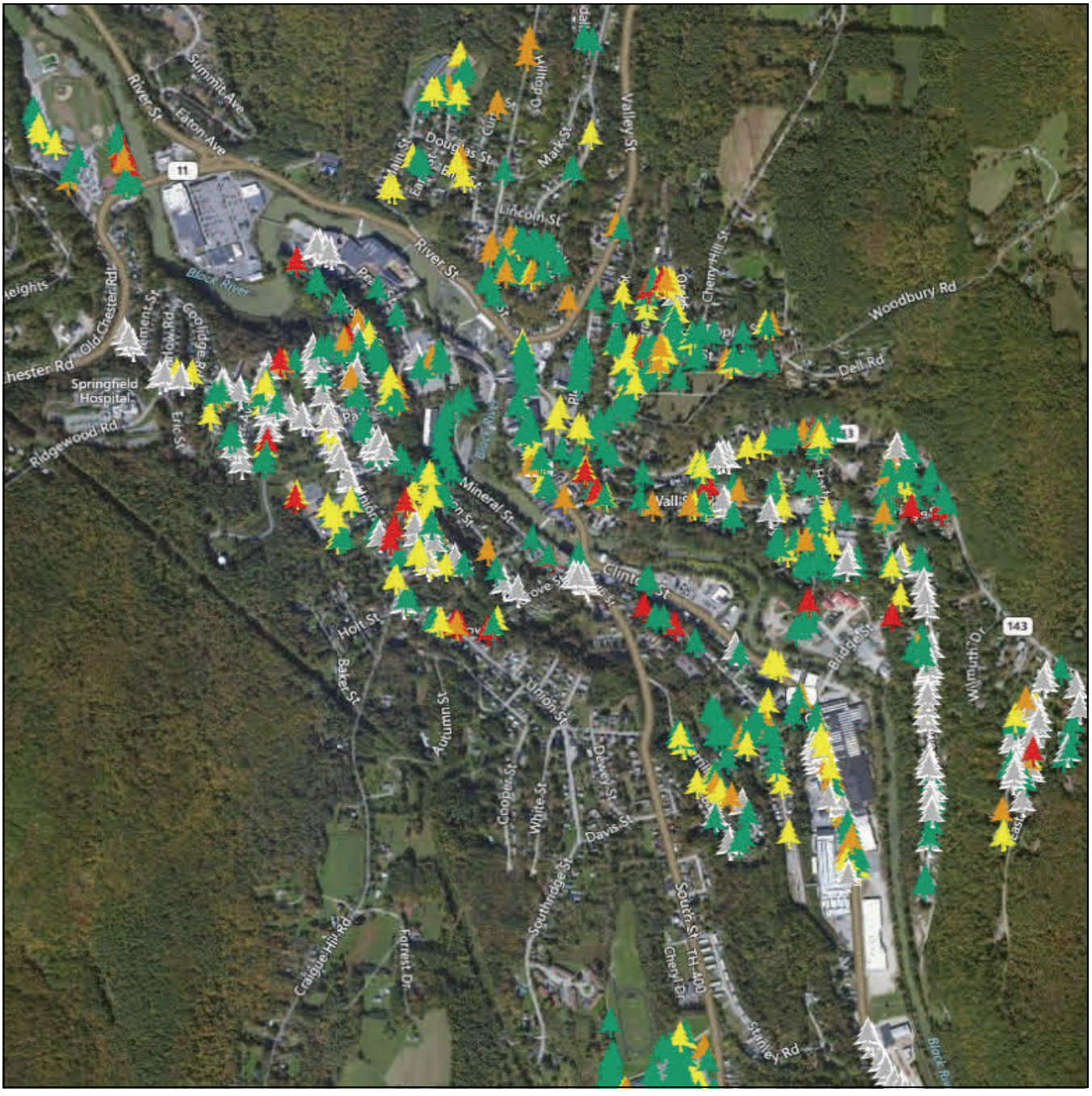
# Springfield Public Tree Inventory Report




***Prepared for the Town of Springfield***
***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 U.S. DEPARTMENT OF AGRICULTURE

VT ANR GIS

## Acknowledgements

This report was developed by the 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 Springfield, Vermont during the fall of 2015. We would like to thank Kelly Stettner, founder of the Black River Action Team (BRAT), Springfield resident, and the main contact for the project. We also appreciate Tom Yennerell, Springfield's Town Manager, and Jeff Strong from the Department of Public Works for their involvement and guidance. This report was made possible with funding from the USDA Forest Service. Special thanks to Rick White and Aaron Hurst with VT FPR for leading the on-the-ground data collection in Springfield. Additional 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 and University of Vermont (UVM) Extension. 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 the urban forest's ecological integrity and diversity. VT UCF's programming and support reaches at least 100 Vermont communities annually. More information about VT UCF and its programming can be found at www.vtcommunityforestry.org.

***VT UCF provides technical, financial, and educational services to VT communities to promote and support vibrant urban and community forests, such as Montpelier's, pictured above.***

## 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
- Urban Forest Diversity ..... 10
- Urban Forest Structure ..... 11
- Urban Forest Health ..... 13
- Tree Health and Maintenance Indicators ..... 16
- Monetary Value and Ecosystem Services ..... 17
- Springfield Full Canopy Assessment ..... 22

Discussion and Recommendations: Springfield's Public Tree Program ..... 25

- Urban Forest Diversity and Structure ..... 26
- Urban Forest Health ..... 29

Assessment Tools ..... 30

Conclusion ..... 32

Appendices ..... 33

- Appendix A: Full Street and Site List for the Springfield Inventory ..... 33
- Appendix B: Full Species and Genera List for Springfield's Public Trees ..... 36
- Appendix C: Leaf Area and Canopy Cover by Species Comprising Springfield's Urban Forest ..... 38
- Appendix D: Instructions for Accessing Public Tree Data in ANR Atlas ..... 40
- Appendix E: Maps ..... 41

## Executive Summary

The goals of Springfield's public tree inventory were to assess the condition, health, and diversity of Springfield's public trees, engage citizens and private property owners about tree stewardship and care, identify potential tree planting locations within the public right-of-way (ROW), explore incorporating trees into Springfield's future infrastructure plans, and support Springfield's beatification efforts and efforts to increase shade with native plants. 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 Springfield's urban forest and will allow Town leadership and organizations such as the Black River Action Team (BRAT) 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, was coordinated with BRAT coordinator Kelly Stettner; Springfield Town Manager Tom Yennerell advised and approved the project. VT UFC and VT FPR staff completed an inventory of **861 trees** located within the public ROW of **91 streets** and on **7 Town-owned properties,** and identified **155 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 December 2015. It presents the results of the inventory and provides a basic assessment of the trees and urban canopy cover in Springfield.

Local government, town boards and committees, 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 ($CO_2$), enhancing property values, and improving the aesthetics of the community. The 861 inventoried public trees provide an estimated **$90,191 in benefits annually** to Springfield's residents and businesses. In addition to

the public trees inventoried, an aerial tree canopy assessment was completed for the land area included in the inventory project, which indicated an existing tree canopy cover of **56%** and an estimated long-term **stored $CO_2$ value of over $2,550,000**.

## Summary of Findings

***Forest Diversity***

- Of the 861 public trees, there are 65 different species in 31 different genera.
- The top five most common tree genera by number of trees are *Acer* (maple) at 43%, *Malus* (crabapple) at 8%, *Fraxinus* (ash) at 6%, *Picea* (spruce) at 5%, and *Quercus* (oak) at 5%.
- *Acer* and *Fraxinus* species together represent half (49%) of Springfield's public trees. Invasive tree pests currently threaten both of these genera: the Asian longhorned beetle (ALB) and the emerald ash borer (EAB), respectively.
- The top five most common species are *Acer plantanoides* (Norway maple) at 16%, *Acer saccharum* (sugar maple) at 15% *Malus* species (crabapple) at 8%, *Acer rubrum* (red maple) at 8%, and *Fraxinus pennsylvanica* (green ash) at 5%.

***Forest Structure***

- Half of the inventoried public trees (50%) have a diameter at breast height (DBH) measurement of 6-18"; 27% of inventoried public trees have a DBH within the 6-12" size class and 23% of the inventoried trees have DBH measurements in the 12-18" size class.
- The remaining 50% of inventoried trees were represented in the following size categories: 0-3" (4%), 3-6" (13%), 18-24" (15%), 24-30" (8%), 30-36" (5%), 36-42" (2%), and 42"+ (3%).

***Forest Cover***

- There is an existing urban tree canopy (UTC) cover of 56% within the extent of the Springfield 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 30% of the land surface; these "possible UTC" areas include low-lying vegetation or grassland (14%), agricultural land (2%), and impervious surfaces (14%) (e.g. parking lots, paved playgrounds, and the ROW).
- 155 potential tree planting locations were identified within the ROW.
- The remaining 14% of Springfield's area is buildings, streets, water, and other permanent features and is generally unsuited to UTC improvement.

***Forest Health***

- Over half (546, or 63%) of the trees inventoried were assessed as being in "Good" condition. Of the remaining trees, 193 (22%) were considered to be in "Fair" condition, 85 (10%) were in "Poor" condition and 37 (4%) were "Dead".
- 367 trees (43%) were assessed to be in need of monitoring by a Certified Arborist, the Springfield Tree Warden, or other qualified individual.

***Tree Health and Maintenance Indicators***

- As per request of the Town, the presence of the following health and maintenance indicators were assessed in Springfield's public tree inventory: presence of absence of decay, presence or absence of stem-girdling roots, and the need for pruning and/or staking.
- Nearly half (406 trees or 47%) of Springfield's urban forest was assessed as needing pruning.
- 3.5% (30 public trees) of Springfield's urban forest exhibited signs of stem-girdling roots.
- 0 inventoried trees require stakes.
- Almost half of Springfield's public *Acer* trees (174 or 47%) require monitoring, representing the greatest monitoring needs of all of Springfield's urban 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 urban 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 Springfield public tree inventory, our priority recommendations for the Town of Springfield are:

- Enhance and promote longevity of the public tree population by establishing a systematic and routine structural pruning program. These efforts should focus on the 406 public trees assessed as in need of pruning.
- Develop a plan to remove – and replace if appropriate – the 37 dead trees inventoried.
- Prioritize the timely assessment and, if needed, maintenance of the 367 trees that were identified as in need of monitoring by a Certified Arborist, a Tree Warden, or another appropriate public official.
- Thoughtfully and intentionally select native species for future public tree plantings that will diversify Springfield's urban forest's current genera composition and refer to the list of potential public tree planting locations to guide those efforts.

***A northern red oak (left) and an eastern white pine (right), both located at The Common Park and included in the Springfield 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 urban forest structure, diversity, and health; (2) helping the community in the development of an urban 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 Town of Springfield and citizen volunteer Kelly Stettner were interested in partnering with VT UCF on the *Care of the Urban Forest* project because of the lack of a current public tree inventory and the package of services available to the Town through the project. The intent of the public tree inventory is to enable Springfield to better understand, steward, and manage its public trees more efficiently and cost effectively. Specifically the goals of Springfield's public tree inventory were to assess the condition, health, and diversity of Springfield's public trees, engage citizens and private property owners about tree stewardship and care, explore incorporating trees into Springfield's future infrastructure plans, identify potential tree planting locations in the ROW, and support Springfield's beatification efforts and efforts to increase shade with native plants. The public tree inventory will provide a foundation for future management decisions and improvements to the urban forest. Additionally, benefits of urban forests, such as the improvement of air and water quality and increased property value, will increase when the Town is able to manage and support healthy public trees.

**Town Profile**

The Town of Springfield is bounded on the east by the Connecticut River and is drained by the Black River, which flows directly through downtown. The town is located in Windsor County, nearing the New Hampshire border of Vermont. Springfield covers a land area of approximately 49 square miles, and has a population of 9,372 people, according to the 2010 U.S. Census. One of the New Hampshire grants, the township was chartered in August of 1761 by Governor Benning Wentworth. Although Springfield's alluvial flats made it among the best agricultural towns in the state, the Black River falls, which drop 110 feet in an eighth of a mile, helped it develop into a mill town, eventually becoming the home of Vermont's machine tool industry. Downtown Springfield has a rich economic history based on manufacturing and commerce that was supported by companies like Jones and Lamson Machine Tool Company, the Fellows Gear Shaper Company, and the Bryant Chucking Grinder Company. In fact, during WWII, Springfield's production of machine tools was of such significance, the U.S. government ranked the Town as the seventh most important bombing target in the country[1]. Springfield Telescope Makers, the oldest

[1] Wayne G. Broehl, Jr., *Precision Valley: The Machine Tool Companies of Springfield, Vermont*. (Englewood Cliffs, N.J.: Prentice Hall, 1959) p. 184, *citing* W. Storrs Lee, *The Green Mountains of Vermont* (New York: Henry Hold & Company, Inc., 1949) p.76.

## Importance of Inventory and Urban 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 numerous 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 urban 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, 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 place and contribute to keeping our communities healthier and our everyday lives more fulfilling.

amateur telescope makers' club in the U.S. has been centered in the Town since its inception in 1927. Since then, several sites in Springfield, including the historic downtown area, have been designated as having historical significance in accordance to the National Register of Historic Places. Among them are the Hartness House, the Eureka Schoolhouse, and the Gould's Mill Bridge.[2]

**Methodology**

Prior to the public tree inventory, VT UCF staff met and communicated with Kelly Stettner and Tom Yennerell to plan for the inventory. Originally, 91 streets in Springfield were selected 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 1.6 square miles, representing about 3% of the total land area of Springfield but encompassing the most densely populated sections of town. The ROW boundaries for all streets were provided by Jeff Strong, the Springfield Public Works Department Director. 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.

VT UCF developed an inventory tool in collaboration with the VT Agency of Natural Resources' (ANR) GIS team. The map-based tool uses the free application *Collector for ArcGIS,* developed by Esri, *(*http://doc.arcgis.com/en/collector/) for data collection and is linked to the ANR Atlas online mapping tool. All inventory data collected on public trees in Springfield is available for viewing on ANR Atlas and instructions are included in Appendix D.

Throughout the month of August, 2015, VT FPR State Lands Foresters walked along predetermined streets and on town-owned sites in downtown Springfield, recording specific data on the public trees and identifying appropriate potential planting locations or grass strips (recorded as "Vacant"). To ensure that only public trees were inventoried (as opposed to trees

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[2] Staff (2010-07-09). "National Register Information System". *National Register of Historic Places*. National Park Service.

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 extent for specific road - road width)/2*

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 maps to allow the user to input information about a tree, linking it to a particular geographic location. Data recorded for each public tree in Springfield 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 (yes/no) of tree decay and/or stem-girdling roots, the need (yes/no) of pruning and/or staking, additional comments, and nearest house or building address. In most cases, a picture was also taken of each tree. 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 Springfield's urban 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 Springfield's public tree inventory

| Data Parameters | Description |
|---|---|
| **Site ID** | Street name or property name. |
| **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<br>● *Fair:* thinning canopy (50-75%), medium to low new growth, significant mechanical damage, obvious defects/insects/disease, foliage off-color and/or sparse<br>● *Poor:* declining (25-50%), visible dead branches over 2" in diameter, significant dieback, severe mechanical damage or decay (over 40% of stem affected)<br>● *Dead:* no signs of life, bark peeling; scratch test on twigs for signs of life (green)<br>● *Vacant:* potential spot for a tree within the public ROW. Add "small", "medium", or "large" in the comments box<br>- Small= max 30' at maturity, presence of overhead wires, minimum planting space 4' x 4'<br>- Medium= 30-50' at maturity, green belts over 6' wide, no overhead wires<br>- 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. |
| **Monitor** | ● *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<br>● *No:* no major defects, tree in good or fair condition |
| **Comments** | Notes, elaborate on any existing conditions; max 255 characters. |
| **Decay** | Yes: noticeable decay present on inventoried tree<br>No: no noticeable decay apparent on inventoried tree |
| **Stake** | Yes: if the tree should be staked. Staking is required when the tree is unable to support itself with its existing root system. Staking supports the roots or root ball until the roots of the tree grow into the surrounding soil and can then support itself. Excessive top movement breaks off the root hairs during formation, limiting the root expansion of the plant.<br>No: staking needed for inventoried tree |
| **Prune** | Yes: flag trees for pruning if any of the following signs are present:<br>broken branches, branches are overlapping /touching/growing on each other, the tree is overcrowded, branches are interfering with utility lines or other built infrastructures, the branches can interfere with pedestrians/vehicles/bikes, etc. Structural Pruning needed.<br>No: no branch needs to the trimmed |
| **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. |
| **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

### Urban Forest Diversity

Of the 861 trees inventoried within the public ROW or on town-owned land, there are a total of 65 different species in 31 different genera. The five most common tree genera, *Acer* (maple), *Malus* (apple), *Fraxinus* (ash), *Picea* (spruce), and *Quercus* (oak), comprise 68% of the urban forest (Figure 1). The top five most common species are *Acer plantanoides* (Norway maple) at 16%, *Acer saccharum* (sugar maple) at 15%, *Malus* species (crabapple) at 9%, *Acer rubrum* (red maple) at 8%, and *Fraxinus pennsylvanica* (green ash) at 5%, comprising 52% of Springfield's urban forest (Figure 2). Complete species and genera lists can be found in Appendix B.

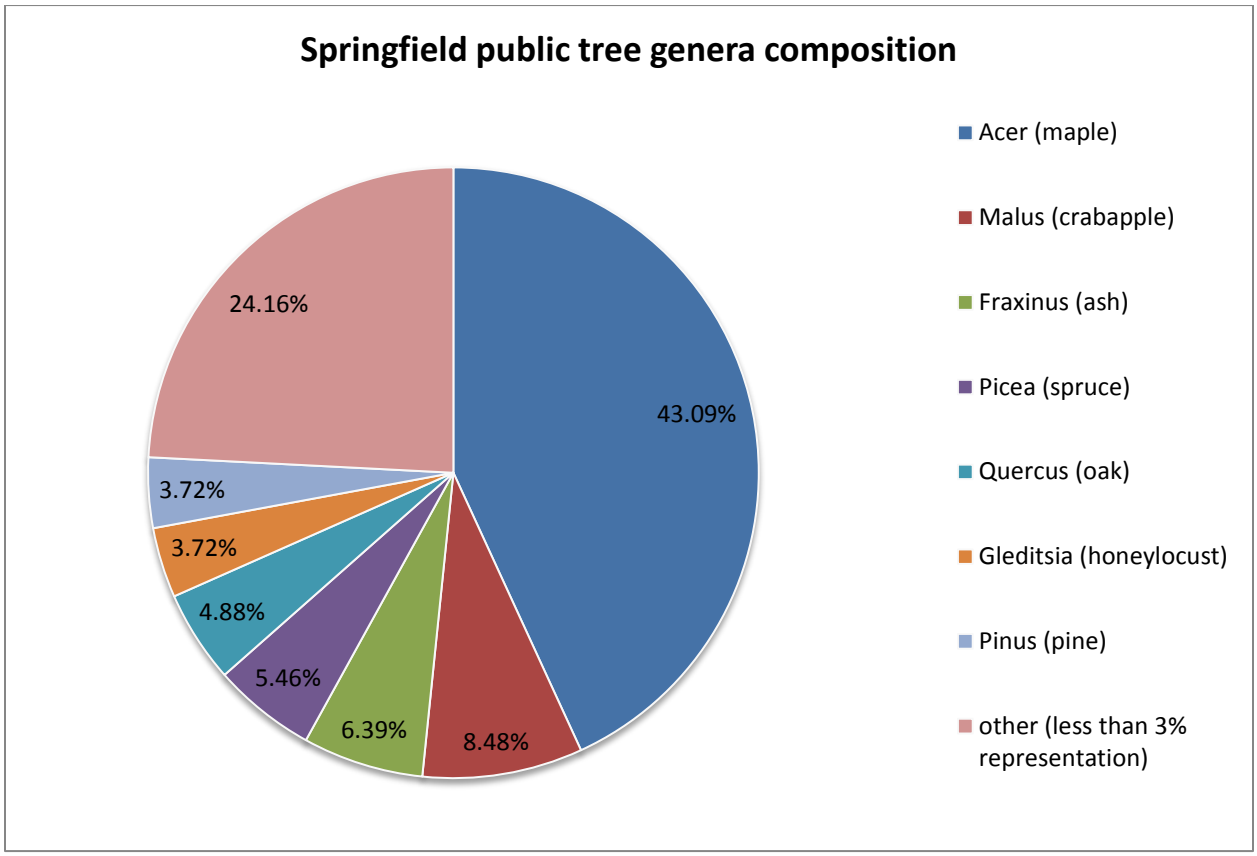



**Figure 1. Tree genera by percent within the public ROW in Springfield.**

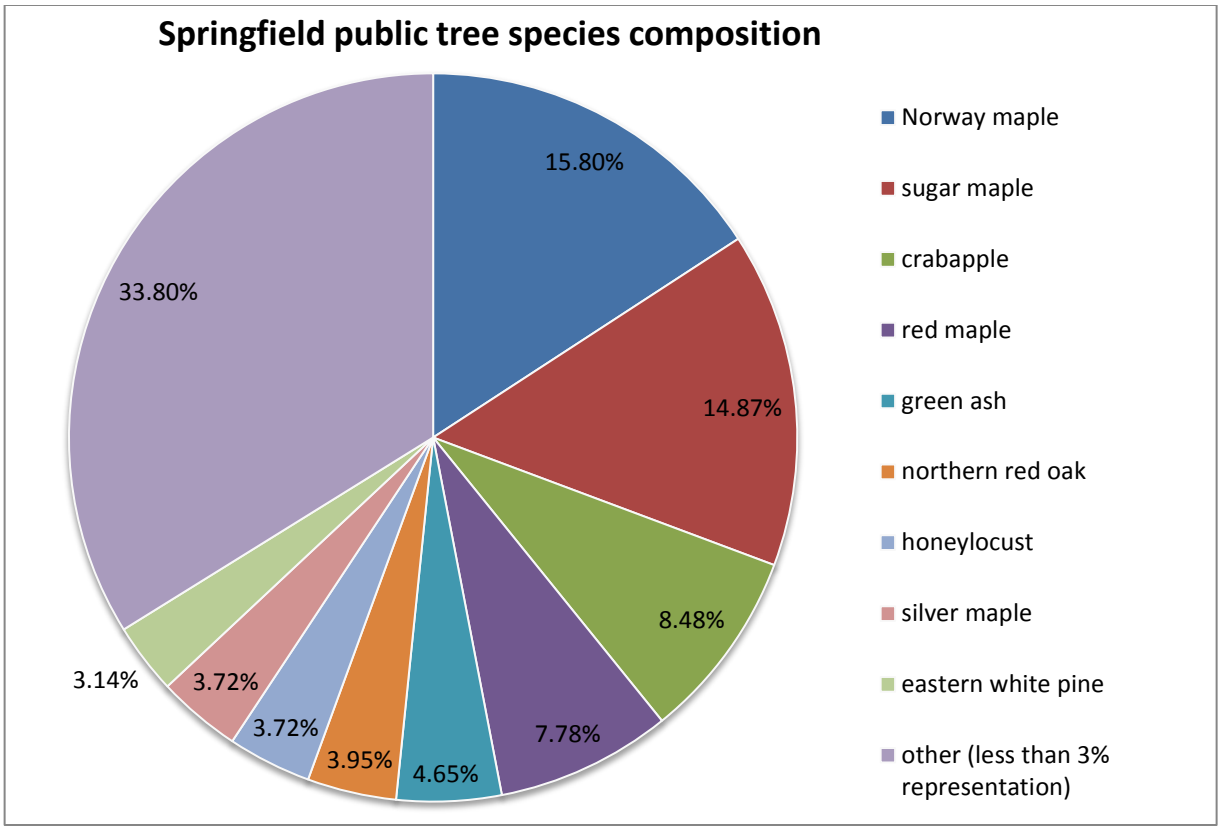



**Figure 2. Species by percent within Springfield's public ROW.**

**Urban Forest Structure**

DBH measurements were taken for all of Springfield's 861 inventoried trees. In descending order by percent size class, the diameter distribution of Springfield's public trees is: 27% (233) at 6-12", 23% (199) at 12-18", 15% (126) at 18-24", 13% (112) at 3-6", 8% (66) at 24-30", 5% (44) at 30-36", 4% (36) at 0-3", 3% (29) at 42+", and 2% (16) at 26-42" (Figure 3). Thus, each size (i.e., age) class is currently represented in Springfield's urban forest, with approximately half of the Town's public trees (50.17%) between 6-18".

The composition of genera and species within each of these size classes (Figures 4 and 5) indicate that *Acer* (maple) is most commonly represented in all size classes. This is likely because the genus comprises close to half of all Springfield's inventoried public trees. The three most abundant size classes represented, 6-12", 12-18", and 18-24", contain a total of 558 trees, comprising 65% of Springfield's urban forest. This indicates that most of Springfield's public trees were planted around the same time. Nearly all of the large-diameter (24+") trees

are Norway or sugar maple, with some red maple. The species represented in the 42+" size class (sugar, Norway, and red maple) were probably not planted as street trees but were likely left as remnants as the town developed. Almost all of the maple trees that are 0-3" are red maples. Honeylocusts, pears, crabapples, and green ashes are prominent in the lower diameter classes, indicating a shift in species preference or availability in recent years.

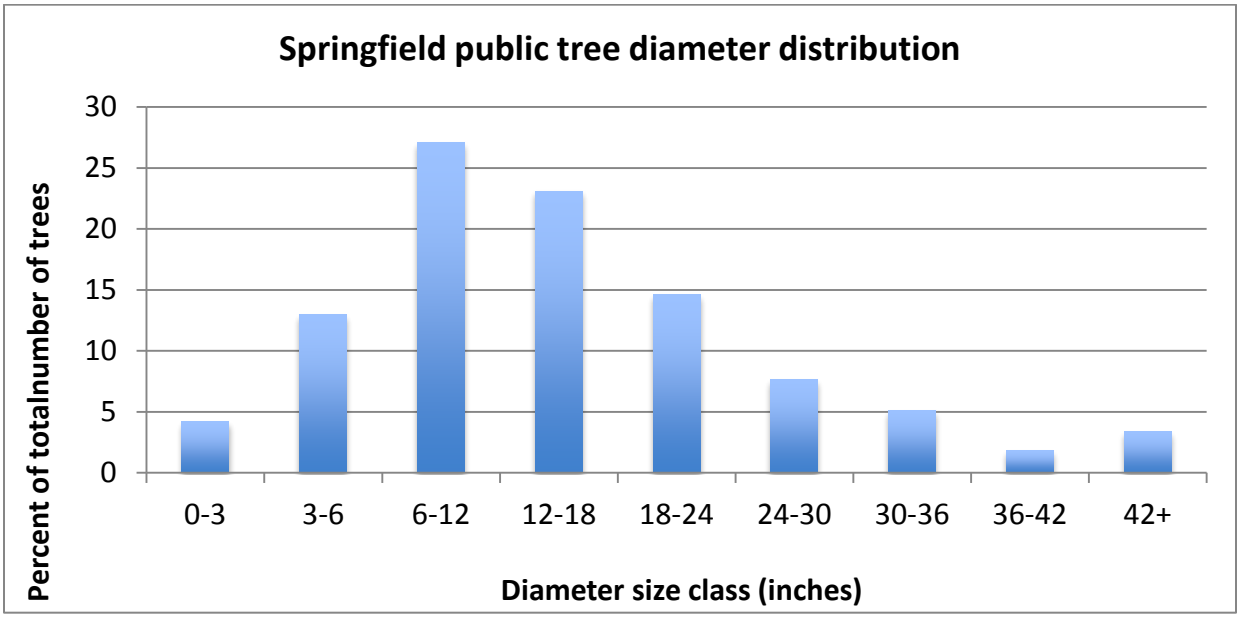



**Figure 3. Percentage of Springfield's trees represented in each diameter class (inches).**

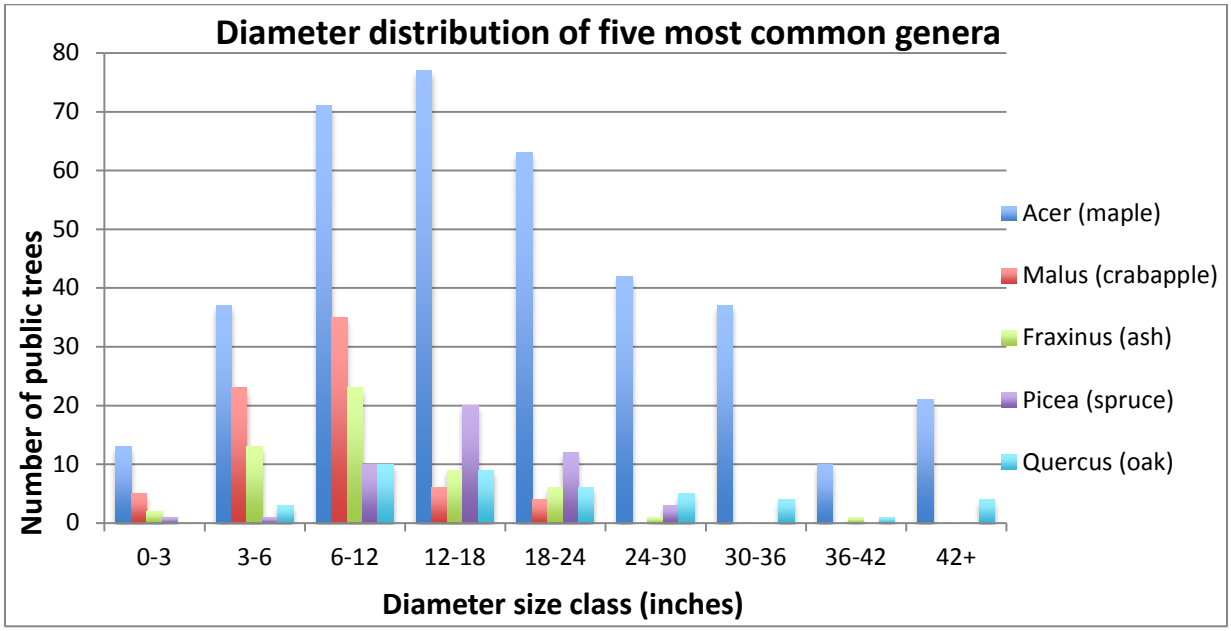



**Figure 4. Diameter distribution of the five most common genera in Springfield's public trees.**

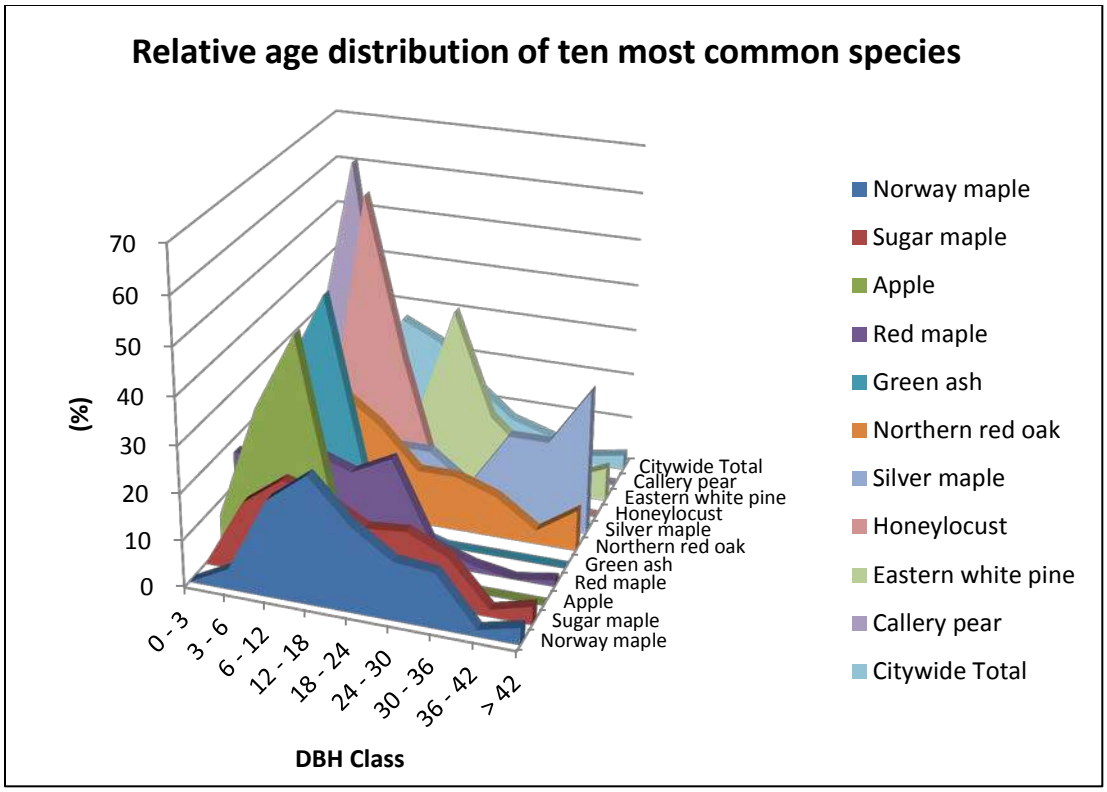



**Figure 5. Diameter (and age) distribution of the ten most common species in Springfield's urban forest. Data from this figure were derived from i-Tree Streets urban canopy structure output.**

There are 155 potential tree planting locations or strips identified within the public ROW (recorded as "Vacant"); Appendix A breaks down these locations by street. Of the inventoried streets, Commonwealth Avenue (25 spots), Clinton Street (24 spots), and Park Street (16 spots) offer the most vacant spots for tree planting. Additional consultation of these sites is necessary to plant a tree of appropriate size and species.

**Urban Forest Health**

Almost three quarters (63%, or 546) of Springfield's inventoried public trees are assessed as being in "Good" condition; of the remaining trees, 193 (22%) are considered in "Fair" condition, 85 (10%) are in "Poor" condition, and 37 (4%) are "Dead" (Figure 6). The *Acer* (maple) genus has the most trees in fair or poor condition; however, this genus also comprises the highest percentage of overall trees inventoried. *Picea* (spruce) is the only other genus with trees inventoried as in "poor" condition. The identifiable dead trees are primarily *Acer* (maple) and

*Picea* (spruce) (Figure 7). Appendix E includes maps detailing the location of inventoried trees by condition.

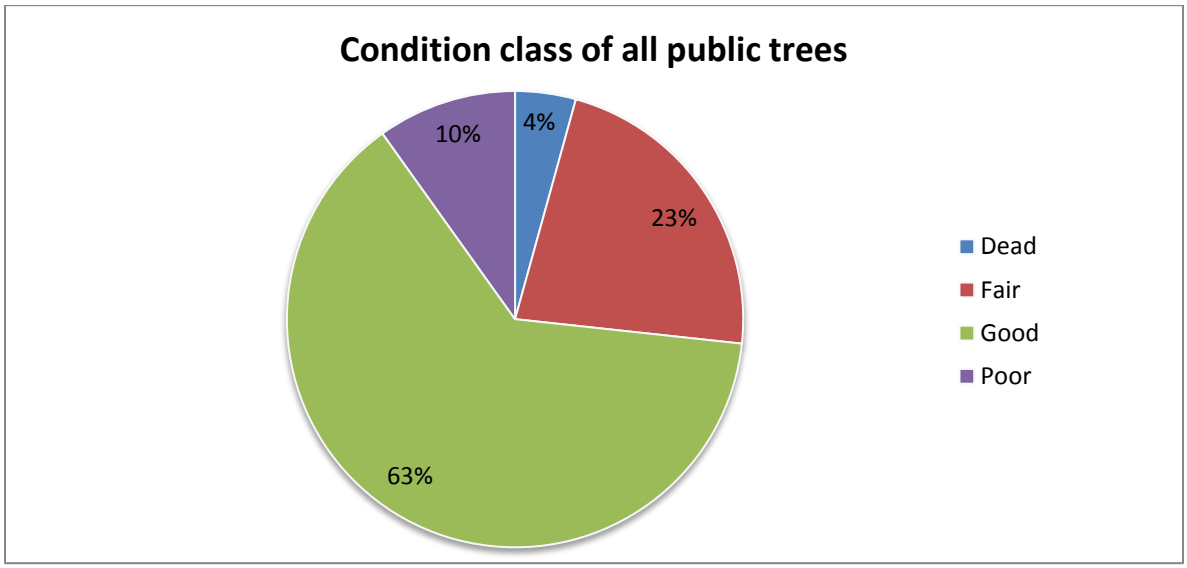



**Figure 6. Percentage of Springfield's public trees in each condition class.**

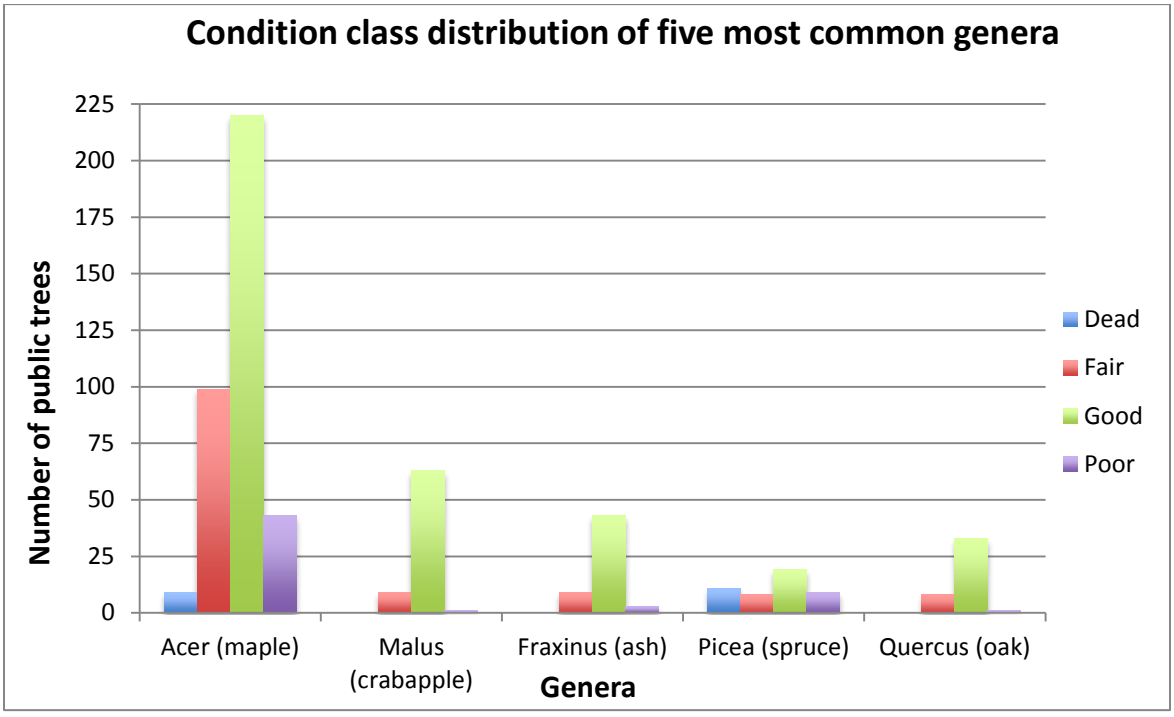



**Figure 7. Number of trees within the five most common genera displayed according to condition.**

367 trees (43%) were flagged to be monitored in the inventory and should be reassessed by a Certified Arborist, the Springfield Tree Warden, or another qualified individual in a timely matter. Figure 8 presents monitoring needs of five most common genera in Springfield. *Acer* (maple) species represent nearly half (47%) of all of Springfield's public trees with monitoring needs. Almost half of Springfield's public maple trees (174, most of which are sugar maple) require monitoring. Trees requiring monitoring 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).

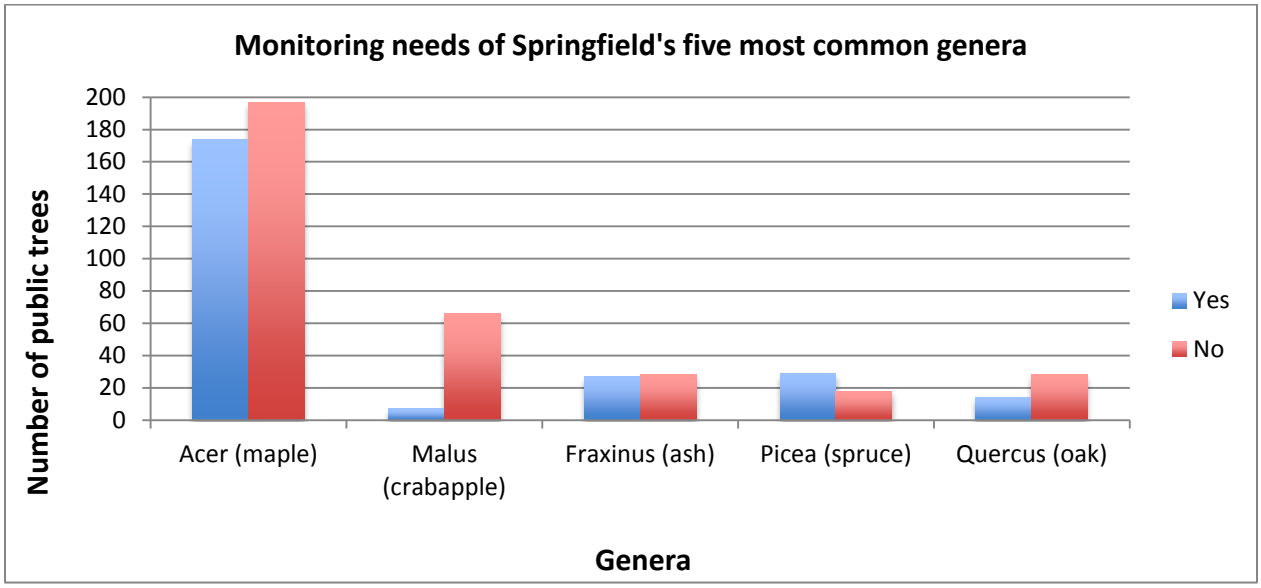



**Figure 8. The number of Springfield's inventoried public trees assessed to require monitoring (yes) within the Town's five most common genera.**

**Tree Health and Maintenance Indicators**

Although Springfield's public trees are generally healthy (63% assessed as in "good' condition), proper maintenance and monitoring is required to promote the health, longevity, and benefits of Springfield's urban forest. To better understand the specific maintenance and monitoring needs of Springfield's public trees, VT UCF staff assessed the presence or absence of decay and stem-girdling roots, and the need for pruning and staking for each inventoried tree (Figure 9). The Springfield Tree Warden, a Certified Arborist, or a relevant public official should therefore be aware of the public trees assessed with the observed health (e.g., decay and stem-girdling roots) or required maintenance (e.g., pruning and staking) characteristics.

Of the assessed health characteristics, decay is most prevalent in Springfield's urban forest, as it is observed in a third (33% or 267) of inventoried public trees. It is important to note that this percentage is derived from the total number of trees (809) assessed for decay. 51 of Springfield's inventoried trees were not assessed for decay as a result of user error. Maple species comprise the majority of trees (147) with decay. In fact, inventoried sugar maples represent 40% of the public trees with decay. Stem-girdling roots is observed in about 4% (30) of Springfield's public trees. 36 of Springfield's inventoried trees were not assessed for stem-girdling roots due to user error, so this percentage is also derived from the total number (825) of properly assessed trees. 70% (21) of the public trees assessed as having stem-girdling roots are maple species, and one third (10) of these are Norway maples.

Of the assessed maintenance characteristics, the need for pruning is most prevalent in Springfield's urban forest. Nearly half (48%) of Springfield's public trees were assessed as requiring some degree of pruning. 13 of Springfield's inventoried trees were not assessed for pruning, thus this percentage is derived from the total number of inventoried trees (847) assessed for pruning maintenance. Nearly half (189) of Springfield's public trees requiring pruning are maple species. Most (72) of these trees are Norway maples. None of Springfield's inventoried public trees require staking (Figure 9).

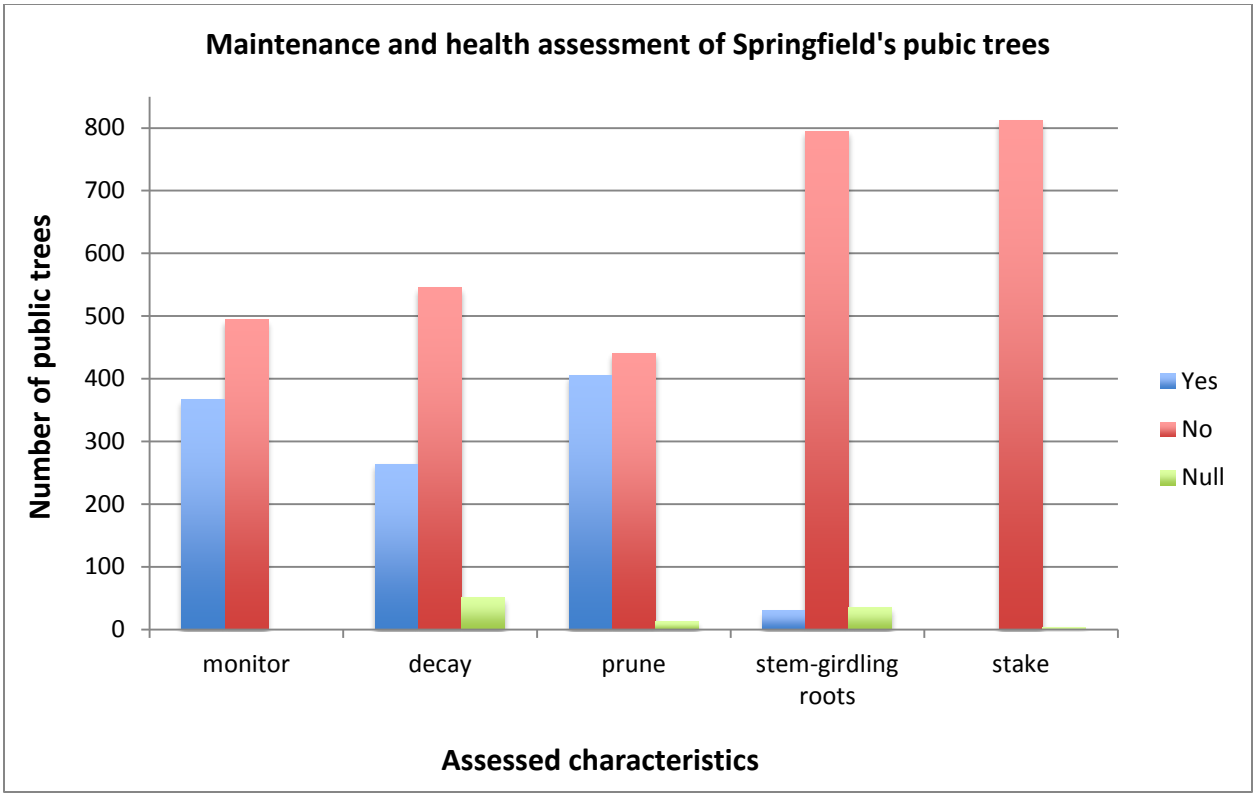



**Figure 9. The number of Springfield's inventoried public trees assessed as having presence or absence of town-specific maintenance and health characteristics. Null values represent the number of unassessed trees, and thus indicate user error. Refer to Table 1 for descriptions of each assessed characteristic.**

## Monetary Value and Ecosystem Services

Springfield's public tree inventory data was analyzed using i-Tree Streets software to determine the monetary value of the ecosystem services provided by the Town's public trees. The 861 trees provide a total of $90,191.00 in annual benefits by filtering air pollutants, mitigating stormwater runoff, sequestering carbon dioxide ($CO_2$), conserving energy, and increasing property values. On average, each public tree offers $104.75 annually in savings or services.

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

It is important to recognize that the trees inventoried through this project are located on approximately 1.62 square miles of Springfield's 49 square miles of total land area; expanding the inventory to all Springfield 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.

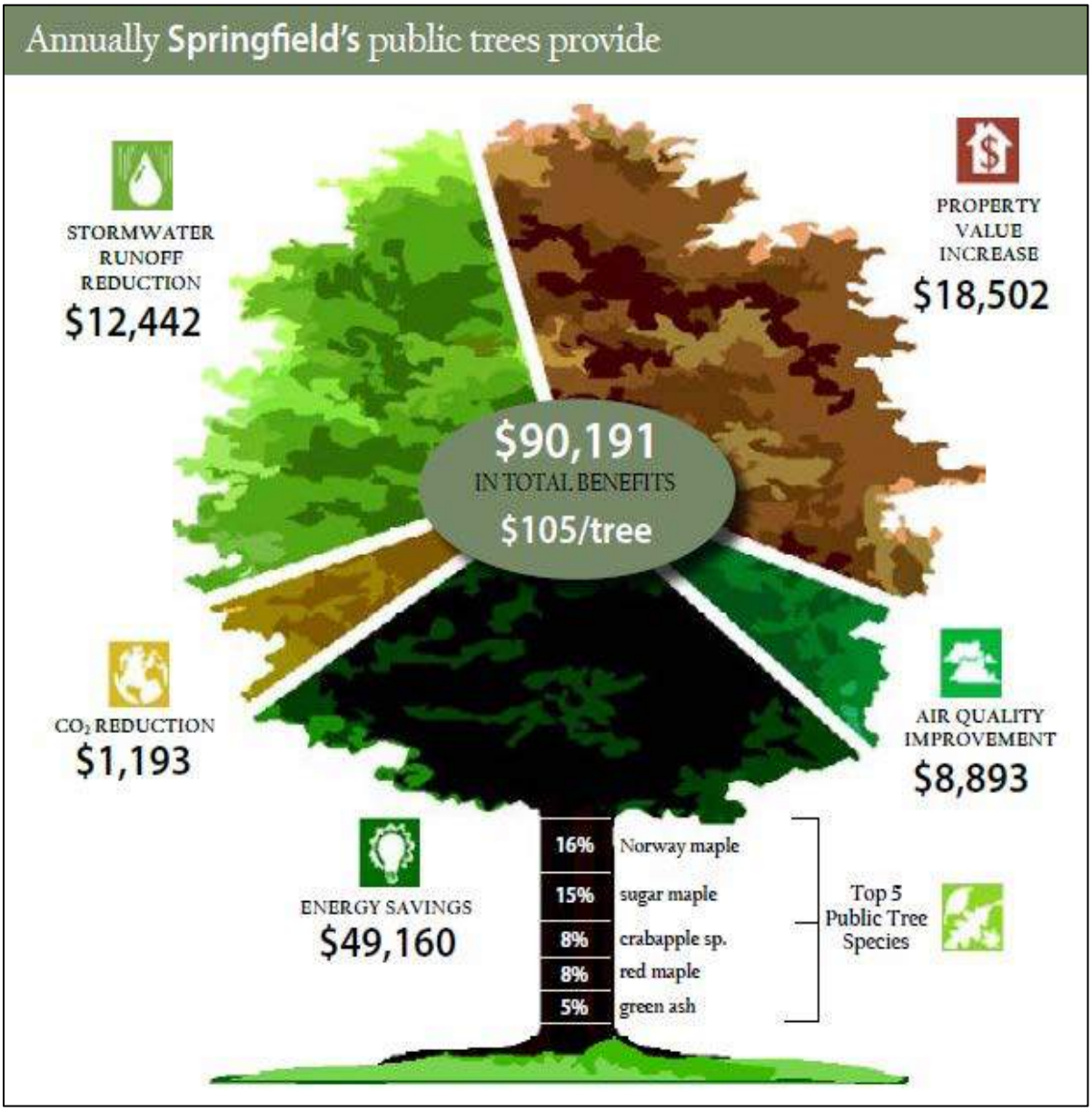



**Figure 10. Summary of the benefits provided by Springfield's public trees inventoried through this project, according to the i-Tree Streets assessment. Tree graphic concept courtesy of City of New York Department of Parks & Recreation.**

**Table 2. Annual environmental and monetary benefits provided by Springfield'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 | $49,160 | $ 57.10 |
| 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. | $1,193 | $ 1.39 |
| 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. | $ 8,893 | $ 10.33 |
| Stormwater | Reductions in annual stormwater run-off due to rainfall interception by trees. | $12,442 | $ 14.45 |
| Aesthetic/other | Tangible and intangible benefits of trees reflected in increases in property values. | $ 18,502 | $ 21.49 |
| 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. | $ 16,179* | $ 18.79* |

Saving the Town and its residents an average of $49,160 annually in energy costs, Springfield's urban forest's most significant analyzed economic benefit is energy conservation (Figure 10). The greatest energy cost savings from the Town's forest is in the form of natural gas (versus electricity), which may be because the Town's primary energy use is natural gas. Of all of Springfield's inventoried species, Norway and sugar maple provide the greatest net annual reduction in energy costs (Figure 11). This is likely partly because these species also have the greatest cumulative leaf area ($ft^2$, Appendix C) of all inventoried species, and thus provide the most shade and temperature regulation. Furthermore, nine of the ten most beneficial energy conservation species are broadleaved (Figure 11), as their larger 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. Of the town's five most common species, Norway and sugar maples are the most prevalent species in Springfield's urban forest, and are thus providing the greatest overall annual net reduction in energy costs for the Town of Springfield. Silver maples, black locusts, and northern red oaks, however, are larger-diameter species in Springfield (Figure 5), and thus provide the greatest mean net annual reduction in energy costs per tree (Figure 11).

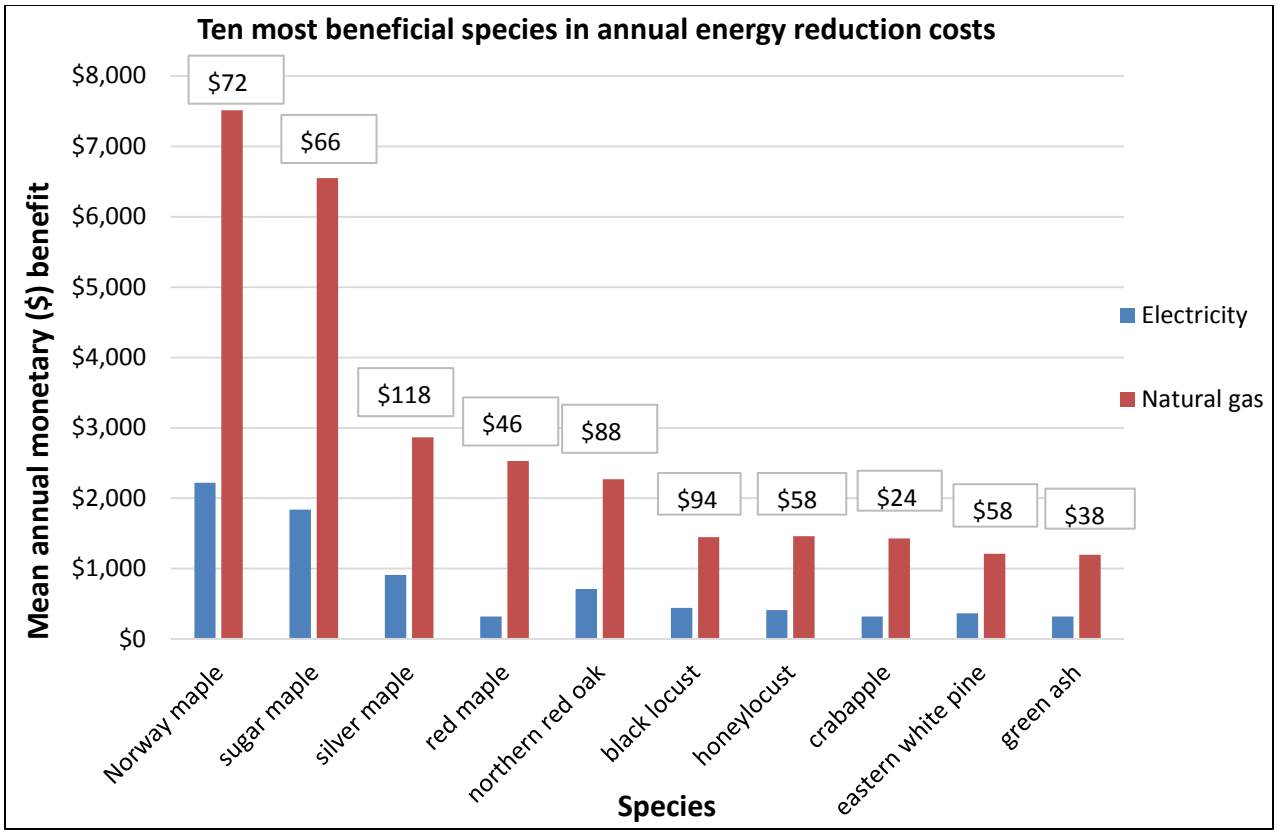



**Figure 11. The average monetary value of the ten most beneficial species in annual energy reduction costs in Springfield's urban forest. The monetary values located above each species' bar represents the average annual energy reduction benefit ($) per tree. Monetary values were derived from tree species,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

Of all the species inventoried in Springfield's urban forest, white oaks and silver maples provide the greatest mean net annual reduction in stormwater costs of about $42 and $41 per tree, respectively (Figure 12). Only two white oak trees are included in Springfield's public forest, so this relatively high monetary stormwater reduction benefit is attributable to their large canopy cover (Appendix C), large DBH's (one is 12-18" and the other is 42+"), and healthy condition. Most inventoried silver maples are large in size (all are above 12" and half are above 30" in diameter), so their older age and greater biomass are lending these trees to greater stormwater reduction benefits. However most (22 of the 33) inventoried silver maples are either in fair or poor condition, which could be why despite this species comparatively greater abundance and larger size classes, it's yielding lower stormwater reduction monetary benefits per tree than the

less abundant and smaller-sized white oaks. All of the ten most beneficial species in reducing Springfield's annual stormwater are deciduous trees (Figure 12).

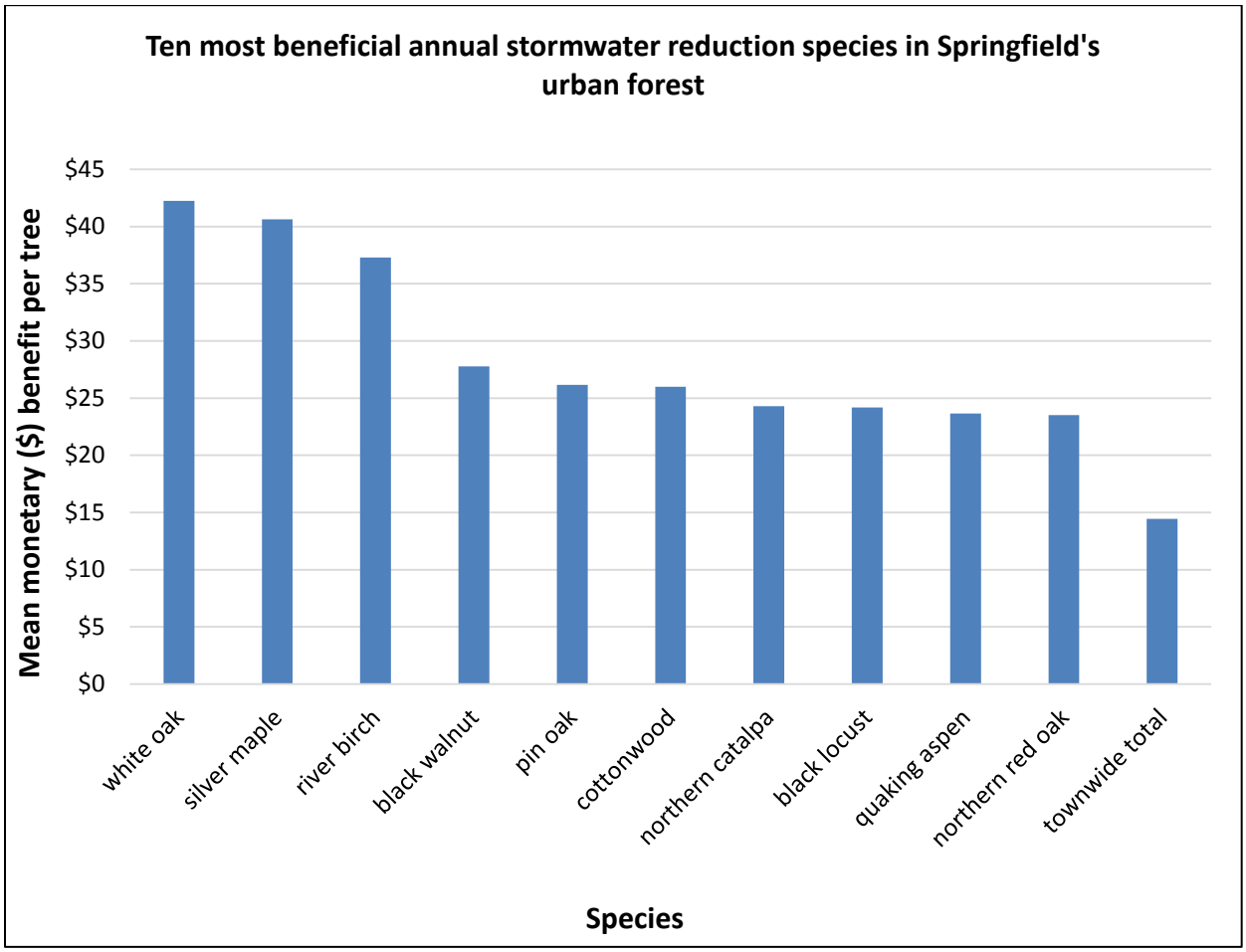



**Figure 12. The average annual monetary value of the ten most beneficial stormwater reduction tree species in Springfield's urban forest. Monetary values were derived from tree species, diameter (inches), and condition inventory data through i-Tree Streets' urban canopy benefits output.**

## Springfield Full Canopy Assessment

As a complement to the public tree inventory, VT UCF staff completed an i-Tree Canopy assessment for the land area covered in the public tree inventory in Springfield. 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 i-Tree Canopy assessment, approximately 56% of Springfield in the land area covered by the tree inventory is currently occupied by tree canopy (Figures 13 and 14). Currently 9% 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, Springfield could potentially increase its total tree canopy cover by an additional 14% on open lands of low-lying vegetation, and 2% on agricultural lands. 5% of Springfield's land cover is water or wetlands, which while not suitable for tree planting provides many other benefits. The remaining 14% 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 overall tree canopy cover in Springfield by 30%, though a portion of this land is privately-owned and/or used for other purposes such as agriculture (Figure 13).

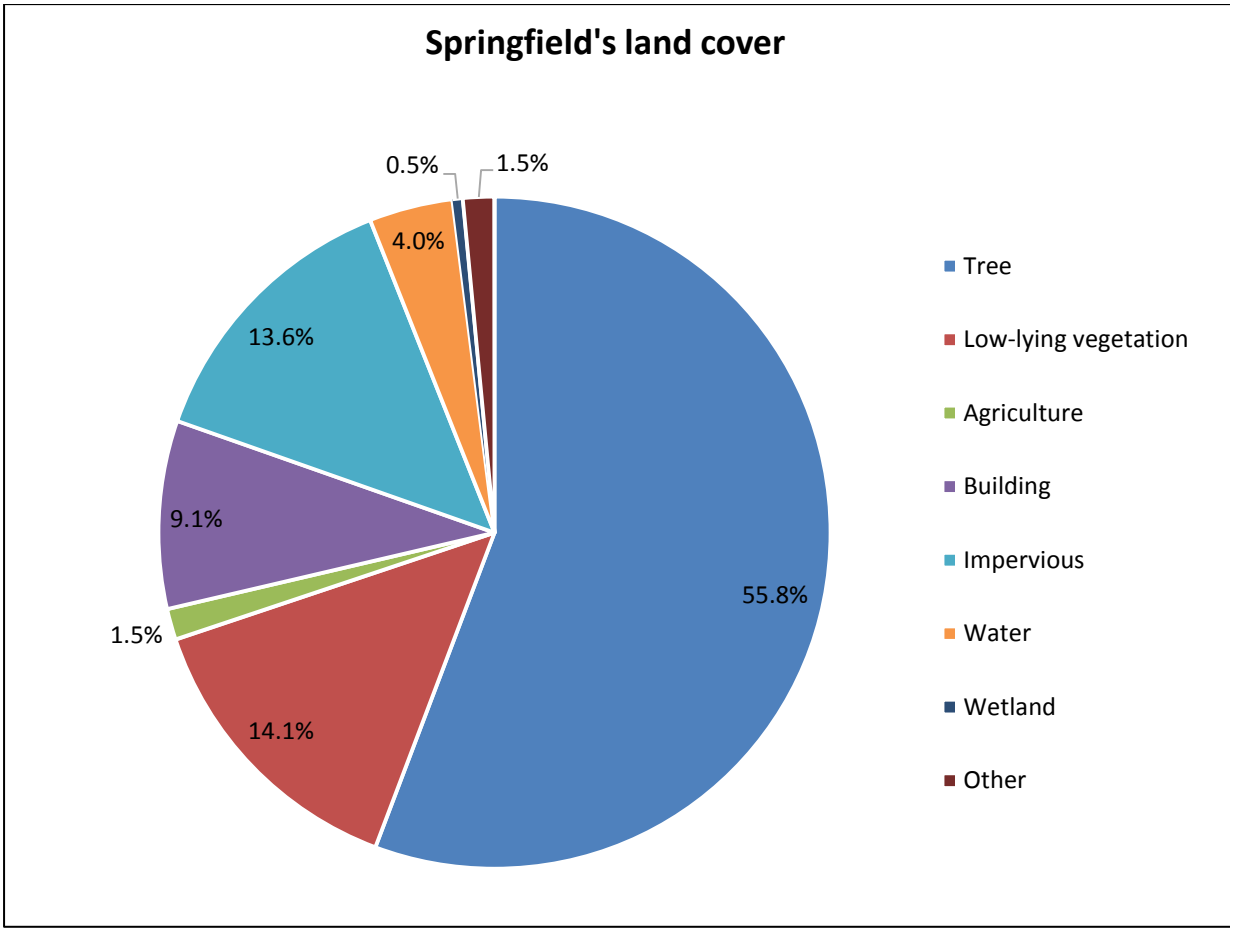
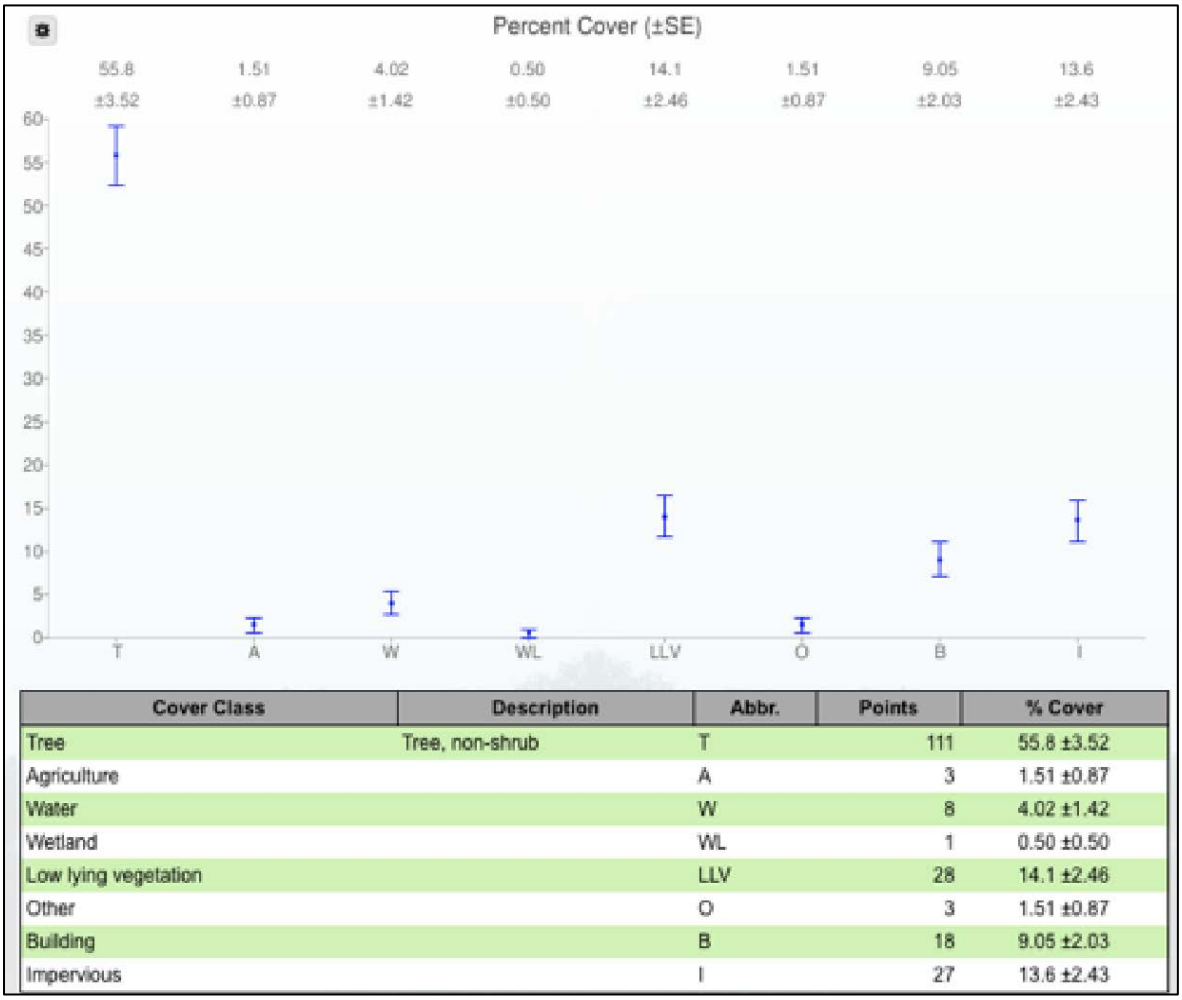



**Figure 13. Land cover of Springfield (includes public and private land).**




| Cover Class | Description | Abbr. | Points | % Cover |
|---|---|---|---|---|
| Tree | Tree, non-shrub | T | 111 | 55.8 ±3.52 |
| Agriculture | | A | 3 | 1.51 ±0.87 |
| Water | | W | 8 | 4.02 ±1.42 |
| Wetland | | WL | 1 | 0.50 ±0.50 |
| Low lying vegetation | | LLV | 28 | 14.1 ±2.46 |
| Other | | O | 3 | 1.51 ±0.87 |
| Building | | B | 18 | 9.05 ±2.03 |
| Impervious | | I | 27 | 13.6 ±2.43 |

**Figure 14. i-Tree Canopy assessment for the area of Springfield, Vermont, including both public and private land. The above image shows the ground cover composition distribution based on 200 points.**

Figure 15 (below) compliments the i-Tree Streets analysis of the monetary value of benefits provided by Springfield's public trees by estimating the air quality benefits and corresponding monetary value for the full urban forest canopy. Of note is an estimated $2,558,115.01 in $CO_2$ storage and $101,447.54 in annual $CO_2$ sequestration.

**Tree Benefit Estimates**

| Abbr. | Benefit Description | Value | ±SE | Amount | ±SE |
|---|---|---|---|---|---|
| CO | Carbon Monoxide removed annually | $21.50 | ±1.36 | 507.11 lb | ±32.01 |
| NO2 | Nitrogen Dioxide removed annually | $37.01 | ±2.34 | 1.38 T | ±0.09 |
| O3 | Ozone removed annually | $1,927.38 | ±121.65 | 13.77 T | ±0.87 |
| PM2.5 | Particulate Matter less than 2.5 microns removed annually | $3,984.25 | ±251.48 | 1,338.21 lb | ±84.47 |
| SO2 | Sulfur Dioxide removed annually | $6.47 | ±0.41 | 1,742.54 lb | ±109.99 |
| PM10* | Particulate Matter greater than 2.5 microns and less than 10 microns removed annually | $1,399.23 | ±88.32 | 4.61 T | ±0.29 |
| CO2seq | Carbon Dioxide sequestered annually in trees | $101,447.54 | ±6,403.17 | 2,803.80 T | ±176.97 |
| CO2stor | Carbon Dioxide stored in trees (Note: this benefit is not an annual rate) | $2,558,115.01 | ±161,463.13 | 70,692.56 T | ±4,461.97 |

**Figure 15. i-Tree Canopy assessment estimates for air quality benefits of Springfield's full canopy.**

## Discussion and Recommendations

### Springfield's Public Tree Program

Springfield'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. Springfield has engaged leadership and residents who are passionate about trees and eager 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 Springfield's public trees, as well as the ways in which residents and town leadership can be engaged for tree stewardship.

#### *Recommendations*

We recommend that Springfield 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 Springfield's public tree program.
- Form a Springfield 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 Springfield 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 (less so) *Fraxinus* (ash) genera, residents should be aware of the signs and symptoms of the Asian long horned beetle (ALB) and emerald ash borer (EAB), 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 urban forest.
- Ensure that those who are caring for Springfield'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 the benefits of Springfield'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 native trees on their private property to increase diversity, overall canopy cover, and the benefits provided by trees in Springfield.

**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, *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 Springfield, 65 species and 31 genera are represented as public trees, indicating diversity in the urban forest. Approximately a third (34%) of the public trees are of species that represent less than 3% of the total tree population. Nearly a half (43%) of public trees inventoried is in the maple (*Acer*) genus, which is significantly over the recommended representation within the public tree population. Norway maple and sugar maple comprise 16% and 15% of *Acer* species diversity, respectively. Norway maple is most prevalent species in Springfield's urban forest and is considered to be a non-native invasive species. Although an urban tolerant and aesthetically pleasing 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 (*Fraxinus*) comprise 6% of Springfield's public tree canopy. Both ash and maple trees are currently threatened by invasive tree pests; EAB and ALB, respectively. While neither of

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

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 urban 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 urban 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 urban 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.

these pests have 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 and maple were observed at Springfield High School, there are numerous green ash concentrated in front of the State complex on Mineral Street, and large densities of maple were also observed on Clinton Street during the inventory. The overall lack of species diversity on Springfield High School's grounds limits the area's resilience to natural disturbances, insects, and disease.

Half of the inventoried public trees are 6-18" in diameter, and 65% of public trees are 6-24", indicating a middle-aged tree population. The context of Springfield's historic mill and manufacturing industries and the recent decades of increased development 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 downtown Springfield. Of note is that only 4% of Springfield's public tree population is in the 0-3" size class and that the majority of young, small trees are located on school grounds, indicating a lack of new street tree plantings by the Town in recent years.

***Recommendations:***

We recommend that Springfield 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 Springfield'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 Springfield, 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 in the future.

- For any future tree plantings at the Springfield High School, focus on increasing species diversity.
- Consider the distribution of size (age) classes in Springfield's current urban forest and consider establishing a young tree planting program for Springfield's streets.
- Refer to the list of 155 identified potential tree planting locations ("vacant" spots) within the public ROW in Appendix A to strategically increase tree species and structural diversity in Springfield. Specifically, there are opportunities to plant trees along the intersection of Pearl Street and Morgan Street
- As Springfield's urban forest continues to mature, promote their health with a systematic structural pruning and maintenance cycle.

**Urban Forest Health**

Overall, Springfield appears to have a fairly healthy population of public trees though a dedicated tree care budget and established maintenance program would further increase the health of the urban forest. Approximately 32% (278) of Springfield's public trees were either considered to be in "Fair" or "Poor" condition and 37 trees were designated as "Dead". There are high concentrations of "Fair", "Poor", and "Dead" trees in Springfield's inventoried public schools, such as the Springfield High School and Riverside Middle School, and on Clinton Street**.** 367 trees were flagged to be revisited by a Certified Arborist, the Springfield 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 decay and stem-girdling roots, and/or the need for pruning (Figure 8). See Appendix E for a map detailing the locations of trees in Springfield by condition and a map indicating the location of the 367 trees requiring monitoring. Low soil volume and fertility, soil compaction, exposure to road salt spray, root damage, mechanical trunk and branch damage, 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 367 trees requiring monitoring will be given to Springfield Town leadership; some recurring themes from these comments are presented in the recommendations below.

***Recommendations:***

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

- Prioritize the monitoring of the 367 trees (which include the 37 dead trees) that have been flagged to be in need of a consult by a Certified Arborist or the Springfield Tree Warden. Specifically, several large silver maples along Olive Street and Norway maples along Furnace Street require monitoring
- Develop a plan to remove – and replace, if appropriate – the 37 dead public trees in a timely fashion. Prioritize the removal of several dead trees located on Gulf Street and the intersection of Union and Grove Street, of the large silver maples on Elm Hill Road and Hillcrest Road, and of the dead and dying spruce trees at Riverside Middle School. A black locust on Lewis Street and a splitting sugar maple on Goodyear Avenue are also recommended to be removed.
- Work with Public Works employees and other staff who are regularly working within the public ROW and on Town-owned properties in Springfield to encourage a culture of regular monitoring of the public trees.
- Assign one Town of Springfield employee to be in charge of updating the tree inventory spreadsheet as necessary as regular tree maintenance and monitoring occurs in Milton.
- A large red maple tree within the public ROW of Cottage Street has been extensively cabled. This is one of the largest inventoried trees in Town, and its cabling should be adjusted in a timely fashion.

## Assessment Tools

Using free i-Tree software developed by the USDA Forest Service, we were able to assess the value and potential expansion of Springfield's urban tree canopy. i-Tree Streets allowed us to determine the economic value of the ecosystem services provided by the 861 inventoried trees in Town. Springfield's forest generates about $90,191 annually through the benefits of air

quality improvement, carbon storage, electricity and natural gas, aesthetics, and storm water mitigation; on average, each tree offers approximately $105 in services or savings every year. 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. The trees of Springfield provide services to the community 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[3]). 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[4]).
- **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[5]). 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.

[3] 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.

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

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

- **Storm water run-off**: Trees and soil improve water quality and reduce costs associated with stormwater treatment by retaining or slowing flow of precipitation.

***Recommendation:***

We recommend that Springfield leadership and residents 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 urban 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 Springfield 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 Springfield leadership based on long-term vision and capacity. Looking ahead, the Town of Springfield should focus efforts on maintaining the quality of the urban trees and consider implementing a young tree planting program to diversify the age class of its overall public tree population. With improved monitoring, regular maintenance, and an engaged and informed citizenry, the potential for a healthy, sustainable urban forest is attainable.

## Appendices

### Appendix A: Full Street and Site List for the Springfield Inventory

| Street/site name | ROW Extent (feet) | Number of Trees | Number of Vacant Spots or Strips |
|---|---|---|---|
| Bacon Street | 49.5 | 2 | 2 |
| Bellevue Street | 33 | 2 | 0 |
| Birch Court | 49.5 | 8 | 0 |
| Bridge Street | 49.5 | 13 | 0 |
| Center Street | 49.5 | 4 | 1 |
| Cherry Hill | 49.5 | 5 | 0 |
| Circular Street | 49.5 | 6 | 0 |
| Clinton Street | 100 | 70 | 24 |
| Common Street | 49.5 | 16 | 0 |
| Commonwealth Avenue | 49.5 | 11 | 25 |
| Cottage Avenue | 49.5 | 4 | 5 |
| Crescent Street | 49.5 | 12 | 1 |
| Curtis Street | 33 | 1 | 0 |
| Cutler Drive | 49.5 | 15 | 9 |
| Dean Street | 49.5 | 0 | 1 |
| Derby Court | 49.5 | 1 | 0 |
| Earle Street | 33 | 1 | 0 |
| East Lane | 49.5 | 9 | 8 |
| Ellis Street | 33 | 4 | 0 |
| Elm Hill Road | 33 | 5 | 0 |
| Elm Street | 33 | 4 | 0 |
| Elm Terrace | 33 | 1 | 0 |
| Essex Street | 49.5 | 7 | 0 |
| Fairview Street | 49.5 | 2 | 0 |
| Foster Avenue | 49.5 | 0 | 2 |
| Franklin Street | 49.5 | 3 | 0 |
| Front Street | 49.5 | 20 | 0 |
| Furnace Street | 49.5 | 15 | 0 |
| Garfield Avenue | 49.5 | 6 | 0 |
| Goodyear Avenue | 49.5 | 6 | 0 |
| Grove Street | 49.5 | 3 | 0 |
| Gulf Street | 49.5 | 7 | 0 |

| | | | |
|---|---|---|---|
| Hartness Street | 49.5 | 22 | 0 |
| Harvard Street | 33 | 16 | 0 |
| Herrick Street | 49.5 | 8 | 3 |
| High Street | 49.5 | 5 | 5 |
| Hillcrest Road | 33 | 14 | 0 |
| Lamson Avenue | 49.5 | 3 | 2 |
| Lewis Street | 49.5 | 8 | 3 |
| Litchfield Street | 33 | 3 | 0 |
| Mary Street | 33 | 1 | 0 |
| Merrill Street | 49.5 | 16 | 1 |
| Mineral Street | 49.5 | 13 | 2 |
| Morgan Street | 49.5 | 2 | 2 |
| Morse Street | 49.5 | 4 | 0 |
| Mt. Vernon Street | 49.5 | 14 | 3 |
| Myrtle Street | 49.5 | 7 | 3 |
| Olive Street | 49.5 | 13 | 0 |
| Orchard Street | 49.5 | 9 | 3 |
| Park Ridge Road | 49.5 | 7 | 3 |
| Park Street | 49.5 | 12 | 16 |
| Pearl Street | 49.5 | 2 | 3 |
| Pine Street | 49.5 | 9 | 2 |
| Pleasant Street | 49.5 | 11 | 0 |
| Poplar Street | 49.5 | 6 | 0 |
| Prospect Street | 49.5 | 27 | 0 |
| Randall Street | 33 | 2 | 0 |
| Reed Street | 49.5 | 11 | 0 |
| Rita Street | 33 | 2 | 0 |
| Royal Street | 49.5 | 7 | 0 |
| School, NS | 49.5 | 180 | 0 |
| Slack Avenue | 49.5 | 3 | 0 |
| South Street | 49.5 | 0 | 3 |
| Summer Hill Street | 49.5 | 14 | 0 |
| Summer Street | 49.5 | 28 | 4 |
| Union Street | 49.5 | 16 | 7 |
| Valley Street | 49.5 | 1 | 0 |
| Velma Street | 33 | 1 | 0 |
| Wall Street | 49.5 | 21 | 3 |

| | | | |
|---|---|---|---|
| Wall Street Court | 49.5 | 1 | 0 |
| Walnut Street | 49.5 | 1 | 1 |
| Whitcomb Street | 49.5 | 1 | 8 |
| Woolson Avenue | 49.5 | 11 | 0 |
| Greenspaces: Elm Hill School, Union Street Elementary School, Park Street School, Springfield High School, Riverside Middle School, Freedom Park, Springfield Police Dept. | N/A | 66 | 0 |
| **TOTAL** | | **861** | **155** |

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

| Common Name | Scientific Name | Number of Trees | Percent of Total Population |
|---|---|---|---|
| Norway maple | *Acer platanoides* | 136 | 15.80% |
| sugar maple | *Acer saccharum* | 128 | 14.87% |
| crabapple | *Malus* sp. | 73 | 8.48% |
| red maple | *Acer rubrum* | 67 | 7.78% |
| green ash | *Fraxinus pennsylvanica* | 40 | 4.65% |
| northern red oak | *Quercus rubra* | 34 | 3.95% |
| honeylocust | *Gleditsia triacanthos* | 32 | 3.72% |
| silver maple | *Acer saccharinum* | 32 | 3.72% |
| eastern white pine | *Pinus strobus* | 27 | 3.14% |
| pear | *Pyrus sp.* | 22 | 2.56% |
| balsam fir | *Abies balsamea* | 21 | 2.44% |
| black locust | *Robinia pseudoacacia* | 20 | 2.32% |
| eastern hemlock | *Tsuga canadensis* | 19 | 2.21% |
| American elm | *Ulmus americana* | 18 | 2.09% |
| blue spruce | *Picea pungens* | 16 | 1.86% |
| white ash | *Fraxinus americana* | 15 | 1.74% |
| Norway spruce | *Picea abies* | 13 | 1.51% |
| white spruce | *Picea glauca* | 13 | 1.51% |
| paper birch | *Betula papyrifera* | 11 | 1.28% |
| northern white cedar | *Thuja occidentalis* | 9 | 0.58% |
| American basswood | *Tilia americana* | 8 | 0.93% |
| eastern red cedar | *Juniperus virginiana* | 7 | 0.81% |
| birch | *Betula sp.* | 6 | 0.70% |
| broadleaf deciduous medium | N/A | 5 | 0.58% |
| spruce | *Picea sp.* | 5 | 0.58% |
| black cherry | *Prunus serotina* | 4 | 0.46% |
| boxelder | *Acer negundo* | 4 | 0.46% |
| pin oak | *Quercus palustris* | 4 | 0.46% |
| serviceberry | *Amelanchier sp.* | 4 | 0.46% |
| black walnut | *Juglans nigra* | 3 | 0.35% |
| cherry plum | *Prunus sp.* | 3 | 0.35% |
| conifer evergreen large | N/A | 3 | 0.35% |
| freeman maple | *Acer x freemanii* | 3 | 0.35% |
| hawthorn | *Crataegus sp.* | 3 | 0.35% |
| Japanese tree lilac | *Syringa reticulata* | 3 | 0.35% |
| mountain ash | *Sorbus americana* | 3 | 0.35% |

| | | | |
|---|---|---|---|
| Quaking aspen | *Populus tremuloides* | 3 | 0.35% |
| red pine | *Pinus resinosa* | 3 | 0.35% |
| lilac | *Syringa sp.*<br>*Pinus sylvestris* | 3 | 0.35% |
| balsam poplar | *Populus balsamifera* | 2 | 0.23% |
| beech | *Fagus sp.* | 2 | 0.23% |
| catalpa | *Catalpa sp.* | 2 | 0.23% |
| common chokecherry | *Prunus virginiana* | 2 | 0.23% |
| conifer evergreen small | N/A | 2 | 0.23% |
| cottonwood | *Populus sp.* | 2 | 0.23% |
| dogwood | *Cornus sp.* | 2 | 0.23% |
| littleleaf linden | *Tilia cordata* | 2 | 0.23% |
| oak | *Quercus sp.* | 2 | 0.23% |
| plum | *Prunus sp.* | 2 | 0.23% |
| white oak | *Quercus alba* | 2 | 0.23% |
| basswood | *Tilia sp.* | 1 | 0.12% |
| broadleaf deciduous small | N/A | 1 | 0.12% |
| butternut | *Juglans sp.* | 1 | 0.12% |
| conifer evergreen medium | N/A | 1 | 0.12% |
| elm | *Ulmus sp.* | 1 | 0.12% |
| fir | *Abies sp.* | 1 | 0.12% |
| ginkgo | *Ginkgo sp.* | 1 | 0.12% |
| grey birch | *Betula populifolia* | 1 | 0.12% |
| hickory | *Carya sp.* | 1 | 0.12% |
| maple | *Acer sp.* | 1 | 0.12% |
| pine | *Pinus sp.* | 1 | 0.12% |
| river birch | *Betula nigra* | 1 | 0.12% |
| Scots pine | *Pinus sylvestris* | 1 | 0.12% |
| white fir | *Abies concolor* | 1 | 0.12% |
| willow | *Salix sp.* | 1 | 0.12% |

**Appendix C: Leaf Area and Canopy Cover by Species Comprising Springfield's Urban Forest**

| Species | Number of Trees | % of Total Trees | Leaf Area (ft2) | % of Total Leaf Area | Canopy Cover (ft2) | % of Total Canopy Cover |
|---|---|---|---|---|---|---|
| Norway maple | 136 | 15.80 | 418,348.05 | 17.59 | 155,150.99 | 20.43 |
| sugar maple | 128 | 14.87 | 553,146.76 | 23.26 | 126,108.90 | 16.60 |
| crabapple | 73 | 8.48 | 46,524.50 | 1.96 | 20,634.53 | 2.72 |
| red maple | 70 | 8.13 | 156,837.05 | 6.59 | 46,750.05 | 6.16 |
| green ash | 40 | 4.65 | 55,630.87 | 2.34 | 19,474.56 | 2.56 |
| northern red oak | 34 | 3.95 | 147,449.32 | 6.20 | 53,255.11 | 7.01 |
| silver maple | 32 | 3.72 | 280,281.15 | 11.79 | 70,517.19 | 9.28 |
| honeylocust | 32 | 3.72 | 60,424.50 | 2.54 | 26,562.10 | 3.50 |
| eastern white pine | 27 | 3.14 | 58,801.46 | 2.47 | 24,844.65 | 3.27 |
| callery pear | 22 | 2.56 | 9,850.46 | 0.41 | 3,650.74 | 0.48 |
| balsam fir | 22 | 2.56 | 32,094.51 | 1.35 | 13,054.07 | 1.72 |
| lack locust | 20 | 2.32 | 101,805.60 | 4.28 | 30,667.71 | 4.04 |
| eastern hemlock | 19 | 2.21 | 12,618.61 | 0.53 | 8,794.09 | 1.16 |
| American elm | 18 | 2.09 | 37,946.12 | 1.60 | 10,685.75 | 1.41 |
| blue spruce | 16 | 1.86 | 23,328.75 | 0.98 | 9,494.06 | 1.25 |
| white ash | 15 | 1.74 | 52,180.17 | 2.19 | 18,638.85 | 2.45 |
| white spruce | 13 | 1.51 | 23,254.41 | 0.98 | 9,762.14 | 1.29 |
| Norway spruce | 13 | 1.51 | 29,764.10 | 1.25 | 12,667.03 | 1.67 |
| paper birch | 11 | 1.28 | 23,042.42 | 0.97 | 8,152.60 | 1.07 |
| northern white cedar | 9 | 1.05 | 6,183.87 | 0.26 | 4,702.77 | 0.62 |
| American basswood | 8 | 0.93 | 34,927.34 | 1.47 | 8,898.50 | 1.17 |
| eastern red cedar | 7 | 0.81 | 7,512.45 | 0.32 | 5,473.55 | 0.72 |
| birch sp. | 7 | 0.81 | 14,928.66 | 0.63 | 4,224.18 | 0.56 |
| spruce sp. | 5 | 0.58 | 6,954.79 | 0.29 | 2,814.81 | 0.37 |
| broadleaf deciduous medium | 5 | 0.58 | 9,731.15 | 0.41 | 2,685.94 | 0.35 |
| broadleaf deciduous small | 4 | 0.46 | 2,785.45 | 0.12 | 1,552.24 | 0.20 |
| serviceberry | 4 | 0.46 | 519.99 | 0.02 | 362.98 | 0.05 |
| black cherry | 4 | 0.46 | 4,278.28 | 0.18 | 2,042.30 | 0.27 |
| pin oak | 4 | 0.46 | 19,910.79 | 0.84 | 6,968.69 | 0.92 |
| pine sp. | 4 | 0.46 | 8,328.18 | 0.35 | 3,493.12 | 0.46 |
| boxelder | 4 | 0.46 | 8,947.24 | 0.38 | 3,737.44 | 0.49 |
| black walnut | 3 | 0.35 | 18,388.81 | 0.77 | 5,015.18 | 0.66 |
| quaking aspen | 3 | 0.35 | 14,994.89 | 0.63 | 4,468.40 | 0.59 |
| Japanese tree lilac | 3 | 0.35 | 727.15 | 0.03 | 483.48 | 0.06 |

| | | | | | | |
|---|---|---|---|---|---|---|
| coniferous evergreen large | 3 | 0.35 | 3,444.60 | 0.14 | 1,441.41 | 0.19 |
| American mountain ash | 3 | 0.35 | 1,452.21 | 0.06 | 810.10 | 0.11 |
| cherry plum | 3 | 0.35 | 993.80 | 0.04 | 637.97 | 0.08 |
| hawthorn | 3 | 0.35 | 727.15 | 0.03 | 483.48 | 0.06 |
| northern catalpa | 2 | 0.23 | 9,408.46 | 0.40 | 3,021.99 | 0.40 |
| plum | 2 | 0.23 | 526.64 | 0.02 | 335.98 | 0.04 |
| balsam poplar | 2 | 0.23 | 6,234.73 | 0.26 | 2,221.20 | 0.29 |
| beech sp. | 2 | 0.23 | 6,234.73 | 0.26 | 2,221.20 | 0.29 |
| white oak | 2 | 0.23 | 16,308.87 | 0.69 | 5,509.72 | 0.73 |
| common chokecerry | 2 | 0.23 | 934.31 | 0.04 | 603.99 | 0.08 |
| coniferous evergreen small | 2 | 0.23 | 2,565.86 | 0.11 | 545.82 | 0.07 |
| dogwood sp. | 2 | 0.23 | 667.66 | 0.03 | 449.51 | 0.06 |
| littleleaf linden | 2 | 0.23 | 3,855.01 | 0.16 | 1,496.81 | 0.20 |
| cottonwood | 2 | 0.23 | 10,732.47 | 0.45 | 3,354.05 | 0.44 |
| oak sp. | 2 | 0.23 | 6,776.70 | 0.28 | 2,341.76 | 0.31 |
| elm sp. | 1 | 0.12 | 1,707.72 | 0.07 | 433.77 | 0.06 |
| white fir | 1 | 0.12 | 2,636.35 | 0.11 | 1,131.63 | 0.15 |
| coiniferous evergreen medium | 1 | 0.12 | 319.99 | 0.01 | 221.67 | 0.03 |
| gray birch | 1 | 0.12 | 1,629.58 | 0.07 | 419.32 | 0.06 |
| willow sp. | 1 | 0.12 | 2,803.45 | 0.12 | 848.97 | 0.11 |
| butternut | 1 | 0.12 | 1,441.02 | 0.06 | 555.05 | 0.07 |
| Scots pine | 1 | 0.12 | 2,636.35 | 0.11 | 1,131.63 | 0.15 |
| river birch | 1 | 0.12 | 8,187.63 | 0.34 | 2,236.32 | 0.29 |
| hickory sp. | 1 | 0.12 | 559.49 | 0.02 | 184.25 | 0.02 |
| basswood sp. | 1 | 0.12 | 2,315.91 | 0.10 | 766.51 | 0.10 |
| ginkgo sp. | 1 | 0.12 | 554.11 | 0.02 | 329.10 | 0.04 |
| maple sp. | 1 | 0.12 | 55.94 | 0.00 | 13.64 | 0.00 |
| **Total** | **861** | **100.00** | **2,378,158.56** | **100.00** | **759,535.52** | **100.00** |

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

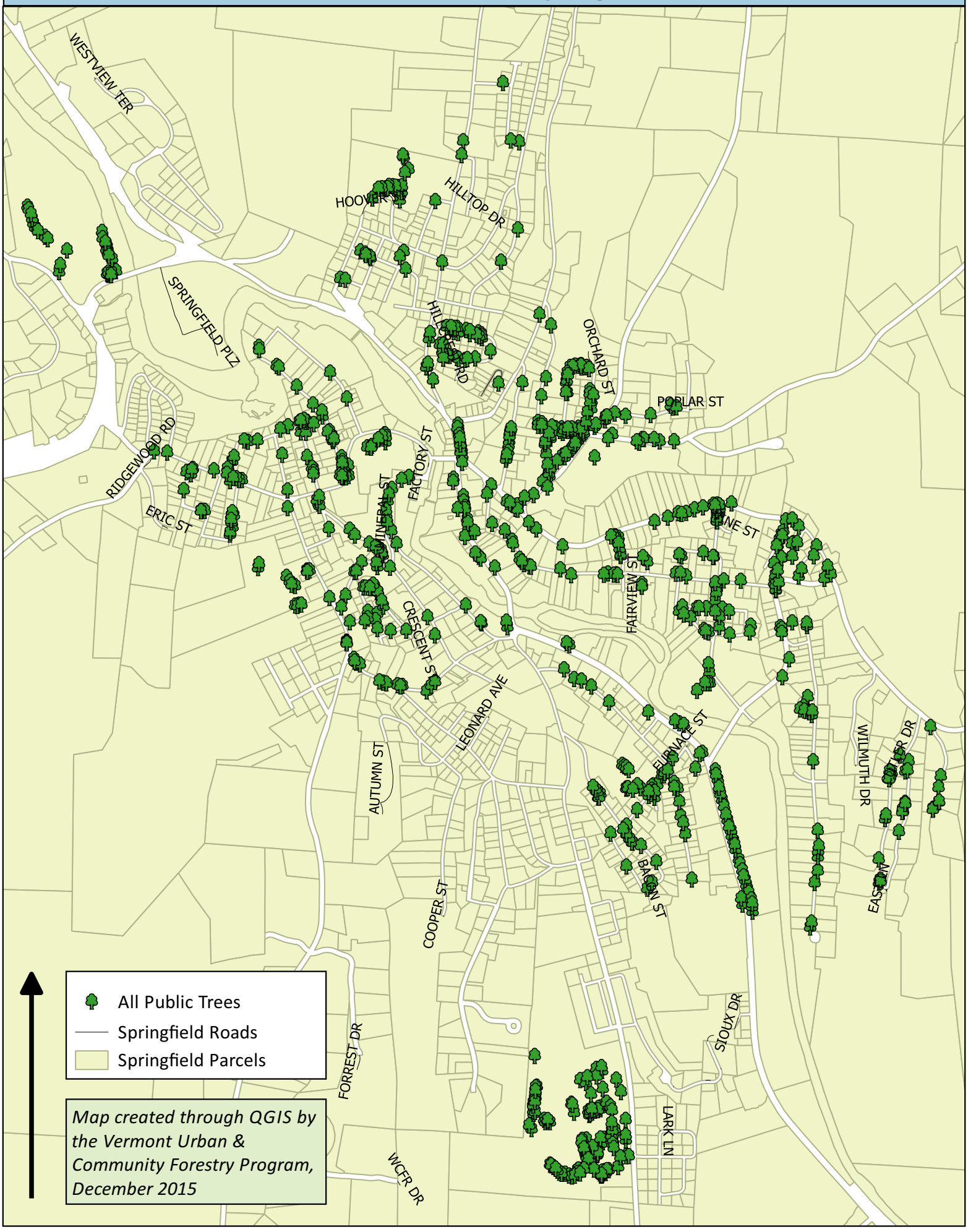
Anyone with Internet access can view all of the inventoried Springfield public trees by using the Vermont Agency of Natural Resources' (ANR) Atlas mapping tool. Follow these simple steps:

1. Set your web browser (Internet Explorer works best; Chrome does not work) to http://anrmaps.vermont.gov/websites/anra/ (or do a web search for "VT ANR Atlas").
2. Zoom in to Springfield 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 inventory area 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.

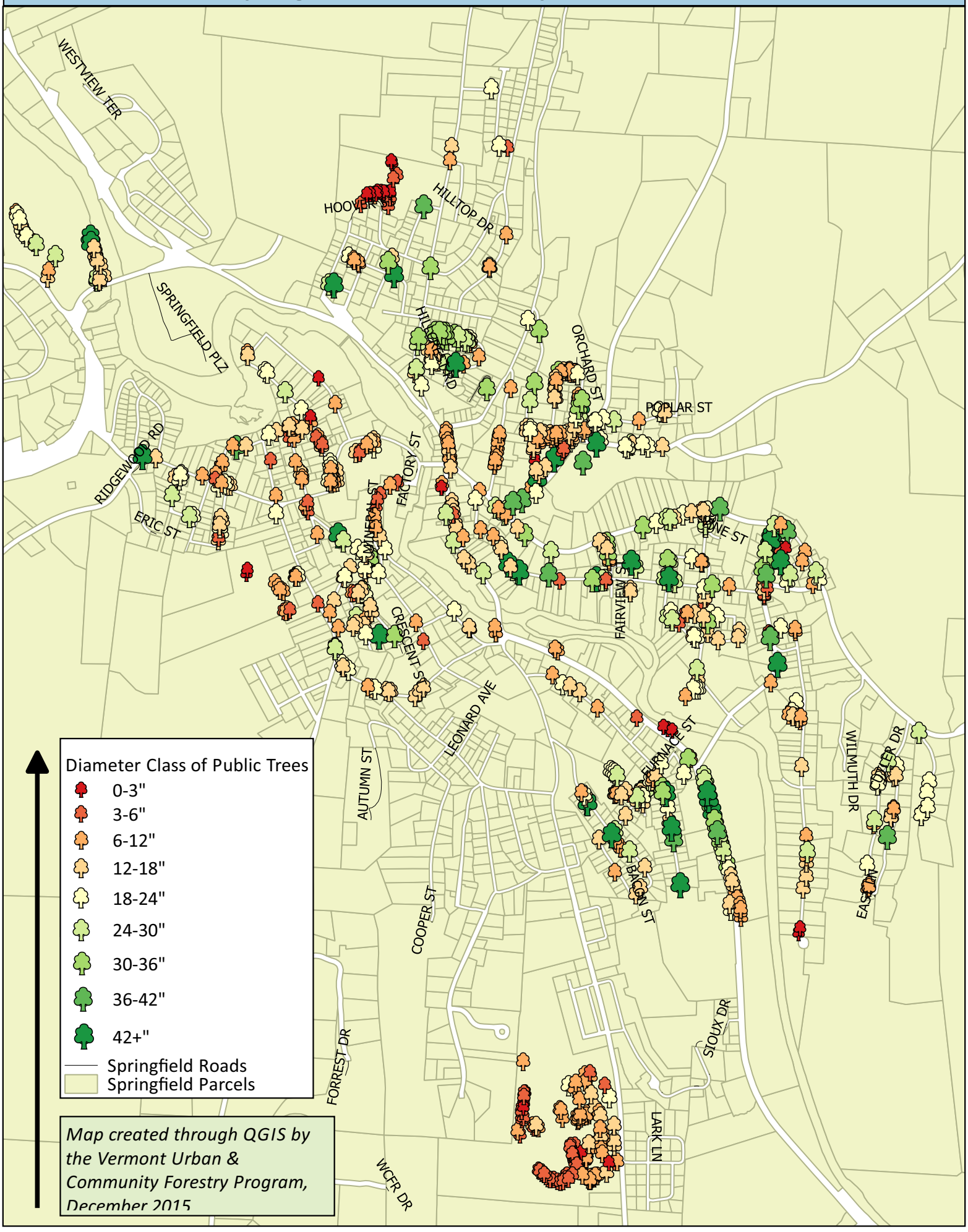
## Appendix E: Maps

1. All Public Trees Inventoried in Springfield
2. All Public Trees Inventoried in Springfield by DBH Class
3. All Public Trees Inventoried in Springfield by Condition Class
4. Public Trees Requiring Monitoring in Springfield
5. Public Ash Trees in Springfield
6. Potential Public Tree Planting Locations in Springfield

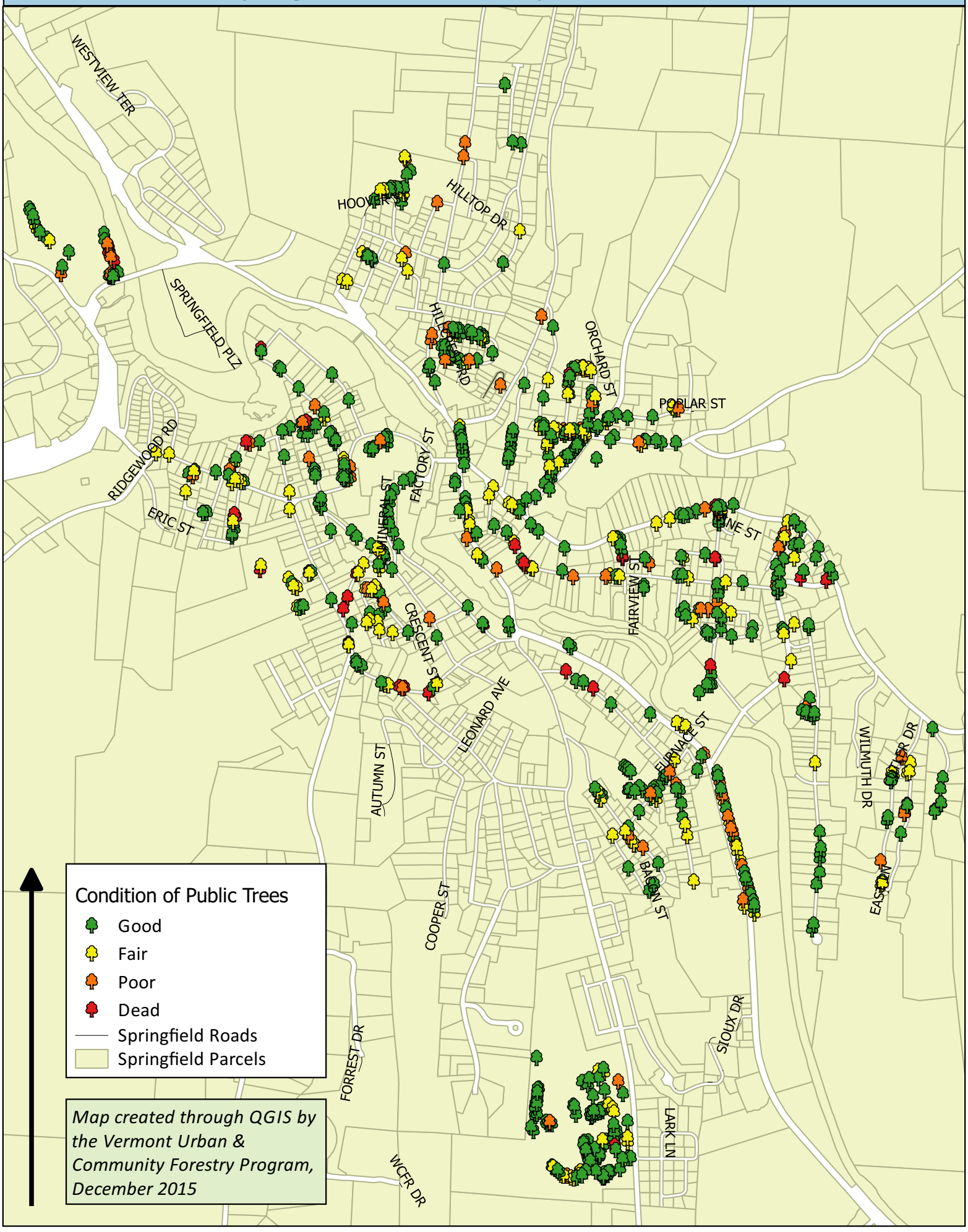
# All Public Trees in Springfield



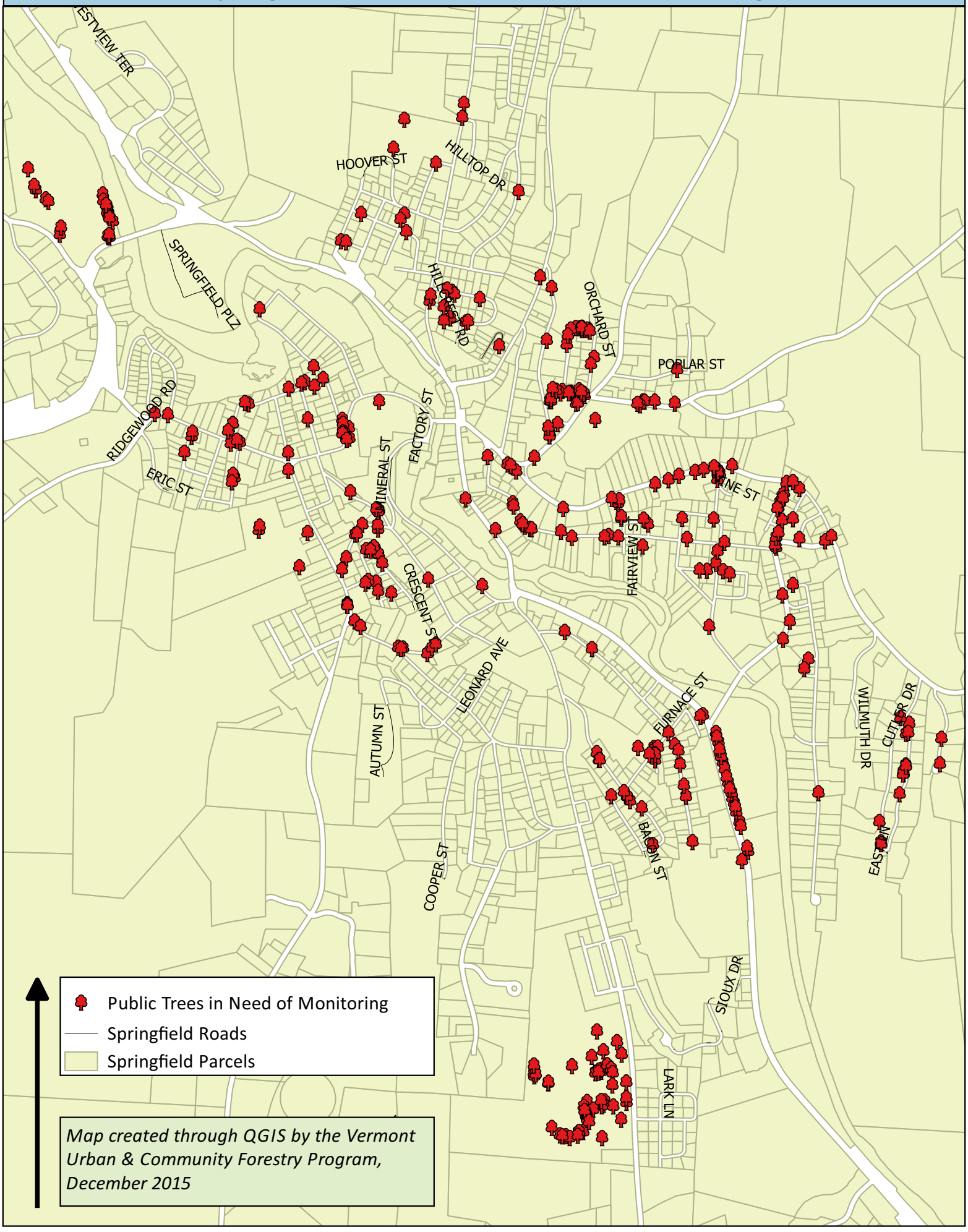
# Springfield Public Trees by Diameter Class



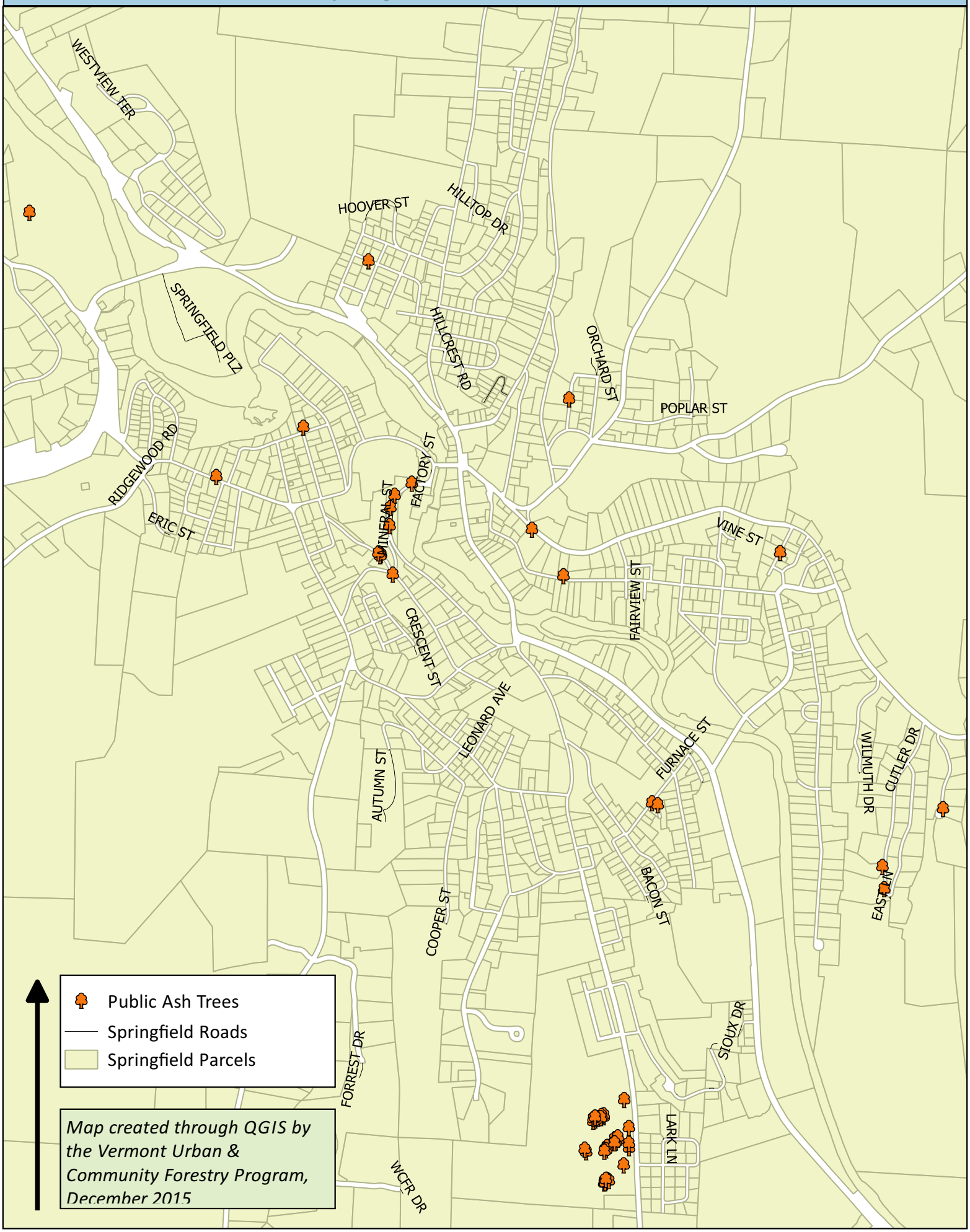
# Springfield Public Trees by Condition Class



# Springfield Public Trees in Need of Monitoring



# Springfield Public Ash Trees



# Potential Public Tree Planting Locations in Springfield