TREE ASSET MANAGEMENT
in PORTLAND, OREGON

CNT
Sustainable Communities
Attainable Results

Page intentionally left blank

TREE ASSET MANAGEMENT in PORTLAND, OREGON

Prepared for:
Portland Bureau of Environmental Services
City of Portland, Oregon
June 28, 2011

Prepared by:
Center for Neighborhood Technology

COVER: PANORAMIC WILLAMETTE RIVER Photo by Cacophony

Acknowledgments

CONTENTS

Introduction

The urban tree canopy has gained broad recognition in recent decades for its contributions to municipalities' ecological and social well-being. The tree canopy delivers benefits to regional stormwater management, urban cooling, air quality, property value, and community livability. However, securing investment dollars to sustain the long-term infrastructure value of urban trees has proved challenging. To recognize trees' infrastructure value, cities must be able to quantify the performance of trees based on the various services they deliver, as well as relating the trees' performance to that of adjacent conventional infrastructure. To harness funding that supports and expands tree canopy's infrastructure service, cities can translate that performance into long-term asset valuation.

This study seeks to define procedures and tools through which Portland can implement tree asset management (TAM), and in doing so to integrate its trees—and potentially other grey-to-green infrastructure features—into an infrastructure asset management format that helps the city maximize the benefits of trees, engage the community, and potentially qualify trees for financing on par with conventional infrastructure.

The level of transparency created by infrastructure management informational systems is a key building block in securing effective, long-term investment not only from federal and state governments, but also from partnerships formed with stakeholders and citizens. By documenting asset values and recurring costs, local governments can develop financing scenarios that will gain the greatest results based on existing and future financial constraints.

Asset management represents a consistent set of standards by which public entities account for the value of capital assets that have useful lives longer than one reporting period. The Government Accounting Standards Board (GASB) established asset management procedures for government infrastructure in 1999 in its Statement 34 (GASB 34). Although Portland adopted GASB 34 a decade ago, the city does not currently classify trees as assets in this process.

Portland does recognize and measure many of trees' benefits, particularly relating to stormwater, energy, and livability values. But the tree canopy's difference from conventional infrastructure has so far precluded the classification of trees as capital assets and eligibility for the capital funds that are the meat of utility investment, a situation encountered by other entities that have considered listing trees as assets. As Portland's Urban Forestry Commission put it, "trees do not fit the traditional capital asset model, particularly as traditional assets depreciate over time, and trees appreciate over time. Challenges to capitalizing trees include accounting principles, ownership and control of trees, tracking and inventory, and measuring benefits."[1] Another potential limitation is the question of whether the capital value of a tree or group of plantings meets minimum asset value and ownership criteria in city or departmental standards.

This report examines the inputs and parameters necessary to establish TAM in Portland. The study reviews the city's canopy-related work completed to date and summarizes related programs and procedures from other cities. This background, along with input from key stakeholders, informs the delineation of a pilot implementation of TAM in Portland and

the components necessary for building an asset management tool to support citywide implementation.

Tree asset management as envisioned in the remainder of this report would adapt conventional asset management such that the distinct performance and value of trees' utility infrastructure functions can become elements of Portland's capital improvement program. Keys to success in a TAM financing scenario include

- establishing performance measures and annual reporting to track the value of utility infrastructure services delivered or enhanced by trees;
- partnering with existing organizations (volunteer organizations, business owner associations, neighborhood associations, schools, faith groups) for outreach activities;
- linking capital investments to community stewardship programs that support maintenance once trees are planted; and
- ongoing monitoring, education, and outreach efforts that ensure program longevity, utilizing and publicizing demonstration projects.

Although TAM would be rooted in operational information management, the linkage to infrastructure service valuation connects this approach to capital investment, enhancement of city services, community engagement, and quality of life. Under emerging federal stormwater rules, TAM also offers the potential to integrate tree canopy as an element of future compliance, including stormwater long term control plans. By clarifying the accounting of trees' condition, performance, and value, TAM would help Portland invest available capital in cost- and ecologically effective trees and other green infrastructure as elements of its sustainable stormwater network.

Parameters of Tree Asset Valuation

The first component of an asset inventory is a tree survey, or the gathering of accurate baseline information regarding the current level of service, health, and diversity of the urban forest. This inventory can be performed first through a census, with updates obtained through sample surveys performed at determined time intervals. A census involves collecting data on every tree within a certain area—in this case, within publicly owned lands (e.g., rights-of-way, non-naturalized highway corridors, school grounds, and parks). A sample, on the other hand, involves collecting data from a subsection of the tree population within a particular area. In a TAM program, once a more comprehensive initial baseline tree inventory is established, sampling can mimic the time intervals and methods performed for traditional grey infrastructure and serve as a cost-effective verification of asset status between census updates.

Measured components and physical attributes of the tree population, discussed later in this report, are collected and compiled into analysis software, such as STRATUM. The next step is to assign monetary values of utility service based upon the level of service, or benefits, that trees provide. At this time, benefits in the STRATUM model are defined in terms of air quality improvements, CO_2 sequestration, stormwater interception and related reductions in processing costs, energy use reductions (especially in terms of residential building usages), and property value increases. Performance and benefit values must address life cycle costs and benefits, including maintenance and trees' cycles of growth within the period of asset management.

To fulfill the accounting requirements for classifying the urban forest as a capital asset, the City of Portland must integrate databases that include valuation data as well as management records. The overall value assigned to a tree asset inventory is based upon structural and replacement value, costs, and benefits. While tree maintenance in Portland is currently the responsibility of adjacent property owners, TAM would recognize proactive tree maintenance on public lands as capital expenses to extend the utility service life of the urban forest. Management reporting should incorporate actions determined by the city's Urban Forestry Management Plan, including benefit maximization through the maintenance and expansion of the existing urban forest canopy, proactive tree health care, and "right tree, right place" optimization strategies.

The Portland Baseline

Portland is already ahead of many cities in its exploration of tree financing options, with research and development completed to date providing the preliminary foundations of a TAM baseline. The city has developed urban forest canopy goals and an action plan that fosters interagency participation. It has quantified costs and benefits of the urban canopy, and implemented successful public education and outreach models.

Policy Initiatives

Comparative canopy coverage research performed by Poracsky and Lackner (2004) for *Urban Forest Canopy Cover in Portland, Oregon, 1972–2002* concluded that levels of canopy coverage in residential areas should be at least 47 percent, and in commercial and industrial areas at least 12 percent. Not surprisingly, the report found that the areas of greatest increases in canopy coverage from the 1972 maps were in well-established neighborhoods which had been targeted by Friends of Trees for increased planting. Additionally, the report recommended further quantifying the relationship between water quality and canopy coverage, as well as promoting the economic benefits of trees as a way to educate and engage the public and policymakers.[2]

Portland's 2004 Urban Forestry Management Plan served to update the 1995 management plan, setting goals of protecting and enhancing the urban forest, distributing tree-related benefits equitably, and increasing the citywide canopy to cover one-third of the city. This plan called for better coordination across Portland's bureaus, agencies, and partners in efforts to better preserve, fund and manage the urban forest.[3]

In response to the goals expressed in the 2004 plan, the 2007 Urban Forest Action Plan established a prioritized, multifaceted work plan comprising 64 actions, including calls for public education, tree planting and maintenance, and policy and regulatory updates.[4] To support the action plan, the city conducted a sample inventory and published the results later in 2007 in *Portland's Urban Forest Canopy: Assessment and Public Tree Evaluation*. This report called for a proactive, wellness-based strategy for urban tree management as a way of maximizing resource longevity. Focusing on publicly owned street and park trees, it described and quantified the aesthetic and environmental benefits that these resources provide. Importantly, this report determined the net annualized returns on tree investments based on these benefits and on maintenance costs.[5] The nearly 4:1 benefit–cost ratio of tree plantings indicates that trees represent undervalued assets that should be recognized in city investment and accounts.

Initiated by the Portland City Council in fiscal year 2007, the Citywide Tree Policy Review and Regulatory Improvement Project (Citywide Tree Project) is a multi-bureau regulatory redesign intended to fulfill two of the main goals of the 2007 action plan: to create a consistent, cohesive regulatory framework for Portland's trees, and to enhance the urban forest through development and redevelopment.[6]

Additionally, the Citywide Tree Project addressed stakeholder concerns by creating a comprehensive tree code (Title 11), improving access to public tree information and customer service, simplifying tree permits across all categories, and enhancing inspection and enforcement activities.

The Bureau of Environmental Services Grey to Green (G2G) Initiative is intended to accelerate the implementation of the stormwater management goals set forth in the Portland watershed management plan. The G2G initiative seeks to expand the city's green infrastructure practices, including ecoroofs, green streets, tree planting, natural area revegetation, invasive plant removal, culvert removal, and land acquisition.

In addition to increasing the environmental benefits provided through green infrastructure, G2G seeks to increase "civic infrastructure" through organizational partnerships, community involvement and stewardship programs, and private industry development. While G2G has already seen successes, it has also served to highlight some challenges, including the following:
- Protecting investments by way of tree maintenance
- The need for cost-effective management strategies that capture the full ecological benefits of those investments
- Meeting community expectations for demonstrable benefits provided by G2G investments in urban canopy expansion

Pressure on financial resources is part of the impetus behind the quest for new funding and implementation models that will provide dedicated resources for urban forest management and expansion.[7]

Community-Centered Initiatives and Research

In addition to policy approaches to managing and encouraging urban tree canopy growth and its related benefits, Portland has already launched a variety of projects and initiatives that could support TAM implementation. These projects, focusing on community input, education, and information gathering, include street tree inventories and neighborhood stewardship plans.

Between 1995 and 2011, the nonprofit Friends of Trees, with the help of city agencies, utilities, and hundreds of volunteers, planted over 28,000 street trees in 62 neighborhoods through their Neighborhood Trees (NT) program. The program's goals included reducing stormwater runoff, reducing energy use in households, improving air quality, and improving community livability and civic engagement. Friends of Trees is also a key implementation partner in Grey to Green, with a target of 21,000 new street trees, about 25 percent of the overall G2G tree-planting goal. NT is not only working to help meet the City's desired increase of canopy cover in residential neighborhoods to 35–40 percent, with 15 percent canopy cover in commercial and industrial areas and 35 percent in rights-of-way, but also to improve the Friends of Trees tree inventory and database.[8]

The Neighborhood Stewardship Plan program, led by the Portland Parks & Recreation, Urban Forestry Division, with additional funding from the East Multnomah Soil and Water Conservation District, is creating neighborhood forest management plans. Community groups are trained by urban forestry staff and then partnered with tree experts to collect data including tree species, size, health, and site conditions. This information is then fed into a GIS-based urban forestry database to keep track of species diversity, stocking levels, site conditions, and ecosystem benefits. The database is also used to track street trees in need of maintenance and to

provide information on area available for new plantings from the Bureau of Environmental Services' tree canopy program.

Portland's extensive research and program development form the groundwork for the development of a tree asset management program. The baseline of work completed to date tracks tree planting and condition, establishes a relationship between and replicable values for trees and environmental benefits, and demonstrates successful community education and outreach initiatives. This body of work also sets urban forestry goals, defining best management practices aimed at preserving and enhancing the urban canopy, and demonstrates the capacity for public-private and inter-bureau collaboration. All of these elements are key pieces of TAM.

Financing Options: Bonding, Borrowing, & Philanthropy

Economists and financing agencies increasingly view sustainable, transparent development practices as an indicator of good management and strategic focus. As such, lenders may view sustainability initiatives as investments that can reduce risk,[9] resulting in lower capital costs or additional debt capacity.[10]

Portland's tree infrastructure work to date follows significant principles and practices that govern public finance:

- **A focus on mechanisms that foster coordination between agencies, creating organizational and management efficiencies.** As previously recognized, Portland already has a multitude of case studies that demonstrate not only inter-bureau coordination, but also public-private coordination.
- **Dedication of revenue streams that are adequate to finance the initial project.** A TAM pilot project would recognize undervalued benefits produced by tree-related funding, allowing the city to assign capital investment to further develop tree-based infrastructure value.
- **Providing clear evidence of the correspondence between dollars paid and benefits received for the project.** This element ties back into the public buy-in aspect of TAM.[11] By maintaining a transparent TAM program and an aggressive community involvement campaign, Portland should be able to track and demonstrate the efficacy of such a program.

Accountability Requirements Under a Tree Asset Management Program

Several elements are necessary to convert the tree programs and data already created into quantified utility service benefits that would allow trees to be managed as assets, and potentially funded as capital improvements:

- **Up-to-date inventory of assets.** This inventory must include location, age, species and diameter of each tree within public lands. With inventory data incorporated into GIS, the physical distribution of trees can also be overlaid with conventional infrastructure, allowing accounting of trees' contribution to service within a given sewershed.
- **Condition standards and a summary of physical condition assessments.** The city would establish a level of service which the trees must provide. This is the minimum standard to which the asset must be maintained.[12]
- **Estimate of costs to maintain and preserve the assets at established target condition level.** This would include each tree's original value at time of implementation of TAM or at time of planting, appreciated or depreciated value (this information is based upon age, physical condition, and level of service), and current replacement value. Although replacement value typically would represent the replanting cost of trees to meet the size and type of a dead or removed tree, it can also be calculated relative to the equivalent cost of delivering a tree's benefits, such as stormwater runoff mitigation or improved water quality, through conventional infrastructure.
- **Reporting of actual costs spent on maintenance and canopy expansion.** While this report recognizes that the general maintenance responsibility currently rests upon adjacent property owners, capital or other utility funds allocated to TAM could support assumption of maintenance activities for trees managed as infrastructure assets.

Specified and renewable easements, or "treesments," could address the issue of ownership. For the Bureau of Environmental Services to ensure durable delivery of trees' service value, street or park trees' stormwater or other values could be assigned by agreement to BES. If trees are considered private property, similar treesment arrangement could assign the tree and its maintenance to the agency. This could involve cost to purchase or secure easements if extended to private property.

GASB 34

In June 1999, the Governmental Accounting Standards Board (GASB) released Statement 34, which requires state, local, and municipal governments to provide annual financial statements regarding infrastructural capital assets. Among the goals of GASB 34 is providing better transparency for taxpayers into how their dollars are being spent.

Typically with the accounting of capital assets, the value is determined by the cost of the actual asset, adjusting for depreciation, and the total capital expenses. This value is based on the expected useful life of the asset.

GASB 34 is essentially a depreciated value approach, meaning that it calls for the accounting of depreciation associated with aging infrastructure. However, it also allows for a Modified Approach through which costs associated with the maintenance and preservation of assets can be accounted for as expenses and expansions can be capitalized. This Modified Approach not only acknowledges the typically long life of infrastructure assets, which makes annual depreciation amounts somewhat negligible, but inherently encourages more thorough asset management practices. It is also viewed as a way to increase public dialogue surrounding government spending. GASB's reporting requirements not only disclose expenditures and conditions, but also provide a forum for discussing trends and outcomes of the management process and the appropriate allocation of resources.

Infrastructure-related spending, which accounts for over 10 percent of local governments' total expenditures, can be reported as an expense under the Modified Approach. This enables governments to report their expenses related to the maintenance and preservation of their infrastructure assets.

GASB indicates that current rules permit accounting for trees as assets at their historical cost, including acquisition and installation,[13] although neither Portland nor other reviewed case study municipalities have yet taken this step. A network of trees that delivers alternative infrastructure services and reduce the cost of service compared to business as usual results in the opposite of depreciation, both on the municipal and the private property side. Although much of trees' additional infrastructure value may fall outside this narrow accounting envelope, GASB 34's alternate method allows for acknowledging this type of value within Management's Discussion and Analysis section of the Certified Annual Financial Report. Inclusion of an additional section in the CAFR describing TAM's value to infrastructure service, expected revenue growth from adjacent private property and associated property tax income, and best practices utilized to maintain the value would establish the accounting framework for TAM.

By Federal Highway Administration definitions, asset management programs are designed to aid decision makers in assessing the economic trade-offs of investment options. By using data compiled by inventories and STRATUM reports, the City of Portland is in a position to analyze benefits of current and proposed urban forest canopy scenarios as compared to the estimated budgets required to maintain and expand those assets. By relating those costs to relative cost of conventional infrastructure, Portland is also positioned to categorize the infrastructure value of aggregated canopy impacts as demand management assets that replace or extend the life of otherwise necessary capacity of their conventional pipe-and-gutter equivalents.

Possible Sources for Tree Asset Management Funding

Bonds

In the case of general obligation bonds, governments assume that the public at large benefits from an infrastructure project proportionally to their tax liability. The cost to the issuer is essentially determined by credit rating agencies, and debt issuances are typically 20–30 year bonds. Revenue bonds, which are considered a more risky investment by the investing world and thus result in a higher interest rate, pledge revenue streams from income-producing activities, such as water purification or mass transit. This type of bond requires "beneficiaries" of the infrastructure to pay for their consumption of the services provided.

Beneficiary-Based Service Fee

This type of service fee, such as a stormwater utility fee, identifies clear users of infrastructure and forms fees based upon "consumption" of a service—in this case, consumption of the stormwater system. Stormwater utilities are increasingly common nationally, and support local tree planting programs in a number of cities.

Special Assessment Districts

Known as local improvement districts (LIDs) in Portland, these districts are designed to raise funds from affected properties to pay for "special benefits," including green infrastructure improvements. To use this approach, the city needs a statute that allows for the issuance of bonds to provide upfront capital costs. Special assessments could apply when the installation of a green infrastructure project benefits property values. These fees have a limited lifespan often set up as a surcharge to the property owner's regular property tax bill. Once the project costs have been covered, the property tax reverts to the pre-project rates, though typically with an increase due to the newly increased value of the property. Special assessments can also be spread out over a longer time frame through a special assessment bond, which assumes that the entirety of costs and benefits related to the project are carried by the present and future property owners and no one else.

Special Service Areas

Referred to as business improvement districts (BIDs) in Portland, these assessment districts have a property-value dependent tax applied, generally in a 10-year repayment schedule, and are usually in designated business districts where infrastructure investments can increase retail appeal.

These areas must have the consent of a majority of the property owners, the local commissioner, and, typically, the local business association which is responsible for administering improvement projects.

Tree Increment Financing ("TRIF Districts")

A CNT-envisioned adaptation of tax increment financing districts, which define spatial boundaries for community improvement projects, TRIF districts could be used to fund green infrastructure projects.[14] Future increases in tax revenues from the established district would be earmarked to pay for current and future green infrastructure investments. In theory, those most benefiting from the improvements will be those most helping to pay for them. Portland's research has already identified increased property value levels associated with street tree plantings.[15] If a TAM pilot included monitoring real estate values, it would also have the basis to invest incremental property tax revenue associated with increasing property values back into canopy maintenance and expansion.

FIGURE 1 & 2
Before & after improvements
Photos by Philadelphia Horticultural Society

2300 North 3rd Street, Eastern North Philadelphia

2300 North 3rd Street, Eastern North Philadelphia
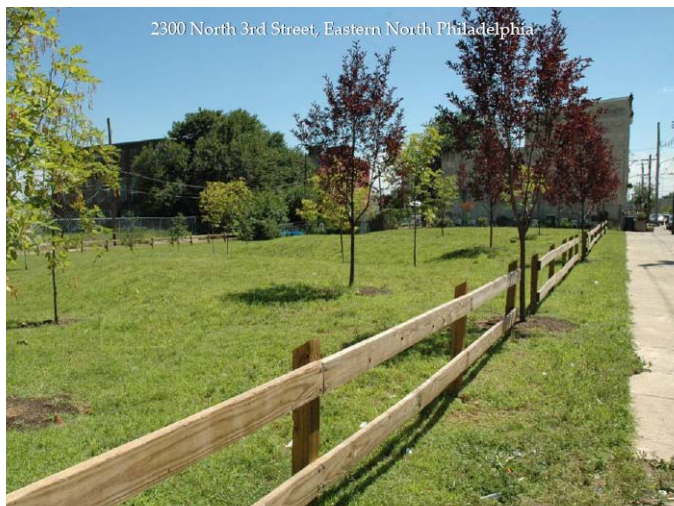
TRIF: A Philadelphia Story
A study of pilot neighborhood improvements in Philadelphia indicated significant gains in adjacent property value related to tree plantings (a 10% increase) and stormwater parks (30%).[16] Potential associated property tax revenue increase could support maintenance and further green infrastructure development.

TABLE 1
TRIF benefits in
New Kensington, PA

Property Value Gain ($)
Property Tax Increment (20 yrs)

■ Tree plantings
■ Lot improvements
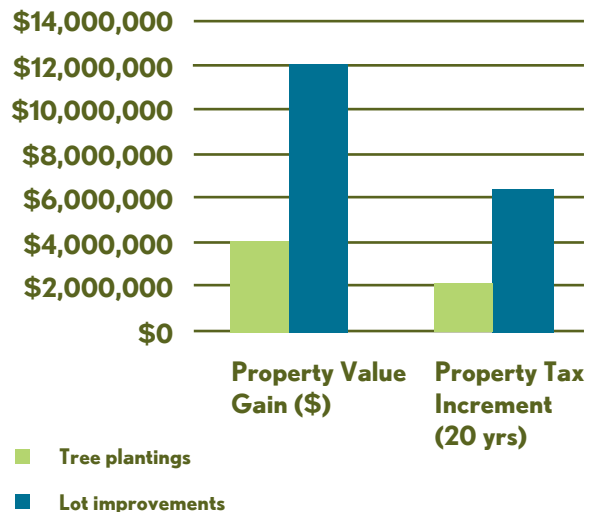
Revolving Loan Funds

Launched along with the Clean Water Act, the Clean Water State Revolving Fund Loan Program is designed to provide low-interest loans to public agencies for the purpose of financing water quality improvement projects. Funding for a tree asset management program could qualify under federally developed Green Project Reserve standards, which several states have made permanent following their inclusion in the American Recovery and Reinvestment Act (ARRA). The City of Portland could also establish its own Revolving Fund Loan specific to green infrastructure projects.[17]

Philanthropic Support

Most leading programs that are capitalizing trees as infrastructure work closely with nonprofit community partners. Those private philanthropic and nonprofit volunteer inputs represent an essential element of successful tree asset management. The philanthropic contributions may include financial support, but they are equally essential in contributing and leveraging human capital. The expertise and community involvement nonprofit partners deliver can extend municipal investment by assisting with planting, monitoring and maintenance, while helping build awareness and support for investment by municipal agencies.

In conjunction with standard financing mechanisms, the community component can be a tremendous resource. Philanthropic donations, matching funds from nonprofits, community matches in terms of time donated, social capital investments, and private funding are all options that deserve further investigation and active recruiting efforts.

Regulatory Compliance Offsets

Federal stormwater standards are evolving to allow and potentially emphasize green infrastructure practices. Expanding use of green infrastructure as allowable volume control is an explicit goal of EPA stormwater rulemaking currently in progress, and at least one municipal agency, the Northeast Ohio Regional Sewer District (NEORSD), has included green infrastructure practices as compliance under a consent decree for its long term control plan (LTCP). NEORSD committed to 44 million gallons of green infrastructure–based capture, and established a mechanism for "Green for Gray substitutions . . . provided that any proposed Green Infrastructure control measures provide the same or greater level of control, in terms of gallons controlled and the number of CSO activations in a typical year." The NEORSD consent decree also envisions accounting for green infrastructure co-benefits including energy, air, property, and quality of life.[18] Development of TAM, or a broader green asset management program, could qualify these activities under future LTCP compliance programs for Portland. To the extent that they avoid construction or replacement of conventional infrastructure, TAM activities would qualify for the same capital and other funds as the replaced control plan infrastructure.

Energy/Carbon Credits

Although relatively minor in financial value according to current carbon markets or as a fraction of targeted reductions in Portland's Climate Action Plan, TAM could also generate value via quantification of carbon sequestration and energy impact reductions. CNT's preliminary analysis

of tree benefits for a green infrastructure subsidy program in Chicago indicated that building energy benefits represent nearly half of trees' annual value. Because the energy value resides with property owners, representing potential savings would bolster the public value of TAM impacts.[19]

Community Case Studies

Several communities have developed elements of tree asset management, although few have so far funded their programs with capital funds, and none we could identify have yet included their tree infrastructure within GASB 34 accounting. As can be seen in the following case studies, public-private partnerships are vital to the success of urban forest management and enhancement, regardless of funding mechanisms. Each of these cases demonstrates the need to look at multiple sources for not only funding, but also for community outreach and the encouragement of municipal and civic buy-in. In addition, to maintain or encourage further canopy coverage, many cities use a combination of ordinances requiring the addition of street trees and canopy cover quotas for new and redeveloped properties, fees, or mitigation for removal of trees on private property.

City	Funding Source(s)	Maintenance Cycle	Inventory Cycle	Incentives for Residents to perform planting	Community Partners
New York, New York	General Obligation Bonds	10 yrs	10 yrs	Expedited process	Bank of America (for the 2005 Census), Bloomberg/Rockefeller Philanthropies, and MilliontreesNYC Stewardship Corps
San Francisco, California	Sales Tax, Gas Tax, Grants, & Capital Improvement Projects	10-12 yrs; Plans call for 3-5 yr cycle in the future	Applying for a grant to perform a full inventory	No	San Francisco Friends of the Urban Forest
Ann Arbor, Michigan	Plantings: Stormwater utility; Maintenance: General Fund	No set cycle	No future inventories planned at this time	Resident Sponsored Tree Planting Program– Residents can receive a letter of charitable donation of up to $1,000 for federal income tax returns for planting a tree	Elizabeth Dean Fund
Brookline, Massachusetts	CIP	7 yrs		Expedited process	None
Washington, DC			5 yrs		Casey Trees Endowment Fund

New York City, New York

In 1995, New York City Parks and Recreation conducted a census of its street trees, creating a baseline inventory that included information on the location, condition, size, and species of every tree growing within the public right-of-way. The intent was to heighten public awareness of the benefits of trees, promote education and citizen involvement, quantify the value of the urban forest, and to begin to analyze changes to the urban forest over time.

In 2005, the New York City Department of Parks & Recreation conducted a second inventory, sponsored by Bank of America, which identified a 19 percent increase in the population over the 1995–96 count,[20] and fed the results into the USDA Forest Service's UFORE model to quantify the annual benefits of the city's street trees. The four-month effort included over 1,100 volunteers from the community,[21] accounting for over 30,000

hours and 42 percent of the census results. For this inventory, research-ers designed a sample method and extrapolated data for the entire street tree population based on the information gathered for the smaller sample population. The next street tree census will take place in 2015, in keeping with the city's commitment to conducting a census every 10 years.[22]

New York City uses Forest Management System (ForMS), a GIS-based application, for tracking tree inventories and maintenance work orders. This program is also designed to allow citizens to submit and track re-quests for maintenance on the parks department's website.[23]

FIGURE 3
Brooklyn Bridge Park trees
Photos by Sive, Paget & Riesel, P.C.
blog.sprlaw.com

PlaNYC and MillionTreesNYC

In 2007, Mayor Bloomberg announced a comprehensive sustainability plan, PlaNYC. With over $200 million in funding, the PlaNYC 2030 initiative includes planting all empty street tree sites with an estimated 220,000 trees by 2017, doubling the current block pruning budget to meet the needs of 592,130 trees, and increasing the frequency of the prun-ing cycle from 10 years to 7 years.[24, 25]

The initiative provided the capital funding necessary for the two PlaNYC components that comprise the MillionTreesNYC program (MTNYC): the addition of 220,000 trees in public rights-of-way and reforestation of 2,000 acres of parkland.[26] The plan calls for accommodating the growing population of New York City, forecast to total over nine million residents by 2030, by increasing access to green spaces and waterfronts, as well as mitigating pollution and encouraging healthier living. MTNYC addresses these requirements through ecosystem services provided by the trees it plants and maintains. Its programs quantify ecosystem benefits—$5.60 in benefits per dollar spent on planting and maintenance—to help justify the use of capital funds.[27] Capital funds supporting the New York tree pro-gram are general obligation bonds, not tied to specific fees or taxes.

Additional funding for MTNYC street tree planting comes through matches by Bloomberg/Rockefeller Philanthropies to municipal capital funding. At the individual level, citizens can make donations to the Tree

Trust, a nonprofit trust account which funds tree planting in city parks. Residents can also apply for permits from the Central Forestry Division and pay for the installation of a street tree on their own,[28] cutting down on the wait time that accompanies requests for the city to install trees (due to high request volumes).[29]

Additionally, a local zoning amendment passed in 2008 requires the installation of a new street tree for every 25 feet of curbside area adjacent to new construction or substantial renovation on private lots. Before developers can receive permission to build, the Department of Buildings requires them to obtain street tree planting permits from the parks department. Another recently passed local law requires that any entity or city agency removing a tree in the public right-of-way either replace the tree or provide funding commensurate with the size or species of tree for the purpose of replanting.

In New York City, the parks department manages all trees growing in rights-of-way and in parks, as well as street trees. While the city owns the space between the curb and the adjacent property lines, adjacent property owners are responsible for maintaining the sidewalks—with some exceptions—and can be issued violations from the Department of Transportation for sidewalk defects that affect public safety.[30]

Within the first two years after planting, contractors hired by the parks department are responsible for street tree maintenance, after which the department itself takes on the responsibility. The MTNYC Stewardship Corps was established in coordination with Trees New York to provide funding and resources to residents who commit to taking care of trees in their community. MTNYC stresses that public investment in tree stewardship is essential to the success of any urban reforestation initiative and encourages engagement of local nonprofits and environmental groups to help maintain new tree installations.

MTNYC tracks all trees it plants, as well as those installed through efforts of its partners, in a comprehensive database, enabling financial accounting to be performed on a tree-by-tree basis rather than through sampling. For the New York Restoration Project, MTNYC's nonprofit partner, to receive dedicated Bloomberg/Rockefeller funding, it must submit a semi-annual report detailing its tree planting efforts.

In an effort to track performance values as canopy cover increases, the parks department is performing long-term mortality studies for both street tree and reforestation planting, as well as collaborating with the New School and Columbia University to evaluate the effectiveness of planting efforts in natural areas through managed research plots. The city will also perform another tree canopy GIS analysis towards the end of the initiative, which will generate information on the ecosystem benefits gained through the initiative's planting efforts.

Tree Map App

The mobile media app Trees Near You (www.TreesNearYou.com) is designed to provide information on every documented tree in New York City. The app utilizes the city's tree census data and an algorithm that results in a display of the monetary and environmental benefits of the tree that the user is profiling.[31]

Ann Arbor, Michigan

With the technical assistance of the Davey Resource Group, the City of Ann Arbor implemented the first step of their urban forest management plan with an inventory of all city-owned trees—both in the right-of-way and in city parks—in February 2009. Ann Arbor's urban forest includes over 40,000 street trees and 6,600 park trees (defined as those trees within mowed areas that the city actively maintains). This inventory is now a layer on the city's GIS maps and integrated into their asset management software, Cityworks.

The inventory itself includes information about individual tree species, size, and diameter, along with geocoded location, condition, and maintenance needs. The city's website houses Google Earth map files, with which users can find the location, size, and condition of every street tree or maintained park tree, as well as recommended maintenance activities and areas that are prime for tree planting.[32]

Currently, the city pays for tree planting and maintenance through the general fund forestry budget, supplemented by annual interest income from the Elizabeth R. Dean Fund, created to support public tree planting in Ann Arbor. Tree inventories are maintained through the use of funds generated from the city's stormwater utility. Although Ann Arbor officials perceive public support for replacing trees after the emerald ash borer decimated much of the street tree population, the question of increasing stormwater fees to pay for maintenance practices represents a challenge. The city is developing education and outreach materials and events in order to raise public awareness of the need for maintenance. Though Ann Arbor had planned to fund street trees within its capital improvement plan (CIP) for fiscal year 2011, it removed tree planting from the CIP budget due to the need for further investigation of accounting for negative depreciation.[33]

Additional fees and regulations include a canopy loss fee and a street tree escrow. The canopy loss fee, part of the public services fees approved by City Council annually, is based on the lower-bound estimate of the value to the community of a city-owned tree removed for developmentpurposes. The street tree escrow is a requirement for approval of a plat or site plan. Contingent on the satisfaction of tree-based requirements, it is refundable after a site inspection typically conducted one year after project completion.

FIGURE 4
Ann Arbor skyline
Photo by Alan Piracha

San Francisco, California

In the city of San Francisco, capital funds for trees in public areas are leveraged by piggy-backing onto existing capital infrastructure projects, such as repaving projects or utility upgrades. The justification is that this helps the city realize cost efficiencies and create more complete street improvements.[34]

FIGURE 5
Lombard Street, San Francisco
Photo by Jon Sullivan

Additional funding measures that San Francisco is exploring include the possibility of creating community benefit districts, parking benefit districts, and proposed annual vehicle registration fees of up to $10 on motor vehicles registered within the city and county of San Francisco.[35] Special taxes are in place through creation of community facilities districts (CFD), which pay for construction and maintenance of improvements to sidewalks, streets, street furnishings, and landscaping. The Department of Public Works also funds tree planting through excess funds generated by tree violation fees enforced by environmental control officers.

The city is also examining the costs and benefits of shifting maintenance responsibilities away from adjacent property owners and onto the city to capture economies of scale. Under the Street Tree Action Plan, the tree maintenance cycle will be reduced from seven years to three years. Under this action plan, the Department of Public Works is also shifting away from a "response to requests and emergencies" maintenance approach to a more proactive preventative maintenance cycle. This shift is expected to add an additional $13.5 million annual expenditure to the current $3.7 million budget.[36]

Currently, the departments of Parks & Recreation and Public Works are responsible for the management of most public trees. Additional maintenance responsibilities fall to the Public Utilities Commission, San Francisco Unified School District, and 13 other agencies.

The city encourages the creation of community stewardship programs, such the Tree Planter and Tree Care Team Player programs, focusing on tree planting and care, which were developed by San Francisco Friends of the Urban Forest.

Brookline, Massachusetts

The urban forestry budget in Brookline is currently funded under the city's capital improvements program, which is predominantly funded through bonds. Maintenance is funded through both operating and capital accounts. Although Brookline does not attempt to calculate or finance the ecosystem service values of trees, state-required open space plans call for estimating such services.[37]

Olympia, Washington

In Olympia, the Department of Transportation pays for much of the street tree planting because of the protection it offers to streets, sidewalks and parking lots. A cost-benefit analysis showed it was more cost-effective to increase canopy cover throughout the city than to invest in repairs to both adjacent infrastructure and the trees themselves.[38]

Washington, DC

A collaboration between the district's Urban Forestry Administration (UFA) and the Casey Trees Endowment Fund, a local nonprofit, have led tree canopy expansion efforts in the district.

In 2002, Casey Trees sponsored a full census inventory to create a street tree data set, updated by sample-based counts in 2004 and 2009. UFORE and i-Tree Eco models were used to perform modeling and analysis. The group has committed to conducting an inventory every five years to document change over time, enabling UFA to use these data sets to form the baseline for setting goals and objectives, as well as for developing and implementing tree management programs.

For the summer 2002 data collection, Casey Trees used a citizen-based approach to inventory every street tree in Washington, DC. The comprehensive GIS inventory identified 106,000 street trees and 25,000 planting locations. In addition to developing an inventory, the project had a goal of creating a "city of citizen foresters," long-term environmental stewards of the district.

In March 2004, Casey Trees made its interactive tree map of the district (www.caseytrees.org) accessible to the general public. The site allows users to view information for individual trees, such as species, size, and the benefits provided. It also shows current data on all of the Casey Trees plantings.

By maintaining an inventory of the city's trees, both Casey Trees and UFA have access to an efficient management system that enables coordination between their organizations and other city agencies. With a reliable, comprehensive data set, it is possible to determine trends, identify planting opportunities, and manage species composition.

Through the GreenTech program, also funded by Casey Trees, DC high school students use GIS to inventory their school's trees, learning about the trees' environmental and economic value, locating planting opportunities, and learning about planting and maintenance standards.

FIGURE 6
Washington Monument & Lincoln Memorial Reflecting Pool
Photo by Josh Carolina

Partnership Potential & Community Input

Leveraging the efforts and investments of numerous agency and community partners is a key strategy inherent in the idea of tree asset management. Within Portland, the following agencies and groups would play roles, as outlined in the table.

TAM Function	Organizations	Roles
Inventory	PP&R	Lead inventory activities & provide information, tools, etc.
	Friends of Trees	Inventory activities
	City Tree Inspectors	Review condition assessments
	Tree care professionals	Review condition assessments
	Property owners	Inventory activities
	Community members	Inventory activities
Benefit Calculation	PP&R	Gathering of all applicable data into valuation tool
	BES	Review and leverage valuation data
Maintenance	PP&R	Provide general maintenance certification for public volunteers; proactive maintenance activities
	BOT	Maintenance activities associated with general roadway maintenance (line-of-sight trimming, etc.)
	BEM	Cleanup after storms, etc.
	Friends of Trees	Oversee volunteer maintenance activities
	Tree care professionals	Provide technical expertise & perform higher-risk maintenance activities
	Property owners	Volunteer maintenance
	Community members	Volunteer maintenance
Outreach	BES	Create and oversee distribution of outreach & education materials
	PP&R	Lead outreach and education activities on the ground
	Friends of Trees	Assist PP&R with roll-out of outreach and education activities
Financial accounting	BES	Consolidation and maintenance of all data inputs necessary for TAM
		Determination of capital allocation and sources available to TAM development

Potential partnerships
Bureau of Parks & Recreation (PP&R)
Bureau of Environmental Services (BES)
Bureau of Planning & Sustainability
Water Bureau
Bureau of Transportation (BOT)
Bureau of Emergency Management (BEM)
City Tree Inspectors
Portland General Electric
Friends of Trees
Tree care professionals
Property owners
Community members

Portland Stakeholder Interview Recommendations and Considerations

To explore opportunities and challenges to community participation, CNT staff interviewed seven people from five stakeholder organizations, both within and outside the city administration, all of which are involved in promoting urban forestry and green infrastructure. The following section highlights some of their key ideas and concerns.

Community and Political Buy-in

- While Portland has years of studies examining and documenting the dollar benefits associated with green infrastructure, trees in particular, translating those academic figures into cash-in-hand remains an institutional challenge in generating buy-in from the community and elected officials. To gain support for additional financing for trees, the public must be able to make the connection between the costs and benefits that they are footing the bill for.
- TAM should present meaningful metrics that could illustrate individuals' contributions to the larger effort of increasing the environmental, health, cultural and economic benefits that trees provide.
- Messaging and marketing to engage community partners is essential to the success of a tree asset management program.
- It is imperative to emphasize the importance of a tree asset management program to the long-term economic success of the city as well as the role such a program would play in maintaining Portland's role as a national leader in sustainability and livability.
- The city must continue to address issues of inequity in terms of canopy distribution and natural resource access among neighborhoods as it rolls out TAM.
- Tapping local nurseries to grow the required trees will bring business opportunities and jobs to the districts in which they're located, a much-needed boon to the local economy during tough times.

Maintenance Roles and Responsibilities

- Maintenance needs stand out as a key concern; if the TAM program can incorporate a proactive care strategy, it can reduce costs in terms of emergency care and perhaps in replacement rates, as well as maximizing asset performance.
- TAM must clearly lay out the terms of success and outline adaptive management strategies.
- There must be significant work on the ground to gain buy-in from property owners, many of whom express concern that such a program will lead to over-management or create greater economic burden if maintenance responsibilities continue to fall primarily on property owners.
- For the City of Portland to have true jurisdiction over what happens in the right-of-way, there has to be a stable source of income to fund enforcement policies.
- A pilot of TAM should examine whether or not the useful life of the tree can be extended, thus depreciation slowed, through maintenance activities.

Financing Strategies and Departmental Roles

- A successful program will keep incentives, regulations, and educational components working in concert. Decision makers, the public,

and the business community have to be able to see the program fitting into their economic modeling and be willing to put it into their accounting documents.

• The concept of income generation, of leveraging resources for the undefinables, capturing service and performance values of the trees, has been examined in Portland. However, moving from theory to practice continues to be a politically tricky leap.

• Determining which departments would be responsible for rate setting, performance monitoring, etc., must be explored further. It is vital to look at what expertise each bureau can bring to the table to achieve a sustainable, benefit-producing urban forest.

Tool Conceptualization

• The conceptualized tool itself should give community members the ability to find their property attributes, allowing individuals to "do the right thing" on their own. It should outline a step-by-step process that gives an explanation of the city's goals and ways to help achieve them. A web-based tool should include links to resources, such as Friends of Trees and other related nonprofits and grassroots organizations, as well as tree manuals, and common FAQs. The tool could also be integrated with permit management databases.

• The tool should demonstrate how the TAM program could provide real-time benefits in terms of money saved or property value increases in two years, five years, ten years, etc.

Tree Asset Management Calculator Components

This section identifies existing tools that enable the creation of maintenance schedules, valuation assessments, and inventories, all necessary components of a viable tree asset management program. Designing a tool that integrates these components must translate from physical inventory to performance.

According to the valuation study on Portland's publicly-owned street and park trees conducted in 2007, the replacement value is estimated at over $2.3 billion, with a structural value of the entire canopy reaching nearly $5 billion. While management of these trees costs the city around $6.5 million annually, with an estimated $3.3 million or more borne by private landowners,[39] the benefits are worth nearly $27 million annually. Initial calculations indicate an average $3.80 return on investment for every dollar invested.[40] Future efforts would track performance based on incremental canopy additions.

The following tools are already available for monitoring assets in terms of valuation and maintenance. Portland is already familiar with the i-Tree software, while the other two examples are tools that Portland could develop further in a fashion that would be specific to the climate, community and political environs of the city.

i-Tree

Developed by the USDA Forest Service, i-Tree is a peer-reviewed software suite that incorporates adaptations of both the Urban Forest Efforts (UFORE) model and the Street Tree Resource Analysis Tool for Urban Forest Managers (STRATUM) model. The i-Tree Eco tool (based on the UFORE model) provides a broad picture of the urban forest structure, environment effects, and the value of the full urban forest. The i-Trees Streets tool (based on and formerly STRATUM) specifically focuses on the ecosystem services and associated dollar value benefits of municipal street trees. This focus on the quantification of benefits makes i-Tree Streets extremely valuable in this context.

The i-Tree Streets tool provides urban forest managers and other users with an easy-to-use computer program that allows them to conduct and analyze a street tree inventory, as well as quantify the dollar value of benefits such as energy conservation, air quality improvement, CO_2 reduction, stormwater control, and property value increase. Users also have the opportunity to document tree health and maintenance data, allowing detailed reporting of costs in conjunction with the benefits, thereby enabling effective resource management, policy development, and priority setting.[41]

Barchan

Developed in association with MIT, Barchan was designed as a capital asset management tool that would assist governments in meeting the requirements of GASB 34. The tool accesses local GIS mapping networks to construct meta-segments based on existing infrastructure maps. These meta-segments are then grouped according to criteria such as spatial layout, typologies, and maintenance schedules. Among the useful layers within the tool are assessment capabilities that can be used to generate maintenance scenarios designed to optimize resources in maintaining (or increasing) the value of an individual asset. This section of the tool

allows the user to define desired condition levels and to assign maintenance activities based on those levels, keeping an electronic log that can be used for budget and accounting purposes.[42]

CAVAT

Used by the London Tree Officers Association, the Capital Asset Value for Amenity Trees (CAVAT) program is a tool that uses a set of data including basic tree value (a function of size), a community tree index (CTI) value/factor, and current functional value based on a safe life expectancy.

One Canadian asset management tool designed for use with traditional grey infrastructure includes a data list that clearly defines the information that municipalities should collect, in order of importance. It also lists tool specifications that define how to collect this required information. This tool creates standardized information that is downloadable into Excel format; thematic mapping in GIS allows for queries to find specific data sets.
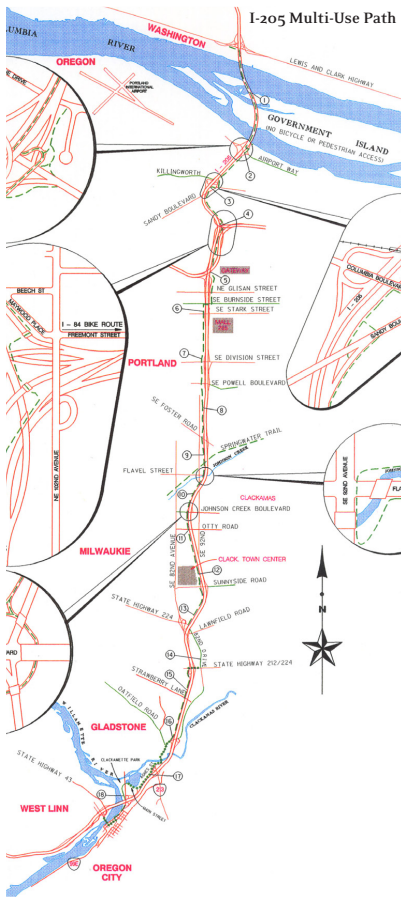
Pilot Program Components

Portland can build upon existing programs and research through a 3-4 year pilot implementation of tree asset management. A multiyear pilot would capture the value and performance of tree canopy expansion in the remaining Grey-to-Green plans, building tools, procedures, agency and community capacity to establish TAM as an effective, enduring component of capitalized utility services on par with conventional grey infrastructure.

Steps to establish TAM would be as follows.

1) Designate sample neighborhoods to organize, project, and track TAM value.

A pilot could begin with approximately four or more neighborhoods already the focus of Neighborhood Stewardship Plan (NSP) activities and Grey-to-Green/Plant It Portland zones that are targeted for canopy expansion. Establishing and tracking asset value in areas inventoried under these programs would both leverage existing inventory work as well as capture incremental value of services from geographically concentrated plantings. TAM pilot areas could also consider other neighborhood archetypes identified in the Davey asset management report[43] to address TAM in areas other than residential zones. Aligning pilot TAM areas with transit corridor development could be of particular interest because of potential access to transportation capital funds and the chance to build on the precedent from the Metro/ODOT/FOT project that capitalized trees along I-205.[44] Selecting pilot neighborhoods that drain to priority sewersheds for runoff reduction would align a TAM pilot most closely with infrastructure service. Also relating activities to stormwater sewersheds would most effectively establish potential for future inclusion in regulatory compliance activities.

2) Conduct a baseline tree inventory/census for pilot areas.

Where inventory work is not yet completed, a baseline census will be necessary, followed by periodic condition, performance, and valuation updates one or more times in each area. Depending on determination of requirements for capital funding eligibility and following the baseline tree census, Portland could repeat a census (every tree) in two neighborhoods and compare results with sampled data (a subset of trees) in two others to determine whether accurate performance value can be projected from sample rather than census to contain assessment costs of future asset management. The subsample rate set to assess tree condition could mirror the fraction of conventional grey infrastructure subject to verification annually.

3) Project the life-cycle asset value of trees' utility service, particularly stormwater, energy, and property value influence, according to a 20- or 30-year potential investment life.

The cumulative performance of existing and added tree plantings would be projected according to species, size, and condition over the relevant financing life cycle. Tree canopy performance and valuation would derive from modeling by i-Tree or similar software, calibrated with performance data from Portland's NPDES monitoring (Liptan), the Grey-to-Green benefits (BES/Entrix) study, and resources such as CNT's Value of Green Infrastructure study.[45]

FIGURE 7
I-205 Multi-Use Path Green Space Initiative
Images by Friends of Trees

The utility performance life-cycle valuation would focus on stormwater service as the primary capital utility contribution, but also could consider energy, air, and property value impacts that might eventually add to utility service and thus capital value. The asset value time frame would relate to trees' life cycle and variable performance by intersecting the age, type, and performance of the tree canopy asset base with the period considered for financing, incorporating the appreciating or depreciating service value that inventoried trees are delivering in the selected period.

Safe Life Expectancy Adjustment

Life Expectancy (yrs)	% Value Retained
80 +	100
40 – 80	95
20 – 40	80
10 – 20	55
5 – 10	30
< 5	10

TABLE 2
An example of tree performance depreciation or appreciation from the CAVAT accounting system for valuation based on service life of trees. A condition/LOS matrix would relate tree age, type and condition to performance over time.

TABLE 3
Green infrastructure benefits & practices
Image by Center for Neighborhood Technology

| Benefit / Practice	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Community Livability					Improves Habitat	Cultivates Public Education Opportunities
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding								Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture		
Green Roofs	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Maybe	Maybe	Yes	Yes
Tree Planting	Yes	Yes	Yes	Yes	No	Maybe	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Yes
Bioretention & Infiltration	Yes	Yes	Yes	Yes	Maybe	Maybe	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Maybe	No	Yes	Yes
Permeable Pavement	Yes	Yes	Yes	Yes	No	Maybe	Yes	Maybe	Yes	Yes	Yes	No	No	Yes	No	No	No	Yes
Water Harvesting	Yes	Yes	Yes	Yes	Yes	Maybe	No	Maybe	Maybe	Maybe	No	No	No	No	No	No	No	Yes

● Yes ◒ Maybe ○ No

4) Construct a web-based database and multi-level interface to connect inventory data, maintenance/level of service, and performance value projections for asset accounting and reporting.

An integrated TAM tool would serve as an administrative tool for both management and accounting, and would help to encourage public involvement and support for tree-based infrastructure services. The internal agency interface would serve city agencies and partners in maintaining tree asset service levels, while a publicly accessible side of the database would build recognition by the public, decision makers and finance community that tree asset value is a functional element of stormwater and community infrastructure.

City agencies as well as Friends of Trees already maintain multiple databases with tree inventories, needs assessments, management plans, and outreach strategies. These data sets would be integrated with i-Tree or comparable performance projections to determine benefits. The integrated TAM tool would manage data flow (illustrated below), between inventory to a GIS-mapping system, and potentially link to city tree permit and agency maintenance information to verify level of service and capital valuation.

The TAM data tool would create a web interface to tree inventory information, as well as periodic assessment data. The web-based tool will

FIGURE 8
Integrated TAM data management tool
Image by Center for Neighborhood Technology

Schematic of Data Interoperability
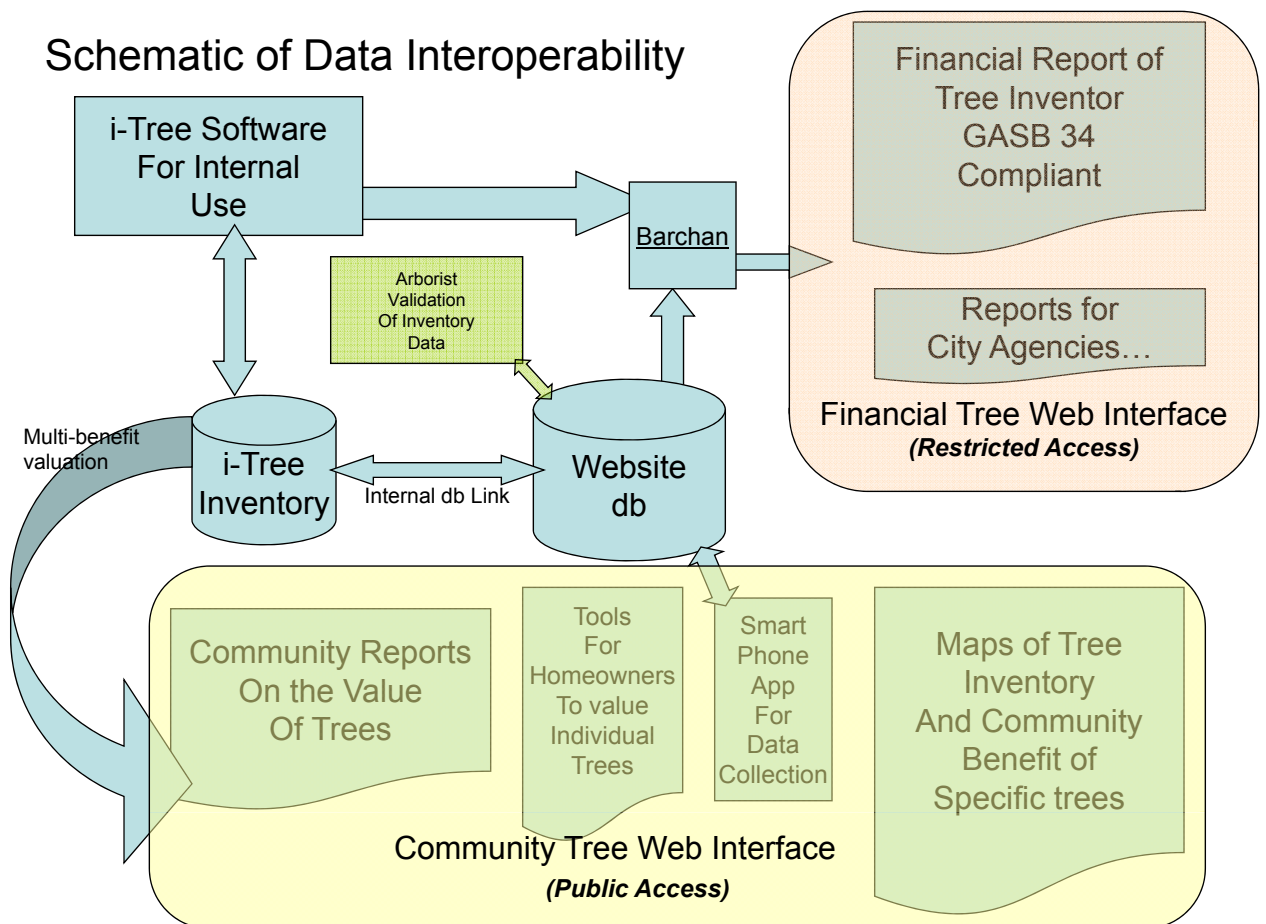
include two levels of access. The first level would be proprietary, with protected access available only to city agencies or officials who manage the financial management aspects of the canopy system, as well as those managing physical canopy maintenance. The internal agency tool would integrate inventories to produce valuations based on aggregate benefit of inventoried individual trees. The agency portal would track management activities with quality controlled data that meets accounting standards for capital expenditure.

The second level of data tool access will act as the public window to TAM, encouraging community involvement, social networking opportunities as they relate to urban forest management activities, and public education. Like other case study cities, a smartphone app could be one element of the community-level tool, both to input monitoring or condition data as well as to identify tree species, conditions, and utilize social networking tools for organizing community training, planting and monitoring activities. This would utilize existing mobile applications that enable tree species identification through photography, geographic data gathering using coordinates registered through the phone during documentation, and quality control through the requirement of photo submission of the tree in question. Additional data points include diameter at breast height (DBH) and a condition assessment based upon a prescribed scoring system. Other cities have utilized community-based data inputs in assessment and inventory and have proven effective toward establishing accurate inventories,[46] although pairing professional personnel with volunteers at least for training would enhance accuracy and consistency. To support the community-based inputs, outreach programs would include stewardship training to ensure accurate data collection.

Data views from the TAM could encourage awareness and neighborhood comparison of trees, canopy level, and utility and other service values, presented as a local "tree score" akin to a Walk Score. Individuals could compare their own property, street, or neighborhood, as well as monitor the citywide status of plantings and tree-based services.

5) Report annually on incremental performance and asset value.
Summaries of canopy expansion, maintenance, community involvement, and value would provide an annual snapshot of the value of tree canopy services, and their incremental growth or decline in the short term, and deliver accountability required for long-term capital financing.

6) Evaluate pilot results and tools toward citywide expansion.
Results of the TAM pilot will allow the Bureau of Environmental Services and other partners to decide whether to expand the program citywide, and to determine the value of capital investment it would commit in long-term capital improvement plans, as well as its next Long Term Control Plan for stormwater management or related utility service. Evaluation would include consultation with city and external bonding agency staff to ensure that inventory, management, data and valuation procedures comply with city and national capital asset financing standards.

Summary of Recommendations

Based on the work that Portland has already compiled, the city has a demonstrated capacity to pilot a tree asset management program. Establishing performance measures and annual reporting to track implementation of public tree canopy expansion will enable Portland to link utility capital investments to the economic, environmental, and social benefits that the urban tree canopy delivers.

The nearly 4:1 benefit–cost ratio of tree plantings indicates undervalued assets that should be recognized in city investment and accounts. Transparently demonstrating the correlation between dollars paid and benefits received for TAM will engage the public and policy makers. By maintaining a transparent TAM program and an active community engagement campaign, Portland can track and demonstrate the efficacy of extending and financing public tree canopy as an element of long term utility infrastructure.

The following table summarizes Portland's current status in elements of potential Tree Asset Management. Because current Portland bureau structure distributes responsibility for elements of tree canopy management, stormwater and related services among several agencies, enhanced interagency coordination—including community partners—is an essential element of TAM implementation.

○ incomplete

◑ partially completed

● ready for integration into TAM

TAM Component	Portland's Status	Agency Responsible
Physical inventory, including location	◑	PP&R Friends of Trees Community volunteers
Condition assessments	◑	PP&R Friends of Trees Community volunteers
Performance data	◑	BES PP&R
Accounting information: Establishing costs to maintain at desired condition level	●	PP&R BES
Accounting information: Actual maintenance costs	◑	PP&R
Accounting information: Funding sources	◑	BES PP&R

Management reporting should incorporate actions determined by the city's Urban Forestry Management Plan, including benefit maximization through the maintenance and expansion of the existing urban forest canopy, proactive tree health care, and "right tree, right place" optimization strategies.

While tree maintenance in Portland is currently the responsibility of adjacent property owners, benefit valuation via TAM would help to fund proactive tree maintenance on public lands in order to extend the service life of the urban forest. This report recognizes that the general maintenance

responsibility currently rests upon adjacent property owners. Implementing TAM may require enhanced agency oversight and financial support based on utility service. Measuring the incremental property value impact of TAM pilot areas would help to establish the additional benefit to private landowners, as well as the potential available tax revenue increment for establishment of Tree Increment Financing zones.

To meet accounting requirements, management activities must be documented. In a TAM program, sampling should approximate the intervals performed for traditional grey infrastructure. Subsampling of inventoried trees would occur annually, and with a full census repeated on decadal scales. Incorporating descriptions of TAM actions, costs and benefits within a custom, additional section of the Management's Discussion and Analysis section of the Certified Annual Financial Report would recognize the service value of tree canopy in compliance with GASB rules, strengthen the municipal asset base, and help to maintain a strong overall bond rating.

The following information and standards are necessary for a tree asset management program:

Up-to-date inventory of assets.
This inventory must include location, age, species and diameter of each tree within public lands. Again, the initial inventory should be performed as a census, with sample surveys providing updates per methods established for Portland's traditional drainage pipe system.

Condition standards and a summary of physical condition assessments.
The City will establish a level of service which the trees must provide. This is the minimum standard to which the asset must be maintained.

Estimate of costs to maintain and preserve the assets at established target condition levels.
This should include each tree's original value at time of implementation of TAM or at time of planting, appreciated or depreciated value (this information is based upon age, physical condition, and level of service), and current replacement value. It should also include the cost that would be incurred should the asset be removed while the benefits it provided, such as stormwater runoff mitigation or improved water quality, were still required.

Reporting of actual costs spent on maintenance and expansion.
While this report recognizes that the general maintenance responsibility currently rests upon adjacent property owners, funds generated through TAM should be used for these activities. To meet accounting requirements, management activities must be documented.

Overlaying TAM performance and benefit accounting with existing conventional stormwater sewersheds both helps to establish the utility service value of tree canopy asset management, but also positions TAM or broader green asset management as a future regulatory compliance strategy. Aggregated by block, neighborhood or sewershed, tree asset performance becomes the equivalent of demand management investments by an energy

utility, and could be funded through similar mechanisms according to the life cycle value of benefits. EPA policy and emerging urban Long Term Control Plans have begun to include such green-for-grey substitutions when water volume performance is equivalent.

Federal and state guidance on use of clean water revolving loan fund capital for green infrastructure projects also provides potential space for TAM. SRF 604b planning funds could support TAM development if available, as a step toward future financing.

A multi-year pilot program would apply the inventory, monitoring, and valuation approaches of TAM to specific neighborhoods. Performance would link to sewershed geography and capacity to quantify the equivalent life cycle performance of conventional infrastructure. A TAM data tool with agency and public interfaces would track tree canopy expansion, while encouraging and allowing public input and recognition of utility and community value generated through trees and other green infrastructure.

Conclusion

Portland's agency and community partners have laid the groundwork for establishing tree asset management as a means of supporting and investing in the utility and quality of life value of healthy tree canopy. Coordinating and consolidating existing programs into a concerted TAM framework could help Portland achieve a variety of goals, including improved utility performance, accountability, financial and ecological sustainability, and cost-effective regulatory compliance.

[1] Portland Parks and Recreation, *Urban Forestry Commission Annual Report 2009* (February 2010).

[2] Joseph Poracksy and Michael Lackner, *Urban Forest Canopy Cover in Portland, Oregon, 1972 – 2002* (Portland: Portland State U. Cartographic Center, 2004).

[3] Portland Parks and Recreation and the Urban Forestry Management Plan Technical Advisory Committee, *Portland Urban Forestry Management Plan* (March 2004).

[4] Portland Parks and Recreation, *Urban Forest Action Plan* (February 2007).

[5] Portland Parks and Recreation, *Portland's Urban Forest Canopy: Assessment and Public Tree Evaluation* (October 2007).

[6] City of Portland Bureau of Planning and Sustainability, *Citywide Tree Policy Review and Regulatory Improvement Project*, draft version (December 2010).

[7] Entrix, Inc. *Portland's Green Infrastructure: Quantifying the Health, Energy, and Community Livability Benefits.* Report prepared for City of Portland Bureau of Environmental Services. (Portland: Portland Bureau of Environmental Services, 2010)

[8] Online at www.homedepotfoundation.org/pdfs/friendsoftrees_3.pdf.

[9] C. Alexander, "Getting Serious about Environmental Issues Beyond Legislative Compliance: Xerox, HP, and Pressted Lead the Way."

[10] For example, location-efficient mortgages recognized the additional income that transit-efficient home locations create by reducing commuting and other transportation costs. That recognition allows lenders to reliably extend additional capital to borrowers because the transportation savings allow individuals to support a larger debt with the same income.

[11] Michael A. Pagano and Rachel N. Weber. "Financing Green Infrastructure." College of Urban Planning and Public Affairs. University of Illinois. Chicago, IL. November 2003.

[12] Portland Parks and Recreation's tree inventory procedures rate trees in four stages of health: good/fair/poor/dead. Such broad classifications may be sufficient for maintenance decisions but may need refinement to translate into projected service and benefits.

[13] Roberta Reese, GASB, personal communication, June 2011.

[14] Center for Neighborhood Technology, "Tree Increment Financing" (research memo), November 2009. One TRIF example, extrapolated from tree plantings in Philadelphia, estimated a 10 percent property value gain associated with potential $2 million incremental tax revenue over 20 years.

[15] Entrix, Inc., *Green Infrastructure*, 5-3. Each tree in front of a home was estimated to add $7,953 per home, and an additional $7,098 potential value to neighboring properties.

[16] Susan Wachter, "The Determinants of Neighborhood Transformations in Philadelphia Identification and Analysis: The New Kensington Pilot Study." The Wharton School, University of Pennsylvania (Spring 2005). www.kabaffiliates.org/uploadedFiles/KAB_Affiliates.org/Wharton%20Study%20NK%20final.pdf

[17] Kenneth A. Knight, "Planning and Financing Future Urban Forests." US Forest Service Pacific Southwest Research Station Center for Urban Forest Research (June 2008).

[18] Consent Decree in United States and State of Ohio v. Northeast Ohio Regional Sewer District, N.D. Ohio, December 2010, pp. 21-2 and Appendix 3. www.epa.gov/compliance/resources/decrees/civil/cwa/neorsd-cd.pdf

[19] Entrix, Inc. (2010) estimated 3,807 metric tons annual CO_2 associated with street tree plantings under Grey to Green, for example.

[20] sustainablecitiescollective.com/localecology/8418/what-are-10-most-common-street-trees-new-york-city

[21] www.nycgovparks.org/sub_your_park/trees_greenstreets/treescount/

[22] Personal communication with Andrew Newman, Project Coordinator with MillionTreesNYC, 25 May 2011.

[23] *Ibid*.

[24] Online at www.nycgovparks.org/sub_your_park/trees_greenstreets/treescount/treecount_summary.php.

[25] Online at www.nyc.gov/html/planyc2030/html/home/home.shtml.

[26] Online at www.milliontreesnyc.org/html/urban_forest/urban_forest_benefits.shtml.

[27] Personal communication with Andrew Newman, Project Coordinator with MillionTreesNYC, 9 February 2011.

[28] While PlaNYC moves this cycle up, in actuality the pruning schedule is still on 10-year cycles.

[29] *Ibid*, 25 May 2011.

[30] Ruth Rae, Gabriel Simon, and Jessie Braden. "Public Reactions to New Street Tree Planting," *Cities and the Environment* 3:1 (2010).

[31] Online at www.isa-arbor.com/publications/arbNews/pdfs/2010/2010-04_Tech.pdf.

[32] Online at www.a2gov.org/GOVERNMENT/PUBLICSERVICES/FIELDOPERATIONS/FORESTRY/Pages/TreeInventory.aspx.

[33] Personal communication with Kerry Gray, Urban Forestry & Natural Resources Planner for the City of Ann Arbor, MI, 7 February, 2011.

[34] San Francisco Planning Department, *San Francisco Better Streets Plan* (December 2010). Online at www.sfbetterstreets.org.

[35] Bay Area Economics. Emeryville, CA. September 2010

[36] http://www.sfenvironment.org/downloads/library/streettreeactionplan.pdf

[37] Personal communication with Tom Brady, City of Brookline, MA, 2011.

[38] Online at www.sfenvironment.org/archive/2868/3388/3391/3760/27405.htm.

[39] US Forest Service Pacific Northwest Research Station, "The Value of Street Trees in Portland, Oregon" (March 2008).

[40] Portland Parks and Recreation, *Urban Forest Canopy*.

[41] See www.itreetools.org.

[42] Thesis on GASB-34 (52757011.pdf in file)

[43] Davey Resource Group, *Initial Assessment of the Costs of Managing Street Trees as a Public Asset* (2009).

[44] Portland Parks and Recreation, *Urban Forestry Commission Annual Report*.

[45] Center for Neighborhood Technology, "The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits" (December 2010). http://www.cnt.org/repository/gi-values-guide.pdf

[46] Cozad, McPherson, and Harding, "STRATUM Case Study Evaluation in Minneapolis, Minnesota," (2005). This Minnesota study indicated volunteer assessments largely accurate in several condition parameters but suggested training for maintenance evaluations. Online at www.itreetools.org/resources/reports/Minneapolis%20Case%20Study.pdf.