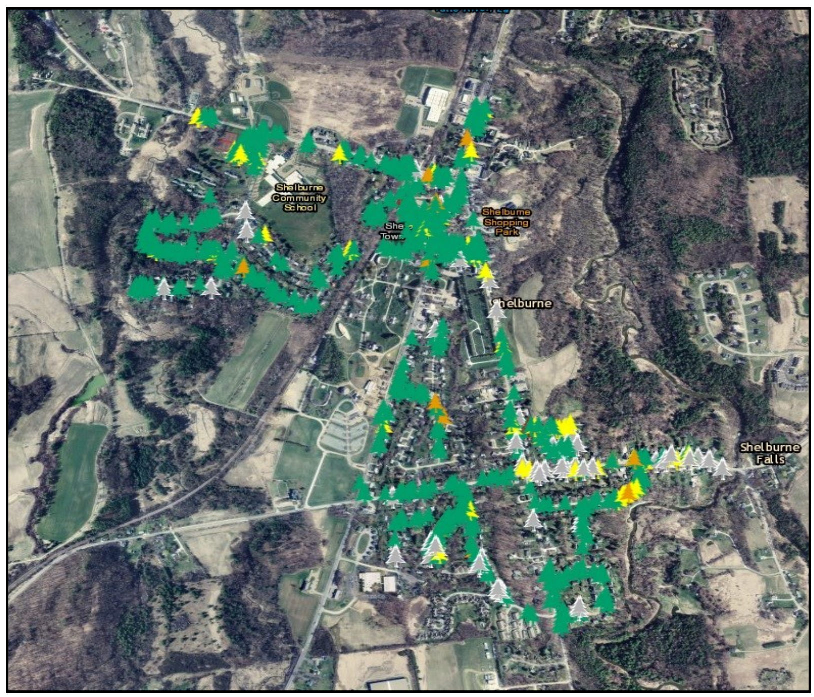
Shelburne Public Tree Inventory Report



Prepared for the Town of Shelburne by the Land Stewardship Program and the Vermont Urban & Community Forestry Program

August 2014

Acknowledgements

This report was created by the Land Stewardship (LANDS) intern team and the Vermont Urban & Community Forestry Program based on work done for the Town of Shelburne, Vermont during the summer of 2014. We would also like to thank the members of the Shelburne Tree Advisory Committee, the Shelburne Town Manager, Joe Colangelo, and the Shelburne Town Planner, Dean Pierce, for their help in planning and designing the public tree inventory project.

LANDS is grateful to the Rubenstein School of Environment and Natural Resources (RSENR) at UVM and the Student Conservation Association (SCA) for facilitating this internship program. We also greatly appreciate the Aiken Center at UVM for providing resources and housing during our office work days.

About the Vermont Urban & Community Forestry Program

The field of forestry management is not confined to the natural areas and forests of Vermont, but extends to the urban and rural spaces where trees play important roles. The trees in public parks, along roadsides, town greens, and municipal forests compose our urban and community forests and merit careful stewardship. The Vermont Urban & Community Forestry (VT UCF) program is a collaborative effort between the Department of Forests, Parks, & Recreation, the University of Vermont Extension, and the USDA Forest Service. The program provides technical and financial assistance as well as educational programs and products for the management of trees and forests in and around Vermont communities. The mission of VT UCF is ***to lead citizens, businesses, and governments in understanding the value of urban and community forests and promote civic responsibility for and participation in the stewardship of these resources for this and future generations***. Since 1991, the program has been guided by a small staff and a twenty-member advisory council. The council meets quarterly to share information and advise the program; its members come from various professional associations, non-profits, educational institutions, tree boards, regional officials, and state agencies.

The trees in our communities offer a wide variety of environmental, social, and economic benefits to the surrounding community, including stormwater control, CO_2 sequestration, and aesthetic value. VT UCF seeks to maximize these benefits by stewarding the urban forest's ecological integrity and diversity. The program assists communities with planning, planting, and caring for their community forests. With more than $1,000,000 in competitive grants, the program has provided assistance to over 150 Vermont communities. The program also provides local training and workshops, educational brochures, and newsletters for the public. All the material and assistance provided by the program is designed to further their mission of enhancing local communities across Vermont.

About LANDS

The field of conservation is rapidly evolving to meet the growing demands of society. New ideas and strategies are changing how we conserve and steward the land; The Land Stewardship Program (LANDS) is one of these new ideas. During the Great Depression, the Civilian Conservation Corps model was pioneered as a means to promote stewardship in the nation and provide jobs for the unemployed. The idea has since been reinvented many times by local and state corps across the United States. However, the theme is the same: young people learning and growing through service. LANDS is an innovative *College Conservation Corps* designed to train tomorrow's conservationist practitioners and leaders, and is a pilot partnership between the University of Vermont and the Student Conservation Association in its eighth year of successful programming.

Thanks to college-level education and prior experience in environmental science fields, LANDS interns are able to take on projects that are more technical than the work traditionally done by conservation crews. LANDS interns draft management plans, map areas of interest using GPS and GIS, inventory resources, survey for non-native species, survey soils, and evaluate river geomorphology. Municipalities, land trusts, state agencies, university researchers, national forests and parks, and volunteer-managed conservation organizations all benefit from LANDS's high quality, affordable services. LANDS interns are advanced undergraduates and recent graduates with natural resource experience from all over the world, and they bring a wide range of skills and interests to the program. LANDS is a unique service-learning model that addresses an ever-expanding list of conservation needs, while training students as future environmental leaders.

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Executive Summary

The goal of the public tree inventory was to document the location, size, species composition, and condition of trees planted within the public right-of-way (ROW) and on town-owned land within the historic Village and most populated residential areas of Shelburne. This information provides residents and decisions-makers with a better understanding of the health and benefits of Shelburne's urban forest and will allow the Shelburne Tree Advisory Committee to plan for future tree planting and maintenance using a map-based tree inventory system.

The inventory was commissioned by the Shelburne Tree Advisory Committee and was approved by the Shelburne Selectboard. LANDS interns completed an inventory of **722 trees** located within the ROW of 22 streets and on town-owned land and identified 64 specific locations or strips of public land appropriate for future tree plantings. Staff from VT UCF provided technical assistance. This report was prepared in the summer of 2014 by the LANDS interns and subsequently edited and supplemented by VT UCF program staff and interns. It presents the results of an inventory and basic assessment of the trees and canopy cover in Shelburne.

Local government, conservation agencies, and private landowners all play an important role in monitoring and maintaining urban forests. Urban trees provide a number of benefits to a community, including reducing stormwater runoff, reducing air pollution, providing shade, sequestering carbon dioxide, enhancing property values, and improving the aesthetics of the community. The 722 public trees that were inventoried provide an estimated **$49,585 in benefits annually** to the residents of Shelburne. In addition to the public trees inventoried, a tree canopy assessment was completed for the full inventory area, which indicated **existing canopy cover of 34%** and a stored value carbon dioxide of over $434,000.

Summary of findings

Forest Diversity

- Of the 722 public trees, there are 49 different species in 21 different genera.
- The top five most common tree genera: *Acer* (maple), *Picea* (spruce), *Fraxinus* (ash), *Malus* (apple), and *Quercus* (oak), make up 80.8% of the urban forest.

- 51.9% percent of the trees are either ash or maple; both of these genera are currently threatened by the invasive tree pests: the emerald ash borer (EAB) and Asian longhorned beetle (ALB).
- The top five most common species: Norway maple (12.6%), apple (8.2%), red maple (8.0%), sugar maple (5.5%), and white ash (4.8%) comprise 39.1% of the stocking.

Forest structure

- The majority of trees (406 or 56.2%) have diameter measurements falling within the 6-18” size category.
- 126 (17.5%) trees fall within the 0-6” size category.
- The remaining 190 (26.3%) are greater than 18” in diameter.
- Canopy cover (public and private property) in the historic Village of Shelburne was assessed to be at approximately 34%.

Forest Cover

- There is existing urban tree canopy (UTC) cover of 34% in the downtown Village of Shelburne and most densely populated residential areas.
- Trees could potentially cover an additional 53% of the Village’s land surface; these “possible UTC” areas include grass, agricultural land, and impervious surfaces (e.g. parking lots, paved playgrounds, and the ROW).
- The remaining 13% of the Village’s area is buildings, streets, water, and other permanent features and is generally unsuited to UTC improvement.

Forest health

- An overwhelming majority (87.7%) of the trees inventoried was assessed as being in “Good” condition; of the remaining trees 84 were considered to be in “Fair” or “Poor” condition and only 5 were dead.
- 77 trees were flagged as in need of a future consultation.

Summary of recommendations

We recommend that the Town of Shelburne work on continuing to ***increase the diversity*** of tree species to ensure the long-term health of individual trees and Shelburne's complete urban forest. Plant a mix of species versus high-density stands of the same species whose close proximity may be conducive to the spreading of disease and pests.

Monitor tree health, specifically for signs and symptoms of EAB, ALB, and other forest pests and diseases.

Maintain tree health by ensuring that those who are caring for Shelburne's public trees are trained in best tree care practices; prune all public trees to promote long-term structural integrity, irrigate newly-planted trees, and prevent mechanical damage to trees.

Plan for the arrival of EAB by developing a community preparedness and response plan.

Inventory the remaining public trees over time to develop a comprehensive record of the Shelburne public trees.

Establish a routine systematic trimming cycle for all public trees to reduce future tree failures due to poor structure, minimize conflicts with people and infrastructure, improve lines of sight, reduce storm damage, and protect public safety.

Develop a comprehensive management and urban forest master plan based on this inventory report.

Communicate about the benefits of Shelburne's public trees at local events, recruit additional members for the Shelburne Tree Advisory Committee to increase local stewardship, and encourage participation in VT UCF educational programming such as the *Stewardship of the Urban Landscape* course and the *Forest Pest First Detectors* trainings.

The LANDS interns spent two full days inventorying the public trees in Shelburne.

Introduction

Project Description

VT UCF currently has a grant from the USDA Forest Service to assist twenty priority communities in Vermont in moving their forestry programs forward. The project, *Care of the Urban Forest*, is a multi-year effort that aims to support these communities in three specific ways: (1) conducting a public tree inventory to assess urban forest structure, diversity, and health; (2) helping the community in the development of an urban forest management plan (or master plan) using information from the inventory; and (3) providing technical training for volunteers and town employees to promote the proper care and management of public trees.

In recent years, the Shelburne Selectboard adopted a tree policy (available at: http://www.shelburnevt.org/HTML/TreePolicy.pdf) and established a Tree Advisory Committee. The Town of Shelburne hopes to expand its urban forest by planting trees as well as increasing community involvement by encouraging private landowners to care for trees adjacent to their properties. Interest has also expressed in developing a historic trees program in Shelburne. The Shelburne Tree Advisory Committee members have actively sought grant funding to meet their objectives as a new town committee and were eager to partner with VT UCF when presented with the opportunity to participate in the *Care of the Urban Forest* project.

The goal of the public tree inventory was to document the location, size, species composition, and condition of trees planted within the public right-of-way (ROW) and on town-owned land within the historic Village and most populated residential areas of Shelburne. Summer interns from the LANDS program conducted a comprehensive public tree inventory over the course of two days. This inventory establishes a baseline for future inventories, management decisions, and improvements to Shelburne's urban forest.

Shelburne Community Profile

The Town of Shelburne is located adjacent to Lake Champlain in Chittenden County, approximately 7 miles south of Burlington, Vermont's most populous city. Shelburne was chartered by New Hampshire on August 18, 1763 to Jesse Hallock and sixty-four associates by Governor Benning Wentworth. Shelburne has a land area of approximately 24 square miles and according to the 2010 U.S. Census the population of Shelburne is 7,144. Shelburne's economy was originally based on farming. Today Shelburne supports a variety of businesses, including manufacturers, a wide array of service providers and retail establishments, and Wake Robin, the state's largest continuing care retirement community. Shelburne is also home to three of Vermont's most popular tourist attractions: the Shelburne Museum, Shelburne Farms and the Vermont Teddy Bear Company (Town of Shelburne, 2014).

Methodology

Prior to the public tree inventory, VT UCF staff met numerous times with the Shelburne Tree Advisory Committee to plan for the inventory. Originally, 26 streets in the historic Shelburne village and most densely populated residential area were chosen to be included in the inventory, as well as a number of priority town-owned properties. In total, the land area of the inventory was about 1 square mile,

Importance of Inventory and Urban Forestry in Vermont

An inventory of urban trees provides a record of the trees present in a community. An inventory can provide information about the species, size, health, and location of each tree and future management needs. This detailed information allows town planners to estimate the monetary contributions of their community's green infrastructure. In the event of a disease outbreak or insect infestation, data from an inventory may assist in monitoring and preventing the spread of a forest health epidemic. An inventory can also help build public support for expanding community forests and to guide future urban planning.

Urban trees improve the quality of life for Vermont communities in a variety of ways. The most readily apparent benefit is the aesthetic value that trees provide a street, home, or public space. Along with this beauty is the functional benefit of providing shade along the streets in the summertime and blocking wind to reduce heating costs in the wintertime. The presence of trees has been shown to positively affect property values (Morales 1973; 1983) and boosts foot traffic in commercial areas. Parks and tree-lined sidewalks promote physical activity by creating shaded, comfortable outdoor spaces. Many types of urban wildlife depend on trees as sources of food and shelter. Unseen environmental benefits of urban trees include improvements in air quality and temperature regulation through reduction of the heat island effect. Trees can mitigate noise pollution common in an urban environment and can clean and conserve water by controlling run-off. Additionally, urban forests create opportunities for environmental education, community engagement and in some instances can be related to crime reduction. Trees are an integral part of the green infrastructure of a community and contribute to keeping our families healthier and our everyday lives more fulfilling.

representing less than .5% of the total land area of Shelburne but including the most densely populated section of town. The ROW boundaries for all streets were provided by the Shelburne Planning and Zoning Office. The list of streets and sites with ROW boundaries is found in Appendix A and maps of the inventory area are found in Appendix C.

VT UCF has developed an inventory system in collaboration with the VT Agency of Natural Resources' (ANR) GIS team. The map-based inventory system uses the application "Collector" by ArcGIS for data collection and is linked to the ANR Atlas online mapping tool.

On June 18th to the 19th, 2014, four teams of LANDS interns walked along pre-designated streets and sites of Shelburne, inventorying the public trees and identifying appropriate potential planting locations or green strips (recorded as "Vacant"). To ensure that only public trees were inventoried (opposed to trees on private property), each team had a list of the ROW boundaries for each street. Their first step upon reaching a new street was to determine the extent of the ROW from the curb; the team measured the road width, subtracted that number from the full ROW boundary, and then divided the number in half to determine the ROW extent back the curb on each side of the street. The following equations express this process:

ROW width = distance from both curbs + road width

ROW distance from curb = (ROW width - road width)/2

Each public tree identified was recorded into the "Collector" application using an iPad, provided by VT UCF. "Collector" is map-based and uses GPS and a base layer map to allow the user to input information about a tree, linking it to a particular geographic location. Data recorded for each tree included condition, tree number, street name, species, diameter class (using a diameter at breast height, or DBH, measurement), consultation recommendation, comments, and nearest house or building number. In most cases, a picture was also taken of each tree or vacant (potential) tree location. A full list and description of the parameters used in data collection can be found in Table 1.

Table 1: Parameters for Inventory Data Collection

Data Parameters	Description
Site ID	Street name or property name.
Tree Number	Count starts at 1 for each street/site. Unique to tree.
Species	Common name. Include in comments box if not listed.
Tree Condition	• *Good:* full canopy (75-100%), no dieback of branches over 2" in diameter, no significant defects, minimal mechanical damage • *Fair:* thinning canopy (50-75%), medium to low new growth, significant mechanical damage, obvious defects/insects/disease, foliage off-color and/or sparse • *Poor:* declining (25-50%), visible dead branches over 2" in diameter, significant dieback, severe mechanical damage or decay (over 40% of stem affected) • *Dead:* no signs of life, bark peeling; scratch test on twigs for signs of life (green) • *Vacant:* potential spot for a tree within the public ROW. Add "small", "medium", or "large" in the comments box - Small= max 30' at maturity, presence of overhead wires, minimum planting space 4' x 4' - Medium= 30-50' at maturity, green belts over 6' wide, no overhead wires - Large= 50'+ at maturity, parks and open space
Diameter (DBH)	Diameter taken at 4.5' above ground in classes of 0-3", 3-6", 6-12", 12-18", 18-24", 24-36", 36-42", 42"+. If on slope, uphill side measured. If abnormal growth, measured above or below growth. If multi-stemmed, each stem's DBH is squared, all squares summed, and the square root taken; indicate "multi-stemmed" in comments box.
Consult	• *Yes:* any one defect is affecting >40% of the tree, posing a hazard to people/infrastructure/cars, growing into utility wires, dead or poor condition, ash tree showing evidence of woodpecker flecking, blonding, epicormic branching/water sprouts, and/or suspicious exit holes • *No:* no major defects, tree in good or fair condition
Comments	Notes, elaborate on any existing conditions; max 255 characters.
House Number	Corresponding house address, numerical field. If a corner lot house is on a different street, enter house number and write "House located on X Street; corner tree" in comments box.
Collection Date/Time	Date and time.
Photo	Photo of full tree. Additional photos of any significant defects.

Left: each morning and afternoon the LANDS interns met to discuss and plan the most effective routes for data collection using a large parcel map.

Right: An example of a photograph of an individual tree that is attached to the record in the "Collector" application.

The data were compiled and subsequently analyzed and summarized using Microsoft Excel and ArcGIS. Data were also uploaded to i-Tree Streets in order to determine the monetary and ecological benefits of Shelburne's public trees inventoried and a VT UCF intern separately did a baseline assessment of the historic Village of Shelburne's full tree canopy coverage, encompassing both private and public property, using i-Tree Canopy. i-Tree is a free software suite developed by the USDA Forest Service and available at www.itreetools.org.

Inventory Results

Urban Forest Diversity

Of the 722 trees inventoried within the public ROW or on town-owned land, there were a total of 49 different species in 21 different genera. The common tree genera: maple (*Acer*), spruce (*Picea*), ash (*Fraxinus*), and apple (*Malus*) comprise 75% of the urban forest (Figure 1). Norway maple (*Acer platanoides)* (12.6%) was the most common species, followed by apple (*Malus sp.)* (8.2%), red maple (*Acer rubrum*) (8.0%), sugar maple (*Acer saccharum*) (5.5%), and white ash (*Fraxinus americana*) (4.8%) (Figure 2). Complete species and genera lists can be found in Appendix B.

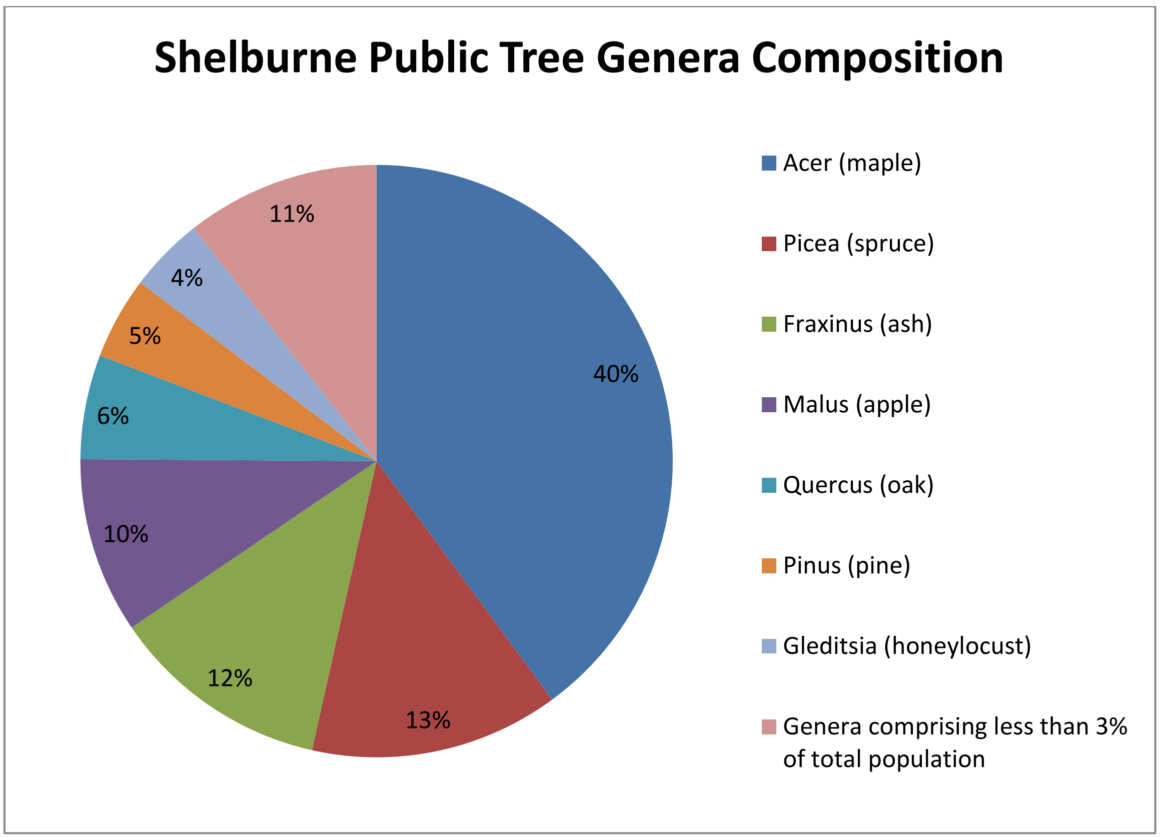


Figure 1: Chart showing tree genus by percent composition.

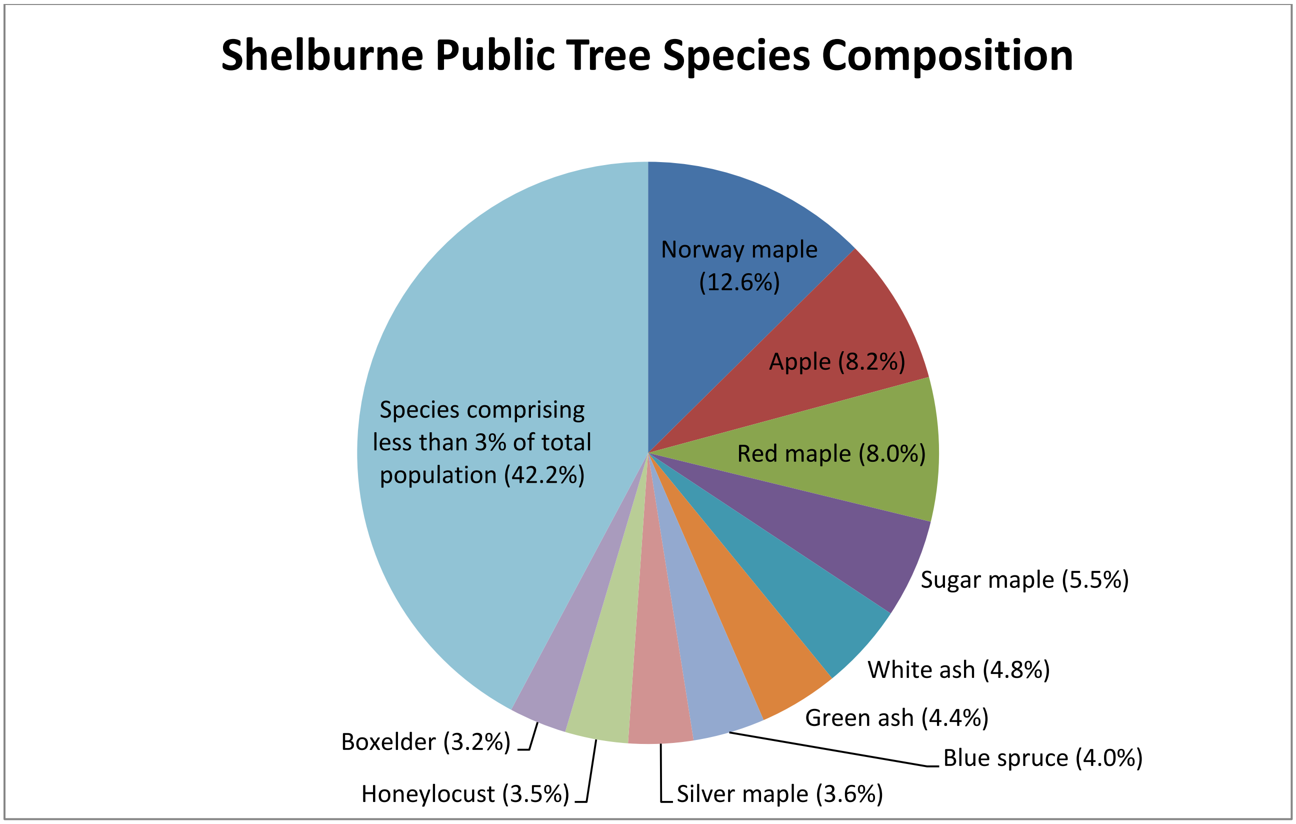


Figure 2: Chart showing tree species by percent composition.

Urban Forest Structure

Of the 722 trees inventoried, 56.2% (406) had a DBH of 6 - 18 inches (Figure 3). Seventeen and one-half percent (126) of the trees had a DBH of 0 - 6 inches, while 26.3% (190) had a DBH greater than 18 inches (Figure 3). The composition of genera and species within each of these size classes (Figures 4 and 5) indicate that the majority of trees of smaller diameter are maple and apple; the low percentage of ash trees within the two smallest DBH class categories perhaps indicates that Shelburne has stopped planting ash because of the threat of the emerald ash borer. The three largest size classes represented, 30-36”, 36-42”, and >42” contain a total of 23 trees. These trees are growing within the public ROW or on town-owned land and were probably not planted as street trees but left as remnants as the town grew. The largest tree inventoried was a silver maple on Shelburne Road in front of the Trinity Episcopal Church. While not included in the inventory because it is located on private property, the large sycamore tree on Falls Road is of particular cultural value to nearly every Shelburne resident encountered while collected inventory data.

There were 64 “Vacant” potential tree planting locations or strips identified within the public ROW. Appendix A breaks down these locations by street; with 22 potential spots, Falls Road seems to have the most potential for tree planting along the ROW. Of the 64 identified locations, 16 were explicitly indicated to be appropriate for a large tree, 21 would be appropriate for a medium tree, and 25 would fit a small tree.

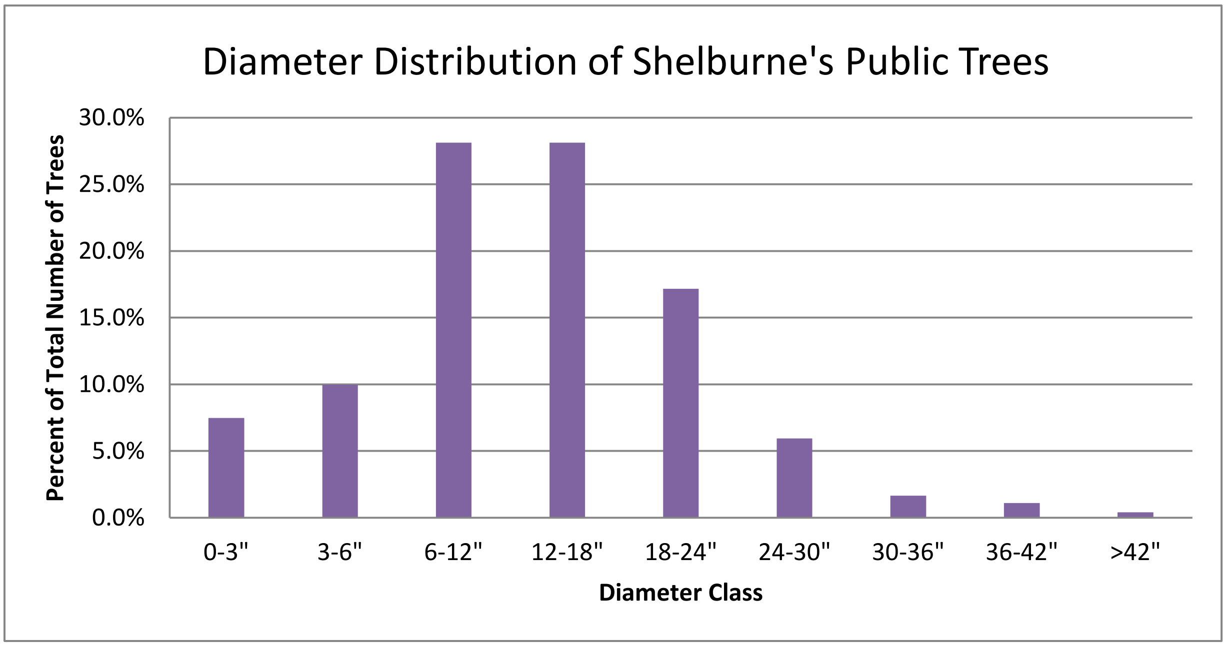


Figure 3: Graph showing percentage of trees in each diameter class (inches).

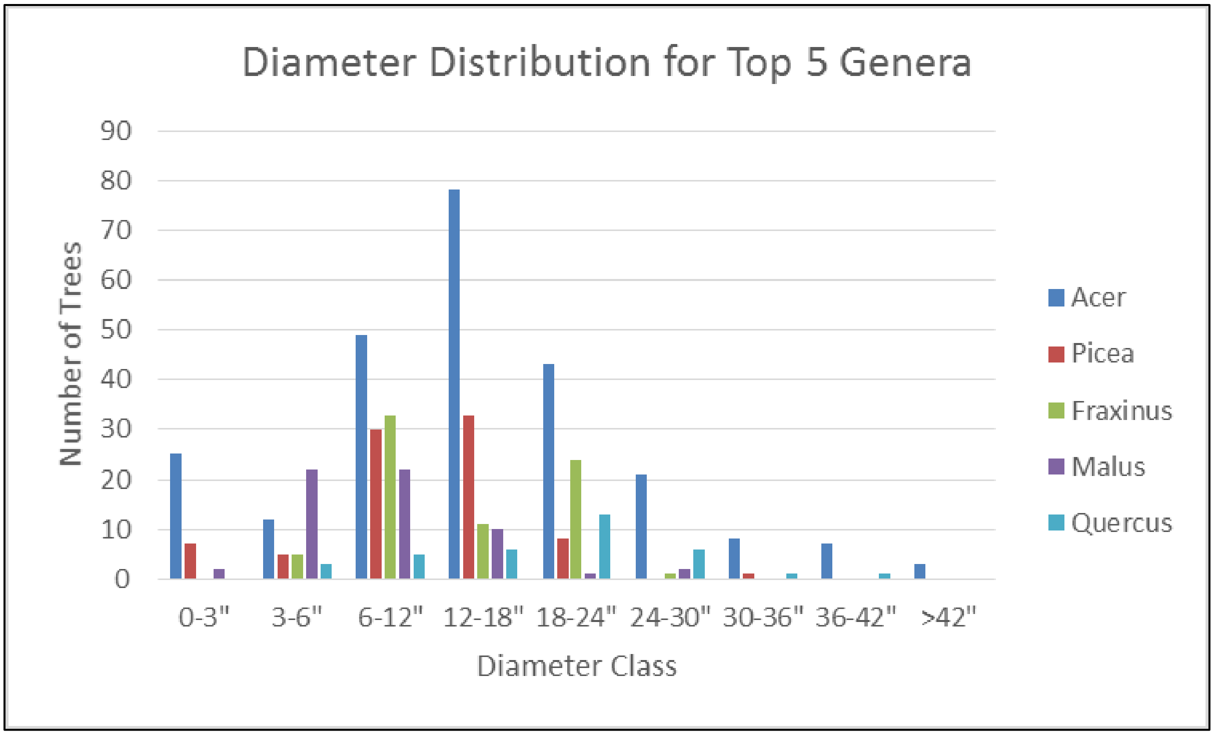


Figure 4: Graph showing diameter distribution for the 5 most common genera.

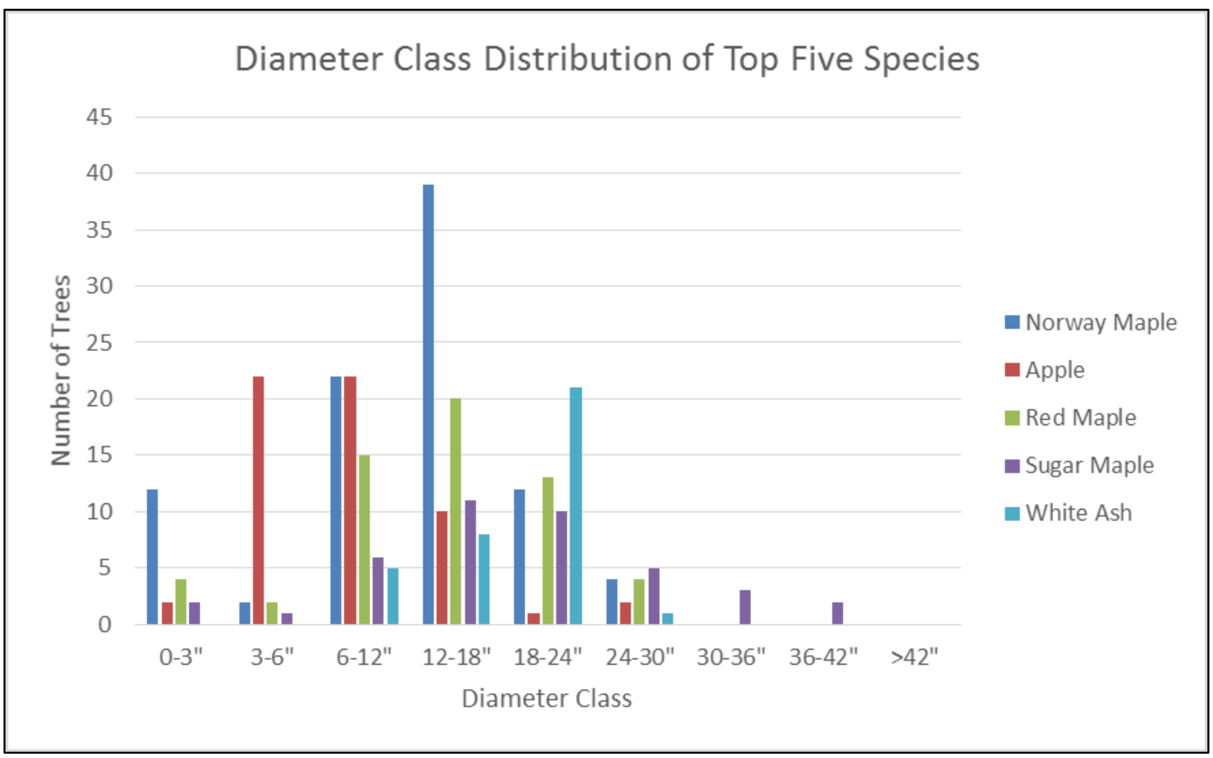


Figure 5: Graph showing diameter distribution for the 5 most common species.

Urban Forest Health

An overwhelming majority (87.7%) of Shelburne's inventoried public trees were assessed as being in "Good" condition; of the remaining trees, 63 (8.7%) were considered in "Fair" condition, 21 were in "Poor" condition, and 5 were "Dead" (Figure 6). The trees in the genera Acer (maple) and Picea (spruce) had the most trees in fair or poor condition; however, these genera also comprise the highest percentage of overall trees inventoried. The dead trees are a red maple, an oak, a pine, a Norway maple, and one tree of unidentifiable species.

There were 77 trees (10.6%) that were flagged for a consult during the inventory and should be reassessed by a member of the Shelburne Tree Advisory Committee or a professional in a timely matter. Trees that were flagged for a consult expressed one or more of the following conditions:

- The tree had a defect affecting >40% of the tree,
- The tree posed a hazard to people/infrastructure/cars,
- The tree was growing into utility wires,
- The tree was dead or in poor condition, or
- The tree was an ash (*Fraxinus*) and was showing evidence of a sign or symptom of infestation by the emerald ash borer (extensive woodpecker flecking, bark blonding, epicormic branching/water sprouts, and/or suspicious exit holes).

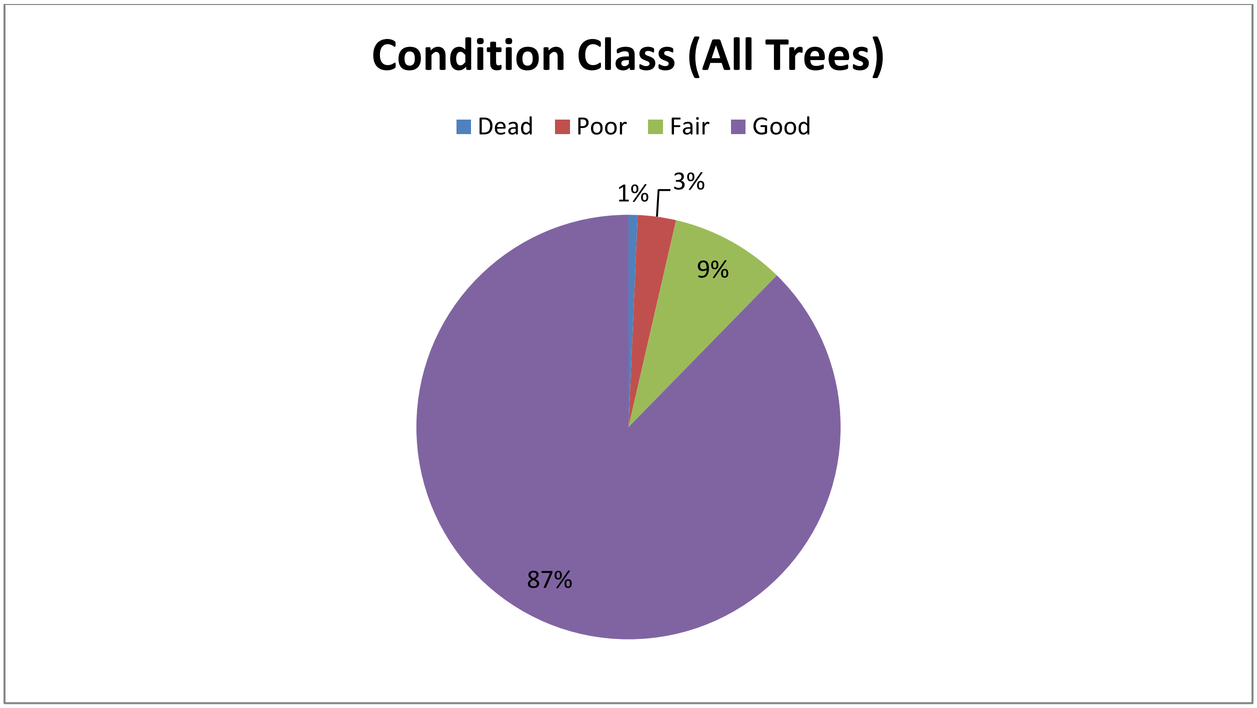


Figure 6: Chart showing percentage of trees in each condition class.

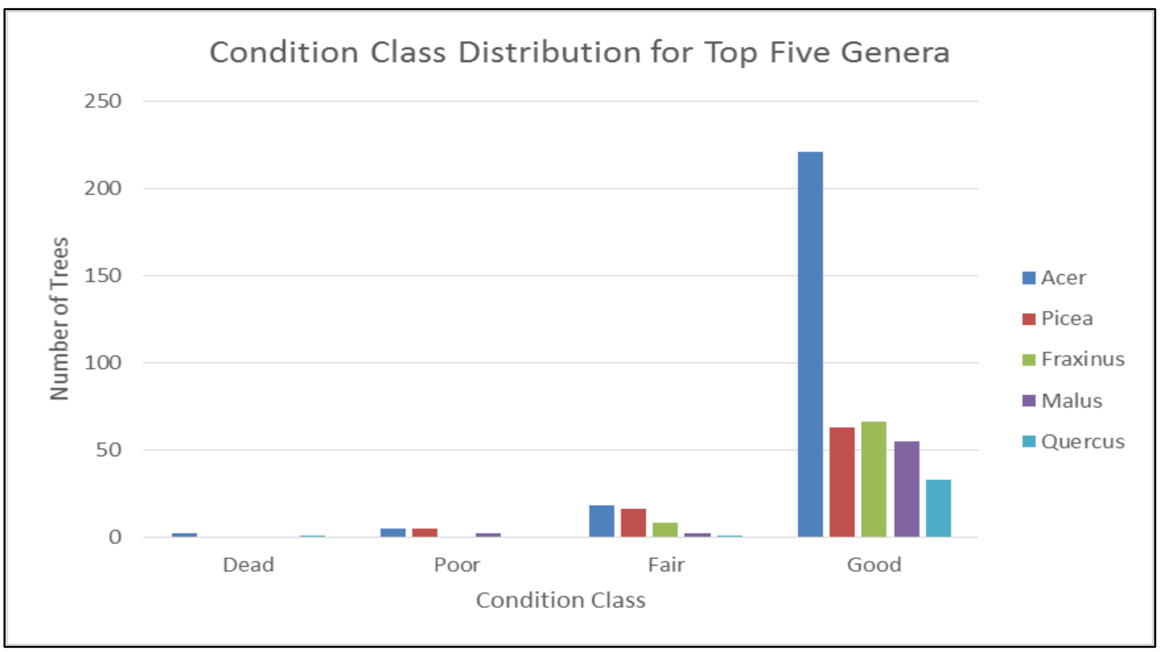


Figure 7: Graph showing the number of trees within the five most common genera displayed according to condition.

Monetary Value and Ecosystem Services

The data was analyzed using i-Tree Streets software to determine the monetary value of the ecosystem services provided by Shelburne's trees. The 722 trees provide a total of $49,585 in annual benefits by filtering air pollutants, mitigating stormwater runoff, sequestering carbon dioxide (CO_2), conserving energy, and increasing property values. On average, each public tree offers $134 annually in savings or services.

Figure 8 and Table 2 provide an overview of each ecosystem service provided by Shelburne's public trees. Energy conservation and property value increase are the most significant services provided by these trees in terms of their monetary value. The full reports produced through the i-Tree Streets program for Shelburne will be given to the Shelburne Tree Advisory Committee.

It is important to recognize that the trees inventoried through this project are located on approximately 1 square mile of Shelburne's 24 square miles of total land area; expanding the inventory to all Shelburne roads would increase these figures dramatically. It is also noteworthy that larger and long-living trees provide substantially more benefits than young, small trees; regular maintenance and care are needed to provide for urban tree health, longevity, and maximized urban forest benefits.

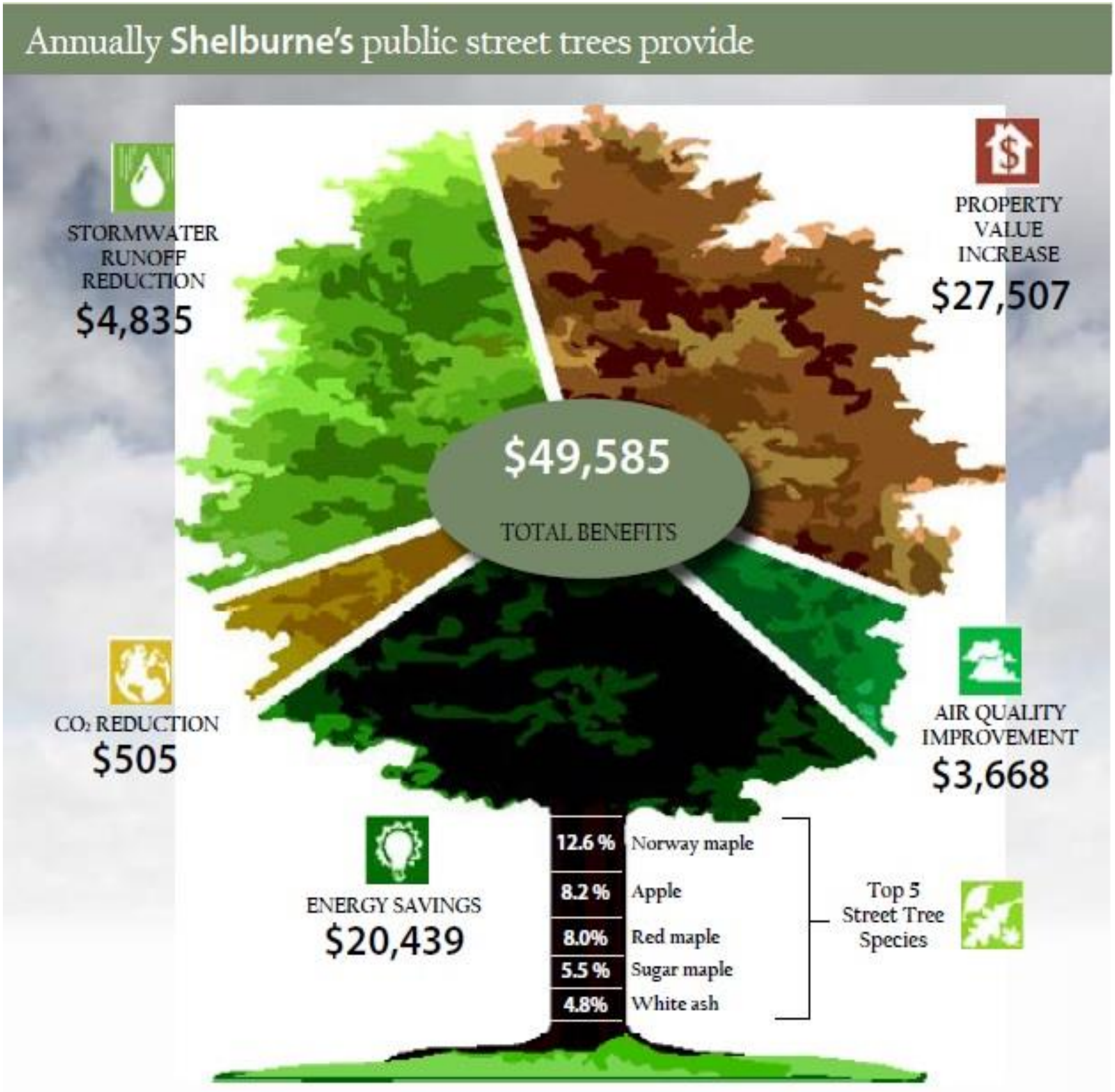


Figure 8: Summary of benefits provided by Shelburne's public trees. Tree graphic concept courtesy of City of New York Department of Parks & Recreation

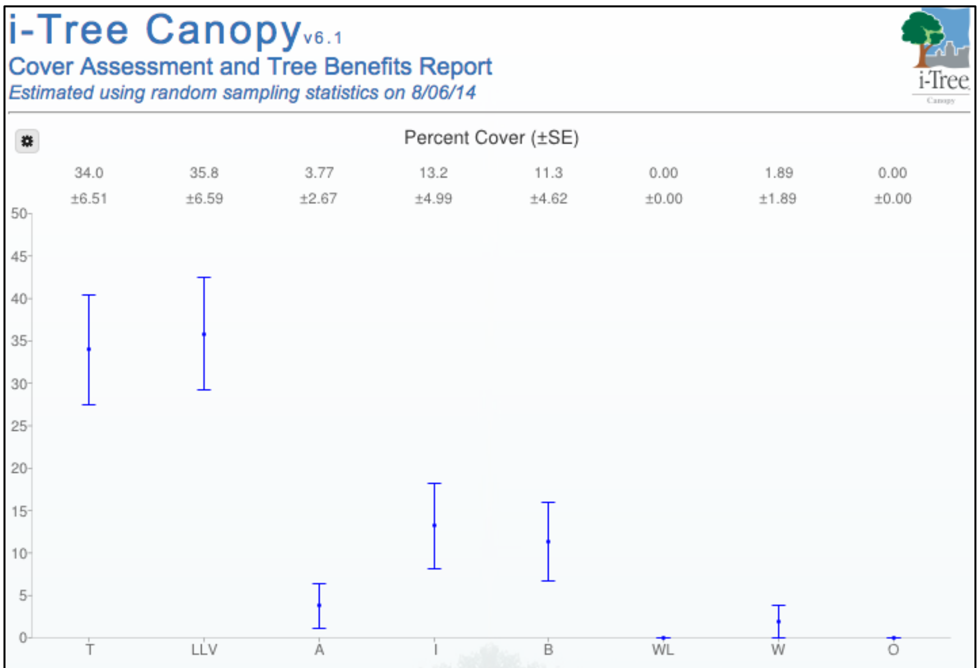
Table 2: Annual environmental and monetary benefits provided by Shelburne's public trees.

Benefit Type	Benefit Description	Total Value of Trees Inventoried	Average value/tree
Energy conservation	Reduced natural gas use in winter and reduced electricity use for air conditioning in summer	$21,489	$66.32
Carbon dioxide	Annual reductions in atmospheric CO2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use. The model accounts for CO2 released as trees die and decompose and CO2 released during the care and maintenance of trees.	$467	$1.44
Air quality	Quantifies the air pollutants (O3, NO2, SO2, PM10) deposited on tree surfaces and reduced emissions from power plants (NO2, PM10, VOCs, SO2) due to reduced electricity use. Also reported are the potential negative effects of trees on air quality due to BVOC emissions.	$4,001	$12.35
Stormwater	Reductions in annual stormwater run-off due to rainfall interception by trees.	$5,458	$16.85
Aesthetic/other	Tangible and intangible benefits of trees reflected in increases in property values.	$12,056	$37.21
Stored carbon dioxide	Tallies all of the carbon dioxide stored in the urban forest over the life of the trees as a result of sequestration; *not an annual benefit but a cumulative benefit.	$6,114	$18.87*
Totals		**$49,585**	$153.04

Shelburne Full Canopy Assessment

As a complement to the public tree inventory, VT UCF's summer intern completed an i-Tree Canopy assessment for the inventory area in Shelburne. i-Tree canopy is a free, easy-to-use online application that allows users to assess total tree cover over an area based on randomly-generated map points and user-defined land cover types. The tool also assigns dollar values to the benefits associated with the overall tree canopy cover. The aim of this type of assessment is to help citizens and decision-makers better understand the existing and potential tree canopy in their community. Based on the Shelburne i-Tree Canopy assessment, approximately 34% of the Village and the most densely-populated residential areas of town are currently occupied by tree canopy (Figure 9). In consideration of the other land cover types present, Shelburne could potentially increase its total tree canopy cover by an additional 40% on agricultural and open lands of low-lying vegetation. Currently 13% of the area is occupied by buildings or water, not suitable for tree planting, but the remaining 13% is impervious surface (parking lots, playgrounds, roads and the ROW) and with strategic planning initiative, could be converted to canopy. In total, there is currently potential to increase overall tree canopy cover in Shelburne by 53% (Figure 10).

Figure 11 compliments the i-Tree Streets analysis of the monetary value of benefits provided by Shelburne's public trees by estimating the air quality benefits and corresponding monetary value for the full urban forest canopy. Of note is an estimated $434,778 in CO_2 storage and $17,244 in annual CO_2 sequestration value.



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	18	34.0 ±6.51
Low Lying Vegetation		LLV	19	35.8 ±6.59
Agriculture		A	2	3.77 ±2.67
Impervious		I	7	13.2 ±4.99
Building		B	6	11.3 ±4.62
Wetland		WL	0	0.00 ±0.00
Water		W	1	1.89 ±1.89
Other		O	0	0.00 ±0.00

Figure 9: i-Tree Canopy assessment for the downtown Village and high-density residential areas of Shelburne.

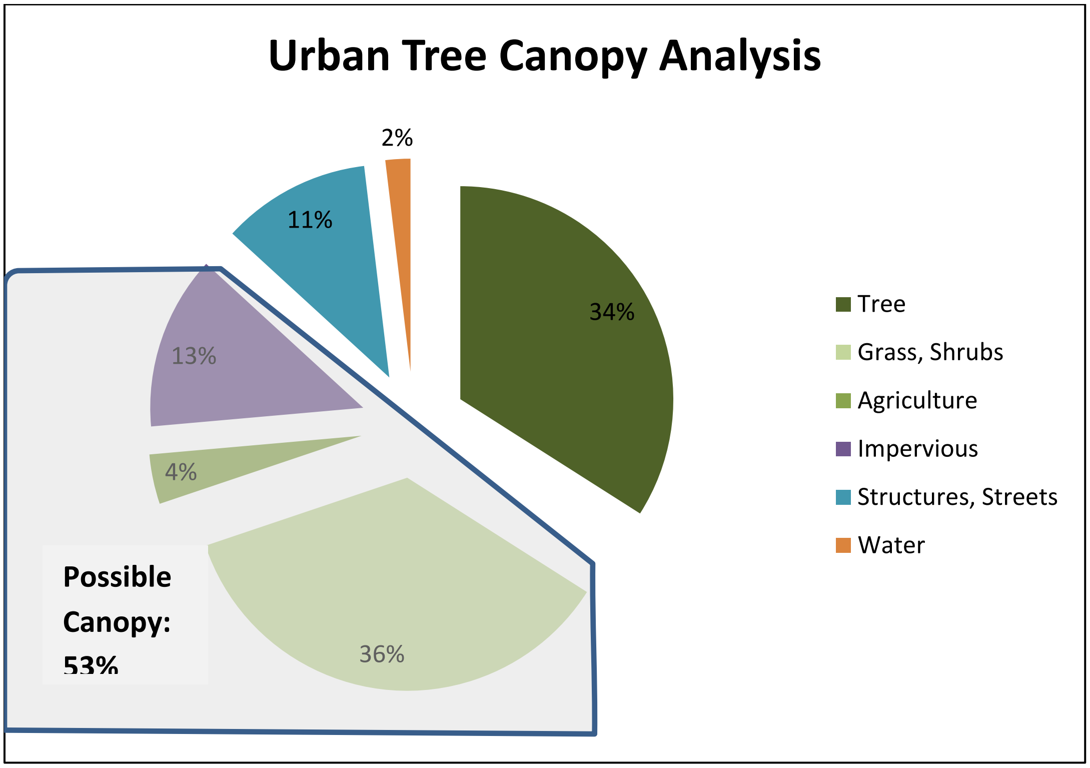


Figure 10: Shelburne's urban tree canopy analysis.

Tree Benefit Estimates

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$6.83	±1.31	161.07 lb	±30.85
NO2	Nitrogen Dioxide removed annually	$11.76	±2.25	878.29 lb	±168.23
O3	Ozone removed annually	$612.18	±117.26	4.37 T	±0.84
PM2.5	Particulate Matter less than 2.5 microns removed annually	$1,265.49	±242.39	425.05 lb	±81.41
SO2	Sulfur Dioxide removed annually	$2.05	±0.39	553.47 lb	±106.01
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$444.43	±85.13	1.47 T	±0.28
CO2seq	Carbon Dioxide sequestered annually in trees	$17,244.14	±3,302.94	890.56 T	±170.58
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$434,778.37	±83,277.52	22,453.69 T	±4,300.78

Figure 11: i-Tree Canopy assessment estimates for air quality benefits of Shelburne Village's full canopy.

Discussion and Recommendations

Urban Forest Diversity and Structure

An important best management practice in urban forestry is to maintain a diverse range of species. It is recommended that communities work towards a goal of no more than 20% representation of a single genus (for example: maples) in a tree population and no more than 10% of one species (for example: sugar maple). Resistance to disease and insect infestation is one of the many reasons that diversity within the urban forest is of paramount concern. A more diverse forest will be more resistant to environmental stressors, and therefore remain healthy and resilient in the face of change. Furthermore, by maintaining higher diversity a community can prevent a rapid loss of canopy due to insect and disease issues.

In Shelburne, 40% of public trees inventoried were in the maple (*Acer*) genus, which is double the recommended representation within the community's urban forest. Specifically, Norway maple, red maple, sugar maple, silver maple, and boxelder represent 13%, 8%, 6%, 4%, and 3% of the species diversity respectively. Norway maple is the most prevalent species in Shelburne, and is considered to be a non-native invasive species. Although an aesthetically pleasing and hearty

Components for Managing a Vibrant and Resilient Urban Forest

A successful urban forestry program requires a combination of organized leadership, comprehensive information about the tree population, dedicated personnel, and effective public relations. We recommend the following components for successful urban forest management.

Public Policies: A tree ordinance or policy provides authority for conducting forestry programs, defining municipal responsibility for public and private trees, passing regulations and setting minimum standards for urban forestry management.

Leadership: Define who is responsible for the oversight of the community forest, including formulating policies, advising, administration, management, representation and/or advocacy.

Partnerships: A well-managed urban forest takes the work of many. Seek strategic partnership to meet a shared vision. At a minimum the tree warden, a local advisory committee like a tree board or conservation commission and municipal staff (parks, roads, planning) should collaborate.

Responsibility: A clear understanding of which trees and areas will be managed is an important first step. Street trees, parks and village greens, cemeteries and schools are typical areas of municipal responsibility.

Assessment: A complete public tree inventory, including tree locations, species, condition, and management needs provides the necessary information to manage the resource. An inventory is the foundation to developing a strategic management plan.

Management Plan: A management plan provides a vision for the long-term management of the community forest. It should include strategies, budgets, and responsibilities for meeting that vision.

Staffing: The care of urban forest requires a certain skill set that can be found in-house with professional staff or through consultants. Whether creating a staff position for a certified arborist or urban forester, or contracting with them on an as-needed basis, professional assistance will have some of the greatest and most immediate impacts on a community forestry program.

Tree Canopy Goals: Consider a community's entire tree canopy to reduce loss and maximize gains over time by protecting undeveloped forest and impacts of land development, enhance the health condition and function of forests, and reforest through active replanting or allowing regeneration.

tree, Norway maple can spread into nearby forests and out-compete native species such as sugar maple. In fact, Vermont's Plant Quarantine Rule prohibits the movement, distribution, and sale of Norway maple, as well as other invasive plant species. Ash trees (genus *Fraxinus*) make up 12% of the public tree canopy of Shelburne. Both ash and maple trees are currently threatened by invasive tree pests; the emerald ash borer (EAB) threatens the former and Asian longhorned beetle (ALB) is a threat to the latter. While neither of these pests has been discovered to-date in Vermont, the largest ALB infestation in North America is a little over 50 miles to our south in Worcester, MA and with the discovery of EAB in New Hampshire in 2013, Vermont is now surrounded on all sides by states or provinces with isolated infestations of EAB.

Recommendation:

Develop species, structural, and age diversity by planting new species and increasing the number of lesser represented species using best management practices in order to promote long-term health and resilience of individual trees and Shelburne's urban forest.

Recommended action practices:

- We advise against planting high-density stands of the same species (monocultures) whose close proximity may be conducive to the spreading of disease.
- We suggest planting tree species that have been grown successfully in the area that do not show any signs of diseases and deformity, and that are not non-native invasive species (specifically Norway maple).
- Existing ash trees should be consulted and regularly monitored for signs of EAB, and additional ash trees should not be planted.
- Plan for the arrival of EAB by using the Community Preparedness Toolbox, available at http://www.vtinvasives.org/tree-pests/community-preparedness.
- Encourage Shelburne citizens to participate in the Vermont Forest Pest First Detector Training to expand local capacity to identify and monitor for invasive forest pests.
- In order to diversify in both species composition and age structure, refer to the 64 identified vacant planting locations within the public ROW and develop a strategic planting plan.

- In planning for future tree plantings, consider obstructions above ground (power lines) and below ground, minimize grey infrastructure conflicts (sidewalks, streets, buildings, etc.) available soil volume, species mature size (height and spread), branching patterns, environmental tolerances (exposure, salt, and drought), and desired function when choosing species. For more information on site assessment and species selection, refer to the VT Tree Selection Guide at http://www.vtfpr.org/urban/documents/vttree%20guide.pdf.
- Encourage residents to plant trees on their properties to increase species diversity, age structure, and overall tree canopy benefits to the community.

Maintenance

Proper tree maintenance, especially pruning, can extend the life and health of trees, as well as reduce public safety issues. There are four main pruning practices of note:

- Crown cleaning: removes dead, diseased, and damaged limbs
- Crown thinning: selective removal of stems and branches to increase light penetration and air movement throughout the crown of a tree
- Crown raising: the removal of lower branches over 2 inches in diameter to provide clearance for pedestrians and vehicles
- Crown reduction: removing individual limbs from structures or utility wires

In addition to pruning, proper and regular mulching for soil health, moisture retention, and to protect from mechanical damage is encouraged. Finally, for newly-planted trees, an irrigation regime should be in place to ensure proper establishment and tree root regeneration.

Recommendation:

Establish a routine maintenance cycle, implemented by trained professionals and overseen by the Shelburne Tree Advisory Committee, for all public trees to promote tree health and reduce any threat to public safety.

Recommended action practices:

- Complete a full inventory of all public trees in Shelburne (beyond the Village and most densely-populated areas) in order to establish a routine maintenance regime for all town-managed trees.
- Work with VT UCF to ensure municipal tree maintenance staff is trained in best management practices.
- Establish a systematic pruning cycle to reduce branch and tree failures due to poor structure, minimize conflicts with people and infrastructure, improve line of sight, and reduce storm damage. When trees are located near electrical utility lines, it is important to work directly with the local utility company.
- Encourage Shelburne citizens to participate in VT UCF's Stewardship of the Urban Landscape training course to continue to build local capacity to care for and promote Shelburne's canopy.

Urban Forest Health

Overall, Shelburne appears to have a healthy population of public trees. Approximately 12% (84) of Shelburne's public trees were either considered to be in "Fair" or "Poor" condition and 5 trees were designated to be "Dead". Concentrations of fair, poor, and dead trees were found at Davis Park, Shelburne Beach, and the Town Office complex and along Laplatte Circle, Bacon Drive, and Falls Road. There were 77 trees flagged to be revisited by a trained arborist or a member of the Shelburne Tree Advisory Committee; many of these trees overlap those designated to be in poor condition or dead, but others were likely noted because of conflict with utility wires or other infrastructure. See Appendix C for a map detailing the locations of the fair, poor, and dead trees in Shelburne and a map indicating the location of the 77 trees requiring a consult.

Low soil volume and fertility, exposure to salt spray, root damage, mechanical damage to the stem, poor pruning, and improper planting are some of the contributing factors that may lead to decreased tree health in an urban setting.

Recommendation:

Continue to monitor trees in good and fair condition, plan to lose trees in poor condition, and remove dead trees to increase overall urban forest health.

Recommended action practices:

- Visit and assess the 77 trees flagged for consultation in a systematic and timely fashion.
- Remove the 5 public trees identified.
- Closely monitor the health of the 21 public trees in poor condition and plan for their removal and replacement in the near future.
- Continue to monitor the health of the trees in good and fair condition and record any changes in tree health.
- Focus efforts on Shelburne Beach, an area of high-use and high-value to the public that contains a high number of trees in poor condition.

Assessment Tools

Using free i-Tree software developed by the USDA Forest Service, we were able to assess the value and potential expansion of Shelburne's urban tree canopy. i-Tree Streets allowed us to determine the economic value of the ecosystem services provided by the 722 inventoried trees in Shelburne. Shelburne's urban forest generates about $50,000 annually through the benefits of air quality improvement, carbon storage, electricity and natural gas, aesthetics, and storm water control; on average, each tree offers $134 in service or savings every year. The trees of Shelburne provide services to the town in the following ways:

- **Aesthetics**: Urban trees can make an urban or suburban environment a more pleasant and satisfying place to live, work, and spend leisure time (Dwyer et al. 1991). In monetary terms, presence of shade trees can significantly increase property value. There are also numerous health benefits to trees. For example, hospital patients with window views of trees have been shown to recover faster than patients without such views (Ulrich 1984).

- **Air quality**: Trees improve air quality by removing air pollutants through their leaves, altering emissions from building energy use, and by lowering air temperature.
- **Energy use**: Trees influence thermal comfort and energy use by providing shade, transpiring moisture, and reducing wind speeds. Over 100 million trees have been established around residences in the U.S. and it saves $2 billion annually in reduced energy costs (Akbari et al. 1988).
- **Stored Carbon Dioxide**: Urban trees can affect climate change by storing carbon in their tissues and reduce emissions through lowered building energy use. Urban trees in the contiguous United States store 770 million tons of carbon, which is valued at $14.4 billion (Nowak and Crane 2002).
- **Storm water run-off**: Trees and soil improve water quality and reduce costs associated with storm water treatment by retaining or slowing flow of precipitation.

Using a random sample method and based on assessing land cover types, i-Tree Canopy allowed us to measure the overall tree canopy cover within the boundaries of the inventory area, capturing both private and public tree canopy.

Recommendation:

Use the information generated through the i-Tree Streets and i-Tree Canopy programs to promote investment in urban forest management and local stewardship.

Conclusion

Trees in our urban landscapes contribute to environmental integrity, social cohesiveness, economic activity, cultural heritage, and overall well-being. This report is one component of a long-term effort by the Town of Shelburne to understand, manage, and steward its urban forest. The recommendations outlined in this report are based on the LANDS interns' observations and data analysis combined with the experience and evaluation of VT UCF staff; they should considered by the Shelburne Tree Advisory Committee based on long-term vision and current capacity.

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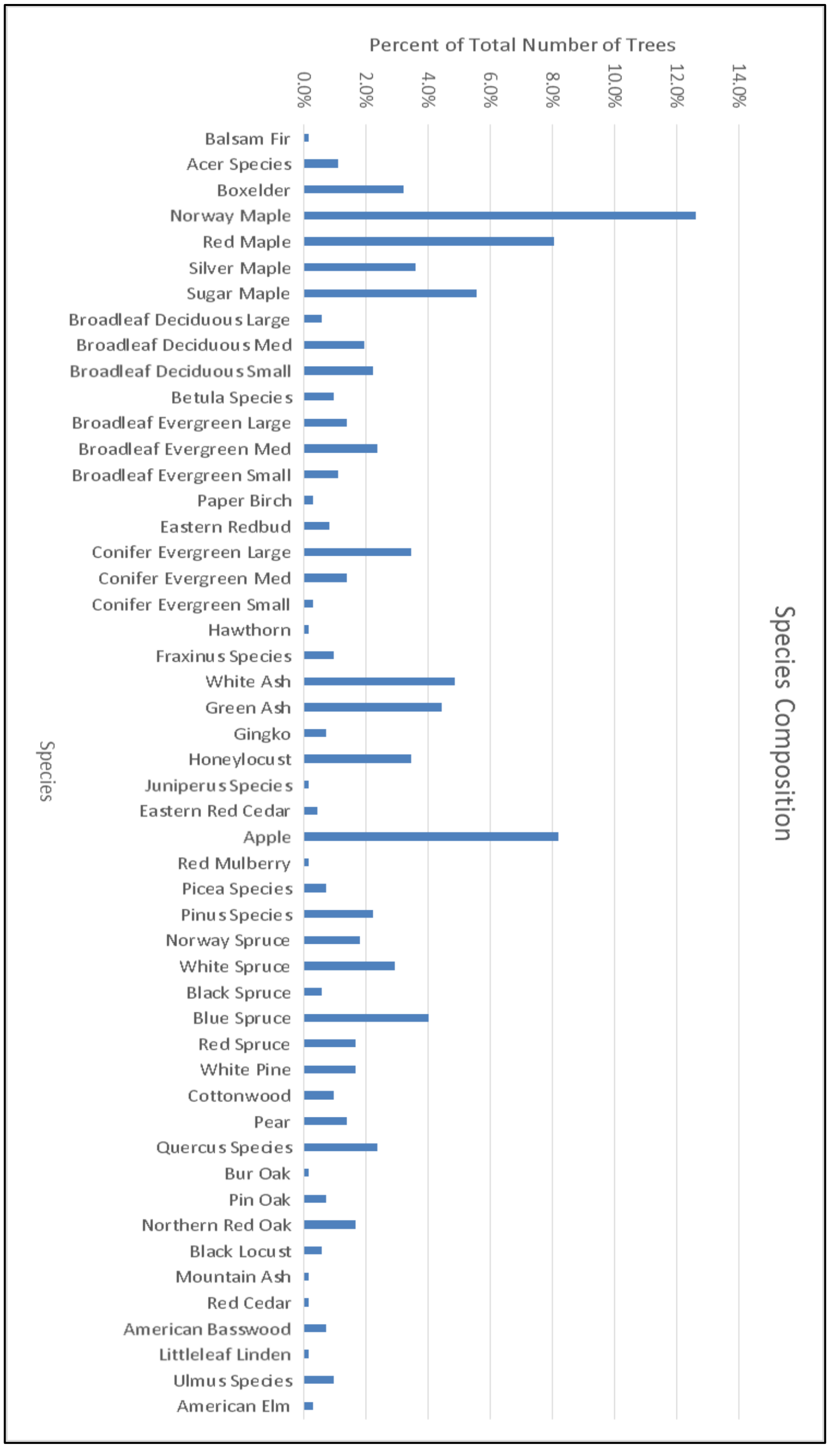
Appendix A: Full Street and Site List for the Shelburne Inventory

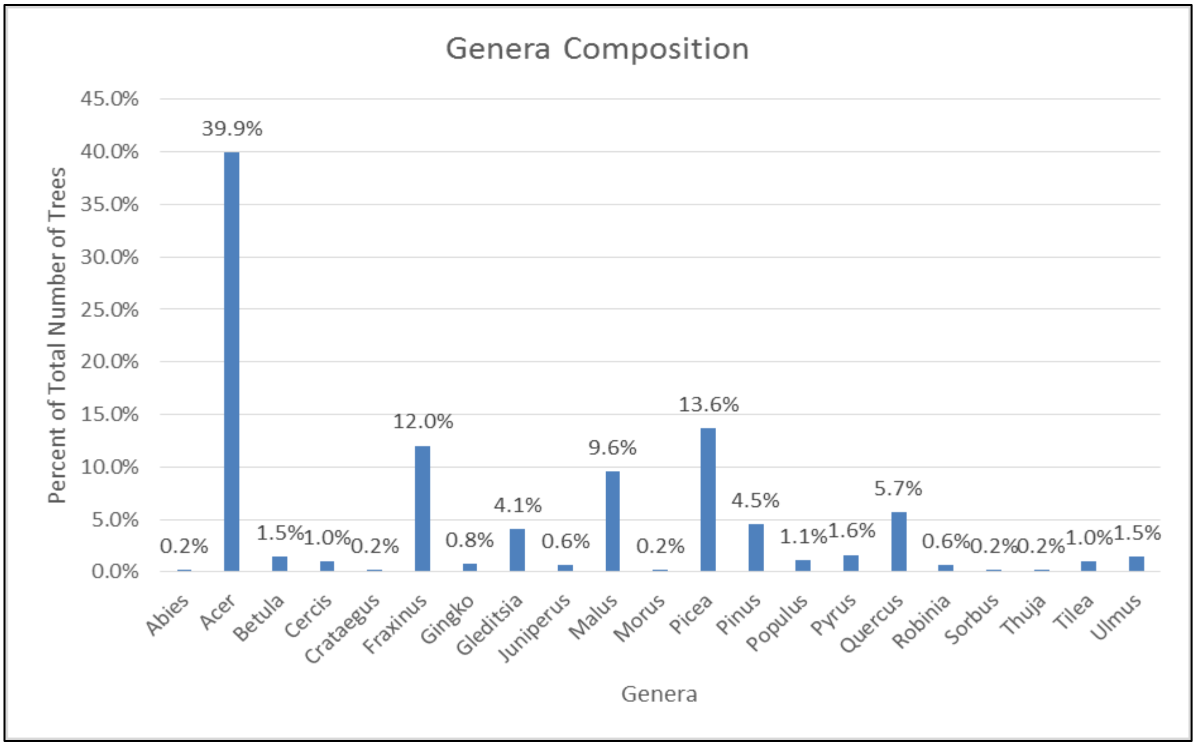
Street/site name	ROW Extent (feet)	Number of Trees	Number of Vacant Spots or Strips
Bacon Drive	60	31	0
Blodgett Street	60	n/a*	n/a*
Covington Lane	60	n/a*	n/a*
Davis Avenue	60	19	0
Falls Road from Route 7 (N) to intersection with Marsett & Mt. Philo where Falls Road continues at a sharp left turn (East); stop at the Laplatte River crossing (bridge).	66	54	22
Fletcher Lane	60	47	0
Green Hills Drive	60	8	1
Harbor Road (E) from Route 7 to the two-way split into Gate and Depot Streets (W)	66	55	2
Heritage Lane	60	14	2
Hillside Terrace	60	8	1
John Street	60	9	2
Kimball Terrace	60	n/a*	n/a*
Laplatte Circle	60	40	7
Littlefield Drive	60	24	2
Maplewood Drive	60	31	8
Marsett Road from Route 7 (W) to intersection with Falls & Mt. Philo (E)	66	19	1
Meadow Lane	60	18**	0**
Mt. Philo Road from Falls/Marsett (N) to Maplewood/Littlefield (S)	66	13	1
Parade Grounds/Church Street	66; n/a for the grounds	32	2
School Street/ Davis Park	60; n/a for the park	38	1
Shelburne Beach	n/a	42	2
Shelburne Road from Webster Road (N) to the light at the Marsett/Botswick intersection (S); Inventory all Municipal Offices grounds trees and trees on the Shelburne Town Green	100; n/a for the municipal offices and green	153	3
Steeplebush Road	60	19	6
Stokes Lane	60	6	1
Timber Lane	60	n/a*	n/a*
Tracy Lane	60	30	0
Village Vale Drive	60	15	0

n/a* = we didn't get to it

** = only partially completed

Appendix B: Full Species and Genera List for Shelburne's Public Trees




Genera Composition
Percent of Total Number of Trees
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
39.9%
0.2%
1.5%
1.0%
0.2%
12.0%
0.8%
4.1%
0.6%
9.6%
0.2%
13.6%
4.5%
1.1%
1.6%
5.7%
0.6%
0.2%
0.2%
1.0%
1.5%
Abies
Acer
Betula
Cercis
Crataegus
Fraxinus
Gingko
Gleditsia
Juniperus
Malus
Morus
Picea
Pinus
Populus
Pyrus
Quercus
Robinia
Sorbus
Thuja
Tilea
Ulmus
Genera

Appendix C: Maps

- All trees inventoried in Shelburne
- Trees designated to be in “Fair”, “Poor”, or “Dead” condition
- Trees designated to be in “Good” condition
- Trees requiring a consultation
- All trees inventoried, by DBH class
- Potential tree planting locations within the ROW or on town-owned property