

Assessing Urban Tree Canopy Cover in the Merrick and Memorial Neighborhoods from a Public Health Perspective



Prepared by
Pioneer Valley Planning Commission
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ASSESSING URBAN TREE CANOPY COVER IN THE MERRICK AND MEMORIAL NEIGHBORHOODS FROM A PUBLIC HEALTH PERSPECTIVE

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The Town of West Springfield, Massachusetts

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INTRODUCTION

Purpose of the Study

This report was prepared for the Town of West Springfield's Tree Warden, Tree Committee, and Mass in Motion Wellness Leadership Team by the Pioneer Valley Planning Commission (PVPC). The two-fold purpose of this assessment is to provide the Town of West Springfield with:

1. a preliminary, aerial analysis of the urban canopy in the Merrick and Memorial neighborhoods, and
2. an economic valuation of the public health benefits that canopy provides.

The data provided in this report will assist the Town in:

- identifying and quantifying the benefits provided by existing canopy cover;
- identifying and prioritizing areas in need of increased canopy cover; and
- providing material for authoring compelling grant narratives to fund future urban forestry projects that expand/improve canopy coverage.

This report does not set canopy cover goals. It is up to the Town to identify and tailor specific canopy goals to specific neighborhoods, based on ecosystem service canopy cover can provide. This report details existing conditions in order to assist the Town in the creation of canopy cover goals.

Key Findings

Using i-Tree Canopy assessment, West Springfield was found to have a roughly 50% townwide canopy cover average, which is high compared to neighboring communities such as Holyoke, with 26.5% coverage in 2013, and Springfield, with approximately 25% coverage in 2014. **This canopy cover provides West Springfield with approximately \$2,226,280.49 in annual public health benefits.**

While it is helpful to have an understanding of the town-wide canopy coverage, it is important to understand that distribution of tree canopy cover is not uniform across any municipality. Therefore, it is more functional to look at canopy coverage on a finer scale, such as by neighborhood, census block,

WHAT IS URBAN TREE CANOPY (UTC)?

Tree canopy, defined as the layer of leaves, branches, and stems of trees that cover the ground when viewed from above (as in from aerial photography), provides many environmental and public health benefits and services to both rural and urban communities. The urban tree canopy (UTC) is a component of the urban forest—all of a community's vegetative material on both public and private land. The urban forest forms landscape-scale green infrastructure which complements a community's grey infrastructure (such as water and sewer lines) and can be managed with equal importance to support municipal resilience.

sub-watershed, or land use or zoning designations.

At 13.7% canopy cover, the Merrick neighborhood has much less canopy coverage than the town as a whole. **Merrick's existing canopy provides approximately \$8,533.83 in annual public health benefits.**

The Memorial neighborhood was found to have 14.3% canopy cover, also much less than the town average. **Memorial's canopy cover provides approximately \$9,907.50 in annual public health benefits.**

Report Contents

This report overlays town and neighborhood demographic data with canopy cover analysis to provide a nuanced characterization of which populations have access to the public health benefits of existing canopy cover.

1. First characterizing general Town demographics, the report then details the populations specific to the Merrick and Memorial neighborhoods in order to provide context for public health benefits provided by canopy cover.
2. The report then quantifies canopy cover in the town as a whole and in the Merrick and Memorial neighborhoods, and values the public health benefits that canopy provides.
3. Finally, the report provides basic guidance in setting canopy cover goals/targets and visualizing prioritization scenarios.

THE VALUE OF UTC

While this report primarily focuses on valuating the public health benefits provided by UTC, healthy tree canopy has myriad benefits beyond public health. With existing i-Tree software, the study was unable to quantify these benefits for neighborhoods in West Springfield; however, previous studies have calculated average savings per tree in temperate climates such as that of New England. UTC:

- improves stormwater management. Based solely on rainfall interception by tree canopy, annual savings per individual trees can range from \$0.28 to \$54.61
- can reduce energy consumption for heating and cooling adjacent buildings. Calculated net energy savings per tree saw values ranging from 12 kWh to 919 kWh. Annual economic benefits ranged from \$4 to \$166 per tree.
- enhances property value. Trees have been shown to effect property sales between \$7 to \$165 per tree.¹

While tree canopy provides these same benefits in rural communities, the effect of the canopy is felt especially strongly in urban areas otherwise characterized by large amounts of impervious surfaces. Impervious surfaces, such as buildings, roadways, and sidewalks, absorb heat from the sun, and radiate it back out over the course of the day and night, causing urban heat islands (UHI), urban regions experiencing warmer temperatures than their rural surroundings. Heat islands affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and deteriorating water quality.²

Town Geographic Context

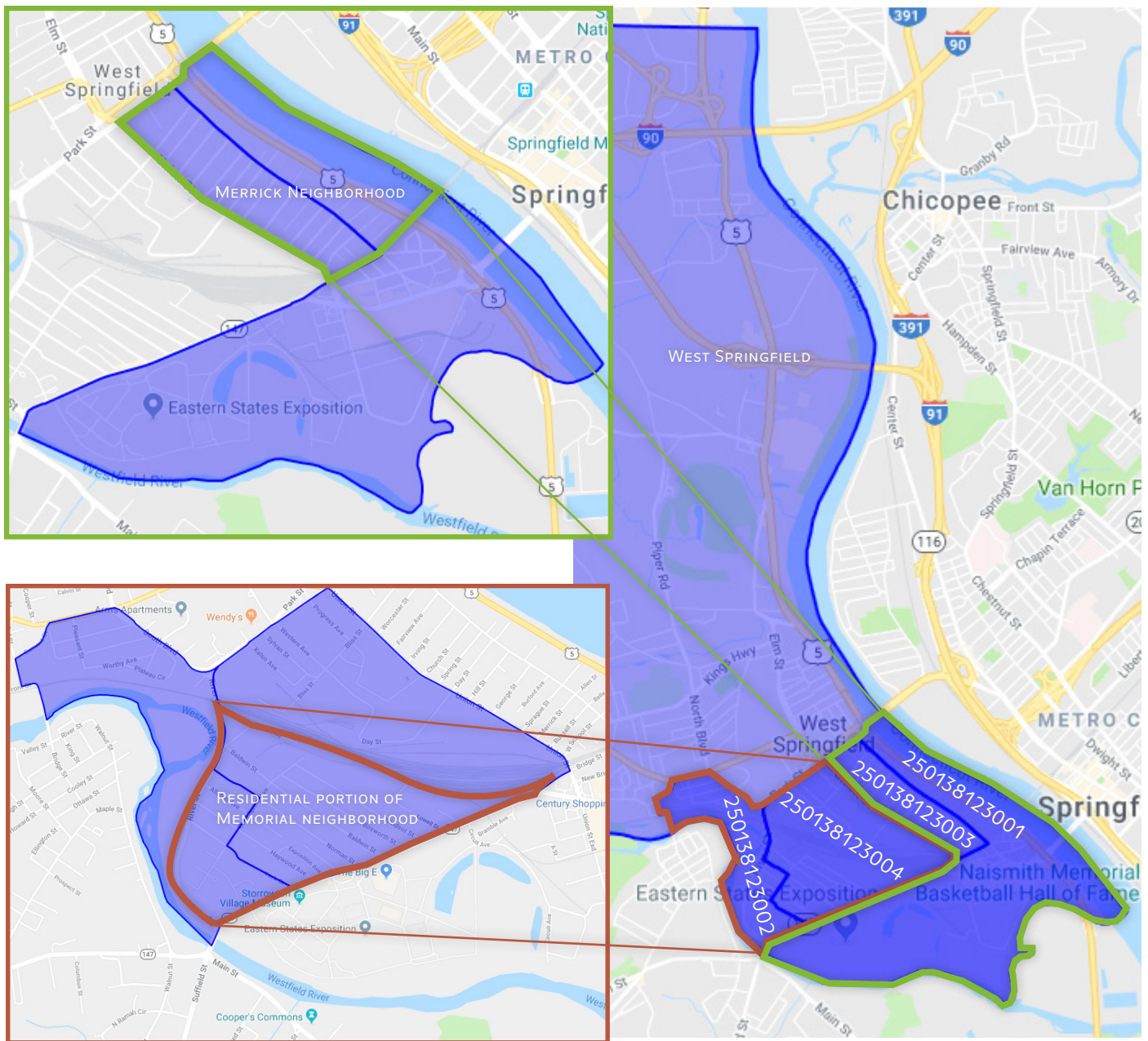
The Town of West Springfield lies within the Connecticut River and Westfield River watersheds. The Connecticut River forms the eastern boundary of the town, separating West Springfield from the Cities of Springfield and Chicopee, and the Westfield

River forms the southern boundary between West Springfield and the Town of Agawam. To the west, East Mountain demarks the town boundary, while the City of Holyoke provides the boundary to the north. While primarily urban and suburban, the community prizes its several large-scale natural areas, including the heavily forested Bear Hole watershed, Mittineague Park, and the preserved floodplains located along the Connecticut and Westfield Rivers.

With a total land area of 16.8 square miles, West Springfield comprises eight historical neighborhoods, according to the Town's Master Plan:

- **Amostown:** The largest neighborhood by land area. Comprises primarily single-family units south of I-90 and north of Route 20.
- **Bear Hole:** A residential neighborhood in the western portion of town, with larger single family homes. Located west and north of I-91 and I-90.
- **Center:** A mixed residential and downtown area that includes smaller single, duplex, and multifamily homes, financial and consumer services, and municipal buildings.
- **Tatham:** A dense residential area located between the Westfield River, Mittineague Park, and Route 20.
- **Riverdale:** A mixed residential and commercial area. Residential units are predominantly multifamily and located off Riverdale Street. Some smaller, isolated single family neighborhoods remain.
- **Merrick:** A dense mixed residential and business area.
- **Memorial:** A divided area with a mixture of residential, commercial, and industrial north of Memorial Avenue (Route 147) and commercial, industrial land and fairgrounds to the south.
- **Mittineague:** A single family residential area, with a large portion of land area preserved as Mittineague Park.

These neighborhoods each feature distinct housing types and land uses, providing significant variation in demographic make-up and built environments across the city. As the focus of this report is the Merrick and Memorial neighborhoods, the report will provide demographic context for the Town as a whole and those two neighborhoods specifically. In order to develop a holistic understanding of the intersection between existing canopy cover and



CENSUS BLOCK / NEIGHBORHOOD CLARIFICATION

current demographic trends, it is recommended that West Springfield conduct canopy cover assessments for the remaining neighborhoods as well.

The Areas of Focus

While the quality and density of tree canopy is important across West Springfield, this report focuses on the Merrick and Memorial neighborhoods. Comprised entirely of designated Environmental Justice (EJ) census blocks (2010), Merrick and Memorial are ethnically diverse, low-income, and relatively dense urban neighborhoods. EJ

neighborhoods are the focus of the state's Executive Office of Energy and Environmental Affairs' (EEA) Environmental Justice Policy, which upholds the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits.³

The Merrick neighborhood is a dense mixed residential and business area bounded by Park Street to the north, the Connecticut River to the east, Bridge Street to the south, and Union Street to the

ABOUT I-TREE

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service (USFS) that provides urban and rural forestry analysis and benefits assessment tools. The i-Tree tools help communities of all sizes strengthen forest management and advocacy efforts by quantifying forest structure and the environmental benefits that trees provide.

For the purposes of this report, PVPC used the i-Tree Canopy and i-Tree Landscape softwares to generate the enclosed data and analysis. i-Tree Canopy produces statistically valid estimates of land cover types using aerial images available in Google Maps. i-Tree Landscape combines geospatial data for an area of interest with demographic data to allow users to overlay environmental data with socio-economic and public health data. It makes use of datasets, such as land cover and U.S. Census data, to provide local information, tree benefits, and planting prioritization by designated management boundaries. This assessment involved an aerial assessment of canopy cover based on available Bing and Google satellite imagery. A next step the Town may want to consider is to ground-truth the report findings by verifying the location and health of individual trees.

west. The neighborhood is located in the southeast corner of West Springfield. Merrick's geographic boundaries comprise two census blocks, one of which (250138123003) lies entirely within Merrick's neighborhood borders. The other (250138123001) lies partially within Merrick's borders but also forms the southern portion of the Memorial neighborhood. However, that southern portion is non-residential—so when referring to Merrick's demographic makeup, the report will be referencing that of census blocks 250138123001 and 250138123003. When referring to Merrick's land cover, the report will be referring to Merrick neighborhood as defined by its cultural and geographic boundaries.

The Memorial neighborhood comprises a mixture of residential, commercial, and industrial land uses. The neighborhood is bounded by Route 5 and the Connecticut River to the east, the Westfield River to the south, the CSX railyard to the north

and River Street to the west. Like those of the Merrick neighborhood, the Memorial neighborhood's cultural and geographic boundaries to do not match the census blocks it comprises. Census block 250138123002 encompasses the western portion of Memorial's population, and a portion of Mittineague as well. The boundary between Memorial and Center in this census block is formed by the railroad tracks, to the south of which is the Memorial population.

Census block 250138123004 encompasses a portion of Center neighborhood and Memorial's eastern population. The boundary between Memorial and Center in this census block is also formed by the railroad tracks, to the south of which is the Memorial population. For this reason, when referring to Memorial's land cover, the report will refer to the Memorial neighborhood as defined by the above stated geographic boundaries. When referring to demographics, the report will refer to the two census blocks which also contain a portion of the Center and Mittineague neighborhoods.

For clarity, please refer to the **Census Block/Neighborhood Clarification** diagram on page 3.

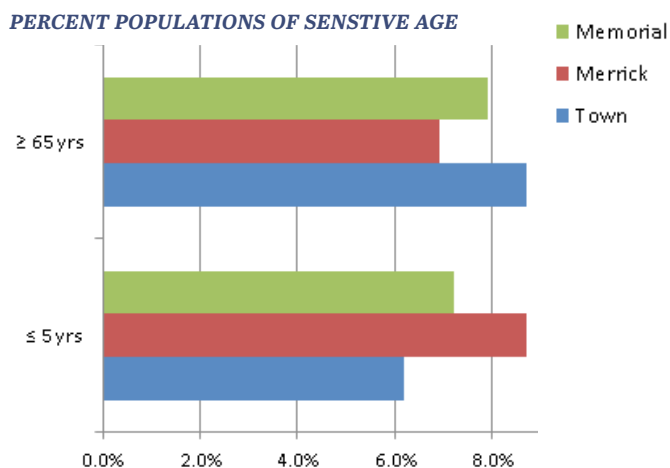
DEMOGRAPHIC CONSIDERATIONS

Because canopy cover assessments are used to prioritize new areas of plantings and form the basis of future urban forestry goal setting and strategic planning, it is important to understand the demographic makeup of the community or neighborhood under study. Historically, in any community, certain populations have enjoyed greater political representation, and therefore have had access to more community resources. Historically disenfranchised communities, such as those inhabiting Environmental Justice neighborhoods, have faced public health risks and increased vulnerability to environmental hazards that their better-situated neighbors have not. Regardless of race or wealth, age can also be a predictor of vulnerability, and some age groups are considered generally more sensitive and prone to specific health risks. Targeted canopy campaigns can help alleviate some health burdens, as described in **Next Steps and Sample Prioritization Scenarios**. For a more detailed description of West Springfield demographics, please see **Appendix B**.

Age

Understanding the age of the local resident population provides important insights when considering the impact and value of a neighborhood's canopy cover. Young children and the elderly are considered vulnerable populations in the event of hazardous environmental events, such as flooding and extreme heat, in part because both groups are generally less mobile during disasters. The elderly are more likely than the general population to experience chronic health conditions, such as diabetes. Children and some older adults, especially those with disabilities, may also need assistance with daily activities. In 2010, nearly half of people over age 65 were reported to have a disability, compared to about 17% of people aged 21–64.⁴ Young children and seniors may also be more likely than other age groups to stay at home during the day, and are therefore more exposed to the local environment around their homes. A recent study found a correlation between higher percentage of tree canopy and more positive mental health among populations age 55 and older.⁵

In West Springfield, children under the age of 5 account for 6.2% of the population while seniors 65 and older account for 8.7%.



Merrick Neighborhood

The Merrick census blocks have a total population of 3,573. Of the census block residents, 310 are under 5 (8.7%) and 247 are over 64 (6.9%), meaning that, combined, nearly 16% of the population is of an age where they are likely to be more vulnerable to heat and weather related hazards and be more sensitive to poor environmental conditions such as air pollution.

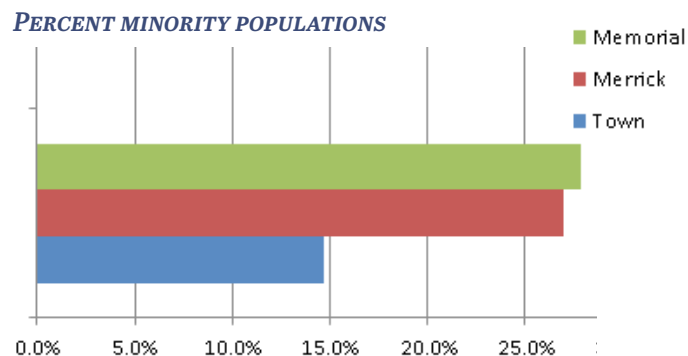
Memorial Neighborhood

With a population of 2,288, almost 15% of Memorial residents are under 5 (7.2%) or over 64 (7.9%).

Race and Ethnicity

Historically, there has been a disproportionate burden of environmental and industrial pollution and lack of regulatory enforcement in communities of color and low-income communities when compared to wealthier, white communities in the same region.⁶ That "zip code is a better determinant of health than genetic code" has been widely documented.⁷ This legacy continues to affect public health across the nation, and the US Environmental Protection Agency has designated at-risk communities as Environmental Justice populations. West Springfield, which is 14.7% minority, has EJ populations within its borders. Poor environmental health is disproportionately affecting minority and low-income populations in town as blacks and Latinos experience higher rates of chronic disease such as diabetes and asthma than their white counterparts.⁸

The Town of West Springfield is actively working to address disparate health outcomes amongst its population. As a participating partner of Massachusetts Department of Public Health's Mass in Motion initiative, West Springfield has an interdepartmental working group staffed by municipal representatives from the departments of Health, Planning, Public Works, Public Schools, Parks and Recreation, and Community Development. This Wellness Leadership Team meets regularly to advance strategies to improve access to healthy eating and active lifestyles amongst resident populations with inequitable health outcomes.



Merrick Neighborhood

Of the total population in these census blocks, 27% identify as a minority—that is over 10% more than

the town as a whole. The Merrick census blocks are designated EJ populations by minority, income, and/or English language isolation. Merrick is known to be West Springfield's primary receiving neighborhood for recent immigrants and refugees. As the EJ designation implies, many of these recent immigrant and refugee populations face English language barriers.

Such populations are important to consider when assessing canopy cover and prioritizing areas for planting because, in addition to the environmental quality concerns that come with living in an EJ area, populations with English language barriers are less able to participate in public processes, may have difficulty advocating for themselves, and be less likely to request government assistance.

Memorial Neighborhood

Of the Memorial census blocks' total population, 27.85% identify as minority. The census blocks are designated EJ by minority and/or income.

Household Median Income and Median Home Value

Similarly to communities of color, low-income communities are more likely to face environmental pollution and health risks than wealthier communities. When assessing the value and services provided by urban forest canopy, it is essential to understand local socio-economic conditions.

The median household income in West Springfield is \$50,649 and the median household value in West Springfield in 2018 is approximately \$218,000.⁹ Median home value is an indicator of socioeconomic status that focuses on wealth rather than income.¹⁰

Homeownership status also affects household wealth as renters, as a rule, have little to no equity built up in their homes, indicating less household wealth overall. Forty percent of households rent in West Springfield.

Merrick Neighborhood

Residents of Merrick census block 250138123003 are generally lower income and have lower overall wealth than residents of West Springfield as a whole. The estimated median household income in the Merrick census block 250138123003 is \$20,066, less than half of the city-wide median household income. The

median home value in the census block is estimated at \$116,500, or about half that of the city-wide median home value.¹¹

A household in the Merrick census block 250138123001 generally has higher income and more wealth than a household in the Merrick census block 250138123003. The median household income in this Merrick census block is \$48,828. At \$158,500, the median home value of this Merrick census block is approximately 27% less than the median city-wide value.

The majority of residents within the Merrick census block 250138123003 are renters (567 out of 877 total units are rented), and therefore do not have equity built up into their homes. Renters generally have much less control over their property improvements than homeowners, and are less able to control the quality and quantity of tree specimens on their properties. Two-hundred-and-eighty household units, over half of the 410 total household units in the Merrick census block 250138123001, are rented.

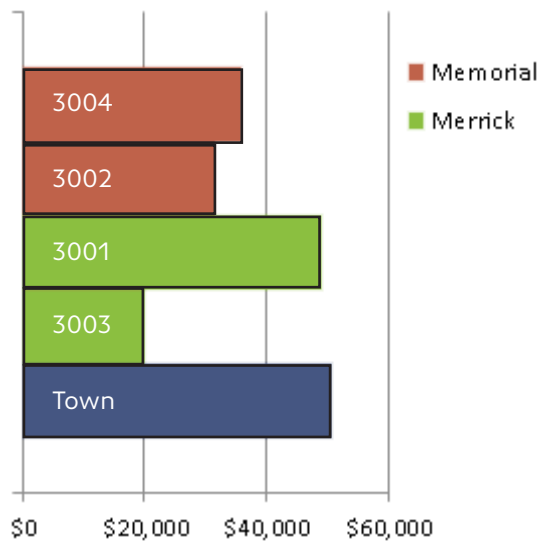
Memorial Neighborhood

Households in the Memorial census blocks generally have lower income than households in West Springfield as a whole. Households in Memorial census block 250138123002 have an annual median income of \$31,626, while those in Memorial census block 250138123004 earn a median income of \$35,809.

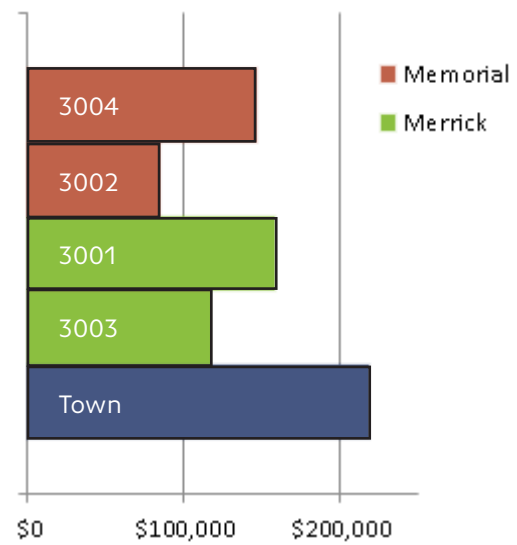
At \$84,500, the median home value of the Memorial census block 250138123002 is approximately 61% less than the citywide median value. Census block 250138123004 has a median home value of \$123,300, about 43% less than citywide.

Of the 760 household units in this census block, 439 units, over half, are rented. The median home value of the Memorial census block 250138123004 is \$146,900, or about 33% less than the city-wide median value. Of 359 total homes, 215 are rented—nearly 60%.

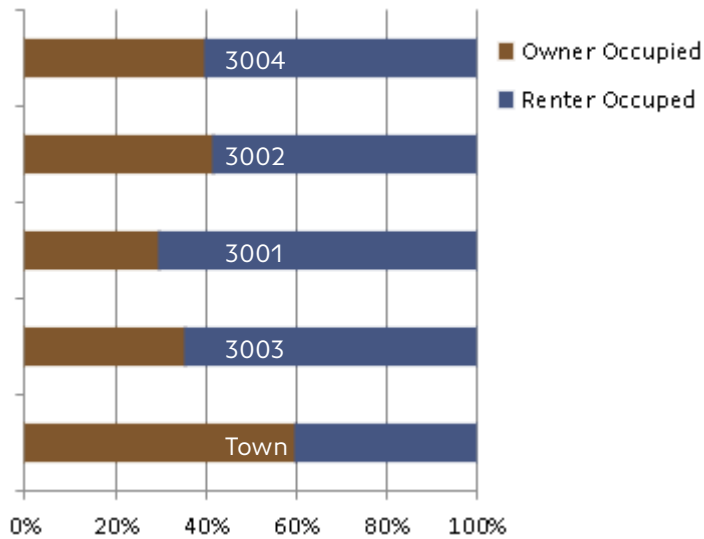
MEDIAN ANNUAL HOUSEHOLD INCOME



MEDIAN HOME VALUES



PERCENT HOMEOWNERSHIP



CANOPY COVER ASSESSMENTS

West Springfield Townwide

Canopy and Impervious Cover Analysis

The Town of West Springfield covers 16.8 square miles of land, of which approximately 3.24 square miles is impervious cover (~19.5%) and 8.8 square miles is canopy cover (~50.2%). The large amount of canopy cover is in part due to the West Springfield's several large-scale natural areas, including the heavily forested Bear Hole watershed area, Mittineague Park, and preserved flood plain forested buffers located along the Connecticut and Westfield Rivers.

As depicted in the visualization to the right, the Riverdale, Merrick, and Memorial neighborhoods are relatively bereft of canopy while most of the rest of the city experiences moderate to dense canopy cover. For the full i-Tree Canopy analysis of land cover in West Springfield as a whole, see **Appendix A**.

Economic Valuation of Existing Canopy Cover

The existing 8.8 square miles of tree canopy cover in West Springfield provides approximately \$2,226,280.49 in annual public health benefits. As enumerated in the chart to the right, this number does not include the total value of carbon dioxide stored in the neighborhood's trees. Trees' ability to store carbon dioxide is not only useful from a public health perspective (represented in the value of carbon dioxide sequestered annually in trees) but it also highly valuable in the effort to mitigate the effects of climate change.

Key Considerations for Public Health

Carbon monoxide, nitrogen dioxide, and sulfur dioxide are air pollutants formed via the combustion of fossil fuels, such as petroleum gas in cars and trucks. These gases can cause inflammation and irritation of the respiratory system, and are of especial concern for residents with asthma or other chronic respiratory conditions.

Likewise, particulate matter (both smaller than 2.5 microns and smaller than 10 microns but larger than 2.5 microns) is a respiratory irritant. Most particulate matter forms in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides. Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires.¹²

Ground level ozone is created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NO_x and volatile organic compounds. Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma. Ground level ozone can also have harmful effects on sensitive vegetation and ecosystems.

Map of the Springfield, Massachusetts area showing tree canopy coverage. The map uses a color scale from green (0-100% canopy) to red (0-100% canopy). Major roads like I-90, I-75, and I-495 are shown. The Connecticut River and Western River are also labeled. Key locations include Springfield, West Springfield, Chicopee, and Robinson. The map shows a high concentration of tree canopy in the western and northern parts of the region, with lower coverage in the eastern and southern parts.

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$1,209.42	±60.17	1,820.32 lb	±90.56
NO2	Nitrogen Dioxide removed annually	\$8,117.90	±403.87	19.25 T	±0.96
O3	Ozone removed annually	\$360,604.21	±17,940.28	118.72 T	±5.91
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$887,822.43	±44,169.72	6.39 T	±0.32
SO2	Sulfur Dioxide removed annually	\$838.50	±41.72	6.24 T	±0.31
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$140,584.79	±6,994.18	22.51 T	±1.12
CO2seq	Carbon Dioxide sequestered annually in trees	\$827,103.24	±41,148.90	23,460.34 T	±1,167.17
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$25,041,039.36	±1,245,807.28	710,275.77 T	±35,336.66

Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

The Merrick Neighborhood

Canopy and Impervious Cover Analysis

The Merrick neighborhood covers approximately 0.25 square mile, of which approximately 0.03 square mile (~13.7%) is canopy cover, and 0.15 square mile (~59.33%) is impervious surface of any kind. For the full i-Tree Canopy analysis of land cover in the Merrick neighborhood, see **Appendix A**.

Economic Valuation of Existing Canopy Cover

The existing 0.03 square miles of tree canopy cover in the Merrick neighborhood provides approximately \$8,533.83 in annual public health benefits. As enumerated in the chart on the next page, this number does not include the total value of carbon dioxide stored in the neighborhood's trees.

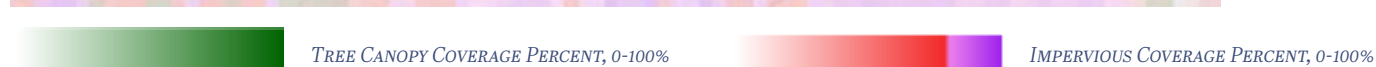
Key Considerations for Public Health

As discussed on page 8, breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma. Essential Power Energy Massachusetts LLC and Fountain Plating Co, Inc, which both have Title V Operating Permits for air quality, are located 1000' and 500' from Environment Justice by minority residential areas in the Merrick neighborhood, respectively.¹³

In the Merrick census block, approximately one-quarter of residents identify as minority. Latinos in West Springfield are hospitalized for asthma at 5 times the rate of whites, and black residents at 3.8 times the rate of whites.¹⁴ Further, recent focus group results show that some Bhutanese refugees perceive the Merrick neighborhood to have poor air quality and this prevents them being active outdoors.¹⁵

In a neighborhood with such a high percentage of minority residents, and in such close proximity to industrial plants, the air pollutant removal capacities of canopy cover might be of high importance.

MERRICK NEIGHBORHOOD TREE CANOPY AND IMPERVIOUS COVER



i-TREE CANOPY VALUATION OF CANOPY COVER IN THE MERRICK NEIGHBORHOOD

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$4.64	±0.67	6.98 lb	±1.01
NO2	Nitrogen Dioxide removed annually	\$31.12	±4.52	147.58 lb	±21.42
O3	Ozone removed annually	\$1,382.28	±200.58	910.18 lb	±132.08
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$3,403.22	±493.84	49.02 lb	±7.11
SO2	Sulfur Dioxide removed annually	\$3.21	±0.47	47.86 lb	±6.95
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$538.89	±78.20	172.55 lb	±25.04
CO2seq	Carbon Dioxide sequestered annually in trees	\$3,170.47	±460.07	89.93 T	±13.05
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$95,987.91	±13,928.81	2,722.65 T	±395.08

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and \$/T/yr: CO 0.322 @ \$1,333.50 | NO2 6.814 @ \$423.19 | O3 42.021 @ \$3,048.13 | PM2.5 2.263 @ \$139,349.44 | SO2 2.210 @ \$134.78 | PM10* 7.966 @ \$6,268.44 | CO2seq 8,303.566 @ \$35.38 | CO2stor is a total biomass amount of 251,395.359 @ \$35.38

Note: Currency is in USD

Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

The Memorial Neighborhood

A portion of the Memorial neighborhood comprises industrial use and the Big E fairgrounds. Because that section of the neighborhood is geographically large but is home to few, if any, residential units, the report assesses the canopy cover in the area north of Memorial Avenue only so as not skew canopy per capita results.

The selected portion of the neighborhood covers approximately 0.28 square mile, of which approximately 0.04 square mile (~14.3%) is canopy cover, and 0.18 square mile (~64 %) is impervious surface of any kind. For the full i-Tree Canopy analysis of land cover in the Memorial neighborhood, see **Appendix A**.

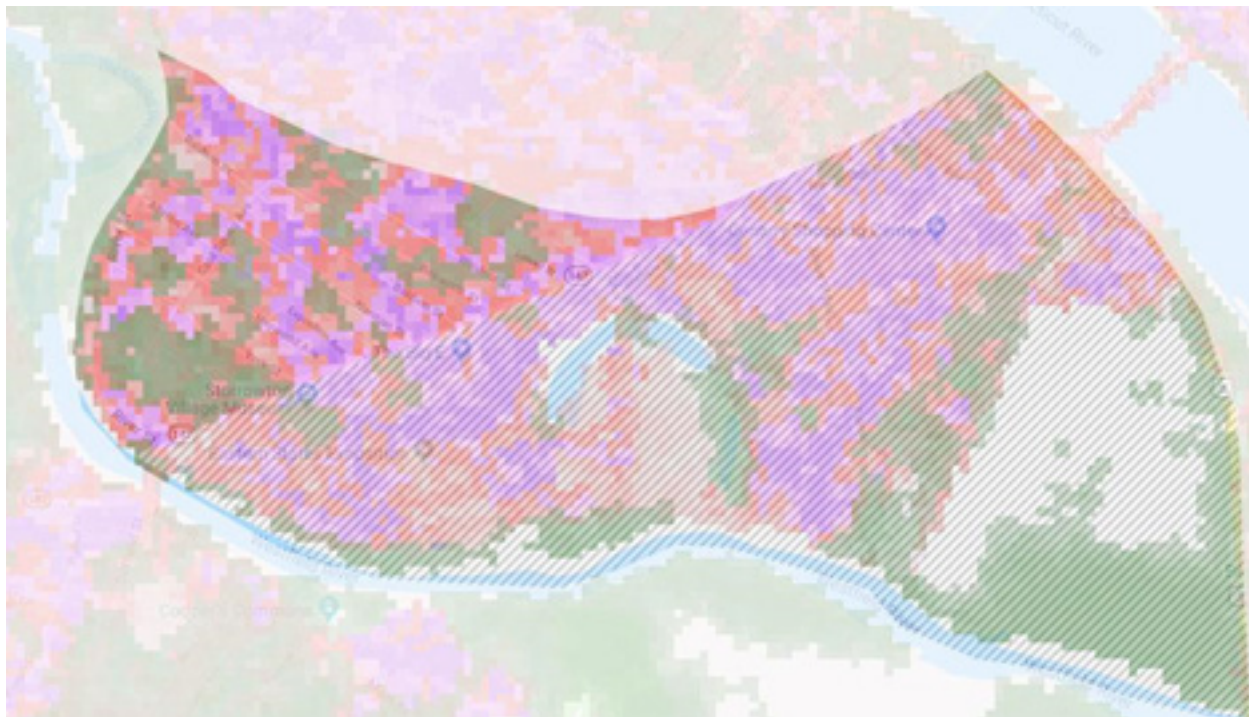
Economic Valuation of Existing Canopy Cover

The existing 0.04 square mile of tree canopy cover in the Memorial neighborhood provides approximately \$9,907.50 in annual public health benefits.

Key Considerations for Public Health

In the Memorial census blocks, about one-third of residents identify as minority. Latinos in West Springfield are hospitalized for asthma at 5 times the rate of whites, and black residents at 3.8 times the rate of whites. In a neighborhood with such a high percentage of minority residents, and in such close proximity to Essential Power Energy Massachusetts LLC and Fountain Plating Co., the air pollutant removal capacities of canopy cover might be of high importance.

MEMORIAL NEIGHBORHOOD TREE CANOPY AND IMPERVIOUS COVER



i-TREE CANOPY VALUATION OF CANOPY COVER IN THE MERRICK NEIGHBORHOOD

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$5.38	±0.75	8.10 lb	±1.13
NO2	Nitrogen Dioxide removed annually	\$36.13	±5.04	171.34 lb	±23.91
O3	Ozone removed annually	\$1,604.78	±223.98	1,056.69 lb	±147.48
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$3,951.03	±551.45	56.91 lb	±7.94
SO2	Sulfur Dioxide removed annually	\$3.73	±0.52	55.57 lb	±7.76
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$625.64	±87.32	200.32 lb	±27.96
CO2seq	Carbon Dioxide sequestered annually in trees	\$3,680.81	±513.74	104.40 T	±14.57
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$111,438.70	±15,553.79	3,160.90 T	±441.18

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and \$/T/yr: CO 0.322 @ \$1,333.50 | NO2 6.814 @ \$423.19 | O3 42.021 @ \$3,048.13 | PM2.5 2.263 @ \$139,349.44 | SO2 2.210 @ \$134.78 | PM10* 7.966 @ \$6,268.44 | CO2seq 8,303.566 @ \$35.38 | CO2stor is a total biomass amount of 251,395.359 @ \$35.38

Note: Currency is in USD

Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

NEXT STEPS AND SAMPLE PRIORITIZATION SCENARIOS

How to Set Canopy Cover Goals

The purpose of this report is to detail existing conditions; the report does not set canopy goals or targets for the Merrick and Memorial neighborhoods. It is up to the Town to prioritize the specific canopy cover benefits it would like to maintain, protect, or enhance in specific areas.

In setting canopy cover goals, it is important that they are both attainable and sustainable. Canopy cover goals for specific areas must be compatible with existing and/or future land uses, and must be developed in conjunction with a program to sustain new trees of over their lifetime.

American Forests, a recognized leader in conservation and urban forest management, states "Targets ...should consider constraints to creating canopy such as:

- Development densities (i.e., dense development patterns with more impervious surfaces have less opportunity for cover);
- Land use patterns (i.e., residential areas may have more opportunity for canopy than commercial areas, but canopy cover tends to be less in residential areas of disadvantaged communities versus wealthy ones);
- Ordinances (i.e., parking lot shade ordinances promote cover over some impervious areas); and
- Climate (i.e., canopy cover in desert cities is often less than tropical cities)."¹⁶

Informed by those constraints, canopy targets should be shaped to achieve specific objectives, such as reaching the canopy percentage necessary to reduce urban heat island temperatures to a specific range, or to reduce stormwater runoff by a projected amount. According to a national analysis by U.S. Forest Service researchers David and Eric Greenfield, a 40-60 percent urban tree canopy is obtainable under ideal conditions in forested states.¹⁷

Canopy cover targets or goals should be shaped by robust stakeholder engagement with municipal boards, commissions, and professionals (Department

of Public Works, Planning, Conservation Commission, Tree Warden, Tree Committee, Parks and Recreation, etc.), as well as with neighborhood committees and local businesses and residents.

Various powerful and free tools exist to aid a community in setting canopy cover targets. Vibrant Cities Lab provides the Urban Forestry Toolkit (<http://www.vibrantcitieslab.com/toolkit>), which provides guidance on canopy cover assessment, prioritization, organization and outreach, creating urban tree plans, and building and maintenance plans.

i-Tree Landscape (<https://landscape.itreetools.org/>) is a powerful visualization tool that allows the user to establish prioritization scenarios based on census data and existing canopy and impervious cover. The web-based software is available to use by professional and laypeople alike, and while it doesn't project an ideal canopy cover target for specific goals, it will allow the user to compare two or more locations to visualize which area will benefit more from increase canopy cover for any default or custom scenario. Below are examples of several default scenarios as provided by the website.

Sample Prioritization Scenarios

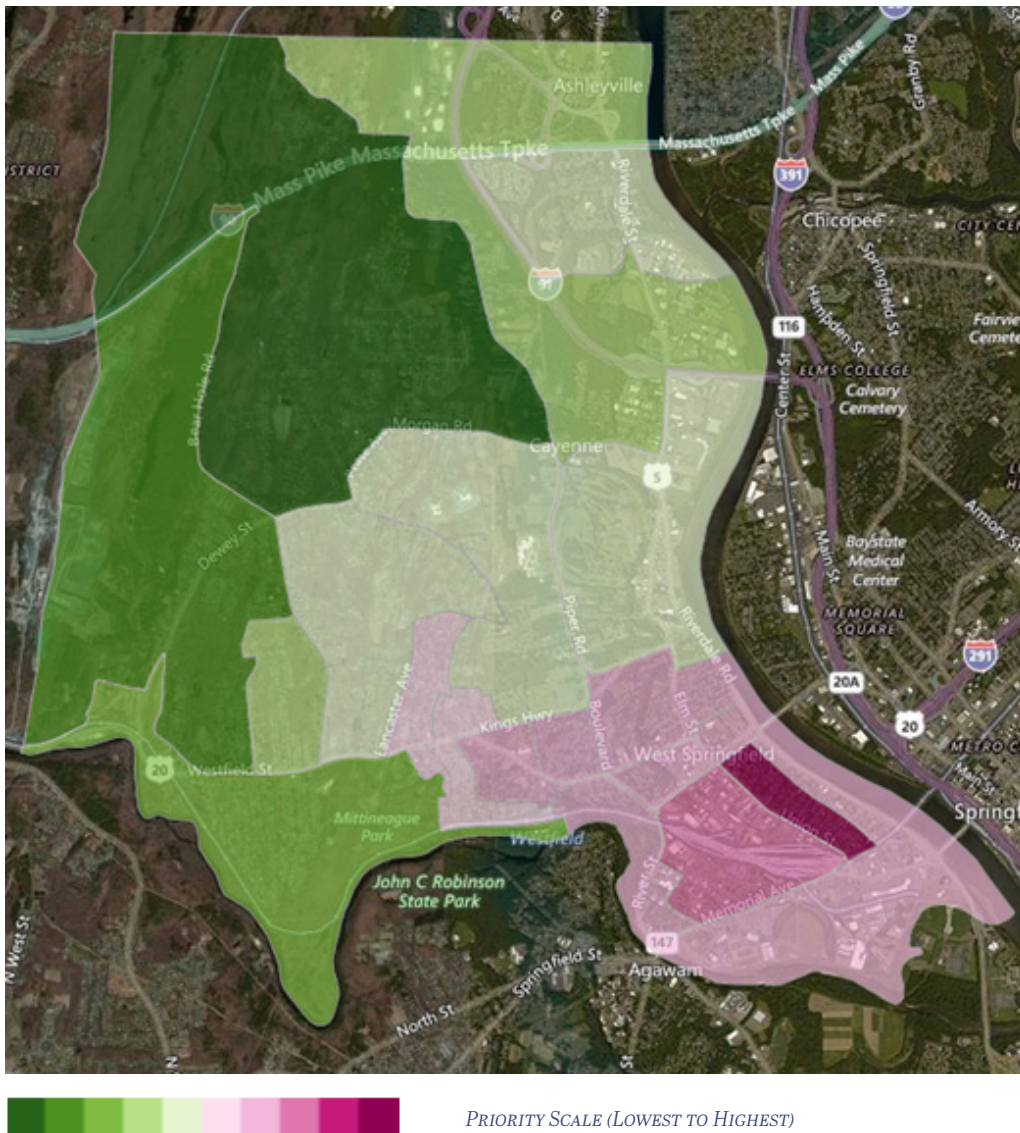
The following canopy cover prioritization scenarios were generated via i-Tree Landscape's Common (default) Scenarios component. Using town's boundaries as the area limit, each Common Scenario is weighted to prioritize specific census blocks within the town based on enhancing specific canopy benefits.

Sample Prioritization Scenario 1: Population Density

Scenario 1: Population Density is an index weighted towards areas of relatively high population density, low tree cover per capita, and high available planting space. Specifically, the scenario is weighted toward areas affected by the following factors: Low Tree Stocking Level (30%), Low Tree Cover Per Capita (30%), and High Population Density (40%).

This scenario identifies the western-most Merrick census block as the highest priority block to increase canopy cover, followed by the adjacent Memorial census block. The surrounding blocks, all forming the southeastern tip of the town, are all relatively high priority in comparison to the rest of the town.

SAMPLE PRIORITIZATION SCENARIO 1: POPULATION DENSITY

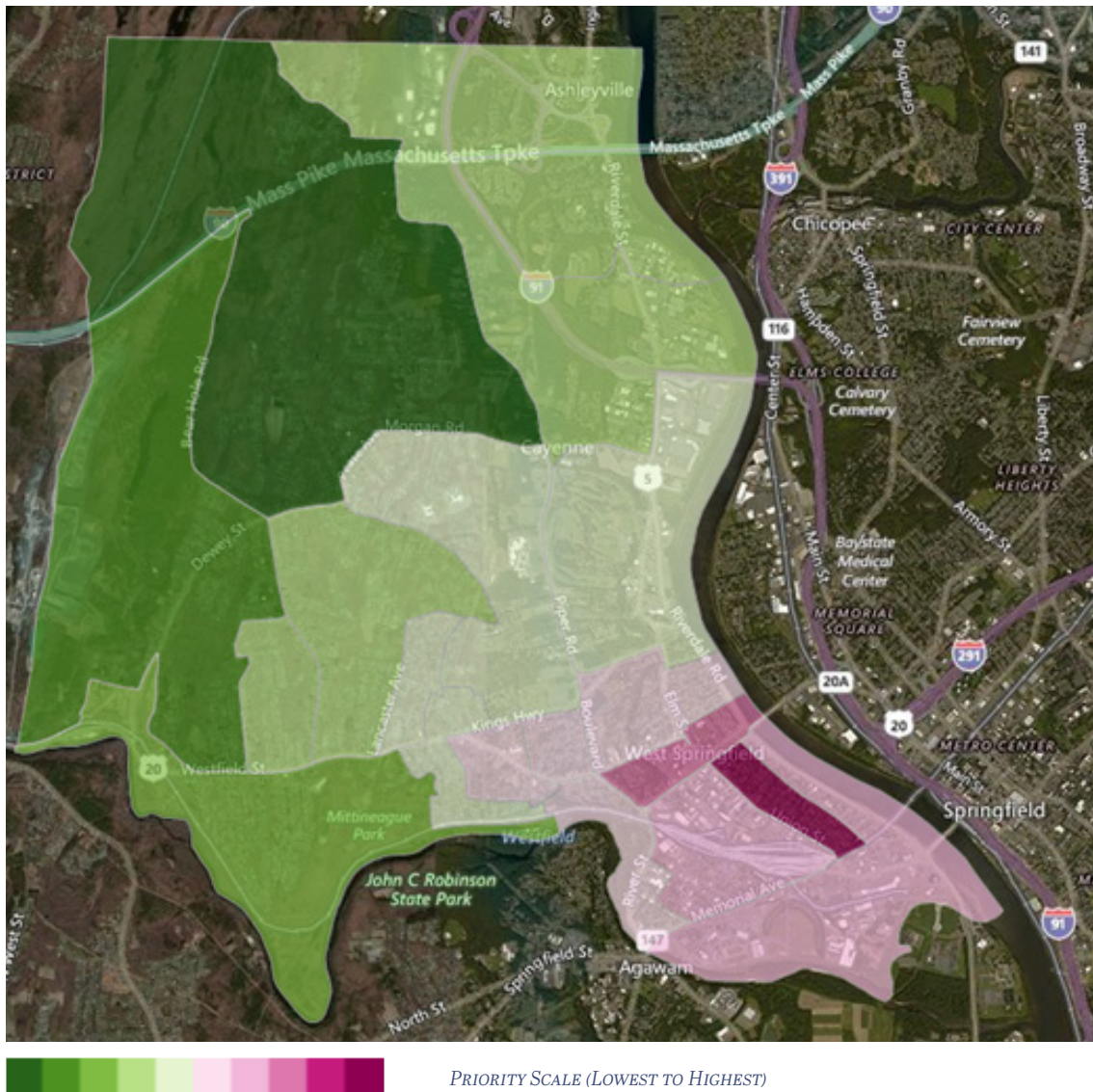


Sample Prioritization Scenario 2: Minority Population

Scenario 2: Minority Population is an index weighted towards areas of relatively high minority population density, low tree cover per capita, and high available planting space. Specifically, the scenario is weighted toward areas affected by the following factors: Low Tree Stocking Level (30%), Low Tree Cover Per Capita (30%), and High Minority Population Density (40%).

In this second scenario, the western-most Merrick census block is again identified as the highest priority area for increasing canopy cover. All of the Merrick and Memorial census blocks are high on the priority list as well, with a census block in the downtown core identified as second-highest.

SAMPLE PRIORITIZATION SCENARIO 2: MINORITY POPULATION



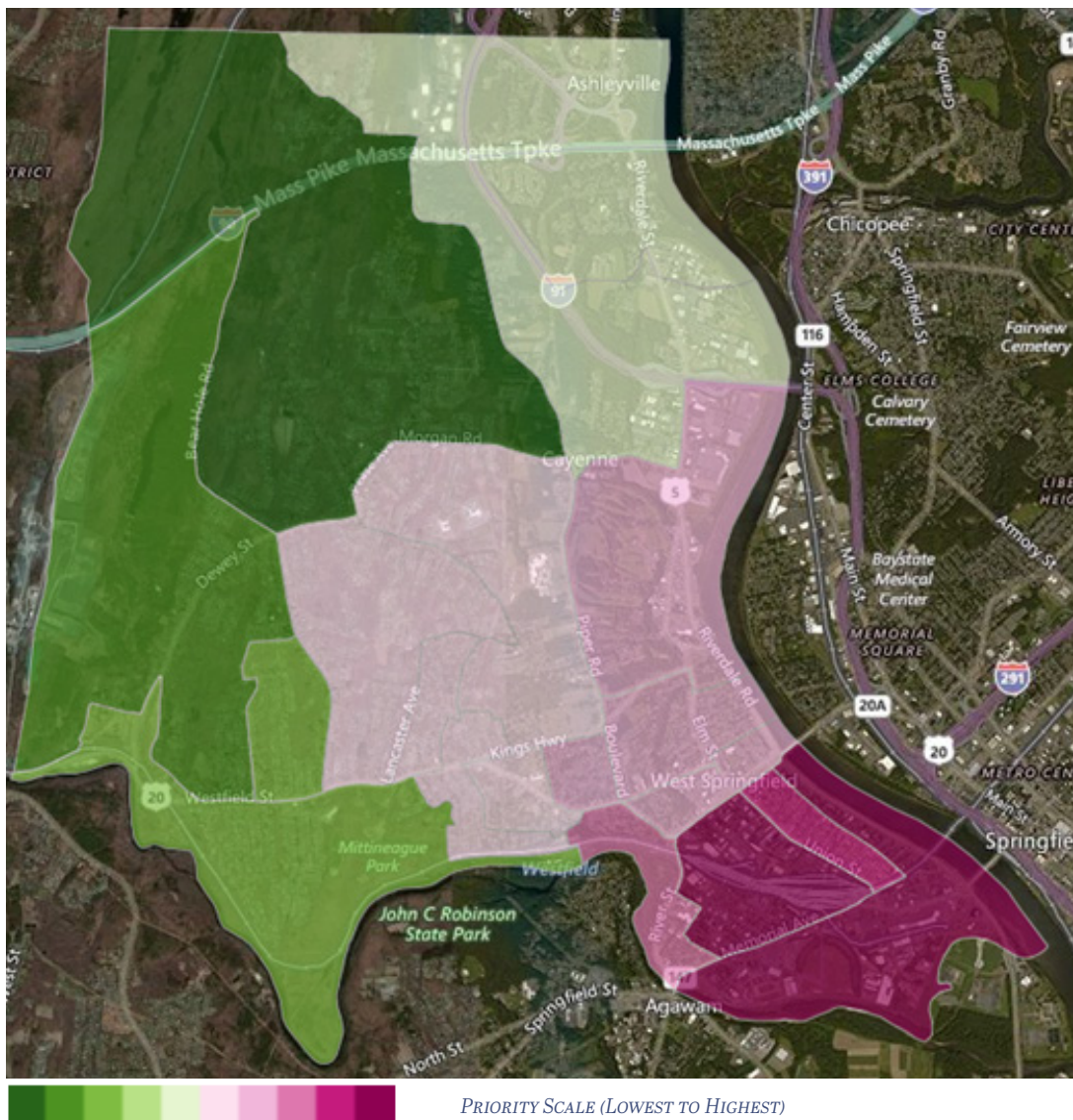
Sample Prioritization Scenario 3: Population Below Poverty Line

Scenario #3: Population Below Poverty Line is an index weighted towards areas of relatively high density of population below the poverty line, low tree cover per capita, and high available planting space. Specifically, the scenario is weighted toward areas affected by the following factors: Low Tree Stocking Level (30%), Low Tree Cover Per Capita (30%), and High Population Below Poverty Line Density (40%).

In this scenario, the eastern-most Merrick and Memorial census blocks have highest priority for increasing tree canopy, while the western-most Merrick census block has second priority. Confirming a theme from the previous two scenarios, the

southeastern tip of the town would benefit the most from tree planting.

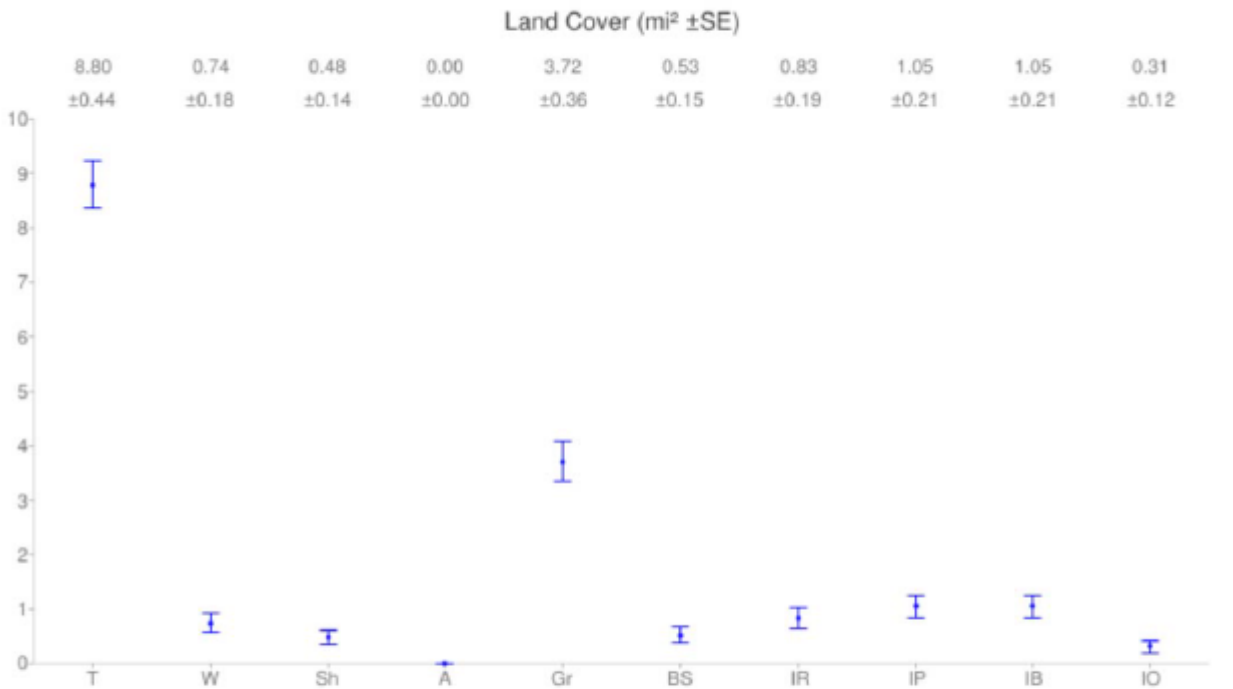
SAMPLE PRIORITIZATION SCENARIO 3: POPULATION BELOW POVERTY LINE



APPENDIX A: I-TREE CANOPY ASSESSMENTS

Town-wide i-Tree Canopy Assessment

i-Tree Canopy^{v6.1}
Cover Assessment and Tree Benefits Report
Estimated using random sampling statistics on 8/20/18



Cover Class	Description	Abbr.	Points	Land Cover
Tree	Tree, non-shrub	T	201	8.80 ±0.44
Water	water, incl. rivers, lakes, ponds, etc. Does not incl. pools.	W	17	0.74 ±0.18
Shrub	shrubs, other herbaceous	Sh	11	0.48 ±0.14
Agriculture	commercial agriculture	A	0	0.00 ±0.00
Grass	grass	Gr	85	3.72 ±0.36
Bare soil	bare soil, exposed earth	BS	12	0.53 ±0.15
Impervious - Roads	roadways	IR	19	0.83 ±0.19
Impervious - Parking	Parking, incl. driveways, parking lots, and industrial paved areas	IP	24	1.05 ±0.21
Impervious - Buildings	buildings	IB	24	1.05 ±0.21
Impervious - Other	All other impervious, incl. sidewalks	IO	7	0.31 ±0.12

Town-wide i-Tree Canopy Valuation

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$1,209.42	±60.17	1,820.32 lb	±90.56
NO2	Nitrogen Dioxide removed annually	\$8,117.90	±403.87	19.25 T	±0.96
O3	Ozone removed annually	\$360,604.21	±17,940.28	118.72 T	±5.91
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$887,822.43	±44,169.72	6.39 T	±0.32
SO2	Sulfur Dioxide removed annually	\$838.50	±41.72	6.24 T	±0.31
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$140,584.79	±6,994.18	22.51 T	±1.12
CO2seq	Carbon Dioxide sequestered annually in trees	\$827,103.24	±41,148.90	23,460.34 T	±1,167.17
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$25,041,039.36	±1,245,807.28	710,275.77 T	±35,336.66

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and \$/T/yr: CO 0.322 @ \$1,333.50 | NO2 6.814 @ \$423.19 | O3 42.021 @ \$3,048.13 | PM2.5 2.263 @ \$139,349.44 | SO2 2.210 @ \$134.78 | PM10 7.966 @ \$6,268.44 | CO2seq 8,303.566 @ \$35.38 | CO2stor is a total biomass amount of 251,395.359 @ \$35.38*

Note: Currency is in USD

Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

About i-Tree Canopy

The concept and prototype of this program were developed by David J. Nowak, Jeffery T. Walton and Eric J. Greenfield (USDA Forest Service). The current version of this program was developed and adapted to i-Tree by David Ellingsworth, Mike Binkley, and Scott Maco (The Davey Tree Expert Company).

Limitations of i-Tree Canopy

The accuracy of the analysis depends upon the ability of the user to correctly classify each point into its correct class. As the number of points increase, the precision of the estimate will increase as the standard error of the estimate will decrease. If too few points are classified, the standard error will be too high to have any real certainty of the estimate.

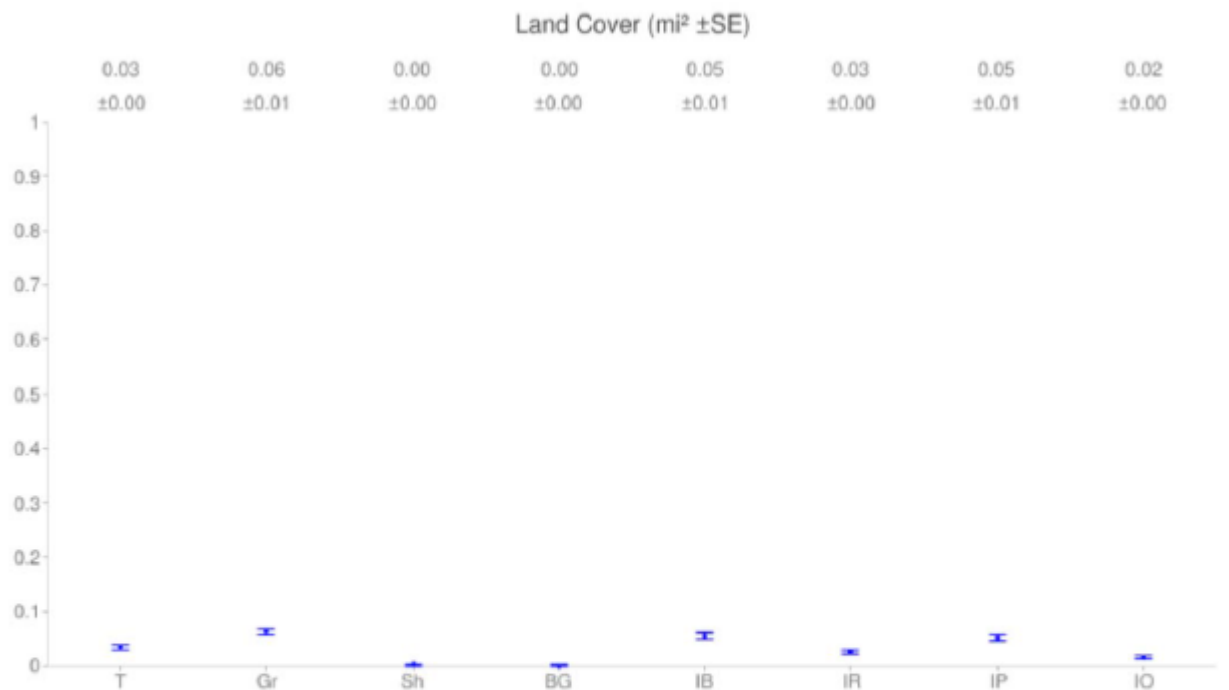
A Cooperative Initiative Between:



www.itreetools.org

Merrick Neighborhood i-Tree Canopy Assessment

i-Tree Canopy_{v8.1} Cover Assessment and Tree Benefits Report *Estimated using random sampling statistics on 8/09/18*



Cover Class	Description	Abbr.	Points	Land Cover
Tree	Tree, non-shrub	T	41	0.03 ±0.00
Grass	grass	Gr	76	0.06 ±0.01
Shrub	shrub / herbaceous	Sh	3	0.00 ±0.00
Bare Ground	Soil or other	BG	2	0.00 ±0.00
Impervious - Buildings	building cover	IB	66	0.05 ±0.01
Impervious - Roads	roadways	IR	31	0.03 ±0.00
Impervious - Parking	Driveways, parking lots, and industrial parking	IP	62	0.05 ±0.01
Impervious - Other	other impervious	IO	19	0.02 ±0.00

Merrick Neighborhood i-Tree Canopy Valuation

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$4.64	±0.67	6.98 lb	±1.01
NO2	Nitrogen Dioxide removed annually	\$31.12	±4.52	147.58 lb	±21.42
O3	Ozone removed annually	\$1,382.28	±200.58	910.18 lb	±132.08
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$3,403.22	±493.84	49.02 lb	±7.11
SO2	Sulfur Dioxide removed annually	\$3.21	±0.47	47.86 lb	±6.95
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$538.89	±78.20	172.55 lb	±25.04
CO2seq	Carbon Dioxide sequestered annually in trees	\$3,170.47	±460.07	89.93 T	±13.05
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$95,987.91	±13,928.81	2,722.65 T	±395.08

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and \$/T/yr: CO 0.322 @ \$1,333.50 | NO2 6.814 @ \$423.19 | O3 42.021 @ \$3,048.13 | PM2.5 2.263 @ \$139,349.44 | SO2 2.210 @ \$134.78 | PM10 7.966 @ \$6,268.44 | CO2seq 8,303.566 @ \$35.38 | CO2stor is a total biomass amount of 251,395.359 @ \$35.38*

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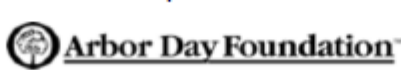
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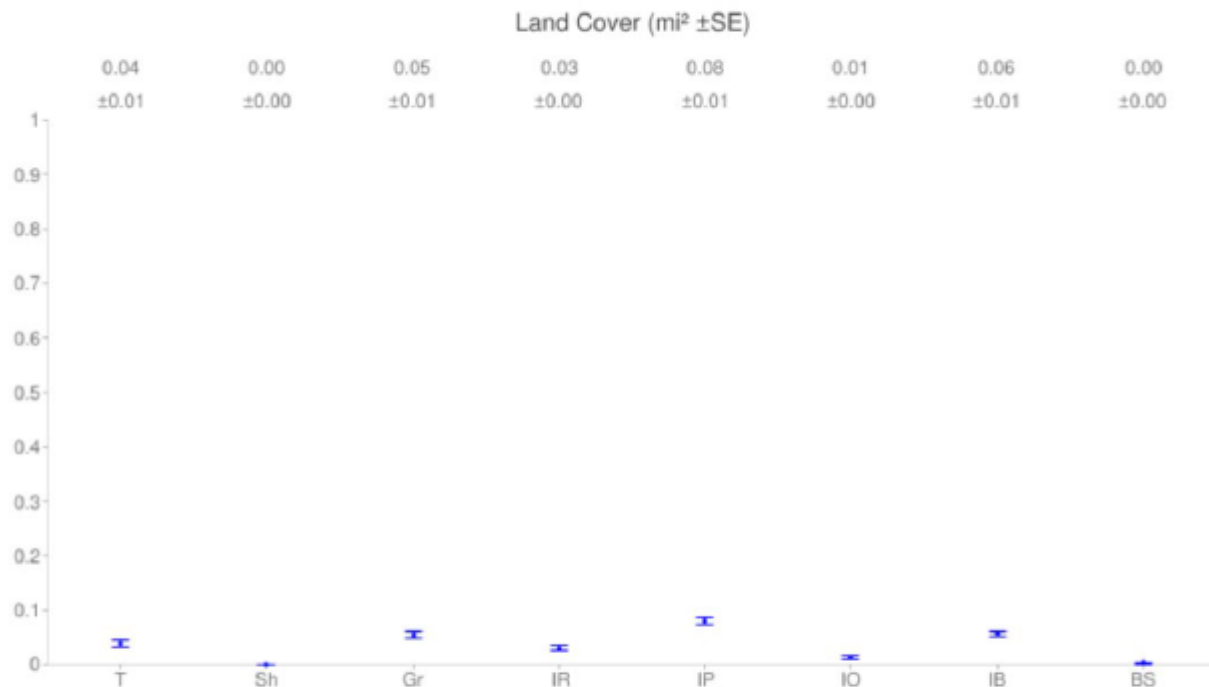
A Cooperative Initiative Between:



www.itreetools.org

Memorial Neighborhood i-Tree Canopy Assessment

i-Tree Canopy^{v6.1} Cover Assessment and Tree Benefits Report *Estimated using random sampling statistics on 8/10/18*



Cover Class	Description	Abbr.	Points	Land Cover
Tree	Tree, non-shrub	T	44	0.04 ±0.01
Shrub	Shrub, herbaceous	Sh	0	0.00 ±0.00
Grass	grass	Gr	60	0.05 ±0.01
Impervious - Roads	roadways	IR	34	0.03 ±0.00
Impervious - Parking	Driveways, parking lots, and industrial parking	IP	90	0.08 ±0.01
Impervious - Other	all other impervious, incl. sidewalks	IO	15	0.01 ±0.00
Impervious- Buildings	buildings	IB	63	0.06 ±0.01
Bare soil	soil	BS	2	0.00 ±0.00

Memorial Neighborhood i-Tree Canopy Valuation

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$5.38	±0.75	8.10 lb	±1.13
NO2	Nitrogen Dioxide removed annually	\$36.13	±5.04	171.34 lb	±23.91
O3	Ozone removed annually	\$1,604.78	±223.98	1,056.69 lb	±147.48
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$3,951.03	±551.45	56.91 lb	±7.94
SO2	Sulfur Dioxide removed annually	\$3.73	±0.52	55.57 lb	±7.76
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$625.64	±87.32	200.32 lb	±27.96
CO2seq	Carbon Dioxide sequestered annually in trees	\$3,680.81	±513.74	104.40 T	±14.57
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$111,438.70	±15,553.79	3,160.90 T	±441.18

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and \$/T/yr: CO 0.322 @ \$1,333.50 | NO2 6.814 @ \$423.19 | O3 42.021 @ \$3,048.13 | PM2.5 2.263 @ \$139,349.44 | SO2 2.210 @ \$134.78 | PM10 7.966 @ \$6,268.44 | CO2seq 8,303.566 @ \$35.38 | CO2stor is a total biomass amount of 251,395.359 @ \$35.38*

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APPENDIX B: TOWN-WIDE DEMOGRAPHIC CONTEXT

Age

As shown in the table below, West Springfield has an aging population and is projected to continue to age over the coming years. This trend is common across the region and state as the Baby Boomer and Millennial generations, two very large age cohorts, continue to age. In 2010, the US Census reported that West Springfield residents aged 65 and older accounted for 15% of the city's total population, and the 2022 projections from Experian Inc. demonstrate that seniors 65 and older may soon account for 19%.

AGE OF WEST SPRINGFIELD POPULATION AND CHANGES IN AGE COHORTS

	2000 Census		2010 Census		2012-2016 ACS		2022 Projections		2000-2010	2017-2022
0 to 4	1,657	5.9%	1,675	5.9%	1,771	6.2%	1,707	6.0%	1.1%	-3.6%
5 to 14	3,617	12.9%	3,209	11.3%	3,200	11.2%	3,027	10.7%	-11.3%	-5.4%
15 to 19	1,730	6.2%	1,787	6.3%	1,971	6.9%	1,429	5.0%	3.3%	-27.5%
20 to 24	1,725	6.2%	1,905	6.7%	2,028	7.1%	1,743	6.2%	10.4%	-14.1%
25 to 34	3,743	13.4%	3,772	13.3%	3,914	13.7%	4,288	15.1%	0.8%	9.6%
35 to 44	4,484	16.0%	3,588	12.6%	3,400	11.9%	3,298	11.6%	-20.0%	-3.0%
45 to 54	3,919	14.0%	4,435	15.6%	3,743	13.1%	3,471	12.3%	13.2%	-7.3%
55 to 64	2,559	9.2%	3,736	13.2%	4,171	14.6%	3,935	13.9%	46.0%	-5.7%
65 to 74	2,246	8.0%	2,077	7.3%	2,486	8.7%	3,048	10.8%	-7.5%	22.6%
75 to 84	1,734	6.2%	1,518	5.3%	1,143	4.0%	1,654	5.8%	-12.5%	44.7%
85+	524	1.9%	689	2.4%	771	2.7%	726	2.6%	31.5%	-5.8%
Median Age:										
	38.6		40.5		39.1		40.8		5%	4%

SOURCE: US CENSUS BUREAU 2000 CENSUS, 2010 CENSUS, 2012-2016 ACS AND EXPERIAN INC. PROJECTIONS

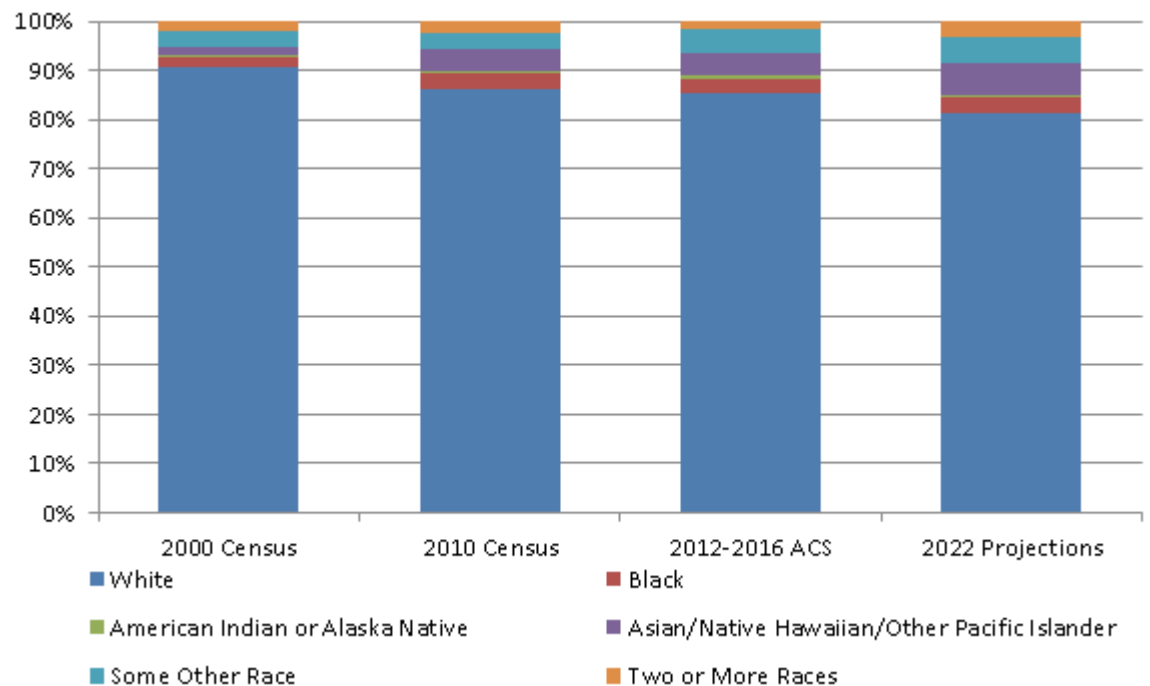
Race & Ethnicity

The Town of West Springfield is primarily white (85.3% of the population); however the Town continues to slowly diversify as West Springfield has seen its non-white racial groups remain steady or grow since the 2000 Census. The number of individuals identifying as Black grew by 41.3% between 2000 and 2017; American Indian or Alaska Natives growing by 334% (this could be an anomaly in the data); and Asian, Native Hawaiians, and Other Pacific Islanders growing by 171%. The Town has also continued to see a growth in populations with Hispanic ethnicities. There were 2,924 Hispanic people in West Springfield in 2017—a 43.1% increase since the 2000 Census.¹⁸

that these numbers reflect only the populations that have come to West Springfield through a refugee program. They do not capture the community members that may have come to West Springfield because other family members had relocated there.

According to the 2012-2016 American Community Survey, approximately 15% of West Springfield's population is foreign born. Of these 4,417 individuals, 1,792 were born in European countries, 1,856 in Asian countries, 300 in African countries, 302 in Latin American countries, and 167 in North American countries.

WEST SPRINGFIELD BY RACE OVER TIME



SOURCE: US CENSUS BUREAU 2000 CENSUS, 2010 CENSUS, 2012-2016 ACS AND EXPERIAN INC. PROJECTIONS

Additionally, according to data from the US Department of State, West Springfield welcomed 2,356 refugees—19% of the total refugees entering the state—between 2010 and 2017. Only the cities of Worcester and Boston saw greater numbers of refugees join their communities. The refugees in West Springfield have predominantly come from Asia (Bhutan-769, Burma-194), the Middle East (Iraq- 492, Syria- 38 individuals, Iran- 4), the countries that make up the former Soviet Union (Ukraine-195, Moldova-187, Belarus-23, Kazakhstan-35, Kyrgyzstand-29, and Russia-27) and Somalia (242). It is important to note

Household Median Income

The Town of West Springfield has seen the average household income in town increase by 38% between 2000 and 2016 from \$48,826 to \$67,691. The town has also seen the number of extremely low to low-income households in town decline over this same time period. This decline can be caused by households gaining higher paying jobs or leaving town. Because the town hasn't seen substantial gains in households earning more of a moderate to middle income wage, it may be that these household haven't stayed in West Springfield and have instead moved to other towns for more affordable housing or job opportunities.¹⁹

Examining housing costs as a percentage of a household's income gives us an idea of the portion of households in West Springfield that are likely to be cost burdened (defined as those spending more than 30% of their income on housing costs) or extremely cost burdened (defined as those spending more than 50% of their income on housing costs). Approximately 34% of all households (4,160 households) in West Springfield are cost burdened or severely cost burdened. When looking at rental households, 1,210 households in West Springfield are cost burdened and 948 households are severely cost burdened; this means that almost 43% of all rental households are paying more than 30% of their income on housing costs, leaving fewer resources for medicine, groceries, and recreation. Hispanic and black households appear to experience significantly higher rates of severe housing cost burden than white households.²⁰

HOUSEHOLD INCOME OVER TIME

	2000 Census	2010 Census	2012- 2016 ACS
Average Hhld Income	\$48,826	\$63,441	\$67,971
Median Hhld Income	\$40,211	\$49,733	\$50,649
Per Capita Income	\$20,685	\$27,166	\$28,438

SOURCE: US CENSUS BUREAU 2000 CENSUS, 2010 CENSUS AND 2012-2016 ACS

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