



Central Business District Street Tree Plan

Dover, NH

February 25, 2021

Acknowledgements

This Central Business District (CBD) Street Tree Plan was developed as part of a coastal resilience project funded by the New Hampshire Department of Environmental Services Coastal Program. The overall goal of the project includes strengthening the City of Dover's resilience to climate change by improving the City's urban landscape through various mechanisms and providing education on innovative approaches to stormwater design.

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EF | Design & Planning, LLC



New Hampshire Coastal Program
DEPARTMENT OF ENVIRONMENTAL SERVICES



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I. Introduction

This Street Tree Plan includes:

Section 1: Guiding principles and objectives for the plan and a discussion of the role and value of street trees.

Section 2: Information about the CBD street tree inventory that was conducted in the summer of 2020 and an analysis of inventory results.

Section 3: A summary of a City-wide GIS-based canopy cover and socio-economic data assessment.

Section 4: A discussion of CBD street tree management, including species selection and street tree design considerations, installation, and maintenance.

Section 5: An implementation schedule to increase resiliency based on street tree inventory findings.

This Street Tree Plan (hereafter the “Plan”) also includes several appendices with the inventory survey questions, inventory instructions, list of species found in the CBD, CBD inventory map set, canopy cover and socio-economic data map set, a summary of pertinent local regulations and guidelines, and a matrix of recommended species for the CBD.

This Plan implements Action Item #45 from the Natural Resources Master Plan Chapter: *Maintain and accurate inventory of City tree and develop and urban tree plan that provides tree planting and removal guidelines.*

Figure I shows a map of the CBD and extent of the street tree inventory. Street trees are trees planted in the right-of-way, often in a tree pit in the sidewalk or in the grassy median between the sidewalk and street.



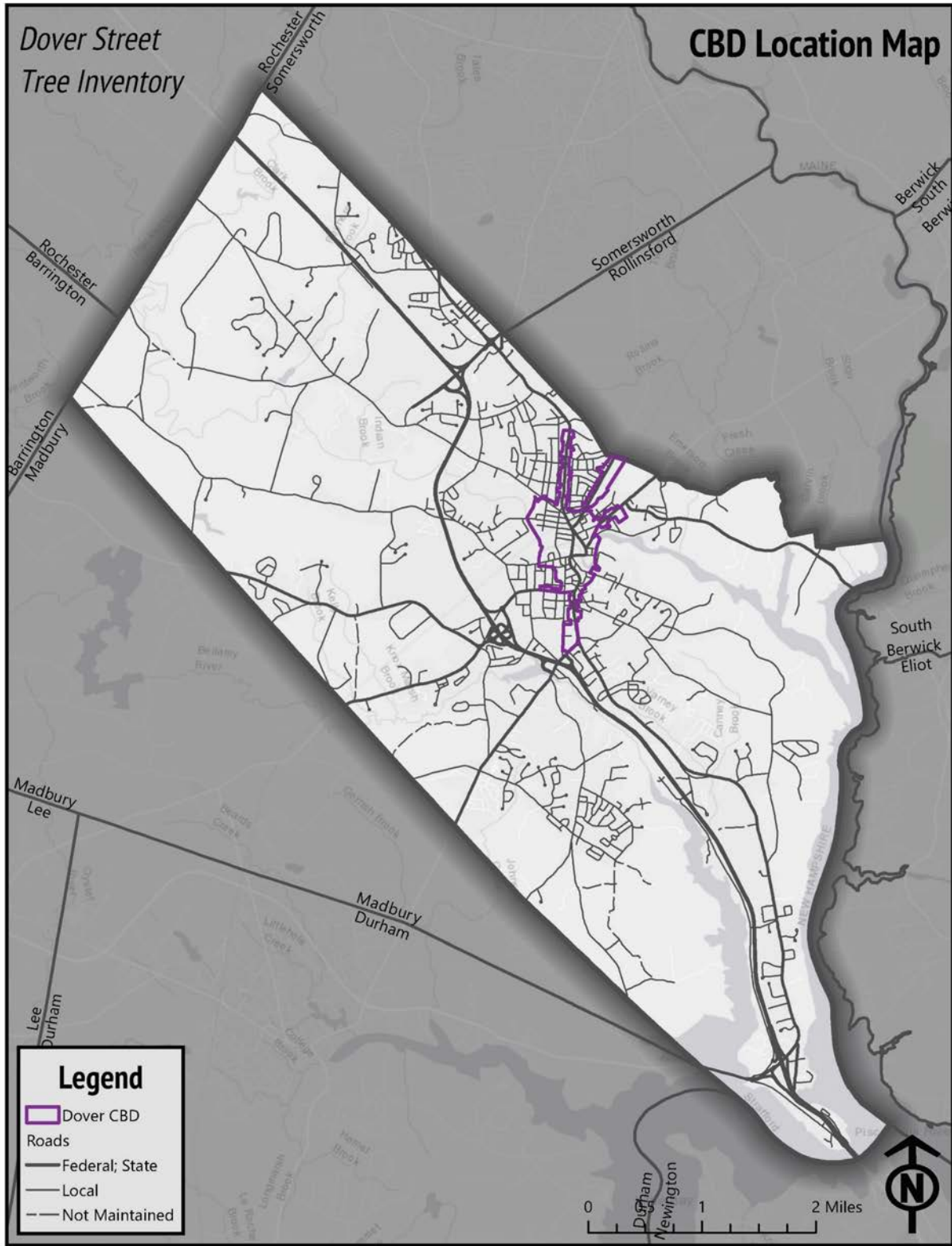


Figure 1. Map of Dover and the Central Business District (CBD)

A) Guiding Principles & Objectives of this Plan

- Strive for compatibility with complete streets practices
- Provide practices to mitigate and adapt to climate change
- Guide equitable tree planting across the city
- Serve as a resource to inform day to day decisions of staff
- Improve integrated, efficient, and effective management of street trees and infrastructure
- Prioritize retention of existing trees when possible, but recognize the need to remove trees that are no longer appropriate for a site
- Adhere to goals, objectives, and findings documented in the City's Master Plan
- Implement Dover's vision for 2023, which includes: *enhanced environmental quality and sustainability are actively pursued and inherent in all the city's activities*

Excerpts from the City's Climate Master Plan

- By the end of the century average summer temperatures could be up to 11°F warmer than the historical average from 1980 to 2009. Extreme heat waves may also become more frequent, putting additional stresses on human health, infrastructure, and the electrical grid.
- Local impacts include drought
- The City recognizes increases in frequency and intensity of extreme precipitation due to climate change will exacerbate stormwater runoff and the grit-suspended solids that carry many of the pollutants of most concern, including bacteria, chloride, sediment, and nutrients.
- Infiltration is a low-impact way to replenish groundwater rather than convey runoff directly to surface water bodies.
- Climate change will cause warmer temperatures, which can increase ground-level ozone formation and may increase the number with days when air quality is poor.
- As temperatures rise, summer heat waves will become longer and more frequent. Faced with these longer hot stretches plus increased population and growing demand, the regional power grid and energy providers will be challenged to supply adequate power. Periods of extreme heat also decrease the efficiency of power plants and place additional stress on the system, especially when demand for electricity is highest. Dover's most urbanized areas, in the downtown core, may experience increases in the urban heat island effect (urban areas become significantly warmer than the surrounding rural areas due to human activities). That would create additional stresses for people living and working there.
- Underserved and vulnerable populations— including low-income persons and families, the elderly, and individuals with disabilities—may be more sensitive to climate change-related impacts.
- Incorporate additional trees and native vegetation, while also preserving mature trees, into the downtown landscape and other City-owned properties in order to help lower surface and air temperatures by providing shade.

B) Role & Value of Street Trees

The urban forest includes trees in parks, landscaped boulevards, gardens, greenways, river corridors, wetlands, preserves, and trees on residential, commercial, and industrial property within cities and towns. Street trees are a critical part of an urban forest. Street trees are a **public resource** that provide a wide range of ecological, social, and economic benefits.

Street trees provide an important **ecological** role in the urban environment. They create habitat for birds, insects, and wildlife and support conservation of urban biodiversity. Native, denser, and larger trees typically provide better habitat for species such as birds.¹

Another key role that street trees play is providing **ecosystem services**, which are benefits that people obtain from ecosystems. One ecosystem service that trees provide is temperature regulation. Tree planting is a highly effective strategy for **cooling urban environments**.² In the summer, leaves and branches typically reduce the amount of sunlight and solar radiation below the tree canopy by 70-90%, depending on the species.³ By providing shade, street trees help to reduce the phenomenon referred to as the urban heat island effect, in which urbanized areas experience higher temperatures – 1 to 7°F higher in the day – than outlying areas due to the prevalence of buildings, roads, and other infrastructure that absorb and re-emit the sun's heat more than natural landscapes.⁴ Shaded surfaces may be 20 to 45°F cooler than peak temperatures in non-shaded areas. Trees planted on the western side of a building typically offer greater cooling benefits than those located on other sides.^{5,6}

Evapotranspiration associated with trees can further reduce temperatures in urban areas. Evapotranspiration is the combination of evaporation from land and transpiration, or the opening of stomata and release of water vapor, from plants. This has a cooling effect on the atmosphere. Evapotranspiration increases as temperature increases and can lower peak summer temperatures by 2-9°F.⁷

Street trees provide benefits in winter as well by acting as a wind break. Properly placed trees that do not block southern facing windows can reduce winter heating bills by 20-50%.^{8,9}

Trees also aid in **stormwater management**. By intercepting rainwater and reducing and filtering runoff in the canopy and root zone, street trees contribute to stormwater management and improve the water quality in receiving water bodies and groundwater.^{10,11} By drawing moisture from the soil, trees increase the soil water storage capacity during rainfall events. They also enhance permeability of soils.¹² Tree

If designed properly trees can provide a significant return on investment and become assets that increase with value over time.

-Congress for New Urbanism

In Dover's Central Business District, where forested land comprises less than 5% of the land area and over 90% of the district is developed, street trees are critical to cooling the urban environment. Enhancing the urban tree canopy is one strategy to adapt to climate change and increasingly warmer temperatures.



Street trees shade Central Ave buildings

roots loosen soils as they grow, which increases infiltration. Trees with tap roots and deeper and more vertical roots have been found to promote greater infiltration than species with fibrous roots and more lateral, shallower roots.¹³ Greater infiltration reduces stormwater runoff, helps to mitigate flooding, and promotes groundwater recharge. Increasing the prevalence of street trees enhances stormwater management in the City.

Trees filter air pollutants and capture and store carbon dioxide, which helps to improve local air quality and mitigate greenhouse gas (GHG) emissions.¹⁴ In parking lots and along streets, trees that shade parked vehicles keep them cooler and reduce evaporative emissions of volatile organic compounds from gas tanks.¹⁵ Leaves **remove pollutants** such as particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and ground-level ozone from the air through a process called dry deposition.¹⁶

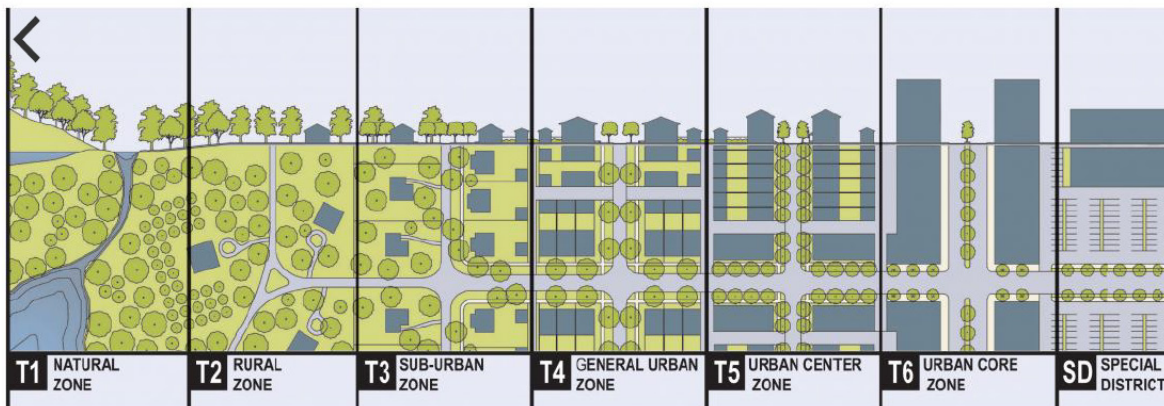
These regulating services have numerous **social benefits**, ranging from public health to enhancing the pedestrian realm. A reduction of pollution has been shown to reduce negative **health** consequences associated with poor air quality.¹⁷ The cooling effect of trees can reduce heat-related illness, which is particularly important in urban areas where residents are at a greater risk of heat stress and will become increasingly at risk as extreme heat events occur more frequently.¹⁸ In addition to cooling, the shade provided by trees reduces direct exposure to harmful ultraviolet rays. An even distribution of canopy cover throughout a community supports social equity.

Street trees contribute to **placemaking** and **aesthetics** of communities. They can soften the appearance of wide streets, large parking lots, utilities, and structures,¹⁹ as well as reduce urban noise.²⁰ Planting trees in medians and along streets has been shown to help slow traffic and create **safer** conditions for motorists and pedestrians.²¹ Trees also improve urban residents' connection with nature.

In addition to environmental and social benefits, street trees in urban environments provide **economic benefits** to individuals and the City. Trees and vegetation increase residential property values by around 3 to 10 percent.²² Studies have shown that customers **stay longer** at shopping centers with landscaping, thus increasing revenue at local shops. Trees that shade buildings reduce the demand for air conditioning by 30 percent, providing property owners with energy savings, **reducing energy demand** by 20-50 percent, and reducing emissions associated with energy demand.^{23, 24} Research has shown that a young, healthy tree can provide a net cooling effect that is equivalent to 10 air conditioning units operating for 20 hours a day.²⁵ In addition to cooling, shading can also **slow pavement deterioration**, which reduces maintenance and can extend the life of roadways and other infrastructure.²⁶

Integrating Nature into Context-Specific Urban Design

The Congress for New Urbanism (CNU) recommends using the rural-urban transect as a tool for integrating nature into context-specific urban design. This approach emphasizes that the primary role of trees in the suburban to urban core transect zones is to enhance the habitat of people. CNU notes that while environmental benefits are realized through the urban forest, compared to the natural and rural transect zones, the social and economic benefits of trees in urban areas are typically greater than the environmental benefits. Secondary benefits include managing stormwater, reducing urban heat island, reducing energy costs, and providing wildlife habitat. In this context, the CBD falls within the core urban landscape, or T6 zone, shown in the diagram below, where social and economic benefits are prioritized and maximized over environmental benefits. In surrounding suburban and rural districts, the reverse may apply.



A version of the rural-urban transect diagram with six successional zones from nature to urban core (Source: DPZ, Congress for New Urbanism)

II. CBD Street Tree Inventory

A) About the Inventory

An inventory of all street trees in the CBD was conducted from mid-July to mid-September 2020. The goal of the inventory was to map the location of street trees and compile information about the species, planting site, and health of each tree. This information will be used to inform future planting and management of street trees within the district.

The inventory consisted of a multi-step process. First, the Project Team (see inside cover) reviewed data collected in several municipal street tree inventories in the U.S. and assembled an initial list of data to collect on each street tree in the CBD. This attribute list was further refined with input from City staff.

Next, SRPC built an online survey using ESRI's Survey123 app. This survey could be readily accessed by volunteers after downloading the app to a mobile device. Paper surveys were also made available to volunteers. A copy of the paper survey is included in Appendix A.

A comprehensive set of instructions was developed to provide volunteers and staff with information about the survey, how to obtain the app, and how to respond to each question. Both the list of survey questions and instructions created for the CBD street tree inventory were designed to allow the City to replicate the inventory in other zoning districts in the future. The CBD Street Tree Inventory Instructions are included in Appendix B.

Volunteers were recruited via the City's newsletter, distribution of a call for volunteers to boards and commissions, and through a posting on NatureGroupie. Over 20 individuals reached out to learn about the inventory. Sixteen volunteers participated in the inventory and contributed a total of 72.25 volunteer hours. Staff contributed 29.25 hours in the field.

After all streets in the CBD had been inventoried, staff processed and analyzed the data collected.

B) Findings

Street tree inventory data was collected at a total of 378 sites within the CBD. Stumps and dead trees comprised nine and three of the sites, respectively, and were not identified by species. Eight empty planting sites were found. Figure 2 shows the location of the surveyed trees along streets in the CBD. The location of each tree was obtained using the Survey123 geolocate feature, which generally has a five-meter accuracy, and then edited by SRPC in ArcGIS to align with streets.



Volunteers submitted a photo of each tree they surveyed

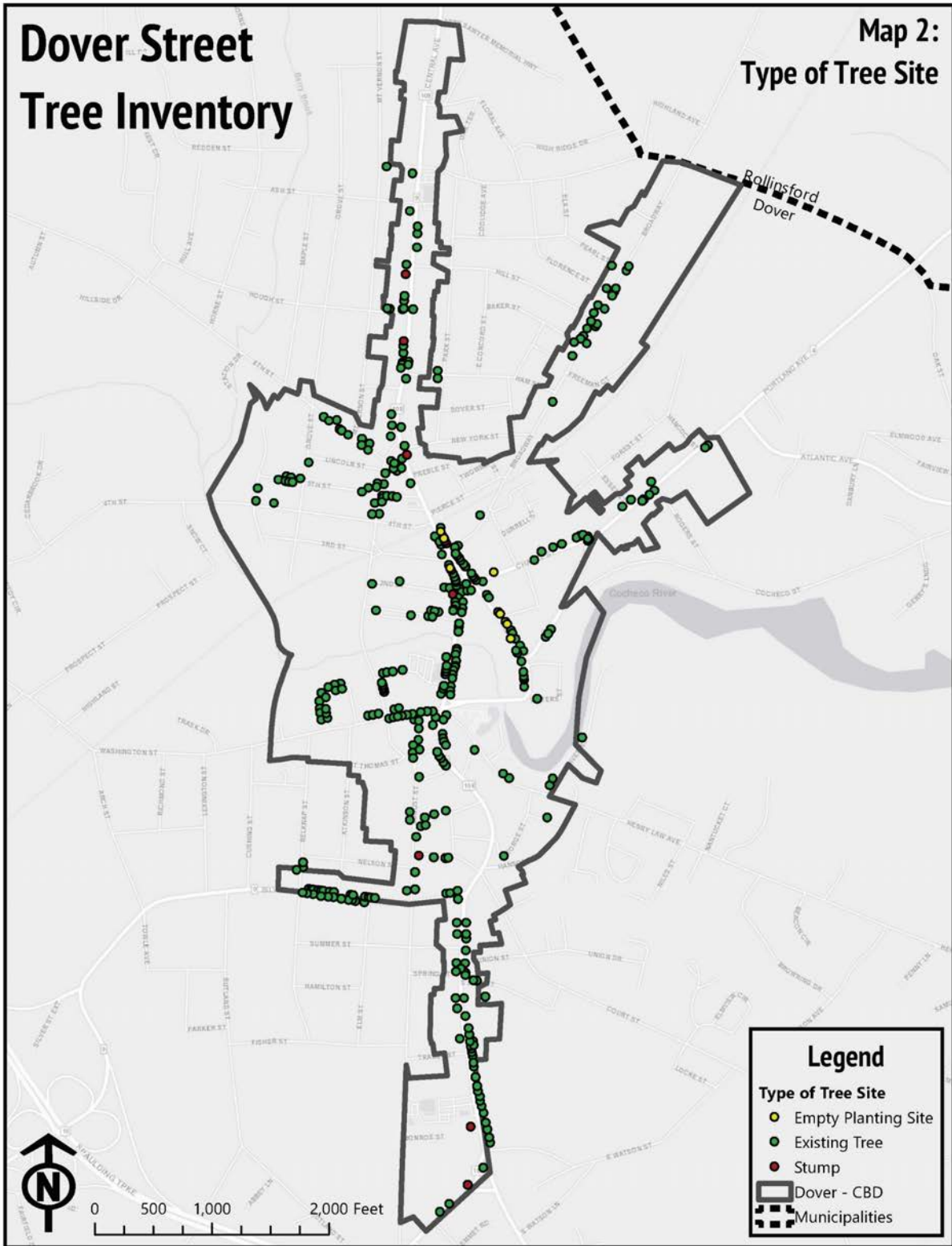


Figure 2. Map of trees surveyed during the 2020 CBD inventory

Staff performed a cursory QAQC on some trees that were identified as species that would not typically be found in the US Department of Agriculture’s Plant Hardiness Zone 5, which is the zone that Dover is located in. The result was a list of 44 different species. The most common species were linden, also known as basswood (*Tilia americana*) and little leaf linden (*Tilia cordata*), which accounted for a total of 68 of the living trees (19%) in the CBD. Norway maple (*Acer plantanoides*) (13%) followed by green ash (*Fraxinus pennsylvanica*) (11%) and red maple (*Acre rubrum*) (9%) were the next most common species. The 12 most prevalent species accounted for 289, or approximately 75%, of all living trees surveyed in the CBD. The remaining 25% consisted of 29 other species (Figure 3). A complete list of species is included in Appendix C.

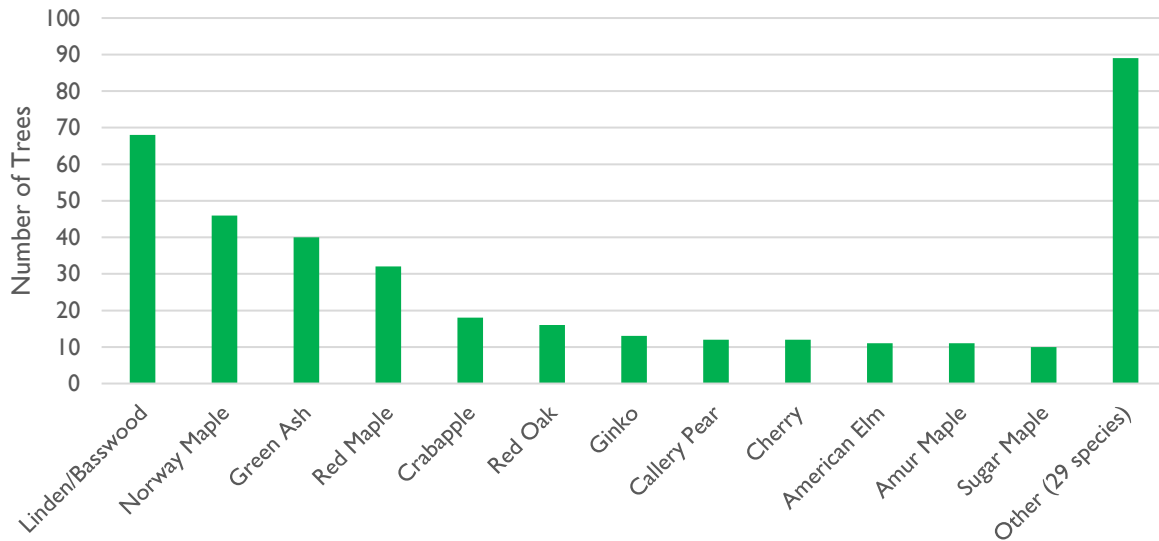


Figure 3. Most prevalent street tree species in the CBD

The diameter at breast height (DBH), or diameter of the trunk at approximately 4.5 feet from the ground, and the estimated tree height were collected for each tree. As expected, the size of trees in the CBD was variable. The box and whisker plot in Figure 4 shows the average DBH of 18.9 inches (indicated by the “x”), median DBH of 13.5 inches (indicated by the horizontal line in the middle of the shaded area), the interquartile range comprising the middle 50% of data points (indicated by the shaded box), and the outliers (shown as dots that extend beyond more than 1.5 times the upper (43 inches) and lower (1 inch) quartiles). As shown in Figure 4, there were numerous outliers, indicating that errors may have occurred when calculating the DBH or inputting the data.

Figure 5 shows the estimated tree height average, median, interquartile range, and outliers. The average tree height was 34.1 feet and the median height was 30.9 feet. Similar to DBH, it is assumed that outliers may be due to data collection and inputting errors.

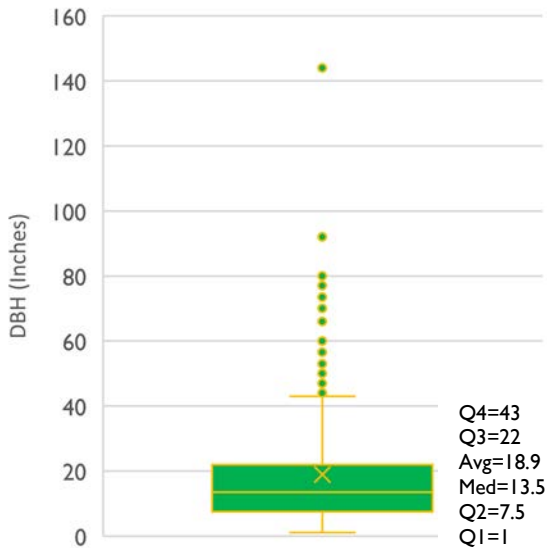


Figure 4. Diameter at breast height (DBH) of street trees in the CBD (Q=Quartile)

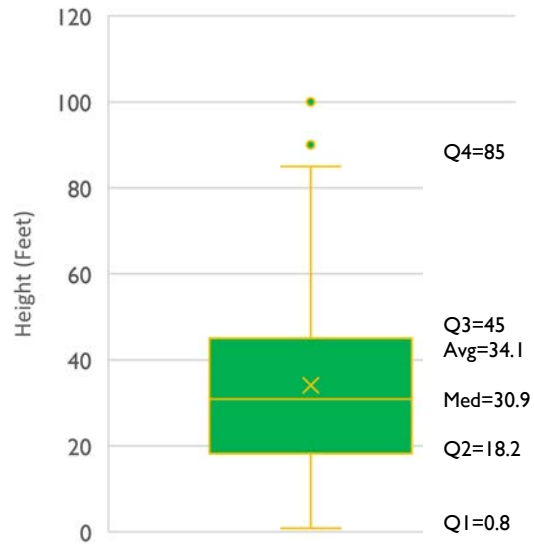


Figure 5. Height of street trees in the CBD (Q=Quartile)

Volunteers were asked to rate the overall condition of each tree, as well as provide input on a series of maintenance issues. The pie chart in Figure 6 displays the overall condition at each site surveyed. A majority (58%) of trees were ranked as being in good condition. Over one quarter of trees were in fair condition. The remaining 16% of sites had trees that were in poor condition, were dead or dying, or had stumps and empty planting sites. Figure 7 displays the overall condition of the trees surveyed by species. Of species with 10 or more trees within the CBD (shown in Figure 2), three species had over 50% of individuals ranked as dead or dying, poor, or fair condition: green ash, red oak, and amur maple. Each of the 11 American Elm trees were ranked as being in good condition. The geographic distribution of tree condition is shown in the map in Figure 8.

Data was collected on eight different categories of maintenance issues, including the presence of injury or damage; disease or pests; pruning, watering, and mulching needs; sidewalk or curb damage from roots; overhead utility wires; or adjacent or overhead streetlights. This information may be used by the City to allocate staff and contractor time to specific maintenance activities as well as prioritize trees that require the attention of professional arborist. Figures 9 and 10 display the findings from the maintenance needs data collection. Pruning, watering, and mulching were commonly identified maintenance needs (Figure 9). Forty percent of trees surveyed required pruning, while 37% required water and 29% needed more mulch. Little vandalism was recorded.

Additionally, there were overhead wires above 37% of the trees surveyed and streetlights near 22% of the street trees. An affirmative response to the questions on the presence of overhead wires and adjacent or overhead lights does not necessarily mean there is an immediate need for maintenance, rather it indicates the potential for greater pruning needs than a tree that is not located in proximity to this infrastructure. It also indicates that future replacement trees should be appropriately sized and maintained to avoid conflicts with utilities.

At approximately 16% of surveyed sites, there was evidence of damage to the sidewalk or curb due to root uplifting. This is an indication that the tree is too large for the street tree pit and available growing

space. It may also indicate that the root system of the particular species may not be appropriate given the constraints of the site.

Seventy-six percent of the trees surveyed were identified as having one to four maintenance needs. Sixteen percent required no maintenance in any of the nine maintenance needs categories (Figure 10)

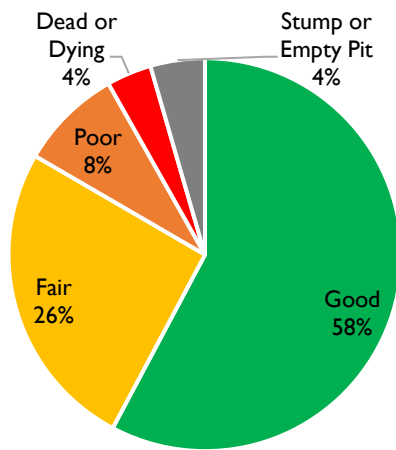


Figure 6. Overall condition of sites surveyed

Nine of the sites surveyed contained stumps.

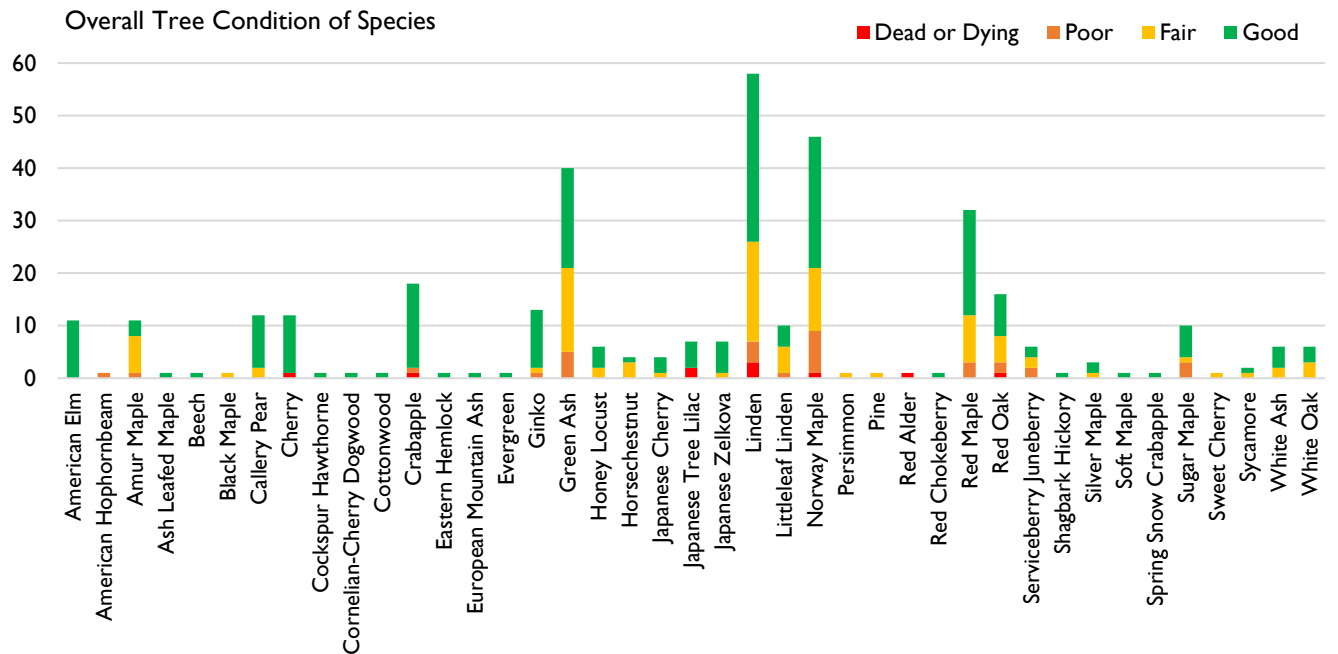


Figure 7. Overall condition trees by species

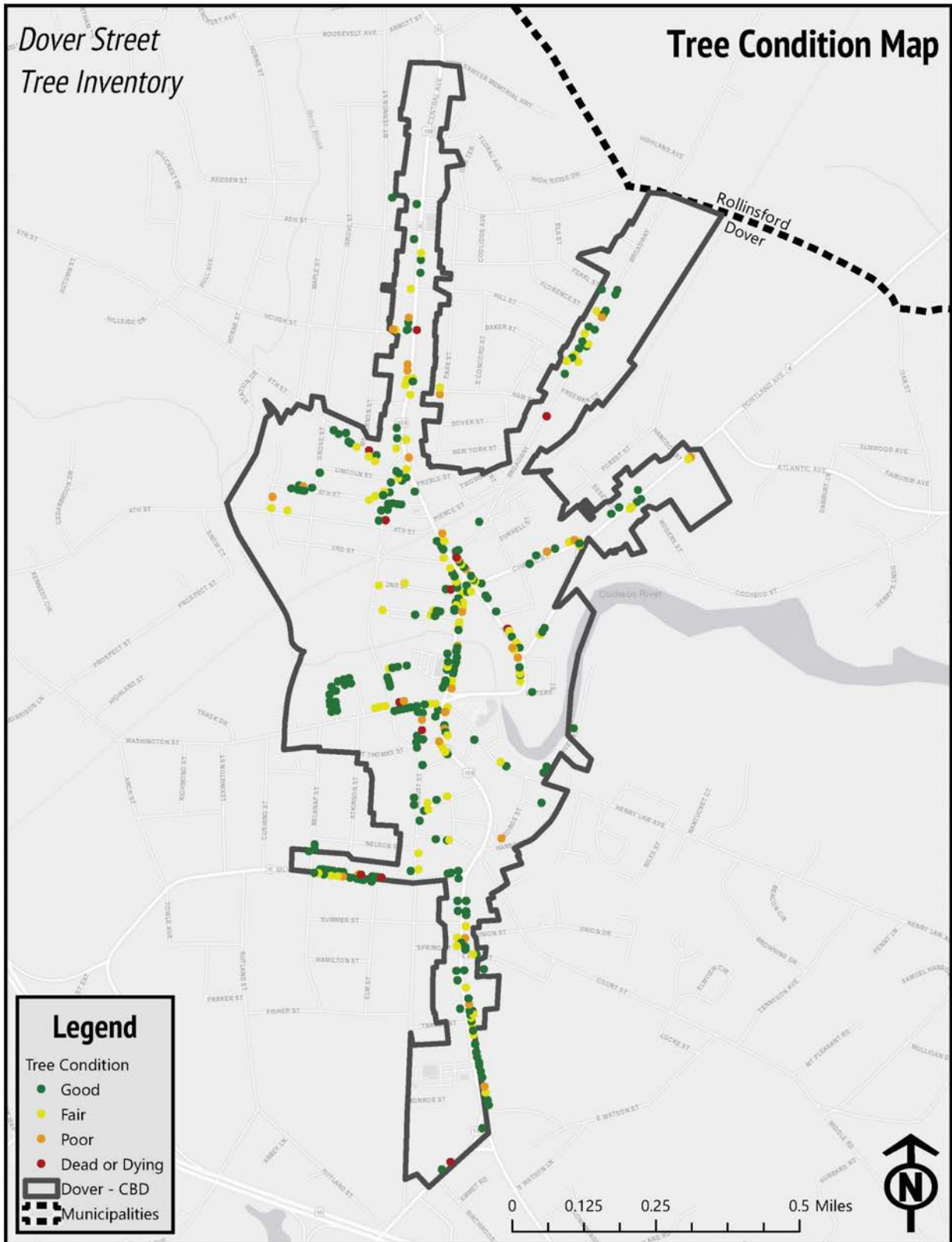


Figure 8. Map of overall condition of street trees in the CBD

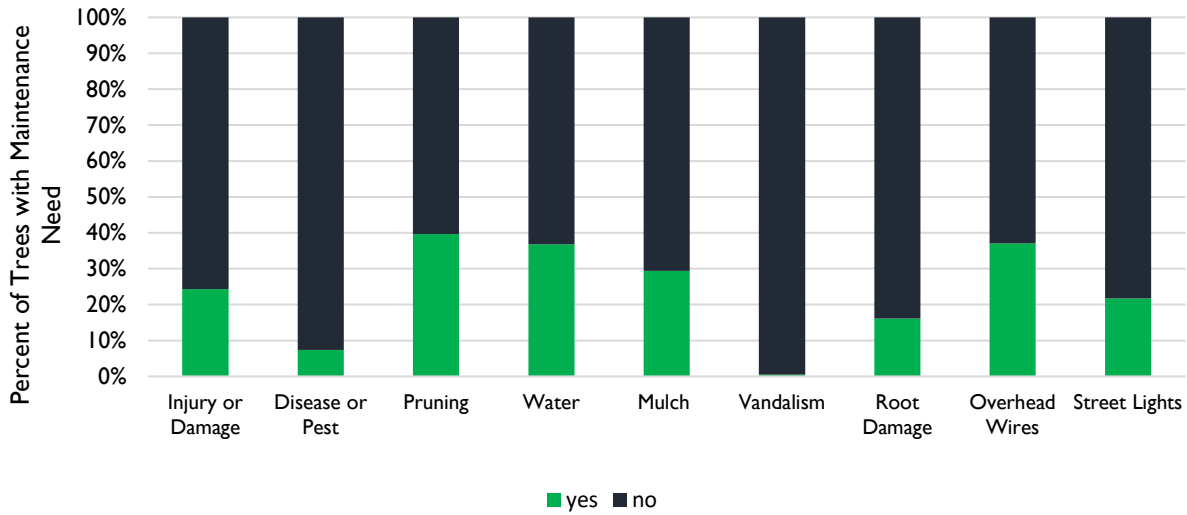


Figure 9. Type of maintenance needs identified in the CBD

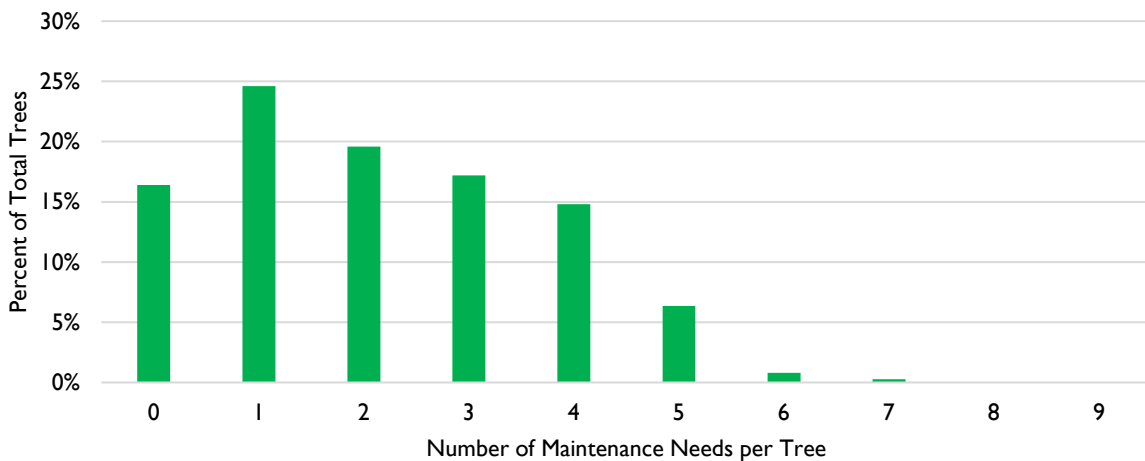


Figure 10. Number of maintenance needs identified per street tree

The geographic distribution of maintenance needs was variable throughout the CBD, with trees located in the more urban areas in street tree pits generally requiring more water and mulching than those located grassy medians in the CBD’s slightly more suburban neighborhoods. Notably, many of the Green Ash located along Central Avenue were identified as needing pruning to remove dead or low hanging branches over the street.

Nearly all of the trees surveyed were identified as having sufficient clearance between the street tree pit and a building or other obstacle to comply with American Disabilities Act standards, or four feet of clear sidewalk width. A sidewalk width of less than 4 feet was identified in 12 locations.

Street tree pit size was recorded for each tree that was located in a street tree pit. Inventory participants were instructed to skip this question if the tree was planted in a grassy median or other location. Data was entered for 140 trees. One data point of 6,411 square feet was determined to be a data entry error and excluded from the data analysis. The median size of the tree pits was 24 square feet, while the average was much higher at 57 square feet. Similar to DBH and height measurements, it is likely that the outliers of this data set are the result of calculation errors or data entry errors (Figure 11). The larger areas may also be measurements of grassy strips or lawns, rather than exclusively street tree pits. However, variation in the size of street tree pits and the number of trees planted in each pit was evident.

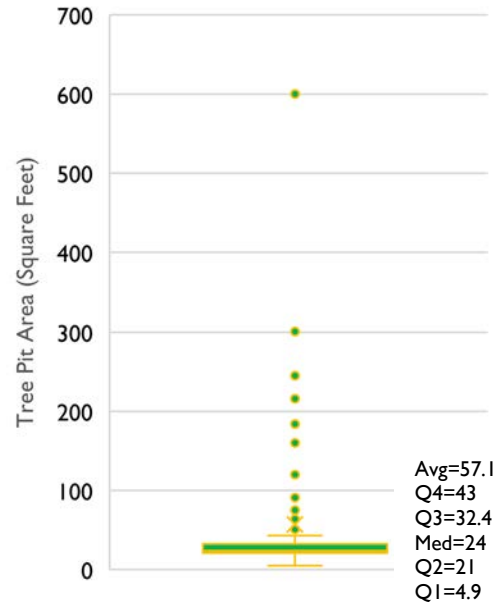


Figure 11. Size of street tree pits

Figure 12 displays the overall condition of street trees in the CBD by tree pit size. As shown in the chart, 6% of the trees in tree pits under 20 square feet and between 20 and 29 square feet were dead or dying. There were no dead or dying trees and few trees in poor condition located in tree pits larger than 30 square feet. Although the determination of overall tree condition was subjective and there are a number of variables that impact tree condition, this data suggests that tree pits over 30 square feet in size in the CBD may contribute to greater overall tree health.

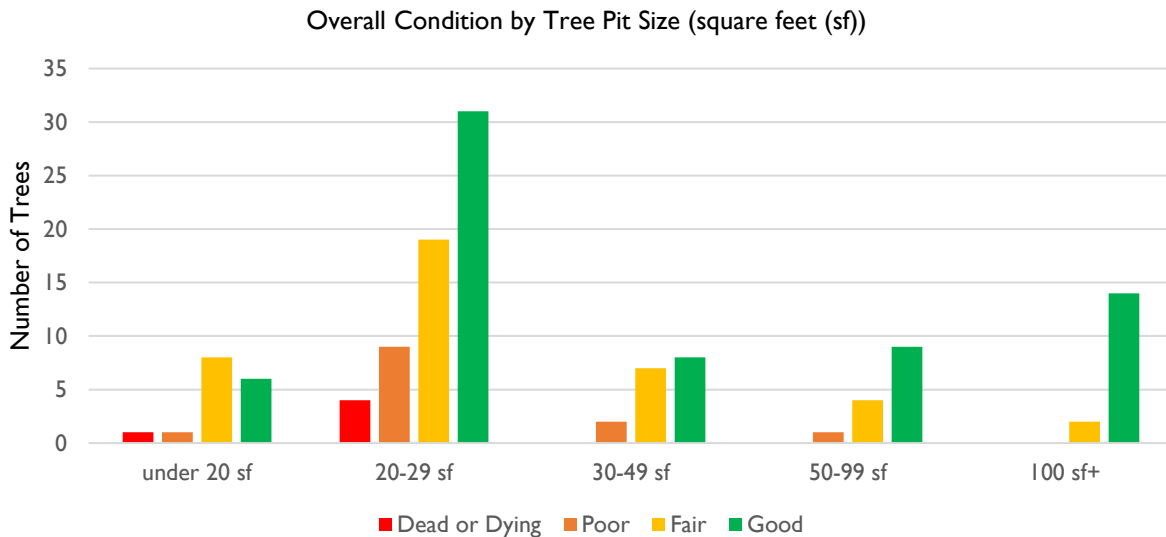


Figure 12. Tree condition by tree pit size

Inventory participants were also asked to assess the overall appropriateness of the site for the specific tree. Figure 13 displays a map of this data. Overall, 86% of planting sites were deemed to be appropriate for the tree. A response of “no” to this survey question typically indicated that the tree was either too large or too small for the site. This information may be used by the City to prioritize removal and replacement of specific street trees.

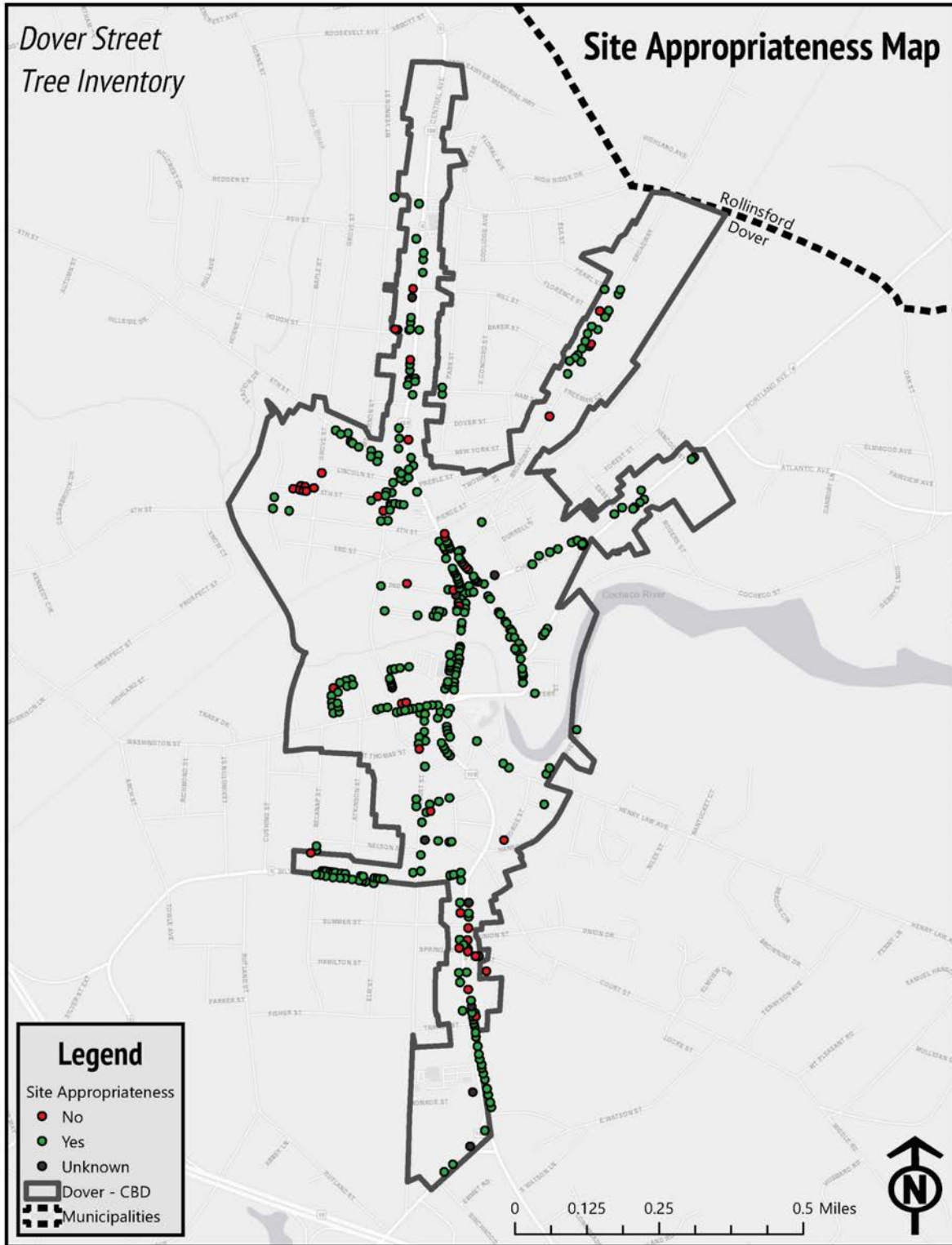


Figure 13. Map of trees identified as being appropriate for the site they are located in

While contributing to aesthetics and shading benefits, canopy shape can also influence site appropriateness. For example, oval or v-shaped trees may fit better in spaces that are closer to buildings than a round or umbrella shaped tree, which may be better suited for a larger space. Nearly half of all street trees in the CBD were identified as having an irregular crown shape. Round and oval shaped crowns accounted for 20 and 13%, respectively, of street trees.

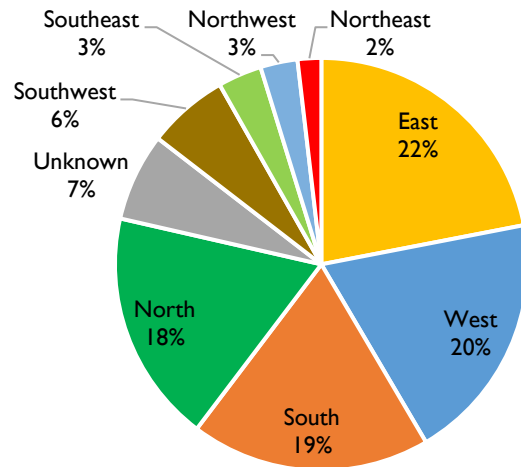


Figure 14. Side of building that tree is located on

Volunteers collected data on the planting aspect, or side of the building the tree was located on. Planting deciduous trees to the west of a building is considered to be most effective for cooling the building.^{27,28} Twenty percent of trees surveyed were located on the west side of the adjacent building, indicating that they may provide increased cooling and energy savings benefits than trees located on alternative sides of the building (Figure 14). In instances where there is no street on the west side of a building to plant street trees along, property owners should seek opportunities to plant trees in western facing side and rear yards and other landscaped areas. The US Forest Service also indicates that planting trees around 10 to 20 feet south of a home will maximize summer shade while also minimizing winter shade.²⁹

Appendix D contains a map set of the street tree inventory results.

III. Tree Canopy Cover Analysis

A) About the Tree Canopy Cover Analysis

A desktop analysis of tree canopy cover in Dover was conducted using LiDAR data available from the US Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP) to supplement the CBD street tree inventory data and better understand the distribution of tree canopy cover city-wide. This analysis is based on an estimate of the total tree cover and includes street trees as well as all other trees such as those in parks, forests, yards. The percentage of land covered by tree canopy cover city-wide and by census tract was determined by dividing the canopy cover by the land area.

B) Findings

The estimated tree canopy cover for the City of Dover is approximately 14.7% (Figure 15). Tree canopy cover ranges from approximately 3.6% in Census tract 814 to 20.5% in tract 811. Within the CBD, the estimated canopy cover is about 2.9% (Figure 16).

When overlaid on land cover data, the distribution of canopy cover in developed areas of the City versus agricultural or forested areas is more apparent (Figure 17).

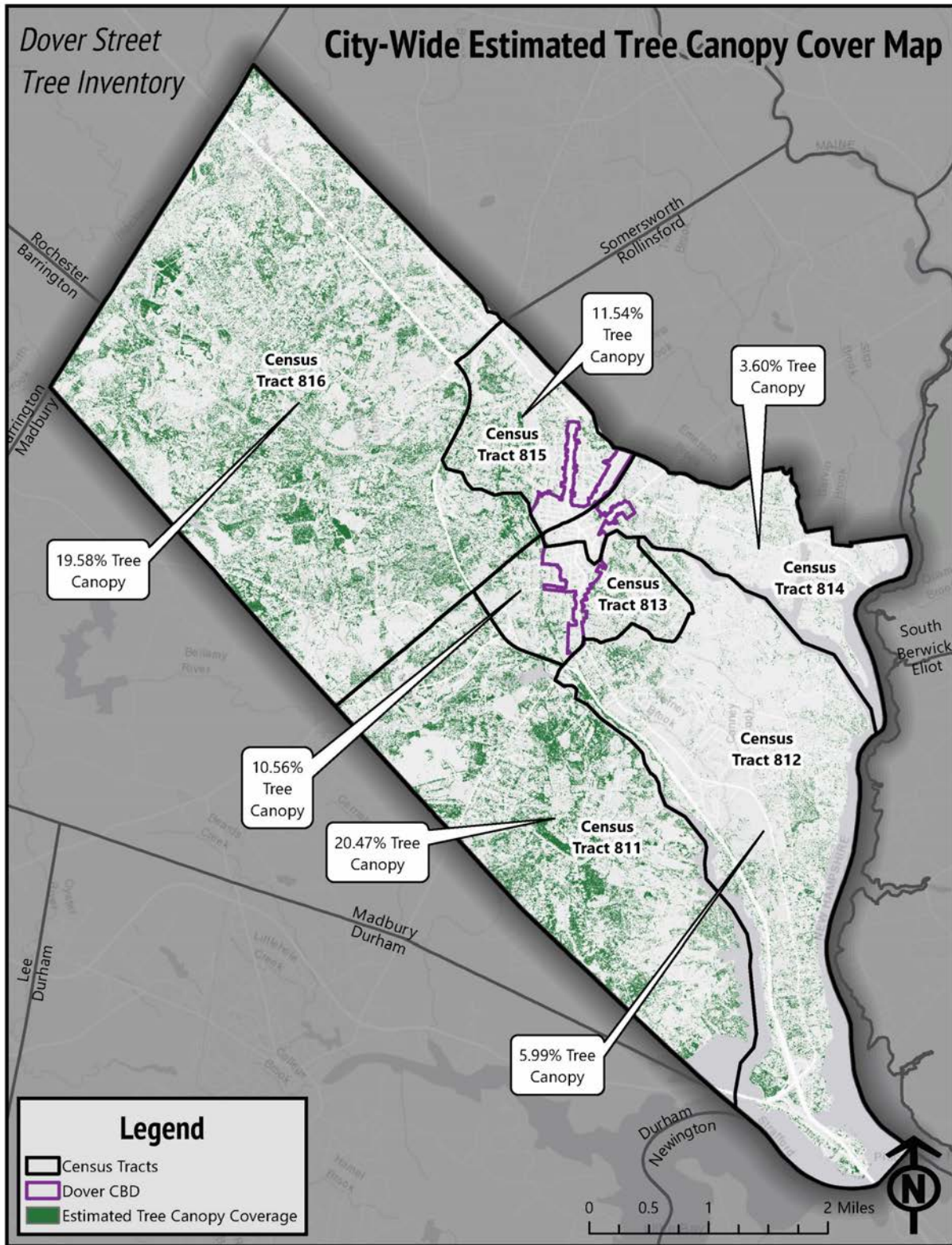


Figure 15. City-wide estimated tree canopy cover (Source: USDA NAIP, US Census Bureau)

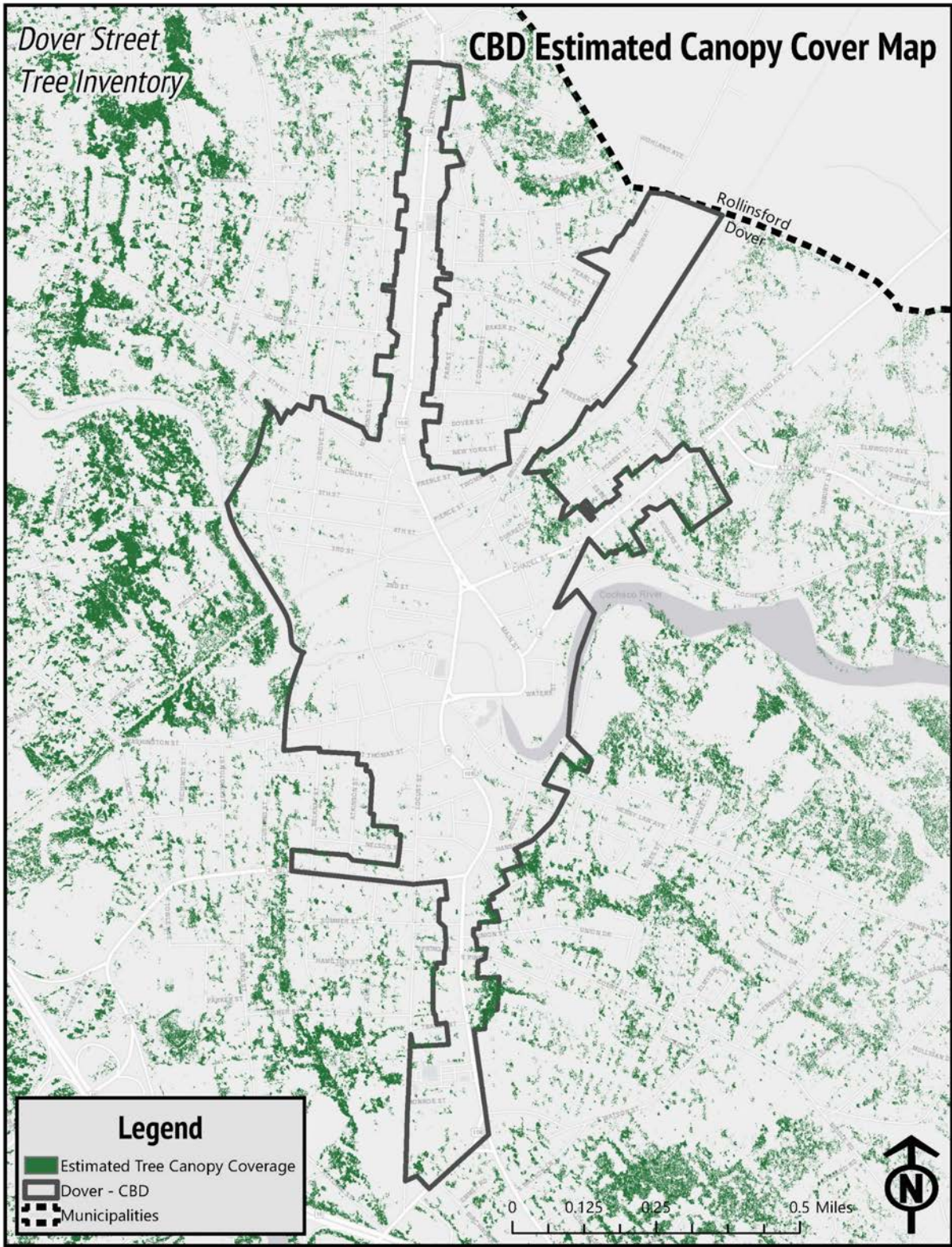


Figure 16. Estimated tree canopy cover in the CBD (Source: USDA NAIP)

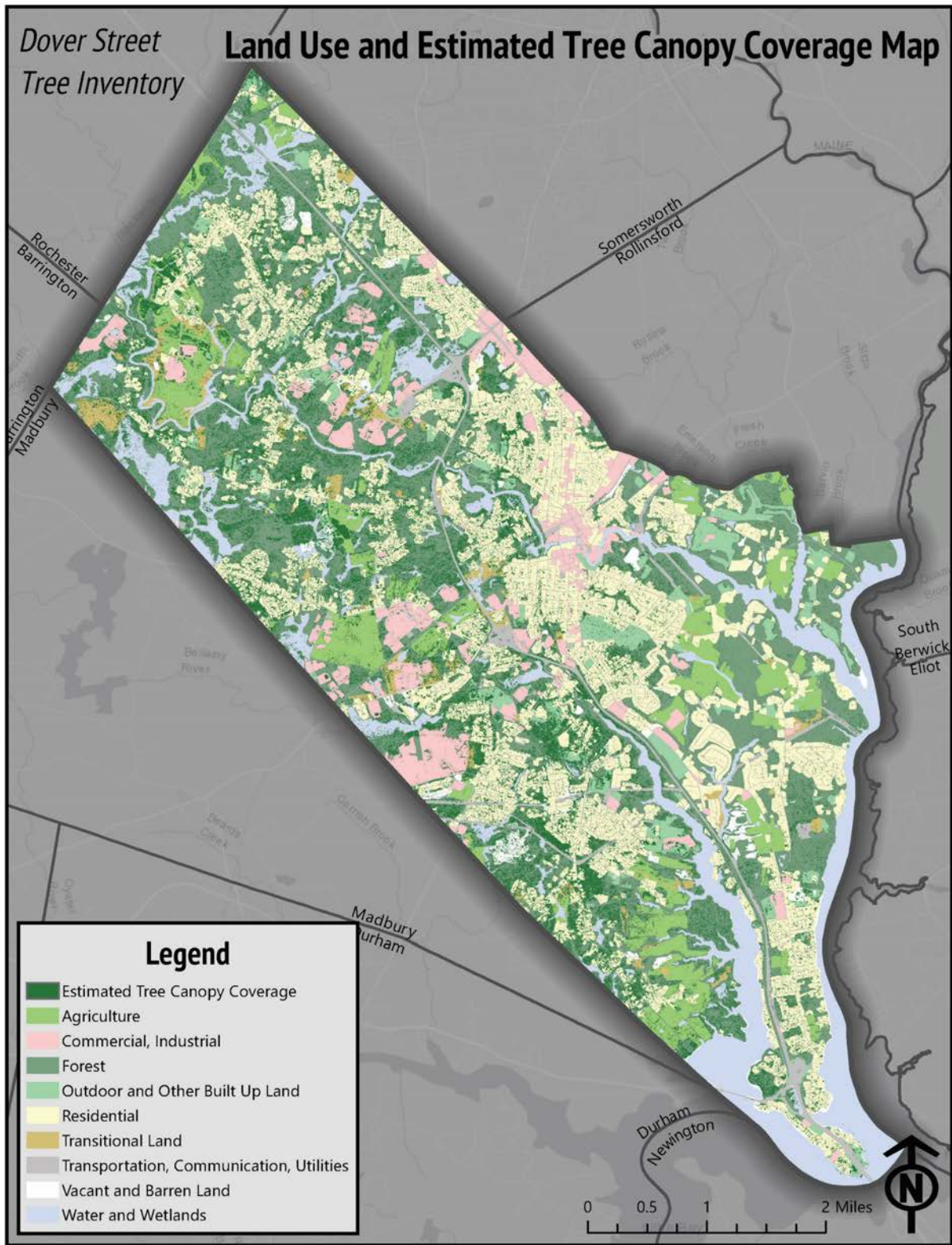


Figure 17. Tree canopy cover and land cover (Source: USDA NAIP, NH GRANIT)

A U.S. Forest Service report on urban and community forests of New England compiled data on the percent urban tree canopy cover of urban land for all available states that can be used as a rough benchmark of canopy cover. The percent canopy cover ranged from less than 5% to nearly 50%.³⁰ The canopy cover of urban land in New Hampshire accounted for 44.2 percent of urban land. Urban land makes up approximately 6.2% of the area of the state.³¹ This data is based on US Census urbanized areas and National Land Cover Database data.

C) Socio-Economic Analysis

Studies have found a disparity in the distribution of urban tree canopy cover, with low income and minority neighborhoods often having less canopy cover than neighborhoods.³² Equitable distribution of canopy cover is critical to ensuring that all populations are afforded the same access to the benefits of tree canopy and to reducing any environmental justice conditions that arise from inequitable access to these benefits. As Dover faces climate change impacts such as increasing temperatures, it will be particularly important to establish canopy cover throughout the city.

To better understand the equity of tree canopy cover in Dover, the percent canopy cover, socio-economic data from the American Community Survey (ACS) (population, median household income, and renter occupied residences), and the Center for Disease Control (CDC)'s Social Vulnerability Index (SVI) for each Census tract were compared (Table I). The CDC's SVI ranks social vulnerability based on 15 factors that may impact a community's resilience or ability to prevent human suffering and financial loss in a disaster. The SVI uses US Census data to rank social vulnerability for the 15 individual factors and four themes: Socioeconomic, Household Composition & Disability, Minority Status & Language, and Housing Type. Census tracts are given an overall social vulnerability ranking compared to other tracts in New Hampshire. Figure 18 shows the overall SVI ranking with tree canopy cover. Additional maps are included in Appendix E.

While there are inherent limitations associated with assessing equitable distribution of canopy cover using these data sets – including the lack of socio-economic data at a finer scale and the use of densely vegetated areas as a proxy for tree canopy – it provides a high-level snapshot of the existing tree cover and reveals areas where canopy cover is more sparse. As shown in Table I, the tracts with the highest overall social vulnerability ranking (811, 812, 813, and 815) have variable canopy cover ranging from the lowest in the City (3.6%) to the highest (20.5%). Census Tract 816 has the second greatest percent canopy cover (19.6%) along with the highest median household income, lowest share of renter occupied residences in the City, and an overall social vulnerability ranking among the lowest in the state.

Further research is necessary to determine the relationship and any correlation between socio-economic status and tree canopy distribution in Dover.

Table I. Tree canopy and socioeconomic data for Census tracts in Dover

Census Tract	Population	Canopy Cover (% of total area) ¹	Median Household Income ²	Renter Occupied Residences ²	Social Vulnerability Index Ranking Relative to Other Tracts in NH ³				
					Socio-economic	Household Composition & Disability	Minority Status & Language	Housing Type & Transportation	Overall Social Vulnerability
811	7,014	20.5%	\$66,176	40%	Medium High	Medium High	Medium Low	Medium High	Medium High
812	4,665	6.0%	\$79,813	20%	Medium High	Medium Low	Medium High	Medium High	Medium High
813	4,669	10.6%	\$54,119	60%	Medium High	Medium Low	Medium High	Highest	Medium High
814	2,021	3.6%	\$54,432	68%	Medium Low	Medium Low	Lowest	Medium High	Medium Low
815	5,874	11.5%	\$64,387	64%	Medium High	Lowest	Highest	Highest	Medium High
816	7,073	19.6%	\$92,781	18%	Lowest	Medium Low	Medium High	Highest	Lowest

¹USDA NAIP; ²ACS 2014-2018 5-Year Estimates; ³CDC SVI Index

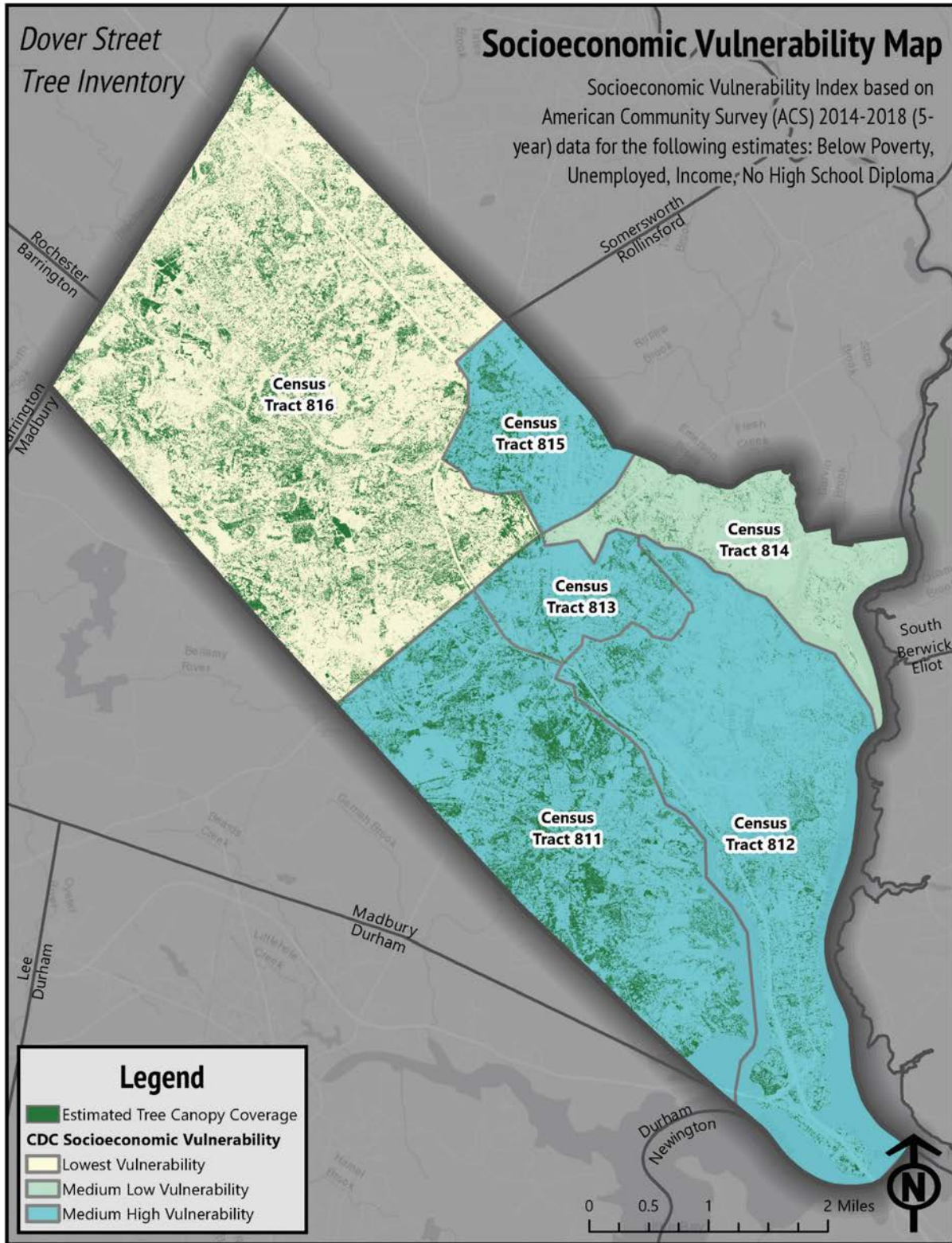


Figure 18. Tree canopy cover with overall social vulnerability index ranking of census tracts in Dover relative to other census tracts in New Hampshire (Source: USDA NAIP, CDC SOVI, US Census Bureau).

IV. Street Tree Management

A) Tree Selection

There are numerous resources available on urban species selection, planting, and maintenance. This section is intended to provide a synopsis of available guidance from an array of existing resources. It is intended to supplement but not replace existing local guidelines and regulations. It is recommended that the City consult a professional arborist prior to planting street trees.

University of New Hampshire Extension (UNH-E), U.S. Department of Agriculture (USDA), and eXtension identify a range of factors to consider when selecting street trees to plant. These include:^{33, 34}

- Growth habit and size
- Form
- Growth rate
- Wood strength
- Pest resistance
- Longevity and maintenance needs
- Leaf type
- Thorns, flowers, and fruits
- Native vs exotic
- Ice resistance
- Salt tolerance
- Drought tolerance.

In New Hampshire, species should be resistant to ice damage. Species such as American elm, hackberry, green ash, and honey locust, which form broad crowns, are more susceptible to ice storm damage.

(Source: UNH Extension)

The size and origin of the tree are also important to consider. Nursery grown trees that are of two-inch caliper have a greater likelihood of surviving the shock of being transplanted than larger trees.³⁵ Larger trees may be warranted in certain situations, however the smallest caliper tree appropriate for the job should be selected and planting trees larger than three-inch caliper trees is not recommended.³⁶ The healthiest stock should be selected.

According to the U.S. Forest Service, the ideal public tree:

- Is not susceptible to wind damage and branch drop
- Does not require frequent pruning
- Produces negligible litter
- Is deep-rooted
- Has few serious pest and disease problems
- Tolerates a wide range of soil conditions, irrigation regimes, and air pollutants.

Examples of solar-friendly deciduous trees include maples, hackberry, honey locust, Kentucky coffeetree, and Japanese pagoda tree.

(Source: US Forest Service)

It is important to select which of these traits are most important on a case-by-case basis because few species have all these traits.³⁷ Context-sensitive species selection will help to ensure survival and to maximize benefits. The better suited a tree is to the site, the greater chance it will have of surviving, growing faster, and maximizing benefits such as CO₂ sequestration.³⁸ For example, small growing species (under 25 feet) should be selected for under overhead power lines. Oval or columnar shaped trees are appropriate for narrow spaces.³⁹ Trees that are considered 'solar-friendly' that provide shading and cooling benefits in the summer while also allowing light to penetrate to buildings during the winter when warming is desired are often ideal.⁴⁰

Among the City’s goals for enhancing tree canopy cover is to improve stormwater management. The US Forest Service offers several guidelines for maximizing management of stormwater runoff at sites and for improving air quality (Figure 19) that can help the City achieve this goal.⁴¹

Tree Selection to Maximize Stormwater Management	Tree Selection to Improve Air Quality
<ul style="list-style-type: none"> • Select tree species with architectural features that maximize interception, such as large leaf surface area and rough surfaces that store water • Increase interception by planting large trees where possible • Plant trees that are in leaf when precipitation is greatest. • Select conifers because they have high interception rates but avoid shading south-facing windows to maximize solar heat gain in winter. • Plant low-water-use tree species where appropriate and native species that, once established, require little supplemental irrigation. • In bioretention areas, such as roadside swales, select species that tolerate inundation, are long-lived, wide-spreading, and fast-growing (Metro 2002). • Do not pave over street side planting strips for easier weed control; this can reduce tree health and increase runoff. 	<ul style="list-style-type: none"> • Select species that tolerate pollutants that are present in harmful concentrations. For example, in areas with high ozone concentration, avoid sensitive species such as white and green ash, tulip poplar, • Species with long leaf stems (e.g., ash, maple) and hairy plant parts (e.g., oak, birch, sumac) are especially efficient interceptors. • Consider the local meteorology and topography to promote airflow that can “flush” pollutants out of the city along streets and greenspace corridors. Use columnar-shaped trees instead of spreading forms to avoid trapping pollutants under the canopy and obstructing airflow. • In areas with unhealthy ozone concentrations, maximize use of plants that emit low levels of biogenic volatile organic compounds to reduce ozone formation. • Sustain large, healthy trees; they produce the most benefits. • To reduce emissions of volatile organic compounds and other pollutants, plant trees to shade parked cars and conserve

Figure 19. US Forest Service tree selection guidelines for maximizing stormwater runoff and improving air quality (Source: US Forest Service)

CNU offers several basic principles of trees in urban design, which are summarized in Table 2 and may be applied throughout Dover.⁴²

Table 2. Basic principles of trees in urban design (Source: Adapted from CNU)

	URBAN DESIGN	ARBORICULTURE	RAINWATER MANAGEMENT
1	Plant tree species that will grow large and provide substantial shade.	Design the tree from the roots up and make space for roots by including root paths, soil trenches, soil vaults, engineered soil solutions, and suspended sidewalk systems.	Establish good place making to enhance the livability and delightfulness of places for people; Bioswales and bioretention basins should not disconnect people from on-street parking or buildings.
2	Limit tree species to those that can tolerate poor drainage, disturbed and compacted soils, limited sunlight, concentration of car exhaust and animal waste, polluted stormwater runoff, and abuse from humans.	Respect the base of the tree by providing space to accommodate the growth of the trunk flare and roots.	Invest in solution multipliers, such as using engineered soils systems that make room for tree roots, increase stormwater retention capacity, and allow durable hardscape surfaces to be used.
3	Plant trees close together using a geometric grid to maximize the contribution of each tree to the urban forest.	Plant the right tree in the right place.	Design for recognition to help people recognize and appreciate the environmental benefits of stormwater management practices.

B) Site-Specific Street Tree Design Considerations

Along with selecting species that are appropriate for Dover’s climate and tolerant of urban settings, there are a number of additional considerations to take into account when developing a street tree landscape. These include, for example:⁴³

- The character of the layout and species
- Whether a formal or informal configuration of trees is desired
- Soil type and volume
- The presence of public infrastructure, which can both limit tree growth and also incur damage from tree roots and branches
- Provisioning of biodiversity, habitat, and benefits to wildlife such as shelter, nesting sites, and food sources
- Site constraints such as vehicle clearance, building setbacks, and availability of sunlight.

Street trees should also conform with local regulations and guidelines including the City’s Complete Streets Guidelines, CBD Architectural & Urban Design Guidelines, Streetscape and Urban Design/Downtown Streetscape Standards, and Site Plan Review Regulations. A brief summary of relevant local regulations and guidelines is included in Figure 20. Refer to Appendix F for additional pertinent local regulations and guidelines.

Relevant Local Regulations & Guidelines

Dover's **Complete Streets Guidelines** provide guidance on context and streetscape sensitivity:

During the planning, design, and review phases of projects every effort shall be made to reflect the context and character of the surrounding neighborhood. Where possible it is desirable to enhance the existing character of a street, and not replace it.

The number of street trees planted is one of the performance measures for evaluating complete streets.

The City's **CBD Architectural & Urban Design Guidelines** and **Streetscape and Urban Design/Downtown Streetscape Standards** also provide guidance on landscaping and species selection:

General guidance:

- I. Document the benefits of trees
- II. Provide new trees where there is an opportunity because of construction
- III. Preserve existing trees wherever possible
- IV. Select trees that complement the downtown's traditional appearance and be composed of trees that thrive in a New England urban environment.
- V. Complement the architecture and do not block important views of businesses.
- VI. Plant street trees at an average spacing of 25 to 30 feet on center. The planting method shall allow for maximum root zone space where possible. Existing healthy street tree shall be protected, if possible. These trees improve the pedestrian environment, compliment building facades, reduce heat island effect, assist with stormwater management, and provide many other benefits to the Downtown.

Guidance for specific locations:

Article I. Chestnut Street is a prime candidate for establishment of single large canopy tree species to help define the corridor. Recommended that *Zelkova serrata* is planted on both sides of the roadway no more than 50 feet apart. The location of the trees should not interfere with utility poles and/or lighting. Adequate distance should be left at the intersections to ensure sight lines for drivers.

Article II. Upper and Lower Squares- Selection of trees planted along the street and within the larger landscape areas should provide adequate shade for pedestrians, require little maintenance, and highlight the significance of the area. *Gledistia triacanthos var. inermis* is recommended as a shade tree along the street. *Pyrus calleryana* 'Chanticleer' is recommended as a shade tree within the larger landscaped beds. Plant no more than 40 feet apart along the street and plant in landscaped areas adjacent to seating. *Amelanchier canadensis* is recommended for planting in the larger landscaped beds.

Article III. Healthy, mature trees along Central Street, Main Street, Washington Street, and First through Sixth Streets should be preserved and infilled with appropriate tree species. *Quercus rubra*, *Ulmus americana* 'American Liberty', and *Acer rubrum* are recommended.

Article IV. In some locations, seasonal planting might be provided with containers that could be removed during winter months. Locations could include broad street corners in Upper and Lower Squares, along the approaches to in the center island of the mini round about at Portland Avenue, and along the sidewalks or approaches to the bridges within the downtown.

Figure 20. Regulations and guidelines for tree planting in Dover

With the exception of Silver Street, which has a streetscape plan and tailored list of species to plant, the street trees in the CBD are generally planted in an informal pattern. Certain areas along Central Street have groupings of one or two species, such as Callery Pears and Green Ash.

C) Suggested Species for the CBD

The City currently has three tree planting lists, including a Silver Street planting list, a list in the [Downtown Dover Pedestrian and Vehicular Access and Streetscape Study](#), and a list of acceptable street trees for Dover. The species in these lists are included in the matrix of recommended street tree species in Appendix G. Information obtained from the Urban Horticulture Institute at Cornell University's [Recommended Urban Trees: Site Assessment and Tree Selection for Stress Tolerance](#),⁴⁴ the Arbor Day Foundation,⁴⁵ as well as data collected during the 2020 CBD Street Tree Inventory is also included in this table.

This species matrix is intended to build off the existing street tree lists by providing information to determine the optimal species for a site based on the particular conditions and constraints of a street tree planting site. In the CBD, species that are shorter, more salt, drought, and heat tolerant, and have a narrower spread are likely to be more suitable for the majority of planting sites than larger and more sensitive species.

The matrix includes additional recommended species that the City may wish to include in future tree planting lists. One common street tree that was not included in Dover's existing street tree planting lists is Northern Catalpa.

Some species that were identified in the CBD street tree inventory, such as silver maple and shagbark hickory, are not recommended for inclusion on the City's street tree list. Silver maples grow very large and would likely exceed the space available for a street tree. Shagbark hickories prefer for well-drained, large, landscapes, which may not be prevalent in a street tree setting.

Lastly, for various reasons, several species may warrant removal from Dover's street tree planting lists. Both Green and White Ash are susceptible to Emerald Ash Borer and other pests and diseases. Ash are also vulnerable to storm damage and therefore may require more pruning than other species. As evident along Central Avenue in the heart of the downtown, many individuals have dead limbs overhanging the road and parked cars that require pruning. Callery Pear and Norway Maple tend to be overused as street trees, and indeed, Norway Maple accounted for nearly 13% of all



Large silver maple on Grove St



Green Ash leaning over Central Ave

The Urban Horticulture Institute's Site Assessment Checklist, available at <http://www.hort.cornell.edu/uhi/outreach/recurbtree/pdfs/~recurbtrees.pdf>, may be a useful resource for determining appropriate trees for a particular location.

street trees in the CBD. Both species are tolerant of urban landscapes but provide little value from an ecological perspective. Norway Maples are considered an invasive species that will spread to nearby natural areas, while Callery Pear offer little benefit to wildlife. Although few American Hophornbeam were identified in the CBD, the condition of these trees was poor. This species' high sensitivity to salt may be a contributing factor to its poor condition in the urban core. Maples and birch trees are susceptible to Asian Longhorned Beetle. While this invasive is not present in New Hampshire at this time, however Worcester, MA has an infestation. If these species are planted they should be closely monitored for this pest. Finally, *Tilia spp.*, including Linden and Littleleaf Linden accounted for a combined nearly 20% of all street trees surveyed in the CBD. To enhance the diversity of street trees, the City may wish to remove this species from its tree planting lists for several years.

Liberty elm have not been removed from the suggested planting list; however this species can be impacted by Dutch elm disease. The City could work with the [Liberty Tree Society](#) in Keene, NH, which offers a 10-year warranty against loss to Dutch elm disease.⁴⁶

Two key considerations for future street tree species selection include drought tolerance and plant hardiness.⁴⁷ The [USDA's plant hardiness zones](#) have shifted and will likely shift again due to climate change. The Seacoast experienced one zone shift between 1990 and 2015. The 2014 National Climate Assessment shows [Zone 7 moving northward](#).⁴⁸ Future street tree species lists may include more southern species, while others such as Sugar Maple – which is a species that is often a desirable street tree and one that is fairly prevalent in the CBD – may become less viable in the urban CBD and therefore is not recommended to be added to the City's planting list. Species with a southern most hardiness zone of 4b or lower should are not likely to thrive in the warmer conditions anticipated in the future. The species included in the suggested planting list in Appendix G have a southern hardiness zone of 7 or greater.

Furthermore, changes in precipitation including more frequent and prolonged drought conditions and larger precipitation events, more severe winter storms, and an increase in the threat of invasive species, associated with climate change will likely impact the appropriateness of certain species in the CBD. Species that are already vulnerable to heat and drought, for example, may be less likely to survive as temperatures rise.



Trees shading Central Ave buildings

Diverse species should be selected and planted in an alternating pattern to reduce opportunities for pests to impact continuous stretches of street trees. Species vulnerable to Asian Longhorned Beetle include maples, birches, and hackberry. The spotted lanternfly, which has not yet reached the state, would be a threat to maple, oak, poplar, sycamore, walnut, and willow. (UNH Extension)

D) Installation

General recommended guidelines for spacing and avoiding conflicts with infrastructure in the CBD are shown in Figure 21. These are intended to supplement the City's existing land use regulations. It is recommended the City establish new street tree pits in areas where spacing requirements cannot be met by existing cuts in the sidewalk.

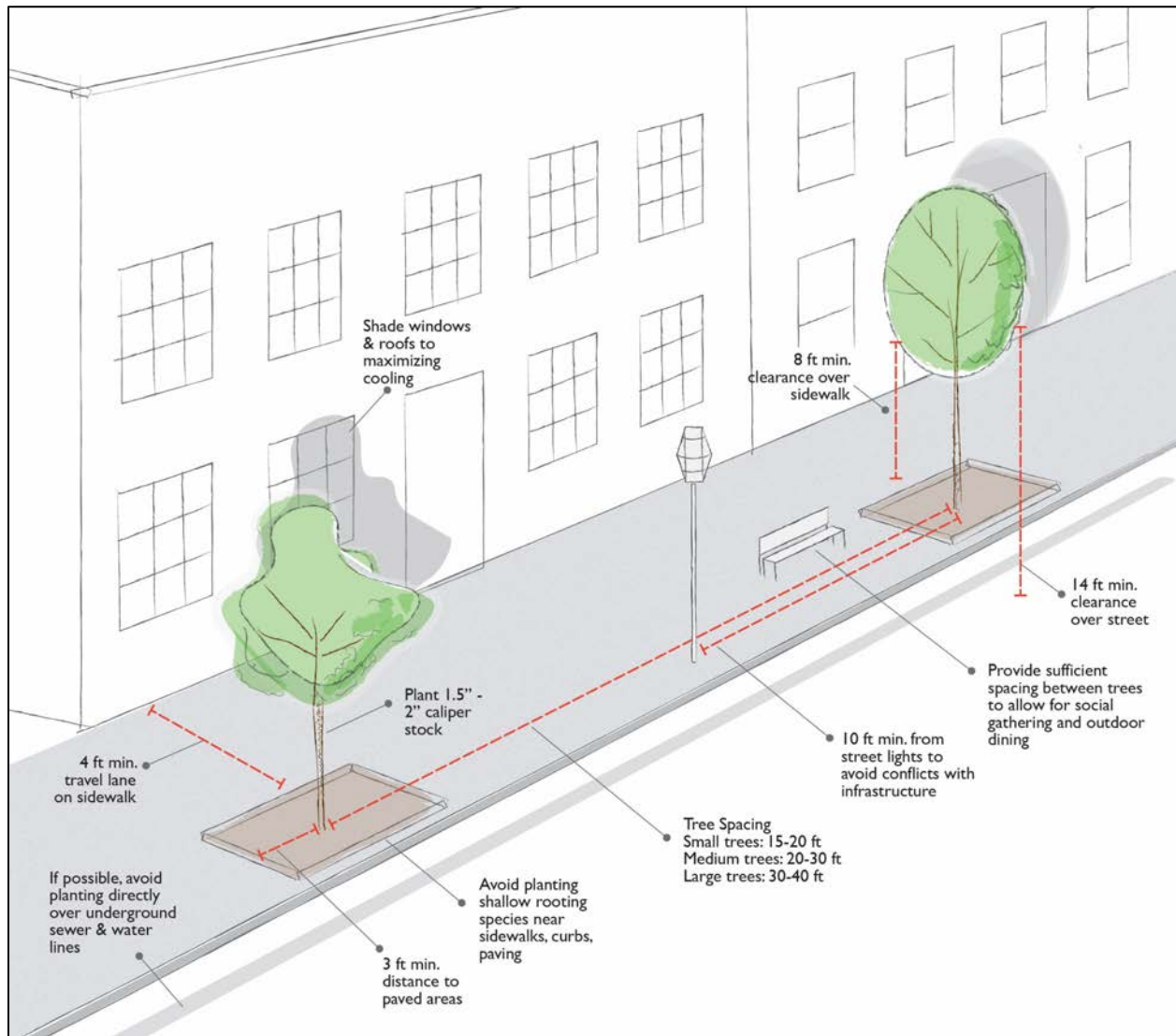


Figure 21. CBD tree planting guidelines and spacing

A number of resources are available with instructions on how to properly plant street trees in urban environments. UNH's [Planting Trees in Designated and Built Community Landscapes, Checklists for Success](#),⁴⁹ is an excellent resource for choosing the right tree in the right place, planting it properly, and maintaining it. Another readily available resource for tree planting in New Hampshire is the [Planting and Mulching Trees and Shrubs Factsheet](#),⁵⁰ developed by UNH Extension. The NH Division of Forests and Lands and US Forest Service State and Private Forestry Service offer several checklists for community tree planting in [Planting Trees in Designated Built and Community Landscapes](#),⁵¹ including Checklist #4 Preparing a Site and Checklist #5 Planting that provide basic guidance on how to plant trees (Figure 22).

Checklist #4 Prepping a Site

If possible, prepare the site before you bring in the tree. Keep the root ball well watered and keep the tree in a shaded place until you are ready to plant. It is imperative to expose the trunk flare on each balled and burlaped tree before the planting site is dug so that the depth of the planting site can be properly measured. The trunk flare is the point where roots begin to branch from the trunk. (The top of the root ball is not always the trunk flare.) Remove burlap from immediate trunk area of tree. Pull back excess soil around trunk of tree to locate trunk flare. Measure the height from the base of the trunk flare to the bottom of the root ball. Dig to the depth of the trunk flare.

- Trunk flare and top of root ball should be at grade.
- Dig the space at least 3 times the diameter of root ball.
- Break up compacted soil. Sides of planting space should not be packed. Leave bottom of space firm.
- Do not amend soil unless planting in building rubble, poor, or severely disturbed soils.

Checklist #5 Planting

- Lift tree into planting space by root ball, not the trunk.
- Balance tree upright in center of planting space.
- For trees in wire baskets, cut and remove wire.
- Cut away strings and burlap or plastic, exposing root ball. Do not remove soil from root ball.
- If tree is container grown, cut and remove container.
- Prune dead or crushed roots and straighten or cut circling roots. Make clean cuts.
- Begin refilling with soil, watering as you fill to firmly set tree. Gently tamp.
- Never plant too deep. Trunk flare and top of root ball should be at grade. (Trunk flare may be hidden within the root ball.) Fill soil up to tree base just to where roots begin to branch from trunk.
- Prune only dead or injured branches. Do not paint wounds.
- Remove tree wrap, tape, or string on trunk. Trunks should be wrapped only to protect them in transit to planting site.
- Stake and brace most trees at planting time. Support tree but allow it to move or sway.
- Use wide, belt-like strapping attached to two sturdy stakes. Do not use rope or wire through a hose.
- Mulch lightly and evenly with 2" of composted material at least to the diameter of crown of tree. Leave 3" circle of bare soil around the trunk. Deep layers of mulch can be harmful.
- Do not plant flowers under tree.
- Do not fertilize at planting time.

Figure 22. Site preparation and planting checklists (Source: NH Division of Forests and Lands and US Forest Service State and Private Forestry Service)

E) Maintenance

As discussed in Section II, less than one fourth of street trees inventoried in the CBD have no current maintenance needs. Pruning, required at 150 (40%) of sites, water required at 139 (37%) of sites, and mulch, required at 111 (29%) of sites, were the most prevalent maintenance needs.

Maintenance needs may change due to climate change. Additional watering, increased monitoring for pests and disease, and increased hazard limb removal following storm events are likely. Watering trees in urban environments is critical now and will likely become more important to tree survival in the future. Factors including elevated urban temperature, dry air and soils, and large radiative loads lead to high evaporative demand. Without irrigation, a street tree's ability to survive and capacity to provide cooling benefits in the urban environment are diminished.⁵²

Dover has a winter road maintenance program to reduce salt usage, which can impact nearby vegetation. The City may wish to explore strategies to enhance street tree tolerance to road salt, such as amending soil with gypsum, which reverses the effects of sodium and chloride accumulation.⁵³ This treatment has been used on roadside vegetation by the Minnesota Department of Transportation.

The overall condition of street trees in the CBD included 8% (32) poor, 4% (13) dead or dying, and 5% (17) stumps or empty pits, indicating that 16% (62) of street trees in the CBD may require replacing. At approximately 16% of the sites surveyed, there was evidence of damage to the sidewalk or curb due to root uplifting. Overall, 14% of trees were determined to be not appropriate for the site.

A general schedule for street tree maintenance is provided in Table 3. Additional considerations for street tree care include protecting trees during construction and repairing damage. The City should keep records that document maintenance of each tree. The GIS database created from the CBD street tree inventory may be a useful resource for tracking maintenance.

UNH Extension Tree Maintenance Resources

[Protect a Tree During Construction](#)

[Repair Damage After a Storm](#)

[How to Mulch Trees & Shrubs](#)

[Planting and Mulching Trees & Shrubs](#)



Photos taken by volunteers showing maintenance needs

Table 3. CBD Street tree maintenance schedule

		Schedule					
		At Planting	1 st 3-5 years	2-3 Year Cycle			
				Spring	Summer	Fall	Winter
Regular Street Tree Maintenance							
Data entry	Document of date planted, type of stock, species and cultivar, map location, maintenance performed, maintenance needs.	X	X	X	X	X	X
Mulch	Evenly spread 3-5 inches throughout entire pit or minimum 2-foot radius from trunk; avoid placing mulch in direct contact with trunk.	X	X	X			
Stake & tie	As needed, place 2 wooden or metal stakes opposite each other about 1.5 ft away from the trunk and use canvas strapping or tree staking straps to attach loosely to tree.	X	X				
Water	Using tree bags or watering truck, provide 10-20 gallons/week for the first 3 years after planting and 8-10 gallons as needed after tree is established.	X	X	X	X	X	
General pruning	Remove limbs to shape canopy, avoid conflicts with overhead wires, streetlights, and street sign, and to remove undesired limbs and suckers; should be completed by trained staff or arborist.	X	X			X	
Crown lifting	Remove lower branches to provide sidewalk and street clearance; should be completed by trained staff or arborist.	X	X			X	
Hazard and dead limb identification and removal	Remove dead or hazard limbs on an as-needed, ongoing basis; should be completed by trained staff or arborist.					X	X
Pest & disease control	Inspect foliage and bark and treat as needed.				X		
Leaf litter collection	Remove fall leaf litter from street and sidewalk.		X			X	
Soil	Supplement or amend soil as needed.	X		X			
Litter/trash removal	Remove litter and trash from tree pit; coordinate with adjacent property owners for assistance.	X	X	X	X	X	X
Weed control	Remove weeds from tree pit or mulched area; coordinate with adjacent property owners for assistance.	X	X	X	X	X	X

The research on street tree longevity is variable and someone inconclusive. Research has shown that street trees planted in tree pits with approximately 150 cubic feet of soil live an estimated 7-10 years, while those planted in larger medians may live over 50 years.⁵⁴ Other resources indicate that 25 years is a short life span for a street tree.⁵⁵ One study of longevity studies found that the typical street tree mean life expectancy is 19-28 years and the annual mortality rate is 3.5-5.1%.⁵⁶

Trees should be removed if they create hazards for pedestrians, vehicles, or infrastructure that cannot be mitigated through pruning. Trees that result in other hazards such as uplifted sidewalks may also require removal. Large trees that significantly infringe on buildings and infrastructure may have outgrown

their site and may require removal and replacement by a younger tree. Tree pits that are located closer than four feet from buildings or other physical barriers should be resized, if there is sufficient space to expand the pit in alternate directions, or relocated, in order to be ADA compliant. Another reason for street tree removal is the presence of invasive species or disease. Failure to remove these trees may create hazardous situations or increase the spread to other individuals. Finally, dead or dying trees should be removed and replaced.

The New Hampshire Municipal Association (NHMA) provides some guidance on tree removal. If a tree that is located in the right of way falls and obstructs a road, bridge, or sidewalk, it creates an “insufficiency” and exposes the municipality to liability if the municipality’s response is deemed grossly negligent under NH RSA 231:90-231:92-a.⁵⁷ When a hazard cannot be addressed immediately, signage warning the public should be placed at the site. NHMA also notes the value of amending local regulations to clearly convey what constitutes “interference with public travel” or a “public nuisance by reason of danger to the traveling public” under NH RSA 31:51 and 231:145.

Excerpt from Tree Maintenance Revisited

Under RSA 231:150 municipalities have a duty and right to remove from highway rights of way all trees and bushes that may damage or pose a danger to the highways or traveling public so long as the vegetation has a circumference of less than 15 inches at a point four feet from the ground. However, for trees with a circumference of more than 15 inches at a point four feet off the ground, consent of the landowner must usually be obtained for pruning or removal. If the highway has been designated a "scenic road" by the town pursuant to RSA 231:157, trees along the scenic road shall not be cut, damaged, or removed without the prior written consent of the planning board or other designated municipal body. The municipality may proceed under RSA 231:145 to have a tree declared a public nuisance. Notice must be provided to the landowner, an opportunity for a local hearing provided, and the landowner is provided a further right to appeal the issue to the Superior Court within 30 days of the decision declaring the tree a public nuisance. All of these procedures are unnecessary in the case of an "imminent threat to safety or property."

Source: NH Municipal Association, Paul Sanderson. May 2011

V. Implementation

A) Prioritized list of planting locations in CBD

1. Replace trees in empty pits

Eight empty tree pits were documented during the inventory. Seven of these sites were located on Central Avenue/Rt 108 between Fourth Street and Portland Avenue and one was located on Chapel Street (Figure 23). Nine tree pits contained stumps (Figure 24). Half of these sites were located on Central Avenue/Route 108 between Fourth Street and Portland Avenue. Eleven sites had dead or dying trees. The location of these trees was distributed throughout the CBD (Figure 25). The City should prioritize installation of trees in existing street tree pits that are empty or have stumps or dead and dying trees.

2. Ash Tree Removal

The City should initiate removal of ash trees. Many of the ash trees that lean over Central Avenue and have dead branches may be potential hazards to pedestrians and vehicles. The fact that these trees are also vulnerable to Emerald Ash Borer is another reason that the City should start to remove and replace ash. UNH Cooperative Extension staff recommend that the City remove ash from its planting lists and determine which trees they would like to retain and which should be removed. Any trees that are retained should be treated with a systemic insecticide every one to three years to protect from pests. Figure 26 shows concentrations of ash trees along and near Central Avenue and Main Street.



Figure 23. Location of empty tree pits/planting sites

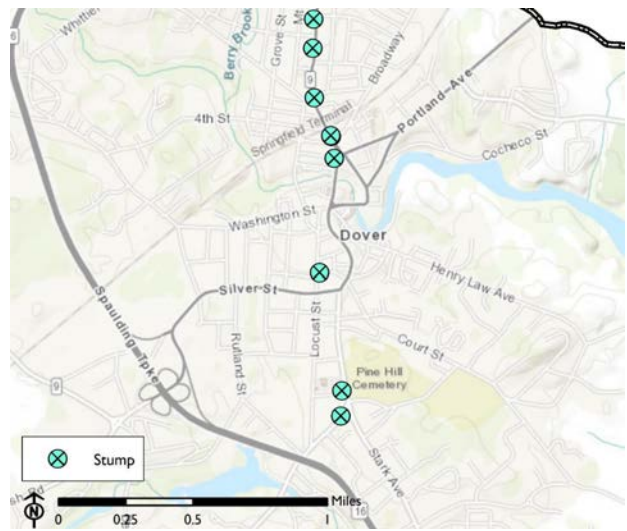


Figure 24. Location of tree pits with stumps



Figure 25. Location dead or dying trees

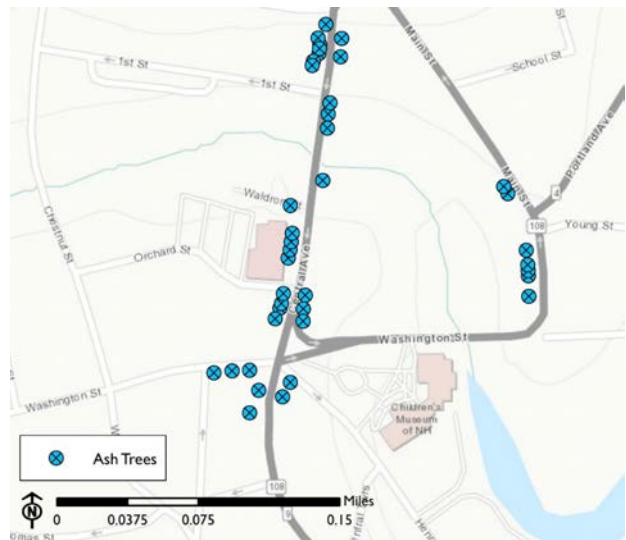


Figure 26. Location of ash trees in the vicinity of Central Avenue and Main Street

3. Establish tree pits in areas with low density of street trees

Figure 27 displays street tree locations with a heat map showing the distribution of street tree density. This map highlights areas with comparably fewer street trees (displayed in light green) than other locations (displayed in darker green) within the CBD. While there are opportunities to increase street tree plantings on nearly all streets in the CBD, several areas stand out as having fewer trees and therefore sparser canopy cover. These include:

- Residential neighborhood including First, Second, Third, Fourth, Fifth, Lincoln, and Grove Streets.
- Southern portion of Chestnut Street.
- Portions of Portland, Broadway, and Central Avenue, which serve as gateways to the CBD.
- Residential streets south of Henry Law Avenue.

Prioritizing plantings in these areas would help establish more equitable tree canopy cover throughout the CBD. Suggested size and minimum number of species is included on the density map.

4. Replace or maintain species in poor condition

Figure 8 displays the overall condition of street trees in the CBD. This map highlights trees that are in poor condition. Along with GIS data collected during the street tree inventory, it can be used to identify trees that require maintenance or potential removal and replacement. It is recommended that the City review the street tree condition data in the vicinity of new development, redevelopment, and street repair projects to identify opportunities to install new trees when pavement is being disturbed.

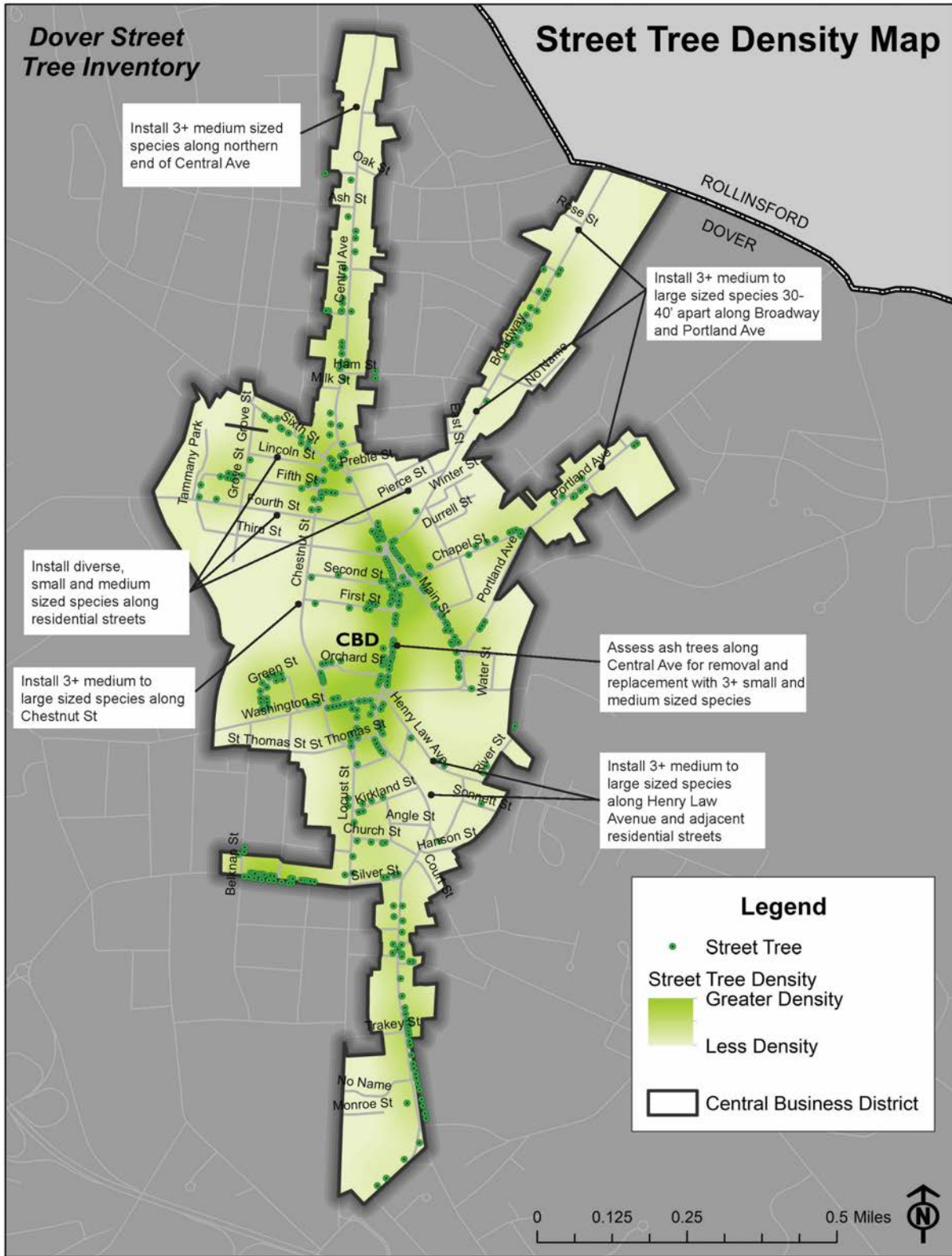


Figure 27. Street tree density map

B) Management Needs

Facilities and Grounds is responsible for maintenance of Dover’s street trees. A list of recommended management strategies for CBD street trees is shown in Table 4. For planning purposes, an estimated cost is provided for each recommendation.

Table 4. CBD Street Tree Management Recommendations

Management Recommendations	Estimated Cost
Establish part-time arborist staff position	\$25,000-\$45,000/year
Hire/contract professional arborist to inspect trees that have identified maintenance needs or are in poor or dead and dying condition	\$2,000-\$5,000
Record all site inspections, maintenance actions, and maintenance needs in the street tree database that was created as part of the street tree inventory	\$2,000/year (staff time)
Examine sidewalk and curb damage and determine whether tree needs to be replaced	\$2,000 (staff time)
Establish protocols for street tree replacement during sidewalk or street construction to ensure trees are protected or, if warranted, removed and replaced during construction activities	\$1,000- \$2,000 (staff time)
Monitor street trees on an annual basis	\$2000/year (staff time)
Develop a procurement plan with local nursery(ies) to ensure desired species are stocked and available	\$500 (staff time)
Amend land use regulations and policies that pertain to street trees, as needed	\$3,000-\$5,000 (staff time)
Formalize operations and maintenance responsibilities	\$500 (staff time)
Replace empty tree pits	\$200/tree
Install new street trees	\$400/tree
Coordinate with arborist to determine which ash trees should be retained and which should be removed. Trees that are retained should be treated with a systemic insecticide every 1-3 years.	\$10,000

In addition to the above management recommendations, the City may wish to expand efforts to inventory trees by surveying trees in public parks and on other municipal property and by replicating the street tree inventory in other zoning districts. An additional next step is to collaborate with scientists to develop a long-term monitoring program to observe and record climate change impacts to street trees.

It is recommended that staff collaborate with the Forest Sub-committee explore opportunities to utilize revenue from forest management harvests to fund a range of urban tree activities, including street tree and park maintenance.

Appendix A 2020 CBD Street Tree Survey Questions

Appendix B 2020 Street Tree Inventory Instructions

Appendix C 2020 Street Tree Inventory Species List

Appendix D 2020 Street Tree Inventory Map Set

Appendix E 2020 Tree Canopy & Socio-Economic Data Maps

Appendix F Pertinent Local Regulations and Guidelines

Appendix G Matrix of Recommended Street Tree Species

Supplemental Data: GIS Database with Street Tree Inventory Data

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