DEPARTMENT OF NATURAL RESOURCES URBAN AND COMMUNITY FORESTRY PROGRAM

"Community and urban forest" is that land in and around human settlements ranging from small communities to metropolitan areas, occupied or potentially occupied by trees and associated vegetation. Community and urban forest land may be planted or unplanted, used or unused, and includes public and private lands, lands along transportation and utility corridors, and forested watershed lands within populated areas.[1]

Urban or Community Forestry is "the systematic management and care of amenity, or landscape trees, collectively, in human settlements[2]

The Department of Natural Resources Urban and Community Forestry Program was initiated in 1990 as a result of the 1978 United States Cooperative Forestry Assistance Act which recognized the contributions made by urban and community forests. . Urban forests are recognized for many benefits include improving air quality, mitigating storm water run-off, improving property values, connecting people to nature and making communities more livable.

The Department of Natural Resources Urban and Community Forestry Program assists communities in the state of Washington to create, develop and manage urban forests within their communities. The program promotes sustainable urban forests by providing tree planting, care and maintenance education as well as a capacity-building grant and recognition programs that promote healthy, sustainable programs.

A sustainable urban and community forestry program has:

- Trees planted in appropriate sites where trees not only grow, but thrive
- Trees maintained to appropriate standards, thereby alleviating 80% of the problems often associated with mature trees growing in urban areas.
- No net loss of trees and canopy; planting as many trees as are removed and planning for preservation where possible.
- A diversity of species; reducing the potential for catastrophic loss due to specie-specific pests and disease

HISTORY AND BACKGROUND OF THE EVERGREEN COMMUNITIES BILL

An assessment of municipal forestry programs was accomplished from 2001 through 2003, including an assessment of tree inventories throughout Washington State, by graduate students at the University of Washington. The reports detailed components of urban and community forest inventories and assessed the strength of community forestry programs in addressing local concerns and management requirements.

The report specific to tree inventories included a summary with the recommendation to standardize inventory data to enable "the exchange of information and the tracking of urban forest data on the state level." [3] The Department of Natural Resources, Urban and Community Forestry program embraced the recommendation and partnered with private and non-profit groups, including Washington Audubon, to propose legislation to develop tools and incorporate funding support for a state-wide community and urban forestry inventory and assessment.

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[1] Chapter 76.15 RCW –Section 10, Definitions (1)
[2] Fazio, James R., Urban and Community Forestry, A Practical Guide to Sustainability, The National Arbor Day Foundation, 2003, p10
[3] Corletta, Robert, An Assessment of Tree Inventories in Washington State, Master's Thesis, 2003, p. 25

The bill passed the state legislature and on April 1, 2008, Governor Christine Gregoire, signed the Evergreen Communities Act (ECA) authorizing the Department of Natural Resources to begin a statewide tree inventory, and to convene a panel of experts to assist in the process.

THE EVERGREEN COMMUNITIES ACT – ENGROSSED SECOND SUBSTITUTE HOUSE BILL 2844 (E2SHB 2844)

The ECA recognizes the many contributions that urban and community forests make to local communities throughout the state, specifically their role in mitigating air and water pollution. The Act, stating that the "preservation and enhancement of city trees and urban and community forests is one of the most cost-effective ways to protect and improve water quality, air quality, human well-being, and our quality of life,"[4] was enacted to provide assistance to cities, towns, and counties in Washington that wish to improve or enhance their community and urban forests in order to reap the many social, ecological, and economic benefits provided by city trees.

The adoption of the ECA was a big step toward support of urban and community forestry programming at the local level across Washington. It is the first time that state funding has been dedicated to urban forestry since the program began in 1991.
Tasks pertaining to Department of Natural Resources are outlined in Section 4 of the bill:[5]

- develop an implementation plan for the inventory and assessment, reporting to the appropriate committees of the legislature upon completion of the plan

- conduct a community and urban forest assessment and develop recommendations to the appropriate committees of the legislature to improve community and urban forestry in Washington

- conduct a prioritized statewide inventory of community and urban forests

The goals and recommendations found in this report are consistent with ECA directives, and reference the following definitions.[6]

"**Community and urban forest**" is that land in and around human settlements ranging from small communities to metropolitan areas, occupied or potentially occupied by trees and associated vegetation. Community and urban forest land may be planted or unplanted, used or unused, and includes public and private lands, lands along transportation and utility corridors, and forested watershed lands within populated areas.

"**Community and urban forest assessment**" means an **analysis** of the community and urban forest inventory to: establish the scope and scale of forest-related benefits and services; determine the economic valuation of such benefits, highlight trends, and issues of concern; identify high priority areas to be addressed; outline strategies for addressing the critical issues and urban landscapes; identify opportunities for retaining trees, expanding forest canopy, and planting additional trees to sustain Washington's urban and community forests.

"**Community and urban forest inventory**" means a **management tool** designed to gauge the condition, management status, health, and diversity of a community and urban forest. An inventory may evaluate

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[4] State of WA 60th Legislature, Engrossed second substitute house bill 2844, 2008, Section 1.1.b, p.2
[5] State of WA 60th Legislature, Engrossed second substitute house bill 2844, 2008, Section 4, p 4-6

[6] RCW 35.105.010 Urban Forest Management – Definitions, 1 & 2

individual trees or groups of trees or canopy cover within community and urban forests, and will be periodically updated by the department of natural resources.

TECHNICAL ADVISORY COMMITTEE

A Technical Advisory Committee (TAC) was appointed in January 2009 to assist in the development of the criteria and implementation plan for the tree inventory project. Members include:

Garth Davis	Forester	Spokane Co. Conservation Dist.
Dan DeWald	Natural Resource Manager	City of Bellevue
Ara Erickson	Green Cities Manager	Cascade Land Conservancy
Terry Flatley	City Forester	City of Renton
Brian Gilles	Consulting Arborist	Gilles Consulting
David Kuhn	GIS Business Manager	City of Olympia
Virginia Lohr	Horticulture and Landscape Architecture Professor	Washington State University
Sharon London	Executive Director	Seattle Urban Nature
Scott Maco	Research and Development Analyst	Davey Tree Expert Company
Kevin McFarland	Consulting Arborist	Sound Urban Forestry, LLC
Mark Mead	Senior Urban Forester	City of Seattle Parks Dept.
Tina Melton	Vegetation Management	Puget Sound Electric
L. Monika Moskal	Assistant Professor of Remote Sensing & Biostatical Analysis	University of Washington
Christy Osborn	Senior Planner	Maul, Foster & Along, Inc.
Galen M. Wright	Consulting Utility Arborist	Washington Forestry Consultants, Inc.

The Department of Natural Resources Urban and Community Forestry staff, with assistance of the TAC developed inventory and assessment protocols along with an inventory project implementation plan, which is the subject of this report.

Other sections of the Act are administered by the Washington State Department Community Trade and Economic Development (CTED) (formerly the Department of Community Trade and Economic Development). The Department of Natural Resources is working closely with CTED to assure that inventory criteria are designed to mesh seamlessly with the model urban forestry management plans, tree ordinances and community recognition program developed by CTED staff.

REPORT RECOMMENDATIONS

Recommendations in this report are based on the following criteria found in the ECA:

- existing data and current inventory technologies must be utilized

- statewide data must be maintained, periodically updated by the department, and made available to every municipality in the state

- data must be compatible with existing and developing urban forest reporting protocols designed to facilitate access to carbon markets

- criteria established for inventory must support the planning needs of local governments

URBAN AND COMMUNITY FOREST INVENTORY INTRODUCTION

Although long considered simple aesthetic amenities, research demonstrates that trees perform as "green infrastructure" to mitigate many of the problems plaguing growing urban areas. Among other benefits, trees help to clean air, improving air quality; reduce storm water run-off, improving water quality; cool pavement, preventing damage due to polarization and reducing the "heat island effect" present in cities; and store carbon.

The greatest benefits are realized through healthy trees that are managed to grow and thrive. Planting a tree is just the first step in growing our urban forests. It is often said that it takes a minimum of ten years to plant a tree, since once planted, a tree needs water, to re-establish the root system damaged during transplanting; structural pruning, in order to develop a canopy that co-exists with traffic and pedestrians; and monitoring, to assure that any damage or disease is addressed in a timely fashion.

A first step toward proper management of trees, resulting in a sustainable urban forest, is a community tree inventory and analysis. An inventory catalogues existing trees and their condition, while an analysis of the resulting information is used to determine immediate maintenance concerns. The data and subsequent analysis is essential in developing a long-term management plan for the tree resource.

STATEWIDE INVENTORY AND ASSESSMENT GOALS
The following lists goals established for the statewide inventory and assessment of urban and community forests:
- Capture a baseline of current statewide tree canopy cover for immediate and future comparisons of change over time
- Quantify and characterize the existing tree resource
- Identify and prioritize potential areas for canopy retention/preservation
- Identify and prioritize areas with potential for future expansion of tree canopy
- Assist in budget creation and policy development for management of the resource
- Utilize information to assist in local community planning and management goals leading toward resource sustainability.
- Create program visibility and gain community support

Community tree inventories typically focus on city-managed street, park and/or natural area trees. However, it is important to remember that a community forest is much larger than the public tree component and that the majority of trees in a community forest are growing on private property.

While communities have opportunities to maintain and expand the urban forest on publicly-maintained lands, well over 60% of existing trees and planting spaces are located on private property; education and industrial campuses, utility corridors, residential properties. While trees on private property are not typically regulated, they are a crucial component of the urban and community forest and cannot be ignored. The statewide inventory and assessment will, by ECA definition of "community and urban forest," be inclusive of privately as well as publicly maintained trees.

COMMUNITY INVENTORY GOALS

Inventories are often viewed as one-time activity to obtain a "shapshot" of the resource. Because the urban forest is dynamic, the most effective inventories are immediately useful as a management and tracking tool and maintain their usefulness through periodic updates. Dynamic inventories help communities become proactive rather than reactive in the management of the tree resource.

Goals for a tree inventory and inventory design will vary by community. Goals may be specific or inclusive. For example a community may inventory to locate a specific species of tree that is susceptible to the presence of insect or disease (American elm, for example), or they may inventory the entire public tree resource in order to develop a sustainable urban forest management plan.

Goals may be divided into four categories; resource management, long-range community planning, policy development and development of community support.

INVENTORY GOALS	Resource Mngmnt	Long-Range Planning	Policy Development	Community Support
Air quality assessment		■	■	
Budget development	■	■	■	
Carbon market (ECA)		■		
Diversity of species	■	■		
Documentation/demonstration of due diligence	■	■		
Educate community		■	■	■
Emergency/Storm preparedness	■	■		
Energy Savings		■	■	■
Hardscape damage, identify &/or prevent	■			
Health/condition of URBAN AND COMMUNITY FOREST	■			
Insect or disease problems, identify and plan for	■	■		
Management plan, proactive		■		
Planning, Long-term community and resource		■	■	■
Planting spaces		■		
Policy development		■		
Private tree assessment		■	■	■
Program Support			■	■
Public Health and safety	■	■	■	■
Risk Assessment	■	■	■	
Social Benefits			■	■
Stormwater Retention/Mitigation assessment		■	■	
Sustainability of Resource		■	■	
Tracking Program Goals	■	■		
Trends (canopy loss/gain)		■		
Utilities, signs and signals, interference	■			
Value of resource			■	■
Water Quality		■	■	■

CANOPY ASSESSMENT AND ANALYSIS

Remote sensing, the act of collecting information about objects from a distance, is useful in identifying the range and percentage of tree canopy coverage in a community, including trees found on private land. Tools used for remote sensing include aerial photography and satellite imagery.

Canopy information, derived by way of remote sensing, can be analyzed to determine the resource capacity for greenhouse gas mitigation, and measure the removal of suspended particulates, improving air quality

Remote sensing canopy assessment and the subsequent canopy analysis is the best technology currently available to quantify effects of the urban forest in relation to the total community environment. Paired with a ground-based sample inventory to capture species, condition, function and value, remote sensing contributes to a holistic picture of the urban forest.

Canopy -level analysis information is useful in long-range planning of the community forest resource: identifying areas of existing canopy that may be impacted by growth, tracking cumulative canopy gain/loss over time and classifying priority areas for canopy retention and tree planting.

EXISTING TECHNOLOGY:

Spatial Analysis: The US Forest Service (USFS) has recently completed a nationwide assessment of urban and community forests. The low resolution, Landsat satellite imagery collected in the year 2000 and paired with and analyzed by utilizing National Land Cover Data (a 21-category land classification scheme) provides a coarse overview of the state's existing urban forestry canopy. The unpublished report for the State of Washington, due to be released fall 2009, will include information and data that describes the urban forest in relation to existing and potential areas of tree canopy, land-cover characteristics and urban tree benefits.

Preliminary report data, recently acquired from the USFS, demonstrates the value of urban and community forests in Washington, including carbon storage, estimated at $515,300,000; annual carbon sequestration valued at $16,986,000; and air pollution removal valued at $156,100,000.[7]

Ground Inventory: To assure accuracy and to provide information about the condition, structure (species composition) and function of the urban forest, it is essential to pair remote sensing analysis with ground-based tree data. The USFS has developed urban forestry ground inventory procedures based on the Forest Inventory and Assessment protocol for forested lands. The Urban Forestry Inventory and Assessment protocol gathers tree data within randomly sampled plots over a defined area. Data is inclusive of private as well as public trees and as such, gives a statistically significant sampling of the entire urban canopy.

Inventory data is then analyzed, using i-Tree, a suite of software tools developed by the USFS. The Urban Forest Effect model (UFORE), one of the components of i-Tree, quantifies structure and function of trees within a defined area based on field data. Utilizing local pollution and meteorological information, UFORE is used to determine hourly urban forest volatile organic compound emissions (emissions that contribute to ozone formation), hourly pollution removal by the urban forest, the effect of trees on building energy use and carbon dioxide emissions, total carbon stored and net carbon sequestered annually by urban trees, insect and disease potential for invasive pests and measures the exotic species component (non-native trees) within the urban and community forest.[8]

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[7] David Nowak, April 2009, *personal communication*, United States Forest Service Northern Research Station
[8] I-Tree, p.1

Pilot projects undertaken in Indiana and Wisconsin utilized the Urban Forest Inventory Assessment protocol for data collection and analyzed the data with UFORE. The projects were highly successful in quantifying the value of the urban forest.

Spatial imagery: Department of Natural Resources possesses recent high resolution and historic aerial photography covering a good share of the state. Landsat satellite imagery and Lidar (laser) imagery are also available, although greatly limited in coverage. In addition Department of Natural Resources imagery, many counties and cities within the state partner to collect high resolution aerial photographing for planning and asset management.

RECOMMENDATION – CANOPY ANALYSIS

State-wide/County-wide analysis: The USFS canopy analysis data used in conjunction with a state-wide ground inventory achieved through random sampling that follows the Urban Forest Inventory Assessment protocol and analyzed using UFORE, will provide a solid base-line assessment of the structure, condition, and function of Washington's urban and community forest resource.

The resulting data will be made available to municipalities statewide and updated on a regular (5-7 years) basis, as required by the Evergreen Community Act. (Ref. RCW 76.15.070, 1.b).

Community analysis:

The ultimate objective of the Evergreen Community canopy analysis project is to develop a standard protocol for measuring and comparing tree canopy, using a combination of existing satellite imagery and aerial photography, which will provide a level of detail useful to urban forestry program managers. Protocol will build on the significant long-term investment, by the Department of Natural Resources, in state-wide aerial photography by using existing data and air photos.

Remote sensing data analysis methodology and protocol will be developed and modeled in partnership with interested agencies, including the USFS and University of Washington Remote Sensing and Geospatial Analysis Lab. The methodology will be tested in two pilot project counties, with rigorous review by the Precision Forestry Coalition. Once protocol is developed, the Precision Forestry Coalition will provide professional-level workshops to train a skilled workforce capable of implementing periodic canopy analysis in communities across the state.

Ground inventory utilizing the Urban Forest Inventory Assessment protocol and i-Tree suite of analysis tools will complement the county-wide community spatial canopy analysis project.

COMMUNITY INVENTORIES - DATA COLLECTION

Ground inventory data provides valuable information about tree structure, function, and value. Inventories of publicly owned street and/or park trees are often the first step taken toward developing a community tree program. Data collection may include the entire resource (complete inventory), or a sample of the resource. The collected data is useful in developing management and maintenance plans, including budget projections for community forestry programming. Information from inventories is also used in policy development and to inform and educate the community about the valuable community forest resource

DATA COLLECTION – WORKFORCE

Reliable field data is essential for successful resource management. Regardless whether data collection is accomplished by staff, consultants or volunteers, a community must determine the costs associated with training and monitoring data collectors, and then balance those costs against the need for consistent, trustworthy data.

The following table illustrates data collection options:

Data Collection Personnel Options and Reliability of Data[9]

Personnel	Labor Cost	Accuracy	Comments
Volunteers	Low	Poor-Good	High level of training and supervision needed to assure good data
Temporary or part-time staff	Low-Medium	Fair-Good	Medium level of training and supervision needed to assure good data
Full-time staff	Medium-High	Good-Excellent	Low training and supervision needed to assure good data
Consultants	Medium-High	Good-Excellent	Low training and supervision for good data, with good specifications; have own equipment

EXISTING RESOURCES

City forestry/arborist staff and professional arboricultural consultants are resources immediately available to assist with ground inventory data collection. Department of Natural Resources foresters could also provide assistance, although recent reductions in workforce will likely limit their availability.

The state-wide Master Gardener program is a great potential resource for volunteer data collection. Tonie Fitzgerald, Washington State University Master Gardener Program Leader has expressed strong support for partnering with the Department of Natural Resources to facilitate recruiting and training experienced Master Gardeners for tree inventory data collection. Utilizing this volunteer resource provides several benefits; master gardeners are found throughout the state and are themselves invested in educating the public and improving their communities; their involvement will bring greater visibility to the Evergreen Community inventory and assessment project and urban forestry in general; a tree inventory is a great first step in developing a tree management program for a community and trained volunteers can help educate citizens toward that end.

Interested, experienced Master Gardeners will undergo training specific to tree inventory data collection. The Department of Natural Resources Urban and Community Forestry Program will work with the Master Gardener Program Leaders to design educational elements and provide training for volunteers.

DATA COLLECTION – EQUIPMENT and DATA MANAGEMENT

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[9] Jerry Bond & Beth Buchanan, *Best Management Practices, Tree Inventories*, (2006 by International Society of Arboriculture)p.6

A community should consider several points in determining the best data collection and management tools for their needs, including:

- How the data will be managed
- Available technology to support a tree inventory database, along with associated costs
- Available support staff to answer questions, provide training and/or assure that the collection software and database are operating at optimum efficiency
- The "usability" of the system, (easily operated so that it will be used for its intended purpose)
- The ability to share data between departments, to assist with city wide planning, operations, and asset management

Inventory field data is recorded on paper or electronically. Tools used for data collection should be selected based on program budget, existing technology and how the information will be used and/or manipulated.

Electronic data collection requires a field computer or hand-held data collector. While specialized equipment is necessary, electronic collection provides standardized data, reduces transmission errors, eliminates formatting and spelling errors, and does not require the extra step (and extra cost) of data entry.

Before collecting, it is necessary to understand how inventory data will be managed. A simple spreadsheet is often sufficient for communities with small tree populations; however databases can be designed to manage information more efficiently, provide greater options for manipulating data and developing reports and can be linked to spatial analysis tools. Several commercial tree inventory products are available, but can be cost prohibitive for smaller communities. Often data bases are designed internally to mesh with other city systems.

TREE ATTRIBUTES

Data collected during a tree inventory is dependent on a jurisdiction's goals for its community forest. The data set should be designed to meet management objectives. It is important to avoid collecting data that is not meaningful or useful for management and/or maintenance objectives, since extraneous information needlessly adds to the cost of inventory data collection.

A data collection table is located in appendix A. The table defines information that is commonly collected in tree inventories. The "essential" data set is considered the minimum information necessary for assessing the health, condition and value of the urban and community tree resource, and provides a base on which to develop a management plan for the community forest.

Because urban trees are variable in location and inventory goals vary, the table is split accordingly. The essential data set is applicable to all types of inventories. Additional attributes can be collected depending on tree type inventoried (single vs. grouped), type of inventory goal (for management or analysis) and/or local program requirements.

EXISTING TECHNOLOGY

Shareware spreadsheet and database products are available, but many are limited in function.

Commercial tree inventory software, designed specifically for data collection and urban forestry management, is readily available. In general, tree inventory software comes with company-supported technical advisory services for a period of time, with annual subscription rates for continued support and system upgrades. When selecting tree inventory software, communities should be sure that the product accommodates their data collection protocols, including the data set described in this document, has the ability to network with existing municipal asset management software, and is compatible with existing or available hardware. It is important to understand the level of staff training necessary to use the technology and the level and extent of available technical support.

The USFS has compiled a list of available commercial tree inventory software that may be found in appendix B.

Communities often choose to develop their own specialized inventory and management databases. Products developed internally can be designed to interface with existing municipal operating and management systems, however product development costs must be considered.

INVENTORY TYPES

The type of inventory selected by a community is largely dependent on program goals and available resources.

Windshield surveys are very general and appropriate if there is need to collect a small but focused data set. An example would be to evaluate a street corridor to determine the need for clearance pruning, or assessing insect and disease outbreaks in a given species population.

Sample Inventories are used to get a generalized picture of the health and condition of the urban forest and are most applicable to larger communities. Sampling is accomplished by gathering data at randomly located plots within a given area. Results are projected to assess the composition and condition of the entire forest. Areas may be stratified by sub-areas before plot selection in order to capture information specific to the sub-area. An example would be conducting a sample inventory within a city's industrial area or within a neighborhood known to have older senescent trees that are a potential risk to public safety. When done correctly, sample inventories are considered to be within a range of approximately 10% accuracy.

Partial inventories are designed to gather data in a defined area within a community (i.e. certain neighborhoods, or districts). These types of inventories are often conducted if there is a perceived issue within the tree population, such as deteriorating or risk trees within a densely populated area. These types of inventories often prove cost effective, if resources are limited. If well designed, partial inventories may eventually achieve a complete resource inventory over a period of time.

Complete inventories collect data on each tree within a management area. Such inventories are the most detailed and accurate in assessing the condition of the municipal forest, but are also the most expensive to undertake. The accuracy of the data lends itself to the development of comprehensive management planning and budgeting. Most municipalities taking complete inventories generally focus on publicly-maintained trees such as; street and/or park and natural area trees.

DATA ANALYSIS

Data analysis quantifies the community forest, beyond its aesthetic contribution, demonstrating the function and value of what has come to be called "green infrastructure."

DATA ANALYSIS - EXISTING TECHNOLOGY

The "i-Tree" suite of tools, available through the USFS at no cost, standardizes both the data collected for urban forestry analysis and the analysis protocol itself. It determines the value of benefits derived from urban and community trees. It has two basic components, Urban Forest Effects Model UFORE (described earlier) and the Street Tree Resource Analysis Tool for Urban-Forest Managers (STRATUM). The product continues to be developed with a new release expected in early summer 2009.

As the name implies, STRATUM enables any community to analyze the benefits of its street tree resource. STRATUM evaluates the structure (e.g., species composition, age distribution, canopy cover); Function (environmental and aesthetic benefits); value (annual monetary value of benefits and costs); management needs (e.g., recommended maintenance, stocking levels, and tree conflicts) of the tree resource [10]

RECOMMENDATIONS FOR COMMUNITY INVENTORIES

FIELD INVENTORY – DATA COLLECTION and ANALYSIS

Communities participating in the Evergreen Communities tree inventory project will, at a minimum, collect the essential core set of pre-determined data elements. The essential data set is designed to address local management needs, provide enough information to create an urban forestry management plan, has the capacity to be referenced in a geodatabase (a database designed to store, query, and manipulate geographic information and spatial data). Communities may choose to collect additional information, beyond these data elements, depending on local program goals.

Data collection forms will be made available to participating communities and will either be spatially-based, consisting of a personal geodatabase (a database designed to store, query, and manipulate geographic information and spatial data such as Arc GIS); or tabular-based, a database application (such as Access) or spreadsheet application (such as Excel) as the standard data form.

Jurisdictions with Geographic Information System (GIS) software may wish to incorporate the personal geodatabase into their GIS workflow, while those without GIS can choose to use a database application such as Access or other data entry applications. Column headings on associated data collection forms will be representative of the required data fields and formatted to assure data consistency.[11]

Data should be collected electronically, whenever possible, to assure consistency, accuracy and eliminate potential transmittal errors, as well as additional data entry costs.

INVENTORY TYPE

Inventory type will be determined at the local level by participating communities. While a complete resource inventory is optimal, and desirable, financial considerations may limit the capacity of some communities to participate at that level. Communities will decide which type of inventory meets their needs based on available

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[10] i-Tree Software Suite Users Manual – Coop. USFS, ADF, Davey Tree, ISA, SMA – February 2008, p.30

[11] Kuhn, David, GIS Business Manager, personal communication, City of Olympia

resources. The Department of Natural Resources Urban and Community Forestry Program staff is available to provide technical assistance.

Communities that cannot perform complete inventories should develop a work plan to collect data on a rotating annual basis, prioritizing areas of concern and working toward achieving a complete tree inventory within a specified time frame. The time frame for completing the inventory should be no longer than 7 years so that data remains valid. Those communities performing complete inventories can utilize the inventory as a management tool, updating information on a regular basis and tracking scheduled maintenance

Analysis of inventory data will be accomplished with the use of i-Tree tools, described earlier in this report. Communities intending to use this tool for resource analysis need to plan data collection based on that goal, so that all pertinent data is collected.

DATA COLLECTION - PERSONNEL

Initial inventory data should be collected by either highly-trained staff or by consultants, to ensure the highest possible quality of baseline data. Follow-up inventories may be undertaken with the assistance of community volunteers.

Recommendations to assure quality data:

- Thorough classroom and field training must be provided for staff and volunteers.
- Training modules should be developed to account for community-specific criteria, species and/or management issues.
- Volunteers should work with a staff person or in teams to gather data, with a minimum of one person with tree identification skills for each team.
- Collection protocols should be standardized, collectors must be monitored and data selectively reviewed to assure accuracy and consistency.

DATA COLLECTION – MASTER GARDENERS

A special advanced Master Gardener training course can be conducted across the state.[12] The goal would be to provide intensive programming that focuses on major areas of interest in the development of state-wide community forestry programming. All participants will be given the training necessary in order to identify all native and non native trees, use global positioning software (GPS) to enable them to accurately describe tree locations, determine tree ages within a given range, tree heights, health of the tree canopy/crown, general tree health, location and functionality of the tree (street tree, yard tree, green belt, park etc.) as well as other critical tree evaluation skills.

Such highly-trained Master Gardeners would not only be capable of assessing general tree information, but would also be given the tools necessary to be involved in the development of tree programs in their communities. The focus of the Master Gardeners' community efforts could be as small as a given area (park, green belt, street) or as large as a total community. Master Gardeners have the potential to be an ongoing

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[12] Freed, James, personal communication

resource to local community decision-makers as well as supporting and assisting community members who have general tree selection, care and maintenance questions.

To accomplish this project:

- A comprehensive set of training materials will need to be developed by Washington State University (WSU)/University of Washington/Department of Natural Resources, and other partners.
- Demonstration areas should be established that provide Master Gardener students a venue to practice their skills to insure they are prepared to provide accurate information based on best available science and practice.
- A support team of professionals (including Department of Natural Resources Urban and Community Forestry staff) should be developed and available to teach the classes and provide support to the Master Gardeners.
- Web-based materials could be developed and be available on the WSU and/or Department of Natural Resources websites providing support for the Master Gardeners and people working with them.
- Funds or funding processes will be needed to develop the materials described above and provide training programs across the state.
- An evaluation protocol should be developed to monitor the effects of this program on the local community forestry programs and provide the necessary feedback to improve the program.
- A selection process must be developed to ensure the highest quality participants in the advanced Master Gardener community tree training program.

CARBON and URBAN FOREST SUSTAINABILITY

The ECA states "… the department shall strive to enable Washington cities' urban forest managers to access carbon markets by working to ensure the inventory developed under this section is compatible with existing and developing urban forest reporting protocols designed to facilitate access to those carbon markets." [13]

The California Climate Action Registry establishes protocols for management of community and urban trees counted as carbon offsets and is considered the current industry standard. The standards are lofty and include the requirement that community and urban forestry programs demonstrate sustainability over a given period of time.

One measure of sustainability, which arguably has the greatest impact on program management, is that a community may have "no net loss" of trees in any given year, before establishing projects intended to offset carbon emissions and be counted in the Registry. Trees managed and counted as carbon offsets must be additional to those previously established as part of the regular community forest planting, care and maintenance program. Carbon projects must be funded with dollars additional to those budgeted for the general community forestry program. General program funding cannot be diverted to care for those trees planted for the specific purpose of being counted within a carbon project. The high level of accountability requires communities to have functional tracking systems in place.

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[13] RCW 76.15.070 1(e)

The report acknowledges that, due to the current low trading value of carbon stock credits, the monetary outlay necessary to achieve Registry standards does not offset program expenses.

Communities may strive toward that goal, positioning themselves to meet performance standards necessary to be accepted by a carbon offset program, such as the California Climate Action Registry, by meeting the following standards:

- implement a community inventory and assessment to develop a baseline of data for the existing community forest within potential program boundaries
- develop a tracking tool to document ongoing resource management activities
- meet Evergreen Communities standards as developed by the department of Community Trade and Economic Development
- achieve the standard of "no net loss" of trees within program boundaries

Currently most Washington communities, whether or not they have existing community forestry programs, do not have the budgetary capacity capable of building and maintaining a sustainable program; demonstrating "no net loss of trees." However it is important to understand that, while communities explore the feasibility of carbon markets by designing sustainable programs, urban forests continue to function to moderate carbon indirectly; reducing energy consumption, through shade and acting as wind blocks and, at the end of a long, productive life, producing energy to offset use of other fuel sources.

The urban forest sustainability model, developed by James R. Clark, Nelda P. Matheny, Genni Cross and Victoria Wake[14] can be used as a map for communities striving toward sustainability of the resource. A sustainable urban forest requires a healthy tree population, community support and a comprehensive management plan. Outcomes include a maximum level of benefits over time. (Appendix C)

PRIORITIZATION & IMPLEMENTATION

The spatial analysis of Washington State's urban forest canopy is a big step toward completion of a state-wide community forestry inventory and assessment. Ground-level data should be collected and analyzed by the Department of Natural Resources utilizing standard Urban Forest Inventory Analysis protocols developed by the USFS. Data can be analyzed utilizing USFS i-Tree analysis tools.

The USFS is working on a canopy change analysis study in two Washington communities, Tacoma and Spokane, providing a good start toward analyzing tree canopy coverage at the local/community level.

Pierce county and Spokane county have been selected for piloting a county-wide high-resolution spatial analysis complemented with ground inventory. Spatial analysis will be accomplished in partnership with the University of Washington Remote Sensing and Geospatial Analysis Lab.

Essential ground data will be collected in communities wishing to participate in the project. The type of inventory used for collecting information will be determined by local communities, based on available resources. USFS i-Tree tools will be used to analyze the data to determine function, structure and value of the resource.

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[14] Clark, James et al, A Model of Urban Forest Sustainability, Journal of Arboriculture 23(1): January 1997

NEED FOR CONSTANCY

Following initial collection, it is important from a management perspective, for inventory data to be updated on a regular basis so that data remains relevant. This can be accomplished by updating tree information as maintenance is performed and scheduling a rotating complete inventory of 20 to 30 percent of the forest each year. In this way all tree information is updated in a timely manner. Rotational updates are often easier to write into an annual budget, where periodic, complete resource inventories (which should be accomplished every 5 to 7 years), are often dependent on the allocation of special project funding, and may not be prioritized.

THE ROLE OF Department of Natural Resources Urban and Community Forestry Urban and Community Forestry Program

Department of Natural Resources Urban and Community Forestry staff will focus on the following points in order to achieve the goals of the Evergreen Communities Act:

- Determine statewide random sample plots, based on UFIA protocols, and coordinate collection of ground data to complement the USFS spatial analysis report.
- Provide training for inventory collectors, (Department of Natural Resources staff, local jurisdictions, Master Gardeners).
- Provide staff, as resources allow, for state-wide assessment data collection.
- Analyze state-wide ground data utilizing i-Tree tools.
- Partner with University of Washington to develop protocols for assessing and analyzing canopy cover in individual jurisdictions, utilizing high resolution imagery
- Develop standard electronic data collection form(s), compatible with spatial and tabular applications, and make the forms available to communities participating in inventory projects.
- Develop model contract templates for commercial providers of data collection services and commercial software, to ensure consistent state-wide data standards.
- Provide technical assistance to communities interested in performing local tree inventory and assessment projects.
- Partner with smaller communities through cost-sharing or grant funding to perform tree inventories and assessments.
- Seek funding sources to assist successful implementation of the initial project, and periodic updates required by the Act.

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APPENDIX A.

Tree Inventory and Management Software: a comparison of available commercial software resources
http://www.na.fs.fed.us/urban/inforesources/inventory/InventorySoftwareListDetails.pdf

APPENDIX B.

Data standards table

APPENDIX C

A Model of Urban Forest Sustainability by James Clark, Nelda Matheny, Ginny Cross and V. Wake