Maintenance

Urban trees typically require maintenance. The goals of maintenance are to promote health, provide safe and functioning public spaces, and maximize the environmental, social, and economic benefits of trees and understory.

Tree maintenance tasks and frequency vary depending on age, species, establishment, and site characteristics. Generally, the first three years of a tree's life, also known as the plant establishment period, are the most maintenance-intensive. Establishment requires attention to tree selection, site preparation, planting, watering, staking, pruning, and mulching to assure their survival. Pruning, disease and insect management are critical throughout a tree's life.

Street trees may require additional watering beyond the plant establishment period because of the impervious paved surfaces, which also radiate heat that increases evaporation. Street trees also require care to protect the tree as it grows in a confined setting. Such care could be removing tight pavers, lawn edging, weed barrier, or tree grates and even making larger tree pits. If not removed, these materials can girdle and kill a tree by cutting off the flow of nutrients and water between the leaves and the roots.

Pruning is a specialized type of maintenance. Pruning can be done reactively to eliminate hazards such as clearing obstructed signs or removing branches at risk of falling or preventively for tree health and safety. Proactive pruning

for health and safety is pruning to remove diseased or insect-infested wood, improve air flow to reduce disease and insects, remove crossing or rubbing branches, develop a strong structure, remove broken limbs to encourage wound closure and prevent hazards, and prevent obstructions with signs and pedestrian traffic. The City's best management practices (BMPs) are guided by the American National Standards Institute (ANSI) 300 Industry standards that define how to prune trees for health, structural integrity, and clearance.

An important benchmark for urban forestry program performance is how often trees are pruned. The City of Milwaukee, Wisconsin, for example, employs one tree trimmer for every 840 street trees, or one 3-person tree crew for every 2,500 trees. As a result, Milwaukee's tree maintenance cycle is well within the industry standard of managing pruning of all trees on a 5- to 7-year cycle. (Miller 1988). The advantage of shorter pruning cycles is longer lived, healthier trees that are able to provide maximum environmental, economic, and social benefits over time. In contrast, Seattle has on average one tree employee for every 6,000 street trees with a resulting 12-year pruning cycle. This cycle means that trees are receiving little or no real preventive maintenance and many will need to be removed much earlier than should be expected. It also means that when the trees are pruned, much more work is required than would be expected with a shorter pruning cycle. In other words, part of the reason that Milwaukee's tree crews can prune 2,500 trees per year is because their shorter pruning cycle requires less work per tree when pruned.

As mentioned earlier, Parks is responsible for 90,000 trees in developed park properties and along park-owned boulevards. Until the late 1980s, Parks had only one 3-person tree crew for all park tree maintenance. With a pruning cycle at the time that exceeded 50 years, over 90% of Parks available tree crew time was spent responding to demand-based tree-related emergencies, primarily the removal of dead, diseased, or fallen trees. A second 3-person crew was added in 1988, which reduced the pruning cycle to 26 years, but the percentage of time spent on demand maintenance did not change in any major way. The second tree crew was actually reduced by two positions in a 1990 budget reduction and then fully restored in 1992.

The 2000 Pro Parks Levy added a third 3-person tree crew to Parks that has been dedicated to providing preventive tree maintenance in high-use park locations (Table 4). As a result, Park's tree pruning cycle went from 26 years to 18 years. After operating for over 100 years with only one tree crew and pruning cycles of 26+ years, Parks is still catching up with the natural process of tree growth and death. In 2000, Parks funded a Hazard Tree Mitigation Program that now allocates over $80,000 per year in contracted hazard tree removal and replacement.

What is Tree Maintenance?

Tree maintenance is the sum of all activities required in the life cycle of a healthy tree, including proper selection and planting, watering, pruning and ultimate removal at old age.

Establishment of all aged trees requires attention to tree selection, site preparation, planting, watering, staking, pruning and mulching.

City of Seattle

Table 4. Estimated Maintenance Needs of City of Seattle Trees

Department	Industry standard vs. current pruning cycle	Current tree inventory	Crews/FTEs to meet desired pruning cycle	Current number of crews/FTEs
SDOT	5 – 7 Years vs. 12 years	35,000 trees	3.17 crews/ 9.50 FTEs	2 crews, 6 FTEs
Parks	5 – 7 years vs. 18 years	90,000 trees	6 crews/18 FTEs	3 crews, 9 FTEs

Managing Woodwaste Products

City of Seattle forestry operations generate considerable amounts of byproducts from large logs to leafy compostable materials. Ideally these so-called 'waste' products would be recycled back into city or private landscapes in the form of mulch or compost. In 2005 to 2006, a team of graduate students from the University of Washington School of Business, funded by a Luce grant, undertook the task of determining the financial impacts for the various options available to the City for managing these green waste products. Their research indicated that it is unlikely that the city could break even on the management of green waste. However, it also indicated that certain products have greater value and have to be dealt with regardless of payback. To that end, several programs have been put into place to begin to deal with city generated green waste on a broad scale. Those programs/decisions include:

- Logs that have commercial value are now being separated from those that don't and are being sold through a public bidding process.

- Logs that don't have commercial value are being temporarily stored at one or more locations to be ground into high quality mulch using a large contracted tub-grinder.

- Chipped waste that is relatively free of leafy material is being delivered directly to Park Maintenance District locations for use as mulch in landscape beds.

- Chipped waste, including that which may have some leafy debris is also being used directly as mulch in forest restoration project sites.

- Green waste debris that has a high content of leafy material is being trucked to one of several commercial composting businesses.

- Selected logs and stumps are being used in forest and riparian restoration projects as large woody debris.

Maintenance of Private Trees

While the City of Seattle does have some influence on preserving trees on private property (Appendix B: Tree Regulations and Policy), ensuring that private citizens know what appropriate tree maintenance is can be a challenge as evidenced by the all too frequent topping practice still employed by some tree maintenance firms. Encouraging private citizens to preserve trees can also be a challenge given concerns with leaf drop, views, solar access, competing uses of space, and the cost of hiring professional tree care workers. Likewise, encouraging private homeowners to plant more trees can be a challenge for the same reasons.

Still, many Seattle residents as individuals or as neighborhood groups are eager to plant trees. The City's Department of Neighborhood's tree fund and City Light's Urban Tree Replacement Program offer free street trees to neighborhood groups and provide information on proper tree planting and care. These publicly-funded programs, however, do not meet the need to provide incentives or assistance for tree planting on private property. In the past, the City successfully partnered with private businesses to sponsor discount tree coupons that were popular and gave residents flexibility as to where trees were planted. However, still more can be done to educate and inform the public about the value of trees that will lead to more tree preservation and planting.

Standards of Practice

City staff and their contractors follow industry standards as defined in the International Society of Arboriculture's (ISA) *Tree Pruning Guidelines* and/or those in the ANSI A300 pruning standards and the Z133.1 Safety standards. Many of Seattle's urban forestry managers and tree-crew personnel have been trained, tested and become ISA 'Certified Arborists'. An increasing number of arborists in the region's tree service firms are also ISA certified.

To encourage the public to plant the right tree in the right place to avoid interference with power lines and impacts on sidewalks and underground infrastructure, both SDOT and City Light distribute attractively-illustrated booklets. This public information gives the characteristics and requirements for a number of tree species. SDOT's tree pruning guide, available on their website, has been translated into six languages in addition to English. This illustrated guide shows how to make pruning cuts and how to prune trees for health and street right-of-way (ROW) clearance.

In 1999 Parks produced a best management practice (BMP) manual for their landscape, horticulture, and forestry operations. Updated in 2004, the manual provides staff with significant information on the best practices for tree maintenance and forested parklands restoration. Most of Parks' staff has also been trained in the field application of these BMPs.

Tools for Inventory and Assessment

A common requirement for all resource managers is a thorough understanding of the resource itself. To that end, Seattle needs better assessment tools to evaluate the condition, values, benefits, needs and opportunities associated with its urban forest. A more complete picture will help the City better plan and manage all tree-related work. The following are three critical needs:

1. More complete and current tree inventory
2. Better maintenance records with records linked to inventory data
3. Better tools/models for determining the value and benefits of the urban forest

As stated earlier, having a good understanding of the resource and its condition is always the first requirement of good resource management. In addition, detailed information on resources expended for maintenance would help staff better plan and budget work. The ability to assign value to the benefits of the forest would aid in creating a business case for valuing green infrastructure in the same way the City considers the capital investment and maintenance needs of its engineered infrastructure. In turn, this could lead to creative mechanisms for funding appropriate levels of maintenance of the urban forest resource.

Developed Areas Tree Inventory

A current inventory of tree locations, species, age, health, and size is critical for planning tree replacement, pruning, disease management, and planting. Seattle's street tree inventory, although now linked into the City's GIS, is neither complete nor adequate. The street tree inventory was not designed to be readily updated. Most of its information was collected between 1989 and 1992, making work records and costs difficult to track. Likewise, it's difficult to summarize tree age, size, condition, and canopy as a basis for estimating upcoming workloads, costs, and benefits.

Based on a 1986 update of Parks' grounds maintenance management system, the City has an approximate count of trees in developed parks and along park-owned boulevards. Another inventory was undertaken in 1997 but has subsequently been determined to be incomplete. Parks does not have information by species, size, and specific location. Although trees in landscaped portions of parks require maintenance comparable to that for street trees, they are not currently part of an integrated inventory or work management system.

Acquiring reasonably accurate information for Seattle's estimated 130,000 street trees and 90,000 trees in developed park areas requires adequate staffing and budget. Once this inventory information is in place, maintaining the inventory need not be costly given the City's GPS and GIS technology. SDOT has received funding for 2007 and 2008 to update street tree data. Having a complete and up-to-date inventory is essential to good resource management. For that reason, obtaining the inventory information referenced above should be given a high priority for continued funding.

Forested Parklands Tree Inventory

Seattle's 3,200 acres of remnant forests have been inventoried in recent years using two different methods. The nonprofit Seattle Urban Nature Project (SUNP) has undertaken a thorough ecosystem-based analysis of all the City's remnant forests. The City was involved with this project in an advisory capacity and has full access to the information collected. In 2004 Parks staff used Lidar (aerial laser radar) to determine citywide canopy cover percentages. Together, these two sets of data provide an excellent inventory of our remnant forests.

Maintenance Record Keeping

Seattle's lack of detailed maintenance records makes workload planning difficult and contrasts with cities known for effective urban forestry programs. Many cities maintain records of per-unit costs and person-hours required for tree establishment, pruning, inspection, removal, and other procedures. Many tracking systems identify such components as time in travel, work set-up, production, and crew productivity. Having such information available also assists greatly in answering questions from the public regarding how and where tree maintenance resources are being used. SDOT currently uses a system that provides basic cost information about tree care operations but is not integrated with any other system or inventory data. City departments are developing the ability to better track maintenance activities. New systems are anticipated to be operational in 2008.

Performance Measures

Though departments track program information such as the number of trees planted or removed, there is currently no citywide system for comprehensively evaluating the condition of the urban forest and tracking our progress in implementing actions that are the goals of this plan. Because the City lacks a performance monitoring system, it cannot as effectively make program and budget decisions, adapt to changing conditions over time, or effectively communicate with senior management and the public.

Some suggested performance measures that evaluate the social, economic, and environmental progress are the following:

Public involvement as urban forestry stewards

- Calls for assistance and information

- Site inspections

- Average response time

- Customer satisfaction, rated by new program participants

- Presentations and educational events

- Volunteers trained

- Volunteers participating

- Youth participating

Effective management of public trees

- Changes in species diversity

- Number of work requests completed

- Changes in canopy cover

- Technical review of projects completed on time

- Changes in survival of new trees

Urban Forestry as a good public investment

- Value of grants, donations, and sponsorships

- Estimated value (in millions) of benefits provided by newly planted trees over a 30- and 50-year period

- Value of programs per unit tree cost (planted and maintained for 5 years)

Tree Policies/Regulations

The City has a number of policies, programs, regulations, and documents that establish a framework for tree preservation, planting and care. The City's wide-ranging effort reflects the complexity of tree management issues in urban settings. This complexity leads to challenges in aligning policy between competing goals.

As the pressure to redevelop land within Seattle continues and the region's population increases, density goals and development pressures need to be balanced with tree protection and planting goals. Finding the right balance is crucial to maintaining the city's livability and encouraging new development within already developed areas rather than pushing it to the metropolitan fringe.

One of the significant gaps in the City of Seattle's current regulations is the limited ability to ensure ongoing tree preservation and planting on private property. Balancing private property rights with the public goal of increasing a healthy urban forest is one of our biggest challenges.

To that end in 2006, the City, through the DPD, enacted the Seattle Green Factor, a new regulatory tool. The purpose of the Seattle Green Factor is to provide property developers with innovative options for increasing the amount of 'green' associated with their developments. It contains a scoring system for greater consideration of green roofs, green walls and other non-traditional landscape design solutions while still encouraging trees and ex-panded tree canopy.

In 2007, DPD will lead a review of the City's current tree preservation regula-tions. The process will begin by soliciting the input and insight of experienced professionals and tree advocates who have an intimate knowledge of the challenges faced in attempting to regulate people's relationships with trees. DPD will also look at best practices used around the country and evaluate how some of those lessons learned could be applied here. Once the background research is completed, DPD will develop a proposal to update the City's tree regulations, which will then be available for public review and comment. Our intention is to have final recommendations submitted to the City Council in the fall of 2007 and new legislation adopted by the end of the year. A summary of Seattle's existing regulations, policies, and programs that protect and in-crease the urban forest can be found in Appendix B.

In addition to existing regulations, stakeholder groups have suggested that the City expand the list of regulations to consider some or all of the following:

- Require all tree service companies working within the city limits to be ISA Certified in order to best protect private home/business interests.
- Place restrictions on the removal of large trees on private property such as those required by Vancouver, B.C. and Lake Forest Park, WA.
- Require one tree to be planted for a given number of on-street parking stalls. For example, Delta, B.C. requires one tree for every four parking stalls).
- Require site plans for building permit applications to locate significant trees on adjacent properties to help ensure these trees aren't damaged or destroyed during development because their existence was un-known.
- Apply tree removal enforcement tools consistently across the city.
- Maximize the amount of plantable space in new development, particu-larly for trees.
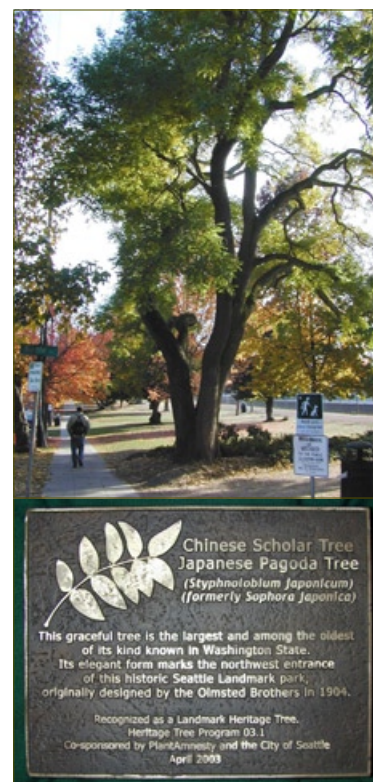
- Strengthen regulations that will preserve existing trees, particularly those that are considered 'Heritage' trees or 'significant' under SEPA standards.

- Consider a range of incentives to encourage tree planting on private property. Incentives to consider could include real estate tax/stormwater fee credits, transfers of development rights, price breaks on fall leaf collection, and free trees. Similar incentives could be made available to property owners who preserve large or significant trees.

2.3. Community Framework Assessment

A sustainable urban forest is a community asset. Community appreciation for the benefits and needs of trees and engagement in planning, planting and caring for trees is essential to the long-term health of the asset. Citizen input and volunteer participation are critical to the success of City programs that support trees and have been since the days of the Olmsted plan. Without the active support and engagement of the community, urban forestry programs cannot succeed. This section describes the ways the community is currently informed about and participates in stewardship of the urban forest.

Outreach

The City has an important role in fostering residents' understanding of the environmental, economic, and community benefits of trees as well as proper tree selection, planting and care. City departments provide information through the City's website, brochures and other publications, environmental learning center activities, and during volunteer events. The book and companion video, *A City Among the Trees,* produced by the Urban Forest Coalition, with a grant from the USDA Forest Service, was designed to provide the public with information on proper tree planting and care and is available at libraries. This document has been shared with literally thousands of Seattle residents.

Different departments within the City communicate with the public about tree-related issues pertinent to their specific missions. For example, DPD provides information on tree planting and preservation requirements during development. SDOT provides information about tree selection, care and related permit requirements regarding planting trees in the street ROW. Parks provides broad information about tree care, benefits and the threat that invasive species pose to trees. Training is also a requirement for receiving Neighborhood Tree Fund grants for planting trees in the ROW. Despite this good work, the amount of coordination between different departments on outreach activities is sometimes limited, and it can be difficult for a resident to know exactly who in the City to contact with questions.

Volunteer Opportunities

Seattle citizens volunteer many thousands of hours of support for the City's urban forestry programs each year. The Parks department's three volunteer coordinators facilitate 110,000 hours of outdoor volunteer stewardship each year in City parks. In 2000, engaged citizen volunteers contributed over 40,000 hours of community service to forest restoration efforts alone. By 2005 that number increased to over 50,000 hours as a result of the work of the Green Seattle Partnership. Neighborhood and civic groups are the major source of citizen involvement in tree planting and stewardship. Volunteers plant trees and maintain park vegetation in developed and forested parklands. In many cases, specific individuals stand out as active volunteers and receive training in organizing and directing tree planting and maintenance projects.

The former SDOT Tree Steward program was a nationally recognized leader in citizen forester training. It demonstrated the benefit of training citizen forest-ers who learned basic tree maintenance and neighborhood organization skills. Since the program's elimination, SDOT has adapted to limited staffing and budget by taking a broader approach to supporting volunteers and provid-ing public information. For example, SDOT recruits and trains volunteers to maintain over 1,000 traffic circles and other street-side landscaped areas. SDOT also works with the Department of Neighborhoods to train residents in proper planting and maintenance in their Neighborhood Tree Program.

Volunteers help remove invasive plants in City forests. Their work is critical to saving Seattle trees from smothering ivy, Himalayan blackberry, holly laurel, morning glory and other undesirables.

Through its Neighborhood Tree Fund, the Department of Neighborhoods has empowered residents to plant over 17,200 street and park trees as part of neighborhood greening projects since 1996. Recipients praise and support the program, but are concerned that the program provides limited maintenance funds or materials for the post-planting period.

Planning and Policy Development

Seattle residents have opportunities to participate in urban forest planning and policy development through public comment during major plan develop-ment, participation in oversight and planning committees, and through the Board of Parks Commissioners. Neighborhoods have become the basic unit of Seattle's ongoing comprehensive planning. Virtually all Seattle neighborhood plans, adopted by the City Council, mentioned tree planting and stewardship among their priorities.

The 2000 Pro Parks Levy and similar initiatives incorporate citizen planning and participation on oversight committees. Parks also has developed a Public Involvement Policy that establishes parameters for when a project or policy

change will include public input; this includes seeking public input on tree planting and maintenance programs as well as notifications of all tree removals. The Seattle's Board of Park Commissioners also provides advice on policy matters in Seattle parks and takes public comment into consideration.

While the City has these mechanisms in place for community input on specific projects or policy changes, there is no ongoing mechanism for community involvement in broader policy and program development and implementation issues. Community stakeholders have indicated a desire for such on-going, formal channels of input as the Urban Forest Management Plan is implemented.

Some cities have tree boards or commissions that are comprised of representatives from various interest groups, green industry, educational institutions, and the business community. In the past, advisory boards were convened to engage the Seattle community on specific issues. In 1969, Mayor Wes Ulhman initiated Seattle's Street Tree Advisory Committee to help prioritize Forward Thrust Bond tree plantings. The committee was reconvened in 1972 to review SDOT street tree planting projects and work on a Street Tree Ordinance and long-range master plan. Again, in the 1990s, the committee was briefly revived to help build private support for street tree planting.

These community boards and committees focus on urban forest issues rather than the broader array of interconnected environmental issues that face urban areas. Therefore, these boards may miss innovative opportunities that lie at the intersection of urban environmental initiatives. Only in the last decade has there been a full appreciation of these connections as for example the link between stormwater and trees and air quality and trees.

A more effective approach would be to bring stakeholders representing air quality and climate change, urban forestry and urban creek and Puget Sound water interests together. This would provide opportunities to increase understanding of these individual issues among all stakeholders as well as to work toward solutions that have benefits and leverage opportunities across all these urban environmental priorities.

In the past, such an advisory board was convened to engage the community on specific issues. In 1969, Mayor Wes Ulhman initiated Seattle's Street Tree Advisory Committee to help prioritize Forward Thrust Bond tree plantings. The committee was reconvened in 1972 to review SDOT street tree planting projects and work on a Street Tree Ordinance and long-range master plan. Jerry Clark, City Arborist from 1988-1997, revived the Street Tree Advisory Board for a brief period to help build private support for street tree planting.

Partnerships

Early in Seattle's history, a few people of vision rallied an entire city behind funding and building the foundation of Seattle's parks and boulevard system with an Olmsted designed plan. In preparation for hosting the World's Fair in 1962, The Weyerhaeuser Company donated 1,000 street trees that were subsequently planted. It was another partnership of insightful civic leaders motivated by the Women's Division of the Seattle Chamber of Commerce and supported by voters who envisioned and passed the Forward Thrust Bond in 1968. Forward Thrust funded the construction of over 50 planted street triangles and thousands of street trees.

In more recent times, in addition to working with neighborhood volunteers on tree programs, the City continues to partner with individual businesses, chambers of commerce, nonprofits, the media, neighborhood councils, business improvement districts, and state and federal agencies. These partnerships illustrate that urban forestry is about community as much as it is about trees.

In 1994 the City of Seattle played an active role in the formation of the nonprofit organization TREEmendous Seattle. Via contract, the staff at TREEmendous provided volunteer recruitment, training, and supervision support for City forestry programs. TREEmendous Seattle was eventually taken over by another nonprofit organization, Earthcorps. The City, particularly Seattle Parks and Recreation, continues to contract for similar volunteer support services from Earthcorps. Another partnership of note is the 1999/2000 Millennium Woods Legacy Project, which, in celebration of the new millennium, surpassed the goal of planting 20,000 trees in city parks, yards and streets. Sponsors included ATT, GTE Wireless, Eddie Bauer, TREEmendous Seattle, and PlantAmnesty.

The Heritage Tree Program is a partnership between the City of Seattle and PlantAmnesty to identify and give recognition to trees distinguished by botanical, historic, or landmark significance. Since 1993, a committee composed of Certified Arborists and residents have identified over 45 trees that have been listed as Heritage Trees. In addition, several Heritage Tree collections have been designated including the Washington Park Arboretum, Kubota Gardens, and Volunteer Park.

The Green Seattle Partnership was formed in 2004 by a Memorandum of Agreement between the City of Seattle and the Cascade Land Conservancy. This 20-year program will restore 2,500 acres of forested parklands by 2025. The partnership plans to restore an increasing amount of forested parkland each year, reaching 150 to 160 acres per year at program peak in 2010. In addition to

3. Recommended Goals and Actions

This section identifies goals and specific actions needed to enhance and preserve Seattle's trees. Establishing the City's goals for **canopy cover** overall and by management unit is a necessary first step and will help guide the identification and prioritization of actions.

3.1. Why Does the City Need Canopy Cover Goals?

A good measure of the health and value of an urban forest is the percentage of land within the city that has tree canopy cover. In order to measure success in canopy cover enhancement, canopy cover goals must first be established. These goals will help the City of Seattle to rally the community around a clear set of common targets. They also help to plan implementation steps that consider planting opportunity, planting limitations, and other priorities specific to individual land-use types. With canopy cover goals, we can target available funding to areas with the greatest potential for new trees or the greatest lack of trees. Finally, having canopy cover goals allows us to target new tree plantings to maximize the ecological services potential (e.g. stormwater mitigation, carbon sequestration) across the city. Within this context, 30-year citywide canopy cover goals have been established to increase existing canopy cover by 2/3 to a canopy cover of 30%.

3.2. How Did We Derive Canopy Cover Goals?

American Forests, a leading urban forest management, conservation and research group, measured tree cover in 440 communities. Their research recommends that a canopy cover goal of 40% would be appropriate for Seattle and other cities in the Pacific Northwest. In developing canopy cover goals for Seattle, the Urban Forest Coalition started with the American Forests recommendation and went through the following process to define an ambitious but doable goal for the Urban Forest Management Plan 30-year planning horizon (Table 5):

- Considered American Forests' recommendations and benchmarked with other cities
- Considered land-use mix in Seattle and other City land-use goals (e.g. encouraging density, facilitating freight mobility, etc.)
- Considered current canopy cover and planting opportunities
- Defined goals for each land-use type

- Factored in the percentage of the total land base within each land-use type and individual land-use goals to calculate the recommended city-wide goal of 30%
- Consulted with external experts from other cities, consultants, the University of Washington, and the public

Table 5. Canopy Cover Goals by Management Unit (MU)*

Land-use cat-egory	Current cover	Current Trees	30-year cover goal	Estimated # of new trees to meet goal
Single-Family	18%	473,300	31%	350,200
Multi-Family	13%	103,400	20%	56,000
Commercial/ Mixed Use	8%	49,700	15%	44,400
Downtown Seattle	9%	9,700	12%	3,800
Industrial	8%	68,100	10%	18,100
Institutional Properties	15%	14,600	20%	5,000
Parks: devel-oped sites	19%	90,000	25%	28,400
Parks: natural areas	64%	568,700	80%	143,200
Citywide	18%	1,377,500	30%	649,100
Transportation Corridors/Street ROW	16%		24%	

*Seattle's street trees are included in the land-use types that contain streets and street tree plantings. Current street tree canopy cover is 16% with a canopy cover goal of 24%.

3.3. What Canopy Cover Goals Have Other Cities Adopted?

The American Forests model was the starting point for setting goals in these other cities:

- Vancouver, WA has current canopy cover of 19.7% and has established a citywide goal of 28%.

- Portland, OR has current canopy cover of 26.3% and has established a goal for residential areas of 47% and for industrial/commercial areas of 12%.

- Baltimore, MD has a current canopy cover of 19.8% and set a goal to double (39.6%) canopy cover citywide within 30 years.

3.4. Recommended Actions

(Table 6) shows the general goals of the plan, the rationale for the goals, and associated recommended actions. The goals and actions have been grouped into the three elements of the urban forest sustainability model: Tree Resource, Management Framework, and Community Framework.

Each goal statement is followed by the supporting rationale for the goal, which is then followed by short, mid- and long-term recommendations/actions to achieve the goals. Implementation will require policy, program, and budget coordination, as well as long-term and stable funding. Accomplishing these goals is essential for the City of Seattle to achieve urban forest sustainability. These actions generally apply to trees throughout the city as opposed to those trees found within a specific forest Management Unit (MU) as described in the next section. The timeline definitions for implementing the proposed actions are as follows:

Urban Forest Inventory and Estimates

The forest canopy of a city can be measured in a variety of methods. For this plan, Seattle's canopy was measured using LIDAR. LIDAR measures the height and location of objects based on reflection of a laser. The data collected is high definition—five measurements for each 1 meter square. The elevations, which are within 2 feet of actual heights, were used to create a topographic map of the city.

A by-product of this data is a highly accurate, 3-dimensional map of Seattle's tree canopy. Existing GIS data for the management units was used to develop values for canopy cover in each unit.

- Short-term actions will be done within the next 5 years. Typically these are actions that are either already partially implemented, budget neutral, or have agreed upon new funding in place.

- Mid-term actions are 5 to 10 years out. These are actions that might require operational restructuring or reorganization, limited additional funding, or 'tooling-up' on the part of internal or external partners.

- Long-term actions are 10 or more years on the horizon. These actions may have significant budget implications, may involve organizational change, and might require significant fund raising.

Table 6. Goals and Recommended Actions for the Seattle Urban Forest Management Plan

Tree Resource				
Goals	Rationale	Short-term	Mid-term	Long-term
A1. Understand the characteristics and complexity of Seattle's urban forest	A fundamental requirement for effective resource management is a thorough understanding of the resource itself. This is accomplished through inventory and analysis and is essential for implementation of all resource management tools from cost/benefit analysis to workload management. An inventory of the urban forest needs to be comprehensive, dynamic, and available to forest managers within all applicable departments.	Coordinate inventory data from SUNP with City needs for inventory and assessment of natural areas. Develop long-term tree management strategies that consider the unique characteristics of the major City land-use types Develop modeling for tree ages and sizes and life expectancy, accounting for species and site factors, to facilitate costs projections.	Develop vegetation data analyses, models and reports for input to policy, planning, and budget decisions. Inventory street trees, trees in developed parks, and trees along park-owned boulevards. Identify and catalog landmark and heritage trees building on existing program.	Examine canopy-cover effects on views, solar access and property values across land-use types. Develop a dynamic inventory process that can be updated and maintained.
A2. Maintain trees to promote health and longevity	Healthy trees contribute more to Seattle's environment and quality of life than do unhealthy trees. Trees maintained on a regular cycle are healthier, live longer and reduce the City's liability from hazards such as dead limbs. City maintenance practices should be consistent with the most current industry standards.	Maintain trees on a regular, more frequent cycle for health and longevity Maintain trees based upon commonly accepted ANSI or ISA practices/BMPs. Determine the desired tree maintenance cycle for all urban forest management units. Request additional tree maintenance resources in future budgets . Use current and future modeling to determine resources required to adequately preserve, restore and enhance urban forest.	Develop an urban forest maintenance plan for all City-owned trees. Consider alternative models for street tree management. Continue to make budget requests to increase tree maintenance capacity and to reduce annual pruning cycles.	Use more understory species, where appropriate, for increased and multi-layered canopy. Continue to make budget requests to increase tree maintenance capacity and to reduce annual pruning cycles Seek and acquire tree maintenance resources required to maintain public trees at industry standards.
A3. Maximize canopy cover and optimize age and species diversity	The many benefits provided by trees increase as the tree population and overall canopy coverage increase. Significant species diversity helps ensure no single pathogen or insect can decimate an entire population. A range of tree ages helps ensure continuity and sustainability of the forest.	Continue planting the right tree in the right place to ensure healthy, stable sustainable trees. Define appropriate age/size/species distribution and life-expectancy goals for different areas and land uses Determine the most strategic locations for new or replacement tree plantings and give them highest priority for planting in the short-term. Place high priority on replacement of missing trees on public property. When possible, transplant trees that would otherwise be removed as the result of construction work.	Plant large trees where they have room to mature and plan shorter rotations of small- and medium-sized trees in areas with limited growing area. Develop tree selection lists for the same. Fund and coordinate City programs to provide trees to the public and support stewardship. Include other agencies such as Seattle Public Schools, WSDOT etc. when considering new tree planting opportunities.	Achieve tree canopy cover percentage goals by land-use type.
A4. Maximize the ecological and environmental benefits of the urban forest	Trees provide ecological services including stormwater mitigation and air and water quality improvement. Maximizing these services saves money and improves quality of life but also requires an investment of resources. Effectively measuring (using financial values whenever possible) and communicating these benefits is necessary to inform decisions about resource allocation so that decision-makers and the community can fully understand the benefits that tree management investments return.	Define the economic and environmental benefits derived from the ecological services provided by a healthy urban forest in Seattle (at current and proposed canopy cover-age % levels). Continue funding of Parks Forest Restoration Program. As part of implementing all urban forest projects and programs, consider potential environmental enhancements. Think citywide when implementing projects to capitalize on potential synergies for environmental enhancements between departments. Consider ecological services values as the basis for creative funding considerations for urban forest restoration and maintenance.	Consider environmental functions in BMPs. Consider streams, trails and other forest amenities when developing forest restoration projects. Seek sufficient funding in budget process to meet operation and maintenance objectives. Ensure an adequate budget to finance the highest priority activities identified in the management plan. Explore funding opportunities with the business community and with regional donors, particularly for special projects identified in a management plan. Examine canopy-cover effects on views, solar access, and property values across different land-use types.	Look at the forest as a population, balancing concern for individual trees with the values and functions of the entire system. To better contribute to wildlife habitat, encourage planting designs that have grouped rather than evenly spaced trees . Explore creative financing mechanisms to obtain funding for City urban forestry programs.

Management Framework				
Goals	Rationale	Short-term	Mid-term	Long-term
B1. Facilitate interdepartmental communication and cooperation to provide decision-makers the information they need to support and implement the UFMP	Urban forestry in the City of Seattle involves many departments and links to outside agencies. Jurisdictional boundaries can sometimes be difficult to determine. Multiple departments each with its own primary mission also manage trees. It's vital that City departments have effective processes in place to communicate with one another regarding common urban forestry issues ranging from budget development and maintenance practices to related programs such as salmon recovery efforts.	Continue Urban Forest coalition (UFC) as the group primarily responsible for implementing the UFMP through the work of the represented departments. Report to the Sustainability and Environment Sub-Cabinet quarterly as the executive level advisory body for the UFC. Link urban forest management to other City programs, especially environmental programs. (e.g., SPU and Parks programs) Integrate urban forest management planning with other City efforts affecting vegetation, open spaces and sustainable development – most notably the new Seattle Green Factor being applied in neighborhood commercial zones and under consideration for the city's multi-family zones. Coordinate all City policies and regulations related to trees. Begin development of long-term funding strategies for UFMP implementation.	Create inter-departmental working groups to coordinate interests, expertise and resources for particular issues areas (e.g., volunteer support, public education, stormwater management, salmon recovery, etc.). Track cost-effectiveness of current organizational structure and management practices. UFC will be responsible for recommending UFMP implementation priorities and associated costs for budget consideration on a biennial basis.	Conduct urban forestry activities as a citywide program with a de-emphasis on the roles of specific departments. Examine canopy-cover effects on views, solar access and property values across different land-use types. Review urban forestry staff functions, roles and responsibilities toward achievement of management efficiencies. UFC will be responsible for tracking and documenting efficacy of UFMP implementation.
B2 Develop and implement resource management tools	The UFMP will provide the basis from which departments can develop urban forest resource management system tools over time. These systems-based management tools include inventory and analysis of the tree resource itself, tree maintenance workload forecasting, documentation of work performed, performance metrics and processes for determining progress on performance goals. All information made available through such systems will be transferable into dollars to enable urban forest managers and policy makers to make well-informed decisions on the levels of funding for various urban forest management programs.	Update or create City tree inventories and link them to work record systems. Develop systems for documenting City tree crew's maintenance hours. Develop performance metrics for City tree maintenance operations. Complete development of the UFMP and obtain budget resources for selected early actions.	Develop an urban forest maintenance plan for all City-owned trees. Develop a dynamic inventory process that can be continuously updated and maintained.	Link work record system with inventory so updates are frequent and automatic.
B3. Preserve and protect existing trees, and encourage new tree planting throughout the city by improving management of trees on private property.	The primary mission of the City's urban forest staff is preservation, restoration, and enhancement of the urban forest so that it can be sustained in perpetuity. Accomplishing this task and meeting long-term canopy coverage goals will require many actions. Many of these will be policy/regulatory environment actions. This is especially true for private property, 74% of Seattle's land base. While a sensitive subject, the development and implementation of incentives and regulations for private land can be effective tools for encouraging tree preservation and new planting. The City will work with private property owners to encourage them through public information and incentives to both plant new trees and preserve existing ones, and practice good stewardship through BMPs.	Review existing tree preservation and planting incentives and regulations. Engage community stakeholders to identify opportunities and barriers for tree planting and preservation on private property. Enforce existing regulations and incentives that preserve trees on private property. Develop new regulations that require preservation of trees or planting new trees on private property. Increase developers', builders' and private property owners' awareness about the value of trees and provide incentives for tree retention and management.	Develop new incentive programs that encourage planting new trees on private property. Research tree preservation and planting incentives, ordinances, policies and regulations that are working in other cities. Establish incentives to promote the appropriate maintenance and preservation of trees on private property. Evaluate the effectiveness of incentives and regulations and make changes as needed. Recommend regulations to protect landmark trees, building upon the current work of DPD. Recommend regulations to protect trees on all property undergoing development including tree protection and retention requirements, again building upon the current work of DPD. Consider development of a single City of Seattle tree ordinance for ease of access to multi-departmental tree policies.	Through education and regulation, implement preventative maintenance programs for all trees in the city Create incentives for developers to adopt tree protection practices, including facilitating permitting processes. Seek private and/or public funding to encourage tree planting on private property. Consider burying certain utility lines to increase street tree planting opportunities.

Management Framework				
Goals	Rationale	Short-term	Mid-term	Long-term
B4. Model good stewardship in City practices	The City needs to be the leader and 'walk its talk' on the need to preserve, restore and enhance the urban forest. The City should be a model of excellent forest stewardship practices in order to effectively manage the trees it owns and to provide an example to the community by demonstrating sustainable urban forestry practices on all City projects.	Continue to provide good examples of sustainability, such as forest restoration or tree friendly public works approaches that enhance trees and the general condition of the forest. Conduct all City tree management practices to ISA or equivalent standards and encourage compliance by private industry. Consistently follow up tree planting projects with maintenance reminders, training opportunities and stewardship activities. Expand opportunities like the 'Forest Stewards' element of the Green Seattle Partnership to provide quality training and enhance volunteer opportunities. Require that all tree care companies/individuals doing business on City property be ISA-Certified Arborists.	Continue to revise and update City BMPs for tree and forest maintenance on a 5-year cycle (next revision due in 2009). Expand pilot programs to salvage, distribute and reuse wood and tree chip products	

Community Framework				
Goals	Rationale	Short-term	Mid-term	Long-term
C1. Enhance public awareness of the urban forest as a community resource	Experts are quick to point out that the urban forest cannot and will not survive without active interaction with and management by humans. For this active care, trees provide many social benefits including aesthetic/architectural, shade, color, fragrance, green in an otherwise gray environment, and opportunities for recreation and even active stewardship. Sustainable urban forests require community involvement. For citizens to become active in caring for, enhancing and advocating for the urban forest, they must first be made aware of the benefits and value it provides. They also need to understand the challenges facing the urban forest and the actions they can undertake personally, or as groups, to enhance forest vitality.	Continue to provide volunteer stewardship opportunities through programs like the Green Seattle Partnership. Use UFC vision as starting point to define and adopt a vision for the future of the City's urban forest. Create a citywide approach to communicating about trees. Develop communication tools that explain urban forestry benefits and programs, using promotional themes and ideas. Provide all tree owners access to City tree maintenance BMPs.	Capitalize on the research being undertaken by others to quantify the financial value associated with the social benefits afforded by the urban forest. Identify special trees and mark their historic, biological or other noteworthy traits with signs or other means. (Heritage Tree Program). Involve community in inventories and assessments as a follow-up to neighborhood planning efforts and current outreach efforts.	Create tree curricula for K-12 schools, providing resources for both classroom and neighborhood-based learning. Use and build on existing programs (e.g. City Among the Trees). Develop community service opportunities with schools and other institutions for urban forest stewardship projects.
C2. Engage the community in active stewardship of the urban forest	In 2004, Seattle citizens contributed over 110,000 hours of outdoor volunteer service in parks alone. Some 40,000+ of those hours were in support of forest restoration projects and others were in support of neighborhood street tree planting projects and other greening type of activities. Implementation of the UFMP complete with the preservation, restoration and enhancement of Seattle's forests, cannot succeed without support of these many dedicated citizen stewards.	Engage the public with developing this UFMP. Continue to support the Green Seattle Partnership to restore 2,500 acres of forested parklands Expand volunteer stewardship opportunities. Provide continued support to the existing 110 'Friends of' groups already providing volunteer support. Add tree experts to the Mayor's Urban Sustainability Advisory Panel Involve community in inventories and assessments as a follow-up to neighborhood planning efforts and current outreach efforts Provide citizens the opportunity to plant trees on public property to commemorate major life events.	Coordinate urban forest activities with neighborhood plans. Promote expanded and coordinated urban forest efforts at a neighborhood level. Coordinate City's urban forest services delivery with neighborhood programs and projects. Explore funding opportunities with the business community and with regional donors, particularly for special projects identified in a management plan. Consider restoration of the Tree Stewards program. Create the mechanism that will allow an active partnership with the community service element of the Seattle Public Schools. As another large landowner, seek tree planting opportunities with the cemeteries in Seattle.	Expand City urban forest resources dedicated to neighborhood outreach p (e.g., free trees, Tree Steward Program, technical assistance). Encourage/support neighborhood tree committees associated with district councils. Continue promoting tree advocate services on DPD design review panels. Create resource centers at neighborhood offices, enlisting citizen foresters as assistants.
C3. Promote citizen-government-business partnerships	Partnerships between city government and citizen or business groups can be of great benefit to the urban forest. Partnerships with nonprofit groups such as the Green Seattle Partnership can generate additional resources to take on major forest programs. Financial or volunteer labor contributions from private businesses have generated significant amounts of forest restoration and other tree planting.	Develop a coordinated approach to seek funding from sources such as local and regional foundations, industry and corporations. Enact the Seattle Green Factor as an update to landscaping requirements. The Green Factor is a new menu of landscaping strategies that will be required for new development in neighborhood business districts. It is intended to increase the amount and quality of urban landscaping in these dense urban areas while allowing increased flexibility for developers to efficiently utilize their properties. The Green Factor encourages the planting of layers of vegetation including the use of larger trees and tree preservation.	Partner with nurseries and landscape industry to make quality information and plant materials available, particularly information to discourage the sale and planting of known non-native invasive plant species. Institute a program to acknowledge and publicize contributions to urban forestry by citizens, businesses, institutions, and neighborhood group organizations.	Facilitate opportunities to collaborate with universities and the private sector on urban forestry science.

4. Goals and Actions by Management Units

Seattle's urban forest covers all 53,000+ acres of publicly and privately owned land within the city limits. Because of the obvious differences between urban spaces, streetscapes, parklands, remnant forests and other land-use types, the urban forest cannot be viewed as a single unit for management purposes.

Instead, it is a collection of management units that together form Seattle's urban forest ecosystem. This plan defines nine management units (MU) that cover all the lands in the city. The MUs were selected based upon unique physical characteristics. They generally conform to land-use types the City uses for comprehensive planning. Using those land-use types allows for easy coordination of GIS mapping layers (Figure 3) and for related planning initiatives. The following are the nine MUs for the plan:

Management Units (MUs)

The purpose of defining urban forest management unit (MUs) is to allow analysis and planning for all of our forest resources at the level where real 'on-the-ground' actions can or are likely to take place.

1. Single-Family Residential
2. Multi-Family Residential
3. Commercial/Mixed Use Areas
4. Downtown Seattle
5. Transportation Corridors/Street Trees
6. Industrial Property
7. Major Institutional Property
8. Developed Parks and Boulevards
9. Parks Natural Areas.

Figure 3. Seattle's Urban Forest Canopy Cover: Distribution by Management Unit

Single-Family Residential

Downtown Seattle

Major Institutional Property

Industrial Property

Multi-Family Residential

Commercial/Mixed Uses Areas

Developed Parks & Boulevards

Parks Natural Areas

TransportationCorridors/Street Trees

Transportation Corridors/Street Trees are distributed throughout all of the Management Units

MANAGEMENT UNITS
Percentage of City

56%	Single-Family Residential
1%	Downtown Seattle
2%	Major Institutional Property
11%	Industrial Property
11%	Multi-Family Residential
8%	Commercial/Mixed Use Areas
4%	Developed Parks and Boulevards
7%	Parks Natural Areas

Lake Washington

Puget Sound

1   0   1 Miles

4.1. Methods

Seattle does not have a complete inventory of trees in the city. However, to determine the total tree benefits, costs, and planting goals for Seattle required that we estimate the total number of existing trees. To obtain this critical information, we used two different sets of data. The first set of data was the measure of total tree canopy in Seattle. The second set of data was past inventories of City-owned trees on ROW and in developed parks. This combined data was then processed through tree benefit models developed for the region to determine costs/benefits.

Canopy cover for the city was determined from remote sensing data known as LIDAR, essentially Laser radar, which uses the reflection of light back to a receiver in an airplane. The study that provided this information was a regional topographic project done in 2000. The data provided spatial information for each meter of the city's surface. By separating out buildings and overhead structures from the LIDAR data we were able to determine the shape and size of a majority of Seattle's tree canopy. The number of trees this canopy represented was derived by dividing the estimated average canopy width for an average tree within the MU into the total canopy area for the unit. In two MUs— Rights of Way (ROW) and Developed Parks—existing tree inventory data (albeit dated) was used to derive the number of trees in the MU.

Based upon currently available national and regional models, the number of trees within each unit was multiplied by estimated costs to plant an average tree in the unit, the cost to maintain the tree within the unit, and the benefits to be derived from each tree within the unit. Benefits were estimated based upon figures obtained from *Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategic Planting* (McPhearson et al. 2002).

Of specific importance to Seattle are the stormwater retention values and the air quality improvement values. These values were used to derive the following tables. Total values citywide are shown on Table 7 for each MU and described individually in sections 4.2 through 4.10.

Table 7. Citywide Management Unit (MU) Data*

Statistic	Citywide	
	Current	*30-year Goal*
Acres in MU	54,324	
MU as % of city land base	100%	
Canopy coverage	18%	30%
Number of trees	1,377,500	2,026,600
Plantings needed		**649,100**
One-time cost of plantings		**$114,200,000**
Maintenance Costs (yr)	$14,054,300	$21,116,300
Benefits (yr)		
Stormwater Mitigation Value (yr)	$20,643,000	**$30,215,000**
Air Cleaning Value (yr)	$4,894,000	**$7,047,000**
Carbon Sequestration (Tons CO2)	52,400	**77,066**
Carbon Sequestration (Value $)	$1,584,000	**$2,331,000**
Other Benefits (Energy, Aesthetics, & etc)	$17,237,300	$26,342,300
Net Benefit (All Benefits - All Costs) (yr)	$30,304,000	$44,585,000

All values are based on estimates and currently accepted models (McPhearson et al. 2002).

4.2. Single-Family Residential

Description

Approximately 56% of all property within Seattle is single-family residential. This element of the city's urban forest is found on private land and does not include the trees that may be growing along the adjacent street. The percentage of canopy cover within Seattle's single-family neighborhoods varies widely. Some neighborhoods are characterized by large trees species while other neighborhoods have canopy cover characteristic of smaller tree species (Table 8).

Because single-family properties occupy so much of Seattle's land base, they also provide the greatest opportunity for increasing the city's overall tree canopy cover. This fact is all the more important as more trees are removed from privately-owned single family zoned property.

The City can do more to encourage tree planting and retention through education, tree planting programs, and expanding the scope of a tree protection ordinance to include trees on private property. City tree planting programs such as the Tree Fund coordinated by the Department of Neighborhoods and Seattle City Light's Urban Tree Replacement Program have added thousands of new plantings along residential streets.

56%
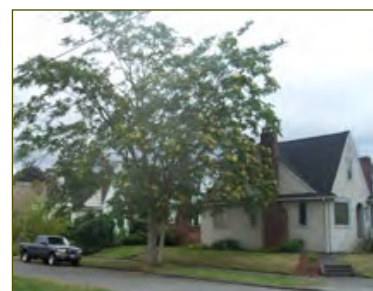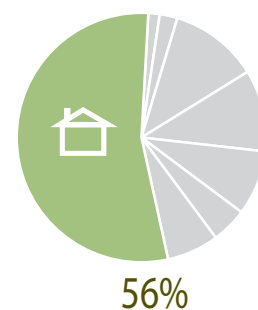
Table 8. Single-Family Residential Property MU Data*

Statistic	Single-Family	
	Current	*30-year Goal*
Acres in MU	29,921	
MU as % of city land base	56%	
Canopy coverage	18%	31%
Number of trees	473,300	823,500
Plantings needed		**350,200**
One-time cost of plantings		**$52,530,000**
Maintenance Costs (yr)	$4,733,000	$8,235,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$7,100,000**	**$12,353,000**
Air Cleaning Value (yr)	**$1,420,000**	**$2,471,000**
Carbon Sequestration (Tons CO$_2$)	**18,000**	**31,300**
Carbon Sequestration (Value $)	**$544,000**	**$947,000**
Other Benefits (Energy, Aesthetics, & etc)	**$6,082,000**	**$10,242,000**
Net Benefit (All Benefits - All Costs) (yr)	$10,413,000	$18,117,000

All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

Current Condition

The current canopy coverage in this unit is 18%, or 5,331 acres. It consists of 473,300 trees, which collectively provide 56% of all canopy coverage in the city.

Desired Condition

The 30-year canopy cover goal for this unit is 31%.

Issues/Opportunities:

Rich Legacy of Large Trees
Many of Seattle's oldest and largest trees are located on single-family property. Preserving these specimen trees should be a priority for the City. Providing citizens with information on the value of these trees to Seattle should likewise be a priority. The City should consider expanding the scope of the Tree Protection Ordinance to apply to regulate removal of trees of a minimum tree diameter on all private property. Forming partnerships with agencies and business involved in property transfer would increase awareness of the City's tree preservation and canopy goals.

Significant Planting Potential
Single-family residential property represents over 56% of all the land in the city. It holds the greatest opportunity for tree canopy cover enhancement. Homeowners should be encouraged, perhaps via incentive programs, to plant additional trees on their property for their enjoyment and to benefit the overall community.

Standards of Tree Care
Too many trees on single-family property are harmed by poor maintenance practices such as tree topping, girdling, volcano mulching, changing the soil grade, and lack of water. Likewise, too many tree care and landscape businesses do unprofessional work on trees and set a bad example for others. Very good public information on tree maintenance practices is available from the City through printed material, classes, and on City web sites.

Tree Planting Incentives
One element of the 1998 Millennium Woods Legacy Project was creating a partnership with the Washington State Nursery and Landscape Association to encourage residents to buy a tree at a discount. Through a

private benefactor, over 3,000 $25 coupons were made available to Seattle residents to be redeemed at local nurseries toward purchase of a tree(s). City Light has offered a similar program in the past with success. Programs like these not only provide incentive for homeowners to purchase and plant trees, they are an excellent opportunity to educate the public on proper tree selection, planting, and care.

Fall Leaves and Other Debris
Sometimes homeowners decide to remove perfectly healthy trees because they drop leaves in the fall or other debris at other times of the year. There may be an opportunity for groups like the scouts or even Master Composters to volunteer or offer leaf collection services to clean up fall leaves and take them to a composting site. It's even possible that the City might be able to provide a location in the future for tree debris to be taken for recycling.

Goals and Actions:

Tree Resource

- Select tree to maximize canopy for the size of the tree planting space (i.e., large space with no overhead obstructions = large tree).
- Focus on tree preservation.
- Complete a more thorough tree inventory.

Management Framework

- Research Portland's private tree preservation program.
- Develop/increased incentives for tree preservation.
- Increase street sweeping frequency for leaf control. Change local regulation to allow citizens to place leaves in the street for City pickup (sweeper).
- Partner with Washington State Nursery and Landscape Association or others to provide free tree vouchers per the Millennium project.
- Implement an Exceptional Tree program.

Community Framework

- Produce and distribute tree education materials that address tree concerns and guide good tree care practices.

- Include tree/forestry representation on the Urban Sustainability Advisory Panel

- Provide widely distributed education materials on tree stewardship and the value of planting and preserving trees.

- Provide directed tree education materials to realtors.

- Increase citizen participation in street tree planting and stewardship programs.

4.3. Multi-Family Residential

Description

About 11% of all property in Seattle is zoned multi-family, an area of over 5,746 acres. Multi-family residential properties tend to be located along major transportation corridors, near college campuses, and adjacent to the downtown core. The amount of available tree planting space is limited in some multi-family developments. In others, the tree canopy is more generous (Table 9).

11%
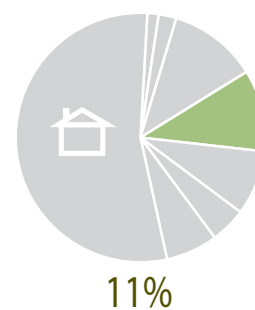
Table 9. Multi-Family Residential Property MU Data*

Statistic	Multi-Family	
	Current	*30-year Goal*
Acres in MU	5,746	
MU as % of city land base	11%	
Canopy coverage	13%	20%
Number of trees	103,400	159,400
Plantings needed		**56,000**
One-time cost of plantings		**$19,600,000**
Maintenance Costs (yr)	$1,240,800	$1,912,800
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$1,299,000**	**$2,002,000**
Air Cleaning Value (yr)	**$325,000**	**$501,000**
Carbon Sequestration (Tons CO$_2$)	**3,900**	**6,000**
Carbon Sequestration (Value $)	**$119,000**	**$183,000**
Other Benefits (Energy, Aesthetics, & etc)	**$1,772,800**	**$2,733,800**
Net Benefit (All Benefits - All Costs) (yr)	$2,275,000	$3,507,000

*All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

Current Condition

Multi-family properties are estimated to currently have 13% tree canopy coverage, about 8% of the city's total tree canopy cover. This equates to approximately 103,400 trees in the MU.

Desired Condition

The current canopy coverage in this MU is 13%. Our canopy cover goal in 30 years is 20%.

Issues/Opportunities:

Owner/Developer Education
Typically, much less tree space is available in multi-family developments than in single-family. The greatest opportunity for trees begins with design and the developer. Multi-family development design takes on many forms with some being much more conducive to planting of trees. Incentive programs might allow variations on development regulations in return for planting and retaining trees.

Turnover Rates
Multi-family developments have high turnover rates. Even though multi-family tenants are not owners and may not reside at one location very long, that does not mean that they can't be great tree advocates. The same level of interest afforded other residential groups needs to be afforded multi-family residents in order to gain their support for the UFMP and urban forestry in general.

Goals/Actions:

Tree Resource

- Develop a list of tree species that would thrive in the often smaller planting spaces found within this MU.

Management Framework

- Consider incentives that would encourage the preservation and planting of trees.
- Consider applying some of the proposed Seattle Green Factor strategies to this MU to expand the potential for additional trees and related greenery.

Community Framework

- Work with condominium homeowner associations to educate these owners and encourage them to plant additional trees.
- Educate apartment building owners about the positive aspects of providing well-maintained trees and green spaces as part of their rental environment.

4.4. Commercial/Mixed Use Areas

Description

This MU includes Seattle's commercial developments along the major transportation corridors and in various commercial hubs. This unit includes the private property within these commercial areas as well as publicly-owned and managed street trees (Table 10).

8%

Table 10. Commercial/Mixed Use MU Data*

Statistic	Commercial/Mixed Use	
	Current	*30- year Goal*
Acres in MU	4,522	
MU as % of city land base	8%	
Canopy coverage	8%	15%
Number of trees	49,700	94,100
Plantings needed		**44,400**
One-time cost of plantings		**$15,540,000**
Maintenance Costs (yr)	$994,000	$1,882,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$624,000**	**$1,182,000**
Air Cleaning Value (yr)	**$156,000**	**$295,000**
Carbon Sequestration (Tons CO_2)	**1,900**	**3,600**
Carbon Sequestration (Value $)	**$57,000**	**$108,000**
Other Benefits (Energy, Aesthetics, & etc)	**$1,250,000**	**$2,367,000**
Net Benefit (All Benefits - All Costs) (yr)	$1,093,000	$2,070,000

*All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

Current Condition

There are 4,522 acres of land within this MU, or about 8.5% of the total city land base. The current number of trees within the MU is estimated at 49,700 creating about 358 acres of canopy coverage. About 8% of the land within the MU has canopy coverage that contributes about 4% to the overall canopy coverage for the city.
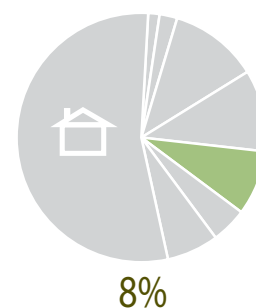
Desired Condition

The opportunity for tree plantings in this MU is varied and generally more limited than in others. Historically, the majority of tree plantings in Commercial/Mixed Use areas are street trees. DPD landscape development and tree retention regulations guide the opportunity for canopy enhancement within Seattle commercial areas. Some of these areas are designated urban villages or urban centers for future land use. This distinction will have some bearing on forest management opportunities within this MU, which has a 30-year canopy coverage goal of 15%.

Issues/Opportunities:

Increased Population Density

As Seattle moves toward an Urban Village model, increasingly it will be necessary to both plant and preserve trees in parts of the city as the city increases in density. Choosing to both plant and preserve trees now will prepare Seattle for new residents. Strategic purchase of available openspace can help preserve wildlife habitat within dense residential areas.

Working with Business Owners

It's not uncommon for some business owners to look at trees as a problem or nuisance rather than a benefit. Cleaning up fall leaves takes time. Trees must be well-sited and appropriate species selected for a successful commercial streetscape. However, repeated studies have shown that shoppers prefer tree-lined streets and, even in Seattle, the shade produced by trees can be truly appreciated on a hot summer day. Opportunities exist to work with business owners to better educate them about the value of trees in a commercial setting and to partner with the City to make repairs and improvements.

Green Roofs and Parking Lots

This MU typically is associated with a high percentage of area given to building footprints (roofs) and parking lots. Opportunities exist, possibly through incentive programs, to increase the green associated with these necessary elements to effectively increase the canopy coverage in the MU.

Goal/Actions:

Tree Resource

- Develop a desired tree species palette for commercial areas that takes into consideration the needs and concerns of business owners.

- Place a high value on preserving existing trees via monitoring construction practices, encouraging professional maintenance practices, educating business owners on trees' value to their business and community.

- Work with local businesses and business associations to develop programs for planting additional trees.

- Over time, achieve desired canopy coverage goal for the MU.

Management Framework

- Undertake an inventory of existing trees within the Commercial/Mixed Use MU and document in a citywide database.

- Enforce existing code requirements regarding tree preservation and planting.

- Consider the full range of Seattle Green Factor incentives to encourage new tree planting as well as the preservation of existing trees.

- Explore existing codes to determine existing authority over private trees and consider expanding if possible.

- Establishing tree planting guidelines/standards for Urban Villages and other areas designated for greater population density will be essential to ensure the livability of the communities that are envisioned: trees/green space = livability = density

- Focus forested open space acquisitions and development of neighborhood-scale parks with trees in areas designated for greater population density.

- Consider expansion of Neighborhood Business District grants for tree planting.

- Encourage other means of incorporating trees into this MU through green roofs and green parking lots.

- Consider providing incentives for adding trees and other landscape assets as part of a building renovation or construction project.

Community Framework

- Make tree preservation and planting a part of the District Council discussions and have City staff prepared and available to participate in those discussions.

- Create or modify existing education programs for business owners, property owners and residents regarding the value of planting and preserving trees.

- Make tree maintenance brochures and standards available to property owners so that they will know how trees should be maintained and will hire qualified arborists for tree work.

- Develop commercial zone "branding."

- Provide parking beneath buildings to provide more tree planting space at the street level.

- Whenever possible, notify the public in advance of the need to remove trees.

4.5. Downtown Seattle

Description

Trees in this MU are found in the City's urban core (Table 11). Most of the trees in downtown Seattle are located within the street ROW. In addition to limited planting space, the downtown environment can be especially harsh. It has very poor soils, poor drainage, a wind tunnel effect between high-rise build-ings, and abuse from human activity. The national average lifespan of an ur-ban tree is 13 years, 6 to 7 years for trees in the central business district.

Table 11. Downtown Seattle MU Data*

Statistic	Downtown	
	Current	*30-year Goal*
Acres in MU	810	
MU as % of city land base	1.5%	
Canopy coverage	9%	12%
Number of trees	9,700	13,500
Plantings needed		**3,800**
One-time cost of plantings		**$1,330,000**
Maintenance Costs (yr)	$485,000	$675,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$97,000**	**$135,000**
Air Cleaning Value (yr)	**$49,000**	**$68,000**
Carbon Sequestration (Tons CO$_2$)	**400**	**500**
Carbon Sequestration (Value $)	**$11,000**	**$15,000**
Other Benefits (Energy, Aesthetics, & etc)	**$541,000**	**$754,000**
Net Benefit (All Benefits - All Costs) (yr)	$213,000	$297,000

All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

Current Condition

This MU is 810 acres or about 1.5% of the city land base. The current tree cano-py coverage is about 70 acres, or about 9%, a fair-to-good percentage by na-tional standards. The estimated 9,700 trees in this unit are equal to less than 1% of the city total, but they are critical in terms of their ability to soften the harsh urban environment. Trees in downtown Seattle are frequently under stress due to limited planting space and other harsh conditions. Given these environmen-tal stresses, the average tree in this MU is typically smaller than in other units and has a shorter lifespan. Changes in development and land-use patterns downtown can also be a challenge to tree preservation.

1%
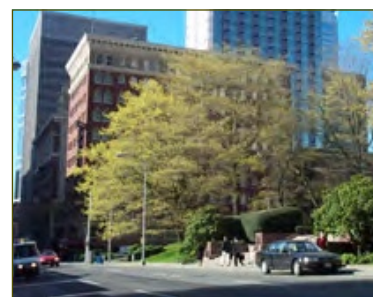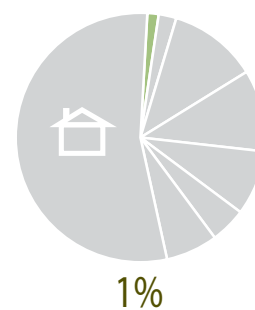
Desired Condition

As stated, the current canopy cover percentage for this MU is 9%. Despite the challenges of planting trees in downtown Seattle, our canopy cover goals for this MU are 12% within 30 years. These numbers are within expected national averages.

Issues/Opportunities:

Canopy Cover Percentage

The current 9% canopy cover for downtown Seattle is roughly half of that recommended by American Forests. Finding planting space to achieve 12% canopy coverage in the downtown core will be a significant challenge. The availability of new planting sites for street trees is limited. It's possible that advancements in green building (roofs) technology or new and innovative planting incentives and strategies like the Seattle Green Factor might provide some of the benefits that would otherwise be provided by trees thus allowing for a more modest actual tree canopy goal for the downtown area.

Perceptions of Business Owners

It's not uncommon for business owners to have strong opinions about trees. Some are strong advocates for trees and others are not, or are even opposed to having trees near their businesses. Some business owners raise concerns about trees blocking signs, creating debris or producing too much shade. For other business owners, the benefits trees provide are very important to their business environment. Without a doubt, there is considerable opportunity to provide more and better information to Seattle's downtown businesses on the value that trees can bring to commerce.

Tree Protection

Tree protection in downtown Seattle is very important because growing trees in the urban core is difficult. Growing trees to a large size in healthy condition is particularly challenging.

Illegal Activity and Trees

In recent years the relationship of vegetation and illegal activities has resulted in the modification of several downtown park landscapes. The need for public landscapes that are safe and inviting to use has led to new terms like Crime Prevention through Environmental Design (CPTED), which have become part of our landscape design and management lexicon. The process of making parks safer for legal use can impact trees including pruning, removal, replanting in alternate locations, and/or replanting with different species.

Tree Planting Incentives

Along with greater public education, it's desirable to offer incentives to business and property owners in the downtown core to encourage them to seek opportunities to plant more trees. Most planting opportunities, of course, are within street ROW. A continuing SDOT challenge will be to work with business and property owners to plant more street trees.

Goals and Actions:

Tree Resource

- Preserve trees in this MU whenever possible.
- Due to the challenges of the downtown planting environment, select tree species with particular care to help ensure long-term success.

Management Framework

- Develop landscape design guidelines that will consider safety, maintainability and other factors as a means of helping to preserve and/or enhance tree plantings. Encourage implementation of the Seattle Green Factor for new or re-development.
- Promote designs that create more space for tree growth above and below ground.

Community Framework

- Meet with Downtown Business Association(s) to discuss tree canopy and preservation goals.
- Seek partnerships and financial support from downtown businesses in order to plant additional trees.
- Also seek financial support from downtown for the maintenance of trees.
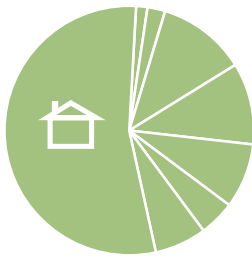
Transportation Corridors/Street Trees are distributed throughout all of the Management Units

4.6. Transportation Corridors/Street Trees

Description

Of the more than 130,000 trees along Seattle's streets, SDOT maintains about 35,000. The remaining 95,000 are regulated by the City through permits issued by SDOT for tree removals and new plantings within street-side planting strips. Existing canopy coverage percentage in this MU is 16% with a goal of 24% (Table 12).

Table 12. Transportation Corridors/Street ROW MU Data*

Statistic	Transportation Corridors/Street ROW	
	Current	*30-year Goal*
Acres in MU	14,412	
MU as % of city land base	16%	
Canopy coverage	16%	24%
Number of trees	130,000	195,000
Plantings needed		**65,000**
One-time cost of plantings		**$26,000,000**
Maintenance Costs (yr)	$3,900,000	$3,900,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$1,820,000**	**$2,730,000**
Air Cleaning Value (yr)	**$780,000**	**$1,170,000**
Carbon Sequestration (Tons CO_2)	**4,900**	**7,400**
Carbon Sequestration (Value $)	**$150,000**	**$225,000**
Other Benefits (Energy, Aesthetics, & etc)	**$2,710,000**	**$4,065,000**
Net Benefit (All Benefits - All Costs) (yr)	$2,860,000	$4,290,000

*All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

SDOT also contributes directly to the population of SDOT-managed street trees via preservation and installation of new trees in conjunction with most SDOT capital improvement projects. Additionally, SDOT works cooperatively with DPD to ensure preservation, replacement, planting of new trees ,and maintenance of trees required by land-use code for private development projects. SDOT also partners with the nonprofit group Plant Amnesty on the nomination of 'Heritage Trees.'

The first street tree inventory of 1992 accounted for 84,000 street trees. A random sampling performed in 1998 estimated the number of street trees to be 98,000, along with over 50 acres of SDOT-maintained ROW landscaping.

Current Condition

Diversity

Street trees have good species diversity except that sweet gum and Norway maple comprise 13.5% and 12.6%, respectively, of trees in retail and commercial zones. Purple-leaf plums comprise 11.2% of residential street trees. More than 10% in any one species is generally discouraged. Average spacing between residential street trees is 152 feet, about 3 times the desirable distance for a medium to large maturing tree.

Distribution

Seattle's street trees have a broad range of size classes (a proxy for age) although the number of 20-inch-diameter (large) trees has decreased. More trees are being planted than lost, precluding any sudden barrenness as trees reach the end of their lifespan. In residential areas, the size distribution of street trees has been virtually unchanged for a decade. Nearly half of these trees are relatively young and have diameters of 5 inches or less(Table 13). Many others are larger, with diameters of 6 to 20 inches, yet are young enough to provide benefits and services for many more years. In residential areas, off-street trees are on average generally larger than on-street trees, but no data have been collected on their sizes.

Table 13. Diameter Classes of Seattle's Residential Trees

Diameter	0 - 5"	6 - 12"	13 – 20"	21 – 30"	>30"
Original inventory	38,232 (47.2%)	29,808 (36.8%)	8,424 (10.4%)	3,240 (4.0%)	1,296 (1.6%)
Current sampling	63,008 (48.9%)	48,190 (37.4%)	13,400 (10.4%)	2,577 (2.0%)	1,675 (1.3%)

SDOT estimates that about 20% of street trees are candidates for removal due to improper location (large trees under utility lines or insufficient growing space) or structural and health issues. SDOT currently removes trees only if they pose an imminent hazard or if removal allows the City to take advantage of opportunities to remove or replace trees as part of a larger planting project. SDOT also frequently removes privately-maintained unhealthy trees when they become imminent hazards.

Desired Goals

SDOT's goals are to have a healthy mix of species and age distribution, with a maximum of 10% for any one species. New trees should be planted as part of a regular, phased program to meet the desired canopy cover goals. A maintenance cycle for small trees of 3 to 4 years and 7 to 8 years for larger trees should be pursued. SDOT will also develop a tree management plan, including a hazard tree mitigation program to ensure that street trees are being managed proactively. Trees planted in substandard tree pits will be identified and the pits expanded if feasible. If not, the trees will be prioritized for removal and replanting where conditions warrant.

Issues/Opportunities:

Conflicting Tree Management Responsibilities
Approximately 75% of street trees have been planted by private citizens or community groups, and are therefore the responsibility of the abutting property owner to maintain. Many property owners are unaware of their responsibility to maintain street trees adjacent to their property, or are unable or unwilling to maintain those trees. The SDOT tree crew is frequently dispatched to prune or remove privately-maintained trees that pose a risk to pedestrians and motorists. About 25 % of crew time is spent responding to such calls.

Many opportunities are available to improve management of the street tree resource. In particular, the public and policymakers are increasingly aware of the importance of sustainably managing our urban forest. Recognition is growing for the environmental, economic, and aesthetic value of trees. An aggressive public education program can increase understanding and build support for a strong maintenance program as the most effective way to preserve our urban forest. Furthermore, a tradition of civic mindedness among Seattle citizens provides opportunities to build strong volunteerism to supplement SDOT's maintenance of street trees.

Conflicts with Other ROW Infrastructure
Providing space within the limited ROW to plant trees is a major challenge. Trees must compete for space with sidewalks, underground utilities, overhead power lines, the desire to retain views, and a variety of street furniture, such as bus stops, curb space for vehicles, traffic signs, etc. Additionally, many planting strips are too small to accommodate large trees and cannot be expanded. It will be a challenge to plant the 65,000 new trees recommended in this plan to meet canopy cover goals citywide.

Street Tree Regulations

The current street tree ordinance is inadequate to properly regulate the planting, pruning and removal of trees in the ROW. For example, the penalties the City can levee against a citizen or property owner who removes or otherwise damages a privately-maintained tree in the ROW are minor in comparison with the value of the resource that is lost. Similarly, private companies working on ROW trees are not required to have qualifications to ensure proper pruning. The result is that many trees are structurally damaged by companies with little or no knowledge of proper pruning techniques. The existing ordinance should be strengthened to enable better management of street trees, and protect trees from these types of activities.

Inadequate Maintenance of Privately-Maintained Street Trees

As Seattle's street-tree population grows older and larger, it is becoming increasingly evident that not all Seattle citizens are willing or able to take on the task of adequately maintaining the street tree in front of their home, even though it is their responsibility. As a result, many street trees are receiving improper maintenance, or no maintenance at all. This will lead to premature death and loss of the asset and the benefits it provides. As important as it is to preserve existing trees, a very important question that the City will need to take on at some point in time will be, "should all street trees be actively maintained by the City?" Doing so will dramatically increase the need for SDOT forestry funding. However, it will also have a substantial positive impact on the health and longevity of the street tree population, will make it much easier to ensure that replacement trees are planted when needed and, in the long run, will encourage better relationships with those citizens who may now have generally negative opinions regarding the presence of street trees in their neighborhood.

Goals and Actions

We have used the urban forest sustainability model to present goals and actions the City should take to create a sustainable forest. The actions described below and the timeframe within which they occur reflect a two-part approach: 1) reverse the trend in which about 4% of trees are lost each year to development, and 2) increase the number of street trees and canopy over the long term.

Tree Resource

- Plant 2 new trees for every tree that has to be removed.
- Make sure that new trees are sufficiently watered, including trees planted through the Department of Neighborhoods Tree Fund.
- Increase number of trees pruned annually by 20% over 2005.
- Continue to evaluate and update SDOT's plant list.
- Initiate phase 1 of a landscape assets inventory and condition assessment.
- Develop a risk assessment plan.
- Initiate phase 2 and 3 of the landscape inventory and condition assessment. Be sure to include undeveloped ROW, alleys and street ends.
- Update existing tree inventory.
- Reduce pruning cycle from current 18-year cycle to acceptable national standards.
- Implement a hazard tree abatement program.
- Expand the use of tree planting strips rather than tree pits with grates to provide greater rooting area as well as enhanced storm water mitigation.
- Use tunneling to bury more power/communication wires to allow larger, healthier trees in areas with adequate space.

Management Framework

- Develop a budget adequate to implement ROW trees and landscaping management over the next 5 years.
- Revise the street tree ordinance; submit it for management and executive review.
- Increase enforcement of BMPs; pass information among tree care and landscape companies.
- Study the feasibility of placing all ROW trees under SDOT management.

- Explore creative financing mechanisms to ensure alternative funding to supplement general fund revenues.

- Develop a long range (20 to 30 years) street tree management budget.

- Identify and establish dedicated funding sources for street trees.

- Utilize asset management and cost-benefit analysis to ensure urban forest sustainability.

Community Framework

- Increase and improve education of the public on tree care responsibilities.

- Continue to promote Heritage Tree program.

- Continue to promote Arbor Day/Tree City USA.

- Develop tree information documents in languages that reflect the diversity of Seattle.

- Develop a plan for community involvement in tree management activities.

- Educate developers in tree retention benefits and techniques to implement a community involvement plan.

11%
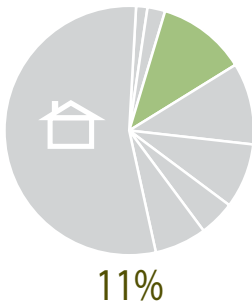
4.7. Industrial Property

Description

The industrial areas of Seattle comprise nearly 11% of the city land base, or about 6,214 acres. The tree planting opportunities within the city's industrial areas vary widely but are generally fairly limited. A high percentage of property in industrial areas is needed for access, egress, and circulation space for large trucks and parking. These requirements also impact the opportunity for street tree plantings (Table 14).

Table 14. Industrial Property MU Data*

Statistic	Industrial	
	Current	*30-year Goal*
Acres in MU	6,214	
MU as % of City land base	11%	
Canopy coverage	8%	10%
Number of trees	68,100	86,200
Plantings needed		**18,100**
One-time cost of plantings		**$5,430,000**
Maintenance Costs (yr)	$2,043,000	$2,586,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$855,000**	**$1,083,000**
Air Cleaning Value (yr)	**$341,000**	**$431,000**
Carbon Sequestration (Tons CO$_2$)	**2,600**	**3,300**
Carbon Sequestration (Value $)	**$78,000**	**$99,000**
Other Benefits (Energy, Aesthetics, & etc)	**$2,267,000**	**$3,442,000**
Net Benefit (All Benefits - All Costs) (yr)	$1,498,000	$1,896,000

*All values are based upon estimates and currently accepted models. (McPhearson et al. 2002)

Current Condition

The industrial areas currently have approximately 68,100 trees. This equates to 8% existing tree canopy cover, or about 491 acres of canopy, about 5% of the City's total coverage. Many trees in this MU are in compromised condition due to the harsh growing environment.

Desired Condition

The 30-year tree canopy coverage goal for this MU is 10%.

Issues/Opportunities:

Finding Space for Trees

Seattle's industrial areas are perhaps the biggest challenge to tree canopy enhancement. They are very harsh environments. Because trucks need access and egress, many ROW planting strips are not available for trees. As well, most businesses seem to maximize their available space for business purposes leaving very little land available for trees. However, there are still planting spaces available. As with downtown Seattle, the greatest opportunity for new trees, although limited, is to maximize street tree plantings in the ROW.

An Opportunity for Tree Planting Incentives

The industrial area probably presents one of the best opportunities for tree planting incentives. Incentives likely provide the best vehicle to entice business owners to plant their own trees. While a significant increase in the canopy coverage percentage in the industrial area may be wishful thinking, it should nevertheless be given a high priority. In this environment, a few additional trees would have significant visual impact.

Inconsistent Tree Maintenance

Perhaps because trees aren't seen as a primary need in the industrial areas, tree maintenance is good in some locations while only fair to outright brutal in others. A campaign to educate business owners about proper tree maintenance might save many trees that would otherwise become victim to poor maintenance.

Goals and Actions:

Tree Resource

- Locate and quantify potential tree planting sites.
- Focus new plantings on Industrial Landscape Streets.
- Select tree species that will maximize the mature tree canopy benefit for the location.
- Select planting locations carefully for maximum sustainability.
- Protect existing healthy trees whenever possible and practical.

Management Framework

- Review current planting requirements and exemptions.
- Research what other cities have done in their industrial areas.

Community Framework

- Create tree planting incentives with business owners.
- Develop and implement a tree planting education program for business owners.
- Engage the Office of Economic Development and the Freight Movers in any tree planting discussions.

4.8. Major Institutional Property

Description

Hospitals, university, and college campuses comprise the Institutional Property MU. For the purpose of this plan, we have also included Seattle Public Schools. The 1,103 acres of institutional property constitute 2.1% of the city's land base. The landscapes found on these properties vary widely in design and use, often containing many park-like plantings, amenities and features, including appearance (Table 15).
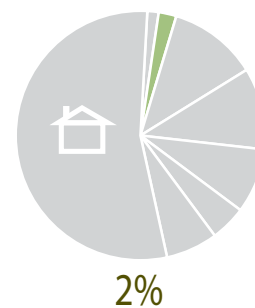
2%

Table 15. Major Institutional Property MU Data*

Statistics	Major Institutions	
	Current	*30-year Goal*
Acres in MU	1,103	
MU as % of city land base	2%	
Canopy coverage	15%	20%
Number of trees	14,600	19,600
Plantings needed		**5,000**
One-time cost of plantings		**$1,250,000**
Maintenance Costs (yr)	$365,000	$490,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$219,000**	**$294,000**
Air Cleaning Value (yr)	**$58,000**	**$78,000**
Carbon Sequestration (Tons CO$_2$)	**600**	**800**
Carbon Sequestration (Value $)	**$17,000**	**$23,000**
Other Benefits (Energy, Aesthetics, & etc)	**$392,000**	**$526,000**
Net Benefit (All Benefits - All Costs) (yr)	$321,000	$431,000

All values are based upon estimates and currently accepted models. (McPhearson et al. 2002)

The trees found on these institutional properties may or may not have been inventoried. They are managed as individuals and as groupings, usually within a landscape setting. Some of these trees are of significant size and character and highly valued by students, staff, visitors, and patients receiving medical care as well as providing nesting sites and habitat for birds.

Current Condition

Seattle's institutional lands currently have approximately 14,600 trees. Canopy coverage is 15%, equaling 164 acres, or about 2% of the city's total tree canopy. Like parklands, trees in institutional properties have considerable species diversity and are found in all sizes, many quite large. It is not known which institutions have tree inventories and to what extent the trees are actively managed.
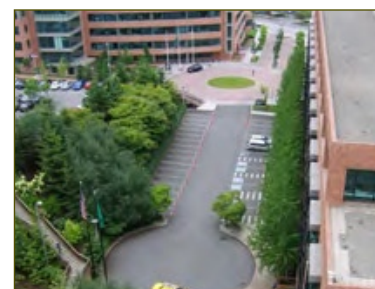
Desired Condition

Institutional lands are typically designed landscapes. The selection of tree species and their location in the landscape must be thoughtful. We feel, however, that planting opportunities do exist throughout the range of institutional properties. The 30-year canopy coverage goal for this MU is 20%.

Issues/Opportunities:

A Source of Significant Trees
Institutional properties represent a small percentage of Seattle's acreage, but they contribute to the city's tree canopy in a significant way. Many of these properties, such as the major college campuses, already have many beautiful and large trees. Some of these properties also have space available for additional tree planting.

The Challenge of Maintenance
The level of grounds and tree maintenance can be quite variable between institutional campuses. When budgets are tight, maintenance may be reduced in lieu of reducing budgets for educational programs. This often can have the double impact of reducing funding for tree preservation as well as new tree planting.

Goals and Actions:

Tree Resource

- Optimize age and species diversity.
- Work with institutional land managers to preserve existing trees.
- Encourage institutional land managers to focus on replanting removed trees first providing that the current function of the landscape can accommodate the tree(s).

Management Framework

- Protect existing healthy trees and encourage tree planting whenever possible and practical.
- Maximize opportunities for wood and byproduct salvage and reuse.

Community Framework

- Engage the institutional community as urban forest partners.
- Identify and work with the largest institutions first.
- Provide opportunities for education based groups such as fraternities, sororities, and clubs to become involved with planting trees on their campuses.

4.9. Developed Parks and Boulevards

Description

Since it was founded in 1884, Seattle Parks and Recreation has grown to over 400 parks and park-owned boulevards on over 6,300 acres of property. Of this total, about 2,400 acres are classified as 'developed parklands or 'park-owned boulevards'. Developed properties have been developed for specific uses, are actively maintained, and are not in a natural state. Over 90,000 trees are located within these developed parks and boulevards (Table 16).
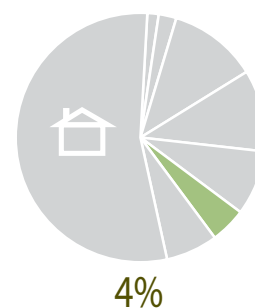
Table 16. Developed Parks and Boulevards MU Data*

Statistic	Parks - Developed Sites	
	Current	*30-year Goal*
Acres in MU	2,400	
MU as % of city land base	4%	
Canopy coverage	19%	25%
Number of trees	90,000	118,400
Plantings needed		**28,400**
One-time cost of plantings		**$11,360,000**
Maintenance Costs (yr)	$1,350,000	$1,776,000
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$1,350,000**	**$1,776,000**
Air Cleaning Value (yr)	**$270,000**	**$355,000**
Carbon Sequestration (Tons CO_2)	**3,400**	**4,500**
Carbon Sequestration (Value $)	**$104,000**	**$137,000**
Other Benefits (Energy, Aesthetics, etc)	**$1,606,000**	**$2,113,000**
Net Benefit (All Benefits - All Costs) (yr)	$1,980,000	$2,605,000

*All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

Specific recreation amenities found within this MU include sportsfields, picnic facilities, play areas, maintained lawns, shrub beds, and other plantings, parking lots, boat launches and numerous other park amenities. These facilities are typically maintained on a routine (daily) basis. These properties are also heavily used and replacement of assets due to use and sometimes abuse is not uncommon.

4%

Current Condition

The urban forest in this MU tends to be made up of individual or small groupings of trees rather than large stands such as would be found in a natural area. These trees need to be individually inventoried and managed. The size and species composition varies widely. Many of these trees are now of great size. Because the park system continues to grow, smaller trees also constitute a part of the standing tree inventory. Hazard tree mitigation is a high priority within this MU because many trees are relatively old and are located in high-use facilities. On average, park trees are currently on an 18-year maintenance cycle. The current canopy cover percentage within this MU is 19%.

Desired Condition

Trees in Seattle's Developed Parks and Boulevards MU need to continue to represent considerable species and age diversity. The 30-year canopy cover goal for this MU is 25%.

Issues/Opportunities:

Tree Maintenance

Currently, Parks has three, 3-person tree crews. One of these crews is funded through the Pro Parks Levy, and the other two are general fund crews. Each crew is fully outfitted with an aerial lift truck, support truck, and a large chipper. The work unit also has a stump grinder. The current pruning cycle for these crews is 18 years. It is recognized that a preferred pruning cycle is 5 to 7 years depending on location, indicating a need for additional tree maintenance resources. The $80,000 spent each year on hazard tree removal and replanting is a strong indicator that the current pruning cycle is leading to the premature death of park trees.

Current Replanting Capacity

Currently, Parks lacks a single, well-defined plan for tree replacement. Trees are removed from some parks without replacement. However, new capital projects typically do include trees as do major maintenance funded landscape restoration projects. The landscape enhancement element of the Pro Parks Levy also includes planting trees. A modest number of trees are planted each year within Parks' general fund programs. Still, these planting programs lack a coordinated plan that will ensure that trees removed from any park are ultimately replaced if so desired. New tree planting should focus first on replacement trees so that the original architecture/design of a park can be restored as desired.

Tree Preservation

Tree preservation in parks is more than simply acquiring additional maintenance resources. Situations arise in which park trees conflict with park use, CIP projects, and park safety. When this occurs, it is important that consideration be given to protection and preservation of park trees and other vegetation. If trees have to be removed, consistent with City tree policy, they should be replaced at the original site at a 2-to-1 ratio or at an alternate location as close as possible.

Hazard Trees

For many years, Parks had just one tree maintenance crew for all 90,000+ trees in the system. As a result, many trees prematurely declined and are standing hazards. In 2000, Parks implemented a Hazard Tree Mitigation Program to methodically locate and remove trees that are most hazardous. This program has generated controversy because many large trees have been removed. However, the nearly hollow shells left behind clearly demonstrate the need to remove the hazard.

Wood and Green Waste Recycling

It is currently estimated that Parks alone produces the equivalent of over 2,500 cubic yards of chipped wood mulch annually. In addition, a larger amount of so-called 'clean-green' waste is produced through maintenance operations and hauled to private vendors for composting. In turn, the City often buys back the composted material for use in Seattle landscapes. While most wood and green waste products are recycled, it is costly to do so. In 2005, an interdepartmental committee was formed to identify options for a better coordinated and more efficient process for dealing with these materials. That committee is first considering options for wood by-products.

Tree Species Selection

Because most parks have substantial areas for planting of trees, large, long-lived trees should be the preferred choice.

Goal/Actions:

Tree Resource

- Inventory existing trees.
- Continue to plant new trees and to replace trees that have been re-moved.

Management Framework

- Determine annual maintenance requirements.
- Purchase or develop a tree management software system to track work performed on park trees.
- Work within the City budget process to request desired additional tree maintenance resources.
- Train staff in tree protection practices.
- Develop BMPs for saving trees.
- Provide public education regarding rationale for tree removals.
- Link Vegetation Management Plan hazard tree needs to the work order system in priority order for removal.

Community Framework

- Increase public education information on "Living Alongside Park Trees."
- Work with the business and nonprofit (Park Foundation) community to create a tree donation account.

4.10. Parks Natural Areas

Description

The property in this MU is in public ownership and includes Seattle's true remnant forests typically located within parklands and undeveloped ROWs. These properties include established forests, riparian corridors, meadows, wetlands, and portions of parks that are in a natural state of varying ecosystem complexity and value. This MU contains a total of 3,200 acres. Much of it is steep hillsides and watershed ravines (Table 17).
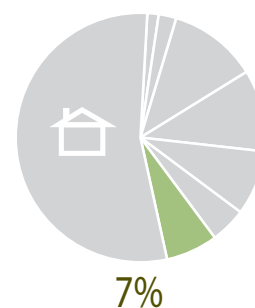
7%

Table 17. Parks Natural Areas MU Data*

Statistic	Parks -Natural Area	
	Current	*30-year Goal*
Acres in MU	3,608	
MU as % of City land base	7%	
Canopy coverage	64%	80%
Number of trees	568,700	711,900
Plantings needed		**143,200**
One-time cost of plantings		**$7,160,000**
Maintenance Costs (yr)	$2,843,500	$3,559,500
Benefits (yr)		
Stormwater Mitigation Value (yr)	**$9,099,000**	**$11,390,000**
Air Cleaning Value (yr)	**$2,275,000**	**$2,848,000**
Carbon Sequestration (Tons CO_2)	**21,600**	**27,000**
Carbon Sequestration (Value $)	**$654,000**	**$819,000**
Other Benefits (Energy, Aesthetics, & etc)	**$3,326,500**	**$4,164,500**
Net Benefit (All Benefits - All Costs) (yr)	$12,511,000	$15,662,000

All values are based upon estimates and currently accepted models (McPhearson et al. 2002)

This MU also contains most of Seattle's salmon-bearing streams. About 8 miles of urban creek area lies within 800+ acres of watersheds. The streams include Piper's, Venema, Thornton, Longfellow, Schmitz, Fauntleroy, and Taylor creeks. In cooperation with Parks, SPU has undertaken numerous projects within these creek systems to remove barriers to fish passage and to generally improve habitat quality.

Current Condition

Because this unit contains a wide variety of ecosystem types, the 'state of the forest' cannot be easily defined. In general, however, Seattle's forests are about 70% deciduous and 30% coniferous, very likely an exact reversal of what
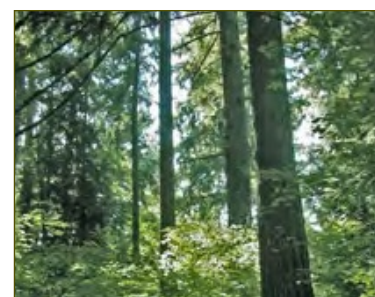
would have been found 150 years ago. Many of these second-growth deciduous forests, primarily big-leaf maple and red alder, are past their prime and are in serious decline. Only Seward Park and Schmitz Preserve still have stands of true old growth Douglas fir forest. Recreation use within the MU is generally passive including more than 70 miles of trails.

Desired Condition

The lands within this MU have the greatest potential for stormwater mitigation, enhancement of water quality, carbon sequestration, and wildlife habitat. However, in their current state, these forested lands are unable to provide these ecological services at a level that would be expected of fully functioning ecosystems. It is vital that the forest restoration work begun in the late 1980s—now stepped up considerably through the Green Seattle Partnership—be continued. The Green Seattle Partnership goal is to restore 2,500 acres of these forests and watersheds by 2025. 'Restoration' means the major invasive plant species have been removed, replanting with native species has taken place, and community volunteer groups have been established to assist with long-term maintenance of the sites. In addition, the City resources required to monitor, maintain, and manage the restored forests will be in place. The current canopy cover percentage in this MU is 64%. The 30-year canopy cover goal is 80%.

Issues/Opportunities:

The Impacts of Logging Operations

In the early 1900s, nearly all the huge Douglas fir, Western red cedar, and Western hemlock in the Seattle area were milled into lumber. As a result, very few conifers were left to provide a seed source to renew the coniferous forest. Instead, deciduous native alders and big-leaf maples claimed the land and became the second-growth remnant forests (or woodlands) of today. These deciduous trees are relatively short-lived and many are already nearing the end of their lifespan. As they decline, they create openings in the forest canopy allowing sunlight to enter. When that happens, it produces ideal conditions for non-native species like English ivy and Himalayan blackberry to invade the forest. As these invasives take over, the ecology of the forest is radically altered, and the many benefits that the forest provides are diminished. Today, over 70% of Seattle's remnant forests have some invasive plants and about 50% are moderately to heavily invaded according to data provided by the Seattle Urban Nature Project (SUNP).

The Loss of Woodland Area

Recent trends in Seattle's woodland areas indicate significant canopy cover change. Between 1972 and 1996, areas with at least 20% canopy cover decreased by more than half (from 19.5% to 8.4% of Seattle's total land area). Further, much of the lost canopy was well distributed across the catchment areas of our urban watersheds where it had maximum effectiveness in reducing stormwater volumes and peaks, could absorb air and water pollutants from wide areas, and provided larger and better connected areas for wildlife.

An Ambitious Plan to Restore Seattle's Forests

Although seriously compromised, Seattle's remnant forests remain an extremely valuable component of Seattle's overall urban forest ecosystem. The Urban Forest Sustainability Model objective to "maintain wildlife corridors to and from the city" is adequately fulfilled by Seattle's woodland. Birds and small mammals (up to the size of coyotes, raccoons, fox, and opossums) move freely. Similarly, the creeks within these forests are witnessing increased populations of fish and other aquatic life, thanks in large part to the efforts of many dedicated volunteers and creek restoration projects funded by SPU. However, one only needs to look at the condition of the flora in many of the so-called forests to realize that the habitat values are soon to change for the worse forever if restorative action isn't taken soon. As mentioned earlier, to enhance forest restoration efforts, the Green Seattle Partnership will restore 2,500 acres of these forests by the year 2025.

The Role of the Community

The community must play a large role if urban remnant forests are to be restored and sustained in perpetuity. In 1994, Parks established a forest restoration working model that was then, and remains today, about 95% dependent on community volunteer support for success. In 2004, community volunteers contributed over 50,000 hours to the restoration of Seattle's forests and trails. The Green Seattle Partnership will continue this model well into the future, with its goal of 100,000+ annual hours of volunteer support at program peak in 2012.

Private Views and Public Trees

Parks owns and manages many acres of forests on steep hillsides. Many homes are located above the forests. These homes in many cases would have dramatic views of mountains and water were it not for City-owned trees. Park's policies on private views have varied over the years. Twenty years ago, trees were allowed to be topped for views at the homeowner's expense. Because topping kills trees, Parks ended the practice. Currently,

City park trees can be pruned for private views but cannot be topped or removed solely for that purpose.

Goals and Actions

Tree Resource

- Continue to work with the SUNP to inventory, assess, and validate existing and new data on Seattle's remnant forests.
- Continue to restore Seattle's forest lands via the Green Seattle Partnership and other means.
- Establish a standalone riparian corridor forest inventory.
- Establish evergreen canopy guidelines to support watershed protection and wildlife habitat.
- Use more understory species, where appropriate, for increased and multi-layered canopy.
- In general use native plants whenever possible with a high percentage of them being coniferous trees. Be sensitive to the needs/opportunities of microenvironments that would support garry oaks, madrone, etc.
- Remember that the shrub layer is very important in woodland plantings.

Community volunteers are the backbone to restoration of Seattle's forested areas"

Management Framework

- Establish a common nomenclature for describing forest assets and the services they provide.
- Develop BMPs for forest restoration work and implement as part of the Green Seattle Partnership.
- Develop database management tools to assist with monitoring, documentation, and evaluation of forest restoration work.
- Develop the framework for long-term management of Seattle's remnant forests, including support for volunteer stewardship.
- Establish long-term funding for maintenance of Seattle's remnant forests.

Community Framework

- Increase volunteer outreach education.
- Engage additional business/corporate sponsors for forest restoration.
- Nurture existing volunteer support groups.

5.0 Implementing the Plan: Early Actions

The Urban Forest Management Plan is a roadmap for a strategic approach to manage Seattle's urban forest. The plan contains goals and supporting actions that are critical to the long-term vitality of the forest. However, in order for the Urban Forest Management Plan to actually have an impact on the forest resource, it requires a stewarding group and financial resources to begin implementation. Further, it needs to be institutionalized as a document *requiring* implementation with a sense of urgency to get things started. The Urban Forest Coalition will steward the plan beginning with the early actions described here as the 2007 Urban Forest Coalition Work Plan (Table 18)

Completion of the Urban Forest Management Plan clearly demonstrates that City leadership understands that a healthy urban forest is critical to guaranteeing the long-term health and vitality of the community, and that it is not a luxury but an absolute necessity. In order to accomplish the plan goals, the approach to overall plan implementation will include the following:

- The Urban Forest Coalition will have overall responsibility for plan implementation. The Urban Forest Coalition annual work plan will be focused on delivery of specific actions and outcomes as recommended in this plan.

- The Urban Forest Coalition will have responsibility for coordinating program-based biennial budgets that bring together all of the initiatives and proposals from the different departments in support of the City's urban forest goals and plan implementation.

- The Urban Forest Coalition annual work plan will be formatted in such a way that it doubles as a tool for annual performance measurement.

- The Urban Forest Coalition will report to the Sustainability & Environment Sub-cabinet for annual work plan approval and performance reviews.

- The Urban Forest Coalition will, as needed, present specific projects and initiatives pertaining to plan implementation to the Urban Sustainability Advisory Panel and the Sustainability & Environment Sub-cabinet for their review and comment.

- The Urban Forest Management Plan will be updated every 5 years including a mechanism for community input into the update.

Table 18. Seattle Urban Forest Coalition 2007 Work Plan

TREE RESOURCE	
Maintain trees to promote health and longevity	Continue restoration on 162 acres of forested parkland and begin restoration activities on an additional 74 acres
	Maintain trees in developed parks on an 18-year pruning cycle
	Maintain SDOT-managed trees on a 12-year pruning cycle
	Accelerate utility line clearance trimming for electrical safety
Increase canopy cover and environmental benefits	Plant 1,320 trees on City property
	Through the Neighborhood Matching Fund Tree Fund program, help community members to plant 500 trees
	Through City Light's Tree Replacement program, help community members to plant 800 trees
MANAGEMENT FRAMEWORK	
Improve management of trees on private property through incentives and regulations	Convene a group of community stakeholders to evaluate options and make recommendations for City incentives and regulations pertaining to tree preservation and planting on private property
Track the condition of the urban forest and implementation of the plan	Develop and implement an Urban Forest Management Plan performance monitoring system
Implement resource management tools	Update and maintain the street tree inventory of 35,000 City-owned trees (4-year process)
Facilitate interdepartmental cooperation and information flow	Convene regular meetings of the Urban Forest Coalition
	Solicit input on key program development and policy issues from the Sustainability & Environment Sub-cabinet and the internal and community stakeholder Urban Sustainability Advisory Panel
COMMUNITY FRAMEWORK	
Enhance awareness of urban forest as a community resource to inspire tree planting & preservation	Develop key messages regarding tree value, preservation and planting to use throughout the City's urban forest communications
	Create a brochure addressing tree benefits and tree preservation, selection, planting and care
	Provide tree benefit/tree planting brochure to anyone who receives a permit to remove a street tree or as part of a land use permit
Public information	Modify the City's urban forest websites to improve access to information and strengthen connections between departmental websites
	Provide information to City Light customers who will be impacted by tree trimming
	Develop brochure about line clearance activities and update the Right Tree Book
	Update permit applications
	Partner with a nursery or a non-profit to present two tree information sessions (do 1st as a pilot and evaluate success and approach)
	Partner with non-profit on a wide-reaching or reputable youth-oriented tree/arts project
Volunteer engagement	Add urban forest stakeholders to the Urban Sustainability Advisory Panel
	Identify opportunities for ongoing stakeholder involvement
	Foster 51,000 hours of volunteer support through the Green Seattle Partnership

References/Bibliography

American Forests. 1998. Regional Ecosystem Analysis Puget Sound Metropolitan Area. Seattle, WA.

American Forests. 1999. Urban Ecosystem Analysis of Seattle, Washington. Seattle, WA.

Bratton, N.J & K.L.Wolf. 2005. Trees and Roadside Safety in U.S. Urban Settings, Paper 05-0946. *In* Proceedings of the 84th Annual Meeting of the Transportation Research Board (January 9-13, 2005). Transportation Research Board of the National Academies of Science. Washington, DC.

Clark, J. R., N. P. Matheny, G. Cross & V. Wake. 1997. A Model of Urban Forest Sustainability. *Journal of Arboriculture*, 23 (1), 17-30.

Gilman, Edward & Sharon Lilly. 2002. Best Management Practices: Tree Pruning. International Society of Arboriculture. Champaign, IL. 35p.

McPhearson, G., S. Maco, J. Simpson, P. Peper, Q. Xiao, AM. VanDerZanden, N. Bell. 2002. *Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategy Planning*, Center for Forest Research, U.S. Department of Agriculture Pacific Southwest Research Station. International Society for Arboriculture. Silverton, OR.

SUNP. Seattle Urban Nature Project. 2004. 16th Int'l Conference, Society for Ecological Restoration, August 24-26, 2004, Victoria, B.C. Canada. A Citywide Survey of Habitats on Public Land in Seattle: a Tool for Urban Restoration Planning and Ecological Monitoring. Matthew Ramsay, Nelson Salisbury, and Suzi Surbey. Seattle, WA.

SUNP. Seattle Urban Nature Project. 2000. Seattle Public Lands Habitat Summary. Seattle, WA.

City of Portland. 1995. Portland's Urban Forestry Management Plan, public review draft. April 1995. Portland Parks and Recreation and the Urban Forestry Management Plan Technical Advisory Committee. Portland, OR.

Miller, R.W. 1997. Urban Forestry: Planning and Managing Urban Green Spaces. Prentice Hall. Upper Saddle River, NJ. 188p.

Victurine, R., A. Wagar, K. Wolf, S. Brace, R. Corletta. 2001. *A City Among the Trees: A Strategic Plan for Seattle's Urban Forest.* Technical Report by the Cascadia Consulting Group submitted to the City of Seattle. Seattle, WA.

Victurine, R., A. Wagar, K. Wolf, S. Brace, R. Corletta. 2000. *Seattle Urban Forest Assessment: Sustainability Matrix and Report.* Technical Report by the Cascadia Consulting Group submitted to the City of Seattle. Seattle, WA.

Wolf, K. L. 1998. Enterprising landscapes: Business districts and the urban forest. *In* C. Kollin (ed.), Cities by nature's design: Proceedings of the 8th National Urban Forest Conference, Washington, DC: American Forests.

Wolf, K. L. 2003. Youth and Mental Health: Work Projects in Urban Green Space. *In* C. Kollin (ed.), Engineering Green: Proceedings of the 11th National Urban Forest Conference. Washington, DC: American Forests.

Wolf, K. L. 2005a. Business District Streetscapes, Trees and Consumer Response. Journal of Forestry, 103, 8, 396-400.

Wolf, K. 2005b. Civic Nature: Valuation: Assessments of Human Functioning and Well-Being in Cities. *In*: Forging Solutions: Applying Ecological Economics to Current Problems, Proceedings of the 3rd Biennial Conference of the U.S. Society for Ecological Economics (July 20-23,2005). Tacoma, WA: Earth Economics.

Appendix A:
Source of Ecological Services Numbers

Detail from: Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategic Planting, E. Gregory McPherson et al, Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station, March 2002, International Society of Arboriculture, Pacific Northwest Chapter P.O. Box 811; Silverton, OR 97381 (503) 874-8263 www.pnwisa.org

Benefits

The sum of all benefits was used to capture the value of all annual benefits (B):

$B = E + AQ + CO2 + H + A$, where:

E = value of net annual energy savings (cooling and heating)

AQ = value of annual air quality improvement (pollutant uptake, avoided power plant emissions, and BVOC emissions)

$CO2$ = value of annual CO2 reductions (sequestration, avoided emissions, release due to tree care and decomposition)

H = value of annual stormwater runoff reductions (water quality and flood control)

A = value of annual aesthetics and other benefits

Costs

The sum of all costs. On the other side of the benefit-cost equation are costs for tree planting and management. Expenditures are borne by property owners (irrigation, pruning, and removal) and the community (pollen and other health care costs). Annual costs for residential yard trees (CY) and public trees (CP) were summed:

$CY = P + T + R + D + I + S + C + L$

$CP = P + T + R + D + I + S + C + L + A$

where

P = cost of tree and planting

T = average annual tree trimming cost

R = annual tree and stump removal and disposal cost

D = average annual pest and disease control cost

I = annual irrigation cost

S = average annual cost to repair/mitigate infrastructure damage

C = annual litter and storm clean-up cost

L = average annual cost for litigation and settlements due to tree-related claims

A = annual program administration, inspection, and other costs.

Average Annual Net Benefits

Net benefits are calculated as the difference between total benefits and costs (B – C). Average annual net benefits (40-year total/40 years) increase with mature tree size:

- $1 to $8 for a small tree
- $19 to $25 for a medium tree
- $48 to $53 for a large tree

For the purposes of this Urban Forest Management Plan the estimated average tree for Seattle was a (larger) medium-sized tree based upon the professional review and opinion of City arborists. Average net benefits were set at $22 per tree.

Appendix B: Tree Regulations

This appendix lists City of Seattle planning documents, policies, programs and regulations that establish a framework for tree preservation, planting and care.

Item	Intent
€Comprehensive Plan ~~Plan~~	The City's Comprehensive Plan, Toward a Sustainable Seattle, is a collection of City-adopted goals and policies about how the City will accommodate growth. Notably, environmental stewardship is one of the four core values that shape the plan. The importance of trees in the city is evidenced by the numerous tree references throughout the plan.
	The significance of trees in our open spaces is recognized as an important element in creating the character of our neighborhoods, making our streets more pedestrian friendly, providing healthy spaces for our children, attracting development, and buffering different land uses. Protecting large and exceptional trees is specifically included in the policy to preserve and enhance the City's physical and aesthetic character and environment.
	Transportation policies include calling for the Transportation Strategic Plan to include design features such as "Green Streets" to support all transportation modes with an emphasis on pedestrian amenities, street trees and landscaping.
	The importance of open space, parks, and green streets are mentioned in all neighborhood plans. Additionally, six neighborhood plans specifically note the importance of trees including the need to seek additional tree planting opportunities (Bitter Lake), create opportunities for people to experience the natural environment through tree planting on private and public property (Crown Hill/Ballard), provide additional pedestrian amenities such as street trees (downtown), enhance the health and quality of vehicle and pedestrian corridors by adding trees and other vegetation (Green Lake), provide streets that are green and tree-lined as well as encouraging development to provide trees and greenery (Greenwood/Phinney) and to mitigate impacts from arterials with measures such as street trees (MLK@Holly).
Regulations	
DPD	The following are summaries of regulations designed to protect and increase Seattle's urban forest. More detailed descriptions of these regulations can be found in Client Assistant Memorandums 242 and 341, which can be found at the DPD Website: http://www.seattle.gov/dpd/publications/client_assistance_memos_(CAMs)/
	Single-family: Tree Requirements in Single-Family Zones. Subsection I of Section 23.44.008. Tree removal, retention and preservation are not regulated for existing built lots unless a tree is in a critical area. For undeveloped single-family lots, exceptional trees may be removed only in limited circumstances. Protection of other trees over 2 feet in diameter is encouraged. Tree preservation requirements cannot limit "development potential" and would be waived.
	This subsection of the Land Use Code requires that trees be planted or preserved when a new single-family residence is constructed. The code requires that, on most lots, 2 caliper inches of tree must be planted or preserved for every 1,000 square feet of lot area. For example, a 6,000-square-foot lot would be required to plant or preserve 12 caliper inches of tree. This requirement could be met by planting new trees, preserving existing trees, or a combination of planting and preserving. In addition, the requirement can be met on the single-family lot or by planting or preserving trees in the public right-of-way (street trees). When trees are proposed to be preserved, a tree preservation plan is required.
	Multi-family: Tree Requirements in Lowrise Duplex/Triplex, Lowrise 1 and Lowrise 2 Zones. Subsection C of Section 23.45.015. Tree removal, retention and preservation are regulated for new development. This subsection of the Land Use Code requires that trees be planted or preserved when new multifamily dwelling units are constructed. The development standards are identical to the tree requirements for single-family zones, described above.
	Commercial: Setback Requirements in Commercial Zones. Subsection C of 23.47.014 and 23.47.016.C. This subsection of the Land Use Code requires a 5-foot setback from all street property lines where street trees are required by subsection C of 23.47.016 and it's not feasible to plant them in ROW according to City standards.
	Commercial: Screening and Landscaping Standards in Commercial Zones. Subsections B, C, and D 23.47.016. This subsection requires, among other non-related items, landscaping for new construction, street trees, and screening and landscaping standards for specific uses, such as parking lots and drive-in businesses. The following are required:
	Landscaping for new construction is required at a rate of 5% of the lot area. The landscaping is required to be in an area visible to pedestrians or customers and an area that has adequate sunlight and space necessary to ensure plant survival. No trees are required as part of the 5% landscaping requirement. The Director is often obliged to waive or reduce this requirement based on the building proposal. In most cases, a landscaped planting strip is all that's required.
	Street trees are generally required for all new construction, and for significant expansions of existing buildings or uses, in commercial zones. The Director, in consultation with the City Arborist, may reduce or waive the street tree requirements if the trees would obscure the visibility of retail uses or obstruct pedestrian access to retail uses.
	Landscaping standards for specific uses, includes general landscaping requirements for surface parking areas, drive-in businesses, outdoor storage, mobile home parks, and lots located within the shoreline. In general, these standards require landscaping but don't specifically require trees.
	Director's Rule 13-92 (Landscaping standards, including trees). While the code specifies how much landscaping and trees are required for a given project, Director's Rule 13-92 specifies what types of landscaping and trees are required. The Rule establishes requirements for drought tolerant plants and trees, and lists when landscaping plans are required and what elements they should contain (e.g., common and botanical names, number of trees, number of shrubs, and quantity of ground cover required, etc.).
	Director's Rule 6-2001 (Exceptional and Heritage Trees) The purpose this rule is to designate exceptional trees and Heritage Trees. This rule clarifies SEPA Plants and Animals Policy (SMC Section 25.05.675 N 2c.) for determining the value of outstanding trees on sites undergoing environmental review to establish appropriate tree protection mitigating measures. This rule also establishes a procedure for identifying Exceptional Trees under SMC Chapter 25.11.
SDOT	City of Seattle Board of Public Works Rules Chapter 4.3 describes beautification requirements within the street ROW area, including permits, planting, maintenance, setbacks, and authority.

Item	Intent
Seattle Municipal Code	
	Tree Protection Ordinance. Chapter 25.11 of the Seattle Municipal Code. Tree Ordinance (SMC Chapter 25.11). Tree protection on sites undergoing development, enforcement and penalties. The following is the purpose and intent of the City's Tree Protection Ordinance: • Implement the goals and policies of Seattle's Comprehensive Plan, especially those in the Environment Element dealing with protection of the urban forest. • Preserve and enhance the City's physical and aesthetic character by preventing untimely and indiscriminate removal or destruction of trees. • Protect trees on undeveloped sites that are not undergoing development by not allowing tree removal except in hazardous situations, to prevent premature loss of trees so their retention may be considered during the development review and approval process. • Reward tree protection efforts by granting flexibility for certain development standards, and to promote site planning and horticultural practices that are consistent with the reasonable use of property. • Especially protect exceptional trees that because of their unique historical, ecological, or aesthetic value constitute an important community resource; to require flexibility in design to protect exceptional trees. • Provide the option of modifying development standards to protect trees over 2-feet diameter in the same manner that modification of development standards is required for exceptional trees. • Encourage retention of trees over 6 inches diameter through design review and other processes for larger projects, through education concerning the value of retaining trees, and by not permitting their removal on undeveloped land prior to development permit review.
	Vegetation and Tree Removal Regulations for Environmentally Critical Areas. Environmentally Critical Areas Ordinance (SMC Chapter 25.09.320) This section of the SMC states that clearing or any action detrimental to trees or vegetation within environmentally critical areas is prohibited unless the Director has given prior approval to a restoration plan pursuant to buffer restoration, reduction, exemption, or exception provisions contained within Chapter 25.09, Regulations for Environmentally Critical Areas. The section also clarifies when vegetation and tree removal in critical areas needs a permit, and under what circumstances tree and vegetation removal in critical areas may be allowed by the DPD Director.
	Safety, Fire Hazard or Nuisance Plants. SMC 10.52 Weeds and Vegetation Ordinance This ordinance regulates plants designated as weeds or overgrowth that are a safety or fire hazard or public nuisance.
	SEPA - Specific Environmental Policies for Plants and Animals. Subsection N of Section 25.05.675. This subsection states that plants living in the urban environment are of aesthetic, educational, ecological and in some cases economic value. Overall, the subsection gives the decision-maker the ability to condition a project in order to mitigate the adverse impacts on rare, uncommon, unique, or exceptional plant or wildlife habitat, wildlife travelways, or habitat diversity for species (plants or animals) of substantial aesthetic, educational, ecological or economic value.
Policy	
	Seattle Parks and Recreation Policy Number 060-P 5.6.1. "Tree Management, Maintenance, Pruning and/or Removal" Referred to as "Parks Tree Policy," this document identifies what can and cannot be done to park-owned trees. Some of the more important elements of the policy pertain to view relief, the development of "vegetation management plans", the permit process for working on park-owned trees, and specific areas of responsibility for these trees.
Programs	
	• Green Seattle Partnership. The City has partnered with the nonprofit Cascade Land Conservancy to restore and maintain the 2500 acres of forested parklands in Seattle that are in serious decline due to invasive plants such as ivy and blackberry. Community involvement is the key to the success of this ambitious 20-year program. • Tree Fund. Every fall the Department of Neighborhoods, provides trees to neighborhood groups to enhance the City's urban forest through the Tree Fund, a component of the Neighborhood Matching Fund. The City provides the trees, and neighbors share the work of planting and caring for the trees. • Heritage Tree Program. Trees that are unique as landmarks, or having exceptional characteristics or being associated with an historic building or event can be designated as Heritage trees. • Community Stewardship Volunteer opportunities for planting and caring for trees and landscapes are available through Parks and SDOT.