Rockingham Public Tree Inventory Report

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

VERMONT URBAN & COMMUNITY FORESTRY PROGRAM

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 Rockingham, Vermont during the summer of 2015. We would like to thank the main contacts for this project: Ellen Howard and Polly Thompson, both residents and members of the Rockingham Tree Committee. 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 Rockingham. 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 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.

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Executive Summary

The goals of Rockingham's public tree inventory were to update the town's current tree inventory in a single electronic file, accurately locate and assess Town-owned trees within the public right-of-way (ROW), assess health and maintenance needs of public trees, identify potential tree planting locations within the ROW, and provide a continuum of accurate public tree information for the members of the Rockingham Tree Committee. The information collected through the inventory and presented in this report provides residents and decisions-makers with a better understanding of the composition, health, and benefits of Rockingham's community forest and will allow the Rockingham Tree Committee, the Rockingham Tree Warden and Deputy Tree Warden, and the Rockingham Highway Department 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 the members of the Rockingham Tree Committee, and was approved by Ellen Howard before she retired as the Rockingham Planning – Zoning Administrator. VT UFC and VT FPR staff completed an inventory of **489 trees** located within the public ROW of **24 streets** and on **5 Town-owned properties,** and identified **83 potential tree planting locations**. The inventory was focused on the Village of Bellows Falls, the Village of Saxtons River, and the Rockingham Meeting House. The data collected in the inventory was 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 Rockingham.

Local government, town boards and committees, conservation agencies, and private landowners all play an important role in monitoring and maintaining urban and 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 489 public trees that were inventoried provide an estimated $**46,568 in benefits annually** to the residents of Rockingham. 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 47% and an estimated long-term **stored CO_2 value of over $1.2 million.**

Summary of Findings

Forest Diversity

- Of the 489 public trees, there are 46 different species in 28 different genera.
- The top five most common tree genera by number of trees are *Acer* (maple) at 29%, *Malus* (apple) at 15%, *Gleditsia* (honeylocust) at 7%, *Thuja* (cedar) at 7%, and *Quercus* (oak) at 6%.
- *Acer* (maple) and *Fraxinus* (ash) species together represent 33% percent of Rockingham'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 top five most common species are *Malus species* (crabapple) at 15%, *Acer platanoides* (Norway maple) at 15%, *Acer saccharum* (sugar maple) at 9%, *Gleditsia triacanthos* (honeylocust) at 7%, and *Thuja occidentalis* (northern white cedar) at 6%.

Forest Structure

- Nearly half of inventoried public trees (48%) have a diameter at breast height (DBH) measurement of 6-18"; 26% of inventoried public trees have a DBH within the 6-12" size class and 22% of the inventoried trees have DBH measurements in the 12-18" size class.
- The remaining 46% of inventoried trees were represented in the following size categories: 0- 3" (8%), 3-6" (14%), 18-24" (15%), 24-30" (8%), 30-36" (4%), 36-42" (3%), and 42"+ (1%).

Forest Cover

- There is an existing urban tree canopy (UTC) cover of 47% within the extent of the Rockingham 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 39% of the land surface; these "possible UTC" areas include grass, agricultural land, and impervious surfaces (e.g. parking lots, paved playgrounds, and the ROW).
- 83 potential tree planting locations were identified within the ROW.
- The remaining 14% of Rockingham's area is buildings, streets, water, and other permanent features and is generally unsuited to UTC improvement.

Forest Health

- Nearly three quarters (367, or 74%) of the trees inventoried were assessed as being in "Good" condition. Of the remaining trees, 83 (17%) were considered to be in "Fair" condition, 39 (8%) were in "Poor" condition and 4 (0.8%) were "Dead".
- 190 trees were flagged as in need of monitoring by a Certified Arborist, the 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 Rockingham's public tree inventory: presence of crown dieback, presence of decay, visible root condition, and pruning needs.
- 88 of Rockingham's public trees were assessed as having crown dieback.
- 156 of Rockingham's public trees exhibited signs of decay.
- 171 of Rockingham's public trees were flagged as having root issues (stem-girdling roots, compacted soil, exposed roots, or mechanical injury to the root area).
- 277 of Rockingham's public trees were assessed to be in need of pruning.

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 Rockingham public tree inventory, our priority recommendations for the Town of Rockingham are:

- Enhance and promote longevity of the relatively young public tree population by establishing a systematic and routine structural pruning program.
- Prioritize the timely assessment and, if needed, maintenance of the 190 trees that were identified as being in need of monitoring.
- Use the Rockingham public tree inventory to strategically guide the direction of the Rockingham Tree Committee's tree planting efforts; there were 83 potential public tree planting locations identified.

Inventorying the trees in downtown Bellows Falls was a priority of the Rockingham public tree inventory. Photograph by Eric H. from http://www.visitingnewengland.com/scenesofnewengland99.html

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 Rockingham Tree Committee was interested in partnering with VT UCF on the *Care of the Urban Forest* project in part to conduct a full public tree inventory of the Villages of Bellows Falls and Saxtons River 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 Rockingham to better understand, steward, and manage its public trees more efficiently and cost effectively. The specific goals of Rockingham's public trees inventory were to update the town's current tree inventory in a single electronic file, accurately locate and assess Town-owned trees within the public ROW, assess health and maintenance needs of public trees, identify potential tree planting locations within the ROW, and provide a continuum of accurate public tree information for the members of the Rockingham Tree Committee. The Rockingham Tree Committee, the Rockingham Tree Warden and Deputy Tree Warden, and the Rockingham Highway Department are all engaged in tree management and stewardship in Rockingham. The public tree inventory will provide a foundation for future management decisions and improvements to the community forest. Additionally, benefits of community forests, such as the improvement of air and water quality and increased property value, will increase when the Town of Rockingham is able to manage and support healthy public trees.

Town Profile

The Town of Rockingham is in Windham County, located in southeastern Vermont, on the banks of the Connecticut River. In population and in its impact on the region, it is the second largest community in Windham County. Roughly 40 square miles in area, Rockingham is predominantly rural and forested, but also includes densely-settled residential neighborhoods, commercial centers, and several industrial areas. Of approximately 5,300 residents, about 4,000 live within two incorporated villages, Bellows Falls and Saxtons River. The other small hamlets of Bartonsville, Brockways Mills, and Cambridgeport are located on the Connecticut River or one of two tributaries to the Connecticut, the Williams and Saxtons Rivers[1].

Methodology

Prior to the Rockingham public tree inventory, VT UCF staff met with the Rockingham Tree Committee for planning purposes. Originally, 24 streets in Bellows Falls and Saxtons River were identified to be included in the inventory, as well as a number of priority Town-owned properties like the Rockingham Meeting House. In total, the land area covered by the inventory was about .87

[1] Town of Rockingham. Accessed 2015 at http://www.rockbf.org/

Importance of Inventory and Urban Forestry in Vermont

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

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

square mile, representing less than 5% of the total land area of Rockingham, but including the most densely populated sections of town. The ROW boundaries for all streets were provided by the Rockingham Tree Committee in consultation with Town administration. 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 has developed a tree 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, for data collection and is linked to the publicly-accessible ANR Atlas online mapping website. All inventory data collected on public trees in Rockingham is available for viewing on ANR Atlas and instructions are included in Appendix D.

Throughout the month of July 2015 VT FPR State Lands Foresters walked along predetermined streets and on Town-owned sites in Rockingham, 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 on private property) each inventory team had a list of the ROW boundaries for every street included in the inventory area. In Rockingham, the majority of streets inventoried were lined with sidewalks; for these streets the VT FPR staff were instructed to use the far edge of the sidewalk as the boundary for the ROW so that all trees within the grass strip between sidewalk and street were included in the inventory. If there was no sidewalk, upon reaching a new street, the team 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 Rockingham 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, root maintenance requirements, and pruning needs, 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 Rockingham'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 Rockingham 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 ● *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.
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 ● *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
Prune	Yes: Flag trees for pruning if any of the following signs are present: 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. No: No branch needs to the trimmed
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: No visible stem-girdling roots
Roots	Yes: The presence of root issues, including stem-girdling roots, compacted soil, exposed roots, or mechanical damage to roots. No: No visible root issues.
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 489 trees inventoried within the public ROW or on Town-owned land, there were a total of 46 different species in 28 different genera. The top five most common tree genera by number of trees are *Acer* (maple) at 29%, *Malus* (apple) at 15%, *Gleditsia* (honeylocust) at 7%, *Thuja* (Cedar) at 7%, and Quercus (oak) at 6% compromise 64% of the total community forest (Figure 1). The top five most common species are *Malus Species* (crabapple) at 15%, *Acer platanoides* (Norway maple) at 15%, *Acer saccharum* (sugar maple) at 9%, *Gleditsia triacanthos* (honeylocust) at 7%, and *Thuja occidentalis* (morthern white cedar) at 6% (Figure 2). Complete genera and species lists can be found in Appendix B.

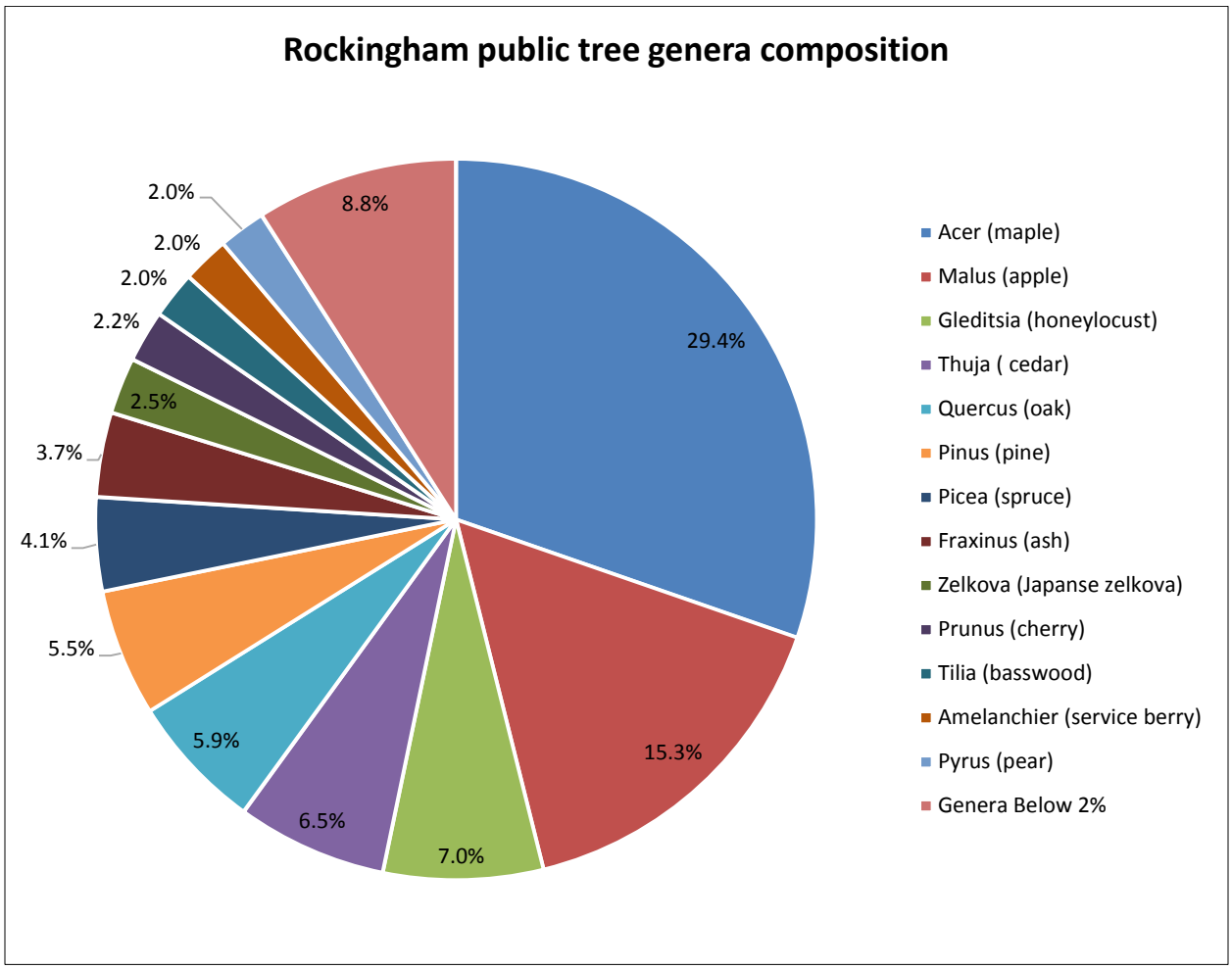


Figure 1. Most common tree genera by percent within the public ROW in Rockingham.

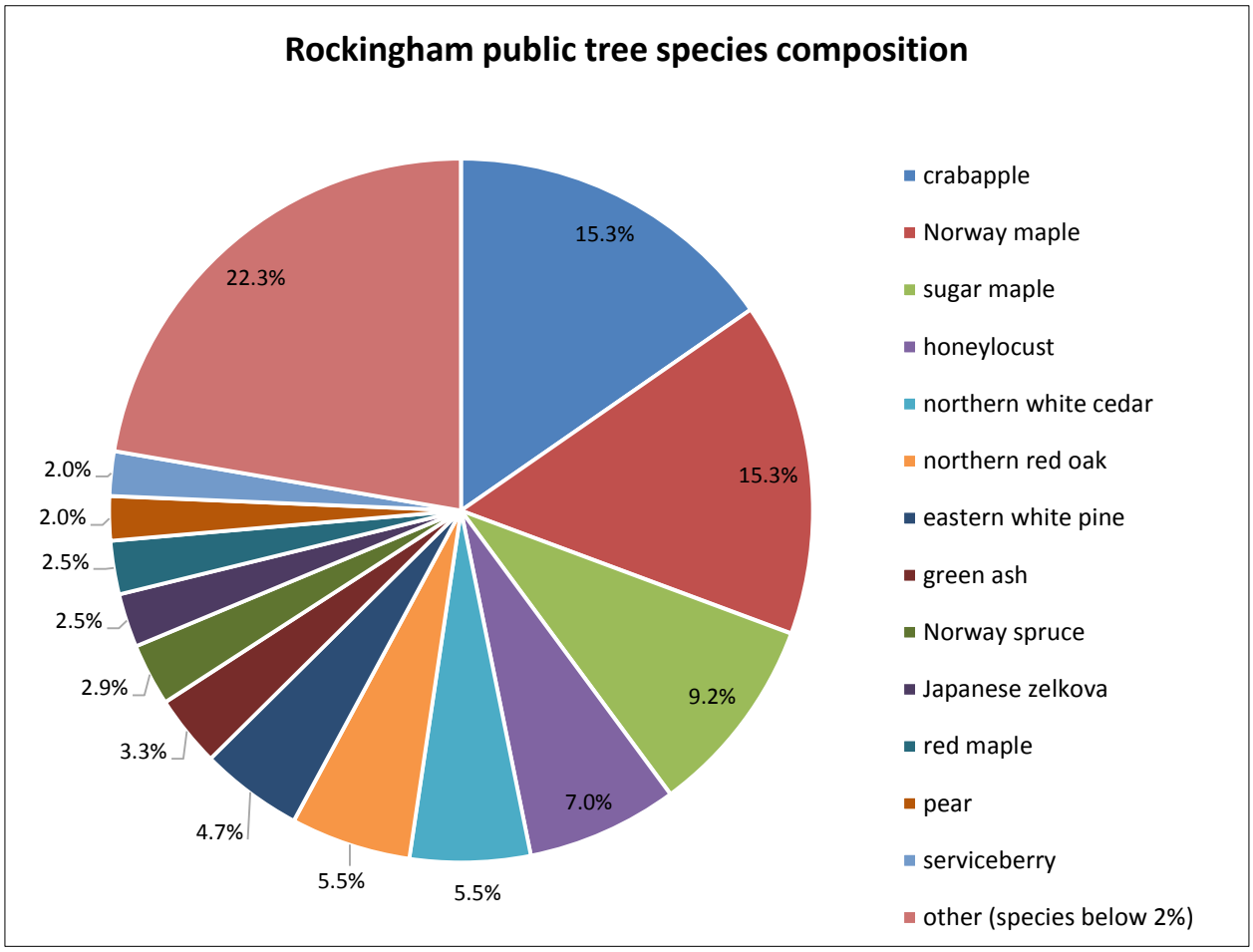


Figure 2. Most common species by percent within the public ROW of Rockingham.

Community Forest Structure

Of the 489 trees inventoried, 489 had DBH measurements taken. In descending order by percent size class, the diameter distribution represented by Rockingham's public trees is: 26% (128) at 6-12", 21% (105) at 12-18", 15% (74) at 18-24", 14% (66) at 3-6", 8% (41) at 0-3", 8% (39) at 24-30", 4% (21) at 30-36", 3% (13) at 36-42", and 0.41% (2) at 42"+ (Figure 3). Approximately 61% of inventoried public trees are between 3 and 18 inches, indicating a relatively young community forest with a significant portion of total trees approaching maturity.

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, which is likely because the genus comprises nearly a quarter of all Rockingham's inventoried public

trees. The three largest size classes represented, 30-36", 36-42", and >42" contain a total of 36 trees (approximately 7% of the community forest). The majority of inventoried trees within these large size classes are maples, eastern white pines and Norway spruces (Figure 5). These trees are for the most part located at Oak Hill Cemetery and Saxtons River Cemetery and are likely natural growing trees, not part of any historic public tree planting program.

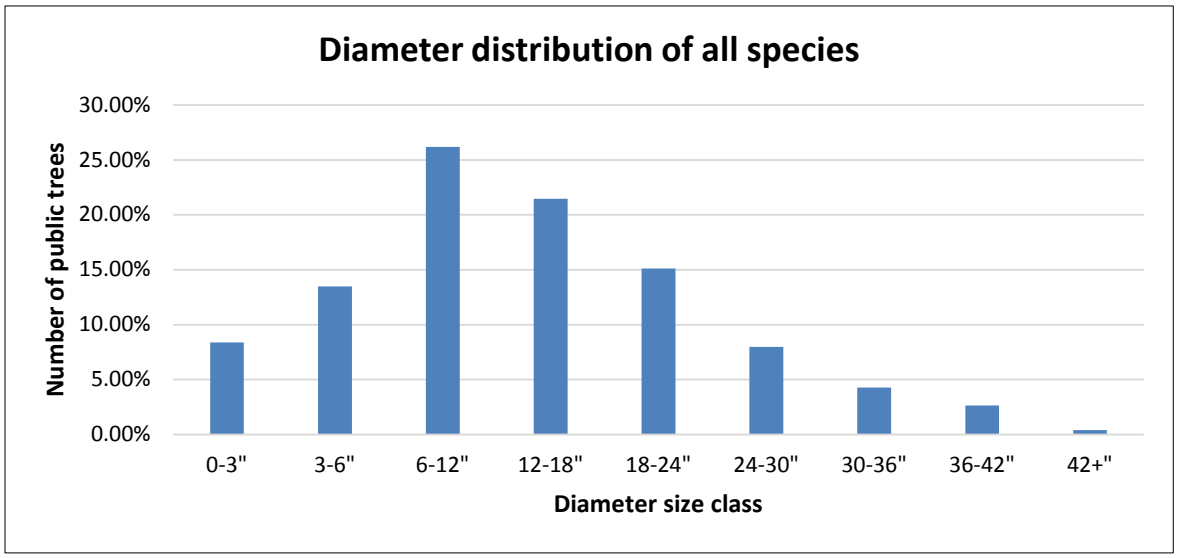


Figure 3. Percentage of trees represented in each diameter class (inches).

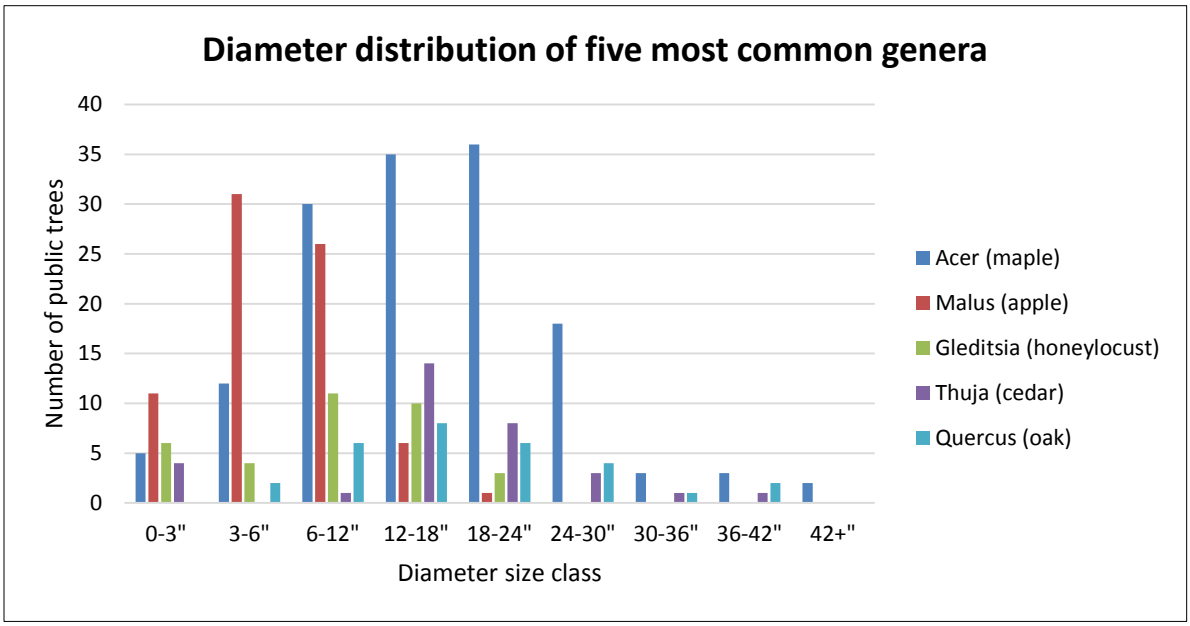


Figure 4. Diameter distribution for the five most common genera of Rockingham's public trees.

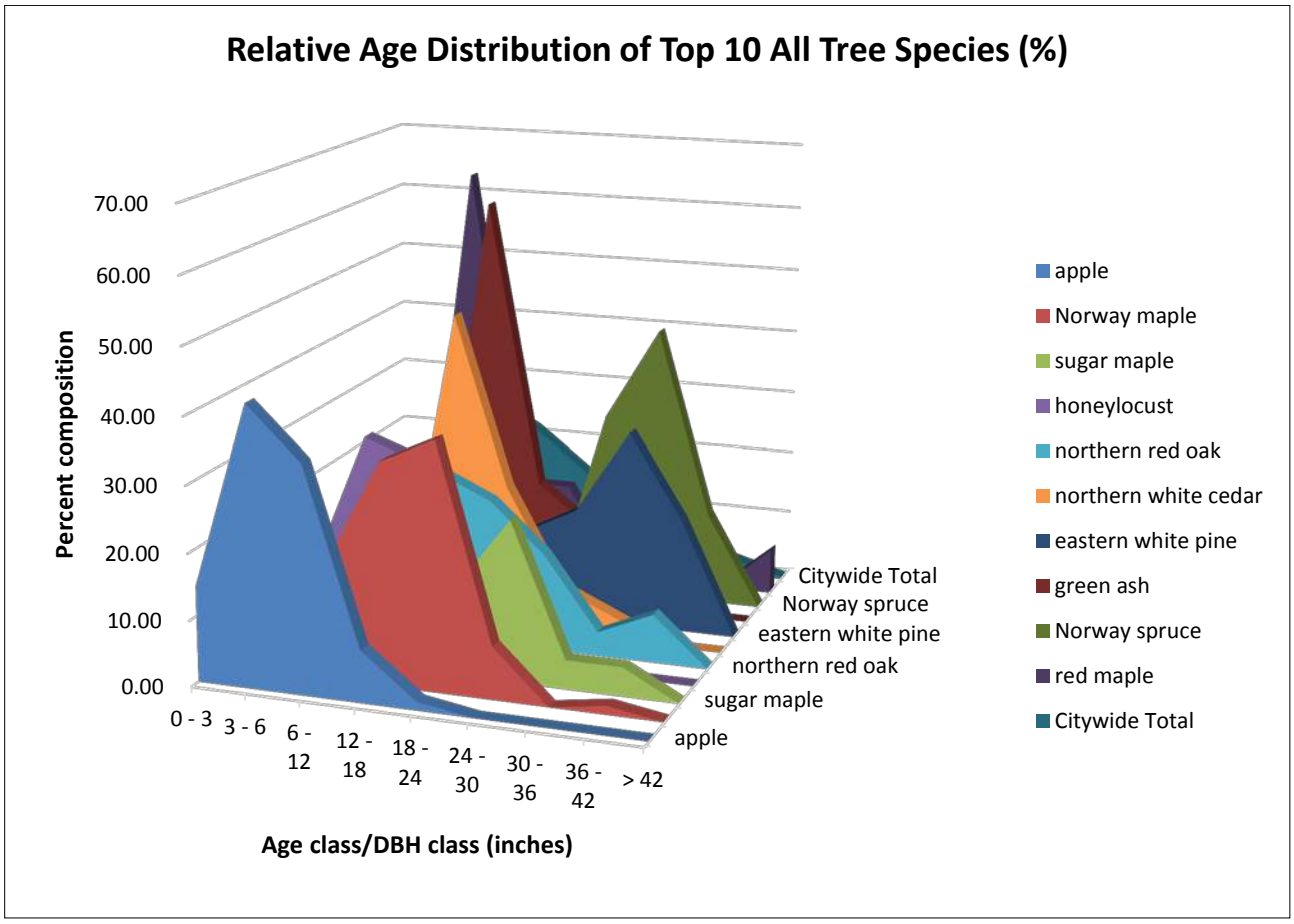


Figure 5. Diameter (and age) distribution of the ten most common species in Rockingham's community forest. Data from this figure were derived from i-Tree Streets urban canopy structure output.

83 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 and sites, School Street, Pleasant Street, and South Street 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

More than three quarters (74%, or 364) of Rockingham's inventoried public trees are assessed as being in "Good" condition; of the remaining trees, 83 (17%) were considered in "Fair" condition, 38 (8%) were in "Poor" condition, and 4 (0.8%) were "Dead" (Figure 6). The trees in genera *Acer* (maple), *Malus* (crabapple), and *Gleditsia* (honeylocust) had the most trees in fair or poor condition; however, these genera also comprise the highest percentage of overall trees inventoried. The dead trees that were identifiable were primarily two sugar maples, an elm, and a crabapple (Figure 7). Appendix E includes maps detailing the location of inventoried trees by condition.

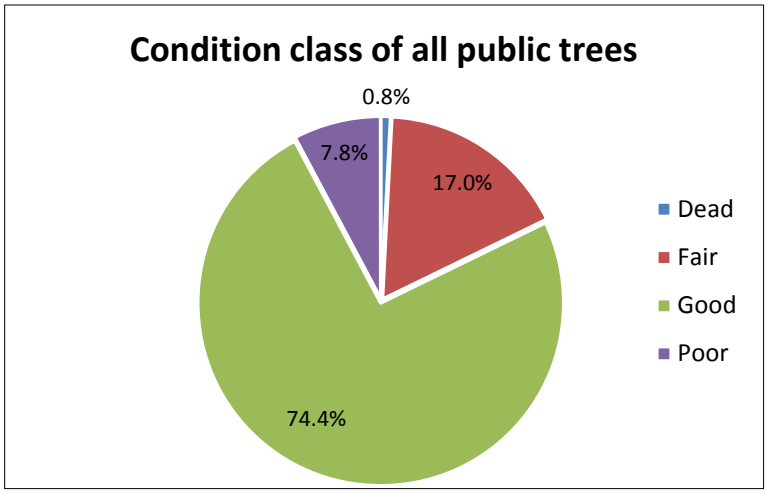


Figure 6. Percentage of trees in each condition class in Rockingham.

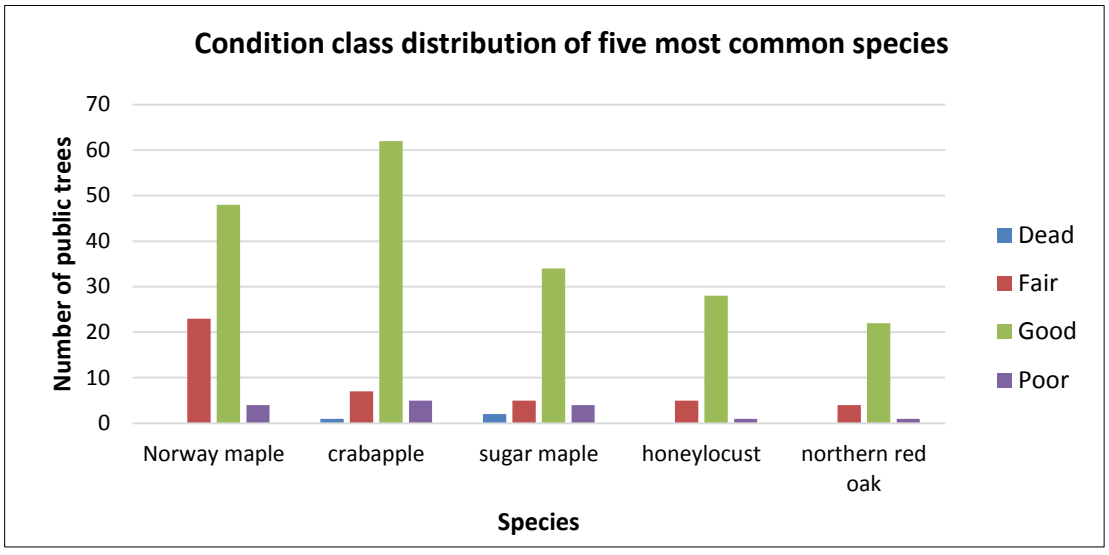


Figure 7. Trees within the five most common genera displayed according to condition.

In conducting the inventory, VT FPR staff flagged 190 trees (39%) as being in need of monitoring. Figure 8 presents monitoring needs of five most common genera in Rockingham. These trees should be reassessed by a Certified Arborist, the Rockingham Tree Warden or Deputy 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 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).

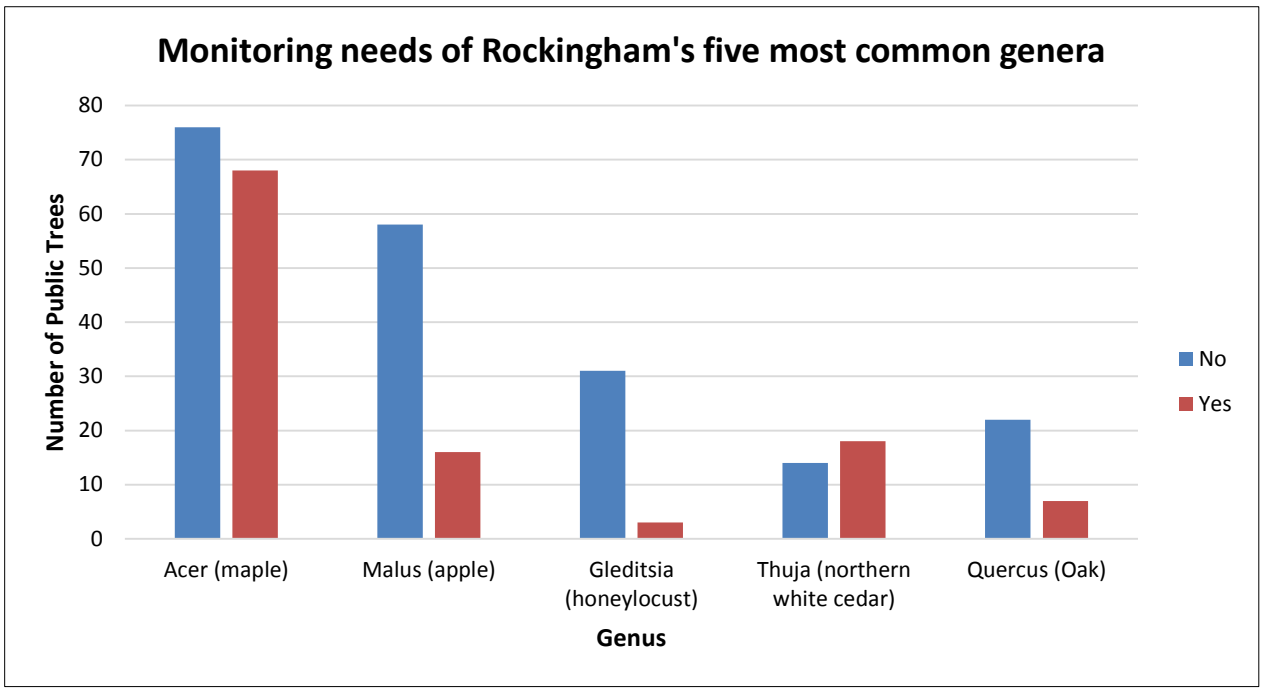


Figure 8. The number of Rockingham's inventoried public trees assessed to require monitoring (yes), within the Town's five most common genera.

Tree Health and Maintenance Indicators

Although Rockingham public trees are generally healthy (74% assessed as in "good' condition), proper maintenance and monitoring is required to promote the health, longevity, and benefits of Rockingham's overall community forest. To better understand the specific maintenance and monitoring needs of Rockingham's public trees, VT UCF staff assessed the presence (or absence) of crown dieback, decay, stem-girdling roots and other visible root issues, and pruning needs for each inventoried tree (Figure 9). The Rockingham Tree Committee should be aware of the public trees assessed with the observed health (e.g., crown dieback, decay, and stem-girdling roots) or required maintenance (e.g., pruning) characteristics.

Of the assessed health and maintenance characteristics, the need for pruning was most prevalent in Rockingham, as it was observed in over half (57% or 277) of inventoried public trees. Maple and apple species comprise the majority (44%) of trees with pruning needs. Norway maples and small crabapples are the main two species with pruning needs (Figure 10). Of the observed trees with pruning needs, 36% (100) can be found one of the inventoried parks or cemeteries (Oak Hill and Saxtons River). Stem-girdling roots and visible root issues are the second most prevalent assessed health characteristics observed on 35% (171) of inventoried public trees. Decay was observed on about 32% (156) of Rockingham's public trees. Finally, crown dieback was observed on 18% (88) of inventoried trees (Figure 9). Norway maples comprise the greatest amount of inventoried trees with evident pruning needs, and root maintenance within Rockingham's community forest.

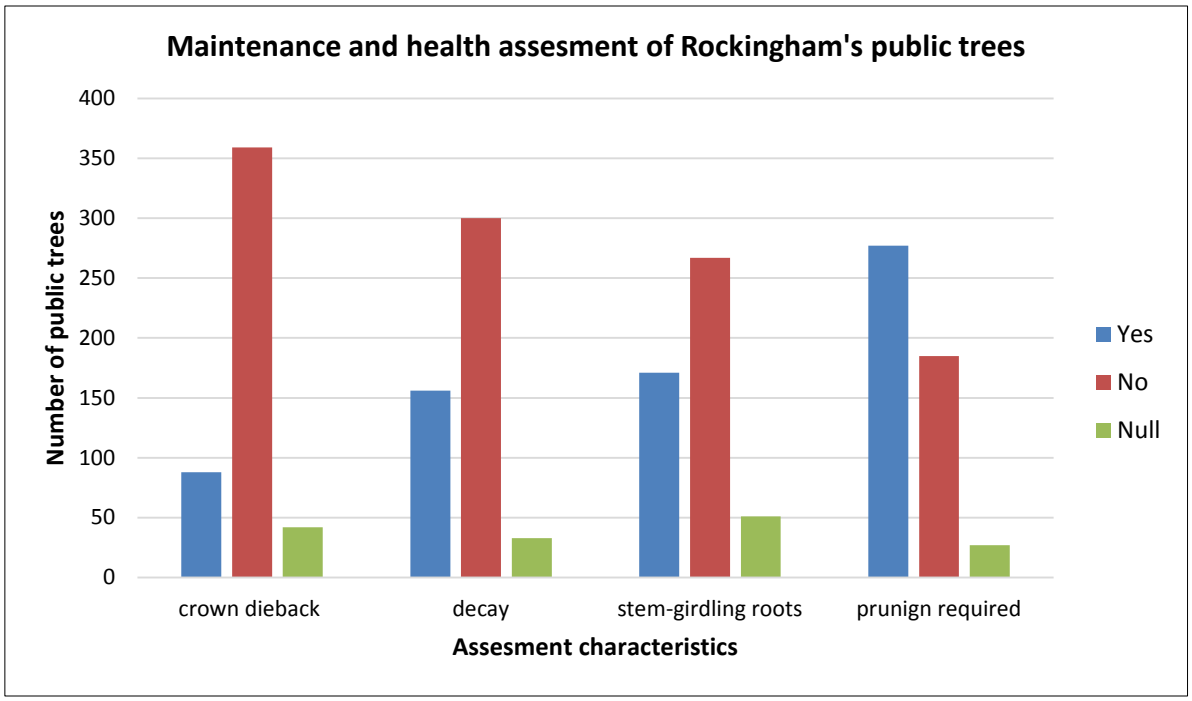


Figure 9. The number of Rockingham's inventoried public trees assessed as having presence or absence of town-specific maintenance and health characteristics. Null values represent the number of unassessed trees, and thus indicate user error. Refer to Table 1 for descriptions of each assessed characteristic.

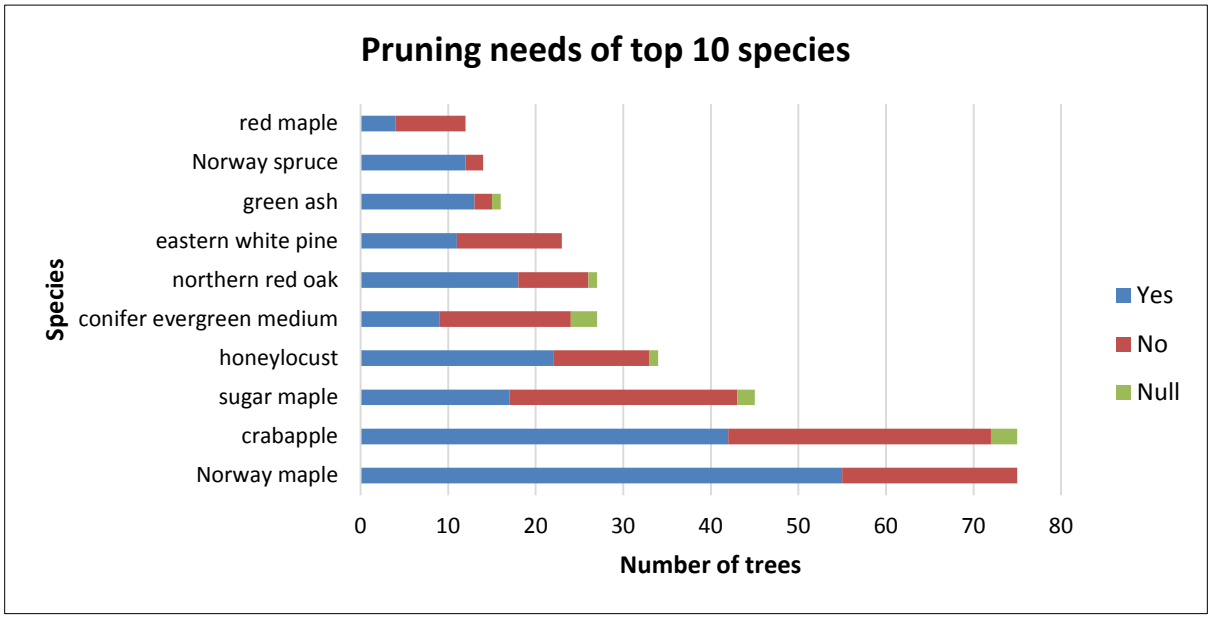


Figure 10. The number of Rockingham's inventoried public trees assessed as requiring (yes) pruning maintenance. Null values represent the number of unassessed trees, and thus indicate user error.

Economic Benefit and Ecosystem Services

The Rockingham public tree inventory data was analyzed using i-Tree Streets software to determine the monetary value of the ecosystem services provided by Rockingham's trees. The 489 trees provide a total of $46,568 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 $95.00 annually in savings or services.

Figure 11 and Table 2 provide an overview of each ecosystem service provided by the Rockingham's public trees. Energy conservation and property value increase are the most significant services provided by these trees in terms of their monetary value. The full reports produced through the i-Tree Streets program for Rockingham will be given to the Rockingham Tree Committee.

It is important to recognize that the trees inventoried through this project are located on approximately 0.87 square mile of Rockingham's 42.3 square miles of total land area; expanding the public tree inventory and the i-Tree Streets assessment to all of Rockingham's roads would increase these figures dramatically. It is also worth noting 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 community forest benefits.

Figure 11. Summary of the benefits provided by Rockingham'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 Rockingham'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	$ 24,927	$ 50.98
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.	$ 570	$ 1.17
Air quality	Quantifies the air pollutants (O3, NO2, SO2, PM10) deposited on tree surfaces and reduced emissions from power plants (NO2, PM10, VOCs, SO2) due to reduced electricity use. Also reported are the potential negative effects of trees on air quality due to BVOC emissions.	$ 4,452	$ 9.10
Stormwater	Reductions in annual stormwater run-off due to rainfall interception by trees.	$ 5,588	$ 1.43
Aesthetic/other	Tangible and intangible benefits of trees reflected in increases in property values.	$ 11,031	$ 22.56
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.	$ 5,897*	$ 12*

Saving an average of $24,927 annually in energy costs, Rockingham's community forest's most significant analyzed economic benefit is energy conservation (Figure 11). The greatest energy cost savings from the Town's public trees is in the form of natural gas (versus electricity). Of all Rockingham's inventoried species northern red oak and green ash provide the greatest annual reduction in energy costs per tree (Figure 12). This is likely because these species have the large overall leaf area (ft^2, Appendix C) and thus provide significant shade and temperature regulation. It is important to note that these values are derived from species, diameter class (inches), and condition class inventory data. Norway maples, sugar maples, and northern red oaks are prevalent larger-diameter species (Figure 5) in Rockingham, and thus provide the greatest annual *net* reduction in energy costs for the community.

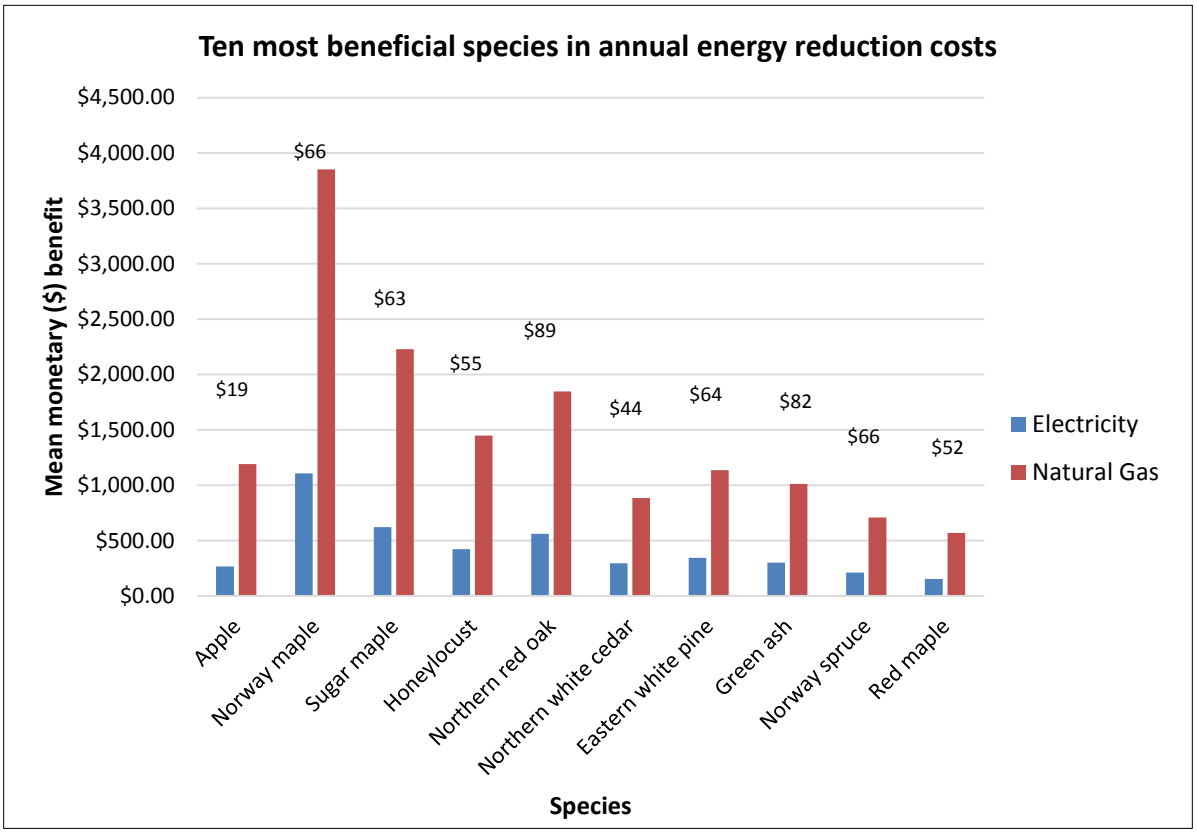


Figure 12. The average monetary value of the ten most beneficial species in annual energy reduction costs in Rockingham's community forest. The monetary values located above each species' bar represents the average annual energy reduction benefit ($) per tree. Monetary values were derived from tree species, diameter (inches), and condition inventory data through i-Tree Streets' urban canopy benefits output.

Of all the species inventoried in Rockingham's community forest, silver maple (*Acer saccharinum*) provides the greatest net annual reduction in stormwater costs of about $57 per tree. Only one silver maple tree was identified in Rockingham's public tree inventory; its relatively high monetary stormwater reduction benefit is attributable to its large size (42+") and healthy condition. Butternut and American basswood, the second and third most beneficial species in annual stormwater reduction costs, are also not represented with high numbers in the Rockingham public tree population, but per tree save about $38 and $22 per tree each year in stormwater mitigation (Figure 13). Understanding the relative per species potential value in both stormwater reduction and energy benefits can inform future decisions about tree species selection.

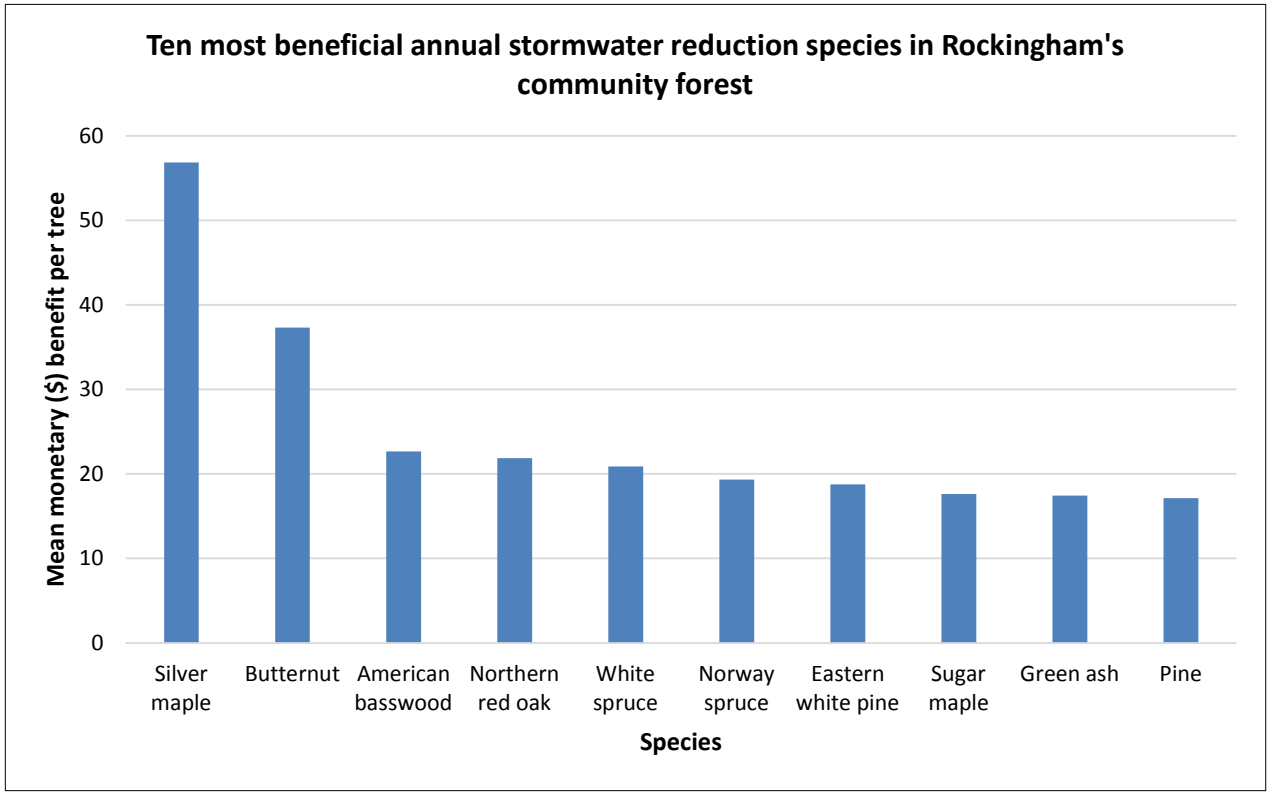


Figure 13. The average annual monetary value of the ten most beneficial stormwater reduction tree species in Rockingham's community forest. Monetary values were derived from tree species, diameter (inches), and condition inventory data through i-Tree Streets' urban canopy benefits output.

Rockingham's Full Canopy Assessment

As a complement to the public tree inventory, VT UCF staff completed an i-Tree Canopy assessment for Rockingham. i-Tree Canopy is a free, easy-to-use online application that allows users to assess total tree cover over an area (in this case, the area covered in the public tree inventory) 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 the Rockingham's i-Tree Canopy assessment, approximately 47% of the area of Rockingham is currently occupied by tree canopy (Figures 14 and 15). Currently 14% of the total area is occupied by buildings, and is not suitable for tree planting. In consideration of the other land cover types present, Rockingham could potentially increase its total tree canopy cover by an additional 14% on open lands of low-lying vegetation. The remaining 23% 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 Rockingham by 37%, though a portion of this land is privately-owned and/or used for other purposes such as agriculture (Figure 14).

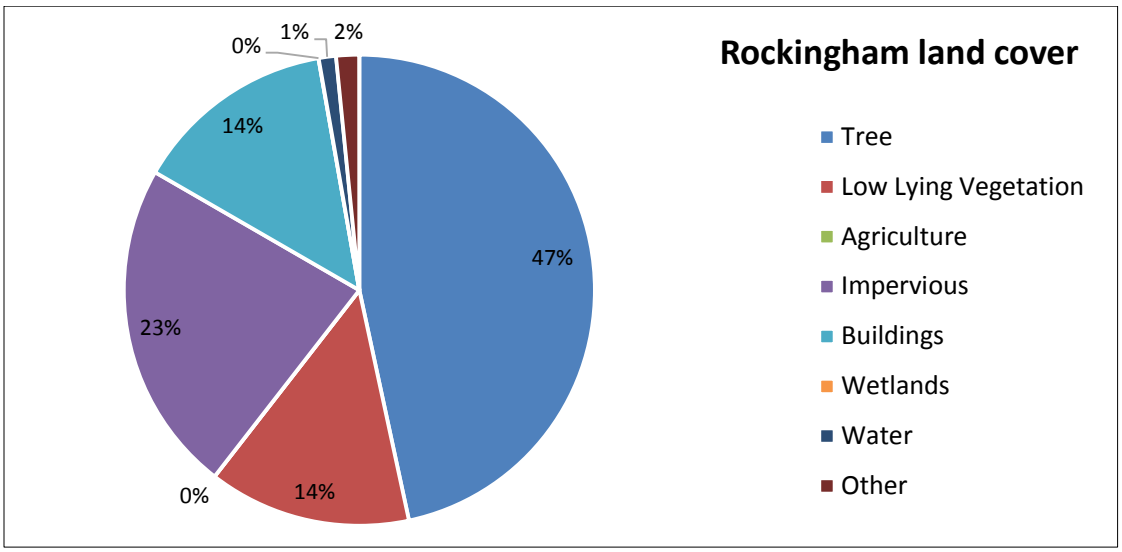
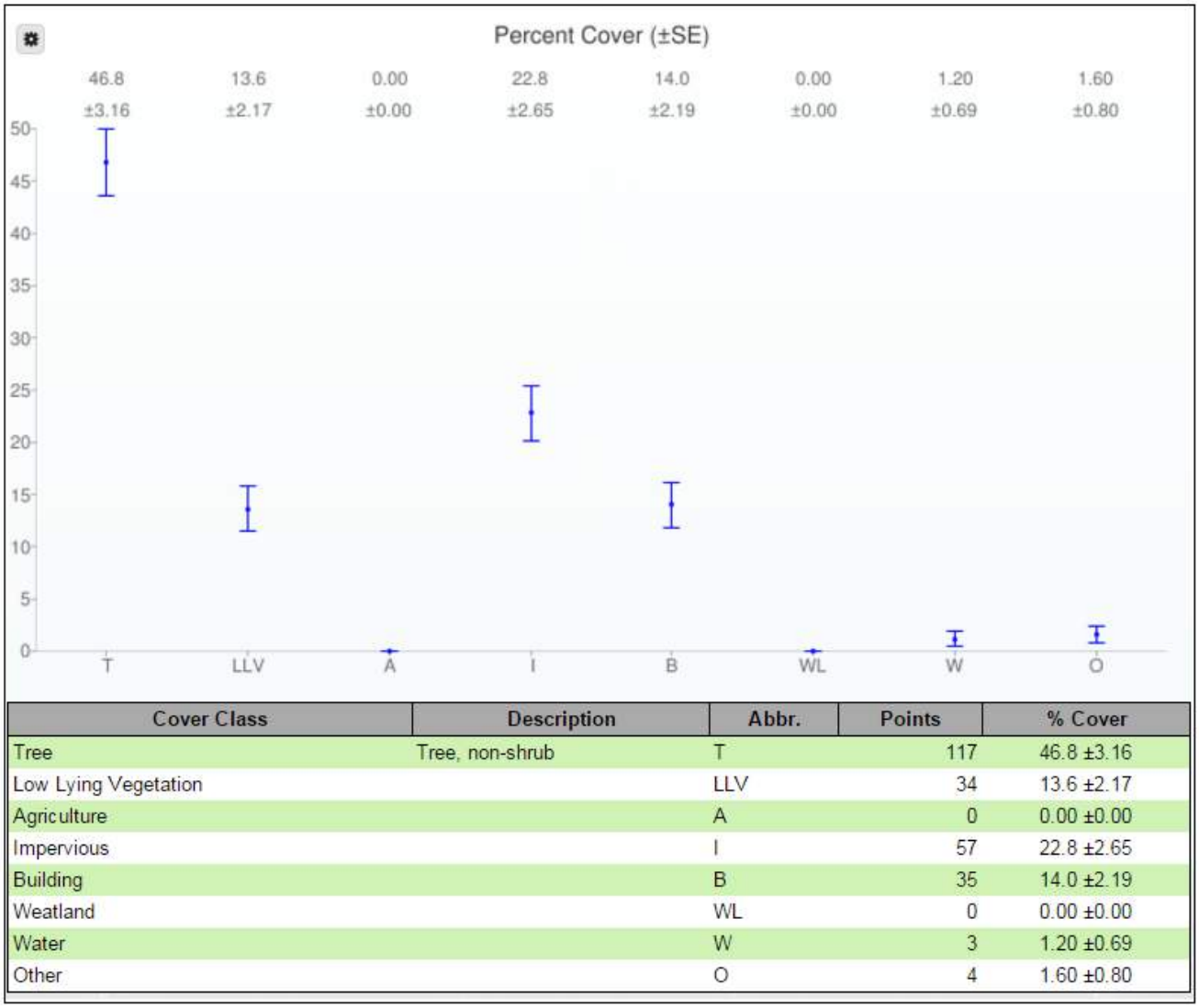


Figure 14. Land cover of Rockingham (includes public and private land)

.



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	117	46.8 ±3.16
Low Lying Vegetation		LLV	34	13.6 ±2.17
Agriculture		A	0	0.00 ±0.00
Impervious		I	57	22.8 ±2.65
Building		B	35	14.0 ±2.19
Weatland		WL	0	0.00 ±0.00
Water		W	3	1.20 ±0.69
Other		O	4	1.60 ±0.80

Figure 15. i-Tree Canopy assessment for the area of Rockingham, Vermont, including both public and private land. The above image shows the ground cover composition distribution.

Figure 16 (below) compliments the i-Tree Streets analysis of the monetary value of benefits provided by Rockingham's public trees by estimating the air quality benefits and corresponding monetary value for the full community forest canopy. Of note is an estimated $1,189,715.18 in CO_2 storage and $47,180.71 in annual CO_2 sequestration value.

Tree Benefit Estimates

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$10.00	±0.67	235.85 lb	±15.90
NO2	Nitrogen Dioxide removed annually	$17.21	±1.16	1,286.01 lb	±86.72
O3	Ozone removed annually	$896.38	±60.44	6.40 T	±0.43
PM2.5	Particulate Matter less than 2.5 microns removed annually	$1,852.97	±124.95	622.37 lb	±41.97
SO2	Sulfur Dioxide removed annually	$3.01	±0.20	810.41 lb	±54.65
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$650.75	±43.88	2.15 T	±0.14
CO2seq	Carbon Dioxide sequestered annually in trees	$47,180.71	±3,181.47	1,303.98 T	±87.93
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$1,189,715.18	±80,224.29	32,877.34 T	±2,216.97

Figure 16. i-Tree Canopy assessment estimates for air quality benefits of Rockingham full canopy.

Discussion and Recommendations

Rockingham's Public Tree Program

Rockingham'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. Rockingham has an active Tree Committee, an active Tree Warden and Deputy 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 Rockingham's public trees, as well as the ways in which residents and Town leadership can be engaged in tree stewardship.

Recommendations:

We recommend that Rockingham 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 Rockingham's public tree program.
- Advocate for an explicit and regular annual tree budget that includes line items for planting, removals, and maintenance of 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), residents

should be aware of the signs and symptoms of Asian long horned beetle (ALB) and empowered to monitor for the invasive forest pests.

- While the pest is not yet in Vermont, plan for the arrival of emerald ash borer (EAB) and its impact on Rockingham's ash trees 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 Rockingham'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 when used, 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 Rockingham'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 Rockingham.

Components of a Managed, Vibrant, and Resilient Urban Forest

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

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

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

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

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

Assessment: A complete public tree inventory 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.

Community 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 within the community forest is of paramount concern. A more diverse forest will be more resistant to environmental stressors, and therefore remain healthy and resilient in the face of change. Furthermore, by maintaining higher diversity a community can prevent a rapid loss of canopy due to insect and disease issues.

Both ash and maple trees are currently threatened by invasive tree pests; the EAB threatens the former, and the ALB is a threat to the latter. While neither of these pests has been discovered to-date in Vermont, the largest ALB infestation in North America is 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. In Rockingham maple is the most represented genus (147 trees, Figure 1). It should also be noted that these maple trees also represent the genera with the highest pruning needs (Figure 9) and should be monitored in the future. Ash (*Fraxinus*) trees currently only make up 4% of the public tree canopy of Rockingham, which is a good sign in light of the anticipated arrival of EAB.

At 29.4% of public trees, maple (*Acer*) exceeds the recommended representation within the community forest. Specifically, Norway maple represents 15.3% of Rockingham's total public trees. Norway maple is one of the two most prevalent species in Rockingham, and is considered to be a non-native invasive species. Although a tolerant and aesthetically pleasing shade 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.

Of the inventoried public trees in Rockingham, 69% are 0-18" in diameter, indicating a relatively young tree population. The Rockingham Tree Committee has implemented an active tree planting program in recent years, evidenced by the 8% of public trees in the 0-3" diameter class. The overall size class distribution of public trees in Rockingham is fairly well distributed, with 15% of 18-24" trees that are like at or approaching maturity. The land use history of Rockingham, focusing on the development and expansion of the Villages of Bellows Falls and Saxtons River, may provide insights as to the absence of many large, mature shade trees; those

that do exist in Rockingham are for the most part concentrated at the two cemeteries, Oak Hill Cemetery and Saxtons River Cemetery and were planted, or grew naturally, in these public spaces long before the establishment of the Rockingham Tree Committee and its current tree planting program.

Recommendations:

We recommend that Rockingham 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 Rockingham'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*) and crabapple (*Malus)* trees in Rockingham, we suggest selecting different species of 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.
- Refer to the list of 83 identified potential tree planting locations ("vacant" spots) within the public ROW in Appendix A to strategically increase tree species and structural diversity in Rockingham.
- The Rockingham Tree Committee has planted many young trees over the years; as these trees mature, promote their health with a systematic structural pruning and maintenance cycle.

Community Forest Health

Overall, Rockingham appears to have a healthy population of public trees, and dedicated maintenance and care would further increase the health of the community forest. Approximately 25% (121) of Rockingham's public trees were either considered to be in "Fair" or "Poor" condition and 4 trees were designated to be "Dead"**.** There were 190 trees flagged to be revisited and monitored by the Rockingham Tree Warden, Deputy Tree Warden, or another qualified individual. Low soil volume and fertility, exposure to road salt spray, root damage, soil compaction, mechanical damage to the stem, poor pruning, and

improper planting are some of the contributing factors that may lead to decreased tree health in an urban setting. Many of the trees that require monitoring in Rockingham overlap with those designated to be in "Poor" condition or "Dead", and others were likely noted because of conflict with utility wires or other infrastructure. See Appendix E for maps detailing the locations of trees in Bellows Falls, Saxtons River, and at the Rockingham Meeting House by condition and a map indicating the location of the 190 trees requiring monitoring. The full inventory data spreadsheet, with specific comments associated with the 190 trees requiring monitoring will be given to the Rockingham Tree Committee; some recurring themes from these comments are presented in the recommendations below.

Recommendations:

- Prioritize the monitoring of the 190 trees (which include the 4 dead trees) that have been flagged for monitoring by a Certified Arborist or the Rockingham Tree Warden.
- Develop a plan to remove – and replace, if appropriate – the 4 dead public trees in a timely fashion.
- Closely monitor the health of the 39 public trees in "Poor" condition and plan for their removal and, if appropriate, replacement in the near future.
- Many of the trees that require monitoring are concentrated in the two cemeteries (Oak Hill and Saxtons River) and in the park adjacent to the Rockingham Canal; prioritize revisiting these trees.
- Encourage a culture of continual monitoring and updating the tree inventory spreadsheet as necessary as regular tree maintenance occurs in Rockingham.
- Many of the park and cemetery trees inventoried in Rockingham were identified as having mower or weed-whacker damage to their trunks; consider mulching these trees in the future to lower the risk of mechanical damage.
- A significant portion of trees that have pruning needs were identified as having poor branching structure, something that should be addressed through structural pruning while the trees are still relatively small (young).

Assessment Tools

Using free i-Tree software developed by the USDA Forest Service, we were able to assess the value and potential expansion of Rockingham's urban tree canopy. i-Tree Streets allowed us to determine the economic value of the ecosystem services provided by the 489 inventoried trees in Rockingham. Rockingham's community forest generates about $46,568 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 $95 in service 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 Rockingham 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[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

[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.

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.

Recommendations:

We recommend that Rockingham 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 Town of Rockingham and the Rockingham Tree Committee 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 Town leadership, the Rockingham Tree Committee, and the Rockingham Tree Warden based on long-term vision and capacity. Looking ahead efforts should be focused on maintaining the quality of the urban trees. With improved monitoring, regular maintenance, and an engaged and informed citizenry, the potential for a healthy and sustainable community forest is attainable.

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

Appendices

Appendix A: Full Street and Site List Included in the Rockingham Public Tree Inventory

Street/Site name	ROW Extent (feet)	Number of Trees	Number of Vacant Spots or Strips
Academy Avenue	Full Road	2	0
Atkinson Street	Sidewalk Greenspace	36	0
Bridge Street	Sidewalk Greenspace	22	0
Church Place	n/a	1	0
Church Street	Sidewalk Greenspace	1	0
Elm Street	Sidewalk Greenspace	0	4
Forrestal Road	n/a	1	0
Green Street	Sidewalk Greenspace	28	3
Greenspaces: includes Oak Hill Cemetery, Saxtons River Cemetery, Canal Street Pocket Park, Bellows Falls Downtown Square, the Recreation Department pool, Hetty Green Park, the Rockingham Library, Island Park, and Star Hotel Park	n/a	217	2
School Grounds	n/a	27	0
Grove Street	Sidewalk Greenspace	6	0
Henry Street	Sidewalk Greenspace	8	0
Lincoln Street	Sidewalk Greenspace	0	4
Meeting House Road	n/a	33	0
Morgan Street	Sidewalk Greenspace	0	6
Pine Street	Within Sidewalk Greenspace	0	3
Pleasant Street	Sidewalk Greenspace	6	15
Rockingham Street	66	51	0
Route 121	n/a	15	6
School Street	Sidewalk Greenspace	16	25
South Street	Sidewalk Greenspace	6	11
Square	n/a	7	0
Steuben Street	Sidewalk Greenspace	2	4
Westminster Street	49.5	7	0

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

Common Name	Scientific Name	Number of Trees	Percent of Total Population
Norway maple	*Acer platanoides*	75	15.31%
crabapple	*Malus sp.*	75	15.31%
sugar maple	*Acer saccharum*	45	9.18%
honeylocust	*Gleditsia triacanthos*	34	6.94%
northern white cedar	*Thuja occidentalis*	27	5.51%
northern red oak	*Quercus rubra*	27	5.51%
eastern white pine	*Pinus strobus*	23	4.69%
green ash	*Fraxinus pennsylvanica*	16	3.27%
Norway spruce	*Picea abies*	14	2.86%
red maple	*Acer rubrum*	12	2.45%
Japanese zelkova	*Zelkova serrata*	12	2.45%
pear	*Pyrus sp.*	10	2.04%
serviceberry	*Amelanchier arborea*	10	2.04%
broadleaf deciduous small	Broadleaf	9	1.84%
American elm	*Ulmus americana*	8	1.63%
red cedar	*Thuja plicata*	8	1.63%
black locust	*Robinia pseudoacacia*	8	1.63%
littleleaf linden	*Tilia cordata*	8	1.63%
maple	*Acer sp.*	7	1.43%
cherry Plum	*Prunus cerasifera*	7	1.43%
conifer evergreen large	*Conifer sp.*	5	1.02%
pine	*Pinus sp.*	4	0.82%
blue spruce	*Picea pungens*	4	0.82%
black Cherry	*Prunus serotina*	4	0.82%
lilac	*Syringa vulgaris*	3	0.61%
douglas fir	*Pseudotsuga menziesii*	3	0.61%
broadleaf deciduous large	Broadleaf	3	0.61%
pin oak	*Quercus palustris*	2	0.41%
boxelder	*Acer negundo*	2	0.41%
Japanese tree lilac	*Syringa reticulata*	2	0.41%
hawthorn	*Crataegus sp.*	2	0.41%
American basswood	*Tilia americana*	2	0.41%
broadleaf deciduous medium	Broadleaf	2	0.41%
white ash	*Fraxinus americana*	2	0.41%
freeman maple	*Acer sp.*	2	0.41%
white spruce	*Picea glauca*	2	0.41%
silver maple	*Acer saccharinum*	1	0.20%
pussy willow	*Salix sp.*	1	0.20%

european beech	*Fagus sylvatica*	1	0.20%
juniper	*Juniperus sp.*	1	0.20%
butternut	*Juglans cinerea*	1	0.20%
white fir	*Abies concolor*	1	0.20%
red mulberry	*Morus rubra*	1	0.20%
european hornbeam	*Carpinus betulus*	1	0.20%
beech	*Fagus sp.*	1	0.20%
cottonwood	*Aigeiros sp.*	1	0.20%

Appendix C: Leaf Area and Canopy Cover by Species of Rockingham's Community Forest

Species	Number of Trees	% of Total Trees	Leaf Area (ft2)	% of Total Leaf Area	Canopy Cover (ft2)	% of Total Canopy Cover
Apple	76	15.54	34,785.64	3.6	16,890.49	4.6
Norway maple	75	15.34	169,233.54	17.52	73,655.98	20.06
Sugar maple	45	9.2	178,087.73	18.44	42,321.30	11.53
Honeylocust	34	6.95	66,831.65	6.92	28,181.65	7.67
Northern red oak	27	5.52	106,079.15	10.98	40,520.55	11.04
Northern white cedar	27	5.52	23,737.04	2.46	18,364.02	5
Eastern white pine	23	4.7	54,698.94	5.66	23,334.12	6.35
Green ash	16	3.27	53,033.36	5.49	19,690.98	5.36
Norway spruce	14	2.86	34,260.35	3.55	14,628.63	3.98
Red maple	14	2.86	35,112.71	3.64	10,216.69	2.78
Japanese zelkova	12	2.45	17,292.28	1.79	6,660.65	1.81
BDS OTHER	12	2.45	2,500.94	0.26	1,665.92	0.45
Callery pear	10	2.04	6,241.06	0.65	2,421.45	0.66
Serviceberry	10	2.04	2,522.98	0.26	1,711.49	0.47
Eastern red cedar	9	1.84	7,123.10	0.74	5,035.37	1.37
American elm	8	1.64	26,107.70	2.7	7,461.27	2.03
Black locust	8	1.64	14,880.87	1.54	5,551.53	1.51
Littleleaf linden	8	1.64	21,161.52	2.19	8,514.21	2.32
Cherry plum	7	1.43	4,645.34	0.48	2,630.36	0.72
Maple	6	1.23	11,550.98	1.2	3,813.42	1.04
CEL OTHER	5	1.02	12,251.78	1.27	5,243.16	1.43
Black cherry	4	0.82	4,971.86	0.51	2,161.77	0.59
Blue spruce	4	0.82	7,896.89	0.82	3,312.34	0.9
Pine	4	0.82	8,685.47	0.9	3,696.55	1.01
London planetree	3	0.61	2,909.48	0.3	1,171.23	0.32
Douglas fir	3	0.61	4,471.96	0.46	1,796.50	0.49
Pin oak	2	0.41	3,162.68	0.33	1,056.05	0.29
White spruce	2	0.41	5,272.69	0.55	2,263.26	0.62
White ash	2	0.41	5,431.19	0.56	2,071.69	0.56
Hawthorn	2	0.41	260	0.03	181.49	0.05
Boxelder	2	0.41	929.57	0.1	541.86	0.15
American basswood	2	0.41	10,654.50	1.1	2,469.70	0.67
Magnolia	2	0.41	96.38	0.01	193.25	0.05
Japanese tree lilac	2	0.41	118.97	0.01	67.96	0.02
Silver maple	1	0.2	12,764.23	1.32	2,919.52	0.8

Butternut	1	0.2	8,187.63	0.85	2,236.32	0.61
Beech	1	0.2	1,441.02	0.15	555.05	0.15
White fir	1	0.2	1,706.39	0.18	716.64	0.2
European beech	1	0.2	1,441.02	0.15	555.05	0.15
European hornbeam	1	0.2	795.1	0.08	136.74	0.04
Willow	1	0.2	795.1	0.08	136.74	0.04
Cottonwood	1	0.2	150.71	0.02	19.14	0.01
Red mulberry	1	0.2	1,629.58	0.17	419.32	0.11

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

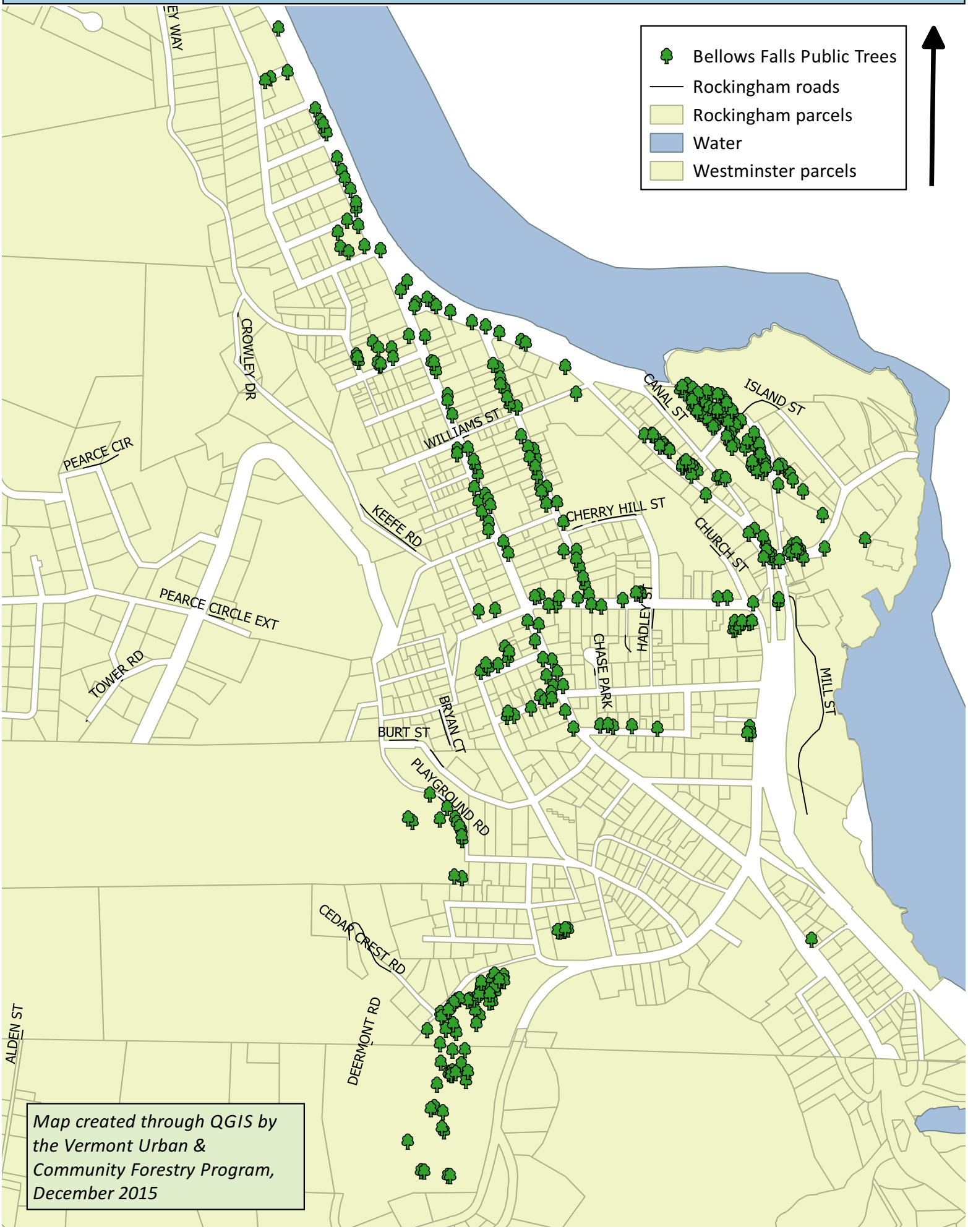
Anyone with Internet access can view all of the inventoried Rockingham public trees by using the Vermont Agency of Natural Resources' (ANR) Atlas mapping tool. Follow these simple steps:

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

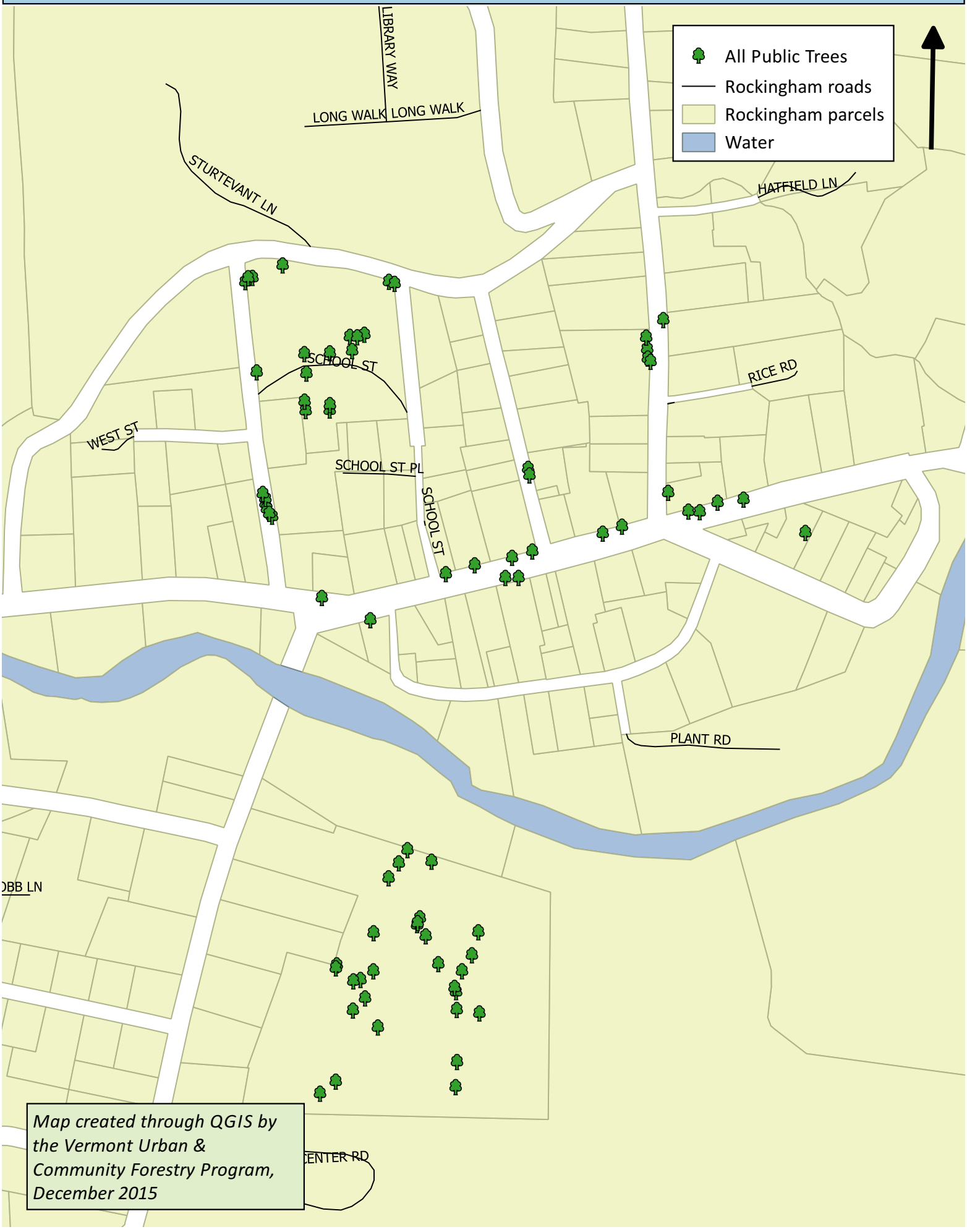
1. All Public Trees Inventoried in Bellows Falls
2. All Public Trees Inventoried in Saxtons River
3. All Public Trees Inventoried in Bellows Falls by DBH Class
4. All Public Trees Inventoried in Saxtons River by DBH Class
5. All Public Trees Inventoried at the Rockingham Meeting House by DBH Class
6. All Public Trees Inventoried in Bellows Falls by Condition Class
7. All Public Trees Inventoried in Saxtons River by Condition Class
8. All Public Trees Inventoried at the Rockingham Meeting House Condition Class
9. Public Ash Trees in Bellows Falls
10. Public Trees in Need of Monitoring in Bellows Falls
11. Public Trees in Need of Monitoring in Saxtons River
12. Potential Public Tree Planting Locations in Bellows Falls
13. Potential Public Tree Planting Locations in Saxtons River

Bellows Falls Public Trees



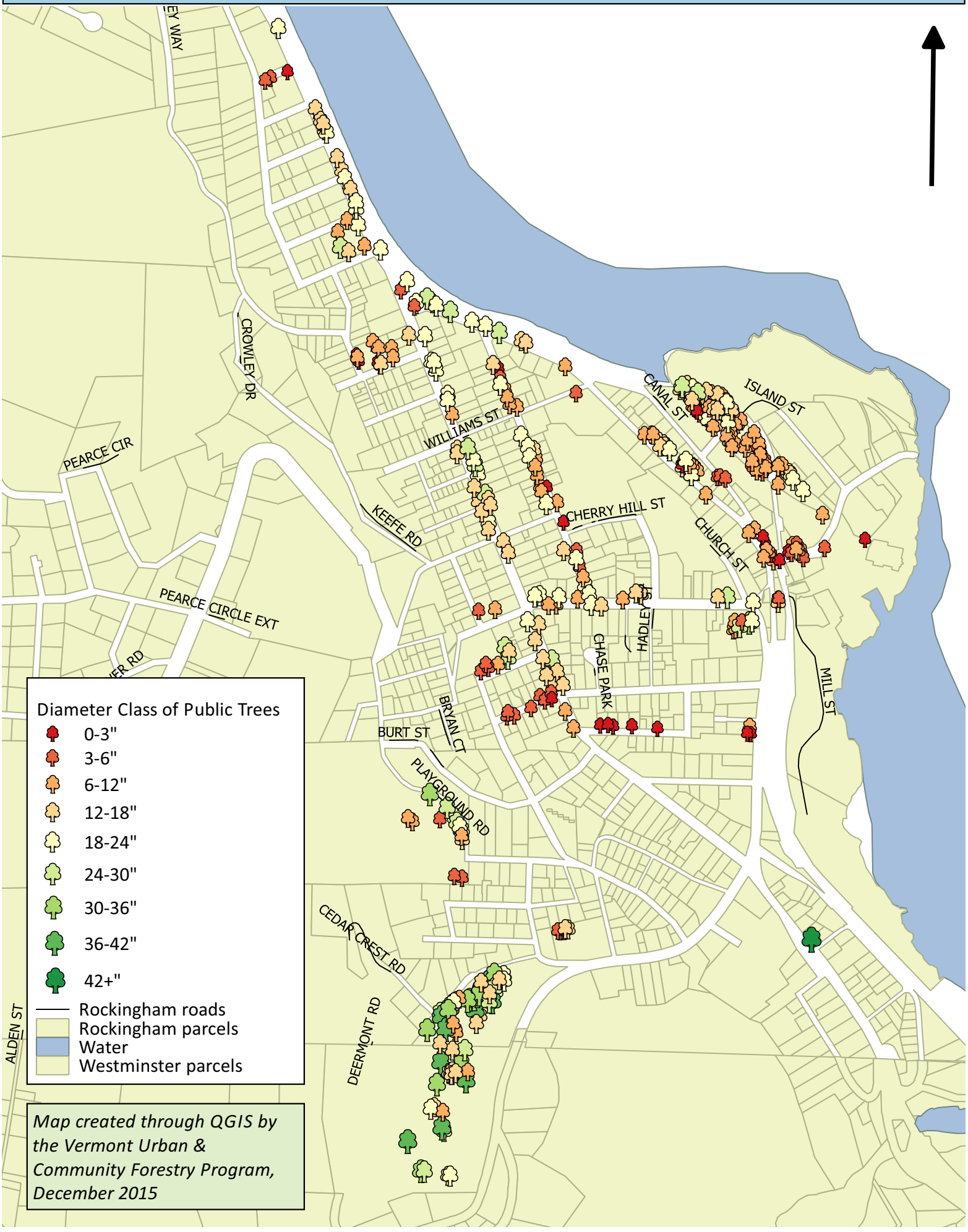
Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

Saxtons River Public Trees

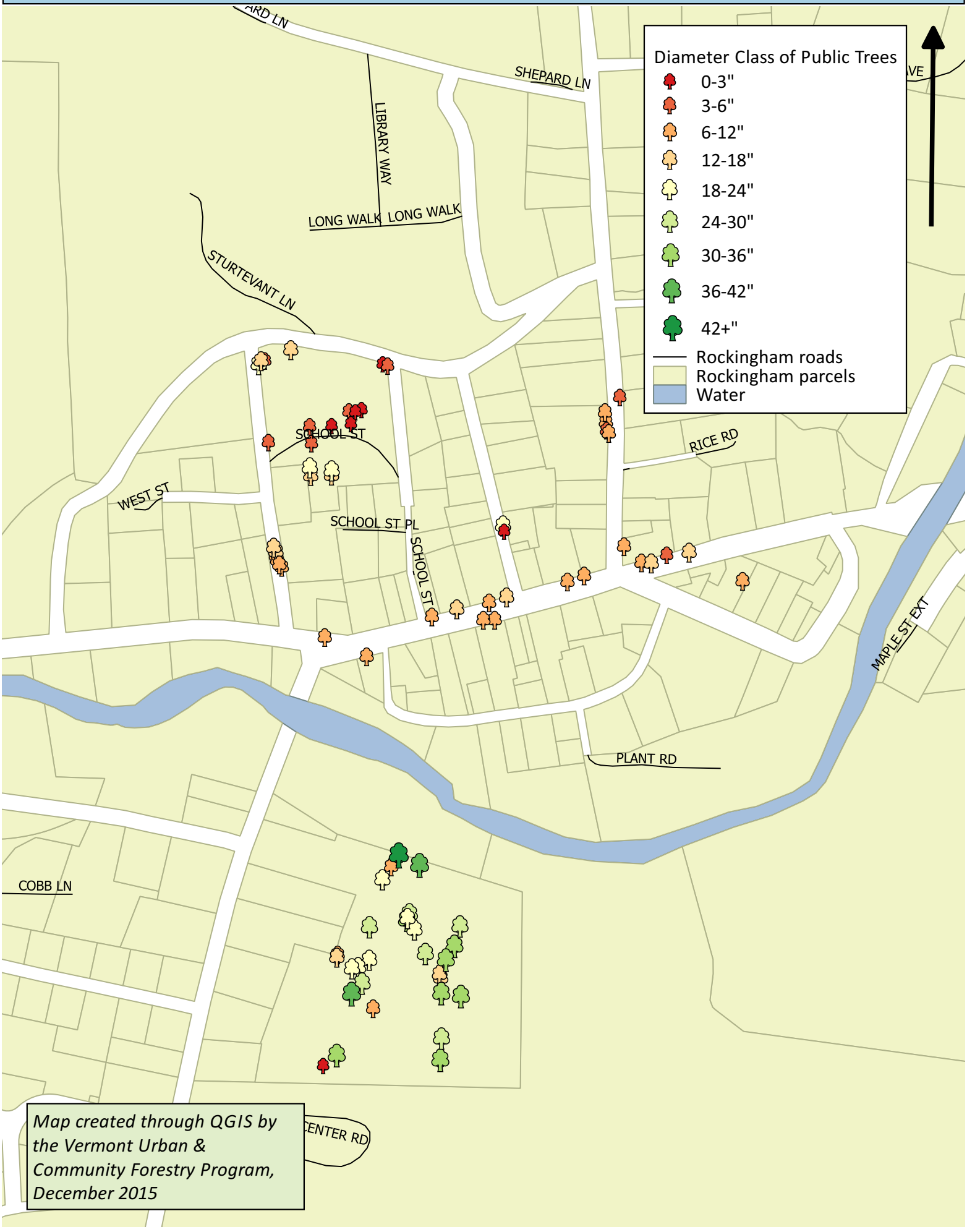


Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

Bellows Falls Public Trees by Diameter Class

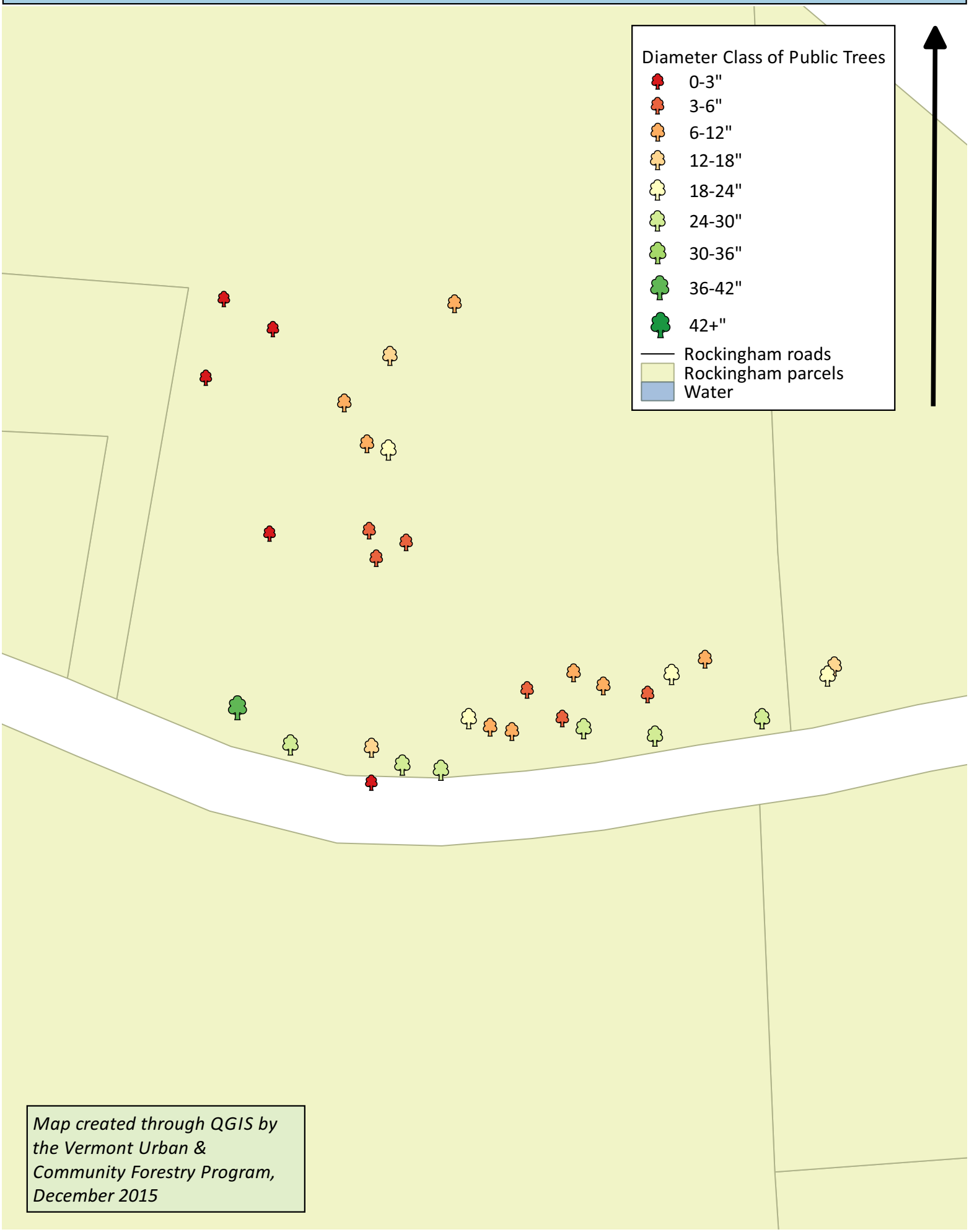


Saxtons River Public Trees by Diamter Class



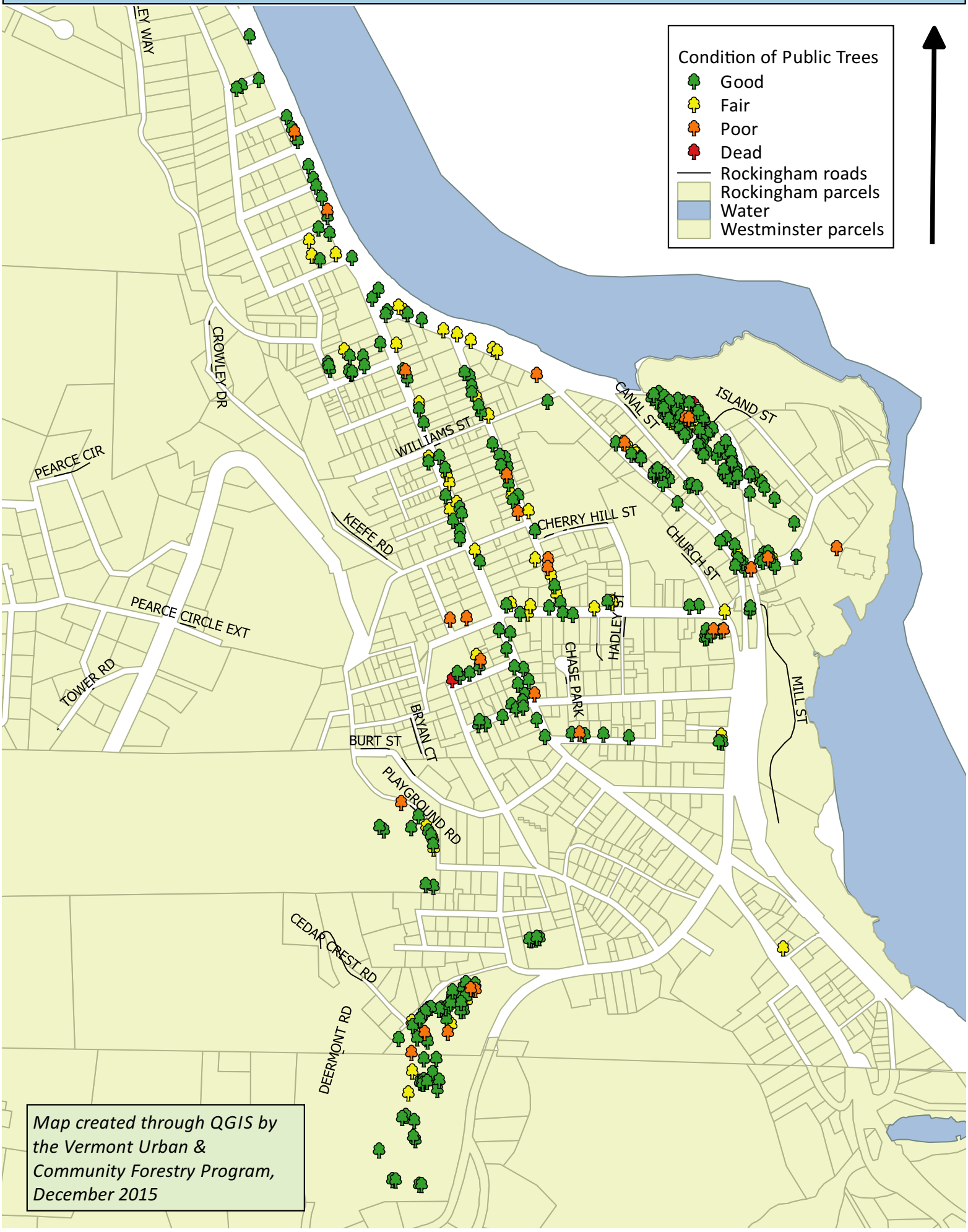
Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

Rockingham Meeting House Public Trees by Diameter Class

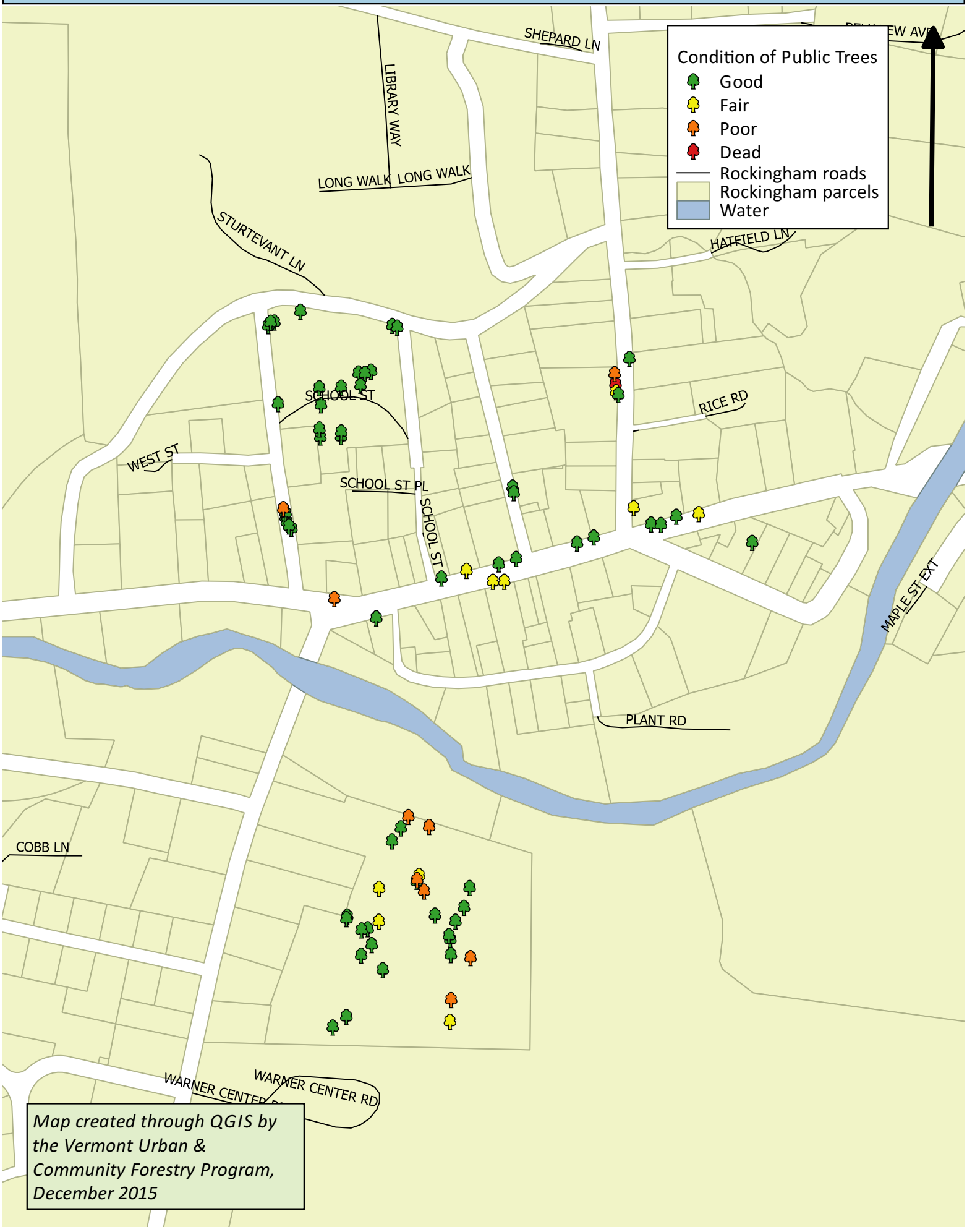


Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

Bellows Falls Public Trees by Condition Class

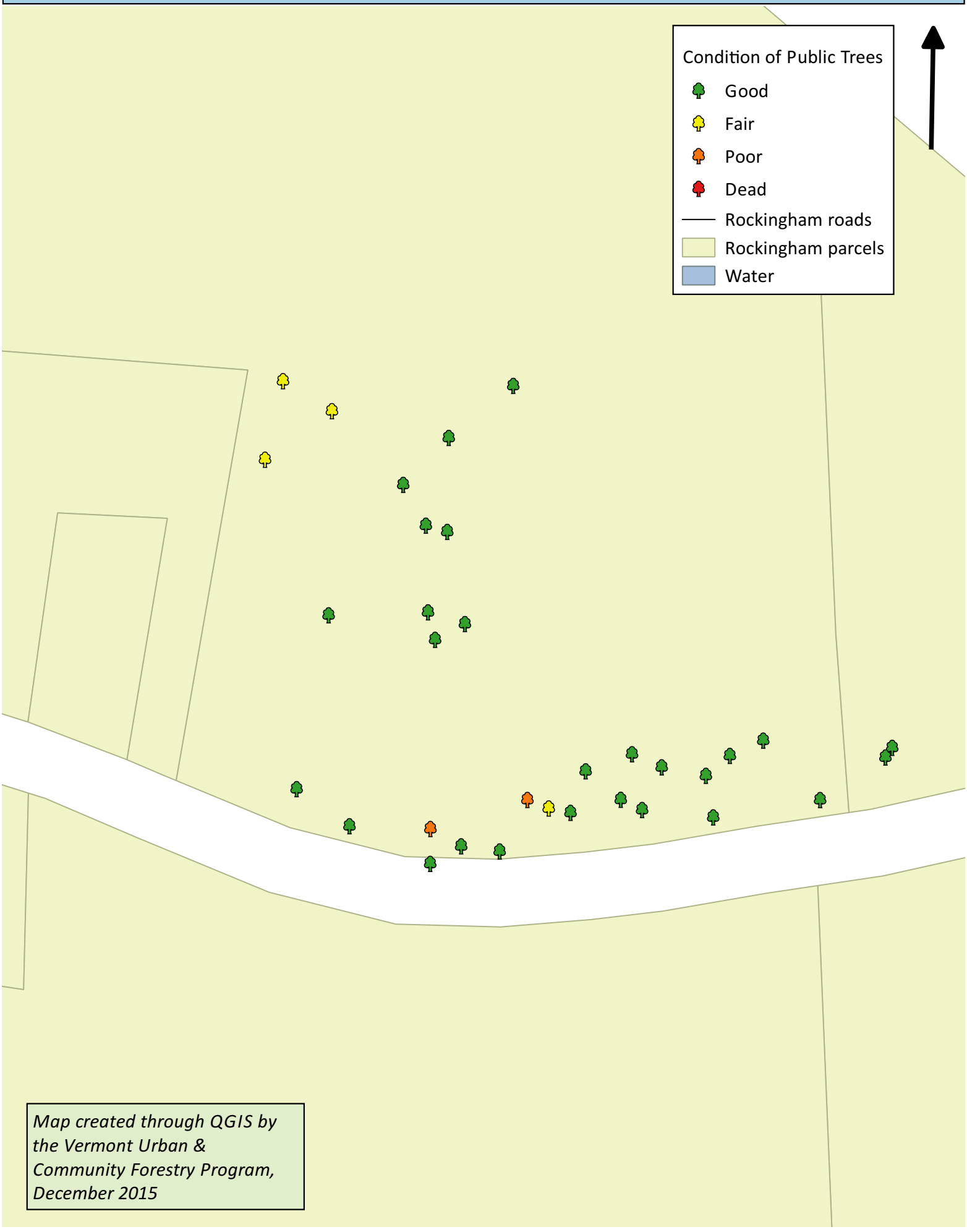


Saxtons River Public Trees by Condition Class



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

Rockingham Meeting House Public Trees by Condition Class

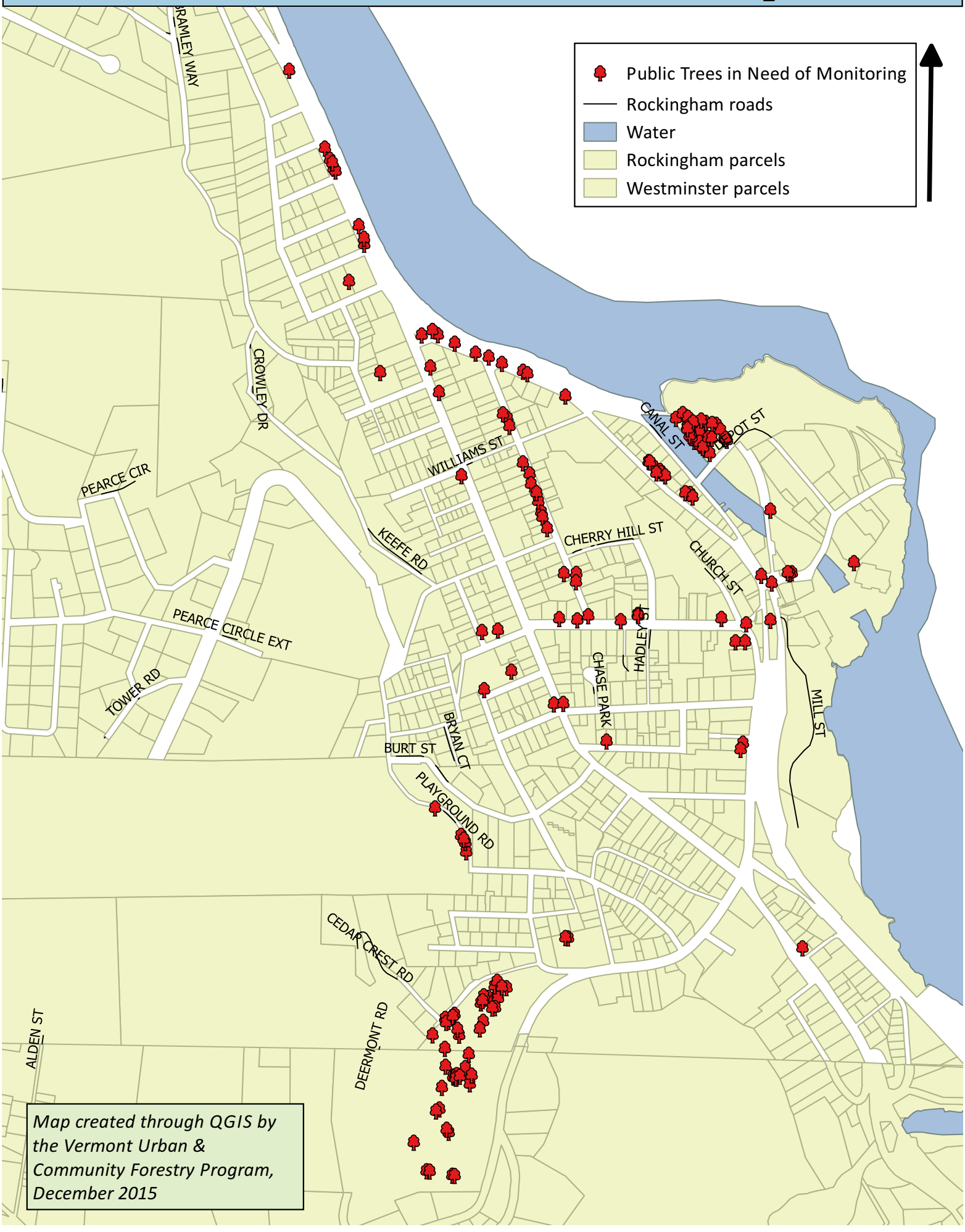


Map created through QGIS by the Vermont Urban & Community Forestry Program, December 2015

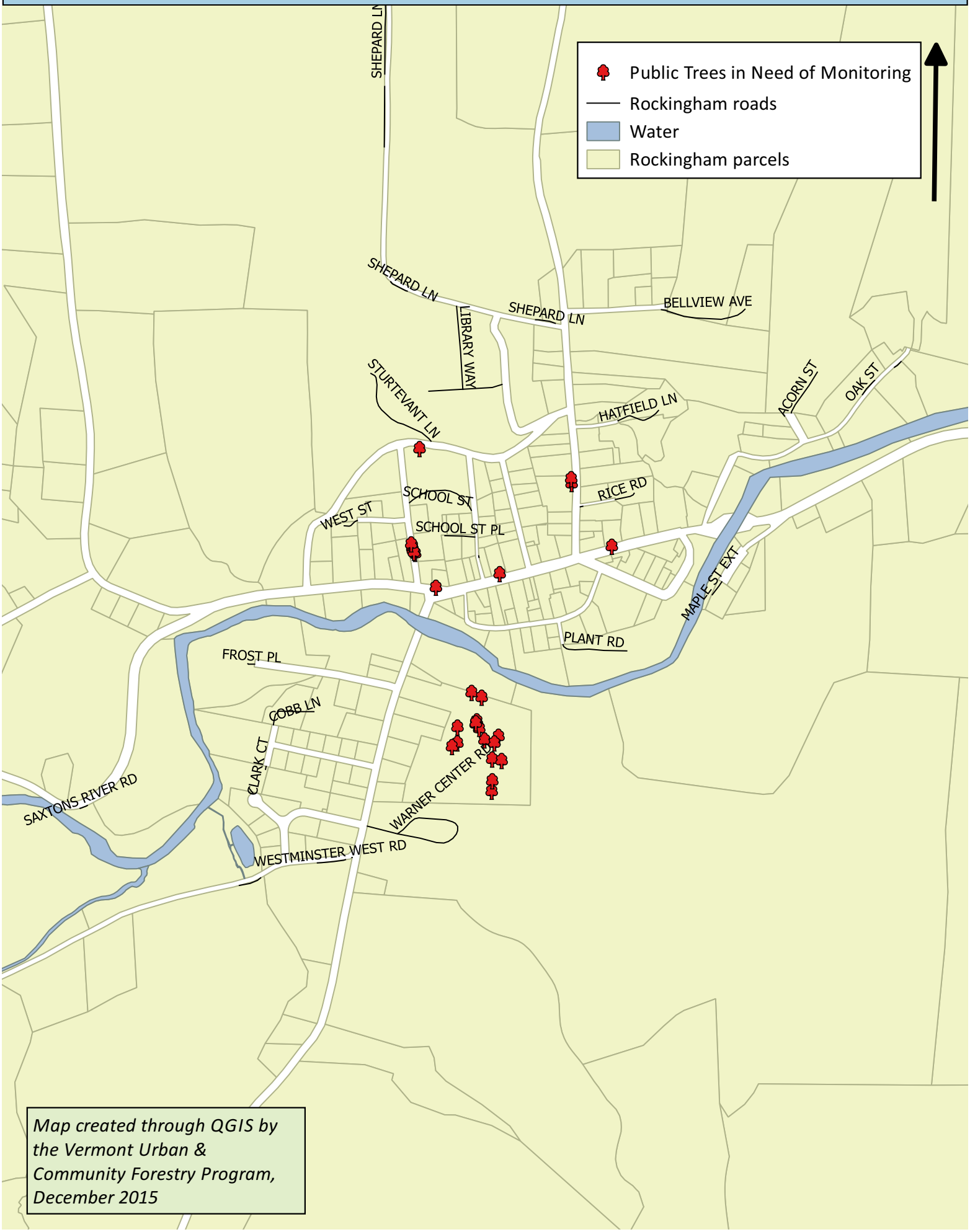
Bellows Falls Public Ash Trees

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

Bellows Falls Public Trees in Need of Monitoring

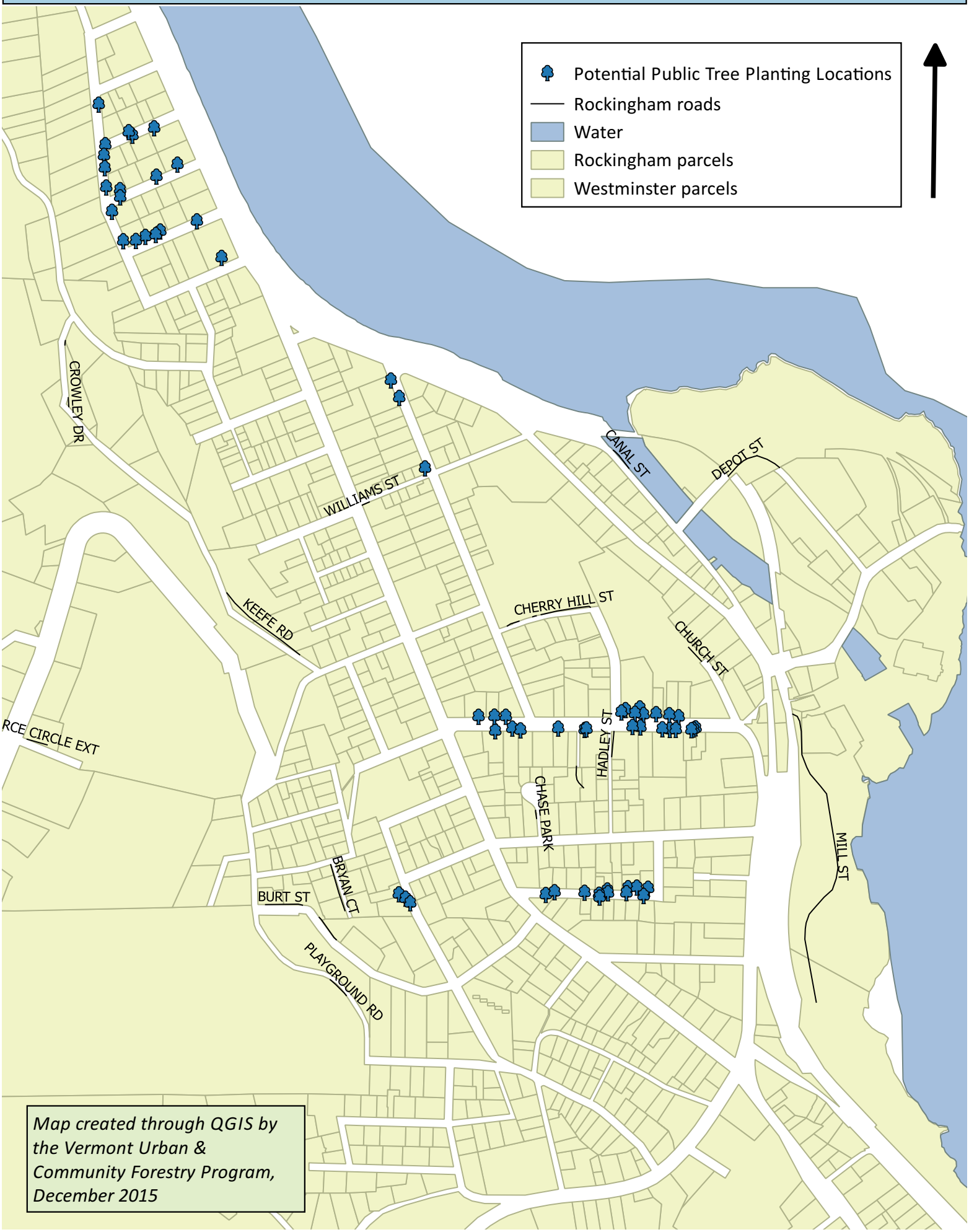


Saxtons River Public Trees in Need of Monitoring



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

Potential Public Tree Planting Locations in Bellows Falls



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

Potential Public Tree Planting Locations in Saxtons River

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