Arlington Tree Management Plan

Based on August 2017 Town Tree Inventory

June 2018

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Vision Statement

Arlington's urban forest will be a large and diverse forest of multi-aged and city-appropriate trees. The urban forest shall be recognized by the Town Government and its citizens as a vital, functioning part of the Town's infrastructure and will be included in the vision for all future development in Arlington. Arlington residents will view the healthy urban forest as an important part of the Town's character, and as an indicator of the Town's overall health and livability.

Executive Summary

This plan was developed by the Arlington Tree Committee, along with the Arlington Department of Public Works, the Town Tree Warden, and two hired Interns. The Town conducted an inventory of its public street trees in the summer of 2017. This report draws from the results of the inventory to gain an understanding of the condition of our existing urban forest and develops a long-term management plan for scheduling maintenance and new plantings.

The inventory included trees on public and private streets, along the Minuteman Commuter Bike Path, on public school grounds, and the Mount Pleasant Cemetery

Section 1.01 Inventory Key Findings

(a) Current Status

- Arlington has 8,734 public street trees and an additional 1,219 trees in locations that may require maintenance by the Tree Department, including cemeteries, parks, the bike path, and school grounds.
- The inventoried trees provide cumulative benefits from CO_2 removed, storm water filtered, energy conserved, and air quality improved estimated at $768,320/year.[1]
- The replacement value of the public trees inventoried is $43,000,000.[2]
- Fifty-seven percent of the trees inventoried were determined to be in 'good health', 33 percent in 'fair' condition, 10 percent 'poor' or 'dead' condition.

[1] This number was provided by the OpenTreeMap (OTM) software used in the initial inventory. OTM determines these values using the US Forest Service i-Tree Streets calculations, available at https://www.itreetools.org/streets/index.php.

[2] Replacement value was calculated using i-Tree tools.

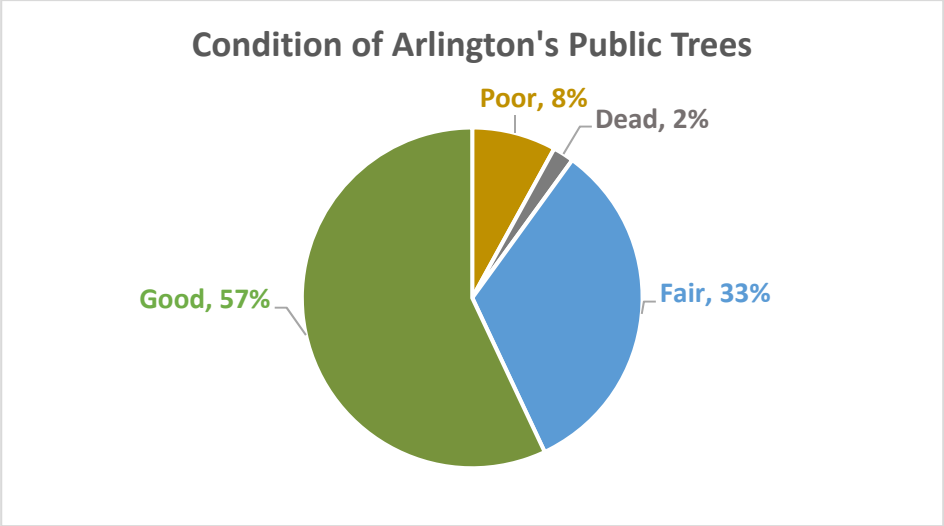


Figure 1: Public Tree Condition

- No evidence of Emerald Ash Borer (EAB) was found in Arlington
- The inventory identified 6,401 potential public street planting sites.[3]

(b) Areas of Concern

- As of April, 2018, the inventory contained over 1,000 trees which require expeditious maintenance due to condition, size, and location, categorized as "Priority." This number is constantly changing as the Town completes ongoing maintenance and removals throughout the year. Trees are assigned a priority level based on the following chart:

	Condition			
Diameter (in.)	**Dead**	**Poor**	**Fair**	**Good**
<8				
8-17				
17-24				
>24				

Priority
Medium Priority
Low Priority
No Priority

[3] The actual number of viable planting locations may be less than the 6,401 identified by the inventory. Potential planting sites include: obvious planting pits that formerly had a tree, obvious planting pits that have been covered with black top, and locations in planting strips with more than 15-20 square feet of available soil for planting a tree. These locations may not have previously had a tree. Arlington's process for planting includes a site visit by the Tree Warden to determine if the location is appropriate for a tree, and if so, which species.

Figure 2: Priority level by Diameter and Condition

- Tree genus diversity is sub-optimal. A well-established urban forestry 'best practice' (Santamour, 1990) (Kendal, Dobbs, & Lohr, 2014) suggests no more than 20% of one tree genus; Arlington has 56% Acer (maple).

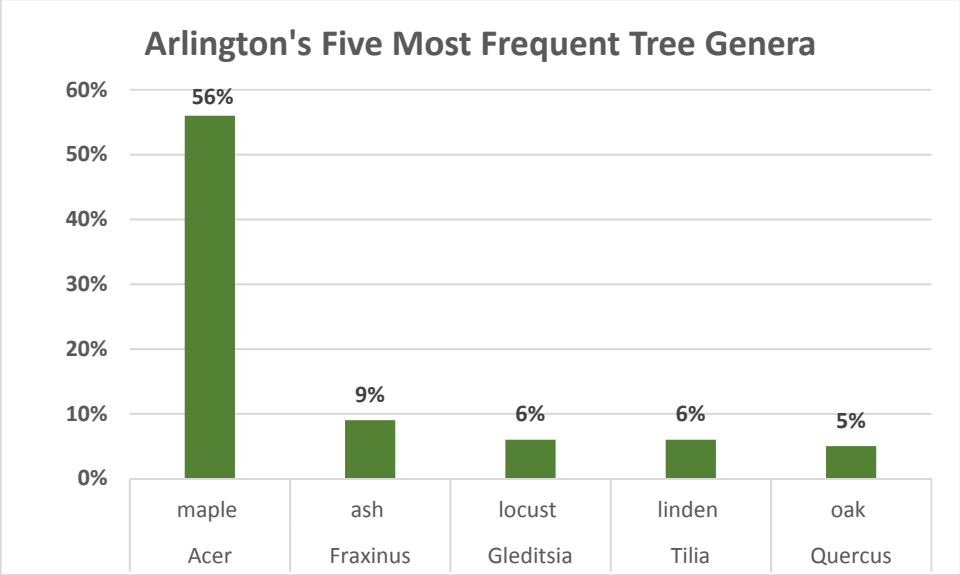


Figure 3: Genus Distribution in Arlington

- Distribution of tree size is sub-optimal. Arlington has fewer young trees (small diameter) and more mature trees (large diameter) than is ideal to maintain a healthy urban forest (Richards, 1983).

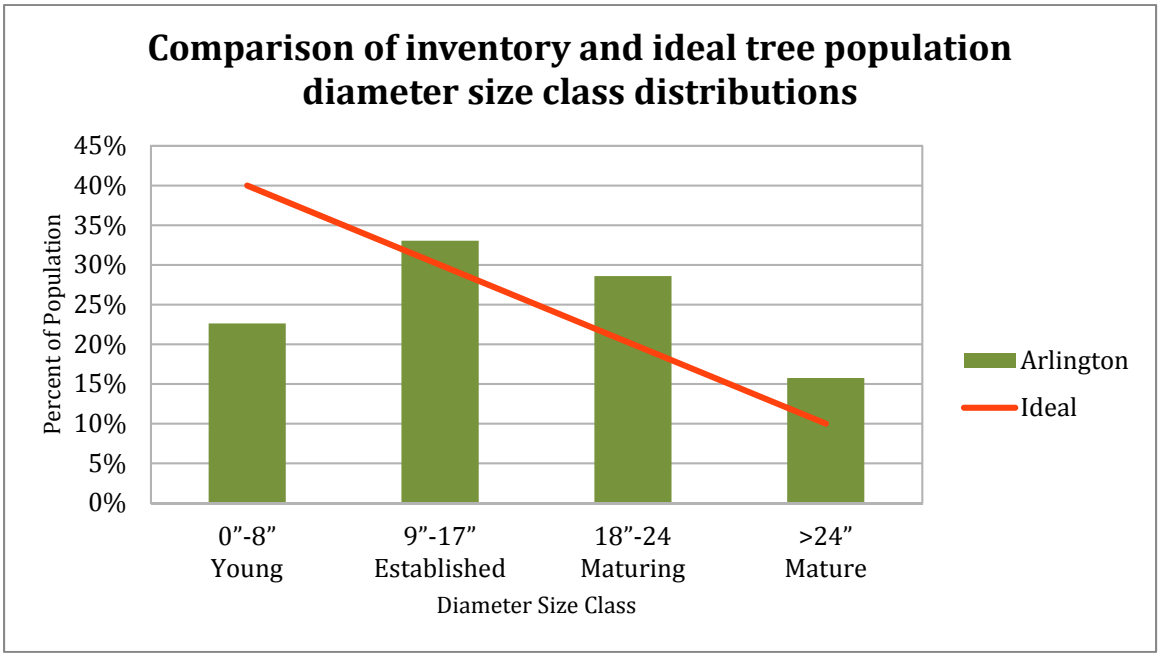


Figure 4: Tree Diameter Distribution

- Arlington's high number of ash trees presents a significant risk if Emerald Ash Borer (EAB) moves into Arlington. The highly-destructive pest was found in nearby Waltham in 2016. EAB can kill an ash tree in less than 2 years. A proactive, health-based treatment and priority removal plan could reduce the risk of the eventual and expensive removal of all 939 ash trees.

Section 1.02 Tree Maintenance and Planting

The Tree Department current funding employs 7 full-time staff and a part-time Tree Warden. As of spring 2018, 2 of the 7 staff positions are vacant and are being actively recruited. Historically, the Town has had difficulty filling tree positions, resulting in frequent staff openings. The Tree Department is tasked with tree plantings, tree maintenance and removals, along with secondary non tree-related tasks, which take up an estimated 25% – 40% of staff hours, such as plowing and salting the streets during snow emergencies, and hanging holiday lights and banners on street poles. The Town supplements internal resources with outside contractors for tree maintenance and occasionally for tree planting. The Tree Warden is currently budgeted for 3-4 days per week and is tasked with approving planting sites, approving removals, managing private tree and public tree laws and regulations, and community education. The 2019 fiscal budget includes increasing the Tree Warden position to full-time.

In addition to the planting and management of public street trees, the Tree Department is tasked with caring for the trees planted as part of redevelopment projects organized by the State Department of Transportation, and the trees planted by contractors on land managed by the Town's Parks and Recreation Department and School Department. Contractor missteps including lack of communication with the Tree Warden, incorrect planting, and failure to adequately water after planting, have occasionally led to high tree mortality.

The Town has historically used a reactive management approach for trees, where planting, removal, and tree trimming work is generated in response to citizen requests. In the summer and fall of 2017, the Town used an outside contractor to significantly reduce the backlog of tree work generated from these citizen requests.

(a) Funding

- The 2018 fiscal budget included:
    a. $40,000 for tree planting
        i. $20,000 for tree purchases
        ii. $20,000 for supplemental watering by Tree Department staff
    b. $150,000 for hiring of an outside contractor for tree maintenance
    c. Tree crew staff budget: $403,590 (assuming 7 positions are filled)
- The proposed 2019 fiscal budget includes:
    a. $90,000 for tree planting including

- $40,000 for tree purchases and watering as in 2018
- An additional $50,000 for tree purchases and watering ($25,000 from the Town and $25,000 from the 2012 John MacEachern family bequest).

b. Funding for a full-time Tree Warden

- Supplemental funding is available for the planting and care of trees, including:
  a) A bequest made in 2012 by the John MacEachern family to the Town earmarked for Arlington's trees has $151,000 as of April, 2018.
  b) Funds collected in the Town's 'Trees Please' fund. As of December, 2017, the fund totaled $30,000 as a result of donations, fees and fines collected in violation of ML Chapter 87 and Arlington's Article 16 Tree Preservation Bylaw.
  c) Depending on the success and costs of higher rates of planting, the Town may consider increased funding in fiscal year 2020 and beyond.

(b) Areas of Concern

- Arlington has had a net loss of approximately 500 public trees since 2006 and an estimated loss of 2,000 public trees since 1980 (Arlington, Town of, 1965-2017).
- Annual tree planting has been limited to 175-200 trees due primarily to resource constraints on follow-up care. Previous Tree Department resources were not sufficient for a watering regimen that would support a larger planting program.
- Street trees have cost implications for other Town departments in addition to the Tree Department. Large surface roots cause sidewalk heaving which must be repaired and brought into ADA compliance. Deeper roots can compromise underground pipes, and tree leaves that block storm drains can lead to flooding if not cleared.

Section 1.03 Tree Management Goals

1. Increase Arlington's Tree Canopy
   a) Replenish the street tree canopy back to 1980 stocking levels, an increase of 2,000 public street trees. To accomplish this on a 20-year timeline, the Town will need to plant 300 street trees per year, assuming a consistent removal rate of 200 street trees per year. This planting goal should be re-evaluated every few years to align with removal rates. Once the replenishment program is complete and stocking levels are reached, Arlington will plant at least the number of trees needed to match annual removals.
   b) Plant more trees on private property to expand the Town tree canopy.
      1. Educate residents and businesses to the benefits of having trees on private property. Leverage the Arlington Tree Committee's ability to reach out and educate the public.

2. Continue use of dedicated tree funds and leverage the Town's buying power to provide reduced cost trees for residents and businesses to plant on private property.

c) Continue planting initiatives in public parks, fields, schools, cemeteries and other open spaces.

2. Better Align tree canopy with "10-20-30" tree diversity guideline
   - The Tree Warden will continue to choose a variety of species to be planted to offset the significant over-abundance of Norway Maples.
3. Proactively manage public trees
   - Develop a data management system that allows Tree Department workers to update the inventory database as work is completed in the field, keeping the inventory data current, open, and usable for regular management.
   - Address the estimated 1,100 Priority trees which require expeditious maintenance as identified by the inventory.
   - Establish a 5-year cycle for regular pruning and maintenance by Tree Zone[4] after the priority maintenance on trees identified in the inventory has been addressed.

Introduction

In addition to their beauty, trees and forests provide numerous benefits, both ecological and economic. Shade from trees is a comfort in hot weather, and the tree canopy acts to reduce the *heat island* effect in cities. This cooling effect can reduce the environmental and financial costs associated with ventilation and air conditioning. Trees remove pollutants like ammonia, nitrous oxide, ozone, sulfur dioxide, and particulates from the air. Carbon dioxide, an important greenhouse gas implicated in climate change, is metabolized by photosynthesis, and sequestered in the trees biomass. Storm water is absorbed by tree root systems. Trees have been found to be correlated positively with real estate values. As such, trees are an important component of green infrastructure in urban areas.

The tree inventory data will be used to answer these two questions:

- Which trees should be removed or maintained, in what order, and over what time frame?
- How should trees be added to the inventory, which species should be planted, where should they be planted, in what order, and over what time frame?

Arlington's Tree Management Plan will propose a timeline to accomplish this work as well as outline necessary budgeting to achieve these goals.

The scarcity of municipal resources limits the amount of increased tree management and planting operations. Upgrading information systems may allow more efficient decision-making and more optimal use of resources. The recommendation to implement a 5-year

[4] A geographic area corresponding to Arlington's current trash routes.

regular maintenance schedule assumes that priority maintenance on trees identified in the inventory can be assessed within 2 years and acknowledges that the backlog of resident requests for tree work will be ongoing.

Status of the Urban Forest

Section 1.04 Context

(a) History and Land Use Changes

When Europeans first arrived, the area that is now Arlington was heavily wooded. The Native Americans had formed limited clearings through burning and some broad tracts of meadowlands existed in Lexington, and the great demand for this land by Europeans led to the formation of what is now Massachusetts Avenue in order to access Arlington from Cambridge.

During the 19th century and into the early 20th, much of East Arlington was cultivated farmland. The view looking west from a farm in East Arlington near present day Lake Street showed "open fields, glass hothouses, boilers, smokestacks, ancient homestead farmhouses." (Commission, 1976) In the late 1800s the area became known for its market gardens.

A notable feature of the Town was the entrance on Massachusetts Avenue from Cambridge, where two stately elms welcomed people heading west into Arlington. These trees were called the Gateway Elms and their image lives on in the Town Seal.

Several main travel routes such as Lake Street and Pleasant Street were once lined with stately elms, all of which were subsequently lost to Dutch Elm disease.

Picture 1: Pleasant St., lined with Elms, 19th century

In the early part of the 20th century, the farmlands in East Arlington were subdivided and built up with multi-family housing. With this development came the continued demise of stately trees that grew in the path of construction. As early as 1842 a "fine sassafrass tree was felled and its roots dug up to allow a stone wall to run in a straight line," (Commission, 1976). Later, a journalist lamented that a massive Lake Street elm "would have to be sacrificed to America's spirit of commercialism, and where it stood will probably stand an apartment house with a puny catalpa tree and a hydrangea bush on a 6 by 8 curbed-in lawn." The felling of cherished trees in the name of progress is hardly a new phenomenon.

Arlington residents have a strong history of shade tree stewardship. In 1904, when a Gypsy Moth infestation caused massive and rapid defoliation, a group of residents, who called themselves the Arlington Heights Tree Protective Association, led the resistance by hosting weekly field days to burn the underbrush of densely wooded areas and to paint pesticide on nests to kill the moth's eggs, often millions at a time (Moth Plague Spreads, 1904). Over the last century, as the Town became increasingly urbanized, Arlington trees faced additional threats. Salting of streets and pollution from vehicles put increasing stress on the Town's existing trees and made it more difficult for new trees to reach full potential. A series of pests and diseases, such as Dutch Elm disease, Maple Die Back, and Ash Wilt devastated entire populations of street trees.

To counter these losses, the Town began planting trees to line the newly developed neighborhoods. In the 1920s and 1930s, the Town planted about 300 trees a year and removed fewer than 50. In the 1940s and 1950s, as new streets were constructed, several

hundred trees were planted each year to line them. For many years the Town operated a nursery on Summer Street and planted exclusively Norway Maples, a practice that was ended in 1965 (Arlington, Town of, 1965-2017). Throughout the 1960s and 1970s Arlington routinely planted more than 400 trees a year and had a tradition of giving out 500 seedlings to elementary school students on Arbor Day.

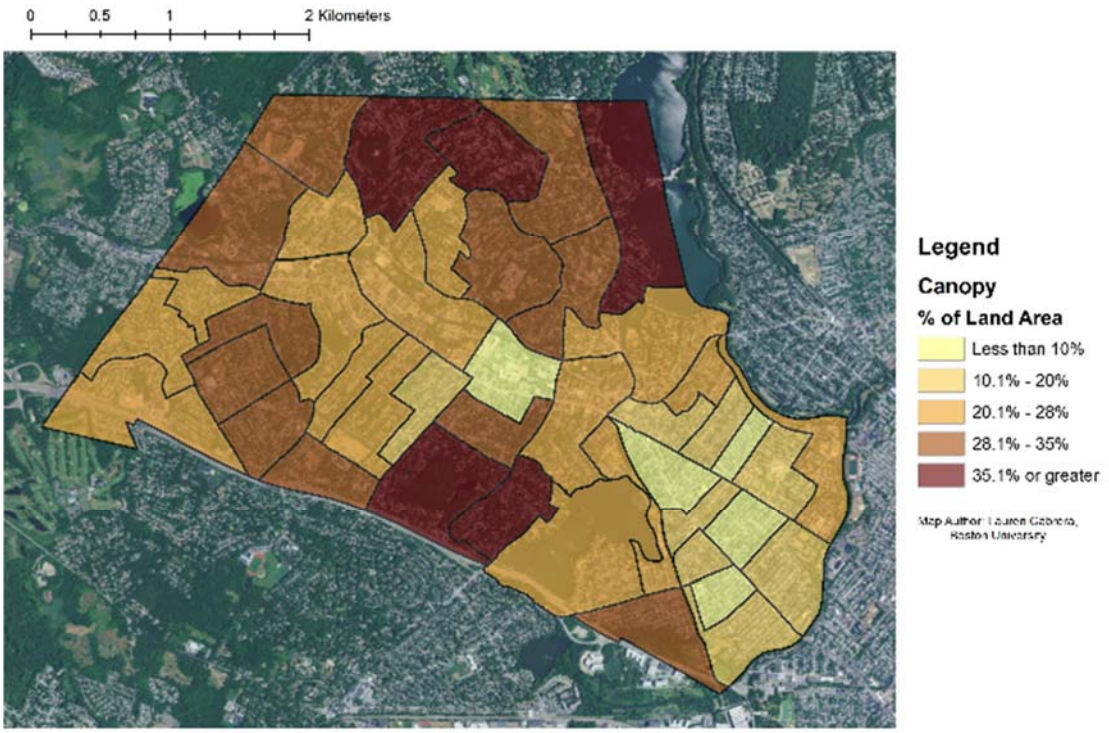
In recent decades, several severe storms, including Hurricane Gloria (1985) and Hurricane Bob (1991) as well as a microburst (2012), caused extensive damage to trees and losses numbered in the hundreds for each storm. By 1980, more trees were removed than planted. Since 1980 Arlington has had a net loss of over 2,000 trees, resulting in a declining tree canopy for the past 40 years. Over the last decade, even with the Town planting 175-200 trees a year on average, there has been only one year where the number of new trees planted has been greater than the number of trees removed.

(b) Environmental

Threats to the health of urban trees are numerous and can increase the risk of morbidity or mortality. An abundance of impermeable surfaces can impair access to water. Soil may be nutrient-deficient from previous plantings, or may be permeated with natural gas, which can asphyxiate roots. Salting of roads, common in New England during winter months, can result in desiccated root systems. Vehicles and snow plows may collide with trees, scraping bark or causing more serious damage. The potential of trees to interfere with overhead utility lines can lead to damage from severe pruning. Insects and other pests, like the Asian Longhorned Beetle (ALB) and the Emerald Ash Borer (EAB), are also threats, with several infestations in Massachusetts. Taken together with the natural aging process, an urban forest will have a significant number of trees in less than good condition. Trees in compromised health represent a threat to public health and property. Additionally, trees ability to provide environmental services may be reduced.

(c) Private trees

Arlington has a large number of trees on private property which provide ecosystem benefits to the Town. The level of total tree canopy (public and private) ranges from over 35% in northwest Arlington to under 10% in parts of East Arlington. The map below, created by a student at Boston University, shows total canopy by census block (Hutyra, 2018).



The private tree canopy is threatened by development and the Town has recently passed bylaws to try to protect this asset. Based on the research provide by BU there is a strong correlation between temperature and total tree canopy. During the summer months surface temperatures in highly treed areas are significantly lower than areas with minimal tree canopy (Hutyra, 2018).

Inventory

In May of 2017, a grant of $15,000 was awarded by the Department of Conservation and Recreation's Urban and Community Forestry Challenge to the Town of Arlington to support an inventory of Arlington's trees. This report will present a GIS and quantitative analysis of the data collected in the inventory and translate into a set of recommendations for expanding and preserving a robust urban forest canopy in Arlington.

The impetus for an inventory emerged late in 2013. John F. MacEachern, a long-time resident, bequeathed $146,510 to the Town for the planting and maintenance of new trees. Understanding tree population demographics, especially species diversity, age diversity, health, and canopy coverage, can inform how to most effectively utilize these funds. Additionally, the inventory presented an excellent opportunity to discover and record potential planting sites in public right-of-ways (ROWs).

Section 1.05 Geographic Scope

Arlington is a densely populated municipality situated in Middlesex County, in the eastern part of the Commonwealth of Massachusetts. It is bordered by six towns: Winchester, Medford, Somerville, Cambridge, Belmont, and Lexington.

The combined length of road infrastructure in Arlington is 128.98 miles, of which 74% are public roadways. A notable feature is the Minuteman Commuter Bikeway. At roughly 3.75 miles, the Bikeway extends the length of Arlington. The total area covered by the Town is 3,517.5 acres. The Metropolitan District Commission (MDC) owns 52.25 acres, represented primarily by the parks along the Alewife Brook and the Mystic River. The tree inventory included trees on all public roadways (excluding the trees owned by the MDC along Mystic Valley Parkway).

In addition to public streets, trees were inventoried along the Minuteman Bikeway, parks, schools, and the Mount Pleasant Cemetery. The exclusive concern driving tree data collection beyond the Town's street trees was to identify trees with an estimated diameter of 10 inches or more that fell within 10-15 feet of either side of the Bikeway. Potential planting sites were not recorded at these additional sites and conservation areas were not included in this inventory.

Trees on private streets/ways were recorded as part of the inventory. The goal in collecting these data was to facilitate a proactive approach to notifying residents on private streets as to hazardous trees and species prone to disease or invasive pests. The Town typically maintains these streets enough to allow for passage of emergency vehicles, but the cost of tree care and removal is the residents' responsibility.

Arlington has additional public trees located in parks and open space that were not mapped. Many of these trees are located in public parks away from the main walking paths. A 1998 survey estimated Arlington had 24,500 trees within 20 feet of the curb of land owned or controlled by the Town (Arlington Town Website, 2018). No estimate is available for all public trees in Arlington.

Section 1.06 Data Collection

(a) Interns

Two interns were responsible for the bulk of the data collection, each working a schedule of 35-40 hours per week. The interns were equipped with Samsung Galaxy S2 tablets, on which were installed two mobile apps, Azavea's OpenTreeMap (OTM) and PeopleGIS SimpliCITY. The OTM mobile app was the primarily tool for data collection. SimpliCITY provided access to the Town's GIS data layers, which were needed in the field to determine plow route boundaries and the ownership status of streets.

(b) Volunteers

Volunteers worked as coordinated groups covering a predetermined area, or on their own covering self-determined areas of interest.

The first coordinated volunteer data collection session was held on June 4, 2017, and the last session was held on July 25, 2017. A total of 20 sessions were held in total, involving 61 volunteers, and five Arlington Tree Committee members in addition to the two hired interns. Efforts were concentrated in the plow routes east of Mount Pleasant Cemetery and north of Massachusetts Avenue.

Terms of the DCR grant stipulated that volunteers must contribute 250 work hours, thus requiring documentation to certify compliance. This was accomplished by use of a Google spreadsheet.

Section 1.07 Data

In its most basic form, data collection consisted of observing a tree and recording four essential fields of data:

1) geospatial location
2) taxonomic classification
3) diameter or circumference
4) health/condition

(a) Location

Trees were visually identified by using its GPS position and the composite satellite/street (or "hybrid") basemap imagery. A total of 16,971 sites were recorded in the inventory; of these, 62% (10,570) contained trees, and 38% (6,401) were identified as potential planting sites. An inventory of the Mount Pleasant Cemetery recorded 404 trees. There were 617 trees counted along private ways, or 6% of all trees. Some streets did not have any trees. Typically, the canopy in these locations consisted entirely of trees on private property just beyond the sidewalk.

Site	Ownership	Type	Total
Planted	Public	Public way	8734
		Bike path	262
		Cemetery	404
		Park	266
		School	287
	Total Public		**9953**
	Private way		617
	Total Private		**617**
Total Planted			**10570**

Figure 5: Number of Trees by Location Type

The inventory data was divided into 5 Tree Zones, which correlate with the Town's existing trash collection routes (See Appendix B). Two mapbooks were produced using ArcMap, both consisting of one page for each of the five Tree Zones. The first mapbook displays planted sites, with tree data point symbology color reflecting location type (see

Appendix C). Unplanted sites are displayed in the second mapbook, in this case with symbology reflecting unpaved or paved status (see appendix D).

(b) Taxonomic Classification

Trees were generally identified by genus and species, with the family name being added after collection. Where identification was uncertain or not possible, data collectors recorded the species as "missing". It was decided that ash and linden trees would be recorded by *genus* only, since species identification can be extremely challenging.

Industry guidelines suggest the composition of a tree population should follow the *10-20-30 Rule* for species diversity: a single species should represent no more than 10% of the urban forest, a single genus no more than 20%, and a single family no more than 30% (Davey Resource Group, 2016). This guideline is encouraged on a community-wide and more localized basis and intended to reduce the impact of tree losses of any one species due to pest or environmental change. In some communities, a more restrictive "5-10-15" rule is used.

1) Tree Species

When possible, species were identified for every tree, but during the inventory it was decided that for certain genera, including ash and linden, it was more important to correctly identify the genus rather than the individual species. As a result, a significant number of the inventoried trees were recorded by genus only. For example, 244 maples (Acer) were listed this way, as well as many ashes (Fraxinus), oaks (Quercus), apples (Malus), and elms (Ulmus). Of the inventoried trees identified by species, Norway Maples were found in abundance, at 42%.

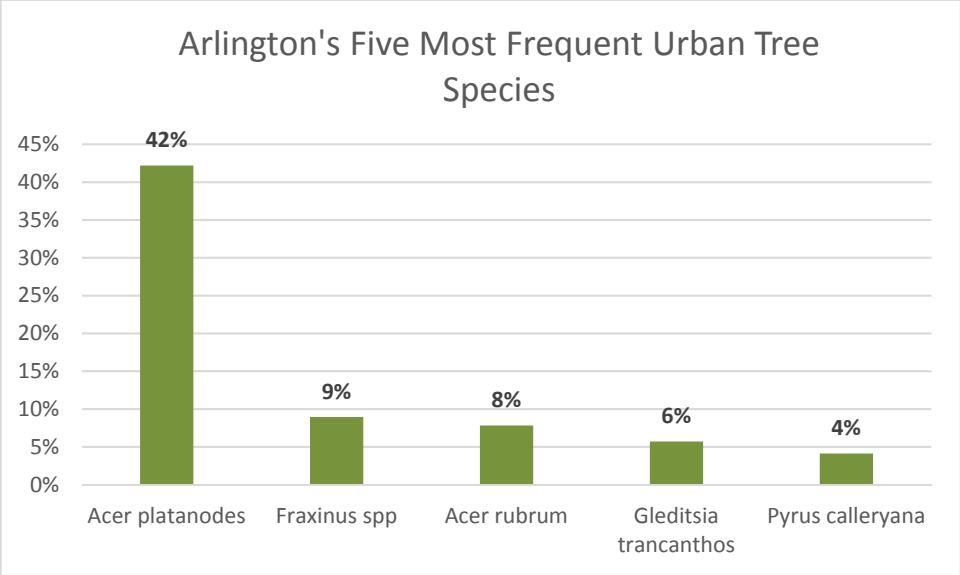


Figure 6: Arlington's five most frequent urban tree species

Trees from 49 distinct genera were recorded. Frequency by genus confirms *Acer* (maple) is abundant, with 56% (5,934) identified as *Acer*. This was the only genus appearing in greater density than the 20% genus guidline. Together the top four genera make up over

75% of all trees, and the top 12 genera capture over 95%. Tree Zone 2 hosts the largest number of *Fraxinus*, with 268 of the 969 town-wide.

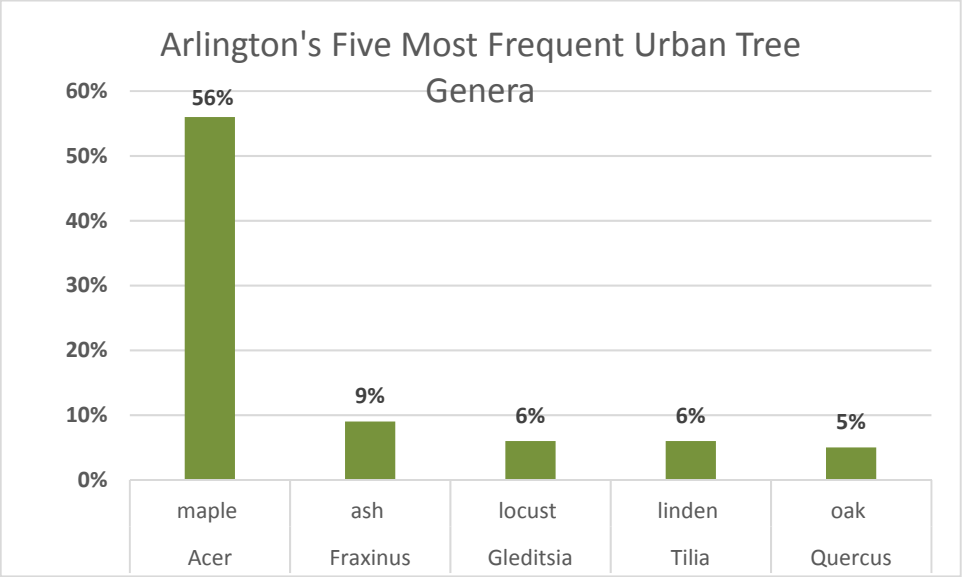
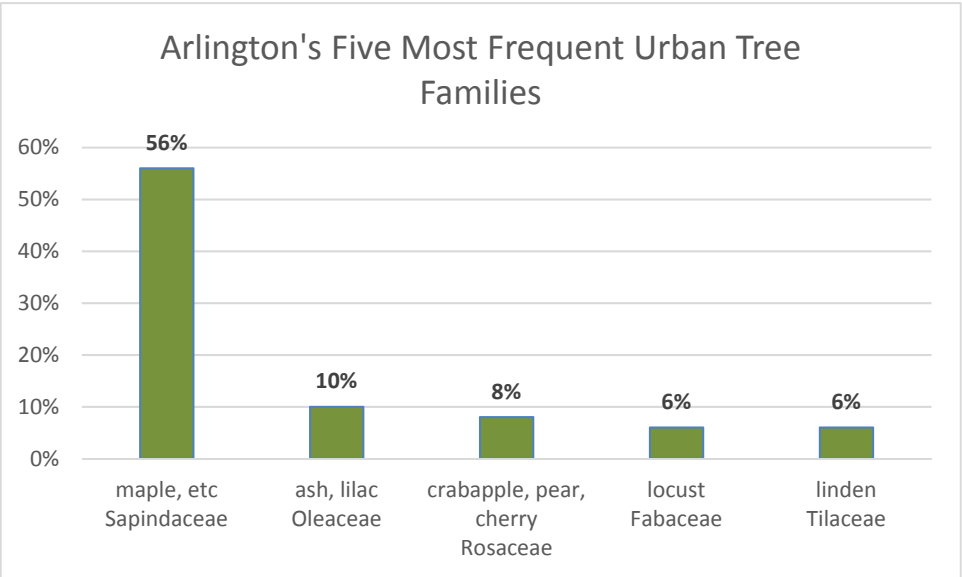


Figure 7: Arlington's five most frequent urban tree genera[5]

2) Tree Family

The family Sapindaceae, which includes the maples and horsechestnuts, were found to be 56% of the tree population. This is largely due to the *Acer platanoides* (Norway maple), which makes up 75% of the Sapindaceae trees in Arlington.



5 Trees for which only genus was recorded numbered 2,214, nearly a quarter of the 10,570 trees recorded, and drawing from 17 genera. Fraxinus constitutes by far the largest group in this category, 944 trees or 42.64%, followed by Quercus at 273 (12.33%), then Acer at 244 (11.02%) and Malus at 201 (9.08%). Together, these four account for 75% of genus-only trees.

Figure 8: Arlington's five most frequent urban tree families

(c) Tree Diameter

Data collectors followed the standard practice of measuring diameter at breast height (DBH). In rare instances where multiple trunks were present, this was noted, and the largest trunk was measured. The diameter of a tree can be used as a rough indicator of a tree's age. The ideal distribution, proposed by Richards (Richards, 1983) uses four class sizes defined as: Young (0" – 8"), Established (9" – 17"), Maturing (18" – 24"), and Mature (>24"). Arlington trees in the Established (9" – 17") size class were most abundant, at 31% of the total inventory, with trees in the Maturing (18"-24") size class at 29% of the total inventory. Richards' ideal size class distribution is skewed to younger trees, which are recommended to make up 40% of a Town's inventory.

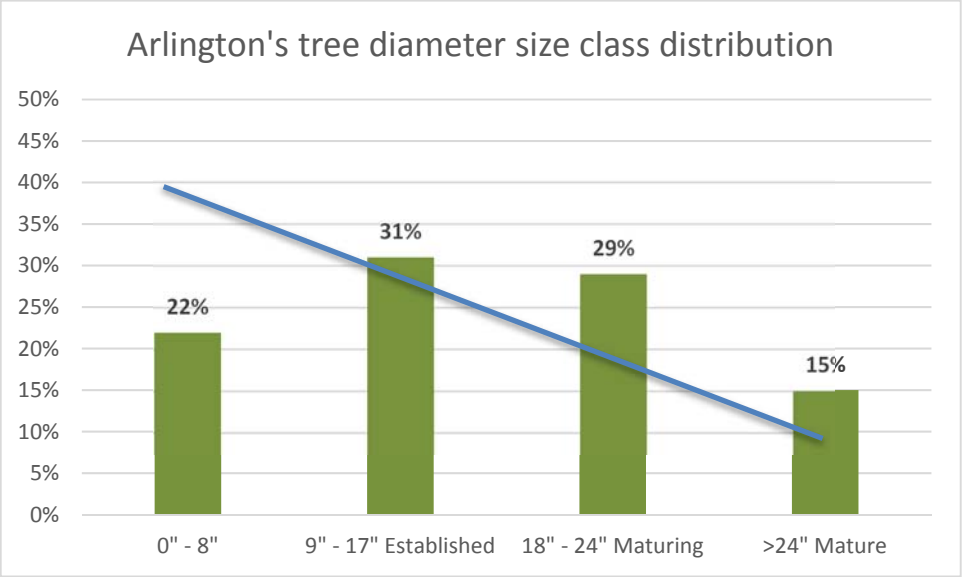


Figure 9: Size distribution of Arlington trees compared to ideal distribution (Richards, 1983)

(d) Tree Condition

Tree health was recorded as "Dead", "Poor", "Fair", or "Good". Defoliation and form of the canopy were factors in establishing condition. Specifically, collectors observed the outline of the tree and noted irregularities in the shape. Severe leaning, missing bark, presence of cavities (especially large ones in the trunk) and fruiting structures (fungal conks, for example) or carpenter ants were other factors noted.

No evidence of ALB or EAB was discovered in the course of the inventory. Three trees were found to be hosting Gypsy moth caterpillars, with two of the three trees determined to be dead.

The majority of public street trees appear to be in good or fair condition. More than half, 57% (5,689), are listed as good, 33% (3,288) are fair, and a total of 10% (951) are in poor or dead condition. Less than 1% (25) are stumps.

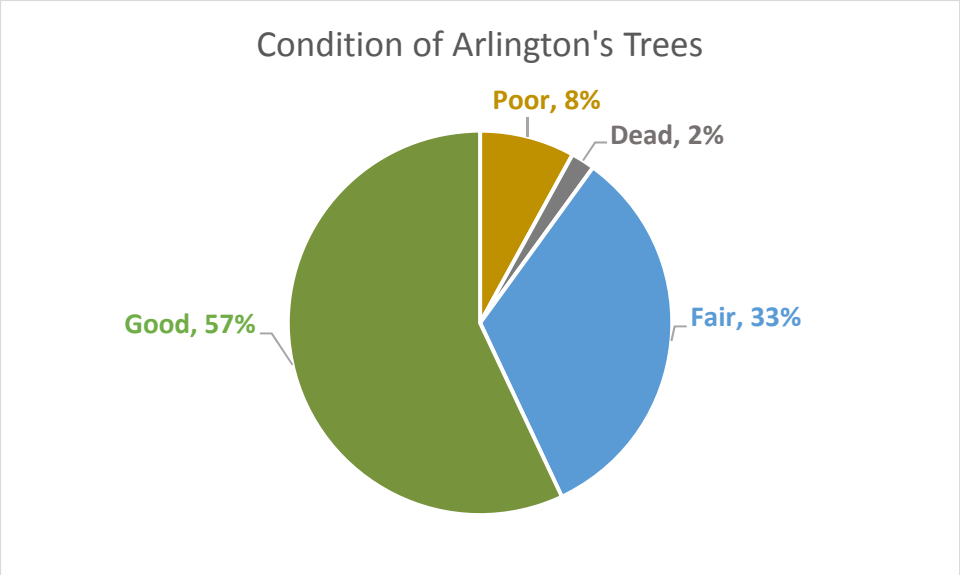


Figure 10: Condition of Arlington's trees

Tree Zone 3 has the lowest percentage of trees in good condition, or 8% (783). This is noticeably less than the other Tree Zones, and Tree Zone 3 is the only Tree Zone where the number of good and fair trees are about equal. Tree Zones 2 and 3 have the greatest share of trees in fair condition, or 7% (736) and 8% (747) respectively, while Tree Zone 1 had the least number of fair trees at 5% (496). Tree Zone 2 has 2% (40) of public trees in dead or poor condition, slightly more than the other Tree Zones.

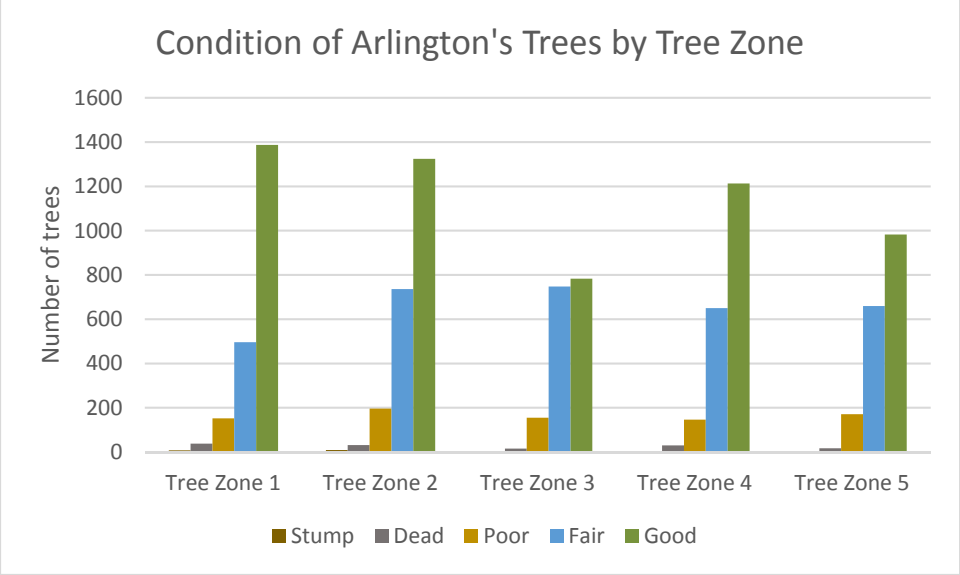


Figure 11: Condition of Arlington Trees by Tree Zone

Tree condition was found to vary by DBH. Eighty-one percent of trees less than 6" DBH were in good condition. The percentage of trees in good condition generally fell as tree size increased. Sixty-two percent of the trees of 7" – 12" DBH were good, 50% of trees 13" – 18" DBH, 46% of trees 19" – 24" DBH, 47% of trees 25" – 30" diameter class, 44% of trees 31" – 36" and 37" – 42" DBH, and 54% of trees greater than 43" DBH.

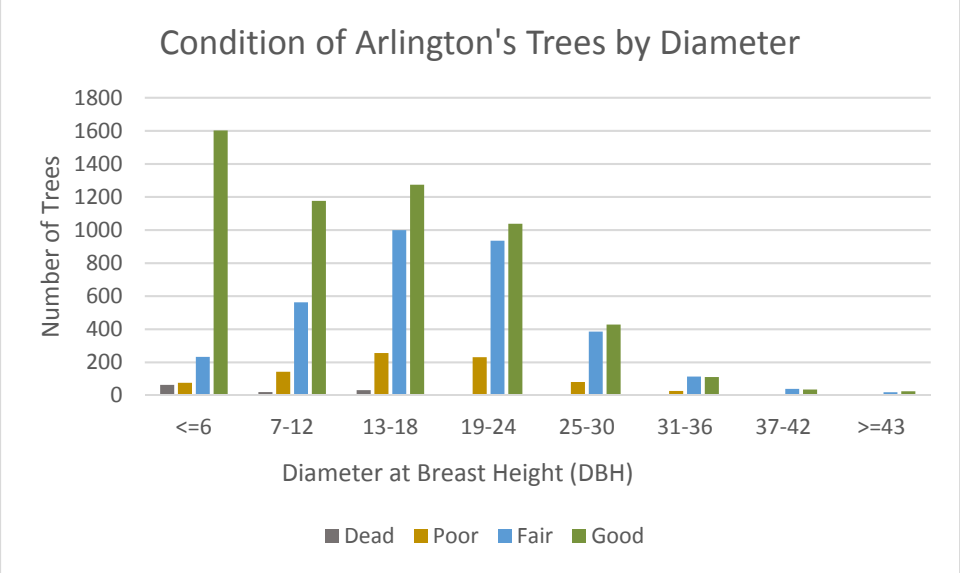


Figure 12: Condition of Arlington's Trees by Diameter

Trees in poor condition and in the 18” – 24"diameter range were 3% (256) of the total. Trees in less than good condition and over 30" DBH total 679 (7%). These trees will be monitored as their size and condition mark them as higher priority for on-going maintenance.

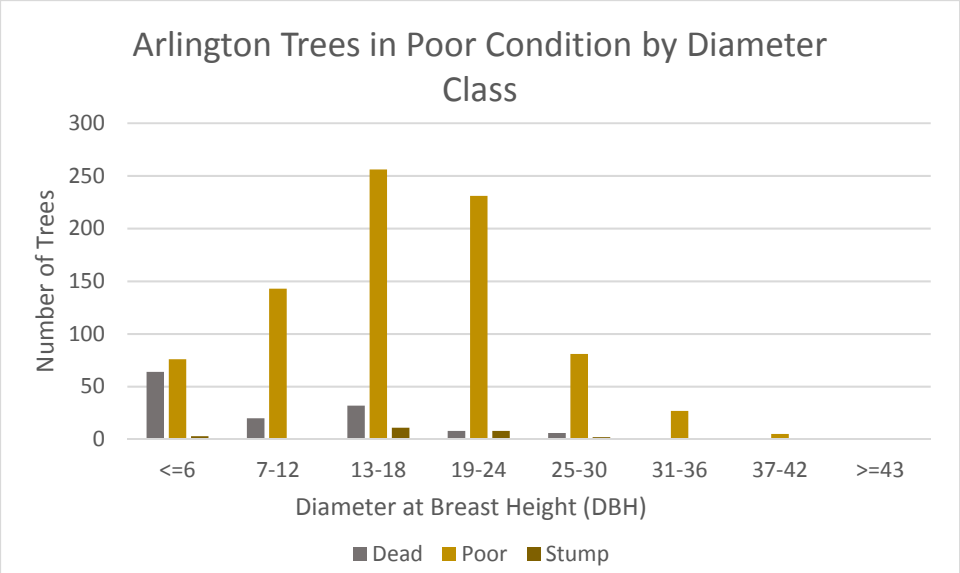


Figure 13: Arlington Trees in Poor Condition by Diameter Class

Large, unhealthy trees growing around overhead lines was frequently observed. This is the result of years of severe pruning by the utility companies. Exposed scaffolding limbs bear a heavier load of snow in the winter months, predisposing limbs to snapping off. No attempt was made to quantify how many trees were affected in this way. Managing utility pruning practices is an on-going responsibility of the Tree Warden. Providing clear

pruning specifications and close monitoring of utility company sub-contractors is and will continue to be essential to ensure the protection of the canopy.

(e) Unplanted Sites

According to The Davey Tree Expert Company, "…it is assumed that any given street ROW should have room for 1 tree for every 50 feet along each side of the street," (Davey Resource Group, 2016), which is equivalent to 212 trees per mile of street assuming plantings on both sides of the street. Arlington has 80 miles of public streets, therefore a total of 16,960 **theoretically possible** planting sites. The inventory recorded 8,743 public street trees, which would leave 8,217 potential planting sites, according to Davey Tree Expert Company's rule of 1 tree per 50 feet of street. The number of recorded potential planting sites in the Arlington inventory is lower than the theoretical number, as various considerations were taken into account when evaluating possible planting sites, and may be even lower still pending site inspections by the Tree Warden.

Inventory workers were instructed to record potential planting sites as well as paved areas that had the potential to be planting sites. The minimum requirement for a planting site was 15 – 20 square feet, the area assumed to be large enough for a small tree. For actual planting purposes, a site visit to each potential planting site is required to determine the suitability of the site as well as the size of tree for the location. Generally, potential sites were not recorded where obstacles were nearby, such as heavy shade created by mature trees nearby. Likewise, utilities such as telephone poles, fire hydrants, and manhole covers also removed areas from consideration.

Tree Zone 4 was discovered to have the highest number of potential planting sites: 1,441 (23%), Zone 2 was found to have the highest amount of paved potential planting sites per road area.

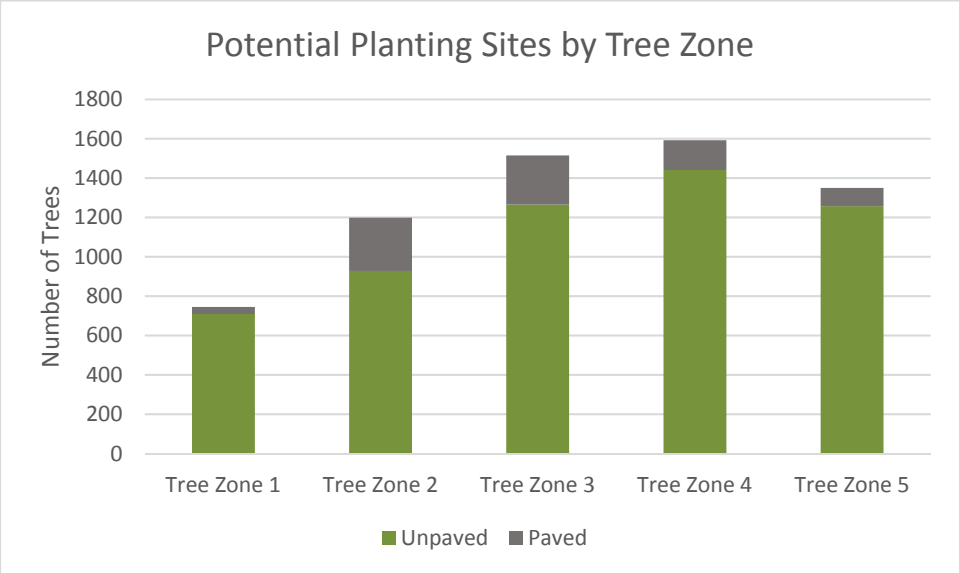


Figure 14: Paved and unpaved planting sites by Tree Zone

(f) Environmental Benefits

A number of ecological services are provided by the Town's urban forest. OTM automatically calculates "Eco Benefits" based on selected trees. These are reported here, and reflect the data as of September 2018, before migration into the Town's GIS:

Total annual benefits: $768,320 in savings to:
Energy conserved: 11,120,974 kWh/year saved $622,057
Stormwater filtered: 17,727,558 gal/year saved $14,182
Air quality improved: 22,721 lbs/year saved $112,729
Carbon dioxide removed: 5,793,971 lbs/year saved $19,351
Carbon dioxide stored: 25,024,460 lbs saved $83,581

Management

Effective tree management can prevent or minimize tree health threats, preserve existing trees, and expand the urban forest. Effective tree management can be accomplished by a regime of removing or pruning existing trees and planting and caring for new trees.

Section 1.08 Management Overview

Current management practices in Arlington can generally be summarized as "reactive," with residents indirectly initiating the majority of tree management actions. New plantings, removals, or pruning requests from residents are received by the Tree Warden through the Town's WebQA software system and implemented by the Tree Department crew. The crew consists of six men working under the supervision of the Forestry Supervisor. Maintenance actions are delegated to the Forestry Supervisor, who in turn directs the crew as appropriate. New planting locations are approved by the Tree Warden.

Historically there has been a large backlog of maintenance requests. While maintenance goes on throughout the year, accurate assessment of a tree's condition can only take place after leaf-out and well before leaf-fall and is exclusively the Tree Warden's responsibility. Removal of large dead trees can be especially resource-intensive, in terms of personnel, equipment, cost, and time. Competing responsibilities of the Tree Department may act to decrease the rate at which requests can be honored.

(a) Organization

Management responsibilities for Arlington's urban forest are shared between several parties including:

(i) Department of Public Works

Tree Department: 7-person department of Town employees, reporting to the Director of the Department of Public Works, responsible for new plantings, maintenance and removals. The Town owns 2 chippers, 1 boom truck, 1 chip truck, 1 crane, 2 bucket trucks, 2 pick-up trucks, 1 stump grinder, 1 skid steer, and 1 watering tank.

Contract Labor: including outside suppliers for tree planting, tree maintenance and removal, hired under contract by the Director of the Department of Public Works.

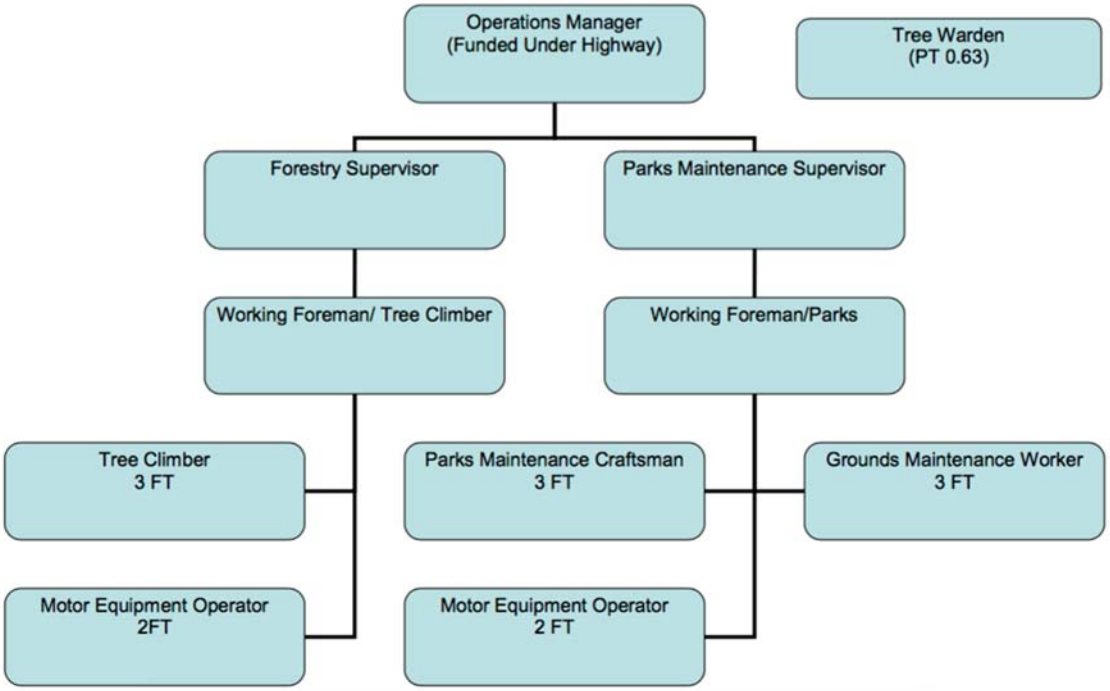


Figure 15: Arlington Department of Public Works organization chart (Arlington Town Website, 2018)

(ii) Tree Warden

General responsibilities: Overseeing planting of new street trees; care of new trees; reviewing proposed tree removals and maintenance; holding tree hearings per requirement of Massachusetts General Law Chapter 87; reviewing and monitoring tree plans per Arlington's Article 16 Tree Preservation Bylaw, and community outreach

(iii) Tree Committee

The Arlington Tree Committee was established in 2010 by the Arlington Board of Selectmen. The mission of the Committee is to promote the protection, planting, and care of trees in Arlington and to support the Town's Tree Department.

The Tree Committee promotes community awareness of trees and their benefits and supports increasing the number of site-appropriate street trees in Town. The Committee has undertaken several initiatives to support these goals:

- Wrote the Tree Protection and Preservation Bylaw (2016)
- Pursued a DCR grant to pay for and then conducted a town-wide street tree inventory (2017)
- Developed the Community Tree Canopy Program – a reduced-cost tree purchase program for homeowners and businesses using funds from the John F. MacEachern bequest (2017, 2018)
- Development of a Town process to plant street trees on private property.
- On-going public outreach, including Town Day, Eco-fest, tree planting demonstrations, social media, a Friends of Arlington Trees volunteer network, and articles for the Arlington Advocate

(iv) Other Organizations

1) Planning Department

The Tree Warden and the Tree Committee work with the Town GIS Coordinator to make use of the tree inventory data to streamline tree management tasks; currently working on the creation of software to enable Tree Department workers to update inventory while in the field.

2) Finance Committee

The Tree Committee informs the Finance Committee about the current state of Arlington's trees by presenting inventory results for consideration for budgeting purposes.

3) Parks Department

The Tree Warden works on a regular basis with the Parks Department to consult about possible locations for additional tree plantings and other tree-related topics.

4) School Committee

The Tree Warden works in coordination with the School Committee to ensure trees are considered in building projects and ongoing care and maintenance of school grounds.

5) Building Department

The Tree Warden and the Tree Committee coordinate with the Building Inspector to ensure that residents and those undertaking construction work in Town are aware of the Massachusetts General Law Chapter 87 (which protects Arlington's public trees) and Arlington's Article 16 Tree Preservation Bylaw (which protects Arlington's private trees) before initiating planning and construction. The Tree Committee is developing posters and other handouts to ensure that the laws are understood and obeyed.

6) Arlington Redevelopment Board (ARB)

The ARB is the Town's Planning Board and is also the redevelopment authority. The ARB manages three Town buildings: Jefferson Cutter House, Central School, and 23 Maple Street.

Section 1.09 Current Practices

(a) Planting:

Planting operations are completed by the Arlington Tree Department. Twice per year, the Arlington Tree Department orders about 100 bare-root trees in late February or early March, and another 100 trees again in August, at a cost ranging from $79-$104 per tree. The trees are generally delivered in mid-April and in Mid-October and are heeled in at the Mount Pleasant Cemetery for temporary storage.

Residents who have requested street trees are at the top of the planting list; the remaining trees are planted in locations chosen by the Tree Warden, who selects appropriate sites and species for plantings. Town Tree Department crews plant the new trees within about two weeks of arrival.

Before planting, the Tree Warden reaches out twice to residents, first with a note to alert homeowners of a new street tree to arrive near their home, and second with written watering instructions. Both are left at the home nearest the planting location. In the event a resident does not want a new tree to be planted in the public tree strip in front of their home, the early warning note helps to avoid conflict during or after planting.

After a tree is planted, a watering bag (gator bag) is affixed to new trees, with a written instruction tag attached asking residents to help water the new trees. In 2017, the Tree Warden spent 2-3 days per week during growing season filling gator bags from the Town's water truck for the spring and fall planted trees. Removal of gator bags once the new tree is 2 years old has been done by the Tree Department or managed by volunteers through the Tree Committee.

Additional plantings on an "ad hoc basis" are conducted by the Tree Warden and DPW Director in coordination with the Parks and Recreation, the School Department, and other community stakeholders.

(b) Removals

The Tree Warden identifies street trees for removal beginning in late May or early June when healthy trees have leafed-out and dead or dying trees can easily be identified. A full list of tree removals is developed with the addition of resident requests for tree removals. Tree Department crews also keep an eye out for hazardous dead limbs, and the Utility Company alerts the Tree Warden during their routine maintenance. Tree trimming and removal work takes place year-round, depending on weather conditions (Arlington, 2018). As per Massachusetts General Laws Chapter 87, healthy street trees cannot be cut down without a Tree Hearing (see Section 1.10 Plans, Policies, Regulations).

Over the last decade Arlington has removed more trees than it has planted, averaging a net loss of 50 trees per year. Since 2006, the Town has planted 1,714 trees and removed 2,270, with a net loss of 556 over eleven years. Of special note is the year 2012 when Arlington was hit by a microburst in July which resulted in the loss of 160 trees, mostly in East Arlington (See Figure 16: Arlington plantings and removals 2006 to 2016).

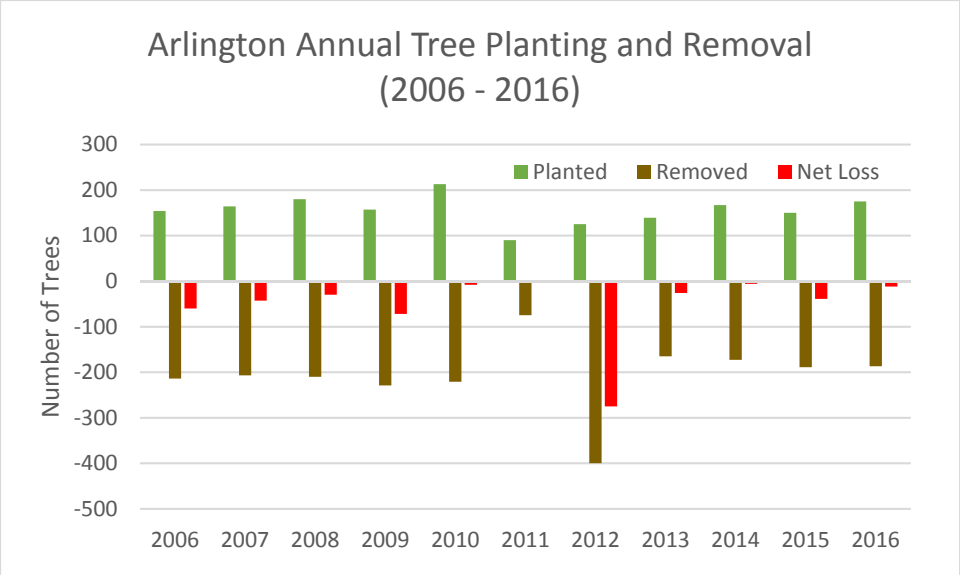


Figure 16: Arlington plantings and removals 2006 to 2016

Historically, Arlington has engaged in large planting programs. In the 1960s and 1970s the Town routinely planted upwards of 400 trees per year. The size/age of Arlington's current inventory is reflective of these historic bursts in plantings, with a skewed age/size distribution. Budget constraints have prevented the department from conducting this type of large scale annual planting since the 1980s (See Figure 17: Arlington plantings and removals 1966 to 2016). Visible in the figure below are tree losses due to Hurricane Gloria (1986) and Hurricane Bob (1991), and the microburst (2012).

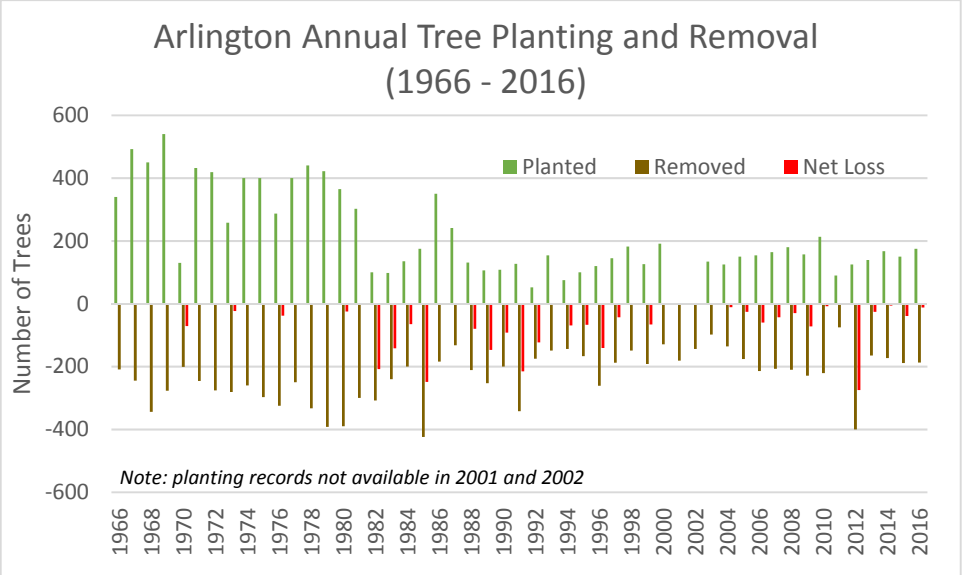


Figure 17: Arlington plantings and removals 1966 to 2016

(c) Health Maintenance

The Town currently does not engage in proactive tree health maintenance, and in recent years there has been no program for spraying or treatment for disease or pests. Trees are maintained in response to resident requests for pruning or removal via the Town's WebQA system.

Over FY 2015, 2016 and 2017, the tree department averaged 178 planting requests per year, 294 pruning requests, and 219 removal requests. All request locations are visited by the Tree Warden who makes a determination about the action required. Not all requests require an action, and in some cases the requested action is different than the completed action. For example, a home owner may request a tree removal, but the Tree Warden may determine that pruning is more appropriate.

Beginning in the summer of 2017 and continuing into the spring of 2018, an outside contractor was hired by the Town to close a backlog of over 300 requests for pruning or removal. Of the 273 pruning requests that were closed during this time period, 24% (66) had been categorized as Priority in the inventory, 26% (72) had been categorized as Medium Priority, 11% (31) had been categorized as Low Priority, and 37% (100) had been assigned no priority.

Of the 1,157 Priority trees identified in the inventory as needing immediate attention, just 6% were addressed as a result of clearing the backlog of resident requests. This highlights the need for more proactive tree management to ensure that Priority trees are receiving the attention necessary to maintain their health.

Section 1.10 Plans, Policies, Regulations

(a) Hearings/Developers/Curb cuts

Arlington's public street trees are protected under Massachusetts General Laws Chapter 87 and may not be removed without a Tree Hearing (except in the case of street widening, pest suppression, or public danger) conducted by the Tree Warden. If there is a request to remove a street tree, a Tree Hearing is scheduled, and the date and time of the hearing is publicized on a placard affixed to the tree, in the legal notices section of the *Arlington Advocate* for two consecutive weeks, and on the DPW website. Anyone who objects to the removal must do so in writing to the Tree Warden or by appearing at the scheduled hearing. The removal request will be denied by the Tree Warden if there are any objections. An appeal may then be filed to the Board of Selectmen. Regulations as of April 2018 include the following fee structure: $100 hearing fee and if the tree is found able to be taken down, a $100 per inch of tree size fee is paid by the party interested in removing the tree. Any funds collected as a result are deposited into the Town's Trees Please Fund.

(b) Bylaw

Article 16, The Tree Preservation Bylaw, passed by a large majority at the 2016 Town Meeting. The Bylaw states that removal of protected trees (healthy trees 10" or greater within the setback) on private property (under applicable circumstances) is prohibited unless the removal is authorized by written approval of a Tree Plan. (See Appendix A).

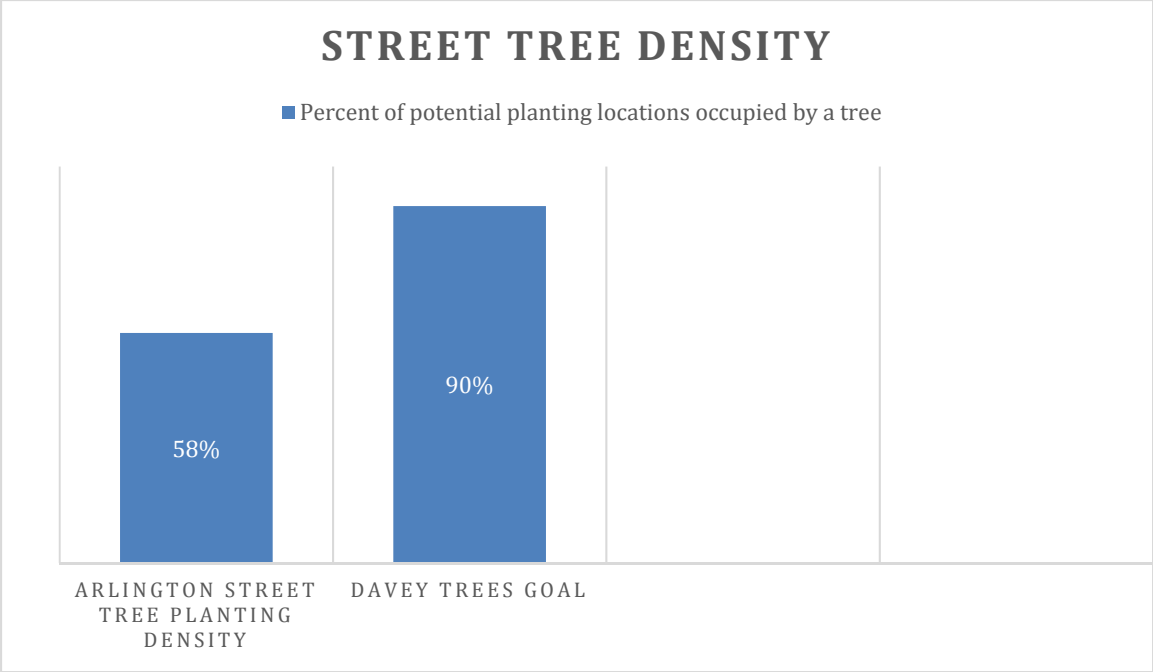
Strategic Plan

Section 1.11 Increase Arlington's Canopy

The 2019 fiscal tree planting budget will increase from $40,000 to $90,000, which will allow the Town the opportunity to evaluate efficient planting strategies and establish improved watering processes. Additionally, the Town and the Tree Committee can encourage, incentivize and educate residents and businesses to plant trees on their private property.

According to Town annual reports, Arlington's street tree canopy generally increased until 1980 as subdivisions were laid out and trees were planted along new streets. After 1980 the tree canopy began to decline due to several factors: increased environmental threats of an increasingly urbanized environment, and, more significantly, the passing of Proposition 2.5 in Massachusetts which severely affected public works funding, resulting in sharp declines in staffing and annual plantings by the Town. Based on plantings and removals listed in Town Annual Reports, it is estimated that the Town reached its peak tree canopy in 1980 with approximately 10,700 public street trees.

In a review of tree management plans from neighboring communities, a common goal outlined by The Davey Resource Group recommends that "the street ROW stocking level be at least 90% so that no more than 10% of the potential planting sites along the street ROW are vacant."



Given the uncertainty of the actual number of planting pits, as well as the limits on planting due to watering constraints, rather than aiming for 90% stocking level, the Town will aim for the more tangible goal of returning to the estimated peak stocking level, 10,700 trees.

(a) Planting Timeline

The Town will aim to replenish the street tree canopy to return to 1980 levels (a net increase of 2,000 trees) over a twenty-year time period. The Town will need to plant 300 street trees per year, assuming a consistent removal rate of 200 street trees per year. The removal rate will need to be re-evaluated every few years to align the number of trees planted accordingly. The Town will aim to plant 150 trees in the spring and another 150 in the fall. Currently, almost all of the spring plantings sites are determined by resident requests. For future plantings, the Tree Warden will evaluate potential planting sites in the inventory and choose the best sites for overflow planting if the Town does not receive 150 resident requests.

Planting sites are and should continue to be carefully evaluated to ensure long-term survival, taking into account the myriad threats from surrounding infrastructure, including planting pit size, proximity to street (for salting and plowing), underground utilities, overhead wires, and nearby resident's enthusiasm for caring for new trees. In 2018, the Town will be using a soil methane tester to check planting sites for natural gas leaks.

Looking forward, the Town should consider planning targeted planting by Tree Zone to reduce travel time of Tree Department staff and add focused, consistent watering during the critical two years following planting.

(b) Private Property Planting

The Arlington Tree Committee will continue community outreach programs to educate residents on the benefits of trees and to encourage private planting. The Arlington Tree Committee ran a pilot Community Tree Canopy Program during the Spring of 2017 using funds from the John MacEachern Bequest to subsidize the purchase and delivery of 25 trees to private property owners in targeted areas of Arlington shown to have relatively low tree density. Due to the success of the pilot program in 2017, The Committee ran the program again in the spring of 2018, and offered 50 subsidized trees.

(c) Watering

A critical bottleneck to increased planting is the requirement for consistent watering in the first 2-5 years to ensure the survival and long-term health of new trees. By allocating resources to this task, the Town could plant more trees each year and ensure that the trees have greater long-term success. For the summer of 2018, the Tree Department plans to offer overtime to current employees to water new plantings. A citizen stewardship program or a volunteer watering program may also allow for increased capacity to water new trees, though both of these options would require oversite.

Section 1.12 Better Align Tree Canopy with "10-20-30" Guideline

(a) Biodiversity

A broader diversity of trees is needed in our urban landscape to guard against the possibility of large-scale devastation by both native and introduced insect and disease pests. Arlington will use the following guidelines for tree diversity: (1) plant no more than 10% of any species, (2) no more than 20% of any genus, and (3) no more than 30% of any family. Given Arlington's overabundance of trees of the genus *Acer*, Town plantings of such trees should be deemphasized or staggered over time.

Section 1.13 Proactively Manage Public Trees

(a) Five Year Plan

Establishing a five-year routine management schedule could provide efficiency by reducing logistical costs to the DPW and targeting management to high risk trees for each Tree Zone. While the current funds do not allow for any one Tree Zone to be fully managed in a single year, the Tree Department can target the high-priority trees for each Tree Zone instead.

(i) Priority Tree Work

The identification of Priority trees is the first step in a multi-step process for tree maintenance. All Priority trees will need to be evaluated by the Tree Warden to create a work order and detailed instructions for the maintenance required. This will be entered into a new spreadsheet likely outside of the existing WebQA form,

and these tasks will be assigned to Town Tree Department staff and outside contractors.

After all trees have been visited, work orders created, and crews sent out, volunteers will update the Town's inventory with maintenance reports (though the tree condition will not be updated) to allow the Town to keep track of the same Priority trees and revisit them in 3-5 years for follow-up inspection by the Tree Warden.

Assuming funds are available, the DPW estimates that it will take 2 years to assess the condition of the 1,157 Priority trees identified in the inventory. This would require the Tree Warden to evaluate and create work orders for 30 trees per week. Several additional years may be required to complete the work on these trees. Once this is completed, the Town will aim to begin a 5-year routine maintenance plan.

Using industry standard cost estimating models[6], tree management on the 1,157 Priority trees is expected to cost between $395,000 (estimate based on outside contractor prices) and $414,000 (estimate based on calculation of the total number of tree diameter inches of Priority trees found in the inventory). The high number of trees identified as Priority and limited time of the Tree Warden will likely be a key bottle-neck in the process.

(b) Data Management Plan

One outcome of the inventory and integration of the inventory with Town GIS has been greater attention to the current limitations of the Town's information technology as it relates to trees and the development of new systems and requirements.

The Town's WebQA software is currently used for both work order management as well as resident communication, but this software is not GIS capable, therefore does not link directly to individual tree locations. The system is also not used for recording completed work (pruning, removals, other action) in a way that can later be reported. There are efforts underway to improve upon this, but the current work flow for the Tree Warden includes several redundant tasks.

The Town's GIS department has used PeopleGIS software and license, at no cost to this project, to develop a SimpliCity map as the visual interface to the tree data and a PeopleForm for data management by staff. This type of staff-facing management system and public-facing map has proven to be successful in similar inventory-based projects. This system will have limited querying and reporting capability, relative to OpenTreeMap, but improvements can be explored over time.

[6] "Davey Resource Group made budget projections using industry knowledge and public bid tabulations. Actual maintenance costs were not specified by the City of Northampton." (Davey Resource Group, 2016)

On August 2, 2017, the inventory data was migrated from OTM to the Town's GIS, as active data collection was completed, as well as several rounds of thorough inventory data quality review. Storing the inventory data in the Town's GIS will allow for future linking with the Town's work orders and citizen requests system software.

On February 28, 2018 the Town made public a People GIS SimpliCITY map showing the tree inventory data. The map indicates the location and common name for every street tree inventoried (it does not include trees inventoried on privately owned property, parks, or cemeteries). In addition, the map contains separate layers for four diameter size classes (Young: <8", Established: 8" – 17", Maturing: 17" – 24", and Mature: >24") and for 7 genus categories (Acer, Fraxinus, Gleditsia, Tilia, Quercus, Pyrus, and Other). Since the inventory was completed, volunteers and the Tree Warden have manually edited the tree inventory with notes from the work orders completed to date.

(c) Emerald Ash Borer

Arlington is currently evaluating strategies for EAB management. One possible approach is to remove the 36 poor condition Ash trees and treat the remaining 916 fair and good condition trees.

The 916 fair and good condition Ash trees include 12,539 inches of tree diameter. A rough cost estimate to treat this amount of ash trees will be $12,539 plus labor if the work is performed internally with Town staff, or $125,390 if the work is done by an outside contractor.[7] This assumes a $1/diameter inch cost for material if done internally versus the $10/diameter inch contractor treatment price (which includes material and labor). The treatment would need to be repeated.

For comparison, a plan of no action or removal of affected trees would cost an estimated $549,600 for removal and stump grinding of the trees (916 trees at $600 per removal, assuming an average of 12" diameter trees and $50 per diameter inch cost), plus an estimated $641,200 to plant replacement trees ($700 per tree for 916 trees), totaling over $1 million.

The Town will also need to determine a strategy for outreach to private land holders including owners who maintain the 11 ash trees found on private streets. An environmentally- and pollinator- friendly pesticide and method of application that is efficacious will be used.

(d) Utilities

(i) Power Lines

In the current inventory, large, unhealthy trees growing around overhead lines were frequently observed. This is the result of severe pruning by the utility company. Traditionally, this was done to avoid the need for frequent maintenance. Recently, an improved relationship with the utility company has been built by the DPW and the Tree

[7] Cost estimates provided by Tree Warden based on previous experience.

Warden. *Eversource* now employs arborists and communicates to residents ahead of time regarding pruning operations.

Eversource has defined geographic circuits and prunes each circuit once every four years. However, circuits run across Town lines so *Eversource* does not necessarily prune one quarter of Arlington's circuits every year. As a result, *Eversource*'s pruning cycle cannot easily be coordinated with the Tree Department's 5-year pruning cycle. Ideally the Tree Department would communicate with *Eversource* and try to coordinate by having the utility line clearance done before the Tree Department conducts routine maintenance. This would provide a safer work environment for the Town's Tree Workers as well as provide cost savings by having some pruning work done ahead of time (Lee & Wolowicz, 2000).

The Tree Department will continue to maintain open communication with *Eversource* and determine whether the 5-year pruning cycle will overlap in a given year with *Eversource*'s circuit pruning, and if so, attempt to schedule the Town's pruning to follow *Eversource*'s work.

(ii) Gas Leaks

The viability of street trees is compromised by underground natural gas leaks. The Arlington Tree Committee is part of a Town-wide effort to identify and repair slow gas leaks. As part of the Town tree planting process in 2018, the DPW will test planting sites for gas leaks and work with National Grid to repair pipes and improve planting conditions

(e) ADA compliance

The Americans with Disabilities Act (ADA) provides guidelines for sidewalks in the right-of-way. The Arlington DPW and Tree Department work to ensure that sidewalks are accessible and unobstructed for use by all people. The Town has begun to utilize asphalt as a material for sidewalks near street trees. Asphalt surfaces are more compatible with trees than concrete because they are more flexible, preventing hazardous "lips" from uneven concrete slabs.

Section 1.14 Timeline and Budget

Budgets for tree planting and maintenance are developed by the Director of the DPW in collaboration with the Town Manager and Town Finance Committee. The Arlington fiscal year runs from June to June. The budgetary data presented below is for planning purposes only; actual costs may vary.

For the purpose of this document we use the following assumptions:

- The FY 2018 budget for Tree Department is maintained and the Department remains fully staffed.
- The FY 2018 $150,000 supplemental funds for hiring outside contractors is maintained.
- The Tree Warden is funded as a full-time position (per 2019 FY budget).
- A budget of $90,000 is available for the planting of new trees (per 2019 FY budget).

Additional assumptions:

- Reviewing Priority trees and creating work orders will take 2 years.
- EAB treatment will cost $120,000 based on the Tree Warden's estimate of $10 per tree inch and 12,000 diameter inches of good and fair condition Ash tree Arlington.
- Maintenance of the 1,157 Priority trees identified in the inventory will cost approximately $400,000 (based on the per tree costs the Town paid an outside contractor as well as published tree maintenance cost baselines).
- The Tree Department staffing and the $150,000 outside contract is sufficient only for response to ongoing inbound requests and storm damage response
- The cost for routine maintenance will be $300,000 per Tree Zone. This is based on a 2014 vendor estimate, and roughly maps to expected per tree costs.
- $90,000 for tree planting and watering will support 300 new trees planted per year (this estimate will be evaluated annually).

FY	Key Goals	Estimated additional costs
2019	• Ongoing citizen request response, storm damage response • Plant 300 street trees • Tree Warden to evaluate Priority trees for maintenance, create work orders • Tree Warden to evaluate Priority trees Plan, budget for EAB	N/A
2020	• Ongoing citizen request response, storm damage response • Plant 300 street trees • Tree Warden to evaluate Priority trees for maintenance, create work orders • Pruning, management of priority trees, EAB treatment (TBD)	• $200,000 for maintenance of Priority trees • $30,000 for EAB treatment • Possible additional funding for tree planting
2021	• Ongoing citizen request response, storm damage response • Plant 300 street trees • Pruning, management of priority trees • EAB treatment (TBD)	• $200,000 for maintenance of Priority trees • $30,000 for EAB treatment • Possible additional funding for tree planting
2022	• Ongoing citizen request response, storm damage response • Plant 300 street trees • Earliest possible start of 5-year routine maintenance cycle • Complete pruning, management of priority trees	• $300,000 routine maintenance Tree Zone 1 • $30,000 for EAB treatment • Possible additional funding for tree planting

2023	• Ongoing citizen request response, storm damage response • Plant 300 street trees • Year 2 of 5-year routine maintenance cycle	• $300,000 routine maintenance Tree Zone 2 • Possible additional funding for tree planting

Conclusion

In the summer of 2017, Arlington conducted a Town-wide tree inventory which included trees on public and private streets, along the Minuteman Commuter Bike Path, on public school grounds and the Mount Pleasant Cemetery. The inventory found:

- Arlington has 8,734 public street trees and an additional 1,219 public trees in locations that may require maintenance by the Tree Department, including cemeteries, parks, the bike path, and school grounds.
- The replacement value of the public trees inventoried is $43,000,000.
- The current inventory of trees provides cumulative benefits from CO_2 removed, storm water filtered, energy conserved, and air quality improved estimated at $768,320/year.
- Fifty-seven percent of the trees inventoried were determined to be in 'good health', 33 percent in 'fair' condition, 10 percent 'poor' or 'dead' condition.
- No evidence of Emerald Ash Borer (EAB) was found in Arlington.
- The inventory identified 6,401 potential public street planting sites.

The tree inventory highlighted areas of concern, including:

- Over 1,000 trees requiring expeditious maintenance due to condition, size, and location, categorized as "Priority."
- Tree genus diversity is sub-optimal. A well-established urban forestry 'best practice' guideline suggests no more than 20% of one tree genus; Arlington has 56% Acer (maple) genus.
- Distribution of tree size is sub-optimal. Arlington has fewer young trees (small diameter) and greater mature trees (large diameter) than is ideal to maintain a healthy urban forest.
- Arlington's high number of ash trees presents a significant risk if Emerald Ash Borer (EAB) moves into Arlington. The highly destructive pest was found in nearby Waltham in 2016. EAB can kill an ash tree in less than 2 years. A proactive, health-based treatment and priority removal plan could reduce the risk of the eventual and expensive removal of all 939 ash trees.

A historical review of planting and removals of street trees in Arlington found a net loss of approximately 500 public trees since 2006 and an estimated loss of 2,000 public trees since 1980. Funding and resource constraints have limited broad scale

increases to the number of trees planted or the management of the current tree inventory, and as such, the Town has historically used a reactive management approach for trees, where planting, removals, and tree trimming work orders are generated in response to citizen requests.

In coordination with the Arlington Department of Public Works, the Tree Warden, and the Arlington Tree Committee, a long-term management plan for scheduling maintenance and new plantings was developed as a result of the 2017 tree inventory.

Goals to increase the Town's tree canopy include both public and private tree planting. Increase the number of public street trees with a goal to replenish the street tree canopy back to 1980 stocking levels, an increase of 2,000 public street trees over a 20-year period. The Town will need to plant 300 street trees per year (an increase of about 100 trees per year from the normal planting numbers from recent years) assuming a removal rate of 200 street trees per year. Additionally, more trees will be planted on private property by educating residents and businesses to the benefits of trees, leveraging the Arlington Tree Committee's ability to outreach; and using Town funds to supplement purchasing trees for residents and businesses to plant on their private property where appropriate.

Goals to manage the tree canopy will include: improving tree diversity by choosing to plant a variety of species to offset the significant over-abundance of Norway Maples; addressing the estimated 1,000 Priority trees which require expeditious maintenance as identified by the tree inventory; establishing a 5-year cycle for regular pruning and maintenance of the tree inventory; and managing the Town's tree inventory with a data management system which allows for the Tree Department to update the inventory database as work is completed in the field.

In response to the data generated and the knowledge gained from the Town tree inventory, the 2019 Tree Department proposed budget includes a doubling of funding from the 2018 levels for tree planting and watering, and increasing the position of Tree Warden from part-time to full time. The timeline and budgets for the subsequent five years has been proposed with the following key goals: responsiveness to citizen requests, planting 300 street trees per year, addressing Priority trees for maintenance during the first two years, budgeting for EAB, and starting of a 5-year routine maintenance cycle for established trees.

These goals are in line with the vision for Arlington's urban forest: a large and diverse forest of multi-aged and city-appropriate trees recognized by the Town Government and its citizens as a vital, functioning part of the Town's infrastructure and included in the vision for all future development in Arlington. Arlington residents will view the healthy urban forest as an important part of the Town's character, and as an indicator of the Town's overall health and livability.

Appendices

Appendix A: Tree Protection and Preservation Bylaw

Article 16: Tree Protection and Preservation (ART. 22, ATM - 05/02/16)

Section 1. Findings and Purpose

The Town of Arlington finds that preservation of the tree canopy and planting of replacement trees is essential to preserving the character and aesthetic appearance of the Town and maintaining quality of life and the environment in the Town. Trees improve air quality, protect from heat and glare, reduce noise pollution, limit topsoil erosion and storm water runoff, provide natural flood control, enhance property values, contribute to the distinct character of neighborhoods, and offer natural privacy to neighbors.

Section 2. Definitions

A. The following definitions shall apply to this By-law:

"Building Footprint" - Outline the total area covered by a building's perimeter at ground level.

"Caliper" - Diameter of a tree trunk (in inches) measured six inches above the ground for trees up to and including four-inch diameter, and 12 inches above the ground for larger trees.

"DBH (Diameter at Breast Height)" - Diameter of a tree trunk measured in inches at a height of four and a half (4 1/2) feet above the ground; or, for multiple-trunk trees, the measured in inches at a height of four and a half (4 1/2) feet above the ground; or, for multiple-trunk trees, the aggregate diameters of the multiple trunks at a height of four and a half
(4 1/2) feet above ground.

"Demolition" - Any act of destroying, pulling down, removing or razing a building or commencing the work of total or substantial destruction of a building.

"Protected Tree" - Any existing healthy tree on private land with a DBH of ten (10) inches or greater, located in the setback area, which does not pose an immediate hazard to person or property or is not under imminent threat of disease or insect infestation.

"Setback Area" - The Portion of the property which constitutes the minimum depth of side, rear and front yards as per the Zoning Bylaw of the Town of Arlington.

"Tree Fund" - An existing Town account established for the purpose of buying, planting, and maintaining trees in the Town which may receive deposit of contributions in lieu of planting new trees by property owners and fines collected under this By-law.

"Tree Plan" - A site plan drawn and stamped by a certified land surveyor or engineer showing all Protected Trees in the setback areas and indicating, on the site plan or in a separate document, which Protected Trees will be retained, which will be removed, and, as to Protected Trees which will be removed, whether mitigation will be by replacement on the property or by payment into the Tree Fund.

"Tree Removal" - The cutting down of a tree.

"Tree Warden" - The Tree Warden or his/her designee.

B. Additional definitions may be provided in rules and regulations approved by the Board of Selectmen where consistent with intent and efficient execution of this By-law.

Section 3. Applicability

A. The requirements of this By-law and all applicable rules and regulations apply to the following Circumstances:

(1) Proposed demolition of an existing residential or non-residential structure;

(2) Proposed construction on a developed lot which would result in an increase of 50

percent or more of the total building footprint of the new structure(s) when compared to the total footprint of pre-existing structures; or
(3) Proposed construction of any scope on a lot with no residential or non-residential structure on it.
B. Sites under the jurisdiction of the Arlington Redevelopment Board ("ARB") or the ARB as the Planning Board, the Zoning Board of Appeals, or the Conservation Commission pursuant to Arlington's Wetlands Protection By-law (Title V, Article 8) may waive the requirements of this By-law in full or in part where such waiver serves the interest of the community and the reasons therefore are memorialized by such bodies.
C. The requirements of this By-law shall not apply to trees defined as Public Shade Trees under G.L. c.87 § 1.

Section 4. Procedures and Requirements for the Preservation of Trees

A. Removal of Protected Trees on applicable sites shall be prohibited unless such removal is authorized by a written approval of the Tree Plan and commencement of work, in accordance with this Bylaw.
B. In all instances of construction or demolition as defined and applicable herein, the owner of the property shall submit a Tree Plan accompanied by a fee of $50, to the Tree Warden prior to or concurrent with an application for a building or demolition permit. Additionally, if any Protected Trees were removed during the 12 months preceding the application for a building or demolition permit, such trees shall be accounted for on the Tree Plan to the best of the owner's ability, and shall be mitigated pursuant to paragraph 4.C
C. For each Protected Tree removed, there shall be either (1) a replacement tree planted on the property no later than 180 days after the Certificate of Occupancy is issued, of a minimum caliper of two and a half (2.5) inches and of a species native to the area and expected to reach a height of 50 feet or more at maturity; or (2) a $500 payment made to the Tree Fund prior to commencement of work on the property, which the Town shall use to plant replacement trees in the vicinity of the tree removal or in other locations in the discretion of the Tree Warden.
D. If the Tree Plan is consistent with the requirements of this Bylaw, the Tree Warden shall so certify in writing approving the Tree Plan and commencement of work. Said certification shall occur within 10 business days. If the Tree Plan as submitted does not satisfy the requirements of this By-law and associated rules and regulations, the Tree Warden shall so notify the applicant with recommendations to achieve compliance. The Tree Warden shall be permitted access to the site during normal business hours to verify and ensure compliance with the approved Tree Plan.
E. An Owner aggrieved of the Tree Warden's determination on a Tree Plan, or with respect to the need for such a plan, may appeal such determinations to the Board of Selectmen at a public hearing. A written decision on such appeals shall be rendered with 14 business days of the close of such hearing(s).

Section 5. Enforcement and Fines

A. Following a determination of violation by the Tree Warden, an owner shall be subject to fines for the activities listed below, to be paid into the Tree Fund, said fines to be set forth in rules and regulations issued by the Board of Selectmen.
Said activities are:

(1) Removal of a Protected Tree on an applicable site without prior written approval of commencement of work per Section 4.D, $300 per day of work. There shall also be a fine for each Protected Tree removed.
(2) Removal of a Protected Tree which is not identified for removal in the Tree Plan. There shall be a fine for each Protected Tree removed, $300.
(3) Failure to mitigate tree removal within the time set forth in Section 4.C of this By-Law. There shall be a fine of $300 for each day until mitigation is achieved.
B. Wherever there is reasonable cause to believe that an owner or their agent willfully violates this By-Law or an approved Tree Plan, the Town may institute a civil action for injunctive relief in a court of competent jurisdiction ordering appropriate parties to correct a condition in violation , or to cease an unlawful use of the property.
C. An owner aggrieved of the Tree Warden's determination of violation(s) may appeal such determination(s) to the Board of Selectmen at a public hearing.

Section 6. Administration

The Board of Selectmen shall establish further administrative rules and regulations for the review and approval of Tree Plans, as well as enforcement determinations. Failure to issue rules and regulations will not have the effect of suspending or invalidating this By-law.

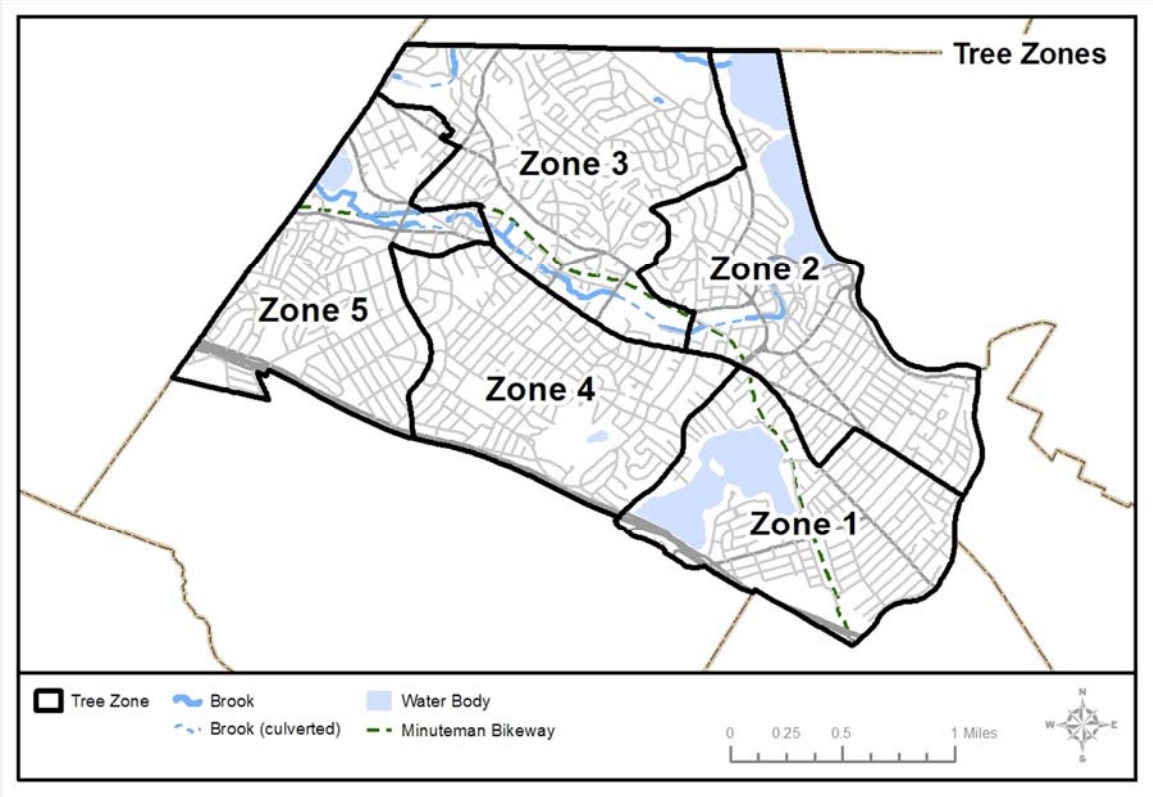
Section 7. Severability Clause

If any provision of this By-law is declared unconstitutional or illegal by final judgment, order or decree of the Supreme Judicial Court of the Commonwealth, the validity of the remaining provisions of this By-law shall not be affected thereby.

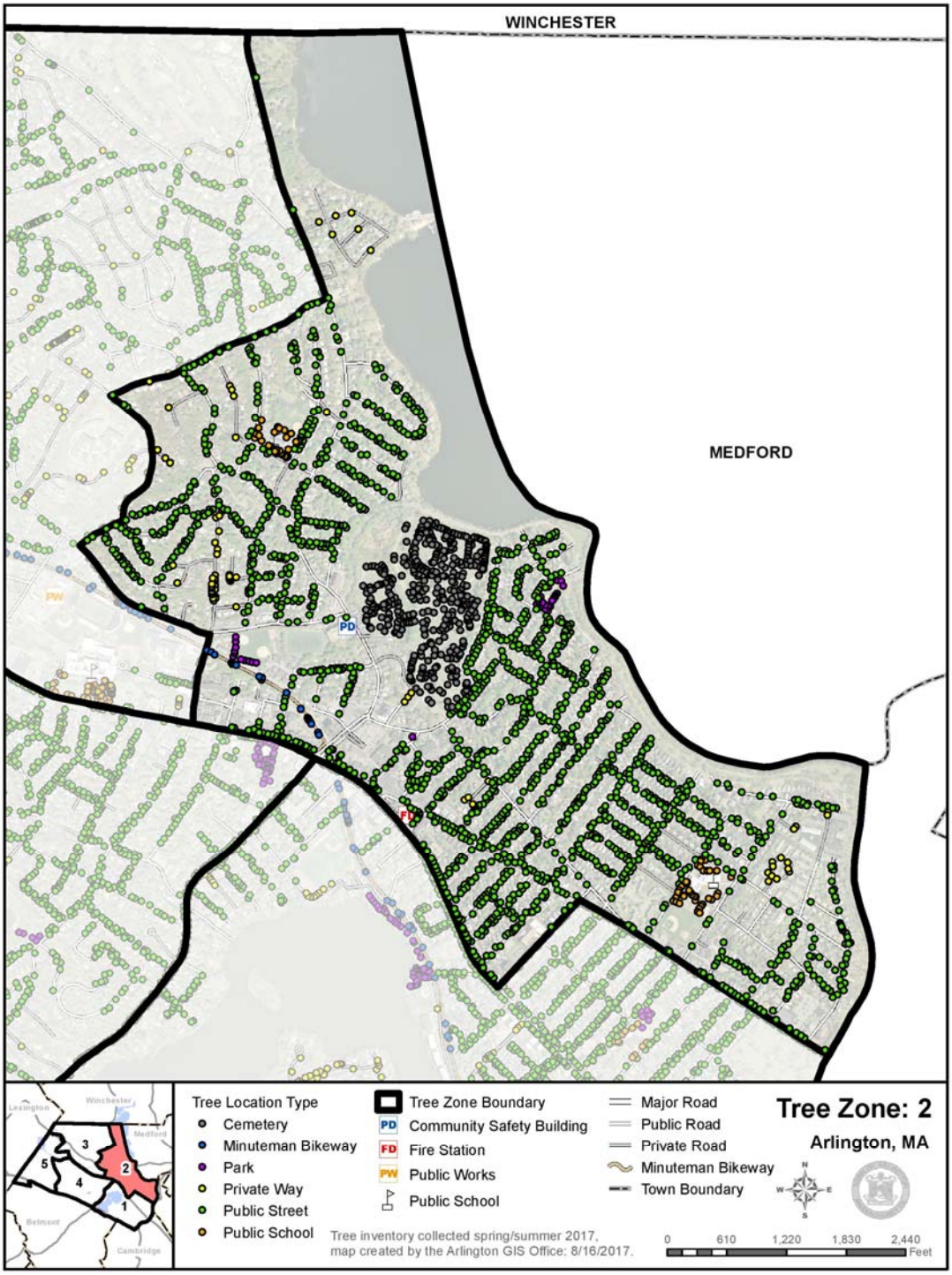
Section 8. Relationship to Other Laws

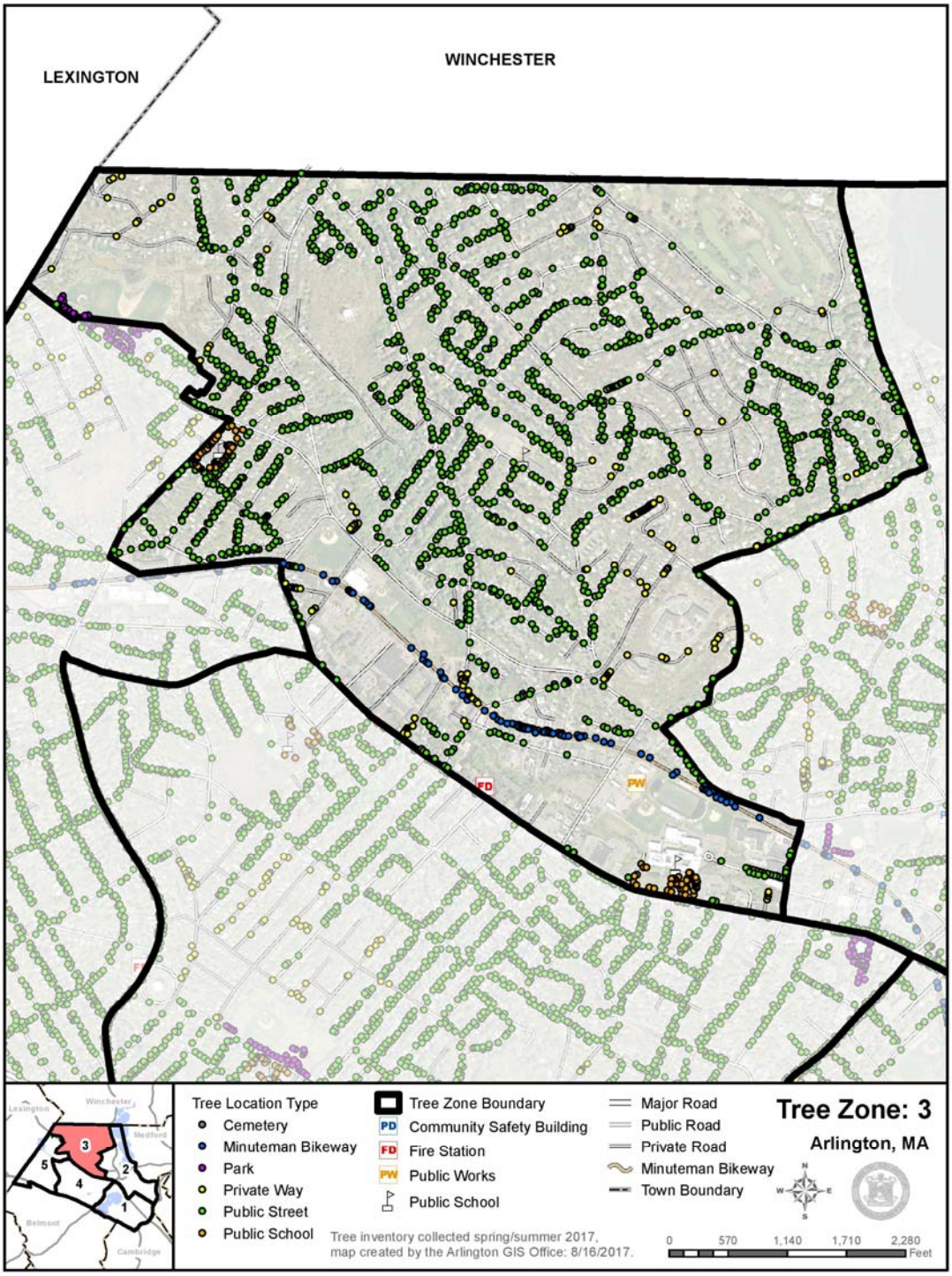
Nothing in this By-law shall be construed to restrict, amend, repeal, or otherwise limit the application or enforcement of existing Town of Arlington By-laws or laws of the Commonwealth of Massachusetts.

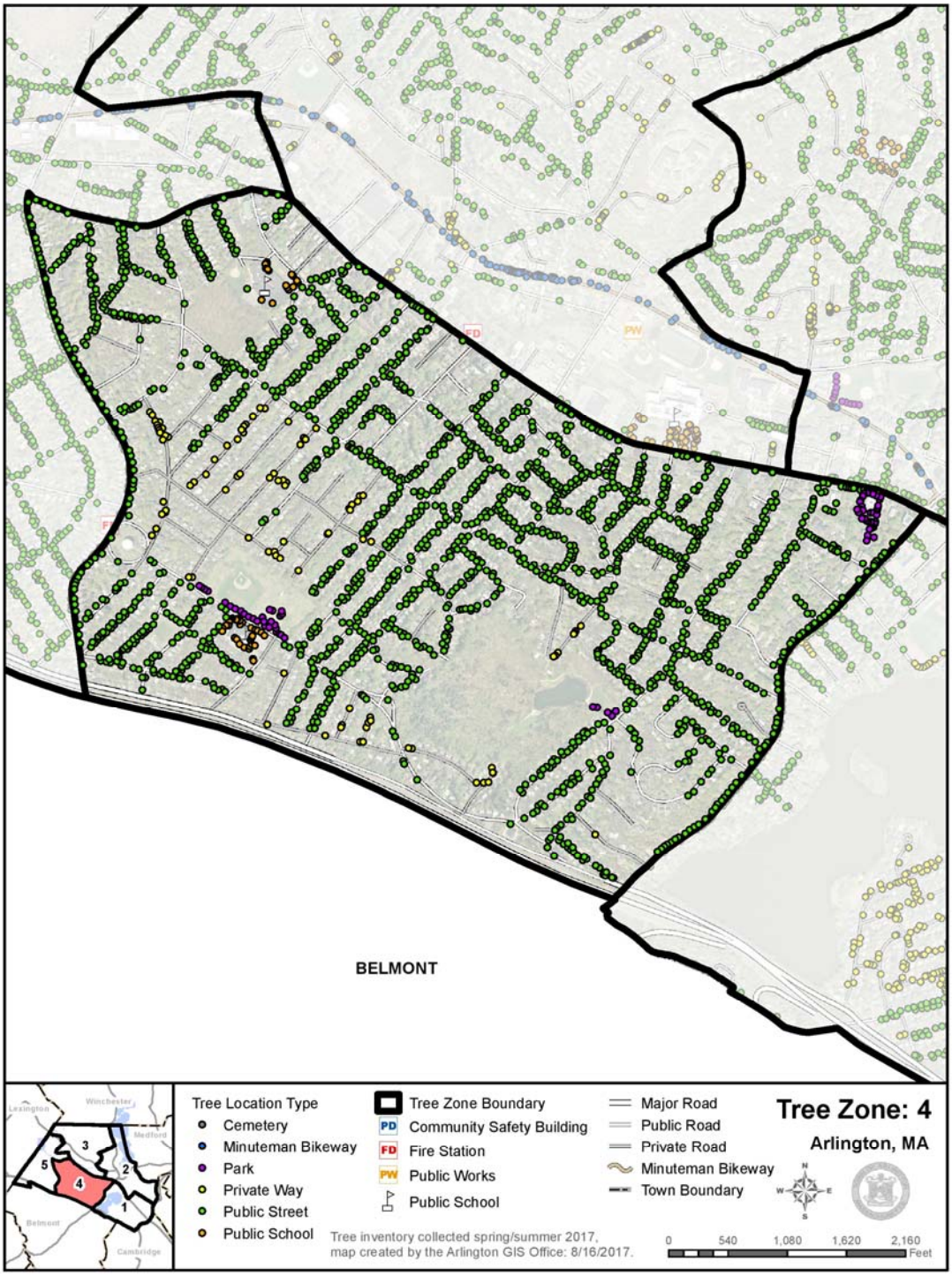
Appendix B: Map of Tree Zones

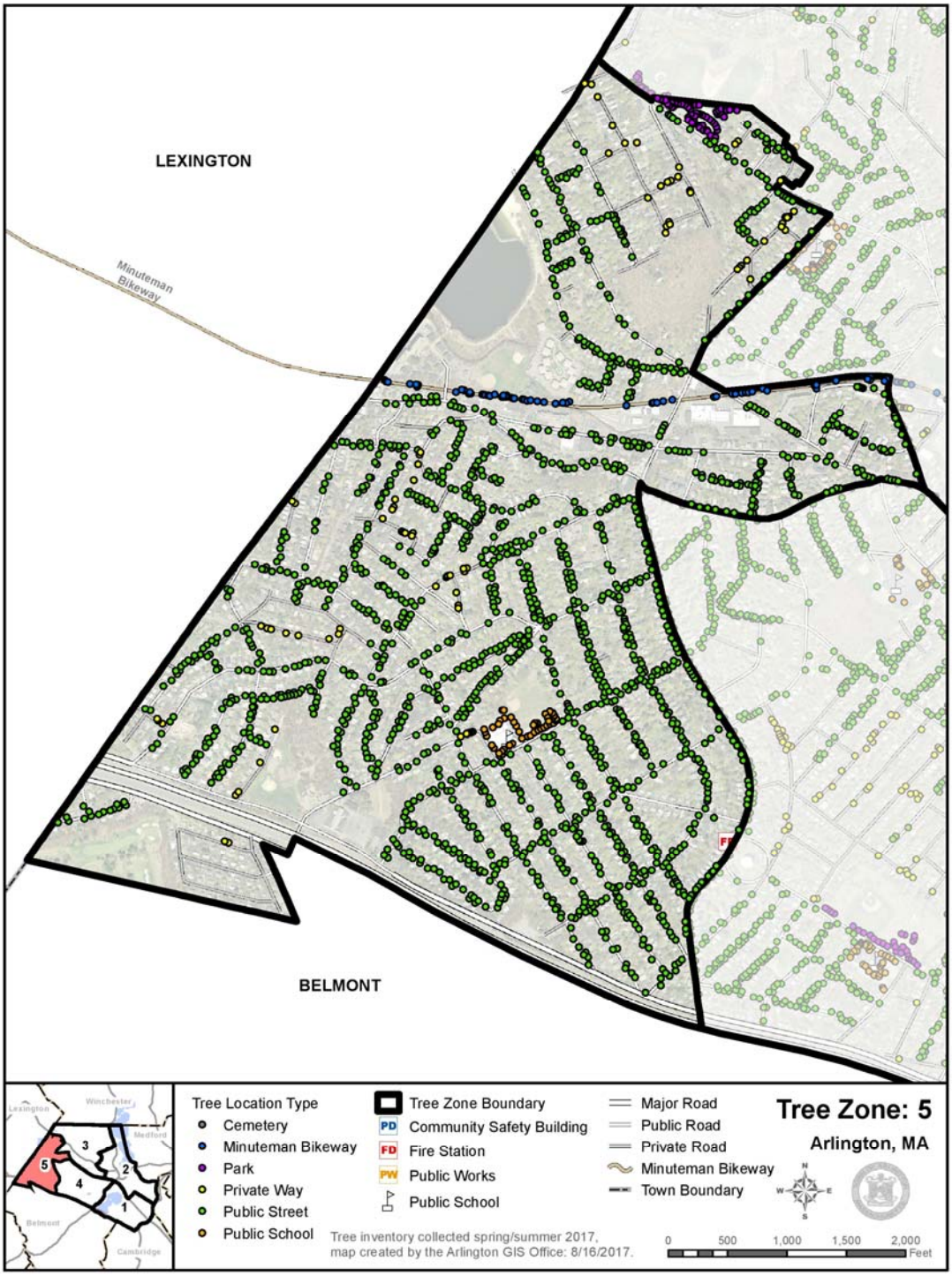


Appendix C: Tree Locations and Type by Tree Zone




LEXINGTON
WINCHESTER
FD
PW
Tree Location Type
Cemetery
Minuteman Bikeway
Park
Private Way
Public Street
Public School
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 3
Arlington, MA
Tree inventory collected spring/summer 2017,
map created by the Arlington GIS Office: 8/16/2017.
0
570
1,140
1,710
2,280
Feet


BELMONT
Tree Location Type
Cemetery
Minuteman Bikeway
Park
Private Way
Public Street
Public School
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 4
Arlington, MA
Tree inventory collected spring/summer 2017,
map created by the Arlington GIS Office: 8/16/2017.
0 540 1,080 1,620 2,160
Feet


LEXINGTON
Minuteman Bikeway
BELMONT
Tree Location Type
Cemetery
Minuteman Bikeway
Park
Private Way
Public Street
Public School
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 5
Arlington, MA
Tree inventory collected spring/summer 2017,
map created by the Arlington GIS Office: 8/16/2017.
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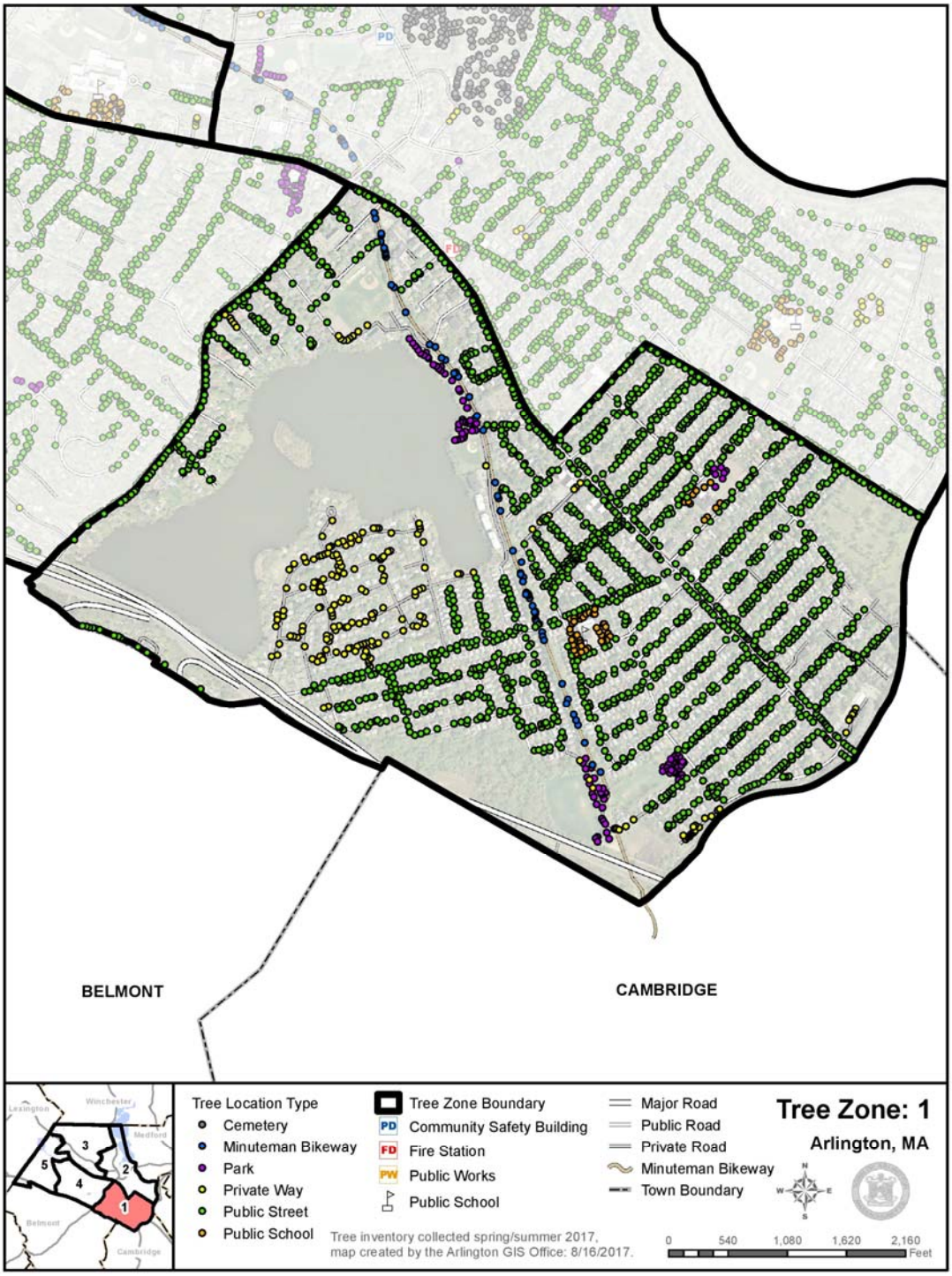
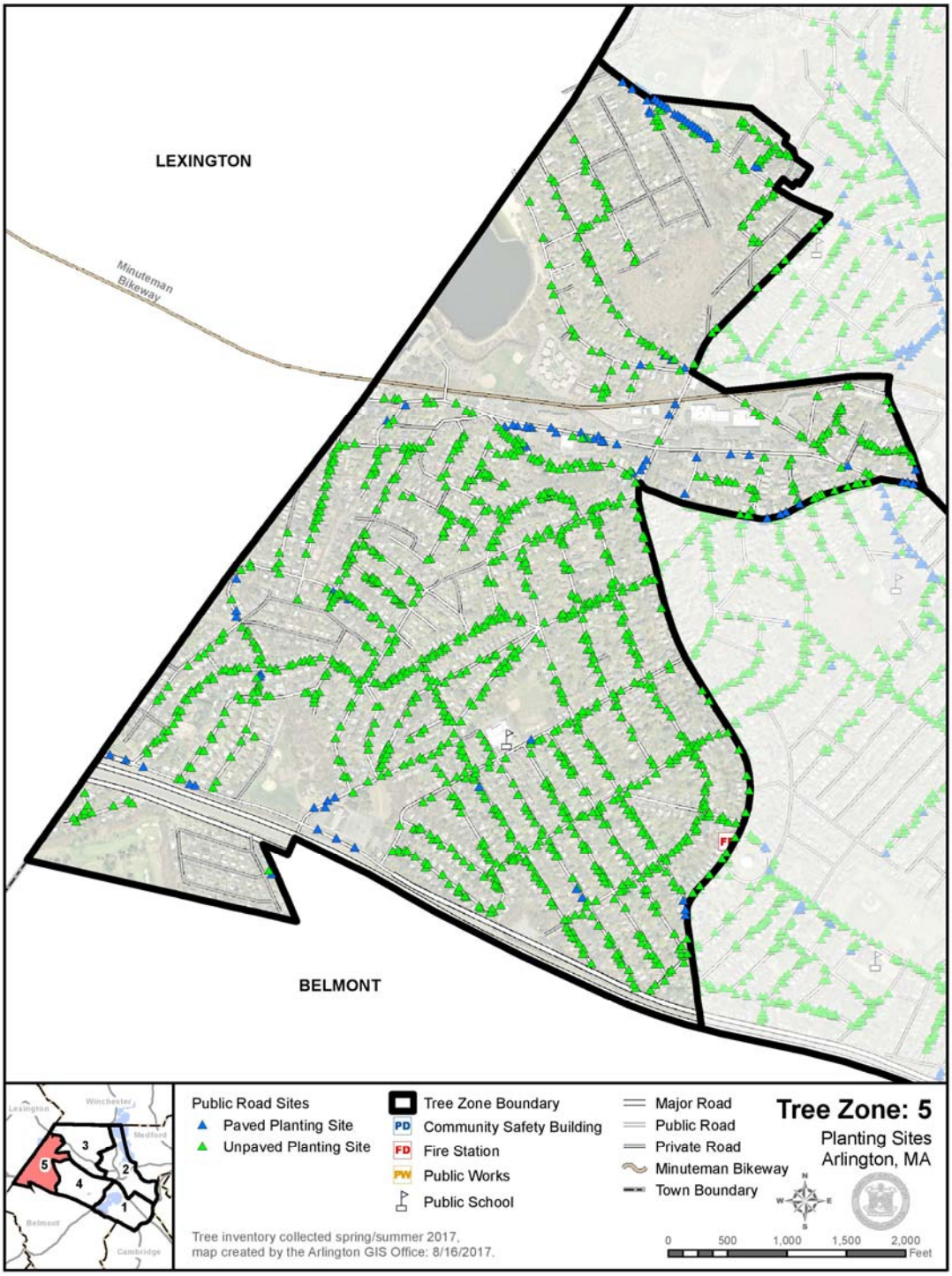
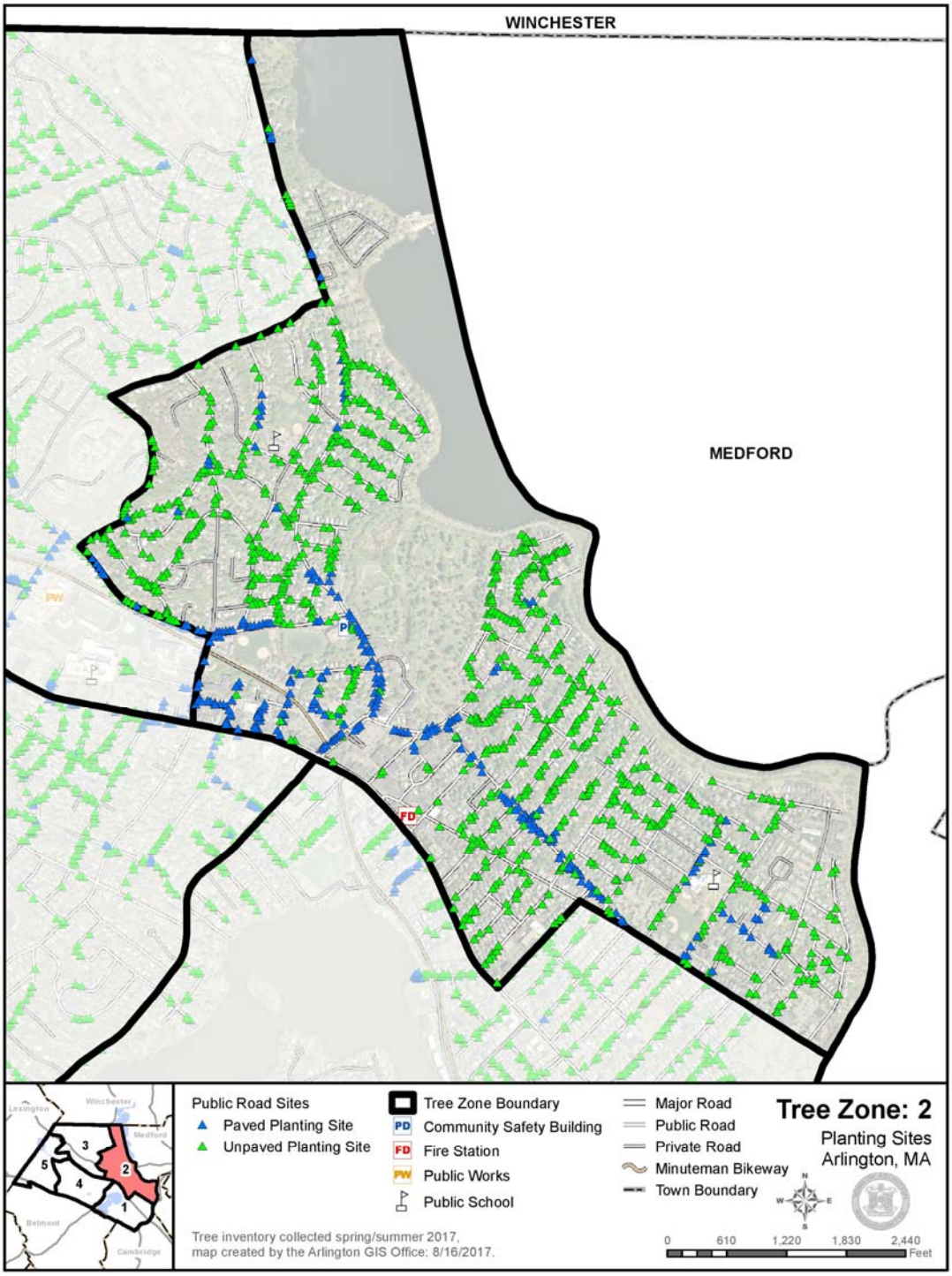
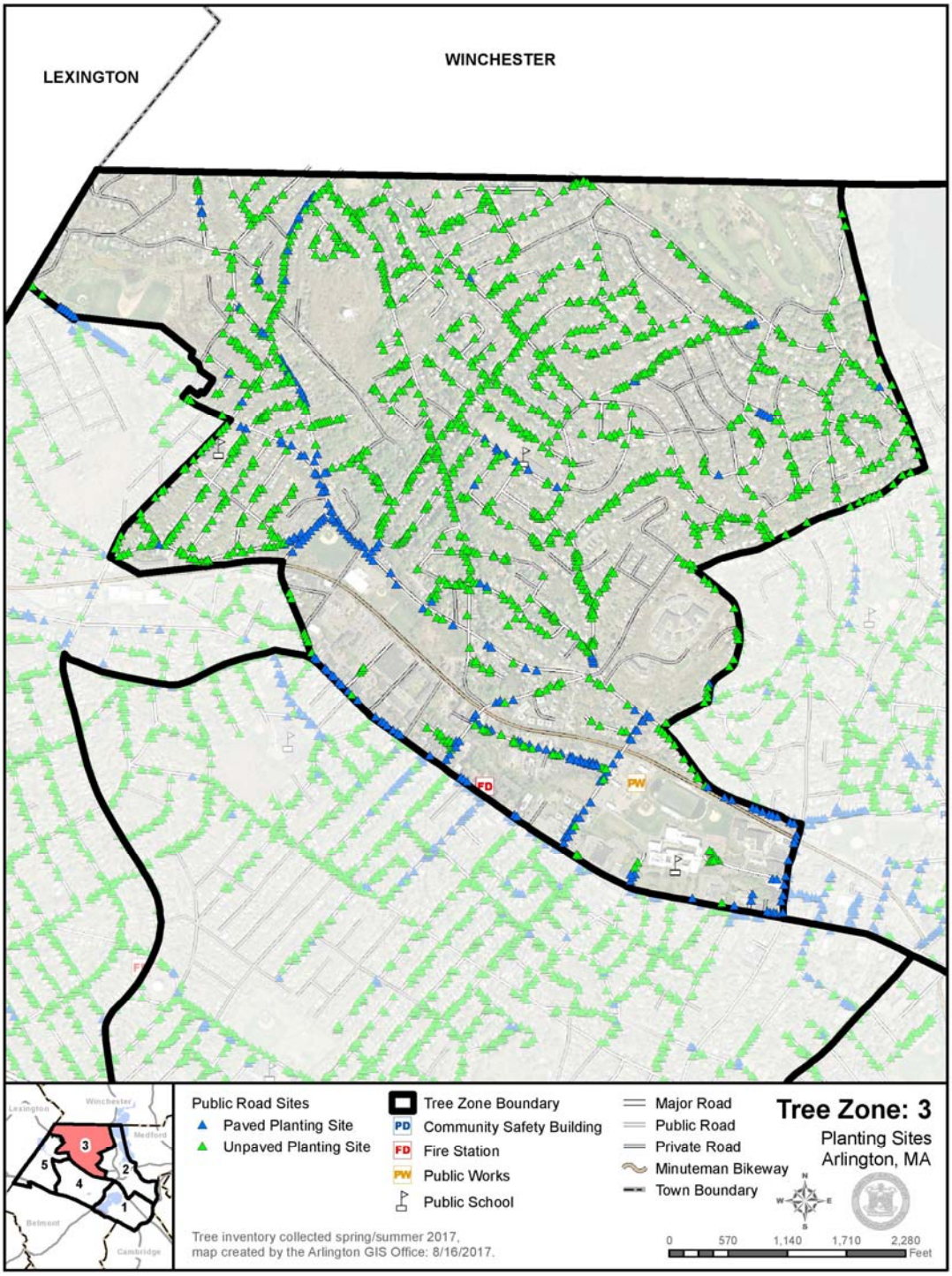
Feet

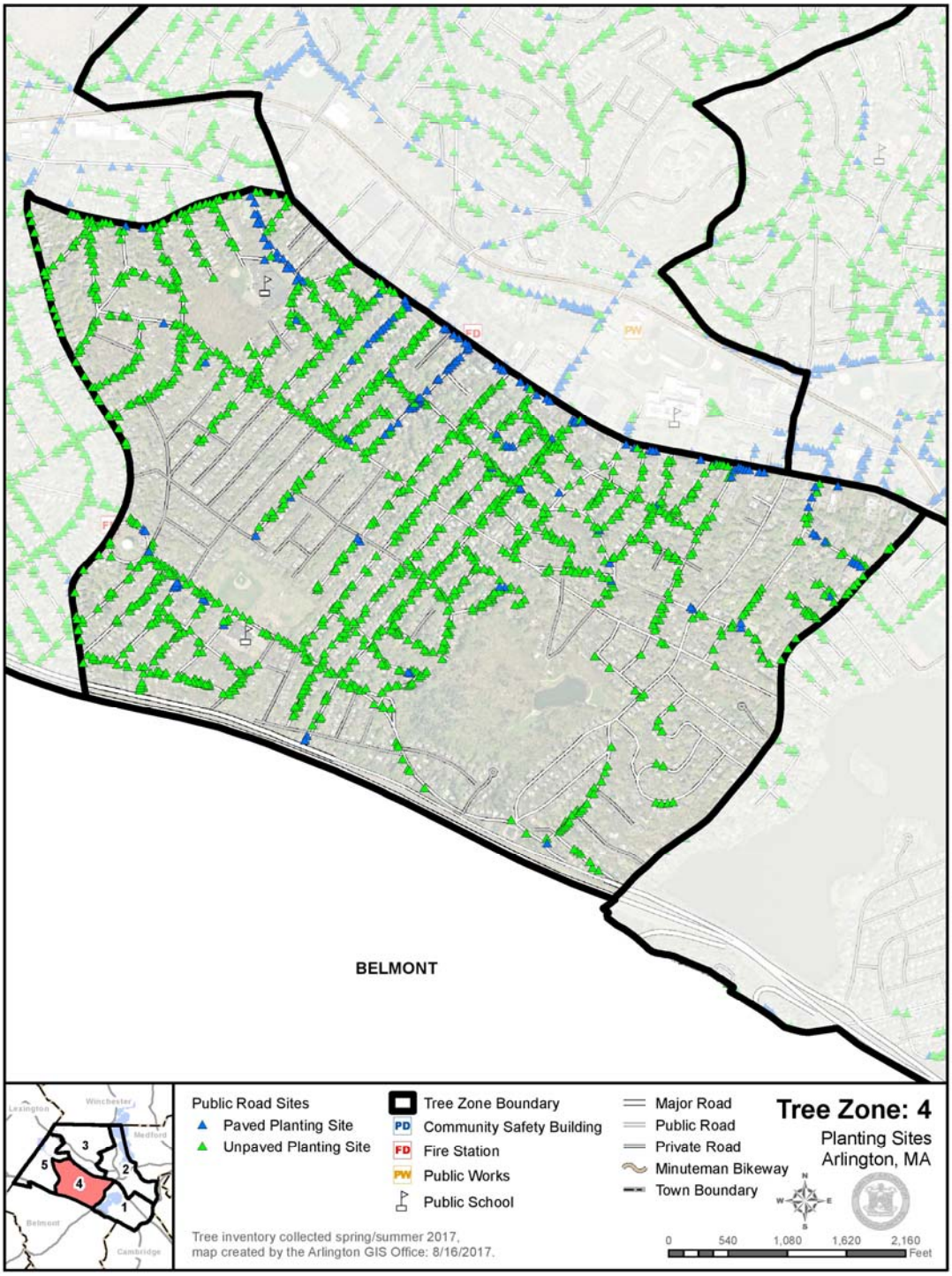

PD
FD
BELMONT
CAMBRIDGE
Tree Location Type
Cemetery
Minuteman Bikeway
Park
Private Way
Public Street
Public School
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 1
Arlington, MA
Tree inventory collected spring/summer 2017,
map created by the Arlington GIS Office: 8/16/2017.
0 540 1,080 1,620 2,160
Feet

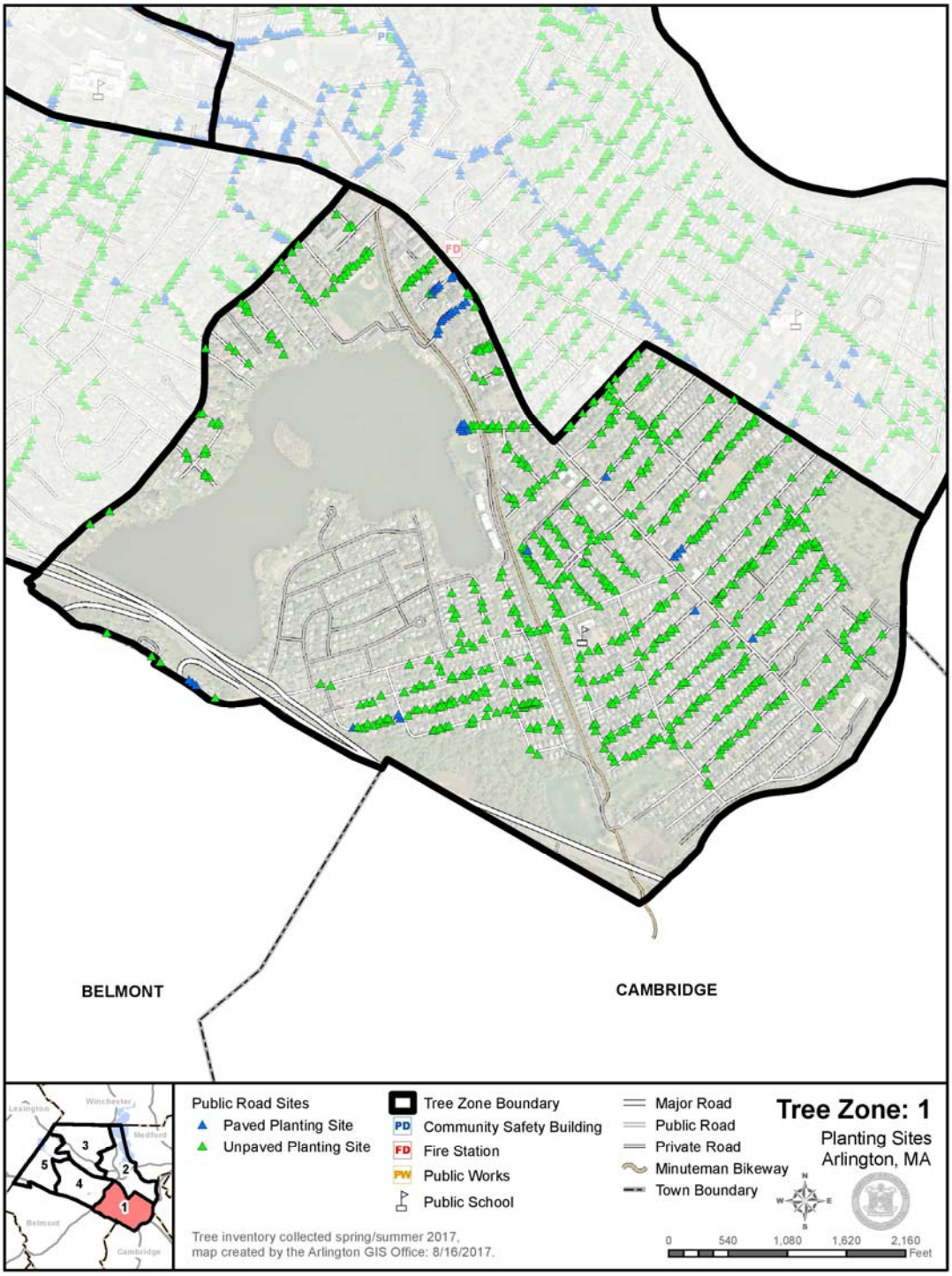
Appendix D: Potential Planting Sites by Tree Zone




WINCHESTER
MEDFORD
Public Road Sites
Paved Planting Site
Unpaved Planting Site
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 2
Planting Sites
Arlington, MA
Tree inventory collected spring/summer 2017.
map created by the Arlington GIS Office: 8/16/2017.
0
610
1,220
1,830
2,440
Feet


LEXINGTON
WINCHESTER
FD
PW
Public Road Sites
Paved Planting Site
Unpaved Planting Site
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 3
Planting Sites
Arlington, MA
Tree inventory collected spring/summer 2017.
map created by the Arlington GIS Office: 8/16/2017.
0
570
1,140
1,710
2,280
Feet


BELMONT
Public Road Sites
Paved Planting Site
Unpaved Planting Site
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 4
Planting Sites
Arlington, MA
Tree inventory collected spring/summer 2017.
map created by the Arlington GIS Office: 8/16/2017.
0
540
1,080
1,620
2,160
Feet


BELMONT
CAMBRIDGE
Public Road Sites
Paved Planting Site
Unpaved Planting Site
Tree Zone Boundary
Community Safety Building
Fire Station
Public Works
Public School
Major Road
Public Road
Private Road
Minuteman Bikeway
Town Boundary
Tree Zone: 1
Planting Sites
Arlington, MA
Tree inventory collected spring/summer 2017.
map created by the Arlington GIS Office: 8/16/2017.
0
540
1,080
1,620
2,160
Feet

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