Hinesburg Public Tree Inventory Report

Prepared for the Town of Hinesburg by the
Vermont Urban & Community Forestry Program
December 2015

FORESTS, PARKS & RECREATION VERMONT

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

PLANT LIVE GROW
VERMONT URBAN & COMMUNITY FORESTRY PROGRAM

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

VT ANR GIS

Acknowledgements

This report was developed by Vermont Urban & Community Forestry Program (VT UCF) staff based on field work conducted by VT UCF staff and State Lands Foresters from the Vermont Department of Forests, Parks, & Recreation (VT FPR) for the Town of Hinesburg, Vermont during the summer of 2015. We would like to thank the main contacts for this project: Paul Wieczoreck, Hinesburg's Tree Warden, and Marie Ambusk, Hinesburg resident and volunteer tree steward. This report was made possible with funding from the USDA Forest Service. Special thanks to Andrea Urbano, VT UCF intern, and Diana Jaramillo, ECO Americorps member with VT UCF, for their work in analyzing data and developing this inventory report.

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 populated urban and rural spaces where trees play important roles. The trees in public parks, along roadsides, on town greens, and in municipal forests compose our urban and community forests and merit careful stewardship. VT UCF is a collaborative effort between the Vermont Department of Forests, Parks, & Recreation, the University of Vermont (UVM) Extension, and the USDA Forest Service. The program provides technical and financial assistance as well as educational programs and resources 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, municipal tree boards and committees, and state agencies.

The trees in our communities offer a wide variety of environmental, social, and economic benefits to the surrounding community, including but not limited to: stormwater mitigation, carbon dioxide (CO_2) sequestration, air quality improvement, shade, wildlife habitat, and aesthetic value. VT UCF seeks to maximize these benefits by working with state and municipal officials, as well as dedicated volunteers and local organizations, to steward community forests' ecological integrity and diversity. VT UCF's programming and support reaches 100 Vermont communities annually. More information about VT UCF and its programming can be found at www.vtcommunityforestry.org.

VT UCF and VT FPR staff assess a young maple as part of the Hinesburg Public Tree Inventory.

Contents

Acknowledgements i

About the Vermont Urban & Community Forestry Program i

Executive Summary 1

- Summary of Findings 2
- Summary of Recommendations 3

Introduction 5

- Project Description 5
- Town Profile 6
- Methodology 7
- Community Forest Diversity 10
- Community Forest Structure 12
- Community Forest Health 14
- Tree Health and Maintenance Indicators 16
- Economic Benefit and Ecosystem Services 18
- Hinesburg Canopy Assessment 23

Discussion and Recommendations 25

- Hinesburg's Public Tree Program 25
- Community Forest Diversity and Structure 26
- Community Forest Health 29

Assessment Tools 30

Conclusion 32

Appendices 33

- Appendix A: Full Street and Site List of Hinesburg's Public Tree Inventory 33
- Appendix B: Full Species and Genera List for Hinesburg's Public Trees 34
- Appendix C: Leaf Area and Canopy Cover by Species Comprising Hinesburg's Community Forest 36
- Appendix D: Instructions for Accessing Public Tree Data in ANR Atlas 38
- Appendix E: Maps 39

Executive Summary

The goals of Hinesburg's public tree inventory were to update the Town's current inventory information, accurately locate and assess Town-owned trees within the public right-of-way (ROW), take note of trees on private property considered a significant component of the town's tree-scape, and assess health and maintenance needs of public trees. The information collected in the inventory and presented in this report provides residents and decisions-makers with a better understanding of the composition, health, and benefits of Hinesburg's public forest and will allow the Hinesburg Tree Warden to plan for tree maintenance and future tree planting using a map-based tree inventory tool.

This project was initiated in the spring of 2015 and was approved by Hinesburg's Tree Warden, Paul Wieczoreck. VT UFC and VT FPR staff completed an inventory of **838 trees** located within the public ROW of **17 streets** and on **6 Town-owned properties** and identified **61 potential tree planting locations**. The data collected in the inventory were checked for quality, analyzed, and interpreted by VT UCF staff. This report was prepared in the fall of 2015. It presents the results of an inventory and provides a basic assessment of the trees and urban canopy cover in the Town of Hinesburg.

Local government, town boards and committees, conservation agencies, and private landowners all play an important role in monitoring and maintaining community forests. Urban trees provide a number of benefits to a community, including reducing stormwater runoff, reducing air pollution, providing shade, sequestering carbon dioxide (CO_2), enhancing property values, and improving the aesthetics of the community. The 838 public trees that were inventoried provide an estimated **$84,811 in benefits annually** to the residents of Hinesburg. In addition to the public trees inventoried, an aerial tree canopy assessment was completed for the land area assessed in the inventory, which indicated an existing tree canopy cover of **51%** and an estimated long-term **stored CO_2 value of over $4,833,945.**

Summary of Findings

Forest Diversity

- Of the 838 public trees, there are 53 different species in 31 different genera.
- The five most common tree genera by number of trees are *Acer* (maple) at 23%, *Thuja* (cedar) at 15%, *Quercus* (oak) at 12%, *Fraxinus* (ash) at 8%, and *Malus* (apple) at 8%.
- *Acer* and *Fraxinus* species together represent 31% percent of Hinesburg's public trees. Invasive tree pests currently threaten both of these genera: the Asian long horned beetle (ALB) and the emerald ash borer (EAB), respectively.
- The five most common species are *Thuja occidentalis* (eastern white cedar) at 15%, *Acer saccharum* (sugar maple) at 11%, *Malus* species (crabapple) at 8%, *Acer rubrum* (red maple) at 8%, and *Fraxinus pennsylvanica* (green ash) at 7%.

Forest Structure

- Over half of the inventoried public trees (56%) have a diameter at breast height (DBH) measurement between 3 and 12". 12% of inventoried public trees have a DBH within the 12-18" size class and 9% of the inventoried trees have DBH measurements in the 0-3" size class.
- The remaining 22% of inventoried trees were represented in the following size classes: 18-24" (8%), 24-30" (8%), 30-36" (4%), 36-42" (1%), and 42"+ (1%).

Forest Cover

- There is an existing urban tree canopy (UTC) cover of 51% within the extent of the Hinesburg public tree inventory. This analysis was done for both public and private land within the extent of the inventory area.
- Trees could potentially cover an additional 40% of Hinesburg's land surface in its most populated area. These "possible UTC" areas include low-lying vegetation or grassland, agricultural land, and impervious surfaces (e.g. parking lots, paved playgrounds, and the ROW).

- The remaining 9% of Hinesburg's land area within the inventory extent is buildings, streets, water, and other permanent features and is generally unsuited to UTC improvement.

Forest Health

- About three quarters (640, or 77%) of Hinesburg's inventoried trees were assessed as being in "Good" condition. Of the remaining trees, 109 (13%) were considered to be in "Fair" condition, 53 (6%) were in "Poor" condition and 36 (4%) were "Dead".
- 257 trees (31%) were flagged as in need of monitoring by a Certified Arborist, the Hinesburg Tree Warden, or another qualified individual.

Tree Health and Maintenance Indicators

- As per request of the Town, the presence of the following health and maintenance indicators were assessed during Hinesburg's public tree inventory: crown dieback, decay, bark splits, stem-girdling roots, and the need for a cable or brace.
- 21% (179 public trees) of Hinesburg's community forest was assessed as having crown dieback.
- 12% (102 public trees) of Hinesburg's community forest exhibited signs of decay and/or bark splits (99 public trees).
- Less than 3% of Hinesburg's community forest exhibited signs of stem-girdling roots (26 public trees) and/or required cabling or bracing (11 public trees).
- Almost half of Hinesburg's public *Acer* (maple) trees (88) require monitoring, which represents the greatest monitoring needs of all of Hinesburg's community forest genera.

Summary of Recommendations

A healthy public tree population is contingent upon proper management, stewardship, and a municipality's commitment to understanding and maintaining its community forest. A comprehensive public tree inventory is an important piece of a vibrant community tree program, along with other components described in the Discussion and Recommendations

section of this report. Based on the results of the Hinesburg public tree inventory, our priority recommendations for the Town of Hinesburg are:

- Enhance and promote longevity of the relatively young public tree population by establishing a systematic and routine structural pruning program.
- Develop a plan to remove – and replace if appropriate – the 36 dead trees inventoried.
- Prioritize the timely assessment and, if needed, maintenance of the 257 trees that were identified as in need of monitoring by a Certified Arborist or the Hinesburg Tree Warden.

Marie Ambusk, Hinesburg resident, devoted tree steward, and coordinator of the TREEage Community Tree Nursery in South Burlington, participated in Hinesburg's public tree inventory.

Introduction

Project Description

In 2013 VT UCF received a multi-year grant from the USDA Forest Service to assist twenty priority communities in Vermont in moving their municipal tree programs forward. The project, *Care of the Urban Forest*, is an effort that aims to support these communities in three specific ways, by: (1) conducting a public tree inventory to assess community forest structure, diversity, and health; (2) helping the community in the development of an community forest management plan or strategic action plan, using information from the inventory; and (3) providing technical training for municipal employees and key volunteers to increase in-house capacity to manage, and promote the proper care, of public trees.

The Hinesburg Tree Warden and Marie Ambusk, tree steward and Hinesburg resident, were interested in partnering with VT UCF on the *Care of the Urban Forest* project to conduct a full public tree inventory of the most populated areas of the town that would be map-based and in a spreadsheet (opposed to on paper). The intent of the public tree inventory was to enable the Town of Hinesburg to better understand, steward, and manage its public trees more efficiently and cost effectively. The specific goals of Hinesburg's public tree inventory were to update the Town's current inventory information, accurately locate and assess town-owned trees within the public ROW in the most densely populated areas of town, take note of trees on private property considered a significant component of the town's tree-scape, and assess public tree maintenance needs. The complete public tree inventory was conducted over the course of four field days and will provide a foundation for future management decisions and improvements to the community forest. Additionally, benefits of tree canopy cover, such as the improvement of air and water quality and increased property value, will increase when the Town of Hinesburg is able to manage and support healthy public trees.

The Town of Hinesburg has had an active tree planting and maintenance history since the late 1990s. The Hinesburg Conservation Commission had a line item for purchasing trees for a period of about ten years and this money was used almost exclusively for tree planting within

the town under the purview of the Hinesburg's Tree Warden, Paul Wieczoreck. Tree maintenance expenses have been paid for from Buildings and Grounds budgets and through tree maintenance grants from various VT organizations (including VT UCF) over the years. Paul Wieczoreck conducted a tree inventory on paper in recent years, which included approximately 250 trees. Marie Ambusk, SOUL Tree Steward and Coordinator of the TREEage Community Nursery in South Burlington, recently moved to Hinesburg and has been promoting more involved citizen stewardship for trees in the community.

Town Profile

The Town of Hinesburg is located in Chittenden County, nestled against the edge of the Green Mountains, southeast of Burlington. Hinesburg covers a land area of approximately 40 square miles, and has a population of 4,396 people, according to the 2010 U.S. Census. Chartered in 1762 by New Hampshire Governor Benning Wentworth, Hinesburg's history is rooted in farming and early water-powered manufacturing. Hinesburg's name was derived from the name of the first Town Clerk, Abel Hine. Although chartered in 1762, it took almost twenty years for a permanent settlement to evolve, and when the first child was finally born in

Importance of Inventory and Community Forestry in Vermont

A public tree inventory establishes a record of the community-owned trees present in a municipality. An inventory can provide information about the species, size, health, maintenance needs, and location of each tree. This detailed information allows community leaders to estimate the contributions and management requirements of the trees of which it is in charge. In the event of a disease outbreak or invasive insect infestation, data from an inventory may assist in monitoring and preventing spread, as well as supporting the response to the disease or infestation. 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 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, community 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 place and contribute to keeping our communities healthier and our everyday lives more fulfilling.

1785, he was named Hine Meacham (Swift, 1977[1]). Today, the village is still surrounded by open green farmland along the LaPlatte River, despite recent significant growth resulting from nearby Burlington's sprawl. A multitude of recreation facilities are available in the Town of Hinesburg. Natural areas and parks of interest include the Lyman Meadows Park, Wainer Park, Geprag Park, the Hinesburg Town Forest, and the Lake Iroquois beach area. Originally known as Hinesburg Pond, Lake Iroquois is the most prominent body of water in town. It is believed that the name came from the Algonquian tribe, who were enemies of the Iroquois. Other notable bodies of water include Texas Brook, Patrick Brook, Lewis Creek, and the LaPlatte River (Swift, 1977[1]). The western half of Hinesburg is in the Champlain Valley, while the eastern half is in the foothills of the Green Mountains.

Methodology

To plan for the public tree inventory, VT UCF staff met and communicated with Hinesburg's Tree Warden and resident Marie Ambusk. Originally, 17 streets in Hinesburg were selected to be included in the inventory, as well as a number of priority Town-owned properties. In total, the inventoried land area was about 2.57 square miles, representing less than 7% of Hinesburg's total land area, but including the most densely populated section of town. The ROW boundaries for all streets were provided by the Hinesburg Road Foreman, in consultation with Town administration, and the Vermont Agency of Transportation. In Hinesburg, many municipally owned and managed trees were planted just outside of a street's provided ROW, but within the grass strips located in between sidewalk and the road. In these circumstances, we considered the ROW to be the far edge of the sidewalk. Otherwise, assessed public trees were included in the inventory based on the official and provided ROW boundary. The list of streets and sites with ROW boundaries is found in Appendix A and GIS maps of the inventoried trees are in Appendix E.

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[1] Swift, E.M. 1977 Vermont Place-Names: Footprints of History. Brattleboro, Vermont. The Stephen Greene Press.

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 free application *Collector for ArcGIS* for data collection and is linked to the ANR Atlas online mapping tool. All inventory data collected on public trees in Hinesburg are available for viewing on the ANR Atlas tool and instructions are included in Appendix D.

Throughout July, 2015, VT UCF staff, VT FPR State Lands Foresters, and community volunteers walked along predetermined streets and on Town-owned sites in Hinesburg, recording specific data on the public trees and identifying appropriate potential planting locations (recorded as "Vacant"). To ensure that only public trees were inventoried (as opposed to trees on private property) each inventory team had a list of the ROW boundaries for every street included in the inventory area. Upon reaching a new street, the team first determined the extent of the ROW from each curb; they measured the road width, subtracted that number from the full ROW boundary, and then divided the number in half to determine the ROW extent behind the curb on each side of the street. The following equation demonstrates this process:

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

In Hinesburg, on each given street with a sidewalk, the inventory team determined the greater of either the ROW extent or the far edge of the sidewalk, so that all trees within the grass strip between sidewalk and street were included in the inventory.

Each public tree identified was recorded into the *Collector for ArcGIS* application using an iPad, provided by VT UCF. The application 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 public tree in Hinesburg included street name, overall condition, species, diameter class (using a measurement for diameter at breast height, or DBH), a recommendation for monitoring, the presence or absence of tree crown dieback, decay, bark splits, and stem-girdling roots, the need (yes/no) of cable or brace, additional comments, and the nearest house or building address. 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.

The data were compiled and subsequently checked for quality, analyzed, and summarized using Microsoft Excel and QGIS, a free and open source geographic information system (http://www.qgis.org/en/site/). Data were also analyzed through i-Tree, a free software suite developed by the USDA Forest Service (www.itreetools.org). VT UCF staff used two applications in the i-Tree suite of tools to further assess Hinesburg's community forest. i-Tree Streets uses sophisticated models to determine the monetary value and ecological benefits of trees. i-Tree Canopy uses aerial imagery and random point locations to produce an estimate of land cover of a defined area - including tree canopy cover - that encompasses both public and private property.

Table 1. Data collection parameters for the Hinesburg public tree inventory

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.

Crown dieback	Yes: noticeable presence of dieback in tree's crown No: no noticeable presence of crown dieback in tree
Bark splits	Yes: one or more vertical splits or cracks in tree's bark is present, and/or presence of sun scale evident No: no evidence of splitting bark or sun scale on inventoried tree
Decay	Yes: noticeable decay present on inventoried tree No: no noticeable decay apparent on inventoried tree
Remove Stem-Girdling Roots	Yes: the presence of roots visibly growing in circular manner around the trees, opposed to radially out of the tree, and/or are growing over larger anchoring roots No: the above was not present or noticeable on inventoried tree
Cable or brace	Yes: if the tree should be cabled or based. Cables are used to support weak (V-shaped and in-rolled, not U-shaped or upturned) or split crotches, or heavy horizontal limbs. Bracing is the use of steal rods to provide rigid support, stabilizing weak crotches or holding rubbing limbs together or apart No: no cable or brace needed for inventoried tree
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.

Inventory Results

Community Forest Diversity

Of the 838 trees inventoried within the public ROW or on Town-owned land, there are a total of 53 different species in 31 different genera. The five most common tree genera, *Acer* (maple), *Thuja* (cedar), *Quercus* (oak), *Fraxinus* (ash), and *Malus* (apple), comprise 67% of Hinesburg's community forest (Figure 1). The five most common species are *Thuja occidentalis* (eastern white cedar) at 15%, *Acer saccharum* (sugar maple) at 11%, *Malus* species (crabapple) at 8%, *Acer rubrum* (red maple) at 8%, and *Fraxinus pennsylvanica* (green ash) at 7% (Figure 2). Complete species and genera lists can be found in Appendix B.

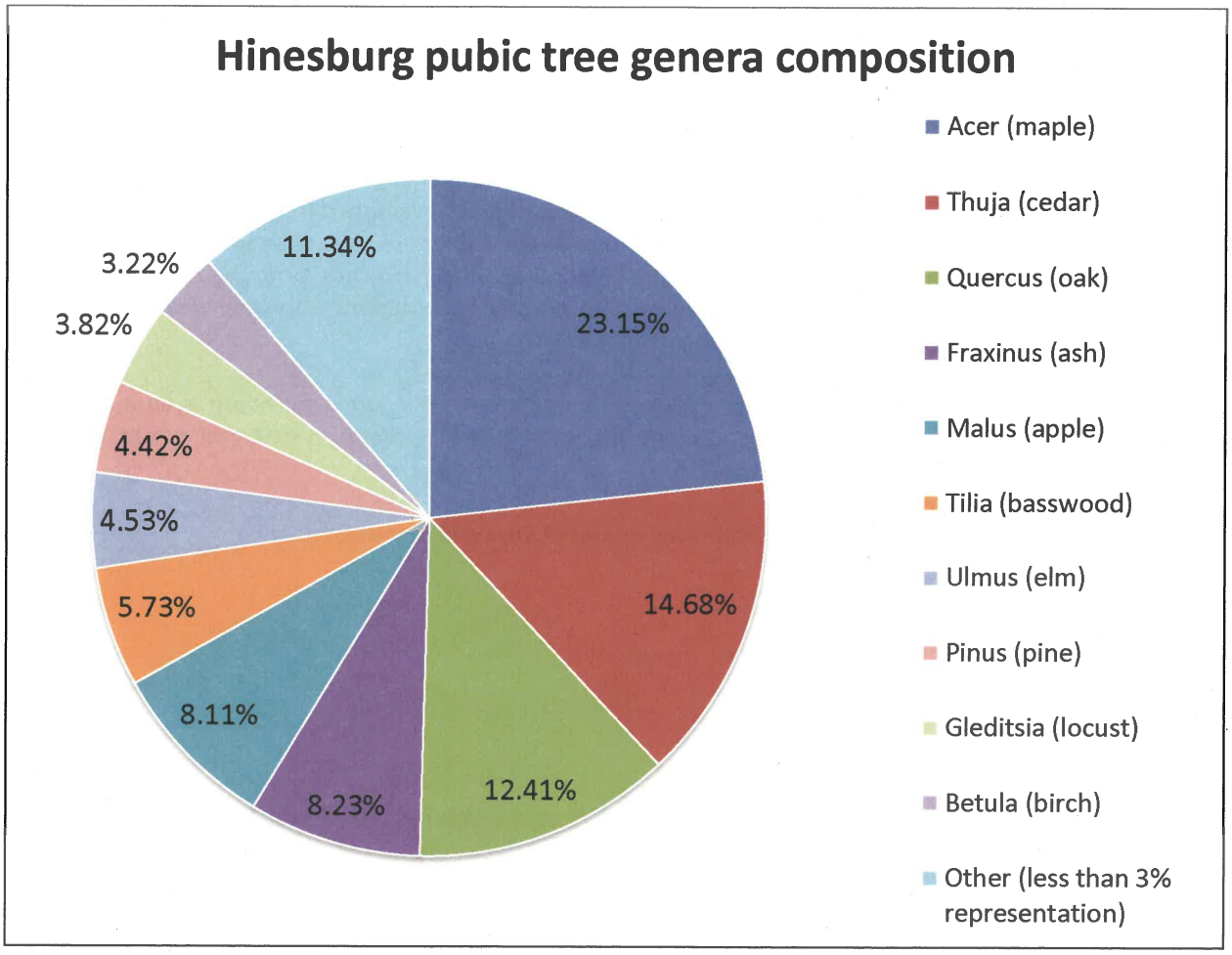


Figure 1. Most common tree genera by percent of Hinesburg's public trees.

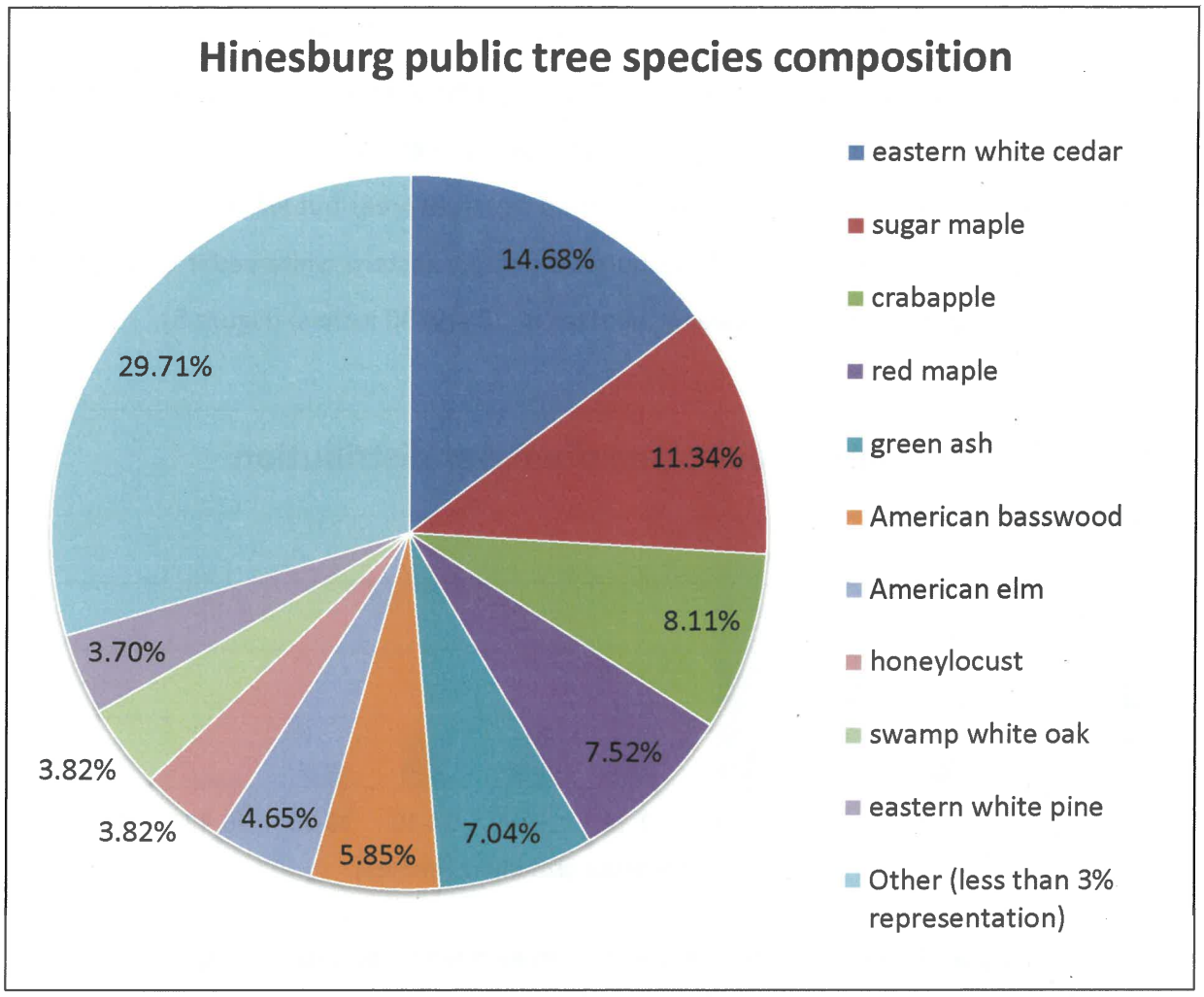


Figure 2. Most common species by percent of Hinesburg's public trees.

Community Forest Structure

In descending order by percent size class, the diameter distribution represented by Hinesburg's public trees is: 33% (280) at 6-12", 23% (194) at 3-6", 12% (104) at 12-18", 9% (77) at 0-3", 8% (66) at 24-30", 8% (63) at 18-24", 4% (31) at 30-36", 1% (12) at 36-42", and 1% (11) at 42+" (Figure 3). Thus, approximately 69% of inventoried public trees are between 3 and 18 inches, indicating a relatively young community forest.

The composition of genera and species within each of these size classes (Figures 4 and 5) indicates that *Acer* (maple) is most commonly represented in all size classes, which is likely because the genus comprises nearly a quarter of all Hinesburg's inventoried public trees. The

three largest size classes represented, 30-36", 36-42", and 42+" contain a total of 54 trees (approximately 6% of the community forest). The majority of inventoried trees within these large size classes are sugar maples (Figure 5). 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 community has grown. Planted in the Hinesburg Cemetery, eastern white cedar comprises the majority of maturing public trees (between the sizes of 18 and 30 inches) (Figure 5).

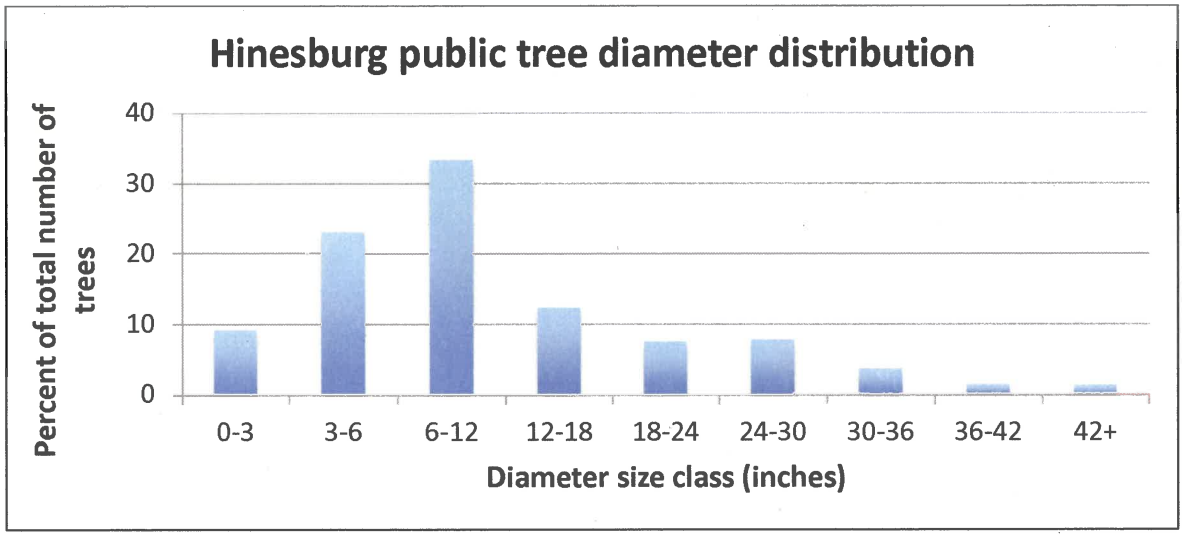


Figure 3. Percent of trees represented in each diameter class (inches).

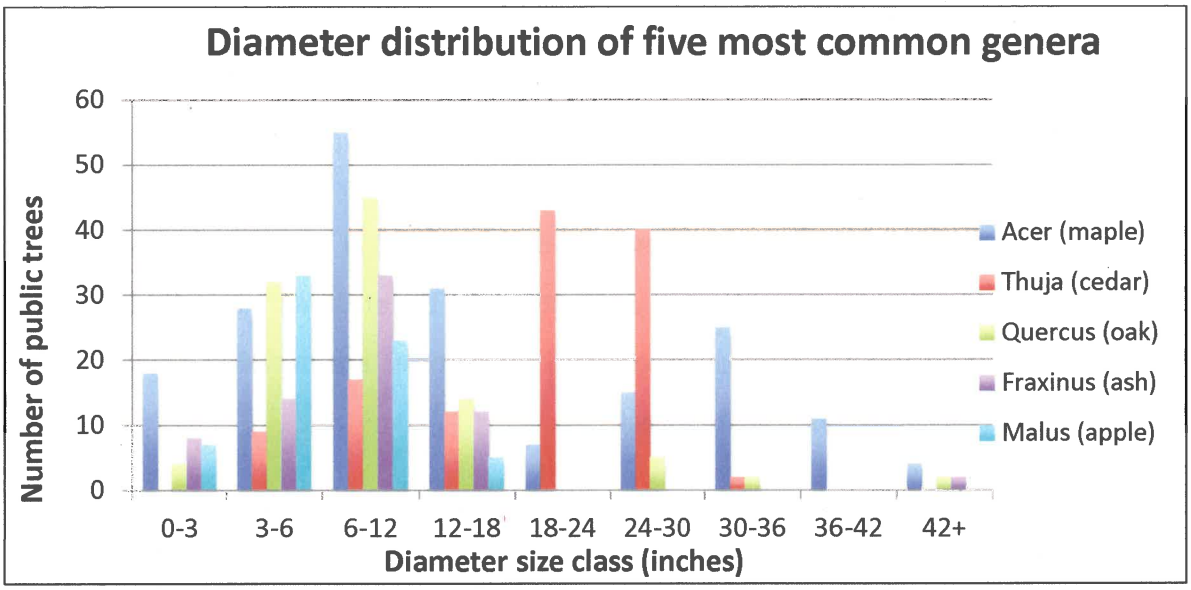


Figure 4. Diameter distribution for the five most common genera of Hinesburg's public trees.

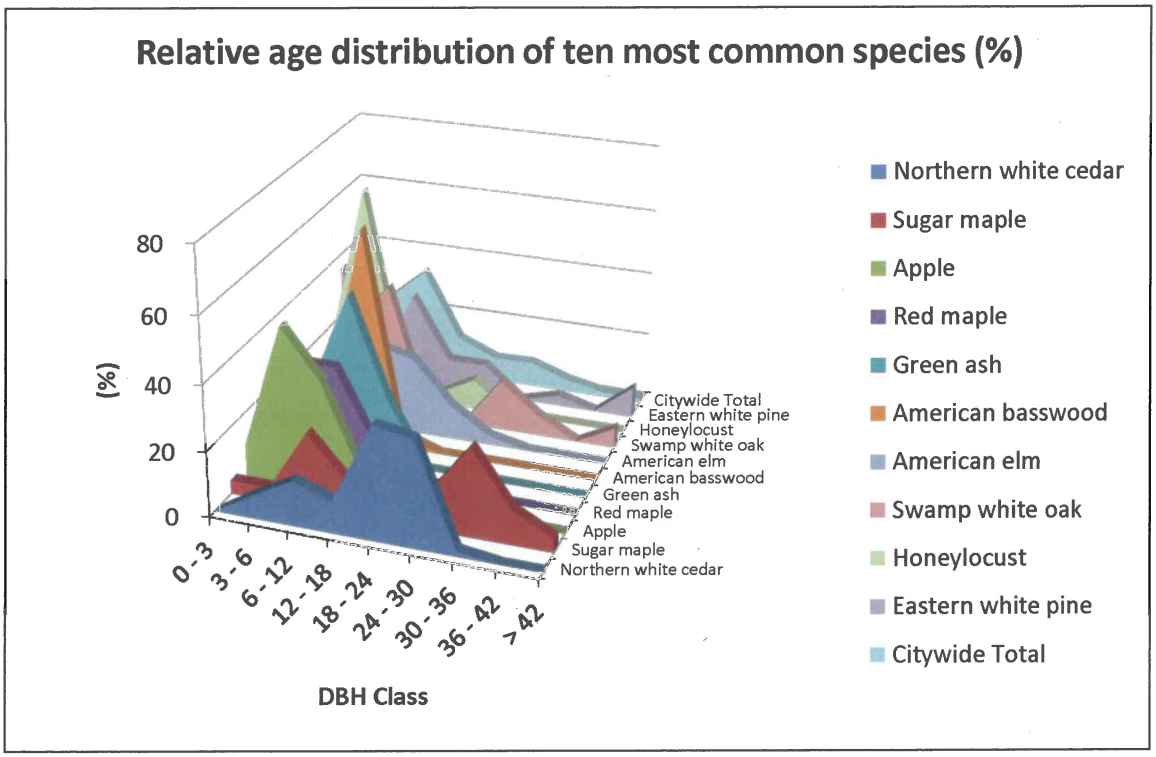


Figure 5. Diameter (and age) distribution of the ten most common species of Hinesburg's public trees. Data from this figure were derived from i-Tree Streets urban canopy structure output.

61 potential tree planting locations or strips were identified within the public ROW (recorded as "Vacant"); Appendix A breaks down these locations by street. Of the inventoried streets and sites, Hinesburg Community School and CVU Road offer the most vacant spots for tree planting. Additional consultation of these sites is necessary to plant a tree of appropriate size and species.

Community Forest Health

About three quarters (77% or 640) of Hinesburg's inventoried public trees are assessed as being in "Good" condition. Of the remaining trees, 109 (13%) are considered to be in "Fair" condition, 53 (6%) are in "Poor" condition, and 36 (4%) are "Dead" (Figure 6). *Acer* (maple) and *Thuja* (cedar) had the most trees in fair or poor conditions; however, these genera also comprise the highest percentage of inventoried trees. Identifiable dead trees were primarily *Acer* (maple), *Thuja* (cedar), and *Fraxinus* (ash) (Figure 7). Appendix E includes maps detailing the location of inventoried trees by condition.

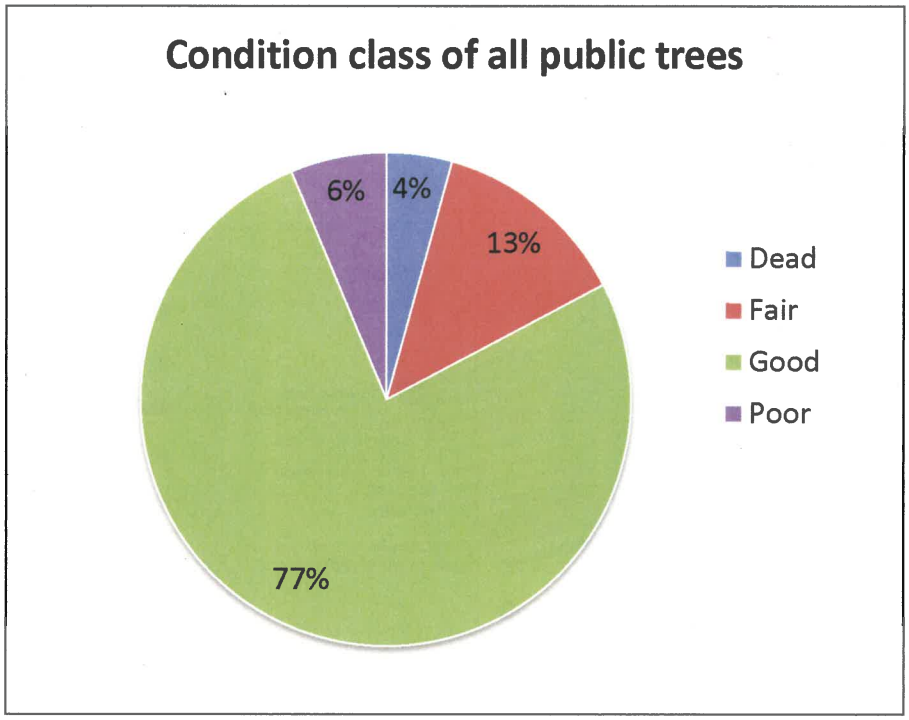


Figure 6. Percentage of public trees in each condition class.

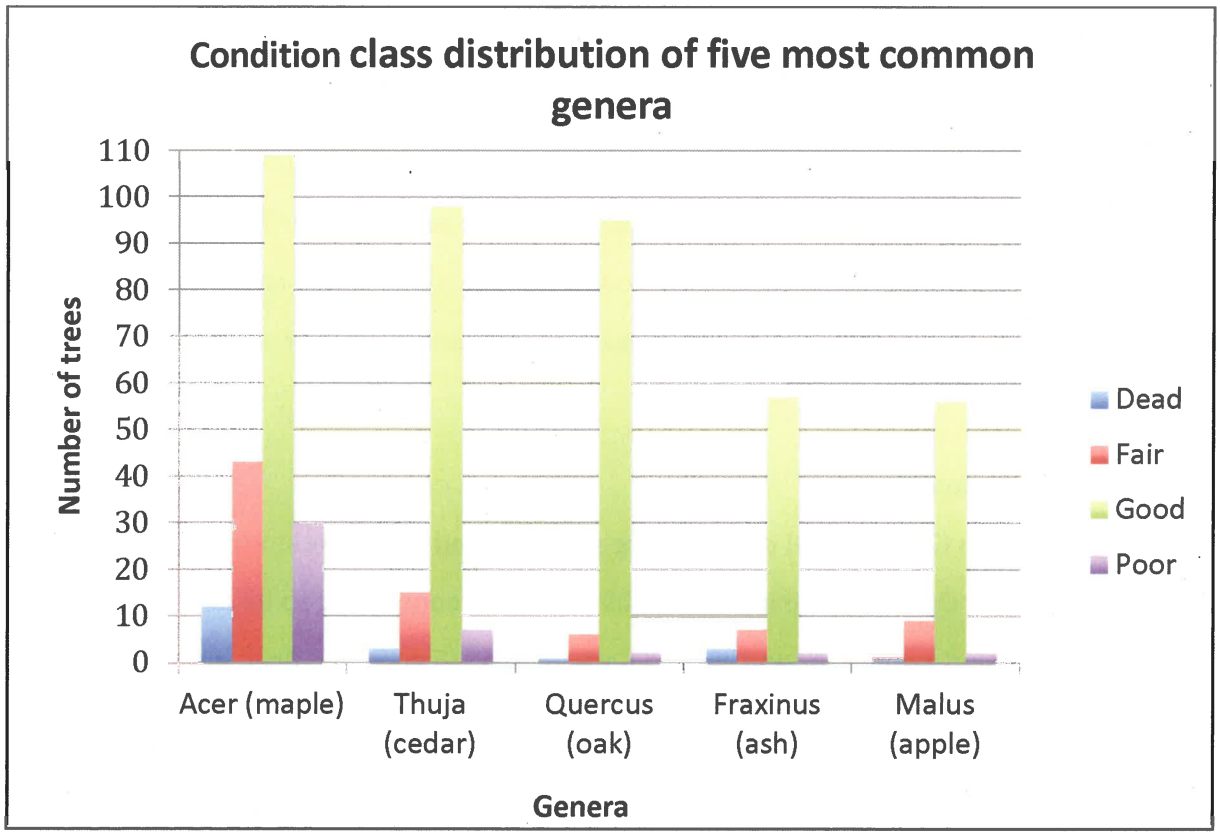


Figure 7. Number of public trees within the five most common genera displayed according to condition.

In conducting the inventory, VT UCF and VT FPR staff flagged 257 trees (31%) as in need of monitoring. These trees should be reassessed by a Certified Arborist, the Hinesburg Tree Warden, or another qualified individual in a timely matter. Trees that were flagged as in need of monitoring expressed one or more of the following conditions:

- The tree has a defect affecting >40% of the tree,
- The tree poses a hazard to people/infrastructure/cars,
- The tree is growing into utility wires,
- The tree is dead or in poor condition, or
- The tree is an ash (*Fraxinus*) and shows 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).

Tree Health and Maintenance Indicators

Although Hinesburg's public trees are generally healthy (77% assessed as in "good' condition), proper maintenance and monitoring is required to promote the health, longevity, and benefits of Hinesburg's community forest. To better understand the specific maintenance and monitoring needs of Hinesburg's public trees, the Town requested VT UCF staff assess the presence (or absence) of crown dieback, decay, bark splits, stem-girdling roots, and the need for cabling or bracing for each inventoried tree (Figure 8). The Hinesburg Tree Warden, a Certified Arborist, or a relevant public official should therefore keep a keen eye on any public tree assessed with the observed health (e.g., crown dieback, decay, bark splits, and stem-girdling roots) or required maintenance (e.g., cable/brace) characteristics.

Of the assessed health characteristics, crown dieback is most prevalent in Hinesburg's community forest, as it was observed in nearly a quarter (21% or 179) of inventoried public trees. Maple species comprise the majority (72) of trees with crown dieback. In fact, inventoried sugar maples represent half of the public trees with crown dieback. Decay was observed in about 12% (102) of Hinesburg's public trees. Similarly, bark splits were found on about 12% (99) of inventoried trees (Figure 8). Sugar maples also comprise the greatest amount

of inventoried trees with evident decay and bark splits within Hinesburg's community forest. Moreover, almost half of Hinesburg's public maple trees (88, most of which are sugar maple) require monitoring (Figure 9). Less than 3% of Hinesburg's community forest exhibit signs of stem girdling roots (26 public trees) and/or require cabling or bracing (11 public trees) (Figure 8). About half of the public trees requiring a cable or brace (5 trees) are located in the Hinesburg Town Cemetery.

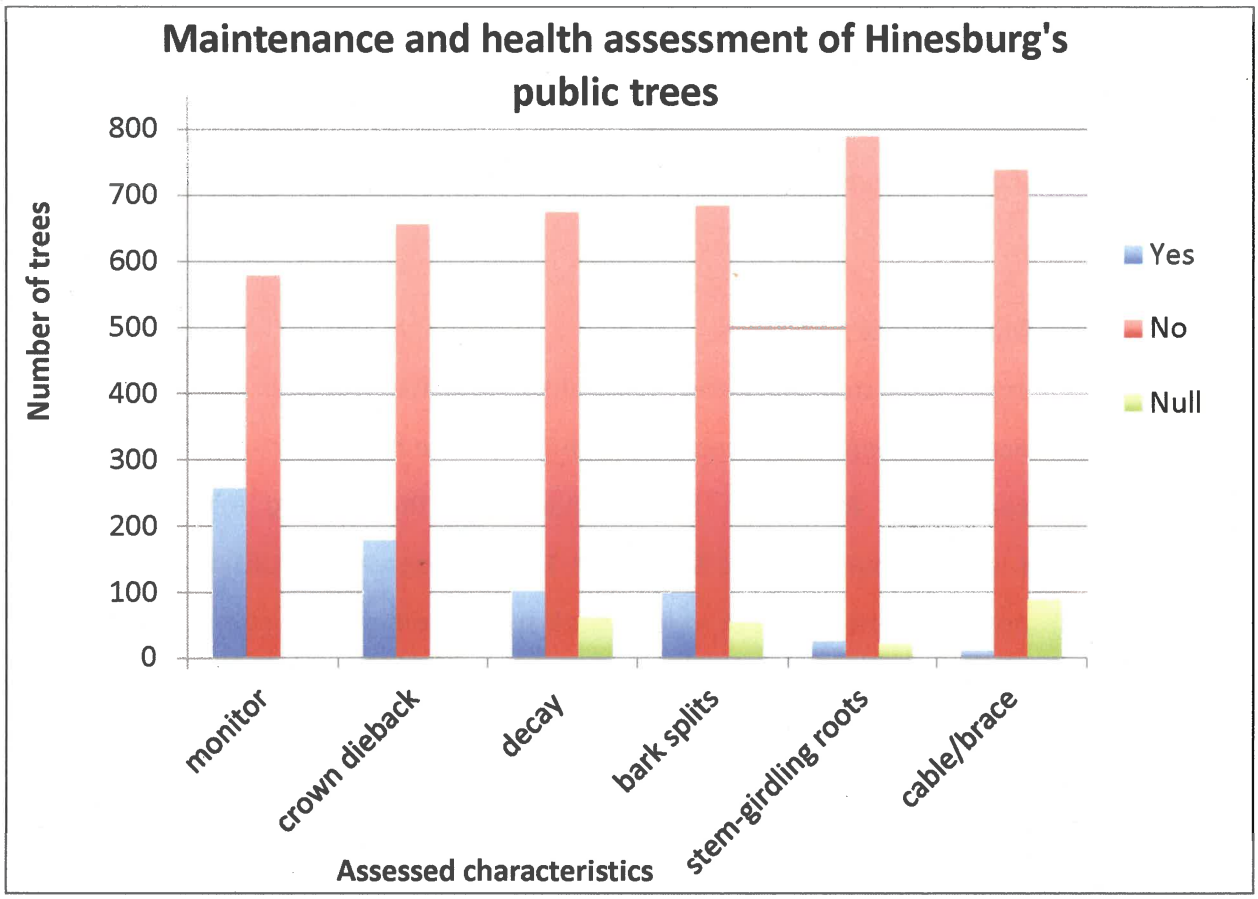


Figure 8. The number of Hinesburg's inventoried public trees assessed as having presence or absence of town-specific maintenance and health characteristics. Null values represent the number of unassessed trees, and thus indicate user error. Refer to Table 1 for descriptions of each assessed characteristic.

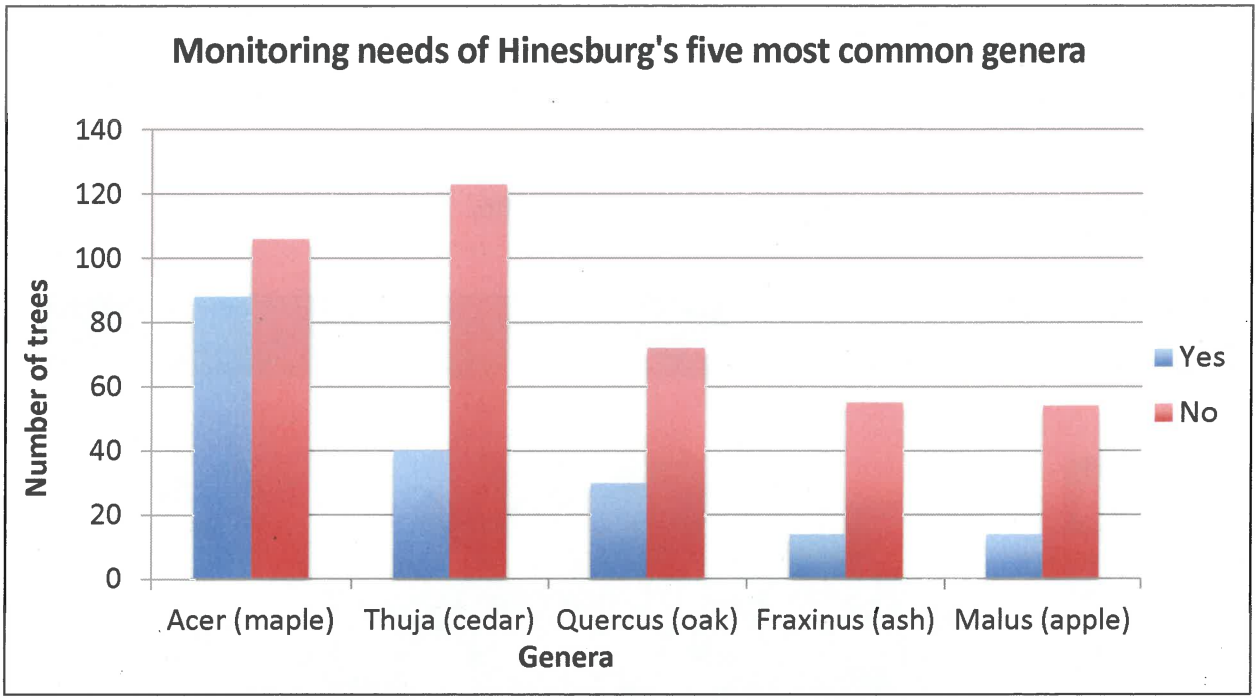


Figure 9. The number of Hinesburg's inventoried public trees assessed to require monitoring (yes) within the town's five most common genera.

Economic Benefit and Ecosystem Services

The Hinesburg public tree inventory data were analyzed using the online tool i-Tree Streets to determine the monetary value of the ecosystem services provided by Hinesburg's public trees. The 838 trees provide a total of $84,811.01 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 $101.21 annually in savings or services.

Figure 10 and Table 2 provide an overview of each ecosystem service provided by Hinesburg's public trees. Energy conservation and property value increase are the most significant services provided by these trees in terms of their monetary value (Figure 10). The full reports produced through the i-Tree Streets program for Hinesburg are available from VT UCF upon request.

It is important to recognize that the trees inventoried through this project are located on approximately 3 square miles of Hinesburg's approximate 40 square miles of total land area.

Expanding the inventory to all of Hinesburg's roads would increase these figures dramatically. It is also noteworthy that larger and long-lived trees provide substantially more benefits than small and young trees. Regular maintenance and care are needed to provide for public tree health, longevity, and maximized community forest benefits.

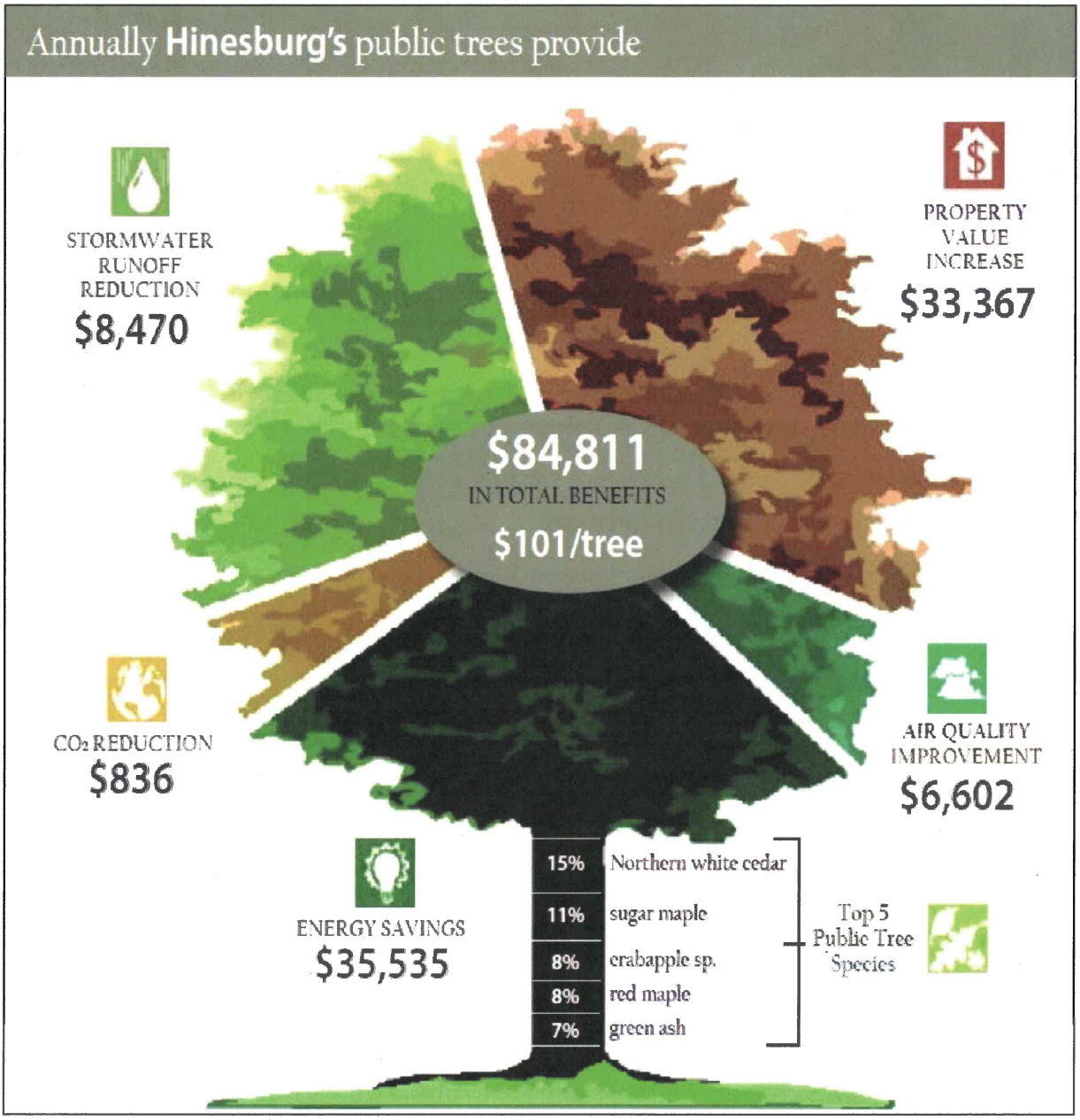


Figure 10. Summary of the benefits provided by Hinesburg's public trees inventoried through this project, according to the i-Tree Streets assessment. Tree graphic concept courtesy of City of New York Department of Parks & Recreation.

Table 2. Annual environmental and monetary benefits provided by Hinesburg'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	$35,535	$ 42.40
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.	$836	$ 1.00
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.	$ 6,602	$ 7.88
Stormwater	Reductions in annual stormwater run-off due to rainfall interception by trees.	$8,470	$ 10.11
Aesthetic/other	Tangible and intangible benefits of trees reflected in increases in property values.	$ 33,367	$ 39.82
Stored carbon dioxide	Tallies all of the carbon dioxide stored in the community forest over the life of the trees as a result of sequestration; *not an annual benefit but a cumulative benefit.	$ 9,738.46*	$ 11.62*

Providing an average of $35,535 annually in energy cost benefits, Hinesburg's community forest's most significant analyzed economic benefit is energy conservation (Figure 10). The

greatest energy cost savings from the town's public trees is in the form of natural gas (versus electricity). Of all of Hinesburg's inventoried species, sugar maple and eastern white cedar provide the greatest net annual reduction in energy costs (Figure 11). This is likely partly because these species also have the greatest leaf area (ft^2, Appendix C) of all inventoried species, and thus provide the most shade and temperature regulation. Furthermore, the ten most beneficial energy conservation species are broadleaved (Figure 11), as their leaf area likely maximizes shade and energy regulation compared to needle-leaved species. It is important to note, however, that these values are derived from species, diameter class (inches), and condition class inventory data. Sugar maples and eastern white cedars are the most prevalent species in larger diameter (i.e., age) classes (Figure 5), and are thus providing the greatest annual net reduction in energy costs for the Town of Hinesburg.

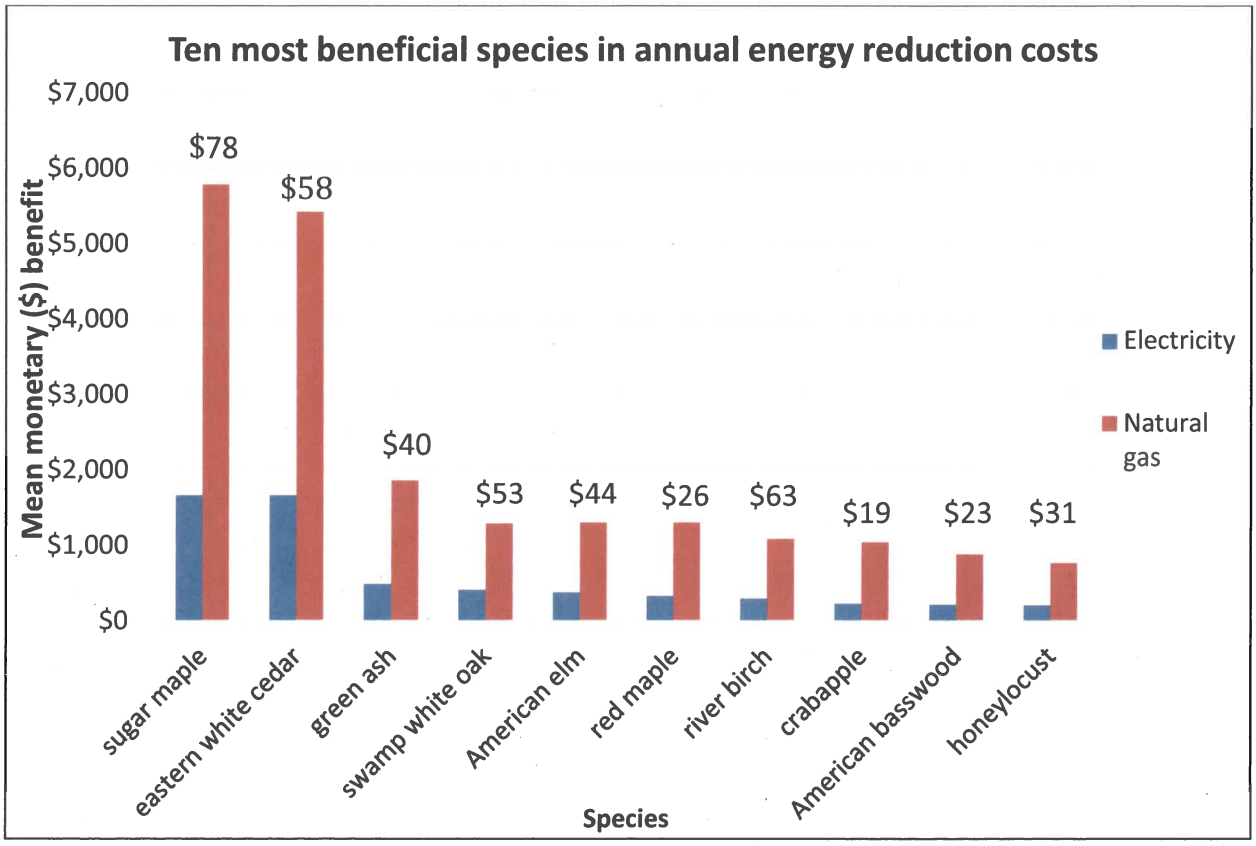


Figure 11. The average monetary value of the ten most beneficial species in annual energy reduction costs in Hinesburg's community forest. The monetary values located above each species' bar represents the average annual energy reduction benefit ($) per tree. Monetary values were derived from tree species, diameter (inches), and condition inventory data through i-Tree Streets' urban canopy benefits output.

Of all the species inventoried in Hinesburg's community forest, willow trees provide the greatest net annual reduction in stormwater costs of about $36 per tree (Figure 12). Only two willow trees were included in Hinesburg's public tree inventory, so this relatively high monetary stormwater reduction benefit is attributable to their large size (both 30-42" in diameter) and healthy condition. American beech and sugar maple, the second and third most beneficial species in annual stormwater reduction costs, save about $27 and $26 per tree each year. Of the ten most beneficial species in reducing Hinesburg's annual stormwater runoff, seven are deciduous trees and only three are coniferous (Figure 12).

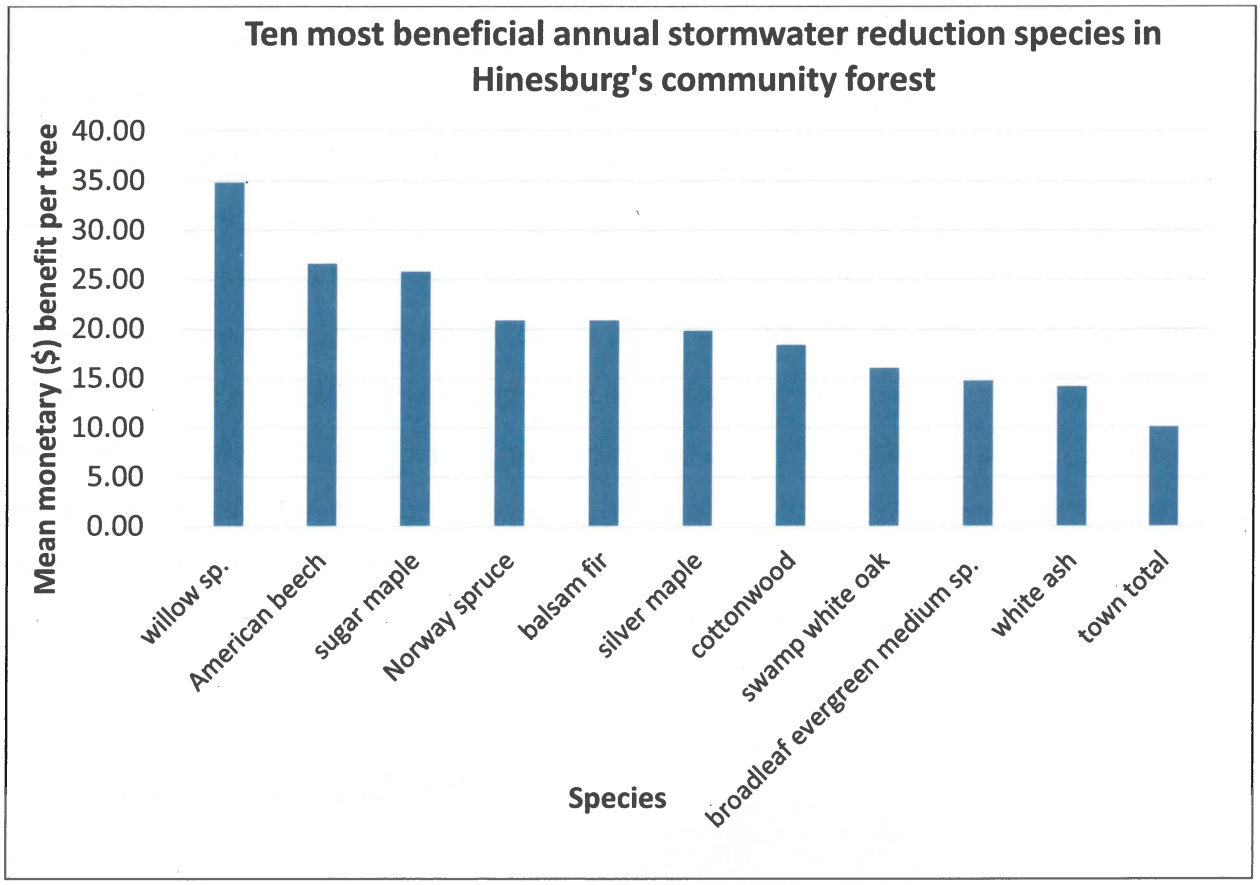


Figure 12. The average annual monetary value of the ten most beneficial stormwater reduction tree species in Hinesburg's community forest. Monetary values were derived from tree species, diameter (inches), and condition inventory data through i-Tree Streets' urban canopy benefits output.

Hinesburg Canopy Assessment

As a complement to the public tree inventory, VT UCF staff completed an i-Tree Canopy assessment for Hinesburg. 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. Like i-Tree Streets, this 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 Hinesburg's i-Tree Canopy assessment, approximately 51% of Hinesburg's land area within the inventory extent is currently occupied by tree canopy (Figures 13 and 14). Currently 2% of the total area is occupied by buildings, and is not suitable for tree planting (although this is likely a higher percentage in the downtown area). In consideration of the other land cover types present, Hinesburg could potentially increase its total tree canopy cover in its most populated area by an additional 22% on open lands of low-lying vegetation, and 15% on agricultural lands. 5% of the land is water or wetlands, which while not suitable for tree planting provides many other benefits. The remaining 4% is impervious surface (parking lots, playgrounds, roads and the ROW), but with strategic planning initiative, some of this could be converted to canopy. In total, there is currently potential to increase Hinesburg's overall tree canopy cover by 40%, though a portion of this land is privately-owned and/or used for other purposes such as agriculture (Figure 13).

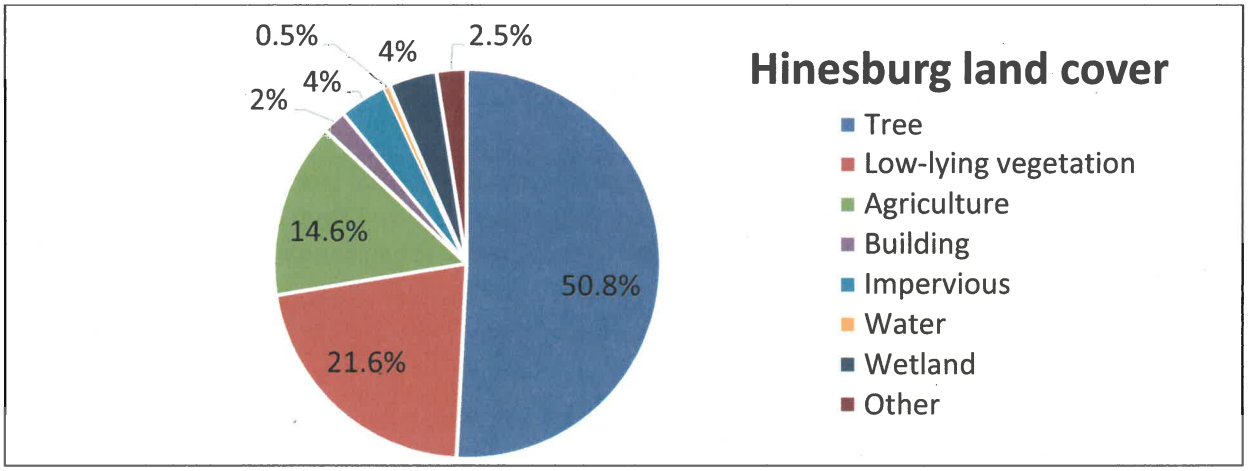
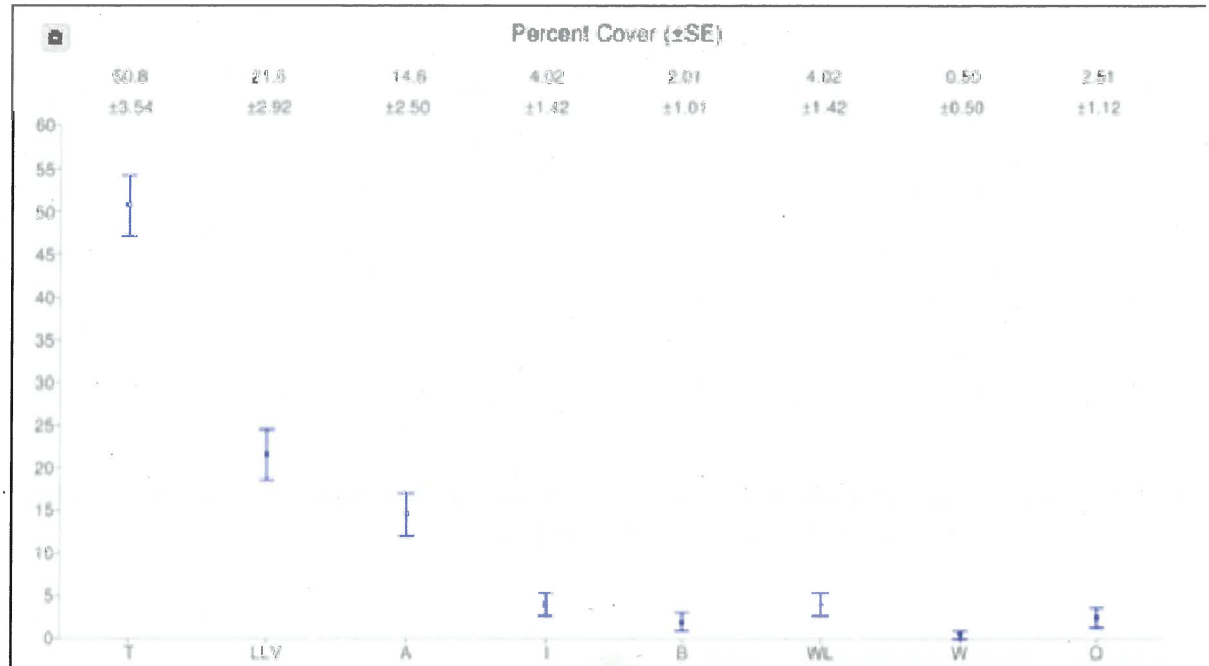


Figure 13. Land cover of Hinesburg (includes public and private land).



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	101	50.8 ±3.54
Low lying vegetation		LLV	43	21.6 ±2.92
Agriculture		A	29	14.6 ±2.50
Impervious		I	8	4.02 ±1.42
Building		B	4	2.01 ±1.01
Wetland		WL	8	4.02 ±1.42
Water		W	1	0.50 ±0.50
Other		O	5	2.51 ±1.12

Figure 14. i-Tree Canopy assessment for the inventory area of Hinesburg, including both public and private land. The above image shows the ground cover composition distribution.

Figure 15 (below) compliments the i-Tree Streets analysis of the monetary value of benefits provided by Hinesburg's public trees by estimating the air quality benefits and corresponding monetary value of the full community forest canopy. Of note is an estimated $4,833,945 in CO_2 storage and $191,700 in annual CO_2 sequestration value.

Tree Benefit Estimates

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$40.62	±2.84	958.27 lb	±66.91
NO2	Nitrogen Dioxide removed annually	$69.94	±4.88	2.61 T	±0.18
O3	Ozone removed annually	$3,642.07	±254.32	26.02 T	±1.82
PM2.5	Particulate Matter less than 2.5 microns removed annually	$7,528.84	±525.72	1.26 T	±0.09
SO2	Sulfur Dioxide removed annually	$12.22	±0.85	1.65 T	±0.11
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$2,644.05	±184.63	8.72 T	±0.61
CO2seq	Carbon Dioxide sequestered annually in trees	$191,700.49	±13,385.94	5,298.21 T	±369.96
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$4,833,945.45	±337,541.80	133,584.30 T	±9,327.84

Figure 15. i-Tree Canopy assessment estimates of air quality benefits provided by public and private trees in the area of the Hinesburg public tree inventory.

Discussion and Recommendations

Hinesburg's Public Tree Program

Hinesburg's participation in the *Care of the Urban Forest* demonstrates that there is local capacity and desire to enhance the community's public tree program. Hinesburg has an active Tree Warden, residents who are passionate about trees, and a history of volunteer tree plantings to enhance streetscapes and recreational spaces in town. The 2015 public tree inventory and this report lay a foundation for better understanding the management needs and value of Hinesburg's public trees, as well as the ways in which residents and Town leadership can be engaged in tree stewardship.

Recommendations

We recommend that Hinesburg consider the following points to continue to develop its public tree program:

- Develop a public tree management plan or action plan based on this inventory report to prioritize goals and establish a timeline for Hinesburg's public tree program.
- Form a Hinesburg Tree Committee or Board to coordinate and implement the Town's tree program
- Advocate for an explicit and regular annual budget for maintenance, planting, and removal of Hinesburg public trees.

- Encourage citizens to participate in tree planting and other stewardship activities; particularly because of the high populations of trees in the *Acer* (maple) and *Fraxinus* (ash) genera, residents should be aware of the signs and symptoms of emerald ash borer (EAB) and Asian long horned beetle (ALB) and empowered to monitor for these invasive forest pests.
- Plan for the arrival of EAB by developing a community invasive forest pest preparedness plan; this process will inform future planning efforts for other threats to the community forest.
- Ensure that those who are caring for Hinesburg's public trees are trained in best tree care practices. All public trees should be structurally pruned to promote long-term integrity, newly-planted trees should be irrigated to promote proper establishment, mulch should be applied properly, and mechanical and compaction damage should be minimized during any construction or regular maintenance activities.
- Establish a routine and systematic pruning cycle (multi-year) for all public trees to reduce the occurrence of branch failures due to poor structure, minimize conflicts with people and infrastructure, improve lines of sight, reduce storm damage, and protect public safety.
- Communicate about the benefits of Hinesburg's public trees at local events and to local leadership, and encourage citizen participation in VT UCF educational programming, such as the Stewardship of the Urban Landscape course, our winter webinar series, the annual VT Tree Stewards Conference, and the Forest Pest First Detector trainings.
- Encourage residents to plant trees on their private property to increase diversity, overall canopy cover, and the benefits provided by trees in Hinesburg.

Community Forest Diversity and Structure

An important best management practice in community 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, *Acer*) in a tree population and no more than 10% of one species (for example, *Acer saccharinum*). Resistance to disease and insect infestation is one of the many reasons that diversity of public trees is of paramount concern. A more diverse

forest is more resistant to environmental stressors, and can therefore remain healthy and resilient in the face of change. Furthermore, by maintaining greater diversity a community can prevent a rapid loss of canopy due to insect and disease issues.

In Hinesburg, 53 species and 31 genera are represented as public trees, indicating diversity in the community forest. Approximately a third of the public trees are of species that represent less than 3% of the total tree population. A quarter (23%) of public trees inventoried is in the maple (*Acer*) genus, which is over the recommended representation within the public tree population. Sugar maple and red maple comprise 11% and 8% of *Acer* species diversity, respectively. Sugar maple is the second most prevalent species in Hinesburg. Ash trees (*Fraxinus*) comprise 8% of Hinesburg's public tree canopy. Both ash and maple trees are currently threatened by invasive tree pests; EAB and ALB, respectively. While neither of these pests has been discovered to-date in Vermont, the largest ALB infestation in North America is just 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. High-density stands of ash were observed at Hinesburg Community School at the perimeter of the playing field, and large

Components of a Managed, Vibrant, and Resilient Public Tree Program

A successful community 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 community 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 community 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 community 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.

densities of maple were observed in the Hinesburg Town Cemetery during the inventory. In fact, maple trees comprise 25% of the Hinesburg Town Cemetery, while eastern white cedars comprise 47% the cemetery. The cedars in the cemetery line the roads and pathways, defining the character of the space. The overall lack of species diversity in Hinesburg Town Cemetery, however, limits the area's resilience to natural disturbances, insects, and disease.

Over two-thirds of the inventoried public trees are 3-18" in diameter, indicating an overwhelmingly young tree population. The context of Hinesburg's rural, farming history and the recent decades of increased development in town may provide insights as to the absence of large, mature shade trees; those that do exist in town are concentrated near the heart – and oldest part – of the village. The large population of eastern white cedars at the Hinesburg Town Cemetery represent a significant portion of the public trees over 18" in diameter, indicating that these were likely planted in this public space long before the current era of volunteer tree plantings in Hinesburg.

Recommendations:

We recommend that Hinesburg continues to develop its species and structural diversity by:

- Planting new species and increasing the number of lesser represented species in order to promote long-term health and resilience of individual trees and Hinesburg's overall tree population. Refer to VT UCF's Tree Selection Guide at vtcommunityforestry.org/resources/tree-care/tree-selection.
- Due to the high number of existing maple (*Acer*) trees in Hinesburg, we suggest selecting non-maple trees for future plantings.
- Existing ash (*Fraxinus*) trees should be regularly monitored for signs and symptoms of EAB and new ash trees should not be planted.
- For future tree plantings in the Hinesburg Town Cemetery, focus on increasing species diversity.

- Refer to the list of 61 identified potential tree planting locations ("vacant" spots) within the public ROW in Appendix A to strategically increase tree species and structural diversity in Hinesburg.
- Over the past decade the Hinesburg Tree Warden, Conservation Commission, and citizen volunteers have planted many young trees; as these trees mature, promote their health with a systematic structural pruning and maintenance cycle.

Community Forest Health

Overall, Hinesburg appears to have a healthy population of public trees; a dedicated tree care budget and established maintenance program would further increase the health of the community forest. Approximately 19% (162) of Hinesburg's public trees were either considered to be in "Fair" or "Poor" condition and 36 trees were designated as "Dead". There are high concentrations of "Fair", "Poor", and "Dead" trees in Hinesburg's inventoried greenspaces, such as the Hinesburg Town Cemetery, Lyman Meadows Park, and within the public ROW of Route 116, concentrated just north and south of the village. 257 trees were flagged to be revisited by a Certified Arborist, the Tree Warden, or another qualified individual. Many of these trees overlap with those designated as in "Poor" condition or "Dead", and others were likely noted because of conflict with utility wires or other infrastructure. Some trees, however, might require monitoring as a result of the presence of crown dieback, decay, bark splits, stem-girdling roots, and/or the need for cabling or bracing (Figure 8). See Appendix E for a map detailing the locations of trees in Hinesburg by condition and a map indicating the location of the 257 trees requiring monitoring. Low soil volume and fertility, soil compaction, exposure to road salt spray, root damage, mechanical damage to the stem, and improper pruning and planting are some of the contributing factors that may lead to decreased tree health in an urban setting. The full inventory data spreadsheet, with specific comments associated with the 257 trees requiring monitoring will be given to the Hinesburg Tree Warden; some recurring themes from these comments are presented in the recommendations below.

Recommendations:

In order to ensure the long-term health and vibrancy of Hinesburg's public trees, we recommend the following activities:

- Prioritize the monitoring of the 257 trees (which include the 36 dead trees) that have been flagged for monitoring by a Certified Arborist or the Hinesburg Tree Warden.
- Develop a plan to remove – and replace, if appropriate – the 36 dead public trees in a timely fashion.
- Encourage a culture of continual monitoring and updating the tree inventory spreadsheet as necessary as regular tree maintenance occurs in Hinesburg.
- Along the pedestrian and bike path on Mechanicsville Road, the beaver guards that are wrapped around many of the trees' trunks are too tight and need to be loosened to prevent trunk girdling.
- The mulch around the base of the trees planted in association with the new housing development on Mulberry lane is mounded too high – volcano mulched – and should be addressed.
- Stakes on all newly planted trees should be removed within a year of planting so that the trees can establish proper taper and root development.

Assessment Tools

Using free and accessible i-Tree software developed by the USDA Forest Service, we were able to assess the benefits, value, and extent of Hinesburg's urban tree canopy. i-Tree Streets allowed us to determine the economic value of the ecosystem services provided by the 838 inventoried trees in Hinesburg. The Town's public trees generate about $84,811 annually through the benefits of air quality improvement, carbon storage, electricity and natural gas, aesthetics, and storm water control; on average, each tree offers approximately $101 in service or savings every year. The trees of Hinesburg provide services to the city in the following ways:

- **Aesthetics**: 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[2]). In economic terms, presence of – particularly mature - shade trees can significantly increase property value. There are numerous health benefits associated with the mere presence of trees. For example, hospital patients with window views of trees have been shown to recover faster than patients without such views (Ulrich 1984[3]).
- **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, mitigating the need for heating of buildings in the winter and cooling in the summer.
- **Stored carbon and sequestered carbon dioxide**: Trees store carbon in their tissues as they accumulate biomass over time; an estimated 770 million tons of carbon, valued at $14.3 billion, is stored in the public forests in the contiguous United States store 770 million tons of carbon, (Nowak and Crane 2002[4]). Trees also mitigate greenhouse gas emissions by sequestering carbon dioxide through the process of photosynthesis.
- **Storm water run-off**: Trees and soil improve water quality and reduce costs associated with stormwater 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.

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[2] Dwyer, J.F., H. W. Schroeder, and P. H. Gobster. (1991). The significance of urban trees and forests: toward a deeper understanding of values. *Journal of Arboriculture,* 17: 276-284.

[3] Ulrich, R.S. (1984). View through a window may influence recovery from surgery. *Science,* 224:420-421.

[4] Nowak, D.J.; D. E. Crane. (2002). Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution* 116(3): 381-389.

Recommendations

We recommend that Hinesburg explore the results of the two i-Tree assessments detailed in this report and:

- Use the information generated through i-Tree Streets and i-Tree Canopy to promote the understanding of tree benefits and the investment in community forest management and local stewardship.
- Explore the other free assessment tools in the i-Tree tools suite (www.itreetools.org).

Conclusion

Trees in our downtowns and densely populated 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 Hinesburg to understand, manage, and steward its public tree population. The recommendations outlined in this report are based on the VT UCF staff's observations and data analysis combined with their experience and evaluation; they should be considered by Hinesburg leadership and the Town Tree Warden based on long-term vision and capacity. Looking ahead, the Town of Hinesburg should focus efforts on maintaining the quality of the urban trees. With improved monitoring, regular maintenance, and an engaged and informed citizenry, the potential for a healthy, sustainable community forest is attainable.

Appendices

Appendix A: Full Street and Site List of Hinesburg's Public Tree Inventory

Street/site name	ROW Extent (feet)	Number of trees	Number of vacant spots or strips
Route 116	66' from Shelburne Falls Road to Silver Street; 49.5' from Silver Street to Buck Hill Road	161	5
Silver Street	49.5	10	0
Charlotte Road	49.5	10	1
Mechanicsville Road	49.5	89	7
Commerce Street	49.5	47	4
Farmall Drive	49.5	82	1
Frederic Drive	49.5	23	3
Ballards Corner Road	49.5	14	0
CVU Road	49.5	1	14
Mulberry Lane	49.5	19	0
Stella Road	49.5	14	0
Greenspace: parks: Carpenter-Carse Library, Police and Fire Department, Treasurers Office, Lyman Meadows, and Hinesburg Community School	N/A	152	0
Hinesburg Town Cemetery (Off of Mechanicsville Road, near intersection with CVU Road)	N/A	216	26
The following streets were either inventoried and had zero trees located within its public ROW, or were not inventoried due to time restraints and should be revisited in future inventories: Shelburne Falls Road, Hawk Lane, Thorn Bush Road, Village Heights Road, Lyman Park Road, and Friendship Lane.			

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

Common name	Scientific name	Number of trees	% of total population
eastern white cedar	*Thuja occidentalis*	123	14.68%
sugar maple	*Acer saccharum*	95	11.34%
crabapple	*Malus sp.*	68	8.11%
red maple	*Acer rubrum*	63	7.52%
green ash	*Fraxinus pennsylvanica*	59	7.04%
American basswood	*Tilia americana*	49	5.85%
American elm	*Ulmus americana*	39	4.65%
honeylocust	*Gleditsia triacanthos*	32	3.82%
swamp white oak	*Quercus bicolor*	32	3.82%
eastern white pine	*Pinus strobus*	31	3.70%
white oak	*Quercus alba*	23	2.74%
river birch	*Betula nigra*	22	2.63%
northern red oak	*Quercus rubra*	20	2.39%
bur oak	*Quercus macrocarpa*	19	2.27%
Norway maple	*Acer platanoides*	14	1.67%
blue spruce	*Picea pungens*	12	1.43%
silver maple	*Acer saccharinum*	12	1.43%
common hackberry	*Celtis occidentalis*	11	1.31%
boxelder	*Acer negundo*	10	1.19%
white ash	*Fraxinus americana*	10	1.19%
pear	*Pyrus sp.*	9	1.07%
northern catalpa	*Catalpa speciosa*	6	0.72%
oak	*Quercus sp.*	6	0.72%
pine	*Pinus sp.*	6	0.72%
serviceberry	*Amelanchier sp.*	6	0.72%
broadleaf deciduous small	N/A	5	0.60%
Japanese tree lilac	*Syringa reticulata*	5	0.60%
broadleaf deciduous medium	N/A	4	0.48%
cottonwood	*Populus deltoides*	4	0.48%
katsura	*Cercidiphyllum sp.*	4	0.48%
pin oak	*Quercus palustris*	4	0.48%
sycamore	*Platanus occidentalis*	4	0.48%
gingko	*Gingko biloba*	3	0.36%

mulberry	*Morus sp.*	3	0.36%
spruce	*Picea sp.*	3	0.36%
yellow birch	*Betula alleghaniensis*	3	0.36%
American beech	*Fagus grandifolia*	2	0.24%
Norway spruce	*Picea abies*	2	0.24%
tamarack	*Larix laricina*	2	0.24%
willow	*Salix sp.*	2	0.24%
balsam fir	*Abies balsamea*	1	0.12%
birch	*Betual sp.*	1	0.12%
black cherry	*Prunus serotina*	1	0.12%
black walnut	*Juglans nigra*	1	0.12%
broadleaf evergreen medium	N/A	1	0.12%
cherry	*Prunus sp.*	1	0.12%
dogwood	*Cornus sp.*	1	0.12%
eastern hemlock	*Tsuga canadensis*	1	0.12%
grey birch	*Betula populifolia*	1	0.12%
hawthorn	*Crataegus sp.*	1	0.12%
lilac	*Syringa vulgaris*	1	0.12%
northern hackberry	*Celtis occidentalis*	1	0.12%
red spruce	*Picea rubens*	1	0.12%

Appendix C: Leaf Area and Canopy Cover by Species Comprising Hinesburg's Community Forest

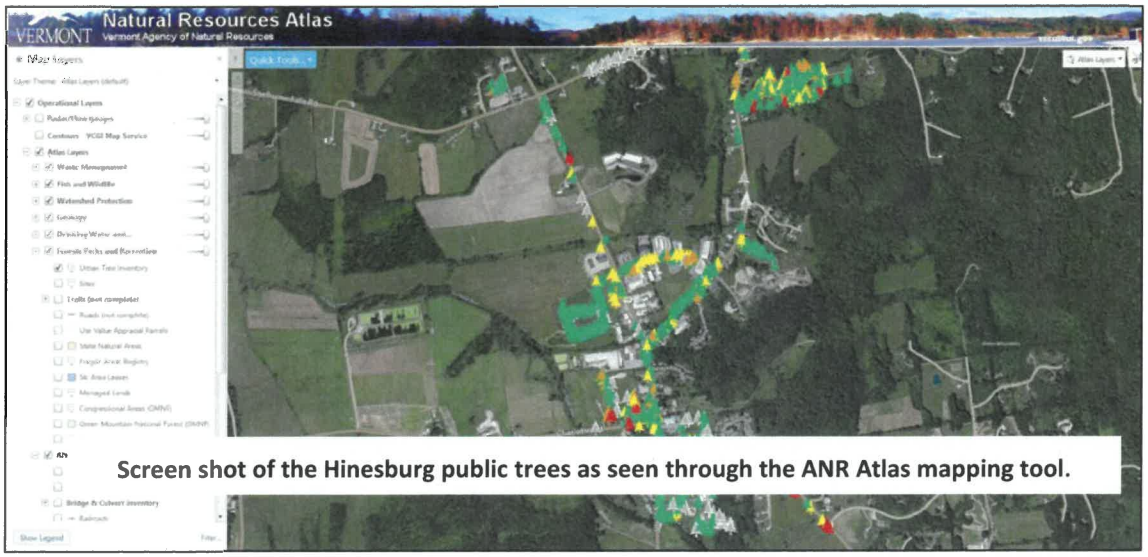
Species	Number of Trees	% of Total Trees	Leaf Area (ft2)	% of Total Leaf Area	Canopy Cover (ft2)	% of Total Canopy Cover
eastern white cedar	123	14.68	144,920.20	9.15	118,826.33	22.43
sugar maple	95	11.34	591,875.18	37.38	119,969.17	22.64
crabapple	68	8.11	28,702.78	1.81	14,682.92	2.77
red maple	63	7.52	80,508.18	5.08	20,807.31	3.93
green ash	59	7.04	85,092.31	5.37	30,443.37	5.75
American basswood	48	5.73	38,080.05	2.41	13,557.58	2.56
American elm	38	4.53	82,596.50	5.22	23,832.05	4.50
swamp white oak	32	3.82	99,383.47	6.28	33,849.89	6.39
honeylocust	32	3.82	36,551.78	2.31	14,473.21	2.73
eastern white pine	31	3.70	32,603.00	2.06	13,250.85	2.50
white oak	23	2.74	42,567.57	2.69	14,216.93	2.68
river birch	22	2.63	39,202.68	2.48	14,618.13	2.76
northern red oak	20	2.39	14,947.05	0.94	4,886.06	0.92
bur oak	19	2.27	24,822.22	1.57	7,963.80	1.50
Norway maple	14	1.67	13,814.52	0.87	7,250.62	1.37
silver maple	12	1.43	47,585.80	3.01	14,209.72	2.68
northern hackberry	12	1.43	8,476.93	0.54	2,952.60	0.56
blue spruce	11	1.31	11,174.38	0.71	4,191.01	0.79
boxelder	10	1.19	9,855.23	0.62	5,092.90	0.96
white ash	10	1.19	29,936.13	1.89	8,874.38	1.68
pear sp.	8	0.95	4,894.21	0.31	1,871.07	0.35
oak sp.	6	0.72	3,419.87	0.22	1,070.65	0.20
pine sp.	6	0.72	5,506.84	0.35	1,994.62	0.38
serviceberry	6	0.72	905.61	0.06	585.42	0.11
broadleaf deciduous small sp.	6	0.72	497.94	0.03	317.40	0.06
northern catalpa	6	0.72	10,116.87	0.64	2,662.98	0.50
katsura sp.	5	0.60	3,226.86	0.20	560.75	0.11
Japanese tree lilac	5	0.60	1,002.54	0.06	737.55	0.14
cottonwood	4	0.48	15,554.37	0.98	4,652.65	0.88
American sycamore	4	0.48	9,598.54	0.61	4,034.42	0.76
pin oak	4	0.48	5,272.39	0.33	1,682.33	0.32
spruce sp.	4	0.48	3,893.77	0.25	1,426.32	0.27
yellow birch	3	0.36	4,323.07	0.27	1,665.16	0.31
ginkgo	3	0.36	2,183.22	0.14	1,134.52	0.21

white mulberry	3	0.36	4,888.73	0.31	1,257.95	0.24
willow sp.	2	0.24	13,489.98	0.85	4,324.81	0.82
broadleaf deciduous medium sp.	2	0.24	841.54	0.05	150.52	0.03
American beech	2	0.24	11,304.99	0.71	3,346.92	0.63
European larch	2	0.24	2,882.05	0.18	1,110.11	0.21
Norway spruce	2	0.24	5,272.69	0.33	2,263.26	0.43
birch sp.	1	0.12	46.44	0.00	13.77	0.00
plum sp.	1	0.12	467.16	0.03	302.00	0.06
eastern hophornbeam	1	0.12	795.10	0.05	136.74	0.03
Black spruce	1	0.12	917.81	0.06	332.44	0.06
black walnut	1	0.12	1,441.02	0.09	555.05	0.10
Canary Island date palm	1	0.12	620.26	0.04	250.25	0.05
balsam fir	1	0.12	2,636.35	0.17	1,131.63	0.21
broadleaf evergreen medium sp.	1	0.12	1,936.55	0.12	740.86	0.14
eastern hemlock	1	0.12	1,293.78	0.08	970.83	0.18
black cherry	1	0.12	200.51	0.01	147.51	0.03
hawthorn	1	0.12	200.51	0.01	147.51	0.03
gray birch	1	0.12	795.10	0.05	136.74	0.03
dogwood sp.	1	0.12	200.51	0.01	147.51	0.03
Total	**838**	**100.00**	**1,583,323**	**100.00**	**529,811.06**	**100.00**

Appendix D: Instructions for Accessing Public Tree Data in ANR Atlas

Anyone with Internet access can view all of the inventoried Hinesburg public trees by using the Vermont Agency of Natural Resources' (ANR) Atlas mapping tool. Follow these simple steps:

1. Set your web browser (Internet Explorer works best) to http://anrmaps.vermont.gov/websites/anra/ (or search "VT ANR Atlas").
2. Zoom in to Hinesburg using the +/- scale navigation tool in the upper left portion of the map (the tree data layer won't show up unless you are zoomed in to the city-level so that you can see the street names on the map).
3. In the information pane on the left of the screen switch to the "map layers" tab at the bottom.
4. Expand the "Forests, Parks, & Recreation" heading,
5. Click on the box to the left of "Urban Tree Inventory" to load public tree data (it might take a moment for the layer to load).
6. Once you see all the trees on the map, you can zoom in and right-click on any individual tree and click on "What's here"; when you do this, the left information pane will change to give you the basic details for that specific tree.
    - To access all of the information collected on that specific tree, click on the grey text title of the tree in the left pane and a new window will open with the inventory data.
    - In this new window there are three tabs: "Details" and "Attributes" display the same information in different formats and if a photo was taken of the tree, it will show up in the "Attachments" tab.

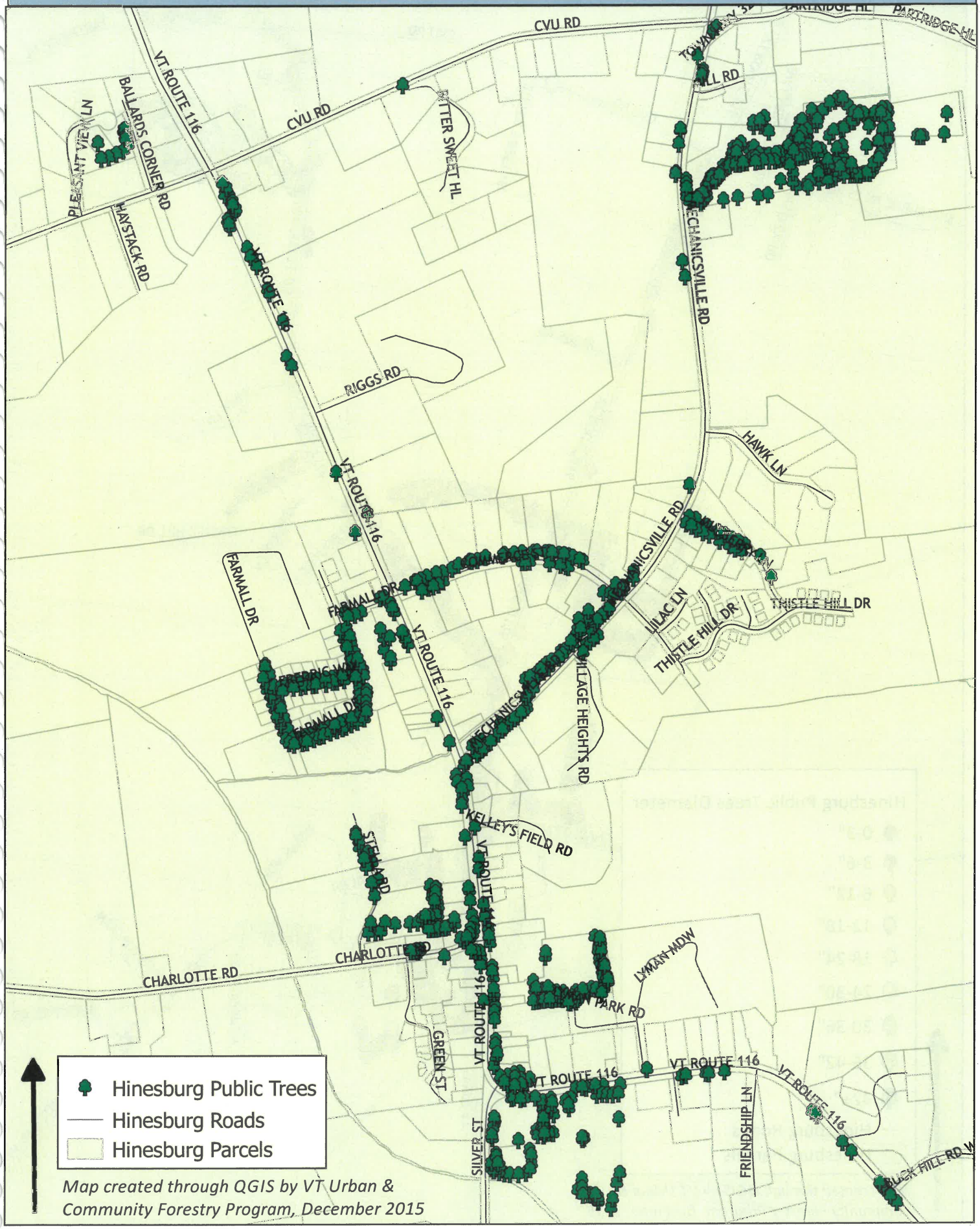


Screen shot of the Hinesburg public trees as seen through the ANR Atlas mapping tool.

Appendix E: Maps

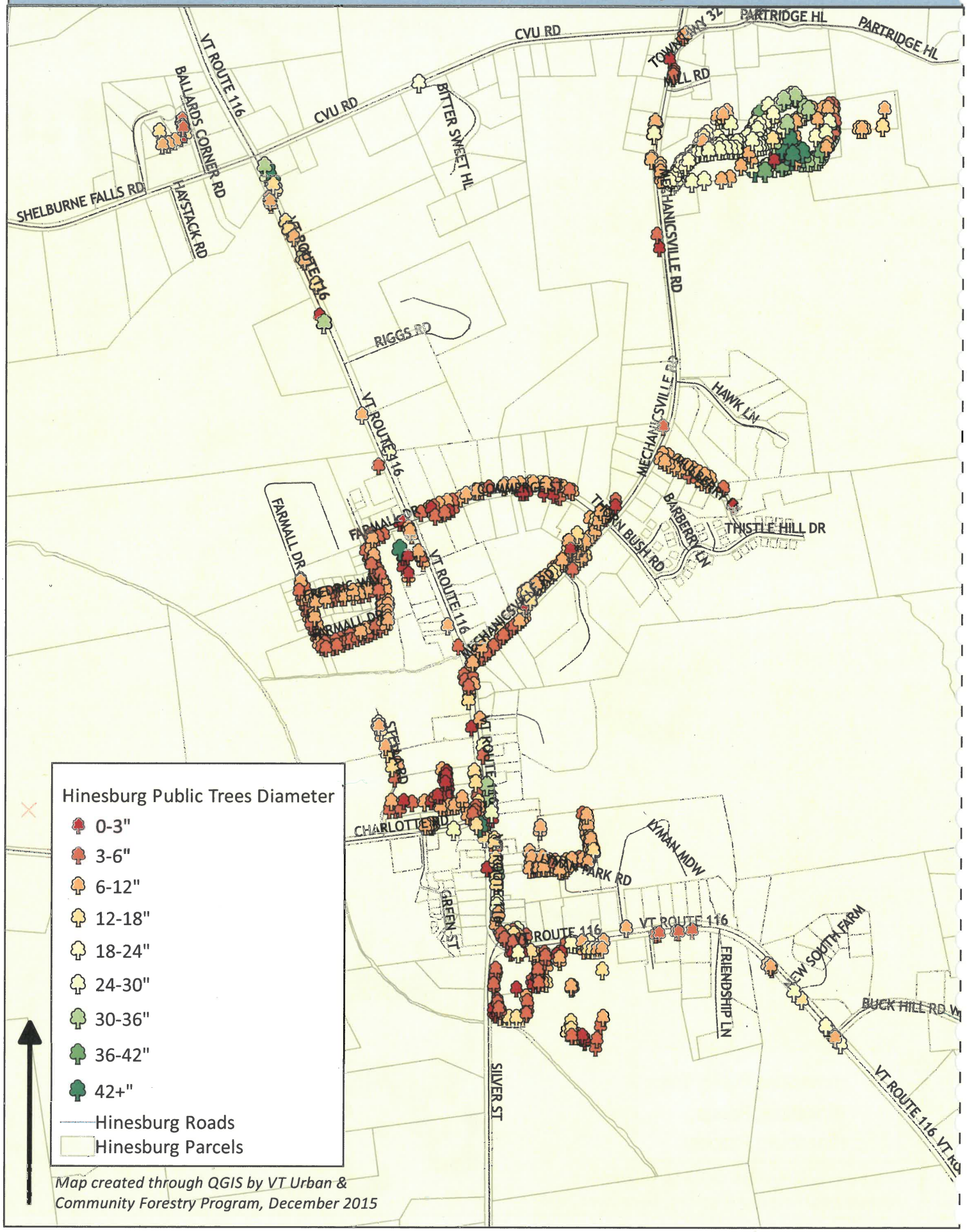
1. Hinesburg Public Tree Inventory: All Trees
2. Hinesburg Public Tree Inventory: All Trees by Diameter Class
3. Hinesburg Public Trees by Condition Class
4. Hinesburg Public Trees in Need of Monitoring
5. Potential Public Tree Planting Locations ("Vacant") in Hinesburg
6. Public Ash (Fraxinus) Trees in Hinesburg

Hinesburg Public Tree Inventory: All Trees



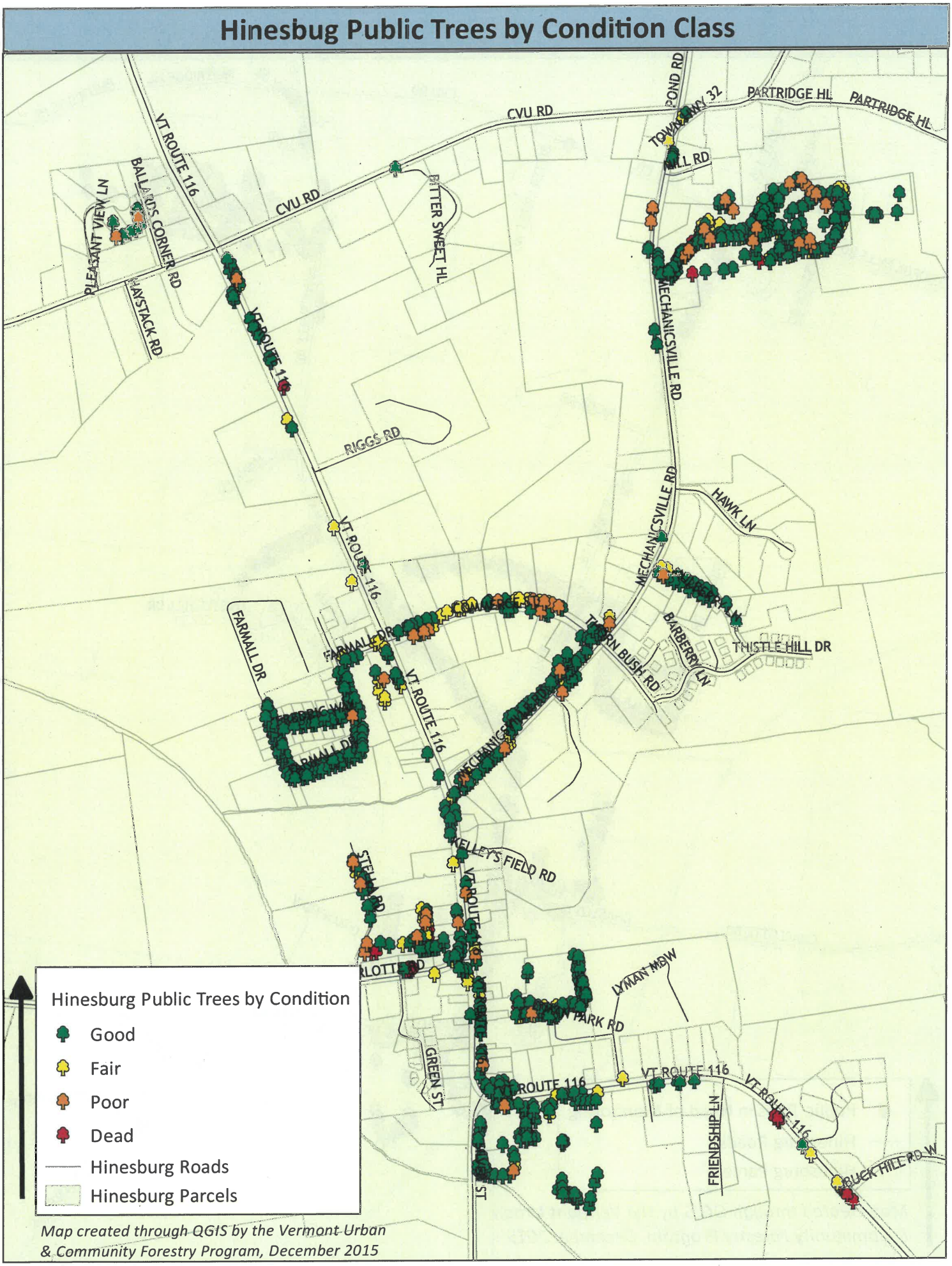
Map created through QGIS by VT Urban & Community Forestry Program, December 2015

Hinesburg Public Tree Inventory: All Trees by Diameter Class



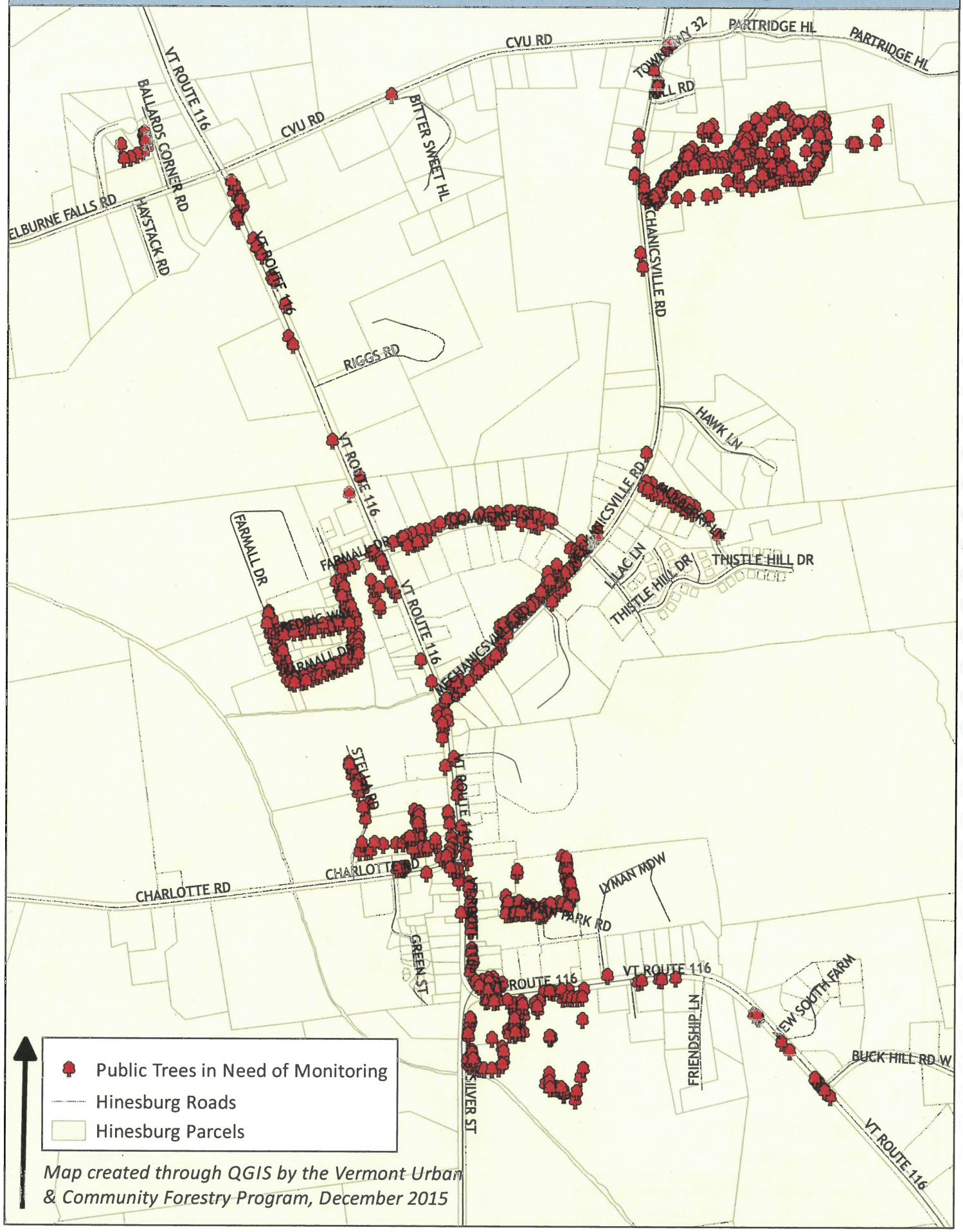
Map created through QGIS by VT Urban & Community Forestry Program, December 2015

Hinesbug Public Trees by Condition Class



Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

Hinesburg Public Trees In Need of Monitoring

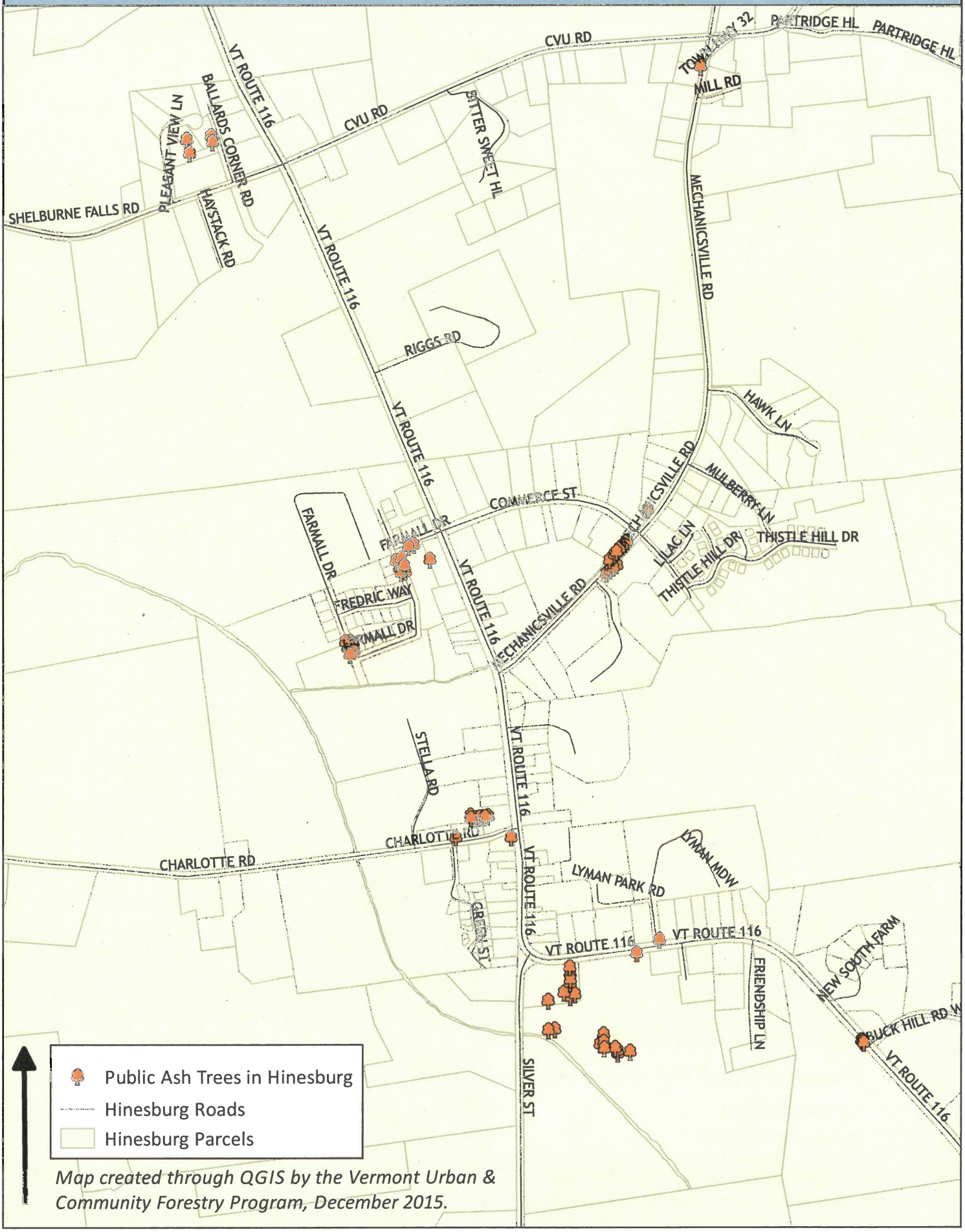


Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

Potential Public Tree Planting Locations ("Vacant") in Hinesburg

Map created through QGIS by VT Urban & Community Forestry Program, December 2015

Public Ash (Fraxinus) Trees in Hinesburg



Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015.