HOLYOKE

URBAN FOREST EQUITY PLAN

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Executive Summary

EXECUTIVE SUMMARY

Holyoke, founded in 1850, is considered one of the first planned industrial cities in the United States. Its growth and development were fueled by the construction of the South Hadley Falls Dam and the city's canal system which used the power of the Connecticut River to produce abundant and inexpensive energy for paper and textile mills. At its peak in the late 1800s, Holyoke had over 25 paper mills, earning it the title of "Paper City" in 1870.

The legacy of Holyoke's industrial past can still be seen today in the city's densely developed and populated downtown City Center neighborhoods of Churchill, Downtown, South Holyoke, and The Flats (Map A). The majority of land in these neighborhoods is covered by roads, sidewalks, and buildings (known as impervious surfaces) and have few trees, canopy cover, and greenspace (Map B). These conditions along with a variety of social and economic factors make the residents of these neighborhoods more vulnerable to community challenges including flooding, air pollution, high summer temperatures, and other climate change impacts.

Image A. Historical Holyoke during its industrial era.

Image B. Historical Picture of Holyoke's Canal System.

CHURCHILL

DOWNTOWN
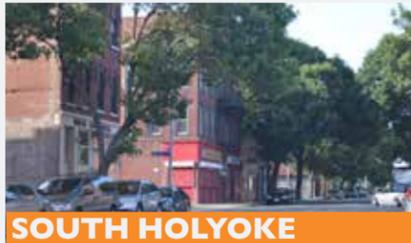
SOUTH HOLYOKE

THE FLATS

Map A. Map of Holyoke Featuring the Four Focus Neighborhoods
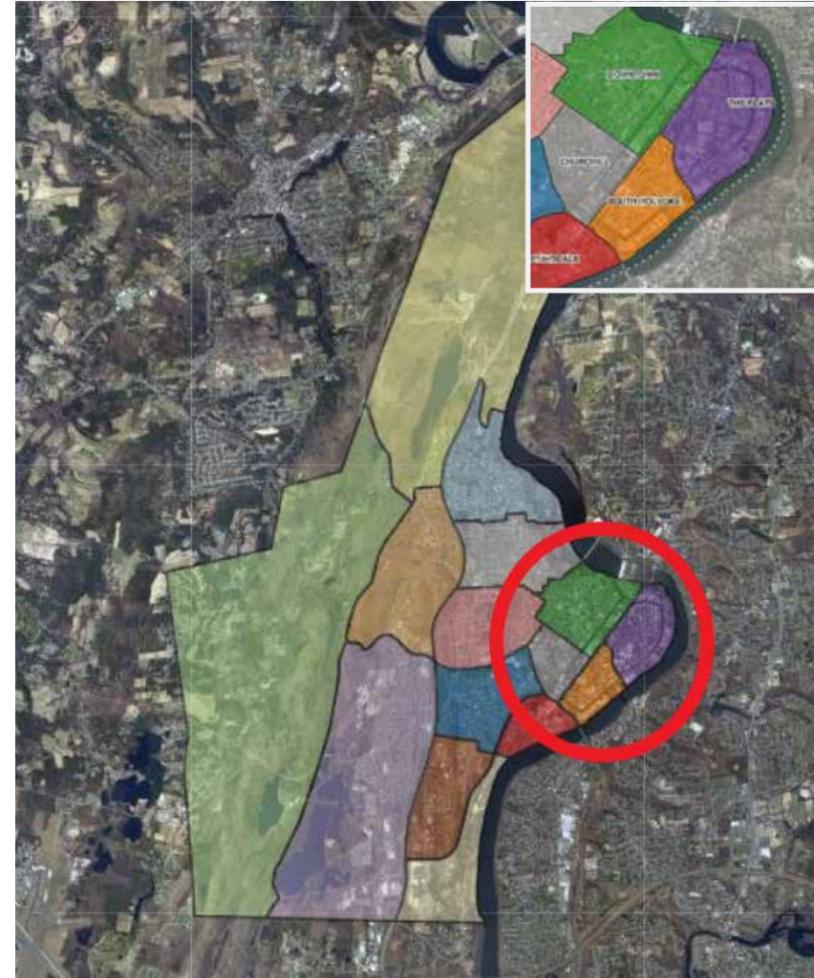
Map B. Holyoke Land Cover
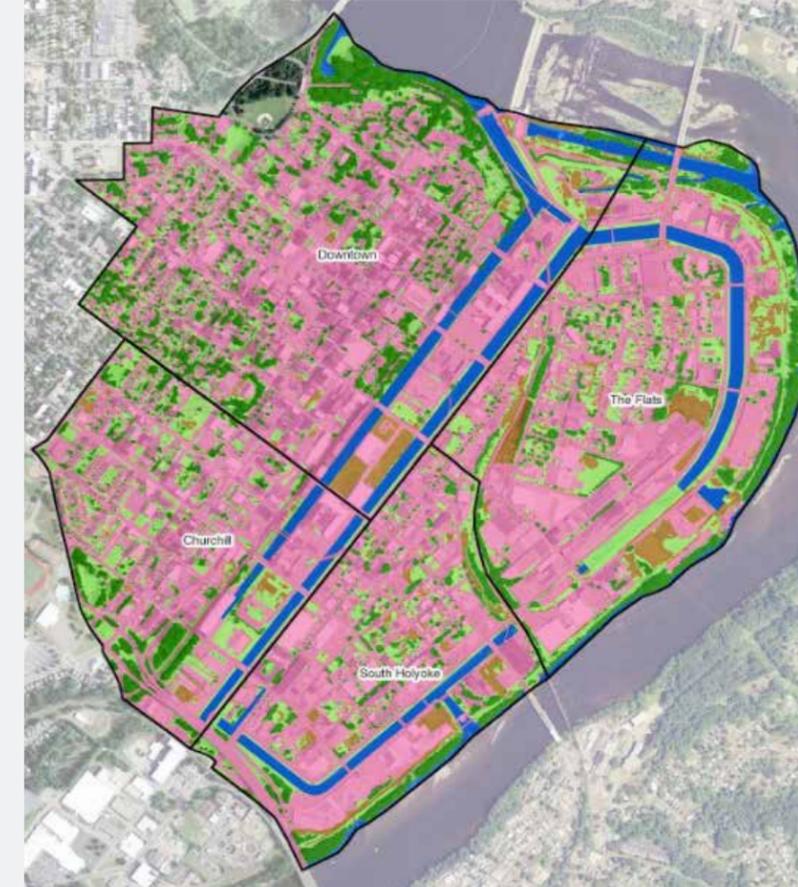
LEGEND

Tree Canopy: The area of land that is covered above by a tree's leaf-covered branches.

Pervious: Land that allows rainfall to infiltrate the soil (grassy areas or low-lying vegetation such as parks, golf courses, and residential lawns.

Bare Soil: Previous surface area with no vegetation (areas such as vacant lots, construction areas, and baseball fields).

Impervious: An area that does not allow rainfall to infiltrate (buildings, roads, and parking lot).

Open Water: All lakes, ponds, streams, wetlands, and other mappable water features.

A SOLUTION FOR HOLYOKE'S CHALLENGES

One of the most effective tools to reduce the impacts of climate change and help address the challenges facing Holyoke's residents are trees.

Trees Make Cities More Livable

Large, healthy trees are key to making cities more livable and improving the quality of life for its residents. Trees add beauty and privacy, create a sense of place, and strengthen relationships among neighbors and communities.

Trees Reduce Temperatures

Shade from large, healthy mature trees reduce the amount of sunlight that is absorbed by roads, buildings and sidewalks, while their leaves release water vapor and cool the surrounding area.

Trees Improve Human Health

Research has shown that people who live in neighborhoods with more tree canopy cover have better overall health, including lower rates of obesity, more social connections, less stress, and lower blood pressure. With the negative impacts that chronic stress has on human health—from anxiety and depression to weight gain and heart disease—trees are proving to be a low-cost solution in helping to reduce these health problems.

Trees Reduce Stormwater Runoff and Improve Water Quality

During storms, trees intercept rainfall in their canopies. This intercepted rainfall evaporates from leaves or slowly soaks into the ground, reducing and slowing stormwater runoff and flooding and lessening erosion.

Trees Help Reduce the Effects of Climate Change

Trees reduce greenhouse gases that can trap heat in the atmosphere, causing a city to get warmer. For example, carbon dioxide, a major greenhouse gas, is absorbed in tree trunks, branches, leaves, and roots during photosynthesis which keeps it out of the atmosphere helping to lower temperatures.

Image C. Pulaski Park, Holyoke, MA

AN URBAN FOREST EQUITY PLAN

Equal access to a healthy and abundant urban forest, **for all Holyoke's neighborhoods and residents**, is essential in helping to address climate change and related health impacts, reduce inequities, and build community capacity and resilience. **To achieve this vision the City of Holyoke has developed its first Urban Forest Equity Plan (UFEP/Plan) with funding from the Massachusetts Municipal Vulnerability Preparedness (MVP).** The Plan focuses on the four City Center downtown neighborhoods—Churchill, Downtown, South Holyoke, and The Flats—that were part of the originally planned city and now are disproportionately impacted by community challenges. The Plan uses an equity lens to preserve, grow, and care for Holyoke's trees through meaningful community engagement and proactive management. It serves as a guide to move Holyoke along the road towards a more equitable, sustainable, and resilient urban forest.

Equity in Urban Forestry

What is Equity? Equity is allocating resources and opportunities based on each person's individual needs and circumstances, to achieve equal outcomes. These outcomes include equal access to "environmental benefits," like a healthy urban forest.

In urban forestry, equity means allocating the resources and opportunities needed to improve the size, quality, number, and maintenance of trees and greenspaces in neighborhoods that may be lacking tree canopy and greenspace.

The goal of equity-focused efforts in urban and community forestry is to achieve equal environmental, economic, social, and cultural urban forest benefits across ALL neighborhoods, regardless of race, income, or other characteristics.

Figure A. Illustration of Equity

Providing the tools and resources based on each person's circumstances to provide equal access to the apples.

The Planning Process

A project team of City of Holyoke staff from the Office of Conservation and Sustainability, Department of Public Works, and the Office of Planning and Economic Development along with the planning consultants led by Davey Resource Group, Inc. (DRG) and supported by Community Circle and Fair Forests Consulting guided the development of Holyoke's Urban Forest Equity Plan. The team used an adaptive management approach of Scan, Ask, Integrate, Develop, and Reflect to develop the plan.

Figure B. Adaptive Management Plan Cycle
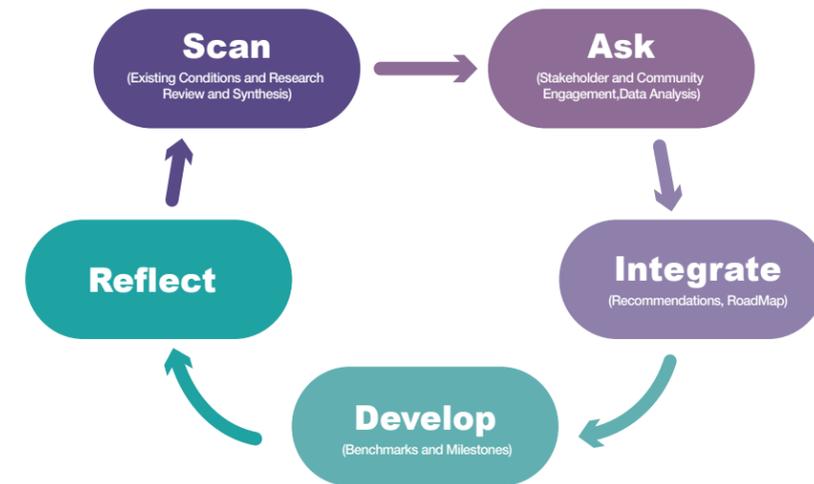
Community Engagement

Community engagement was an important part in developing the UFEP and will be equally important in its implementation. The focus of the community engagement activities were to reach and involve Holyoke residents most impacted by the city's challenges and inequities, and provide them an opportunity to help shape the Plan's recommendations. To provide meaningful and equitable access to participate in the planning process, the project team used a variety of strategies to gather input and feedback from Holyoke residents.

These strategies were developed and implemented based on COVID-19 restrictions that limited indoor gatherings, and included:

 » Bi-lingual (English/Spanish) UFEP Engagement Activities Flyer
 » Dedicated UFEP Webpage on City of Holyoke's Website
 » Media Outreach
 » Postcards
 » Call for Selfies *(Included throughout the Executive Summary)*
 » Virtual Community Forums on Zoom and Facebook Live
 » Online Surveys in English and Spanish
 » Printed Copies of the Online Surveys in English and Spanish

"This tree is my favorite because this was the first place that I visited in Holyoke after Hurricane Maria 2017. This is the first tree that I saw with this beautiful color, the first time that I saw it in real life!"

"Este árbol es mi favorito porque este fue el primer lugar que visité en Holyoke después del huracán Maria. ¡Este es el primer árbol que vi con este color hermoso, la primera vez que lo vi en la vida real!"

MEET THE RESIDENTS:
FERNANDO

What Did We Hear?

TREE BENEFITS

The top five **tree benefits identified by residents as most important to their neighborhood are:**

- » Provide shade/reduce energy bills
- » Reduce air pollution
- » Provide wildlife habitat
- » Beautify the neighborhood
- » Improve mood

> "My mother and I go to the park near our house and my mother who has Alzheimer's sits under a tree and removes her shoe so that she can feel the energy from the tree (nature)."
>
> -Holyoke Resident, Community Forum A

NEIGHBORHOOD TREES

75% of residents said that there were **too few trees in their neighborhood**. It follows that the majority also prioritized the need for additional trees to be planted.

> "The roads are unbearable in the summer as there are too few trees."
>
> -Holyoke Resident, Community Forum B

TREE PLANTING

93% of residents agreed or strongly agreed that planting trees is important to improving the City of Holyoke.

80% of residents would be willing to help water and maintain a newly planted tree.

TREE CONCERNS

54% of residents indicated that not owning the property where they lived was their biggest tree-related concern.

> "I rent and can't plant trees where I live."
>
> -Holyoke Resident, Survey Respondent

> "I live in a condo and am not allowed to plant trees, even as an owner."
>
> -Holyoke Resident, Community Forum A

MEET THE RESIDENTS:

LINDA

"The old tree in Pulaski Park looks like it would have many stories to tell."

"Este viejo árbol en Pulaski Park parece que tendría muchas historias que contar."

TREE PRIORITIES

The top tree priorities for residents:

- » Plant more trees on school and park properties
- » Plant more trees in public spaces in neighborhoods
- » Better care for the trees we do have
- » More funding for tree planting and care
- » Help people who want to plant more trees where they live

TREE PROBLEMS

The top five problems that residents encounter with trees:

- » Roots cracking sidewalk and pavement
- » Not enough trees in neighborhood
- » Leaves and fruit dropping
- » Limbs blocking sidewalks, signs, and streetlights
- » Safety problems from trees or limbs falling

Community Themes and Priorities

The input and feedback received during the Community and Stakeholder Engagement activities identified a set of community themes and priorities.

Equity. Residents do not have equal access to the environmental, social, and economic benefits Holyoke's urban forest provides.

Tree Canopy. The four neighborhoods of Churchill, Downtown, South Holyoke and the Flats have low tree canopy cover, ranging from 10–16%.

Impervious Surfaces (Buildings, Road, Sidewalks, etc.). The landscape of the four focus neighborhoods is dominated by impervious surfaces, which cover, on average, 70% of the land in the neighborhoods. For comparison, citywide impervious surfaces cover 30% of the land.

Resources (Budget & Staff). The City does not have sufficient funding or staff to address all of Holyoke's public tree care needs and ensure that high risk trees are removed in a timely manner.

Tree Maintenance. The City's current public tree maintenance program is *reactive*. A reactive program impacts the community's perception of the city's responsiveness to tree care needs and puts the public trees at risk, impacting their health and storm-readiness.

Climate Change. The effects of climate change are already being felt in Holyoke, including extreme storm events, flooding, and increasing temperatures, which can have a disproportionate impact on the city's most vulnerable residents.

Land Ownership. Over 90% of the residents in the four focus neighborhoods rent their homes and do not have control over whether they can plant trees on their property.

Community Engagement, Outreach and Education. Tree planting and care information that is culturally, linguistically, and age appropriate was identified as a need within the community.

Tree Protection/Preservation/Planting Standards. The City of Holyoke does not have tree protection, preservation, or planting standards or ordinances for use by city staff or external stakeholders (e.g., developers).

Infrastructure Conflicts. Residents were concerned about tree roots raising sidewalks and creating tripping hazards, while other stakeholders raised concerns that the needs of infrastructure (e.g., roads and utilities) and development are sometimes prioritized over trees.

Interdepartmental Collaboration/Communication. Interdepartmental collaboration and communication needs to be improved to ensure that tree protection, preservation, and planting are considered in all construction and development projects.

Tree Planting & Post-Planting Care. The City does not have best management practices, standards, or specifications in place to ensure proper species selection, planting, and post-planting care of newly planted trees.

MEET THE RESIDENTS:
LAUREN

"I took a selfie in front of my favorite tree, a deciduous redwood that was planted at our residence on Pine as part of my City's tree program a few years ago. It's doing well."

"Me tomé una selfie al frente de mi árbol favorito, un secuoya de que se fue sembrado en nuestra residencia en Pine como parte del programa de los árboles de la Ciudad hace unos años. Hasta haciendo bien."

State of Holyoke's Urban Forest

TREE CANOPY COVER

The amount, location, and distribution of tree canopy is the driving force behind the benefits an urban forest provides to the community. **As tree canopy increases, so do the tree benefits.** In 2014, an urban tree canopy assessment studied Holyoke's Environmental Justice areas, which includes the four urban core neighborhoods (Churchill, Downtown, South Holyoke, and The Flats).[A] The assessment used aerial imagery from 2012 to measure the amount of tree canopy (leaves, branches, stems of trees and other woody plants) and other land cover in the study area.

The amount of tree canopy cover in the four target neighborhoods is low (average 12%), while the amount of impervious surfaces, like roads, buildings, and sidewalks is high (70% average) (Table A). The large amount of impervious surfaces in the four target neighborhoods are of particular concern because research has found that urban heat island effects (warmer temperatures in cities) are greatest in areas where impervious surfaces cover more than 35% of the land[B] (Figure C).

Table A. Percent of Impervious Surfaces v. Tree Canopy by Neighborhood

Neighborhood	Percent of Land Covered by Impervious Surfaces*	Percent of Land Covered by Tree Canopy**
Churchill	69%	10%
Downtown	72%	16%
South Holyoke	73%	12%
The Flats	66%	11%
City Average	30%	Data not available
*Holyoke Impervious Surfaces Mitigation Plan (2020)		
**Community Based Assessment of Urban Forestry Conditions, Holyoke (2014)		

Figure C. Urban Heat Island Effect in Urban Areas.

This image illustrates the impact that impervious surfaces and tree canopy/greenspace have on afternoon temperatures. Downtown areas that have more buildings, roads, and sidewalks (impervious surfaces) and less tree canopy and greenspace are warmer than surrounding suburban and rural areas that have more tree canopy. greenspace and less impervious surfaces.
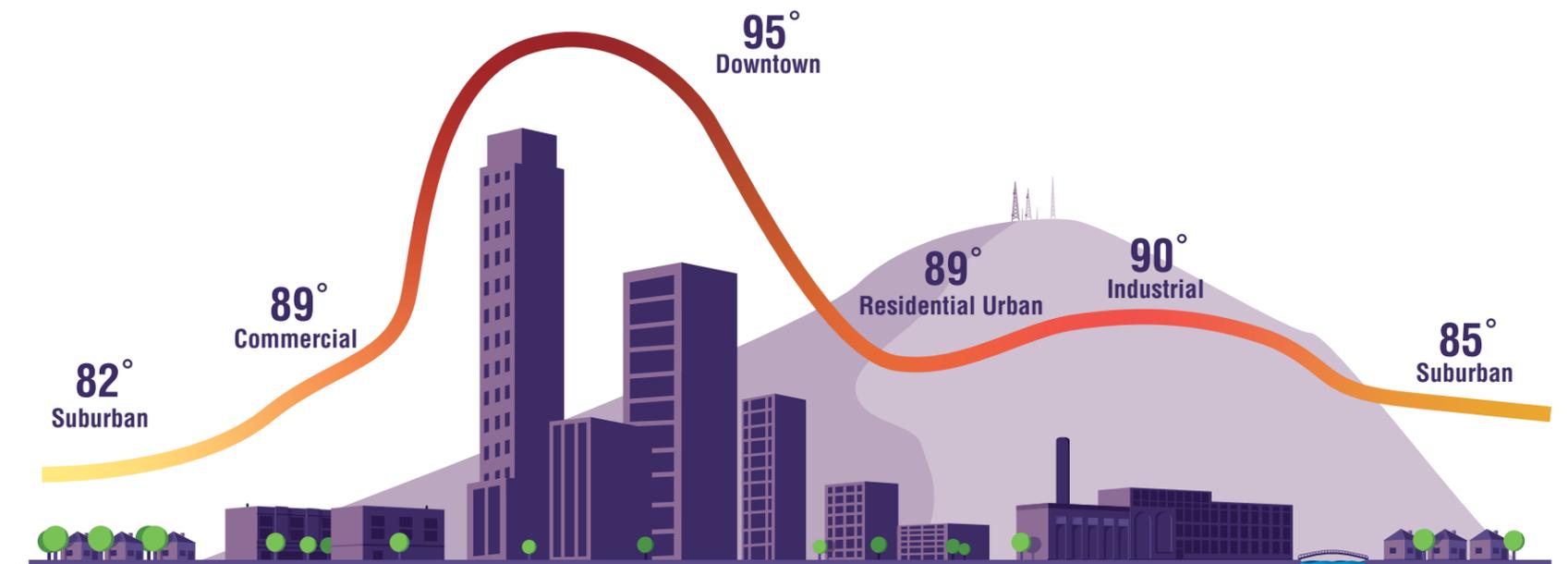
TREE CANOPY CHANGE OVER TIME

The amount of tree canopy varies across Holyoke changing over decades sometimes gradually and other times abruptly due to factors, including weather, climate, disease, disinvestment, economics, and development. This variability leads to an inequitable distribution of tree canopy cover and areas with lower tree canopy cover receiving fewer of the tree benefits.

Marc Healy, a Ph.D. candidate in the Graduate School of Geography at Clark University in Worcester, Massachusetts, conducted a study to measure the changes in Holyoke's tree canopy from 1952–2017. In the four focus neighborhoods, the study found that the greatest gains in tree canopy cover were in areas with the most impervious surfaces and that during poor economic periods tree canopy increased, while during economically strong periods tree canopy decreased.
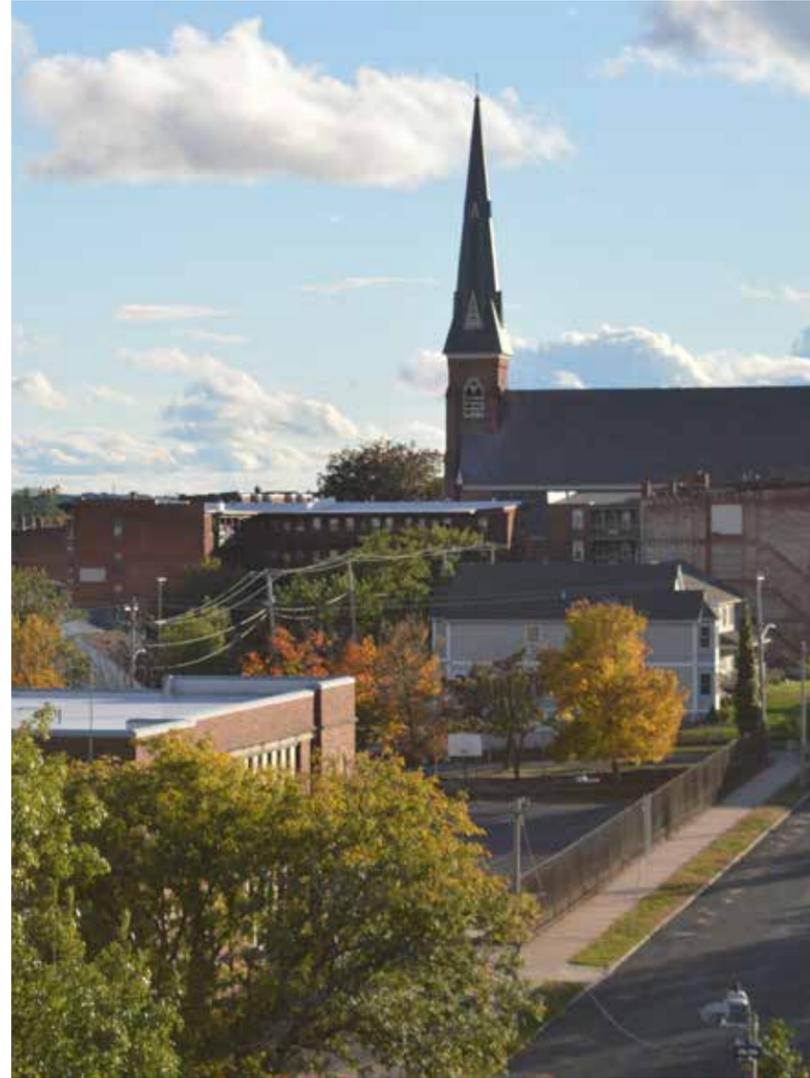
Table B. Holyoke Tree Canopy Analysis

Neighborhood	1952 Tree Canopy Cover	1971 Tree Canopy Cover	2003 Tree Canopy Cover	2014 Tree Canopy Cover
The Flats	2.9%	6.0% ↑	13.2% ↑	12.3% ↓
South Holyoke	2.9%	4.4% ↑	9.4% ↑	11.5% ↑
Downtown	8.7%	8.2% ↓	14.7% ↑	13.6% ↓
Churchill	7.1%	5.2% ↓	7.6% ↑	9.6% ↑

1953–1971   **1971–2003**   **2003–2014**

■ GAIN   ■ LOSS   ■ PERSISTENCE

Street and Park Trees in the Focus Neighborhoods

As part of the development of the UFEP, **Holyoke's first inventory of public street and park trees** was conducted in the four target neighborhoods. Arborists from Davey Resource Group visited each street and park tree in the Churchill, Downtown, South Holyoke, and The Flats neighborhoods and gathered information on their species, size, location, condition, and maintenance needs.

TREES BY NEIGHBORHOOD

A total of 2,653 trees were inventoried in the four neighborhoods (Figure D). The Downtown neighborhood has the most street and park trees while the fewest were found in The Flats.

Figure D. Holyoke Tree Inventory by Neighborhood

- Churchill: 777
- Downtown: 1,235
- South Holyoke: 378
- The Flats: 263

Holyoke Trees
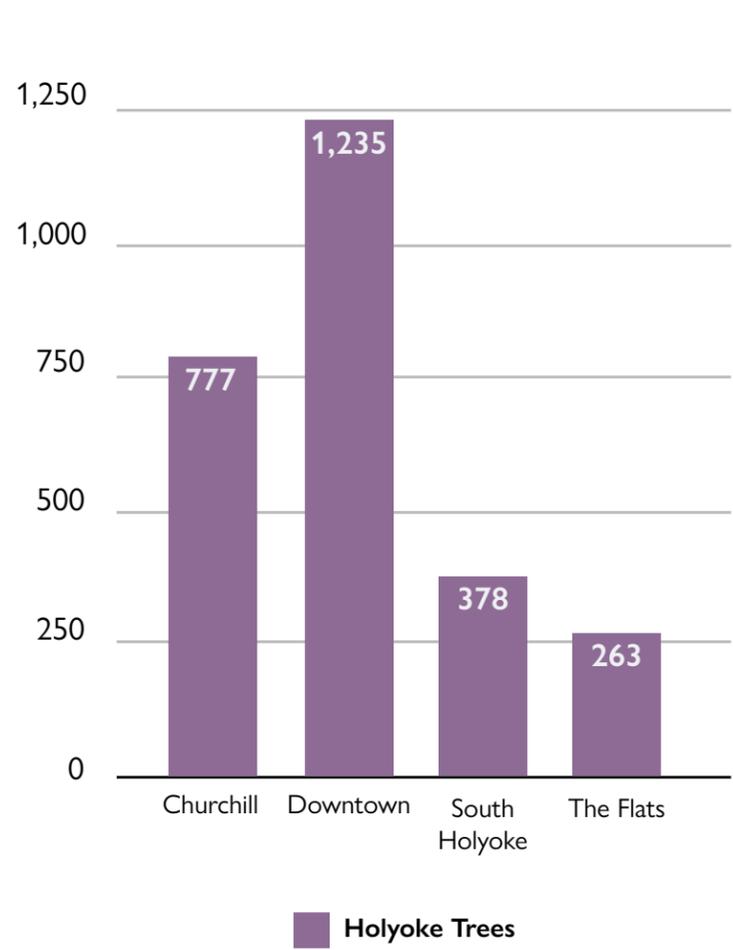
Map C. Aerial View of Public Trees Inventoried (TreeKeeper®)
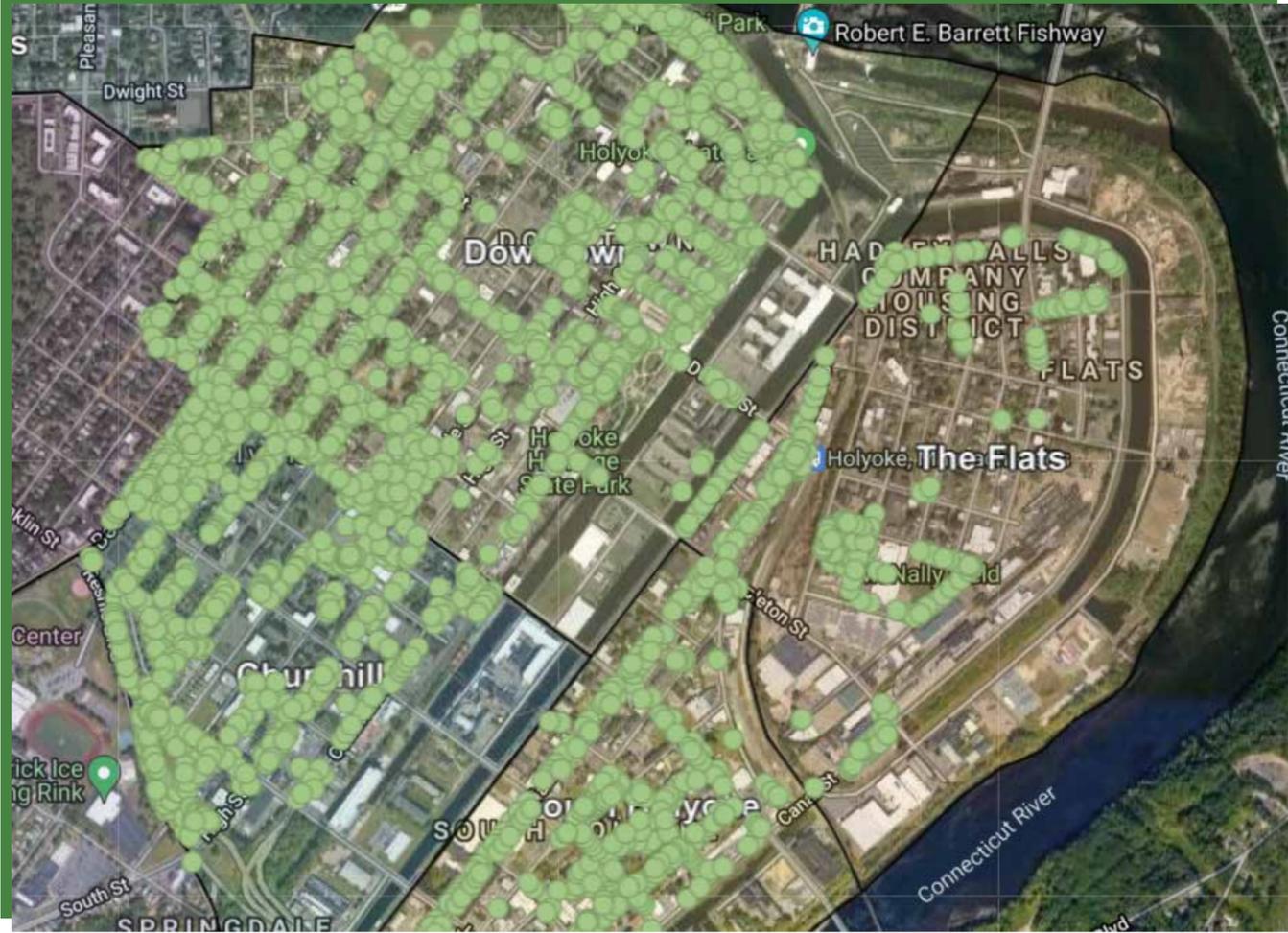
Green dots are the inventoried public street and park trees in the four neighborhoods.

NEIGHBORHOOD SPECIES DIVERSITY

Species diversity is the variety of tree species growing in an urban forest. Having more tree species (greater diversity) maximizes the many benefits that trees provide, and helps protect the urban forest from pests, diseases, and extreme weather events such as storms and drought.

The top five species in the four neighborhoods shown in Figure E are: Norway Maple, Honeylocust, Green Ash, Callery Pear, and Littleleaf Linden. Industry guidelines recommend that a single species should compose no more than 10% of the tree population to reduce species susceptibility to insect pests and diseases.

Figure E. Top Five Species in the Four Neighborhoods
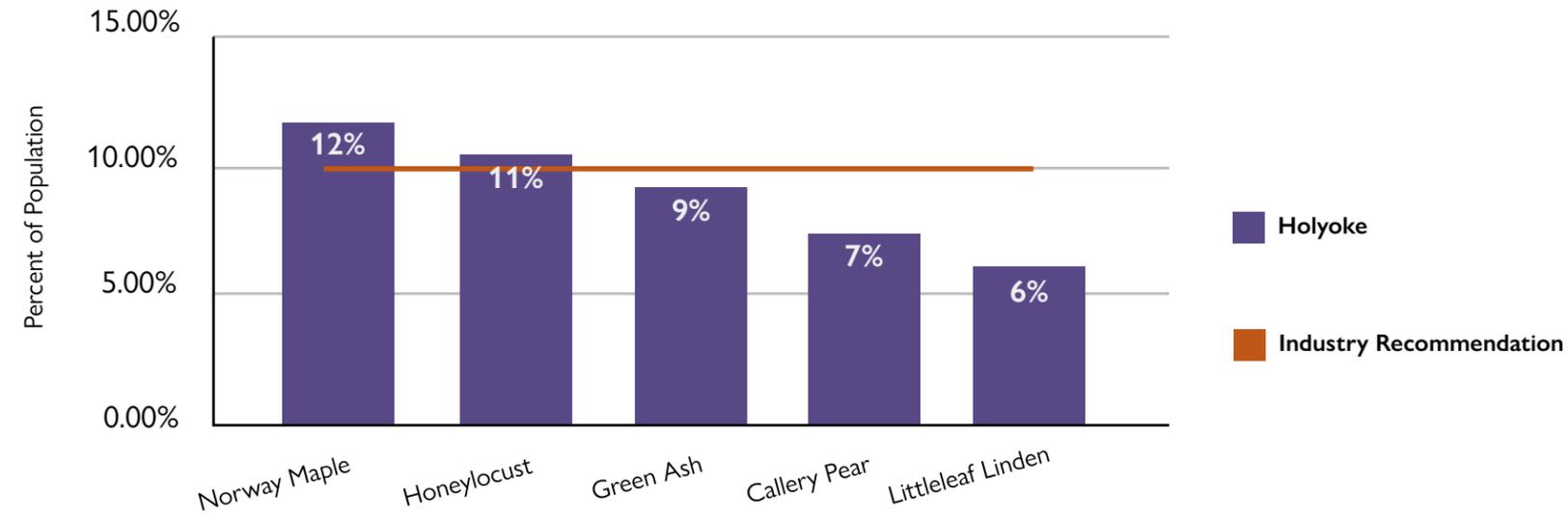
Legend:
- Holyoke
- Industry Recommendation

Bar values: Norway Maple 12%, Honeylocust 11%, Green Ash 9%, Callery Pear 7%, Littleleaf Linden 6%

HOLYOKE'S TOP FIVE TREE SPECIES IN THE FOCUS NEIGHBORHOODS

Norway Maple

Honeylocust

Green Ash

Callery Pear

Littleleaf Linden

Neighborhood Benefits of Holyoke's Public Trees

The 2,653 inventoried public street and park trees in the Churchill, Downtown, South Holyoke and the Flats neighborhoods provide $5,605 ($2.11 per tree) in **annual** environmental benefits to residents.

CONDITION OF NEIGHBORHOOD TREES

Understanding tree condition together with size/age provides insight into the longevity and stability of the City's inventoried street and park trees. While most of the trees were found to be in fair condition or better across size classes, **nearly 20% of the trees in the established, maturing, and mature size class are in poor or dead condition** (Figure F). Proper tree maintenance and care will help reduce the number of mature and maturing trees in "Poor" or worse condition.

Figure F. Condition of Inventoried Trees

Legend: Excellent-Good | Fair | Poor-Dead

Mature (>24"): 29%, 54%, 17%
Maturing (18–24"): 23%, 57%, 20%
Established (9–17"): 26%, 51%, 23%
Young (0–8"): 48%, 43%, 10%

Y-axis: Percent of Trees (0% to 60%)
X-axis: Relative Age Based on Size Class

MAINTENANCE & FUNDING

Stable and predictable funding is critical to effectively manage and grow Holyoke's public street and park trees. In fiscal year 2021, Holyoke's Forestry budget was $158,825, of which just over $60,000 was for tree care contractors to conduct street and park tree removal and pruning activities.
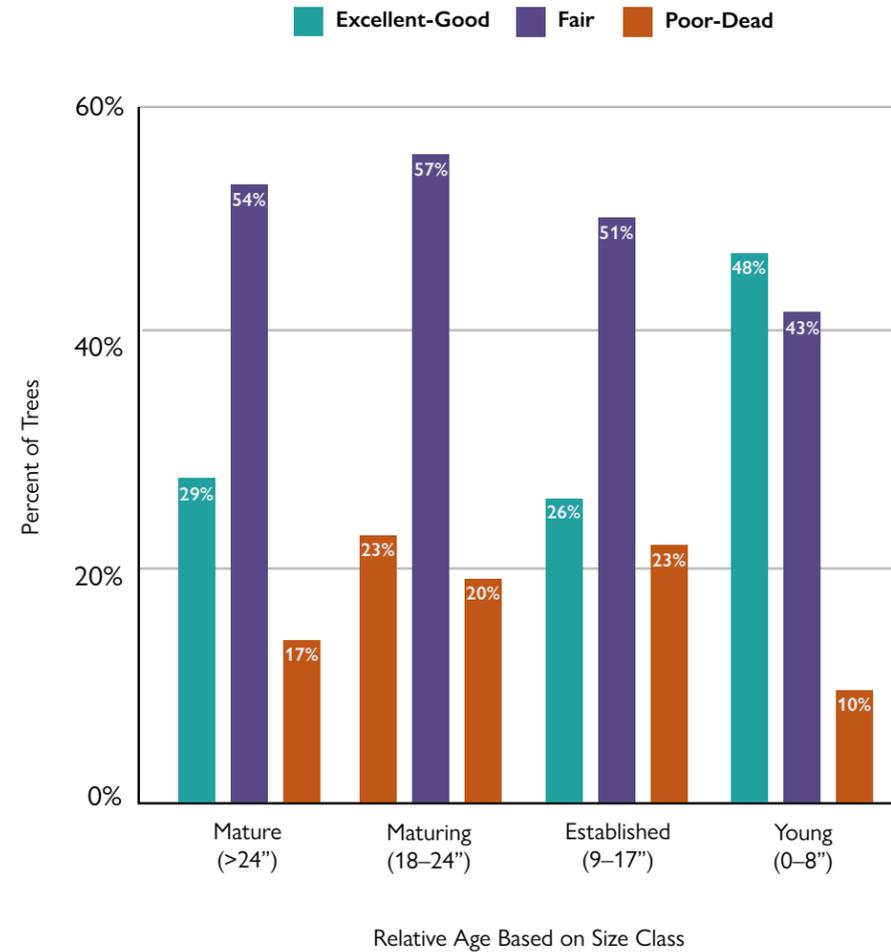
Holyoke's Forestry budget is not sufficient to address all of the City's public tree care needs. For example, based on the Holyoke's current Forestry budget and the recommended maintenance needs of the newly inventoried public trees (Figure G), it will take three to five years to remove all 307 identified trees removals in the four target neighborhoods.

The UFEP provides a five-year proactive tree management program for the street and park trees in the four target neighborhoods. However, **a complete inventory of the remaining street and park trees in Holyoke is crucial in determining the true funding needs of the public tree care program**.

Estimated Cost to Complete Holyoke's Street and Park Tree Inventory

To complete Holyoke's public tree inventory, an estimated 9,000 public street and park trees will need to be inventoried. Based on the cost to inventory the four target neighborhoods, it is estimated to cost $37,170 to inventory the City's remaining trees.

Note: This is an estimate and actual costs to complete the inventory will depend on several factors, including the number of trees and the data/information being collected?

Figure G. Recommended Maintenance Needs

Legend: Remove | Train | Prune

Remove: 307
Train: 818
Prune: 1,494

Y-axis: Percent of Population (0 to 1,500)
X-axis: Number of Trees
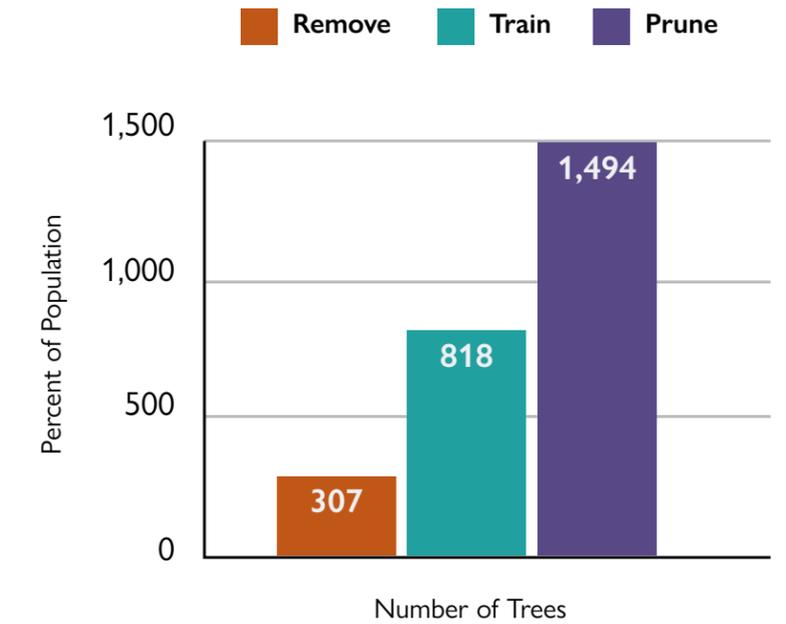
Figure H. Moving Towards a Proactive Maintenance Program

Reactive tree maintenance (top)

Attending to tree hazards and conditions on an as-needed or emergency only basis is costly and yields more long-term damage to roadways and tree health.

Preparing the City (middle)

Before proactive tree maintenance can happen, current conditions need to be tended to. Trees must be removed or replaced, and sidewalks and streets must be repaired.

Proactive tree maintenance (bottom)

A proactive management approach has many benefits for the City and urban canopy, including cost savings, reduced hazards, and creating a resilient and healthy urban forest for Holyoke's residents.

"I took a selfie in front of the Old Pine Oak Tree behind my row house on Suffolk and Pine—It's a great tree in the summer, as the leaves shade the house, and a great tree in the winter when most of its leaves are gone and so it lets in needed sunlight at the back of the house."

"Me tomé una selfie frente al un viejo árbol pino y roble detrás de mi casa asosada en Suffolk y Pine—es un gran árbol en el verano, ya que las hojas dan sombra a la casa, y un gran árbol le en el inverno cuando la mayoría de sus hojas se han ido y deja entrar la luz necessaría en la parta trasera de la casa."

MEET THE RESIDENTS:

DAPHNE

Recommendations

The recommendations are listed in implementation order based on community feedback and the consultant team's professional opinion related to the management needs of Holyoke's public tree population. The highest priority for implementation is Recommendation #1, while Recommendation #8 is a lower priority. However, no matter where a recommendation is ranked—its implementation is an important piece in ensuring that Holyoke's urban forest is equitable, sustainable, and resilient.

The UFEP provides a description of each Recommendation along with action steps, implementation ideas, and resources.

Table C. Recommendations

Category	Recommendation
	Recommendation #1: Engage, encourage, and support active participation by rental property owners, residents, and neighborhood & partner organizations in tree planting & care.
	Recommendation #2: Develop and implement culturally, linguistically, and age-appropriate public engagement, outreach, and education strategies around the importance of trees and their care.
	Recommendation #3: Develop and implement a strategy to maximize investment and resources to meet the desired level of service for the planting, care and management of Holyoke's public trees.
	Recommendation #4: Improve care and planting of public trees.
	Recommendation #5: Improve communication & collaboration among city departments and between the city and external organizations.
	Recommendation #6: Establish best management practices for tree planting, tree maintenance, and planning with a focus on equity.
	Recommendation #7: Ensure Holyoke's regulations and guidelines are in place to support tree canopy growth and preservation.
	Recommendation #8: Prioritize and ensure space for trees.

The Urban Forest Equity Plan recommendations and action steps are based on the priorities, challenges, and opportunities identified during the planning process. They focus on providing **all Holyoke residents and neighborhoods with equal access to a healthy, sustainable, and resilient urban forest and the many benefits it provides.**

The recommendations and action steps will help Holyoke to:

ENGAGE

and connect with residents, property owners, businesses, and community partners about the important role that they play in the growth, preservation, and care of Holyoke's trees.

PLAN

for an equitable, sustainable, and resilient urban forest by developing strategies to support tree canopy growth and preservation, and to maximize investment.

MANAGE

public tree maintenance and planting more effectively by improving data and ensuring resources are in place to support their long-term growth and care.

SECTION ONE:

Introduction
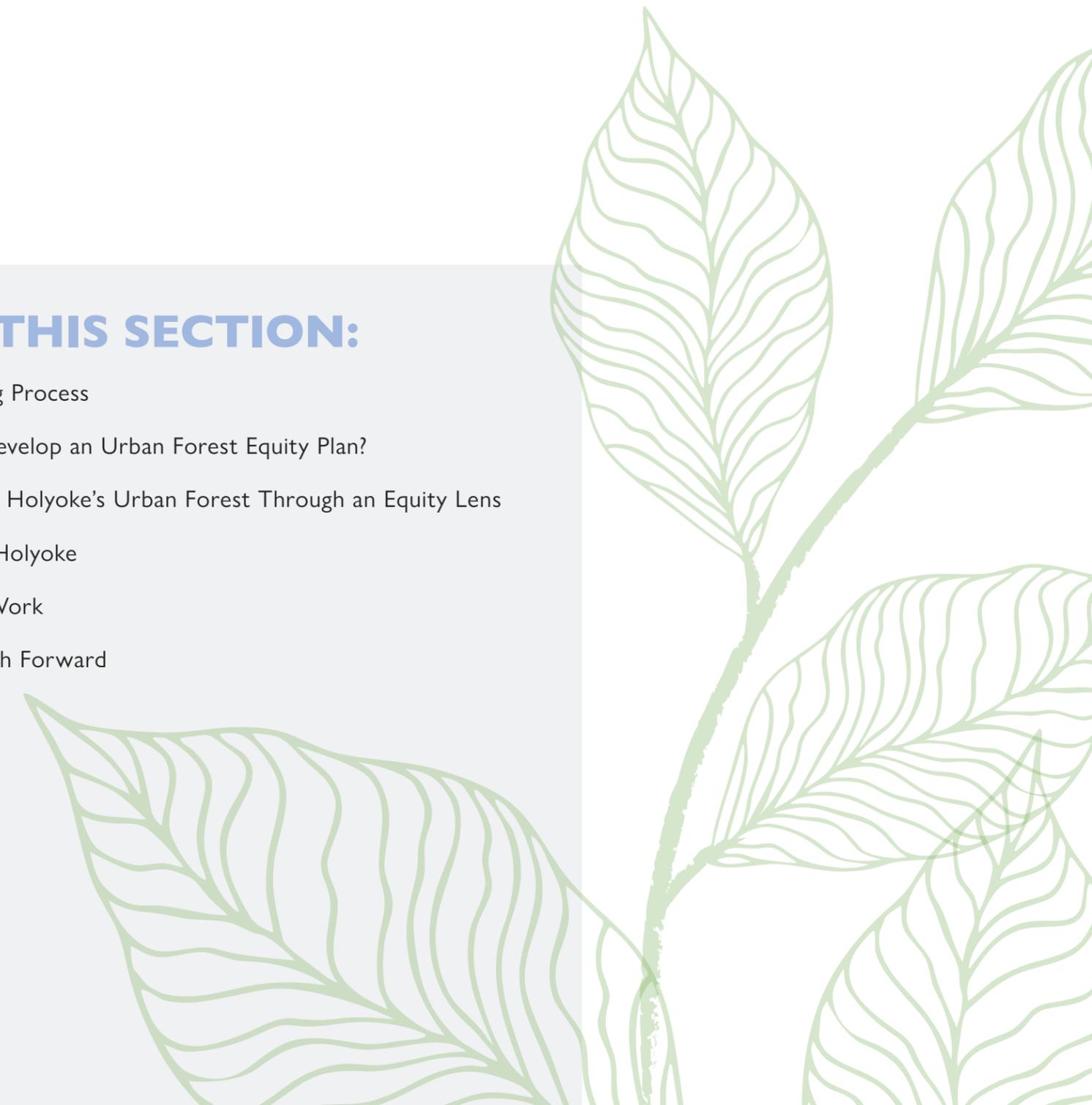
Introduction to the Plan

The City of Holyoke has created its first Urban Forest Equity Plan (UFEP/plan)! Developed with funding from the Massachusetts Municipal Vulnerability Preparedness (MVP) Program, the plan uses an equity lens to ensure that all of Holyoke's neighborhoods and residents have equal access to a healthy urban forest and the many benefits trees provide.

Holyoke has a unique history as one of the first planned industrial cities in the country. The remnants of this industrial past are still evident today in the city's densely developed and populated downtown urban core, with its system of canals that once powered a massive complex of paper and textile mills. This heavily built-up environment presents a number of challenges for its residents, including stormwater/flooding, air pollution and high temperatures (urban heat island effect).
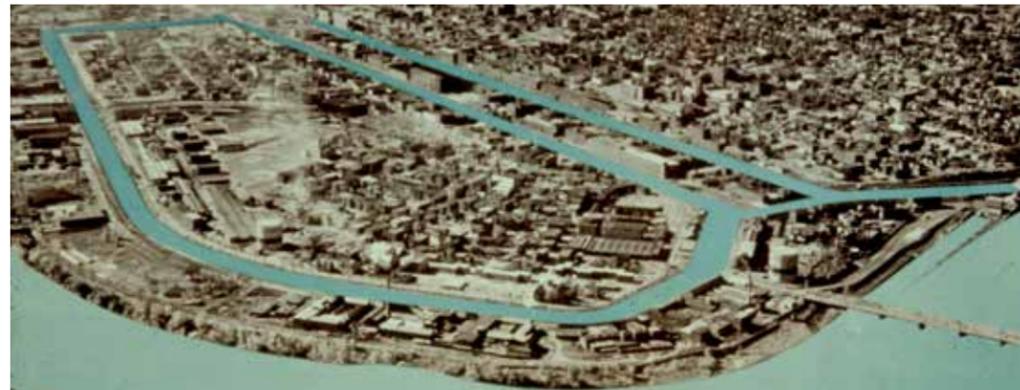
Image 1. Historical Picture of Holyoke's Canal System.

Image 2, 3 (Top to bottom) Comparison of High Street in South Holyoke, Circa 1895 and 2012.

The Urban Forest Equity Plan focuses on four urban core downtown (Center City) neighborhoods—Churchill, Downtown, South Holyoke, and The Flats—that were part of the originally planned city and are now disproportionately impacted by these challenges (Map 1). The conditions in these neighborhoods, including low tree canopy cover, large amounts of impervious surfaces, and social and economic factors outside the scope of this plan, have created disparities that increase the vulnerability of residents to these challenges.

The intent of the Urban Forest Equity Plan is to address these challenges through a focus on growing and preserving tree canopy to take advantage of the many benefits and opportunities trees provide including:

» Reducing energy costs

» Providing residents with a connection to nature

» Creating an inviting and pleasant environment for those living in and visiting the city of Holyoke.

The plan also includes broader planning and management recommendations to improve the care and maintenance of Holyoke's public street and park trees throughout the city.

Map 1. Map of Holyoke Featuring the Four Focus Neighborhoods

THE FOUR FOCUS NEIGHBORHOODS
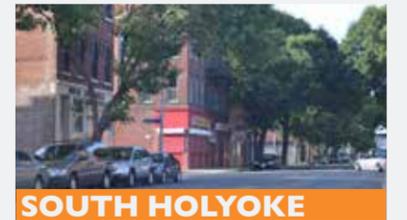
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DOWNTOWN

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THE FLATS

The Planning Process

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Figure 1. Adaptive Management Plan Cycle
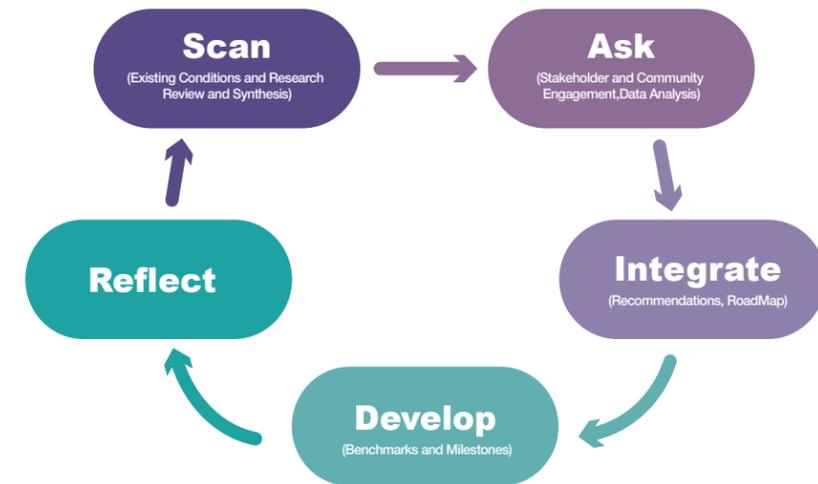
Scan. To gain an understanding of the current state of Holyoke's urban forest in the four target neighborhoods, DRG conducted an inventory of the public street and park trees. The inventory provides important information on the size, condition and maintenance needs of the trees growing in these neighborhoods. The inventory was followed by an extensive review of existing City of Holyoke plans and studies including, the Urban Tree Canopy Assessment (2014), Natural Hazards Mitigation Plan (2016), Community Resilience Building Workshop (2018), Impervious Surfaces Mitigation Plan (2020), and Open Space and Recreation Plan (2018).

Ask. Public and stakeholder engagement and outreach were important elements of the UFEP. The project team engaged community partners from OneHolyoke CDC, South Holyoke Neighborhood Association, Neighbor to Neighbor, and Holyoke Media to assist with reaching out to target audiences to ensure their voices were heard. Engagement activities included online public forums, surveys, social media events, and stakeholder interviews.

Integrate & Develop. The needs and priorities of the Holyoke community and stakeholders paired with information gathered during the *Scan* phase serve as the foundation of the plan's equity-focused recommendations and action steps.

Reflect. A series of metrics and tools have been identified to monitor, assess, and measure progress in the implementation of Holyoke's UFEP.
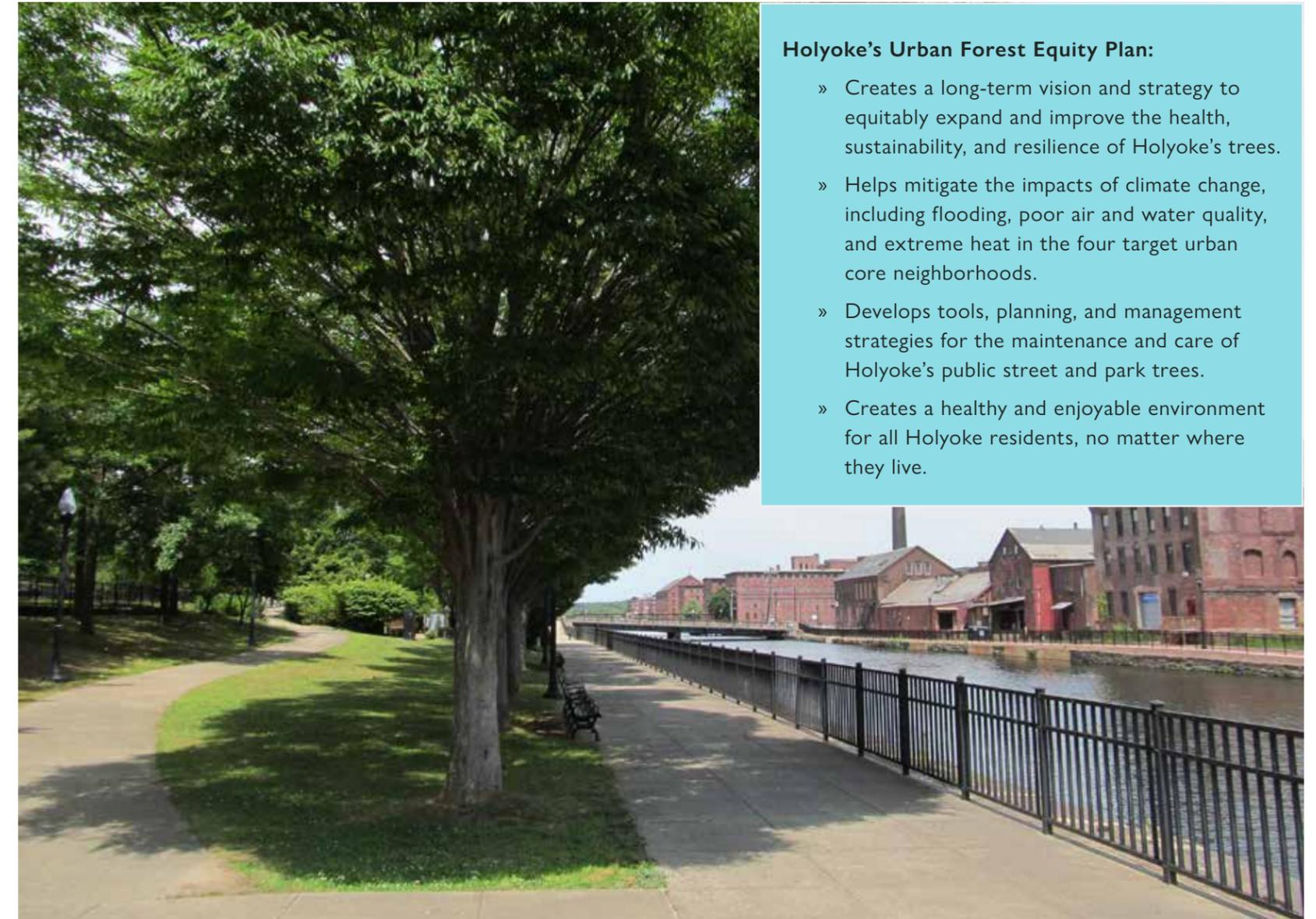
Holyoke's Urban Forest Equity Plan:

» Creates a long-term vision and strategy to equitably expand and improve the health, sustainability, and resilience of Holyoke's trees.

» Helps mitigate the impacts of climate change, including flooding, poor air and water quality, and extreme heat in the four target urban core neighborhoods.

» Develops tools, planning, and management strategies for the maintenance and care of Holyoke's public street and park trees.

» Creates a healthy and enjoyable environment for all Holyoke residents, no matter where they live.

WHY DEVELOP AN URBAN FOREST EQUITY PLAN?

In 2018, the City of Holyoke, local stakeholders, and residents participated in a Community Resilience Building workshop as part of the Massachusetts MVP Program.[1] The workshop identified Holyoke's natural and climate-related hazards along with its strengths and vulnerabilities to create an action plan and implementation strategy to improve Holyoke's resilience through community collaboration.

The workshop identified **wind events, flooding/extreme precipitation, heat/extreme heat, disease, drought, and extreme cold** as the top hazards facing Holyoke. These hazards are exacerbated by challenges and vulnerabilities in Holyoke, including:

- » Large amounts of buildings, roads, and paved areas downtown (impervious surfaces)
- » Lack of shade downtown
- » Insufficient and/or aging infrastructure
- » Lack of available resource to respond and assist the community
- » Vulnerable populations
- » Communication barriers
- » Lack of internal municipal coordination

The Community Resilience workshop identified **Five Priority Action Items** for Holyoke to implement to address these hazards and improve the city's resilience:

1. Coordinate and implement city plans, and ensure certain standards and capacities are met.
2. Install alternative power supplies at critical facilities, including back-up generators and battery storage.
3. Rebuild the right of way for climate resiliency, including complete streets, combined sewer overflow (CSO) separation, and burying utilities.
4. Conduct a public education campaign.
5. Develop a tree management, maintenance, and planting program with appropriate species for tree planting.

The development of the Urban Forest Equity Plan supports implementation of Action Items 1, 3, 4, and 5.

"This tree is my favorite because this was the first place that I visited in Holyoke after Hurricane Maria 2017. This is the first tree that I saw with this beautiful color, the first time that I saw it in real life!"

"Este árbol es mi favorito porque este fue el primer lugar que visité en Holyoke después del huracán Maria. ¡Este es el primer árbol que vi con este color hermoso, la primavera vez que lo vi en la vida real!"

MEET THE RESIDENTS:
FERNANDO

Viewing Holyoke's Urban Forest Through an Equity Lens

This plan uses an equity lens to inform priorities and key recommendations—but what does that mean and why is it important to consider in urban forestry?

WHAT IS EQUITY?

Equity is allocating the resources and opportunities each person needs, based on their circumstances, to achieve equal outcomes.[2] These outcomes include equal access to "environmental benefits", like a healthy urban forest.

Figure 2. Illustration of Equity

Providing the tools and resources based on each person's circumstances to provide equal access to the apples.

WHY IS EQUITY IN URBAN FORESTRY IMPORTANT?

Historical Redlining and disinvestment has impacted the amount, quality, and care of trees and greenspace in lower income and working class neighborhoods throughout the United States. These neighborhoods typically have fewer, lower quality, and under-maintained trees and greenspaces compared to more affluent neighborhoods.[3] They have also experienced a disproportionate burden from industrial pollution and related health impacts (e.g., asthma), as well as economic decline over generations.

Equity in urban forestry means allocating the resources and opportunities needed to improve the size, quality, number, and maintenance of trees and greenspaces in neighborhoods that may be lacking tree canopy and greenspace.

The goal of equity-focused efforts in urban and community forestry is to achieve equal environmental, economic, social, and cultural benefits of urban forests across all neighborhoods, regardless of race, income, or other characteristics.

Left unmitigated, existing disparities in urban forests based on race and income will likely expand, threatening the health and sustainability of the urban forest and surrounding human communities.

Neighborhoods with disproportionately low and under-maintained tree canopy face climate-related inequities and are at greater risk for health impacts associated with climate change. These may include heat-related illness and death, as well as impacts from flooding and polluted stormwater run-off and waterways.[4]

Fewer trees also mean less shade. This may affect residents' ability to walk along city streets or recreate in city parks during warmer months, potentially impacting an individual's fitness. An observable disparity in tree canopy across neighborhoods also sends a message—even if unintentional—that the city values the residents of some neighborhoods less than those in greener, better cared for areas. Applying an equity lens to urban forest planning and management is crucial to improving environmental, social, economic, and health outcomes in predominantly lower income and non-white neighborhoods.

Image 4. Historical Redlining Map of Holyoke—Circa 1937.
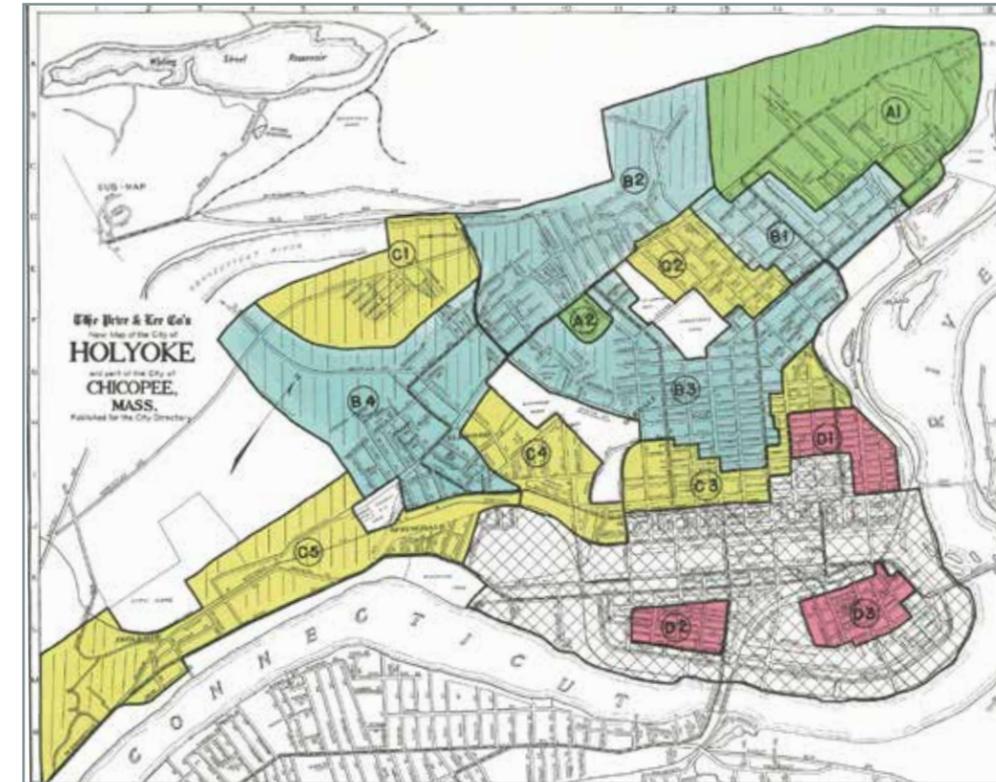
What is Redlining?

"Redlining is the discriminatory practice of denying services (typically financial) to residents of certain areas based on their race or ethnicity. The term "redlining" was coined by sociologist John McKnight in the 1960s and derives from how the federal government and lenders would literally draw a red line on a map around the neighborhoods they would not invest in based on demographics alone."

-Investopedia

Area Ratings for Lending

- "A" Areas: "Best" Areas For Lending
- "B" Areas: "Still Desirable" Areas For Lending
- "C" Areas: "Definitely Declining" Areas For Lending
- "D" Areas: "Hazardous" Areas For Lending

About Holyoke

COMMUNITY HISTORY

Holyoke, located in the Connecticut River Valley, is situated between the Connecticut River to the east and Mount Tom/East Mountain Range to the west. Its original inhabitants were Native Americans from the Algonquian, Agawam, and Nonotuck tribes.[5] The first European settlers began to arrive in the 1600s, drawn to the area by the Connecticut River and the abundant agricultural opportunities. In the mid-1800s Holyoke became **one of the first planned industrial cities in the United States** with construction of the dam at South Hadley Falls and the city's canal systems—which produced abundant and inexpensive energy (Image 7).

The power generated by the dam and canal network led to the rapid industrialization of Holyoke, making it a prominent player in the country's industrial revolution. At its peak, in the late 1800s, the city had over 25 paper mills along with textile and other manufacturing facilities. Paper production became Holyoke's dominant industry, earning it the title of "Paper City" in 1870.[6] Workers flocked to Holyoke to take advantage of the employment opportunities the mills provided, and between 1865 and 1920 the city saw its population grow over 1,200%, from 4,600 to 60,000 residents.[5]

The boom in the industry and population required infrastructure, housing, schools, and other developments to support the growing city. This planned development occurred primarily in Holyoke's urban core—in the four neighborhoods known today as Churchill, Downtown, South Holyoke and The Flats.

As the industrial revolution waned in the 1920s, Holyoke's mills and factories began to close and its population declined, but the factories, infrastructure, and other developments built to support it remained.

The legacy of Holyoke's industrial past endures today; at just over 22 square miles, the city is a distinct mix of industrial/urban neighborhoods to the east of Mount Tom/East Mountain, and rural/agricultural lands to the west.[7] The majority of the city's 40,117 residents live in the city's industrial/urban neighborhoods—with over 26% of the population (10,701 residents) living in the 1.6 square mile area that makes up the four Center City neighborhoods.[8] Manufacturing, hospitality, health care, and retail are the lead contributors to the city's economy.[9]

Image 5. Construction of the dam at South Hadley Falls.

Image 6. Historical Holyoke during its industrial era.
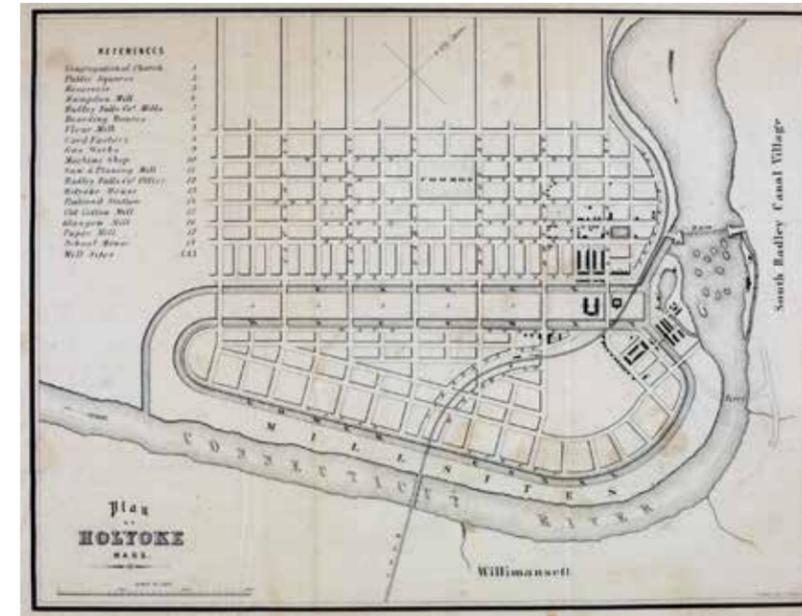
Image 7. City of Holyoke plan drafted by the Hadley Falls Company (1853).

Day Brook

"The Secret Stream"/"La Corriente Secreta"

The rapid expansion of Holyoke has had a significant ecological impact on the landscape that continues to impact the community today. The burying and piping of Day Brook, known as "The Secret Stream"/"La Corriente Secreta" is one of those lasting impacts.

Day Brook begins at the East Mountain Wildlife Management Area and flows east. As it enters the Oakdale neighborhood, it is channeled underground into the pipes of the city's combined stormwater and sanitary sewer system. It continues to travel underground through the Elmwood, Churchill, and South Holyoke neighborhoods for 1.8 miles where it then enters Holyoke's Wastewater Treatment Plant before ending its journey in the Connecticut River. During this journey, the freshwater from Day Brook is combined with sewage from the sanitary system and rainfall during storm events. At times the volume of water in the pipes exceed the capacity of the Wastewater Treatment plant causing raw sewage overflows into the Connecticut River and localized flooding.

The legacy of Holyoke's industrial past endures today.
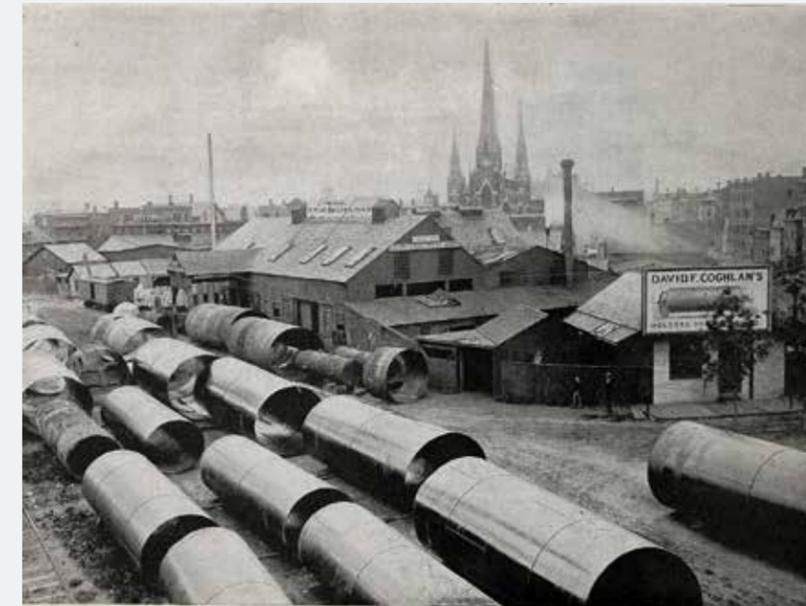
Historical pictures of Holyoke.

THE FOUR FOCUS NEIGHBORHOODS

CHURCHILL

DOWNTOWN

SOUTH HOLYOKE
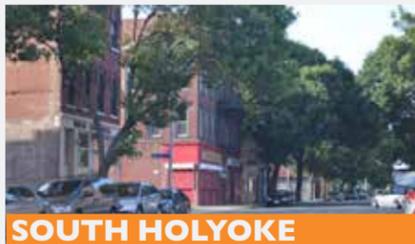
THE FLATS

FOCUS NEIGHBORHOODS: CHURCHILL, DOWNTOWN, SOUTH HOLYOKE AND THE FLATS

The Urban Forest Equity Plan focuses on the four **Center City neighborhoods of Churchill, Downtown, South Holyoke, and The Flats** (Map 1). As part of the original planned city, these four neighborhoods not only carry the burden of its industrial past but have also been subjected to the discriminatory practices of "redlining" and historical disinvestment (Image 4). Residents in these neighborhoods have substantially lower median household incomes (ranging between $17,741–$22,807) compared to the city of Holyoke as a whole ($40,764); and are more likely to be renters (92%) compared to the city average (56%). 87% of the center city residents identify as Hispanic/Latino and 79% of adult residents speak Spanish as their first language.[8]

The neighborhoods are densely developed with large amounts of impervious surfaces (e.g. roads and buildings), low tree canopy cover, high numbers of polluting businesses, high population density, and traffic.[10, 11] The narrow streets and lack of greenbelts make it challenging to find locations to plant trees and will require retrofitting and rebuilding areas to accommodate them. As a result, residents living in these neighborhoods face many **environmental inequities** including poor air quality, high summer temperatures (urban heat island), and poor water quality and flooding.

Childhood Asthma in Holyoke

Holyoke has a significantly higher percentage of children (kindergarten–8th grade) with asthma (27.2%) compared to the statewide average of 11.9%; and Hispanic and Black children have higher rates of emergency department visits for asthma-related issues than White children (Figure 3). Higher incidences of asthma and other respiratory issues has been associated with greater exposure to air pollution for children living in urban areas.

Figure 3. Emergency Department Visits Discharges per 10,000 Residents

MASSACHUSETTS
- 50.32
- 180.22
- 150.69

HOLYOKE
- 95.37
- 219.69
- 280.98

Legend:
- Hispanic
- White, Non-Hispanic
- Black, Non-Hispanic
- = 50 people

HOLYOKE'S CHANGING CLIMATE

Holyoke, like cities across the United States, is experiencing the effects of climate change, including extreme storm events, flooding, and increasing temperatures which impacts the health and well-being of its residents. By 2050, the average annual temperature in Holyoke is projected to **increase 3.0°F–6.4°F**; and each year city residents could experience up to **35 more days where temperatures are above 90°F** (known as "high heat days").[12]

High temperatures in cities contribute to a phenomenon called the urban heat island effect. An urban heat island occurs when impervious surfaces, like roads, buildings, and sidewalks, trap and hold heat– causing air temperatures to be hotter than nearby areas that are less built up and have more greenspace (Figure 4). According to the Environmental Protection Agency, a city which has extensive areas of impervious surfaces can be **1–7° F warmer than surrounding suburban areas during the day and up to 5° F warmer at night**.[13]

Research has found that urban heat island effects are greatest in areas where impervious surfaces cover more than 35% of the land.[14] This is of particular concern for the UFEP's focus neighborhoods, where impervious surfaces cover 66–73% of the land (Table 1).

Table 1. Percent of Impervious Surfaces v. Tree Canopy by Neighborhood

Neighborhood	Percent of Land Covered by Impervious Surfaces*	Percent of Land Covered by Tree Canopy**
Churchill	69%	10%
Downtown	72%	16%
South Holyoke	73%	12%
The Flats	66%	11%
City Average	30%	Data not available
*Holyoke Impervious Surfaces Mitigation Plan (2020)		
**Community Based Assessment of Urban Forestry Conditions, Holyoke (2014)		

The high proportion of impervious surfaces in the four target neighborhoods also impacts stormwater run-off, flooding, and water quality. Climate models predict that precipitation and the frequency of extreme storm events will increase in Holyoke over the next century.[15] **As impervious surfaces produce over 5 times as much run-off as forested areas** (Figure 5), the combined sanitary and stormwater sewer systems in Holyoke's urban core neighborhoods are not always adequate to accommodate this volume of run-off.[16] When the system is overtaxed, peak flows can cause stormwater to back up leading to localized flooding and sewer overflows into the Connecticut River, where it impairs water quality.[17]

Figure 4. Urban Heat Island Effect in Urban Areas.

This image illustrates the impact that impervious surfaces and tree canopy/ greenspace have on afternoon temperatures. Downtown areas that have more buildings, roads, and sidewalks (impervious surfaces) and less tree canopy and greenspace are warmer than surrounding suburban and rural areas that have more tree canopy. greenspace and less impervious surfaces.
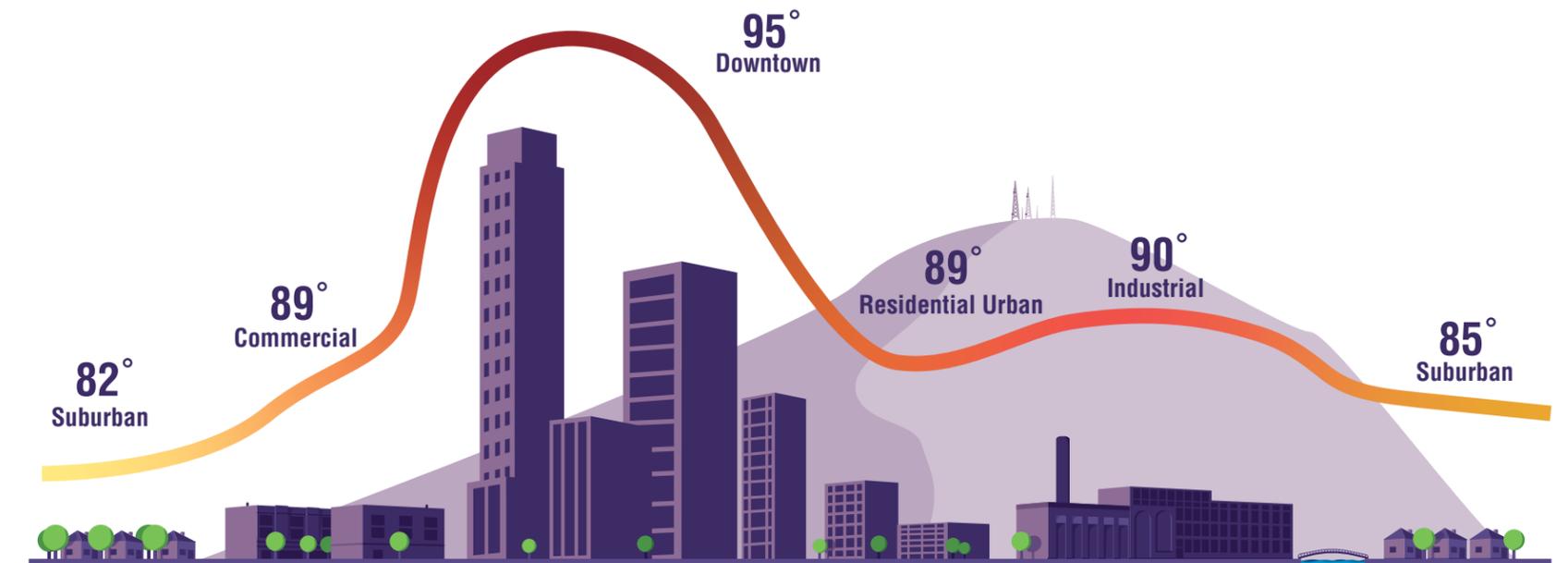
Figure 5. Natural Ground Cover v. Impervious Surfaces.
The impacts of impervious surfaces on the amount of stormwater runoff.
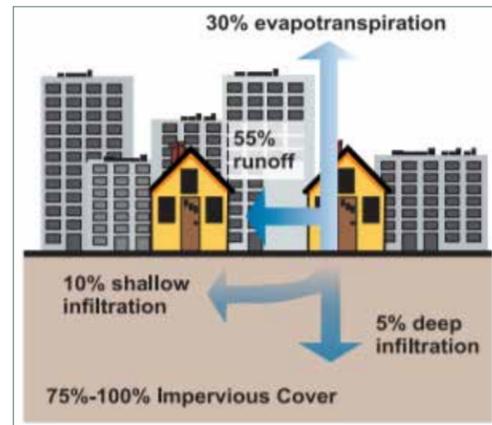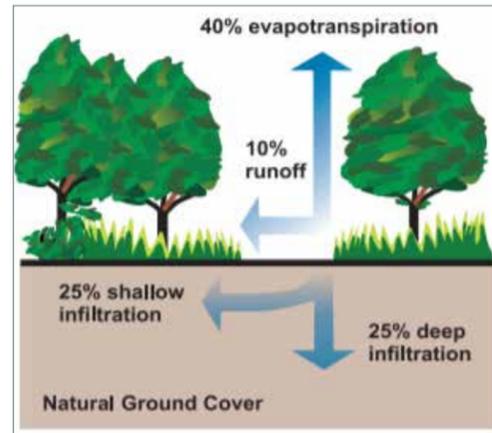
The low canopy cover and large amounts of impervious surfaces in these neighborhoods also has a significant impact on the health and well-being of its socially and economically vulnerable residents, including:

Heat-Related Mortality. As temperatures increase heat stroke, and heat-related mortality also increase. **For every 1° F increase** in temperature during a heat wave **there is a 2.5% increase in the risk of heat-related mortality.**[18]

Poor Air Quality & Increased Ozone Levels. Ground level ozone is created by chemical reactions of atmospheric gases/compounds with sunlight and heat. Ground level ozone has serious impacts on human health including asthma attacks, irritation of lungs and airways, coughing and difficulty breathing, non-fatal heart attacks, and premature death.

Higher Energy Usage. When the city gets hotter, there is an increase in electricity used to cool homes and businesses, resulting in higher energy bills. The Department of Energy has found that **low income households spend three times more (nearly 9% of their household income) on energy bills,** compared to 3% of household income for non-low income households.[19]

MEET THE RESIDENTS:
REVEREND HUNTER

"This is an absolutely ancient Beech Tree on Pine St. I love how it towers over the rooflines and can be seen from all over the neighborhood. In the spring and summer it is full of singing birds, and in the fall, the leaves turn an amazing copper color and wait until the very end of the season to come down at once."

"Esto es un árbol de haya absolutamente antiguo en la calle Pine. Me encanta cómo se eleva sobre los techos y se puede ver desde todo el vecindario. En la primavera y el verano está lleno de pájaros cantores, y en el otoño, las hojas se vuelven de un color cobrizo increíble y esperan hasta el final de la temporada para caerse todas juntas."

ADAPTIVE CAPACITY

According to the International Panel on Climate Change (IPCC), the effects that climate change has on human populations varies and is dependent on the elements of **vulnerability—exposure, sensitivity, and adaptive capacity**.

Exposure: The level at which a population is subjected to a stressor such as heat, poor air quality, or extreme weather events.

Sensitivity: The level at which a population can be harmed by the stressor due to health, income, or other factors.

Adaptive Capacity: Having access to the tools, skills, and strategies to adjust to and address the consequences of the stressor.

Building adaptive capacity in Holyoke is key to reducing vulnerability, addressing inequities, and increasing resilience.

Figure 6. Adaptive Capacity Neighborhood Comparison

THE FLATS

High Heat **Exposure** (Temps Above 90°F)

Median Household Income: $17,741
Neighborhood has residents with heart disease who have a higher sensitivity to heat-related illnesses.

HIGH VULNERABILITY

Neighborhood has **low tree canopy cover** and the residents **do not have the financial resources (adaptive capacity) to cool their homes.**

HIGHLAND PARK

High Heat **Exposure** (Temps Above 90°F)

Median Household Income: $81,094
Neighborhood has residents with heart disease who have a higher sensitivity to heat-related illnesses.

LOW VULNERABILITY

Neighborhood has **abundant tree canopy cover** and the residents **have the financial resources (adaptive capacity) to cool their homes.**

Trees Work

An abundant and healthy urban forest has been proven to be one of the most effective tools for mitigating the effects of climate change by providing essential services and benefits, and building adaptive capacity in communities.

TREES MAKE CITIES MORE LIVABLE.

Large, healthy trees are a key component in making cities more livable and improving the quality of life for its residents. They add beauty, privacy, and help to create a sense of place. **Trees and greenspace also enhance neighborhoods by strengthening ties between neighbors, encouraging outdoor play by children, reducing crime, and providing an overall sense of safety.**[20]

TREES REDUCE TEMPERATURES

Shade from large, healthy mature trees reduces the amount of sunlight that is absorbed and stored by impervious surfaces, while their leaves release water vapor (through transpiration), cooling the surrounding area. Through shade and transpirational cooling, trees modify the environment and reduce urban heat island effects. **Trees can reduce summer temperatures by 2–9°F.**[21]

TREES IMPROVE HUMAN HEALTH

People living in neighborhoods with more tree canopy cover have been shown to have better overall health, including lower rates of obesity, more social cohesion, less stress, and lower blood pressure.[22, 23] Residents reporting **poor mental health decreased 63%** 18 months after vacant lots near their homes were planted with grass and trees.[24]

With the negative impacts of chronic stress on human health—from anxiety and depression to weight gain and heart disease—trees are proving to be a low-cost solution in helping to mitigate these health problems.

Image 8. Pulaski Park, Holyoke, MA

TREES REDUCE STORMWATER RUNOFF AND IMPROVE WATER QUALITY

During storm events, trees intercept rainfall in their canopies. This intercepted rainfall evaporates from leaves or slowly soaks into the ground, reducing and slowing stormwater runoff and lessening erosion. Underground, tree root growth and decomposition helps to increase the amount of water the soil can hold, allowing for greater absorption of rain. [25]

Allowing rainwater to slowly soak into the ground where it lands can reduce stormwater runoff and pollutants by 20 to 60 percent.[26] The Holyoke Impervious Surface Mitigation Plan recommends the use of trees and green infrastructure to help address stormwater and flooding concerns in the city.[10]

TREES HELP REDUCE THE EFFECTS OF CLIMATE CHANGE.

Trees reduce greenhouse gases that can trap and retain heat in the atmosphere—causing the city to get warmer. Carbon dioxide, a major greenhouse gas, is absorbed (sequestered) in tree trunks, branches, leaves, and roots during photosynthesis. The amount of carbon that can be stored is directly related to the size of the tree— meaning **larger trees store more carbon.**[27] A **large, healthy swamp white oak** shade tree (*Quercus bicolor*) **stores 8.5 times more carbon over its lifetime than a small, healthy, mature flowering redbud tree** (*Cercis canadensis*).[28]

An abundant and healthy urban forest has been proven to be one of the most effective tools for mitigating the effects of climate change.

Benefits of Trees:
By the Numbers

While some of the benefits that trees provide cannot be measured, like how they make people feel or their natural beauty, many of the environmental benefits of trees can be definitively tracked. To provide an introduction to the measurable benefits individual trees provide, an analysis was conducted on three tree species of various mature sizes commonly found in Holyoke: Redbud (*Cercis Canadensis*), Blackgum/Tupelo (*Nyssa Sylvatica*), and Swamp White Oak (*Quercus Bicolor*) using i-Tree's MyTree Tool.

As this analysis illustrates, different tree species provide different levels of benefits depending on their size, structure, form, and age. **Planting and maintaining a diversity of tree species is the key to maximizing the benefits trees provide, and creating an urban forest that is resilient to insect and disease pests and the impacts of climate change.**

What is i-Tree?

i-Tree is a suite of tools developed by researchers at the USDA Forest Service and partner organizations to quantify and measure the benefits trees provide.

To find out about the benefits of trees in your yard visit https://mytree.itreetools.org/ or www.itreetools.org.

SMALL FLOWERING TREE
Redbud Spp.
(Cercis Canadensis)

3 POUNDS OF CARBON DIOXIDE (CO_2) SEQUESTERED (ABSORBED) EACH YEAR	**8"** TRUNK DIAMETER
9 OUNCES OF OZONE REMOVED FROM AIR EACH YEAR	**1,522** POUNDS OF CO_2 STORED OVER LIFETIME TO DATE
ANNUAL VALUE OF BENEFITS **$17.64**	**664** GALLONS OF RAINFALL INTERCEPTED EACH YEAR
6 KWH OF A/C ENERGY SAVINGS EACH YEAR	ENERGY SAVINGS VALUE EACH YEAR **$13.20**
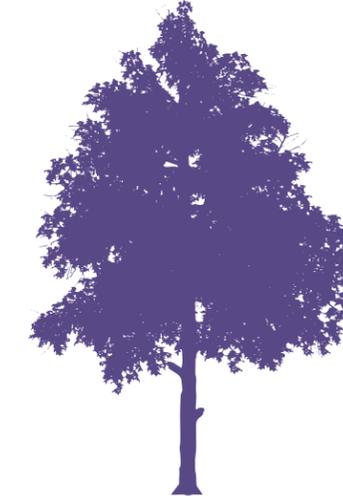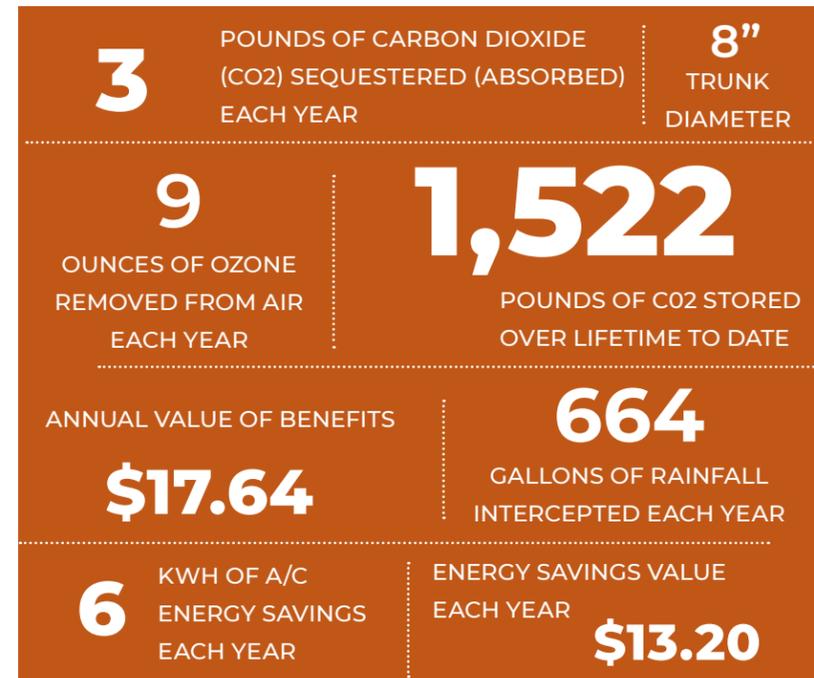
MEDIUM SHADE TREE
Blackgum/Tupelo
(Nyssa Sylvatica)

218 POUNDS OF CARBON DIOXIDE (CO_2) SEQUESTERED (ABSORBED) EACH YEAR	**14"** TRUNK DIAMETER
21 OUNCES OF OZONE REMOVED FROM AIR EACH YEAR	**4,764** POUNDS OF CO_2 STORED OVER LIFETIME TO DATE
ANNUAL VALUE OF BENEFITS **$37.85**	**1,185** GALLONS OF RAINFALL INTERCEPTED EACH YEAR
12 KWH OF A/C ENERGY SAVINGS EACH YEAR	ENERGY SAVINGS VALUE EACH YEAR **$26.42**
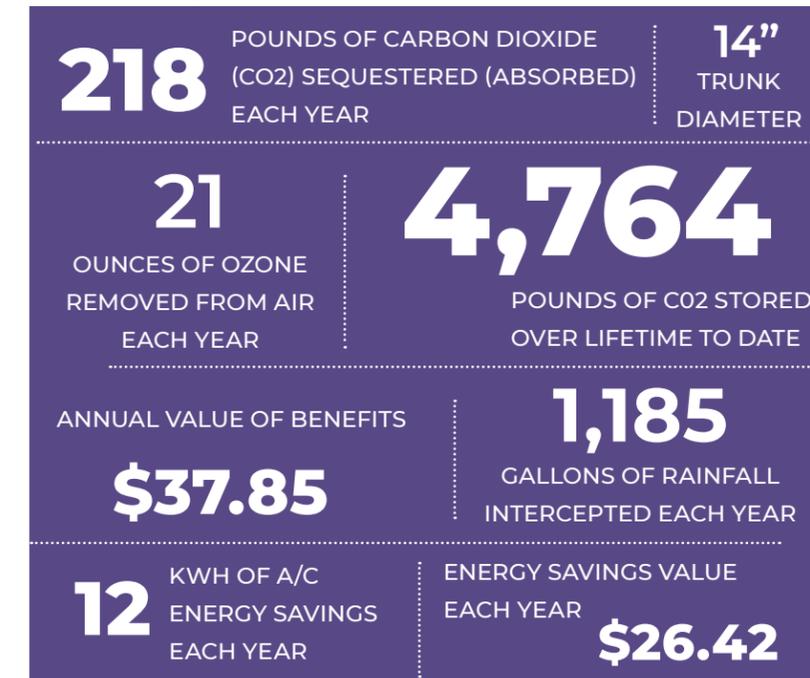
LARGE SHADE TREE
Swamp White Oak
(Quercus Bicolor)

324 POUNDS OF CARBON DIOXIDE (CO_2) SEQUESTERED (ABSORBED) EACH YEAR	**20"** TRUNK DIAMETER
37 OUNCES OF OZONE REMOVED FROM AIR EACH YEAR	**13,254** POUNDS OF CO_2 STORED OVER LIFETIME TO DATE
ANNUAL VALUE OF BENEFITS **$41.14**	**2,076** GALLONS OF RAINFALL INTERCEPTED EACH YEAR
12 KWH OF A/C ENERGY SAVINGS EACH YEAR	ENERGY SAVINGS VALUE EACH YEAR **$26.42**

"I took a selfie in front of the Old Pine Oak Tree behind my row house on Suffolk and Pine—It's a great tree in the summer, as the leaves shade the house, and a great tree in the winter when most of its leaves are gone and so it lets in needed sunlight at the back of the house."

"Me tomé una selfie frente al un viejo árbol pino y roble detrás de mi casa asosada en Suffolk y Pine—es un gran árbol en el verano, ya que las hojas dan sombra a la casa, y un gran árbol le en el inverno cuando la mayoría de sus hojas se han ido y deja entrar la luz necessaría en la parta trasera de la casa."

MEET THE RESIDENTS:

DAPHNE

The Path Forward

Equal access to a healthy and abundant urban forest for all of Holyoke's residents is essential in helping to address climate change and related health impacts, reduce inequities, and build adaptive capacity. The Urban Forest Equity Plan serves as a guide to achieve that vision and move Holyoke along the road towards a more equitable, sustainable, and resilient urban forest.

The plan is organized into five sections. This is the conclusion of **Section 1: Introduction.** The next section, **Section 2: Engagement**, examines the values, needs, and priorities the Holyoke community and stakeholders hold with regard to trees. **Section 3: State of the Urban Forest** presents information and data on the current state of Holyoke's urban forest to help understand opportunities and challenges facing the city's trees. The plan's recommendations and action steps, which are based on community priorities and themes, are presented in **Section 4: Recommendations.** They focus on creating a healthy and equitable urban forest through engagement, planning, and management. **Section 5: Assessing Progress** provides ways to monitor and measure Holyoke's progress in improving and ensuring equitable access to abundant and healthy tree canopy.

The Urban Forest Equity Plan is designed to maximize the benefits trees provide by equitably growing and caring for Holyoke's urban forest through meaningful community engagement and proactive management. Let's begin by exploring the values, needs, and priorities of the Holyoke community.

Note: Citations and image sources can be found in the Appendices and References section at the end of the plan. They are organized by plan section.

Engagement

IN THIS SECTION:

Understanding Community and Stakeholder
Needs and Priorities

Stakeholder Engagement

Themes and Priorities
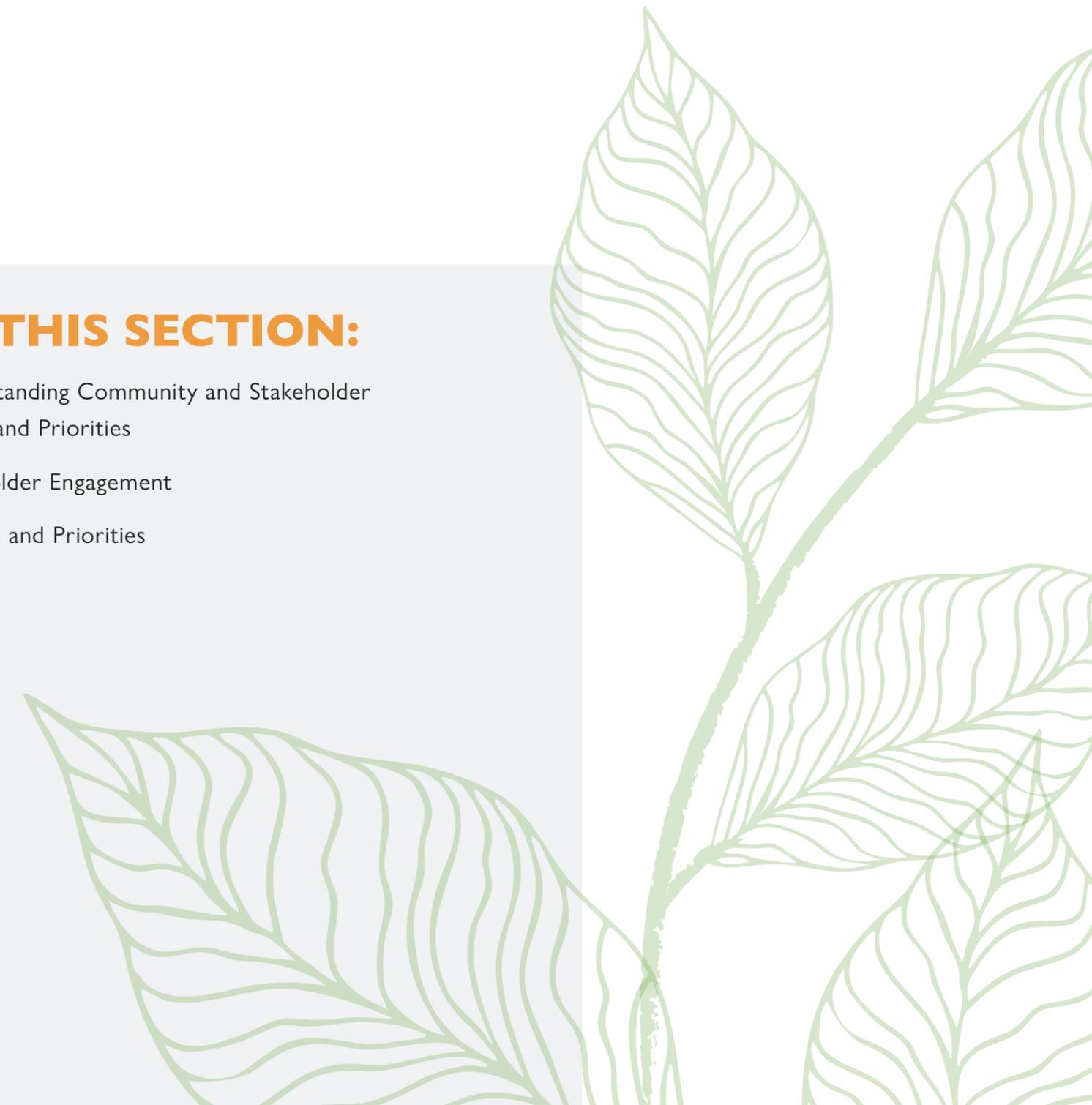
Understanding Community & Stakeholder Needs and Priorities

COMMUNITY ENGAGEMENT

Community engagement was a key component in the development of this UFEP and will be equally important in its implementation. The goals of the plan's community engagement activities were to reach and involve those most impacted by the challenges and inequities highlighted in the **Introduction** and provide them an opportunity to help shape the plan's recommendations. To provide meaningful and equitable access to participate in the planning process, the project team used a variety of strategies to gather input and feedback from Holyoke residents. These engagement strategies were developed and implemented based on COVID-19 restrictions that limited indoor gatherings, and included:

Bi-lingual (English/Spanish) Flyer promoting UFEP engagement activities and providing information on how to participate.

Dedicated UFEP webpage on the City of Holyoke's website with planning information and ways to be involved in the process.

Media Outreach through press releases and participation in interviews with Holyoke Media to promote the UFEP and engagement activities.

Postcards handed out by Davey Resource Group Arborists during tree inventory data collection.

Call fo**r Selfies** where residents sent in selfies by their favorite tree in Holyoke and explained why it is special to them.*

Virtual Community Forums via Zoom and Facebook Live with sessions offered in English & Spanish (bi-lingual) and Spanish-only. Forum A held in February 2021 discussed tree benefits and community values around trees. Forum B held in March 2021 discussed values, challenges and opportunities, and shared tree inventory findings.

Online surveys available in English and Spanish. Survey #1 released in February 2021 coincided with Community Forum A to identify the values, needs, opportunities and challenges around trees. Survey #2 released in April 2021 gathered feedback on the draft UFEP recommendations.

Print (hard copy) version of the online surveys (English and Spanish) available at community food distributions at Key Foods.

* **Pictures from the Call for Selfies are seen throughout this document and labeled as "Meet the Residents".**
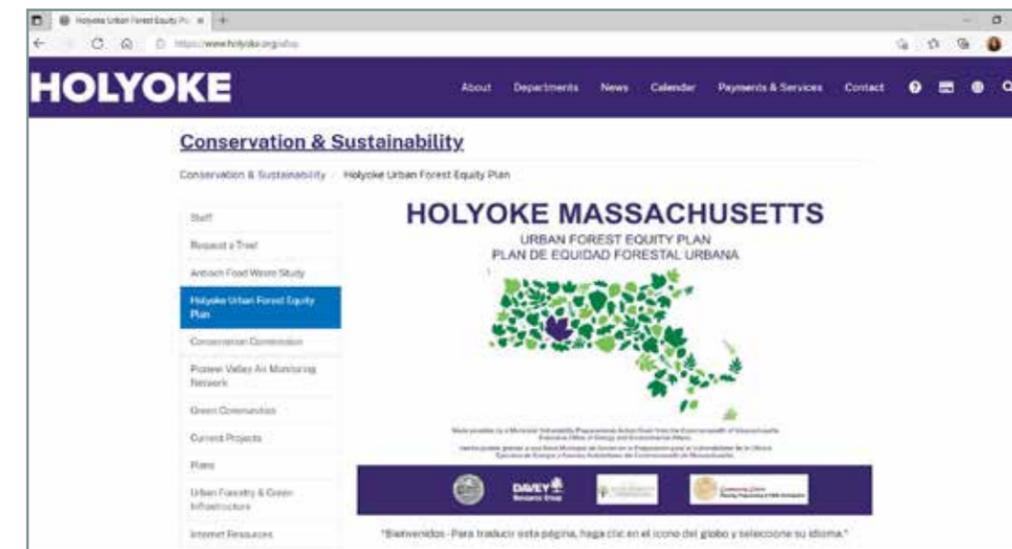
Image 9. (Top Left) Bi-lingual flyer created for holyoke to promote ufep engagement activities.

Image 10. (Top Right) Urban Forest Equity Plan Survey (Page 1).

Image 11. (Bottom) Dedicated City of Holyoke UFEP webpage.

COMMUNITY PARTICIPATION

Participation by residents who lived in the four target neighborhoods of Churchill, Downtown, South Holyoke, and The Flats was a priority for the plan's outreach and engagement efforts. The City of Holyoke and the consultant team engaged with community partners from OneHolyoke CDC, South Holyoke Neighborhood Association, Neighbor to Neighbor, and Holyoke Media to help publicize and assist with the engagement efforts. All engagement activities and materials were translated and interpreted in both English and Spanish. To further encourage participation, residents that participated in each engagement activity were automatically entered into a free raffle and were eligible to win a $25 Visa gift card.

Forum A: The majority of participants in both the bilingual and Spanish-only forums were from the four target neighborhoods, with the exception of Churchill.

Survey #1: 64% of survey respondents were from the four target neighborhoods, with 38% of the respondents representing South Holyoke. Residents from the neighborhoods of Elmwood, Highlands, Oak Dale, West Holyoke Springdale, Rock Valley, Ingleside, Smith Ferry and Jarvis also completed the survey.

Forum B: The majority of residents who participated in both the bilingual and Spanish-only forum were from outside the four target neighborhoods, including Elmwood, Homestead Ave., Oakdale, and the Highlands.

WHAT DID WE HEAR FROM THE COMMUNITY?

While the feedback and input received from residents in the four City Center neighborhoods was limited due to a variety of factors (including impacts from COVID-19), the engagement activities provided important community insights. Holyoke residents value and understand the many benefits that trees provide to the community and are interested in increasing the city's tree canopy cover. They are also aware of the challenges that exist in tree planting, care, and maintenance in the city, including limited space, land ownership, and lack of funding and resources. There was some concern expressed about the risks that lack of maintenance creates, including roots lifting sidewalks and fallen limbs in parks, though residents acknowledged that the main reason for the lack of maintenance was most likely insufficient city funding and resources.

"I took a selfie in front of my favorite tree, a deciduous redwood that was planted at our residence on Pine as part of my City's tree program a few years ago. It's doing well."

"Me tomé una selfie al frente de mi árbol favorito, un secuoya de que se fue sembrado en nuestra residencia en Pine como parte del programa de los árboles de la Ciudad hace unos años. Hasta haciendo bien."

MEET THE RESIDENTS:

LAUREN

COVID-19 & Community Engagement

The impacts of COVID-19, including infection rates, decreased work opportunities and remote schooling, disproportionately affected Holyoke's economically and socially vulnerable residents that were a focus of the UFEP and engagement efforts.

The pandemic also significantly altered the UFEP's outreach and engagement efforts. Where in the past, in-person interactions would have been used for promotion, outreach and engagement (e.g. community bulletin boards, in-person events and meetings); the pandemic limited interactions and engagement activities to virtual events and online surveys.

It is unclear if these factors limited participation, however, it is important to acknowledge the impacts that COVID-19 had on the UFEP's community engagement. **Appendix A** provides observations, reflections and lessons learned from the community engagement process that can be used as Holyoke implements the UFEP.

TREE BENEFITS

The top five **tree benefits identified by residents as most important to their neighborhood are:**

» Provide shade/reduce energy bills
» Reduce air pollution
» Provide wildlife habitat
» Beautify the neighborhood
» Improve mood

> "My mother and I go to the park near our house and my mother who has Alzheimer's sits under a tree and removes her shoe so that she can feel the energy from the tree (nature)."
>
> -Holyoke Resident, Community Forum A

PARK TREES

The majority of residents (70%) felt that they were able to safely enjoy the trees in their neighborhood park.

TREE SPECIES

Residents who participated in Community Forum B were interested in having a variety of tree species growing in Holyoke, including flowering/ornamental trees, edible fruit and nut trees, and large shade trees. There was a strong preference for large shade trees, including species like sycamore and oak, that produce the most shade, cooling, and air quality benefits.

NEIGHBORHOOD TREES

75% of residents said that there were **too few trees in their neighborhood**. It follows that the majority also prioritized the need for additional trees to be planted.

> "The roads are unbearable in the summer as there are too few trees."
>
> -Holyoke Resident, Community Forum B

TREE CARE

When asked about whether they thought that **trees were well cared for in Holyoke, 40% agreed or strongly agreed. 50% responded as neutral** and explained that the reason for their answer was that maintenance varied by geographic area, timing, and availability of money.

> "My experience with city staff is that they have great care for trees, but not enough money is allocated to maintain trees well."
>
> -Holyoke Resident, Community Forum B

> "Tree maintenance is really expensive, so incentivizing people to take care of trees might help the private tree stock."
>
> -Holyoke Resident, Community Forum B

MEET THE RESIDENTS:
LUZROSA

"Birch Tree: The only one of the species I saw at Holyoke Heritage State Park. My favorite one, beautiful. The leaves of the tree, which contain a lot of Vitamin C, are used to make medicine. Birch is used for infections of the urinary tract that affect the kidney, bladder, uterus, and urethra. It is also used as a diuretic. Also provides shade and shelter for fauna..."

"Abedul: en único árbol de la especie que vi en Holyoke Heritage State Park. Mi favorito, hermoso. Las hojas del árbol, que contienen mucha vitamina C, se utilizan para fabricar medicamentos. El abedule se utiliza para las infecciones del tracto urinario que afectan al riñon, la vejiga, el útero, y la uretra. También se utiliza como diurético. También proporciona sombra y refugio a la fauna..."

"Here is me with my new English Plane tree that you planted! We have named him Reginald."

"Aquí estoy yo con mi nuevo plátano inglés árbol que plantaste! Los hemos llamado Reginald."

MEET THE RESIDENTS:

PRICE

TREE PLANTING

93% of residents agreed or strongly agreed that planting trees is important to improving the City of Holyoke.

80% of residents would be willing to help water and maintain a newly planted tree.

> "I can think of five trees alone in my neighborhood that have semi-recently been cut down. And not a single replacement has been planted. Trees are very important and provide numerous benefits, specifically to urban cities such as Holyoke."
>
> -Holyoke Resident, Survey Respondent

TREE PRIORITIES

The top tree priorities for residents:

» Plant more trees on school and park properties

» Plant more trees in public spaces in neighborhoods

» Better care for the trees we do have

» More funding for tree planting and care

» Help people who want to plant more trees where they live

> "Roots are breaking the pavement on the sidewalk, making it unsafe for walking and there are not enough trees for shade."
>
> -Holyoke Resident, Community Forum A

TREE PROBLEMS

The top five problems that residents encounter with trees:

» Roots cracking sidewalk and pavement

» Not enough trees in neighborhood

» Leaves and fruit dropping

» Limbs blocking sidewalks, signs, and streetlights

» Safety problems from trees or limbs falling

TREE CONCERNS

54% of residents indicated that not owning the property where they lived was their biggest tree-related concern, followed by 24% who never thought much about tree concerns and 11% who stated they produced too much yard waste.

> "I rent and can't plant trees where I live."
>
> -Holyoke Resident, Survey Respondent

> "I live in a condo and am not allowed to plant trees, even as an owner."
>
> -Holyoke Resident, Community Forum A

Stakeholder Engagement

To manage, grow, and care for Holyoke's urban forest, it is also important to understand the issues and priorities of City of Holyoke staff, elected officials, and partner agencies. To gather this input, interviews and surveys were conducted with the following stakeholders:

- » City of Holyoke Departments
- » Community Development
- » Conservation and Sustainability
- » Parks and Recreation
- » Planning and Economic Development
- » Public Works: Forestry
- » Public Works: Engineering
- » Public Safety: Building
- » City of Holyoke Mayor and City Council
- » Massachusetts Department of Conservation and Recreation

WHAT DID WE HEAR FROM STAKEHOLDERS?

The stakeholders varied from one another in terms of how often they interact with trees in their work, ranging from frequent to very limited. Even so, the following set of common issues and opportunities emerged over the course of the interviews.

City resources to properly maintain and plant trees (budget and staff). There are not sufficient resources dedicated to properly care for and plant trees in the city. The City of Holyoke relies heavily on grant funding and programs like the Massachusetts' Department of Conservation's Greening the Gateway to plant public trees; but those funding sources do not support routine pruning and removal of public trees. Stakeholders unanimously identified a need for sustainable and stable funding for urban forestry as a top priority.

Residents & maintenance on public trees. Insufficient city resources has led to a lack of proactive and routine tree maintenance and planting which leads to residents complaints and a "feeling that the city is unresponsive."

Tree canopy in the core downtown neighborhoods. There was a strong recognition among stakeholders that the downtown core neighborhoods lacked tree canopy cover, due in large part to the extensive amounts of impervious surfaces. Stakeholders identified opportunities to increase tree canopy cover in the core downtown neighborhoods including, updating development landscape standards, and using green roofs, suspended pavement and structural soil technologies to provide more growing space for trees.

Community engagement, outreach, and education. Community engagement, outreach, and education was recognized as a tremendous opportunity to improve Holyoke's tree canopy. Using feedback, input, and lessons learned from the UFEP's community engagement activities can help tailor the outreach strategies and educational content to meet the needs of the community and to help foster stewardship of tree planting and maintenance in the future.

What is Suspended Pavement?

Suspended pavement is a term that describes any system that supports the weight of pavement and allows for minimally compacted, quality soil to be available for tree roots to grow. Theses systems are used in highly urbanized, paved environments. An example of this technology is the trade product 'Silva Cells'.

Figure 7. Suspended Pavement

Downspout transfers roof runoff to underground storage system

Runoff flows to underground storage system and tree roots

Reinforced concrete sidewalk

Undisturbed soil sub-base

Uncompacted soil supports a healthy root system and holds more stormwater

Excess water overflows into stormwater distribution pipe

Concrete pillars or prefabricated modules set on undisturbed sub-base provide support of sidewalk over uncompacted soil layer
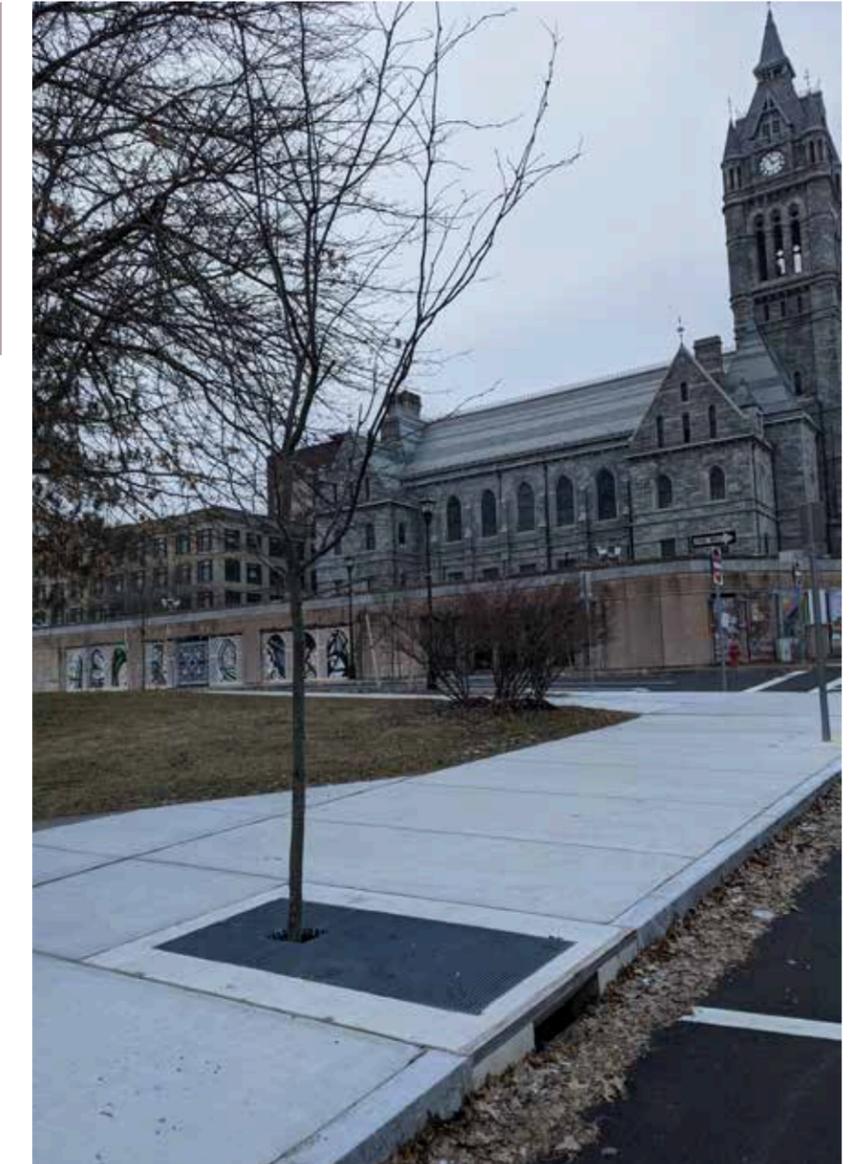

Image 12. A Honeylocust tree in Holyoke planted with suspended pavement.

Themes and Priorities

The input and feedback received during the Community and Stakeholder Engagement activities identified a set of community themes and priorities.

Equity. Residents do not have equal access to the environmental, social, and economic benefits Holyoke's urban forest provides.

Tree Canopy. The four neighborhoods of Churchill, Downtown, South Holyoke and the Flats have low tree canopy cover, ranging from 10–16%.

Impervious Surfaces (Buildings, Road, Sidewalks, etc.). The landscape of the four focus neighborhoods is dominated by impervious surfaces, which cover, on average, 70% of the land in the neighborhoods. For comparison, citywide impervious surfaces cover 30% of the land.

Resources (Budget & Staff). The City of Holyoke does not have sufficient funding or staff to address all of Holyoke's public tree care needs and ensure that high risk trees are removed in a timely manner.

Tree Maintenance. The City's current public tree maintenance program is *reactive*. A reactive program impacts the community's perception of the city's responsiveness to tree care needs and puts the public trees at risk, impacting their health and storm-readiness.

Climate Change. The effects of climate change are already being felt in Holyoke, including extreme storm events, flooding, and increasing temperatures, which can have a disproportionate impact on the city's most vulnerable residents.

Land Ownership. Over 90% of the residents in the four focus neighborhoods rent their homes and do not have control over whether they can plant trees on their property.

Community Engagement, Outreach and Education. Tree planting and care information that is culturally, linguistically, and age appropriate was identified as a need within the community.

Tree Protection/Preservation/Planting Standards. Holyoke does not have tree protection, preservation, or planting standards or ordinances for use by city staff or external stakeholders (e.g., developers).

Infrastructure Conflicts. Residents were concerned about tree roots raising sidewalks and creating tripping hazards, while other stakeholders raised concerns that the needs of infrastructure (e.g., roads and utilities) and development are sometimes prioritized over trees.

Interdepartmental Collaboration/Communication. Interdepartmental collaboration and communication needs to be improved to ensure that tree protection, preservation, and planting are considered in all construction and development projects.

Tree Planting & Post-Planting Care. The city does not have best management practices, standards, or specifications in place to ensure proper species selection, planting, and post-planting care of newly planted trees.

These themes and priorities together with issues and opportunities described in the next section, **State of the Urban Forest**, are the foundation of the UFEPs recommendations and action steps.

SECTION THREE:

State of the Urban Forest
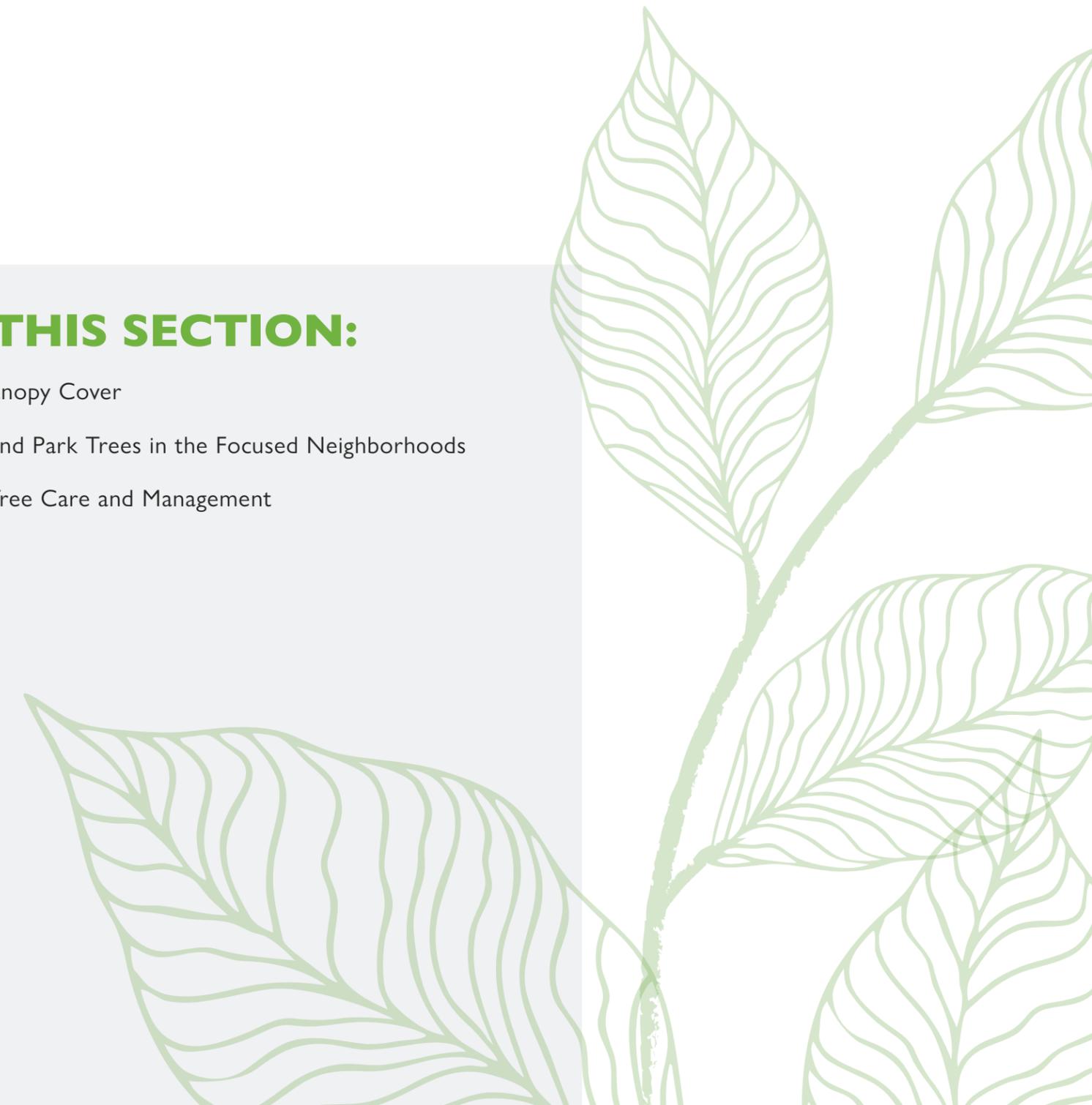
Introduction to the Urban Forest

To effectively and equitably grow and maintain its urban forest in the future, it is essential that Holyoke has knowledge and insight into the current conditions of the urban forest. This section explores Holyoke's urban forestry data, policies, and practices to gain an understanding of the current state of the urban forest.

What is the urban forest?

Holyoke's **urban forest** is made up of all of the trees growing within the city on both public and private property.

Image 13. Holyoke's Springhill neighborhood urban forest.

Tree Canopy Cover

The amount, location, and distribution of Holyoke's tree canopy is a driving force behind its ability to produce benefits to the community; **as tree canopy increases, so do the tree benefits**. In 2014, an urban tree canopy assessment studied Holyoke's Environmental Justice (EJ) areas, which includes the four focus neighborhoods (Churchill, Downtown, South Holyoke, and The Flats).[29] The assessment used aerial imagery from 2012 to measure the amount of tree canopy and other land cover in the study area (Map 2). Tree canopy is measured as the layer of leaves, branches, and stems of trees and other woody plants that cover the ground when viewed from above.

As Table 2 illustrates, the amount of tree canopy cover in the four target neighborhoods is low (12% on average) while the amount of impervious surfaces, like roads, buildings and sidewalks, is very high (average of 70%). The report established a canopy goal for Holyoke's environmental justice areas of 30% canopy cover by 2044.

Table 2. Canopy Cover in the Four Focus Neighborhoods

Neighborhood	Percent of Land Covered by Impervious Surfaces*	Percent of Land Covered by Tree Canopy**
Churchill	69%	10%
Downtown	72%	16%
South Holyoke	73%	12%
The Flats	66%	11%
City Average	30%	Data not available
*Holyoke Impervious Surfaces Mitigation Plan (2020)		
**Community Based Assessment of Urban Forestry Conditions, Holyoke (2014)		

Image 14. Trees in Pulaski Park (Downtown Neighborhood).

What is an Environmental Justice Area?

The Commonwealth of Massachusetts defines Environmental Justice areas as having **at least one** of the following:

Median Household Income. A census block group with an annual median household income that is equal or less than 65% of the statewide median household income;

Race. 25% or more of the residents identify as a race other than white;

English Isolation. 25% or more of households do not have anyone 14 years of age or older that speaks English only or very well.

Map 2. Holyoke Land Cover

LEGEND

Tree Canopy: The area of land that is covered above by a tree's leaf-covered branches.

Pervious: Land that allows rainfall to infiltrate the soil (grassy areas or low-lying vegetation such as parks, golf courses, and residential lawns).

Bare Soil: Previous surface area with no vegetation (areas such as vacant lots, construction areas, and baseball fields).

Impervious: An area that does not allow rainfall to infiltrate (buildings, roads, and parking lot).

Open Water: All lakes, ponds, streams, wetlands, and other mappable water features.

PRIORITY PLANTING AREAS

To help the city in achieving the Environmental Justice (EJ) areas canopy cover target, the 2014 urban tree canopy assessment provided a priority planting analysis. The analysis identified specific areas that would most benefit from tree planting by assessing a variety of environmental, economic, and social factors along with tree canopy cover. The priority planting analysis looked at proximity to hardscape, canopy fragmentation, floodplain proximity, soil permeability, slope, soil erosion, urban heat island index, income, minority populations, and English isolation. A priority ranking from Very Low (purple) to Very High (red) was assigned to areas within the four neighborhoods based on these factors to identify where tree planting would provide the most benefits (Map 2).

TARGETING TREE PLANTING EFFORTS

In 2014, the Massachusetts Department of Conservation and Recreation's (DCR) Greening the Gateway Cities program began working in Holyoke to plant trees in these high priority areas. As of 2020, approximately 2,000 trees (including replacement trees) have been planted.

One potential issue for Holyoke in reaching its 30% canopy goal is that to achieve it, tree planting must occur on both **public and private property.** This may present challenges in the four urban core neighborhoods where most residents are renters and cannot readily plant on the property where they live without landowner permission.

Map 3. Holyoke Priority Planting Areas

LEGEND

- ■ Very Low
- ■ Low
- ■ Moderate
- ■ High
- ■ Very High
- ☐ Neighborhood Boundary

HOLYOKE HISTORIC CHANGE ANALYSIS

Distribution of tree canopy varies across Holyoke, and changes over decades sometimes gradually and sometimes abruptly due to factors including, weather, climate, disease, disinvestment, economics, and development. This variability has led to an inequitable distribution of tree canopy cover, which means that areas with lower tree canopy cover receive fewer benefits from the urban forest.

Marc Healy, a Ph.D. candidate in the Graduate School of Geography at Clark University in Worcester, Massachusetts, conducted a historical change analysis of Holyoke's urban tree canopy from 1952–2017. An overview of his research is shown below.

Healy studies urban canopy cover change at the municipal level by analyzing aerial imagery paired with local social, economic, and political histories to uncover legacies that have led to present day urban tree canopy conditions. His research offers municipalities and urban forestry professionals a method to utilize historical datasets in management decision-making.

METHOD

Canopy cover was assessed by calculating a tree canopy cover percentage for each time period. Canopy cover layers from two subsequent years (1952–1971, 1971–2003, 2003–2014) were then crossed to create a layer of canopy that exists between the two time periods. This was then combined with the original canopy layers to make gain/loss maps. All imagery used in this study was leaf on (captured while trees had leaves) and analyzed manually.

FINDINGS

The greatest gains in tree canopy cover (TCC) percentage came from areas with the most impervious surface, but some existing canopy may be in danger as areas are redeveloped. The research found that during poor economic periods unmaintained tree canopy increased while during economically strong periods canopy loss increased.

These show the canopy change in the four target neighborhoods from 1952–1971; 1971–2003; and 2003–2014, highlighting areas where canopy was lost (red), gained (yellow), and remained the same/persistence (blue).

Table 3. Holyoke Tree Canopy Analysis

Neighborhood	1952 Tree Canopy Cover	1971 Tree Canopy Cover	2003 Tree Canopy Cover	2014 Tree Canopy Cover
The Flats	2.9%	6.0% ↑	13.2% ↑	12.3% ↓
South Holyoke	2.9%	4.4% ↑	9.4% ↑	11.5% ↑
Downtown	8.7%	8.2% ↓	14.7% ↑	13.6% ↓
Churchill	7.1%	5.2% ↓	7.6% ↑	9.6% ↑

1953–1971

1971–2003

2003–2014

GAIN   LOSS   PERSISTENCE

Street & Park Trees in the Focus Neighborhoods

As part of the development of the UFEP, **Holyoke's first inventory of public street and park trees** was conducted in the four target neighborhoods of Churchill, Downtown, the Flats, and South Holyoke. Arborists from Davey Resource Group visited each street and park tree in the four neighborhoods in February 2021 and gathered information on their species, size, location, condition, and maintenance needs. The information that follows provides a summary of the composition and benefits of the public street and park trees in the four neighborhoods.

TREES BY NEIGHBORHOOD

A total of 2,653 trees were inventoried—Figure 8 shows the breakdown of trees collected by neighborhood.

A majority of the street and park trees inventoried are found Downtown (1,235 trees or 47% of the inventoried trees), while significantly fewer street and park trees were found growing in South Holyoke (378 trees or 14%) and The Flats (263 trees or 10%) neighborhoods. The Downtown area is slightly larger than the other neighborhoods, and contains several larger parks and public areas (e.g., Pulaski Park, Veteran's Park, and the Library). However, when looking at an aerial image of the public trees inventoried, it is clear that there is an uneven distribution of street and park trees in The Flats neighborhood compared to Downtown (Map 4).

Figure 8. Holyoke Tree Inventory by Neighborhood

Legend: ■ **Holyoke Trees**
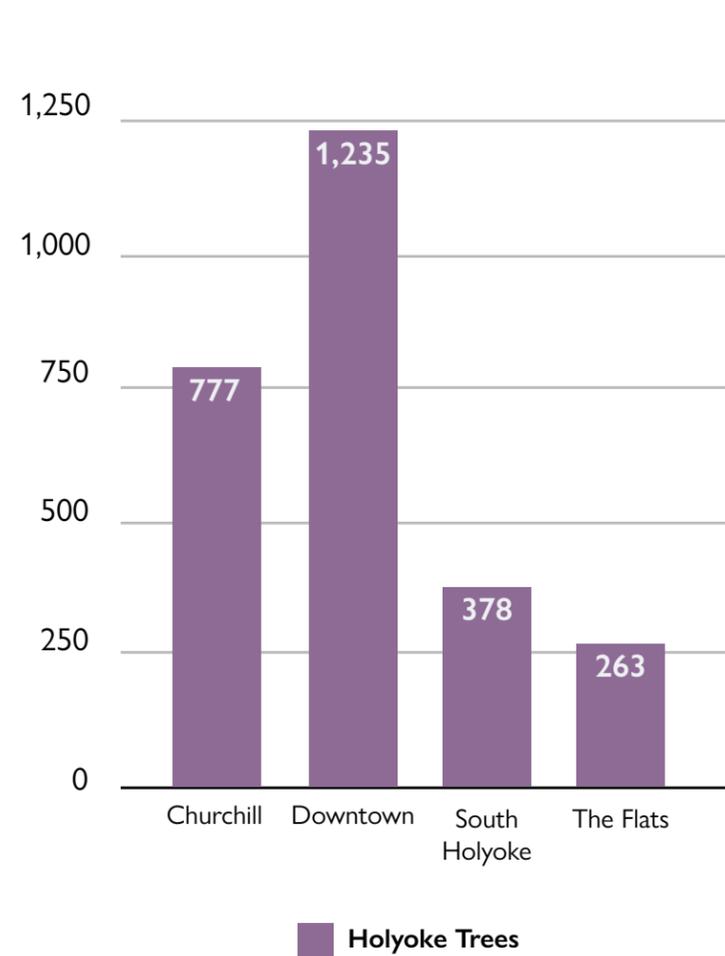
Map 4. Aerial View of Public Trees Inventoried (TreeKeeper)

Green dots are the inventoried public street and park trees in the four neighborhoods.

Street & Park Tree Inventory vs. Urban Tree Canopy Assessment. What's The Difference?

Street & Park Tree Inventory. An assessment of the public street and park trees managed by the City of Holyoke. The inventory involves an Arborist visiting each tree in the field and gathering data on a variety of attributes, including species, size, condition, and maintenance needs.

Urban Tree Canopy Assessment. This analysis uses aerial imagery to measure tree canopy and other land cover on public and private property. The data from an urban tree canopy assessment can help identify and prioritize locations for tree planting and tree protection on public and private property.

NEIGHBORHOOD SPECIES DIVERSITY

Species diversity is the variety of tree species in the urban forest. Having more tree species (greater diversity) maximizes the many benefits that trees provide, and safeguards the urban forest from pests, diseases, and extreme weather events such as storms and drought.

In the inventoried area, approximately 100 different species were recorded. However, they are not evenly distributed across the population. In fact, the top five species in Holyoke make up almost half (45%) of the trees inventories in the neighborhoods.

The top five species in the four neighborhoods shown in Figure 9 are: Norway maple (12%), Honeylocust (11%), Green Ash (9%), Callery Pear (7%), and Littleleaf Linden (6%). Industry guidelines recommend that a single species should compose no more than 10% of the tree population to reduce species susceptibility to pests and diseases. Norway Maple and Honeylocust exceed the recommended 10% threshold. When planting new tree species, Holyoke should look at planting species that are less common but suitable for growing in Holyoke's climatic conditions with a preference towards Massachusetts-native tree species, where appropriate.

Figure 9. Top Five Species in the Four Neighborhoods
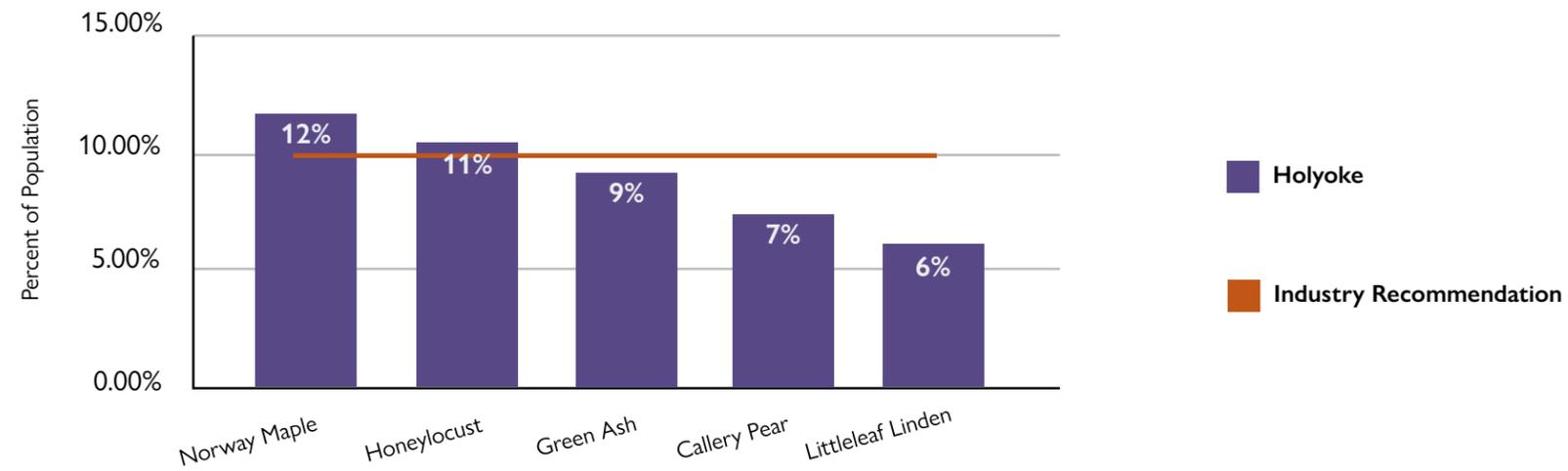
Legend:
- Holyoke
- Industry Recommendation

HOLYOKE'S TOP FIVE TREE SPECIES IN THE FOCUS NEIGHBORHOODS

Norway Maple

Honeylocust

Green Ash

Callery Pear

Littleleaf Linden

Neighborhood Benefits of Holyoke's Public Trees

The 2,653 inventoried public street and park trees in the Churchill, Downtown, South Holyoke and the Flats neighborhoods provide $5,605 ($2.11 per tree) in **annual** environmental benefits to residents.

INVASIVE TREE SPECIES

Holyoke's inventoried street and park trees are made up of a variety of native and non-native species. This mixed composition is considered typical, based on DRG's experience conducting tree inventories for hundreds of US cities, as the harsh urban environment requires species that are tolerant of these conditions. What Holyoke needs to be aware of are non-native, invasive tree species that can seed and grow prolifically—having a potentially negative impact on native forests. Norway Maple, for example, is considered an invasive species by the Commonwealth of Massachusetts.[30]

Norway Maples produce high numbers of seeds each year, leading to dense monoculture stands that crowd out native plants. The City of Holyoke should periodically review what types of trees are allowed to be planted in the city to ensure they are not planting invasive species. Natural areas, parks, vacant lots, and yards that are near plantings of new, unproven, non-native tree species should be monitored to ensure new species do not start sprouting up on their own and aggressively spreading.

Image 15. Norway Maple

SPECIES VULNERABILITY—TREE PESTS & DISEASES

Insects and diseases can cause considerable damage and even death to trees. Their impacts can negatively affect the health, resilience, and benefits the urban forest provides; and can also lead to unexpected costs for residents and the city who must care for or remove the affected trees.

Figure 10 shows the percent of the inventoried trees susceptible to some known pests and diseases in and around Massachusetts. The introduced pests winter moth (*Operophtera brumata*) and spotted lanternfly (SLF, *Lycroma delicatula*) have the potential to affect the largest portion of the inventoried trees (56% and 43%, respectively). The ability of these two insect pests to survive on a wide range of host species makes them potentially devastating invasive pests. While there are currently no SLF infestations in Massachusetts, it is a potential threat to Holyoke and should be monitored. Winter moth outbreaks have been observed on Cape Cod and along the coast of the state, and the insect has been found as far west as Athol.[31, 32]

Figure 10. Percent of Inventoried Species Susceptible to Pests and Diseases

Invasive Pests with a Regional Presence	Percent of Inventoried Trees Susceptible
Wintermoth	56%
Spotted Lanternfly	43%
Asian Longhorned Beetle	38%
European Gypsy Moth	25%
Oak Wilt	9%
Emerald Ash Borer	9%
Southern Pine Beetle	1%
Pine Shoot Beetle	1%
Dutch Elm Disease	1%
Elongate Hemlock Scale	0%
Hemlock Wooly Adelgid	0%
Beech Leaf Disease	0%
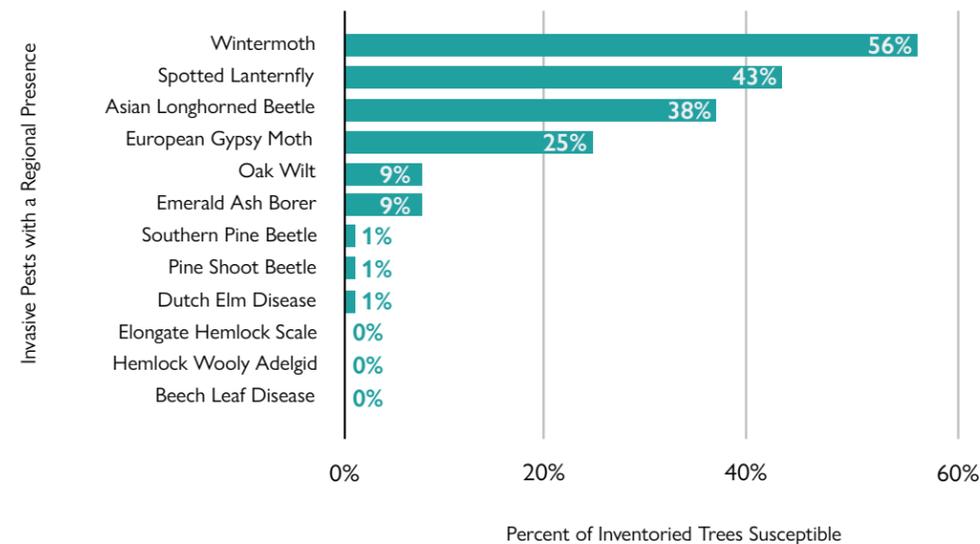
Image 16. Spotted Lanternfly

An insect that currently poses a significant risk to Holyoke's tree canopy is the emerald ash borer (EAB, *Agrilus planipennis*). EAB is an invasive wood boring beetle from Asia that feeds on and can kill all North American species of Ash (*Fraxinus*). EAB is present in Holyoke, and provides an example of why species diversity is important to consider. In the neighborhood of South Holyoke alone, over 35% of the trees growing along streets and in parks are Green Ash (*Fraxinus pennsylvanica*). There is a significant risk of losing those trees if they are not chemically treated to kill the insect (Map 5).

As this plan is being drafted, there are plans to treat some affected ash trees. Ash trees that have been selected for treatment are those that were identified during the February 2021 tree inventory as being in fair or better condition and are only moderately infested by EAB with few dead and dying branches. Unfortunately, not all of Holyoke's ash trees will be selected for treatment. Research has shown that heavily infested ash trees with many dead and dying branches are not able to be saved with treatment and will need to be removed.

It is important to remember that Figure 8 only represents public tree data collected during the inventory of the four focus neighborhoods. Many more trees throughout Holyoke, including those on private property, may be susceptible to hosting these and other invasive pests (see **Appendix D** for information on tree pests and diseases). Regularly updating the public tree inventory and routine inspection of city trees for signs and symptoms of pests and diseases should be conducted to catch and control infestations early before they can become well-established within the urban forest.

Image 17 (Above). Close up of an Emerald Ash Borer.

Image 18. (Right) Downy Woodpecker trying to reach EAB larvae.

Image 19. Ash trees located on Main Street in South Holyoke.

Map 5. Ash Trees in the South Holyoke Neighborhood
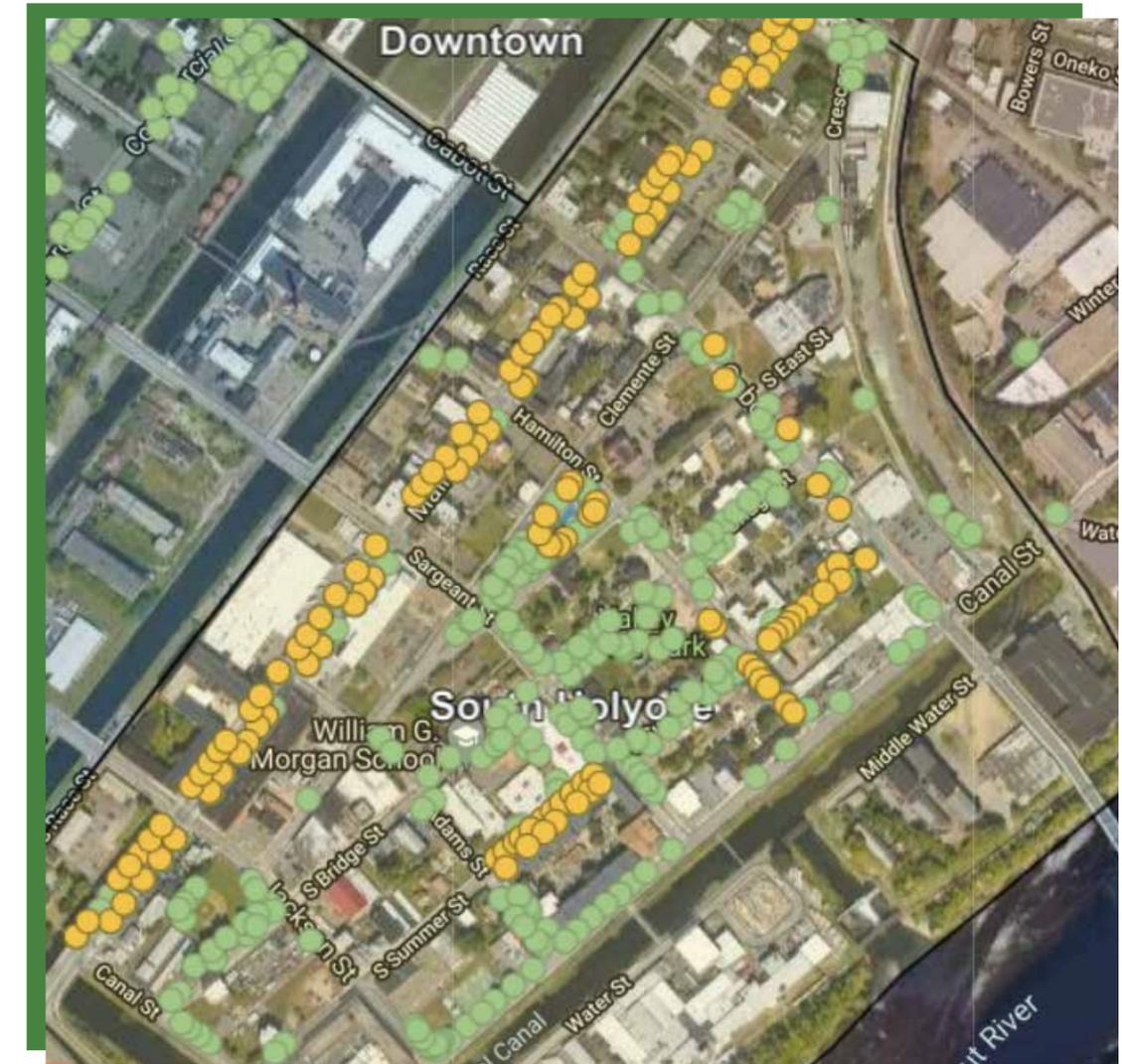
Yellow dots represent ash trees in South Holyoke. Green dots are other tree species.

SIZE AND AGE COMPOSITION

The size of trees (the trunk diameter) can serve as a general predictor of their relative age. Figure 11 compares the relative age distribution of the inventoried tree population in Holyoke's four target neighborhoods to the industry recommended distribution. In the inventoried neighborhoods, tree size class distribution trends towards industry recommendations.

The industry recommended age distribution helps ensure that the overall canopy contains trees at varying stages of maturity. If most of a city's tree population is the same age, there is a risk of greatly reduced canopy cover when these trees die and are removed around the same time at the end of their natural lifespan.

The DCR Greening the Gateway Cities program has planted over 2,000 trees (including replacements) in downtown Holyoke neighborhoods, which likely accounts for the majority of trees in the Young (0–8" DBH) size class. Without this program it is likely the City of Holyoke would have far fewer young trees throughout its urban core.

To maintain a sustainable urban forest, it is important for Holyoke to have a mix of size/age classes to prevent a significant loss in tree canopy cover. To ensure there is an adequate mix of size/age classes:

» Preservation and care of mature trees should be prioritized to prevent loss of current tree canopy.

» New trees, especially species with large canopies at maturity, should be planted to replace old, dying, or dead trees.

» A variety of tree species should be planted that have different growth rates, mature size, and life spans.

CONDITION OF NEIGHBORHOOD TREES

Figure 12 analyzes the condition of the inventoried tree population along with its relative age distribution, providing insight into the inventoried population's stability. While a majority of the trees are in fair condition or better across size classes, **nearly 20% of the trees in the established, maturing, and mature size class are in poor or dead condition.** Proper tree maintenance and care will help reduce the proportion of mature and maturing trees in "Poor" or worse condition.

Figure 11. Relative Age Distribution
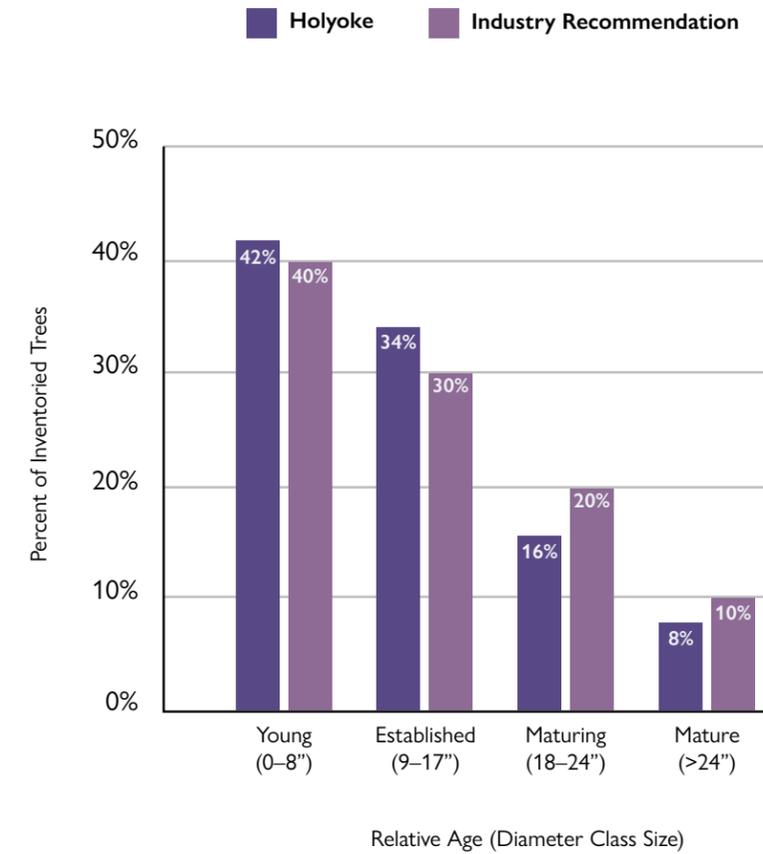
Figure 12. Condition of Inventoried Trees
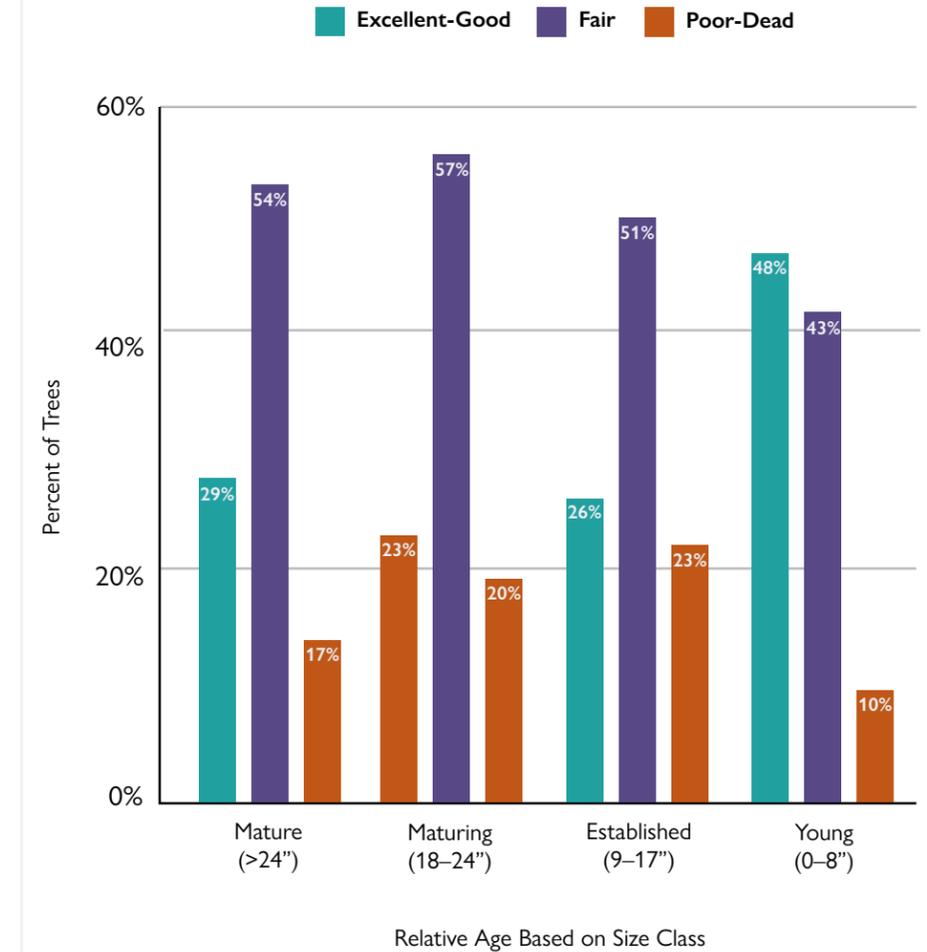
HOLYOKE PLANS AND POLICIES

Across the City, departments are actively working to improve and enhance the services provided to the community. In order to support trees and the urban forest, collaboration and engagement across City departments and divisions is essential. A review of select City of Holyoke plans, studies, programs, and initiatives was conducted to identify how the UFEP can support the implementation of their recommendations, and vice versa.

Community Based Assessment of Urban Forestry Conditions (2014): Urban canopy assessment of Holyoke's urban forest. Provides recommendations to expand and improve the urban forest and establishes a goal of 30% tree canopy cover in Holyoke's Environmental Justice areas by 2044.
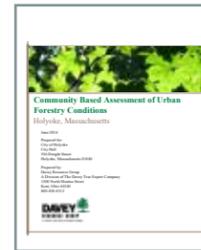
It was found that significant participation would be needed from private landowners to plant trees on their property to hit 30% UTC. The UFEP provides recommendations and action steps for community engagement to educate the public about trees and support activities to increase tree canopy cover on public and private property to achieve the 30% tree canopy goal.

Greening the Gateway Cities (2014): A program of the Commonwealth of Massachusetts Department of Recreation and Conservation, Greening the Gateway Cities has been planting trees within Environmental Justice areas of Holyoke since 2014. The goal is to plant 2,400 trees within the city.

Once this goal is reached, the program plans to move out of Holyoke in the coming years to focus on other Massachusetts gateway communities. As this program moves out of Holyoke, the UFEP provides recommendations to engage the public and community to continue the momentum of tree planting and care in the community.
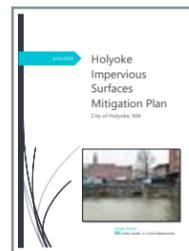
Impervious Surfaces Mitigation Plan (2020): Plan developed to identify strategies to reduce and mitigate impervious surfaces in the core downtown neighborhoods. Strategies for mitigation include incentivizing green infrastructure in development projects, implementing the Green Streets Vision, and developing a community planting program.

In the downtown core the goal is to incorporate green spaces between and among buildings, with plans for newly constructed areas to cluster buildings together to set aside open space when land is developed. The UFEP supports implementation of these recommendations.

Natural Hazards Mitigation Plan Update (2016): Plan to address natural hazards including floods, droughts, dam failures, earthquakes, snow/ice storms that face Holyoke. The plan acknowledges trees and the potential damage they can cause during hazard events and references the removal of "high risk trees" as a strategy to mitigate against damage.

When the Natural Hazards Mitigation Plan is updated, new data and information on Holyoke's trees and tree canopy from the UFEP should be incorporated into the plan.

Open Space and Recreation Plan (2018): Goal of making open space an integral component of community development at the neighborhood, city-wide, and regional scale. Trees and greenspace are incorporated throughout this plan.

Open space should be enjoyed by all, and the UFEP supports implementation of this plan to ensure that opportunities are available for people of all ages, abilities, and socioeconomic backgrounds.

Urban Renewal Plan (2012): Plan to develop and revitalize Holyoke's core downtown area. The plan includes using trees and other green infrastructure to help improve the streetscape.

One example from the Urban Renewal Plan is the Cabot Street Gateway, which has the goal of providing better access to the Flats neighborhood through streetscape improvements such as the addition of more street trees. The recommendations of this plan, when implemented, will support the UFEP and help increase canopy cover in the four downtown target neighborhoods.

Note: The Pioneer Valley Planning Authority is conducting a review of Holyoke's stormwater, floodplain, zoning, subdiviston, and wetland protection codes and regulations for opportunities to promote trees and low impact development practices.

CITY NURSERY

In 2015, the City of Holyoke established a tree nursery with funding from a DCR Urban Forestry Challenge Grant. The Nursery, located near the city's Wastewater Treatment Plant, was planted with 250 whips of varying species planted in grow bags. The goal of the Nursery was to provide Holyoke's Department of Public Works with trees that could be planted in a few years in areas outside the Greening the Gateway planting zones. Unfortunately, the nursery has not been able to meet its intended goal due to lack of city staff available to manage and support it.

Many of the trees that remain in the nursery have grown too large to be transplanted easily.

The City Nursery does present many opportunities including growing tree species specific to community needs that may be hard to find at commercial and wholesale nurseries; nurturing free or inexpensive tree saplings; providing workforce development training in growing and caring for trees. It also provides potential partnership opportunities between Holyoke and community organizations including utilizing the nursery to grow trees for community tree giveaways; acting as an outdoor classroom for young tree training education program; and providing volunteer opportunities to learn about nursery operations.

Image 20. City of Holyoke's Nursery.

Public Tree Care and Management

In accordance with Massachusetts General Law Chapter 87, trees that fall within the public right-of-way (ROW) are considered a public shade tree. The chapter establishes the powers of the Tree Warden (City Forester), policies for removing and planting public trees, and penalties for violating the law.

In Holyoke, the city's Tree Warden (Urban Forester) is housed in the Department of Public Works, and is responsible for the maintenance of trees growing in the city ROW. Care and maintenance of Holyoke's public trees are conducted primarily by City Tree Care Contractors, and are generally completed on a reactive basis and not through a proactive or routine maintenance program.

MANAGEMENT TOOLS

Tree Inventory

The City of Holyoke does not currently have a comprehensive inventory of all public trees. The inventory completed as part of this UFEP only covered Holyoke's Center City neighborhoods (Churchill, Downtown, The Flats, and South Holyoke). A comprehensive, up-to-date GIS-based public tree inventory is the foundation of a municipal urban forestry program—providing crucial information on the composition, condition, risk, and maintenance needs of public trees. It serves as the basis for managing risk, prioritizing tree care activities, delivering urban forestry services cost effectively, and developing plans and policies that maximize tree benefits and minimize risks.

Using tree inventory data to establish work priorities helps to identify the resources needed, including funding, staff, and equipment to sustainably manage and care for the urban forest. The inventory should be updated every 5–10 years, and can serve as a measuring tool for Holyoke's progress toward urban forestry goals.

Plans & Programs

Holyoke does not currently have essential urban forestry management plans or programs in place, including:

Urban Forest Management Plan and Public Tree Maintenance Program. A three- to five-year **work plan** for the city's publicly managed trees **based on updated data from a public street and park tree inventory**. It provides an assessment of the current city-managed trees based on inventory data, identifies risk and maintenance needs, the resources needed to address them, and a schedule for completion.

Risk Management Program. A risk management program focuses on ensuring the urban forest is proactively managed to **eliminate risk with a focus on public safety.** This program can be outlined in an urban forest management plan.

Storm Response and Disaster Preparedness Plan. A disaster preparedness and response plan **addresses and responds to disasters in the community**. The plan includes staff, roles, contracts, response priorities, debris management, and a communication plan.

Tree Planting Plan. Outlines the **locations of tree planting over a one- to five-year time horizon.** The plan uses data from the tree inventory and/or urban tree canopy assessment to target planting in areas of greatest need within the community.

The development of a comprehensive urban forest management plan should address cohesive management of the urban forest across city departments and fold in many of the other plans and programs that Holyoke is missing (risk management, public tree maintenance, disaster preparedness) to develop a comprehensive management plan. A public tree inventory is a key component in developing an urban forest management plan.

Tree Maintenance Through an Equity Lens

A reactive City street and park tree maintenance program is not only costly but it can also raise equity issues.

In a reactive management system, trees are not maintained based on their need but instead are prioritized for maintenance based on requests by residents, City management, and City leadership. Typically residents that report tree concerns own their homes and live in more affluent neighborhoods. Renters may feel they cannot report tree issues since they do not own the property, which can be a major concern in the four target neighborhoods where the majority of residents are renters.

Trees can be prioritized by Risk Rating, which will ensure that the trees that need immediate care (no matter where they are located) are attended to first. Risk Rating data was collected during the tree inventory of Holyoke's four Center City neighborhoods, but will need to be collected for the remainder of the city when the tree inventory is completed.

RESOURCES

Funding

Stable and predictable funding is critical to effectively manage and grow Holyoke's publicly managed urban forest. In fiscal year 2021, Holyoke's Forestry budget was $158,825, of which just over $60,000 was allocated for contracted forestry services which includes tree removal and pruning.

Holyoke's Forestry budget is not sufficient to address all of Holyoke's public tree care needs. For example, the tree inventory identified recommended maintenance needs of the public trees within the four neighborhoods (Figure 13). As a majority of maintenance work is performed by City Tree Care Contractors and not city staff, the $60,000 contracted services budget was used to determine how many years it would take to perform all the recommended tree removals in the four target neighborhoods. Based on city estimates that contractors can remove two to three trees per day, it will take between three- and five years to remove all 307 trees (Figure 13) in the four target neighborhoods.

To estimate pruning, industry sources were used to determine the average amount of trees that can be pruned in an eight-hour work day. The number of trees that can be pruned per day is approximately four to five trees.[33] Using the same contracted services city budget of $60,000, and the 1,494 trees that are recommended for pruning (Figure 13), it would take approximately 10 years to prune just the trees within the four inventoried neighborhoods.

Estimated Cost to Complete Holyoke's Street & Park Tree Inventory

To complete Holyoke's public tree inventory, an estimated 9,000 public street and park trees will need to be inventoried. Based on the cost to inventory the four target neighborhoods, it is **estimated to cost $37,170** to inventory the City's remaining public trees.

Note: This is an estimate and actual costs to complete the inventory will depend on several factors, including the number of trees and the idata/information being collected.

The next section, **Maintenance Schedule and Budget**, provides a program to proactively maintain the trees in the four target neighborhoods.

Maintenance Schedule and Budget

Utilizing 2021 Holyoke tree inventory data from the four focus neighborhoods, an annual proactive maintenance schedule was developed detailing the recommended tasks to complete each year. The budget projections are based on DRG's industry knowledge and public bid tabulations. A complete table of estimated costs for Holyoke's five-year tree management program follows.

This schedule provides a framework for completing the recommended inventoried tree maintenance over the next five years. Following this schedule can shift tree maintenance activities from a reactive to a more proactive tree care program.

This maintenance and budget schedule is just for the public trees in the 1.6 square mile area of the four target neighborhoods. **A complete inventory of the remaining street and park trees in Holyoke is crucial in determining the true funding needs of the public tree care program.**

Figure 13. Recommended Maintenance Needs
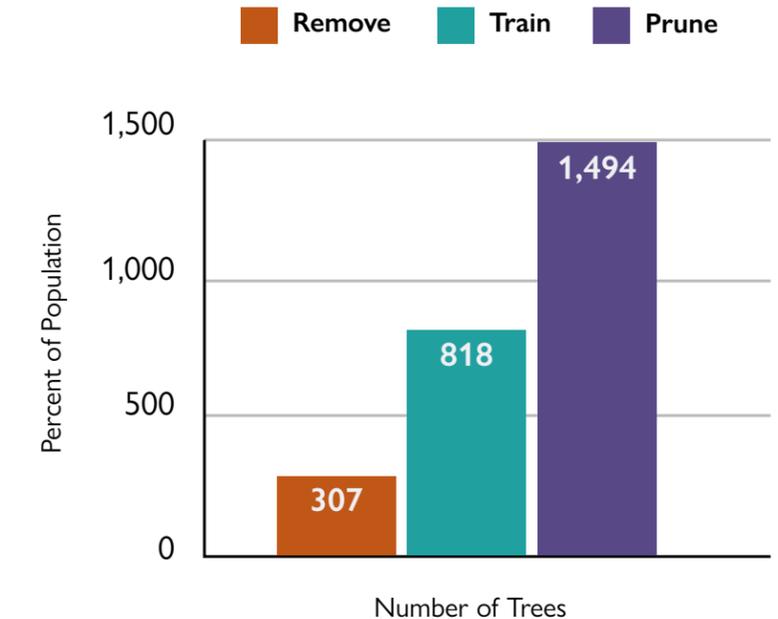
As the reactive maintenance transitions to proactive maintenance the overall budget lowers, which means **significant investments early on will reduce tree maintenance costs over time.**

Table 3. Budget Table

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High and Moderate Priority Removals	1-6"	$43	-	-	-	-	-	-	-	-	-	-	$0
	7-12"	$138	21	$2,898	-	-	-	-	-	-	-	-	$2,898
	13-18"	$314	47	$14,758	-	-	-	-	-	-	-	-	$14,758
	19-24"	$605	35	$21,175	-	-	-	-	-	-	-	-	$21,175
	25-30"	$825	10	$8,250	-	-	-	-	-	-	-	-	$8,250
	31-36"	$1,045	2	$2,090	-	-	-	-	-	-	-	-	$2,090
	37-42"	$1,485	2	$2,970	-	-	-	-	-	-	-	-	$2,970
	>43"	$2,035	2	$4,070	-	-	-	-	-	-	-	-	$4,070
Activity Total(s)			119	$56,211	0	$0	0	$0	0	$0	0	$0	$56,211

Table 3. Budget Table (Continued)

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Low Priority Removals	1-6"	$43	-		-	-	77	$3,311	-	-	-	-	$3,311
	7-12"	$138	-	-	-	-	60	$8,280	-	-	-	-	$8,280
	13-18"	$314	-	-	35	$10,990	-	-	-	-	-	-	$10,990
	19-24"	$605	-	-	11	$6,655	-	-	-	-	-	-	$6,655
	25-30"	$825	-	-	1	$825	-	-	-	-	-	-	$825
	31-36"	$1,045	-	-	3	$3,135	-	-	-	-	-	-	$3,135
	37-42"	$1,485	-	-	0	$0	-	-	-	-	-	-	$0
	>43"	$2,035	-	-	1	$2,035	-	-	-	-	-	-	$2,035
Activity Total(s)			0	$0	51	$23,640	137	$11,591	0	$0	0	$0	$35,231
High and Moderate Priority Pruning	1-6"	$25	-	-	-	-	-	-	-	-	-	-	$0
	7-12"	$75	1	$75	-	-	-	-	-	-	-	-	$75
	13-18"	$120	31	$3,720	-	-	-	-	-	-	-	-	$3,720
	19-24"	$170	28	$4,760	-	-	-	-	-	-	-	-	$4,760
	25-30"	$225	18	$4,050	-	-	-	-	-	-	-	-	$4,050
	31-36"	$305	9	$2,745	-	-	-	-	-	-	-	-	$2,745
	37-42"	$380	8	$3,040	-	-	-	-	-	-	-	-	$3,040
	>43"	$590	6	$3,540	-	-	-	-	-	-	-	-	$3,540
Activity Total(s)			101	$21,930	0	$0	0	$0	0	$0	0	$0	$21,930

Table 3. Budget Table (Continued)

Activity Cost			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Routine Pruning (5-year Cycle)	1-6"	$25	14	$350	13	$325	13	$325	13	-	13	-	$1,000
	7-12"	$75	97	$7,275	97	$7,275	97	$7,275	96	$7,200	96	$7,200	$36,225
	13-18"	$120	86	$10,320	86	$10,320	86	$10,320	86	$10,320	85	$10,200	$51,480
	19-24"	$170	53	$9,010	52	$8,840	52	$8,840	52	$8,840	52	$8,840	$44,370
	25-30"	$225	17	$3,825	17	$3,825	16	$3,600	16	$3,600	16	$3,600	$18,450
	31-36"	$305	6	$1,830	6	$1,830	6	$1,830	6	$1,830	5	$1,525	$8,845
	37-42"	$380	6	$2,280	5	$1,900	5	$1,900	5	$1,900	5	$1,900	$9,880
	>43"	$590	4	$2,360	4	$2,360	3	$1,770	3	$1,770	3	$1,770	$10,030
Activity Total(s)			283	$37,250	280	$36,675	278	$35,860	277	$35,460	275	$35,035	$180,280
Young Tree Training (3-year Cycle)	1-10"	$30	273	$8,190	273	$8,190	272	$8,160	273	$8,190	273	$8,190	$40,920
Activity Total(s)			273	$8,190	273	$8,190	272	$8,160	273	$8,190	273	$8,190	$40,920
New Tree Planting and Maintenance	Purchasing	$250	50	$12,500	50	$12,500	50	$12,500	50	$12,500	50	$12,500	$62,500
	Planting & Watering	$200	50	$10,000	50	$10,000	50	$10,000	50	$10,000	50	$10,000	$50,000
	Mulching	$25	50	$1,250	50	$1,250	50	$1,250	50	$1,250	50	$1,250	$6,250
Activity Total(s)			150	$23,750	150	$23,750	150	$23,750	150	$23,750	150	$23,750	$118,750
Activity Grand Total			926		754		837		700		698		3,915
Cost Grand Total				$95,190		$92,255		$79,361		$67,400		$66,975	$401,181

STAFF AND EQUIPMENT

Holyoke's City Forester is the only staff person that has dedicated public tree care responsibilities. However, their duties also include parks maintenance activities, which often take precedence over tree care responsibilities. The biggest challenges expressed by staff were lack of staff capacity and equipment to perform tree maintenance in-house.

Table 4 lists the forestry equipment as of April 2021, and staff's assessment of equipment condition.

Benchmarking

Benchmarking is an important tool to help a community understand how its urban forestry activities and budget align with other communities. Holyoke's urban forestry operation and maintenance budget was benchmarked against the nearby municipalities of Chicopee and Springfield. Holyoke's per-capita spending was about 20% lower than the average of the two communities (Table 5).

Table 4. Holyoke Available Equipment

Equipment Year/ Make/ Model	Condition	Department
2017 Ford F250 SD	Like new	Parks/Forester
1990 Ford F700	Replacement on order	DPW—Forestry Aerial Tree Truck
1994 Rayco RG 1635A	Operable	DPW Forestry Stump Grinder*
1994 Brush Bandit 200+	Operable	DPW Forestry Wood Chipper
*Equipment needs identified by City of Holyoke staff:		
» New stump grinder		

Note: These municipal budgets are not sufficient to perform all necessary work. For example, the City of Springfield required an additional budget allocation of $248,000 this fiscal year for emergency storm work—bringing their actual FY21 budget to $970,000. As more frequent and intense storms, rising temperatures, and extreme weather occur due to climate change, Holyoke will need to prepare and factor this into their municipal budget.[34]

Table 5. Urban Forest Operations and Maintenance Budgets for Holyoke, Chicopee, and Springfield.

Municipality	2021 Forestry Budget	Population (US Census: 2019 estimate)	Per capita	Contracted Maintenance	Contracted amount	# of Forestry Employees	Street Miles
Holyoke	$158,825	40,117	$3.96	38%	$60,346	1	138
Chicopee	$277,000	55,126	$5.02	3%	$10,000	5	221
Springfield	$722,000	153,600	$4.70	12%	$90,000	9	540

*Budgets provided by the City of Chicopee and City of Springfield

HOLYOKE'S URBAN CANOPY

In order to pursue a more proactive approach to Holyoke's urban canopy, additional funding and resources are required for the forestry department. Lack of a routine and systematic tree maintenance program puts Holyoke's public trees at risk, impacting their health and storm-readiness. Trees pruned on a routine basis by trained professionals develop proper form and structure which leads to a variety of benefits[35], including:

Lowering costs. Reduces per tree trimming costs (economies of scale) compared to reactive pruning done in response to storm damage.

Addressing hazards & reducing liability. Eliminates sight clearance and immediate hazards.

Actively monitoring tree health. Early identification and correction of insect/disease problems leading to fewer tree mortalities.

Lessening storm damage. Properly pruned trees develop correct form and structure and are less susceptible to storm damage.

Reducing future tree care costs. Trees pruned on a regular cycle—especially when young—require less work in the future lowering maintenance costs.

Improving customer service. Reduces the number of tree-related service requests and improves customer service by pruning before trees become a problem or hazard.

Creating a resilient urban forest. Proactive tree pruning helps to develop a healthy, sustainable, and resilient urban forest.

When the city maintains public spaces, it sends a positive message to residents who then feel valued and cared for.

Figure 14. Moving Towards a Proactive Maintenance Program

Reactive tree maintenance (top)
Attending to tree hazards and conditions on an as-needed or emergency only basis is costly and yields more long-term damage to roadways and tree health.

Preparing the City (middle)
Before proactive tree maintenance can happen, current conditions need to be tended to. Trees must be removed or replaced, and sidewalks and streets must be repaired.

Proactive tree maintenance (bottom)
A proactive management approach has many benefits for the City and urban canopy, including cost savings, reduced hazards, and creating a resilient and healthy urban forest for Holyoke's residents.
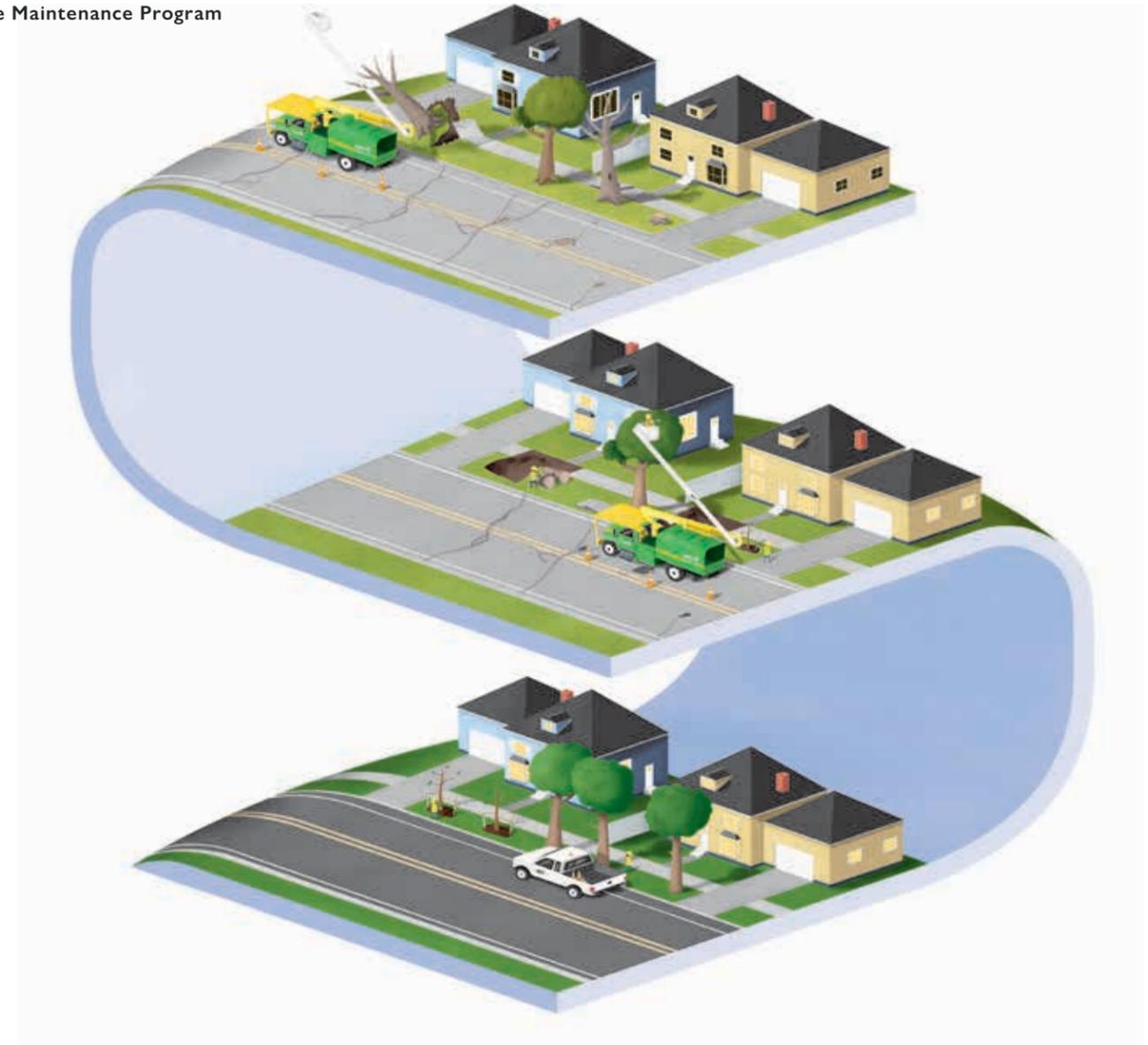
Recommendations

Recommendations

The Urban Forest Equity Plan recommendations and action steps are based on the priorities, challenges, and opportunities identified during the planning process and outlined in **Sections Two and Three**. They focus on providing **all of Holyoke's residents and neighborhoods** equal access to a healthy, sustainable, and resilient urban forest and the many benefits it provides.

The recommendations and action steps will help Holyoke to...

ENGAGE
and connect with residents, property owners, businesses, and community partners about the important role that they play in the growth, preservation, and care of Holyoke's trees.

PLAN
for an equitable, sustainable, and resilient urban forest by developing strategies to support tree canopy growth and preservation, and to maximize investment.

MANAGE
public tree maintenance and planting more effectively by improving data and ensuring resources are in place to support their long-term growth and care.

The recommendations are listed in implementation order based on community feedback and the consultant team's professional opinion related to the management needs of Holyoke's public tree population—with #1 being the highest priority for implementation and #8 a lower priority. However, no matter where a recommendation is ranked—its implementation is an important piece in ensuring that Holyoke's urban forest is equitable, sustainable, and resilient.

MEET THE RESIDENTS:
LINDA

"The old tree in Pulaski Park looks like it would have many stories to tell."

"Este viejo árbol en Pulaski Park parece que tendría muchas historias que contar."

1. Engage, encourage, and support active participation by rental property owners, residents, and neighborhood & partner organizations in tree planting & care.

An important component in building a resilient, growing, and well-maintained urban forest is engaging the community in its management. The Discovery Phase of the UFEP planning process found that 75% of residents felt there were too few trees in their neighborhoods. However, in the four target urban core neighborhoods, over 90% of residents rent their homes, and therefore cannot easily plant trees on the property where they live. With a large amount of available space for tree planting on private property, especially in the four target neighborhoods, the assistance of rental property owners, residents, and community organizations in tree planting and care is critical.

Action 1.A. Develop a City Tree Commission.

The city has a variety of boards and commissions that oversee aspects of Holyoke's natural areas, (including the Conservation Commission, Parks and Recreation Commission, and Board of Public Works), but there is currently no authorized citizen body that focuses specifically on trees. From an equity perspective, a Tree Commission would provide the public an opportunity to further identify tree planting and maintenance priorities and continue the conversations that began during the UFEP's public engagement process. The Commission would support city departments as they undertake tree planting and care activities, ensure all city departments are held accountable for activities that impact Holyoke's urban forest (both positively and negatively), and help pursue urban forestry program objectives.

The Tree Commission would include residents, rental property owners, and partner organizations who could assist with implementing the recommendations of the Urban Forest Equity Plan and ensure the equitable access of trees remains a priority for the city. An alternative to establishing a new commission would be to create a tree subcommittee on an existing board or commission. A subcommittee, however, may not be as effective as a stand alone commission based on the capacity of existing commission members and other committee obligations they may have.

Action 1.B. Develop Messaging Targeted to Specific Groups.

Identify key sectors and groups of private property owners (i.e. rental property owners, homeowners, developers, health care companies, large landholders, schools, neighborhood groups) and develop specific messaging and outreach that targets each group. Consider creating toolkits for each group including information on the importance of tree canopy, planting, and preservation that specifically resonates with their needs. For example, hospitals might be encouraged to start their own planting programs on the basis that trees reduce childhood asthma rates. Landlords may plant trees because trees improve tenant retention and business profitability. (However, one equity factor to consider is that if rents are increased due to tree planting, this could displace low income residents.) Share Holyoke's vision that all residents have access to trees, and share ways they can "join the movement" to help make Holyoke a healthy, vibrant community for all. Ensure that all messaging is bilingual and that community representatives and leaders are called upon to help create and promote the messaging.

Implementation Idea:

Rental Property Owner Engagement. Identify city departments, organizations, or individuals who are trusted members of the community that can assist in leading conversations with rental property owners to discuss the findings of the UFEP, the benefits of trees, and concerns that rental property owners have about tree planting and care.

"Canopy Conversations"

TreesAtlanta, a non-profit organization in Atlanta, Georgia offers a program where residents can request the organization facilitate a "Canopy Conversation" in their neighborhood.

Action 1.C. Strengthen and Support Existing Relationships and Partnerships.

For Holyoke to be able to grow a healthy, sustainable, and equitable urban forest, the city needs to actively harness and strengthen its network of community, regional, and state partners. Fostering and nurturing partnerships can help to align the goals of the UFEP with those of the partnering organizations. This can help those organizations meet their missions while enhancing and growing Holyoke's urban forest and ensuring there is equitable access to the benefits that it provides.

During the UFEP plan development process, community partners including OneHolyoke CDC, South Holyoke Neighborhood Association, Neighbor to Neighbor, and Holyoke Media were instrumental in helping with outreach and gathering community feedback.

Implementation Ideas:

Partner Workshop. Host a workshop with community partners, including schools and after school programs, about the Urban Forest Equity Plan to identify how the plan's recommendations align with the goals and mission of partner organizations.

Access to Urban Forestry Experts. Provide the community with access to technical expertise on tree planting and care (e.g., how and what to plant; how to properly care for trees). With limited staff resources, partnerships with organizations and agencies, like Massachusetts Department of Conservation and Recreation and University of Massachusetts Extension Landscape, Nursery, and Urban Forestry Programs, can help Holyoke provide that technical expertise. These resources can be added to the City of Holyoke's website and promoted through social media.

Action 1.D. Policy and Operations Adjustments.

Explore City of Holyoke and partner agency policies to identify ways they could be modified to encourage tree planting and care.

Implementation Ideas:

Review Stormwater Program. Review the city's stormwater program to explore how the city can utilize green infrastructure, including tree planting, to improve the combined sewer system, and reduce overflows and flooding.

Low Income or Rental Property Maintenance Assistance. Explore a maintenance assistance program for low income areas to encourage tree care instead of tree removal. The use of "property tax support" that reduces the burden of property taxes based on household income, and reduces tax liabilities for properties that provide affordable housing or fulfill sustainability and "green markers," including tree planting and stewardship, is another option to explore.[36]

Trees and Schools

Multiple studies have found that trees around schools are associated with higher student test scores (Sivarajah, et al., 2018, Kuo, et al., 2021). Sharing these studies with Holyoke Schools can lead to tree planting opportunities on school grounds that can support student academic performance, and lead to higher neighborhood tree canopy and access to the many benefits trees provide.

Large Tree Assistance Pilot Program

The City of Charlotte, North Carolina provided lower income residents in the Wesley Heights neighborhood financial and technical assistance to maintain large trees on their property. Charlotte City Council allocated funding for this project.

2. Develop and implement culturally, linguistically, and age appropriate public engagement, outreach, and education strategies around the importance of trees and their care.

Description: Development of an engagement, outreach, and education strategy is important in building community awareness and support for the urban forest and for promoting action. The plan's discovery process highlighted the need for developing culturally and age appropriate outreach strategies to ensure equitable community engagement that maximizes the number of points of view around trees that are heard. To be effective, the program also needs to be responsive, emphasize two-way communication, and identify unique ways to reach and target different audiences using traditional and innovative engagement tools.

Action 2.A. Develop an urban forestry engagement plan that focuses on different groups.

The plan should identify groups, engagement strategies, and community/neighborhood partners that can assist with implementing these strategies (e.g., programs for youth, family, and adults of different ages; bilingual events; and activities designed with community groups).

Implementation Idea:

Host an urban forestry booth at cultural events that includes bilingual (English/Spanish) activities for kids, adults, and seniors.

Tree Education & Outreach

The results of UFEP Survey #1 found residents are interested in more information on the following topics:

- » Tree species selection (low maintenance, native species, species that attract birds and insects)
- » How to plant trees and care for newly planted trees
- » How and when to prune trees
- » How to get trees to plant on private property
- » City tree care activities

Action 2.B. Create or provide access to bi-lingual (English and Spanish) educational materials on tree planting and care based on community needs.

Implementation Idea:

Use existing resources to provide education materials: Tree Campus K-12, Project Learning Tree, Nature Conservancy, Trees Are Good websites.

Partner with education organizations, such as Eagle Eye and Latino Outdoors.

Launch contests related to trees—drawing, photography, essays, poetry—to engage youth and increase awareness regarding tree benefits. Post entries at a public location (e.g., library, city hall, community center), select winners, and give public accolades.

Provide information about trees that are desired by residents in a visually-engaging way (and in languages spoken by a large proportion of residents) to promote dialogue and shared decision-making, like this postcard (right) made by Provo Power in Provo, Utah.[37]
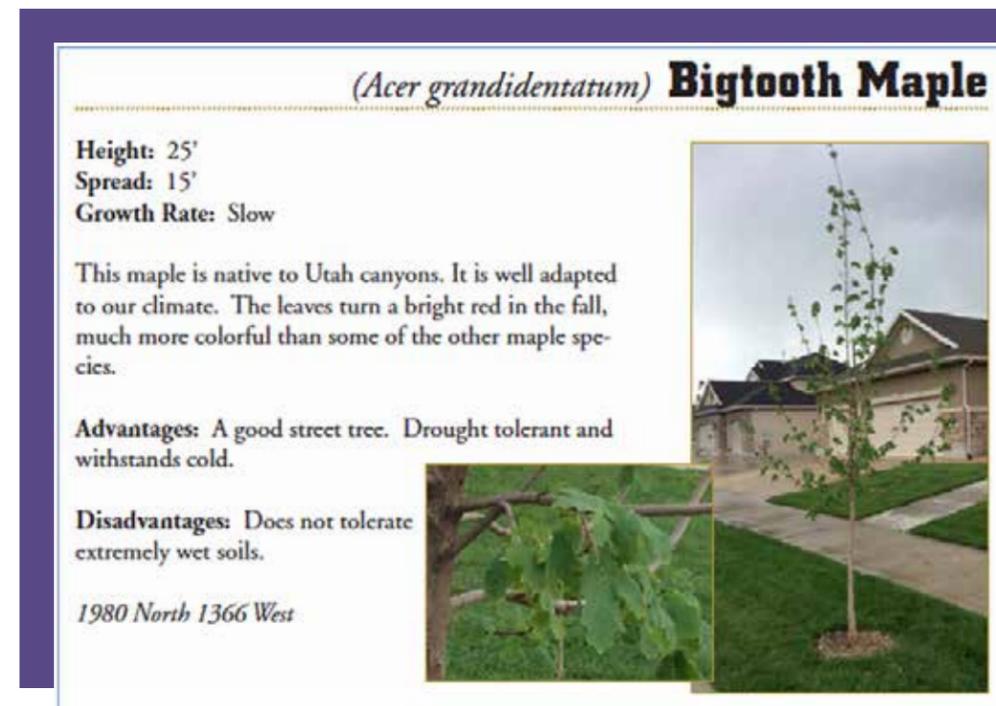
(Acer grandidentatum) **Bigtooth Maple**

Height: 25'
Spread: 15'
Growth Rate: Slow

This maple is native to Utah canyons. It is well adapted to our climate. The leaves turn a bright red in the fall, much more colorful than some of the other maple species.

Advantages: A good street tree. Drought tolerant and withstands cold.

Disadvantages: Does not tolerate extremely wet soils.

1980 North 1366 West

2. Develop and implement culturally, linguistically, and age appropriate public engagement, outreach, and education strategies around the importance of trees and their care. (Continued)

Action 2.C. Explore opportunities to compensate and/or provide incentives to increase community participation in urban forestry.

Providing compensation, stipends, food and/or child care at tree planting and care events are all tools that can be used to increase community and partner organization participation in these activities.

Implementation Idea:

Municipal-level policy tools can help to generate funding for green job training programs and to hire local residents to create or maintain parks and greenspaces in their neighborhoods. For example, in Portland, Oregon, the Portland Ballot Measure 26-201 (known as Portland Clean Energy Initiative) taxes large retailers to fund green job training programs and energy-efficiency home upgrades for low income residents.[38]

Partnering with local non-profits to develop job training programs (see Living Cully) can provide Holyoke residents in lower income neighborhoods that have less tree canopy an avenue for economic advancement while participating in growing and sustaining the urban tree canopy to meet the community's goals.

> **Living Cully**
> **Portland, Oregon**
>
> A local non-profit organization called "Living Cully" in the Cully neighborhood of Portland began a sustainable landscaping business in 2005 for affordable housing developments built by a local Latino Community Development Corporation called Hacienda CDC. The landscaping company provides paid training, certification, and medical and dental benefits. It has trained over 200 area residents in stormwater management and habitat restoration, among other skills.

Action 2.D. Build on existing efforts to engage Holyoke residents (including youth) in tree planting stewardship activities.

Identify the types of support existing programs need around tree care and stewardship, and discuss ways for the city and its partner organizations to provide that support. Support could include loaning equipment (e.g., shovels, buckets for watering trees, pruning tools), technical assistance, training, and/or guidance around tree care from a local tree warden, or assistance with communications and outreach to create more awareness and encourage participation in these activities (e.g., printing and sharing flyers with local organizations at grocery stores, or other places people frequent; posting on social media pages of the city and its partnering organizations).

A program to draw inspiration from is the Urban Resources Initiative in New Haven, Connecticut, which provides "plant material, gardening supplies, and the assistance of a community forester" as well as training workshops and landscape architects to support resident-driven community greening projects.

> **Green Corp—The Greening of Detroit**
>
> The Greening of Detroit offers a paid summer youth employment program for students 14–18 years old. The 6–8 week program teaches students how to plant and maintain trees while helping to develop leadership, conflict resolutions, and team building skills.The program also provides Green Corp students with ACT/SAT test preparation, resume writing, financial literacy, nutrition advice and opportunities to meet arborist and urban forestry professionals.

Action 2.E. Evaluate opportunities to plant fruit and nut trees in Holyoke Parks and open spaces.

The UFEP's community engagement identified an interest from residents in increasing the amount of fruit- and nut-bearing trees in the city to serve as a local food source. Planting such trees along streets may create public nuisance and/or safety issues, however, planting crop trees in city parks and open spaces may be feasible and should be explored.

Fruit and nut bearing trees require more intensive maintenance—successfully implementing this action item will require thoughtful planning and commitments from community members and partner organizations in tree species selection, care, maintenance and fruit/nut collection.

> **Food Forests**
>
> Take inspiration from other cities that have developed "urban food forests." Atlanta's Community Food Forest has created a community vision, harvest guidelines, and other resources to bring fruit and nut bearing trees to neighborhoods that are currently "food deserts." Seattle's Beacon Food Forest was created more than a decade ago to provide fruit and nut-bearing trees to neighborhoods.

3. Develop and implement a strategy to maximize investment and resources to meet the desired level of service for the planting, care, and management of Holyoke's public trees.

Without a full comprehensive public tree inventory in place it is not possible, at this time, to determine the ideal level of funding and resources needed each year for proper city tree care and maintenance. However, what is known is that the current level of funding and resources are not adequate to meet the current demand for services and needs of Holyoke's public trees.

Development of a strategy to maximize investment and secure funding and resources should consider two types of funding needs, long-term operational funding, and short-term project-based funding. Short-term project-based funding is for projects that are one to five years in length and may be better suited to be raised through project partners. Long-term operational funding is for activities that extend out past five years, and typically include operational tasks such as annual street tree pruning cycles **(see Funding Sources to Explore for potential short and long term funding sources).**

Action 3.A. Utilize the priorities identified in the Urban Forest Equity Plan to identify short-term and long-term funding needs.

The UFEP can provide a good starting point to identify areas that can use short-term project-based funding and which require long-term funding sources. For example, a short-term project that is important for understanding the management and maintenance needs of Holyoke's public trees is completion of the public tree inventory (Action 4.A); while a long-term operational project would be to dedicate city staff to support urban forest operations and education (Action 4.D).

Action 3.B. Use Funding Sources to Explore section to identify potential funding sources for the items identified in Action Item 3.A.

The list provides potential funding sources for both short and long-term projects that Holyoke can utilize to improve the urban forest on both public and private property.

Action 3.C. Create messaging about the value of Holyoke urban forest and its benefits to the community to share with funders.

People, businesses, and organizations are more likely to support initiatives if they understand their value and benefit—including trees. Developing messaging around the important role that trees play in improving health and achieving equity in Holyoke can help build support for the urban forest and lead to increased investments in maintenance and planting.

Developing messaging around the important role that trees play in improving health and achieving equity in Holyoke can help build support for the urban forest and lead to increased investments in maintenance and planting.
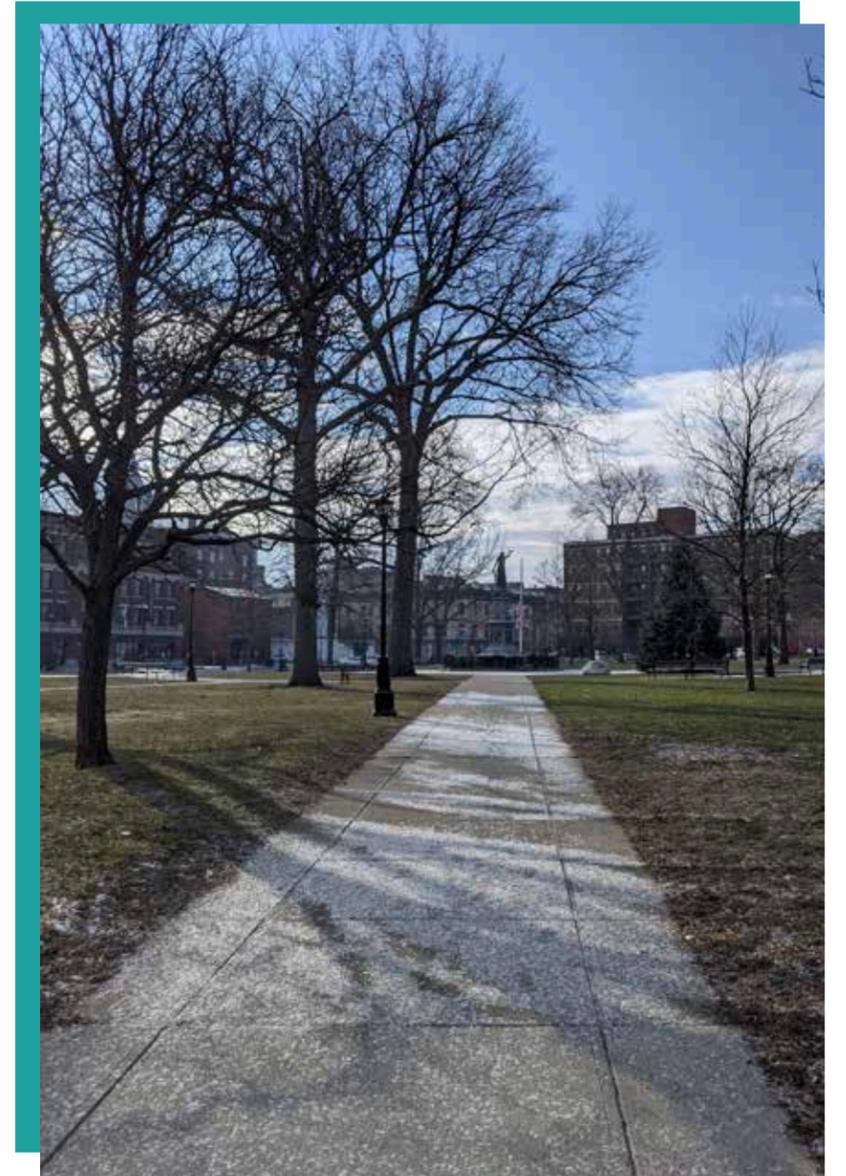
FUNDING SOURCES TO EXPLORE

Community Development Block Grants (CDBG). The CDBG is a program of the US Department of Housing and Urban Development that provides grant funding to states and municipalities to build stronger, more resilient communities. CDBG funding can be used for a variety of activities including infrastructure, housing rehabilitation, community/public facilities, social services, planning, and downtown/area revitalization.

Many communities have used CDBG funding to support municipal urban forestry activities, including:

» Murfreesboro, Tennessee has used CDBG funds to remove trees on private property that posed an imminent hazard

» Columbus, Ohio allocated CDBG funds to conduct street tree inventories in neighborhoods that were identified as having low canopy cover and high social equity need.

» Ferndale, Michigan funded street tree planting using CDBG resources.

Street Tree Assessment. An assessment charged to property owners for the management, planting and care of public trees.

The State of Ohio authorizes municipalities to collect a street tree assessment (Revised Code Chapter 727.011 Control, planting, care, and maintenance of shade trees). Municipalities can charge a fee based on the amount of right-of-way frontage (typically from $0.19–$1.16 per foot of right-of-way frontage) or assess the fee based on property value. The cities of Toledo, Ohio and Cincinnati, Ohio utilize this mechanism to fund their street tree programs.

Mitigation Funds. Funds collected as part of a site development project to mitigate for the removal of public and/or private trees. Funds are collected in-lieu of on-site tree mitigation and are established in zoning and development code as part of tree protection and preservation regulations.

Tree Mitigation Funds are established in many communities across the United States including, Cambridge, Massachusetts; Columbus, Ohio; Novi, Michigan; Frisco, Texas; and Dallas, Texas.

Create a Holyoke Tree Fund. A fund to accept donations and grants to be utilized for both public and private property urban forestry activities and programs. The Western Massachusetts Community Foundation may be able to provide Holyoke support in developing a fund and may be able to serve as the fiduciary.

» The City of Monona, Wisconsin has a set-up a fund that accepts community donations to plant city trees.

» Pennsylvania has established the "Keystone Tree Fund." Residents can check a box when renewing their license or vehicle registration to donate $3 to the fund.

Capital Improvement Plan (CIP). Utilize CIP funding to support public tree management, planting, maintenance and planning.

Charlottesville, Virginia has established trees as a community asset and utilizes CIP funding for proactive tree maintenance, tree planting, and care. Funds have been earmarked for emerald ash borer treatments, tree pruning, tree planting and planning activities.

Stormwater Utility Fees. In recognition of the important benefits public trees provide in mitigating the effects of stormwater run-off, a portion of the fees collected through the city's Stormwater Utility is directed towards the maintenance and care of public trees.

Ann Arbor, Michigan; Arlington County, Virginia; Mount Rainier, Maryland; and Milwaukee, Wisconsin utilize their Stormwater Utilities to fund the maintenance and planting of public trees.

Special Taxing Districts/Assessment District. An area of a city (e.g., street, several blocks) as a special taxing district, where a majority of property owners allow the city to provide a public improvement or special service through a non-ad valorem assessment (not based on property value).

The City of Modesto, California has set up Landscape Maintenance Assessment Districts to fund landscape and lighting improvements in designated districts.

Expand Grant Options. Explore grants connected to the benefits trees provide to improve public health and equity.

The Environmental Protection Agency (EPA) offers several environmental justice (EJ) grant opportunities, including:

» State EJ Cooperative Agreement Program (SEJCA) provides funding to support and/or create model state environmental or public health activities that lead to measurable results for communities disproportionately burdened by environmental risks.

» EJ Collaborative Problem-Solving Cooperative Agreement Program (CPS) provides funding to address local environmental and public health issues within impacted communities.

» EJ Small Grants Program funds projects that help communities understand and address exposure to environmental risks.

Grants to help establish and sustain community "food forests" include:

» The Fruit Tree Planting Foundation (FTPF) donates orchards to community gardens, public schools, city/state parks, and low-income neighborhoods.

» Community Food Forests provides a list of other grant opportunities (See resources at end of this section).

4. Improve care and planting of public trees.

As with other infrastructure, like roads, bridges, and utilities, city-managed trees require proactive and routine maintenance. Proactive management ensures an efficient, safe, and sustainable urban forest that maximizes benefits to the community. Holyoke's urban forest management program, like many communities, can best be described as reactive. Based on the program's limited resources, tree maintenance activities are driven by resident requests and emergencies.

Action 4.A. Complete the tree inventory of all of Holyoke's right-of-way and park trees.

A comprehensive, up-to-date GIS-based public tree inventory is the foundation of a municipal urban forestry program. It provides crucial information on the composition, condition, risk, and maintenance needs of the publicly managed tree resource. The inventory also serves as the basis for prioritizing tree care activities and delivering urban forestry services efficiently and cost effectively.

As part of the development of the UFEP, an inventory of street and park trees was conducted in the four target neighborhoods (Churchill, Downtown, South Holyoke & The Flats). Completing a public tree inventory for the rest of the City of Holyoke will provide information needed to address tree maintenance and planning needs, though priority for tree planting and stewardship should focus on neighborhoods currently experiencing the greatest inequities in the urban forest, including the four target neighborhoods examined in this UFEP.

Action 4.B. Develop an urban forest management plan for Holyoke's public trees.

A management plan differs from a master plan in that it focuses specifically on the needs of the city's public trees and the programs, policies and activities that must be in place to sustainably manage them. It provides an assessment based on public tree inventory data, identifying and prioritizing risk and maintenance needs, developing a budget for the resources needed to address them, and outlining a schedule for completion.

A comprehensive urban forest management plan should include a risk management program; public tree maintenance program; disaster preparedness and response plan; and explore wood utilization options, all components of a sustainable urban forestry program.

An up-to-date tree inventory is a key component in developing an Urban Forest Management Plan; however, a lack of a full inventory of all public trees should not keep Holyoke from beginning to plan and manage its public street and park trees.

Action 4.C. Track and report on tree care, planting, and maintenance activities and service requests.

Holyoke currently uses the phone and web app "See, Click, Fix" for residents to report service requests, but the city does not have an asset management software system to track these requests or the tree maintenance work that may occur as a result. A GIS-based tree/asset management software system (e.g., TreeKeeper®, Cityworks, PubWorks) can help the city to manage, track, and report on tree maintenance and planting activities and resident service requests.

An asset management system can also ensure that tree care activities are occurring equitably across the city and not just in areas where residents request tree work, which are typically more affluent neighborhoods. The system should include an alternative for residents to request tree work in Spanish without support from a computer, and this service should be publicized to residents to encourage its use.
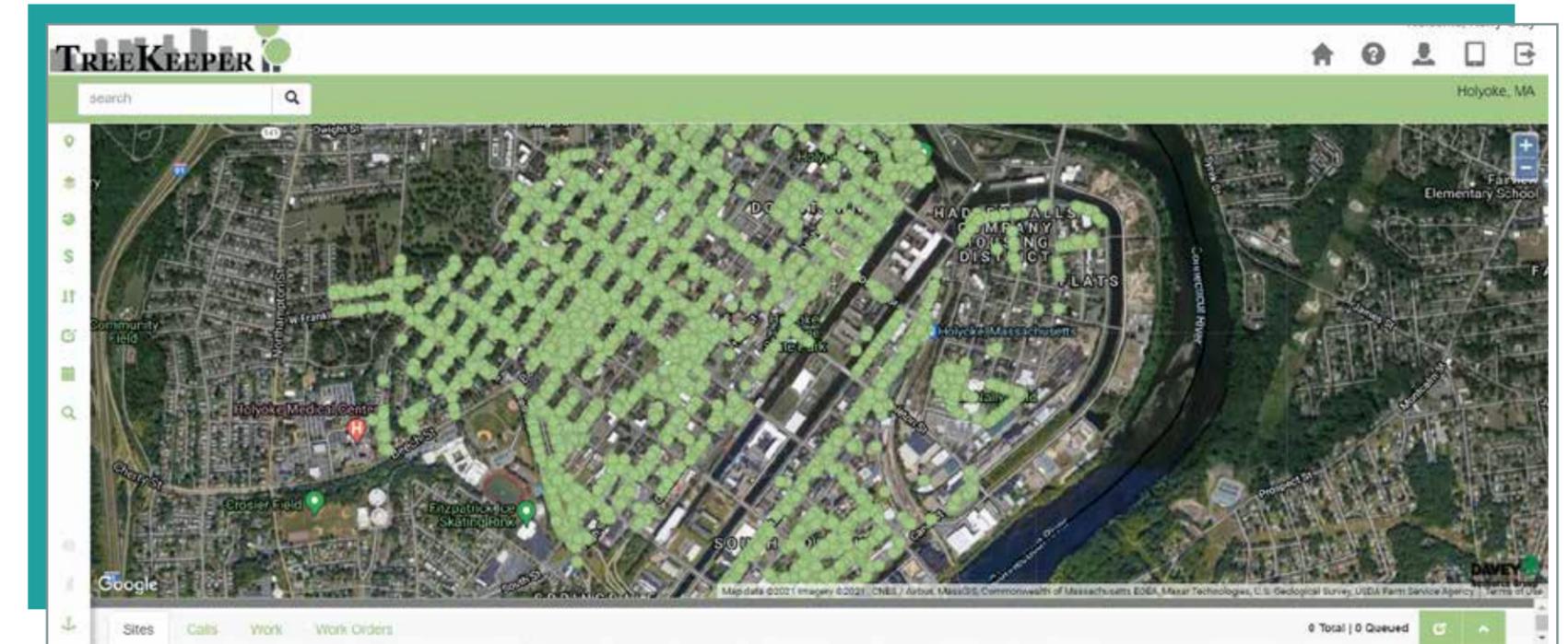
4. Improve care and planting of public trees. (Continued)

Action 4.D. Dedicate City staff to support urban forest operations and education.

There are not sufficient city resources available to proactively care for and manage Holyoke's public trees. The City Forester (Tree Warden) has non-forestry duties and responsibilities that take precedence over tree planting, care, and maintenance. Dedicated forestry staff will help move Holyoke towards a more proactive and equitable program that will improve the health and sustainability of the city's urban forest.

Holyoke should explore reducing outside responsibilities of the City Forester (Tree Warden) to allow for focused attention on public tree care. The city should also consider hiring a three-person in-house crew to perform tree maintenance that includes at least one International Society of Arboriculture Certified arborist or Certified Tree Care worker. All tree work performed by tree crews should be in accordance with the United States Department of Labor Occupational Safety and Health Administration (OSHA) standards (https://www.osha.gov/tree-care/standards) and ANSI Z133 Safety Requirements for Arboricultural Operations. Tree crews of less than three people may not be able to conduct all tree pruning and tree removal operations safely and in accordance with these standards.

As described in the "Implementation ideas" for Action item 2.C., explore municipal policy tools that could fund green job training for local residents and support hiring local residents to care for trees in their neighborhoods. This approach can enhance the equity components of this plan by providing opportunities for greater income generation among residents in lower income neighborhoods.

Urban Forester & Arborist Salaries

Municipal Urban Forester and Arborist salaries are dependent on level of skill, knowledge and years of experience.

Average Salaries (not including benefits)
according to govsalaries.com:
- » Arborist: $52,207/year
- » Urban Forester: $66,000/year
- » City Arborist: $73,537/year

Action 4.E. Develop a plan for the City Nursery

The City Nursery provides an opportunity to grow tree stock for city projects, residents, and can even provide workforce development opportunities. Development of a Nursery plan that outlines tree stock type (container, balled & burlapped, etc.), target user, resources needed, and budget needs can help to right-size the nursery to the needs of the community and the resources available. It could also be used to seek funding or partners to operate the nursery.

It is important that residents and community-based organizations are meaningfully involved in development of a Nursery plan to avoid conflict and inequitable outcomes that may not benefit the community, as was the case in Detroit, Michigan. (See references section)

Tree Pittsburgh Heritage Tree Nursery

TreePittsburgh, a non-profit organization in Pittsburgh, Pennsylvania operates a tree nursery that grows containerized tree stock for local ecological restoration projects.

Action 4.F. Increase the City's public tree care and planting capacity

To help build capacity in tree planting and maintenance the city should partner with community-based organizations, youth groups, and interested residents to assist in these activities.

5. Improve communication & collaboration among city departments and between the city and external organizations.

The needs of infrastructure (e.g., utilities and roads) and development are typically prioritized over trees. When done without coordination and oversight certain activities, such as cutting tree roots during excavation, trimming for utility clearance, and tree removal for development, can have a negative impact on Holyoke's neighborhoods and the overall urban forest.

A theme heard during the UFEP development process was the need for improved communication and collaboration around tree issues, both internally among city departments and externally between the city and outside organizations.

Action 5.A. Establish regular meetings between City of Holyoke departments.

Discuss current and upcoming city and private development projects and identify tree-related project design or construction opportunities, issues, or challenges.

Action 5.B. Develop a list of utilities, organizations, and contractors that work in Holyoke

The creation of working relationships with key personnel whose activities impact trees can provide opportunities for collaboration and reduce the negative impacts their work could have on Holyoke's urban forest. Identify city staff to contact and create working relationships.

Action 5.C. Educate businesses, organizations, and contractors on city best management practices and tree related policies.

The development of urban forestry best management practices and tree related policies—Recommendation #6—is an important step in creating a sustainable and resilient urban forest in Holyoke. To reach this goal will require that everyone in Holyoke follow them to ensure that trees on both public and private property are properly planted and maintained.

Action 5.D. Establish an annual "State of the Trees" summit.

To help continue building momentum around the urban forest, a "State of the Trees" summit should be held each year. The summit can be used to update community partners on UFEP implementation progress and to foster collaboration, education, and engagement around trees in Holyoke.

6. Establish best management practices for tree planting, tree maintenance, and planning with a focus on equity.

Increasing canopy cover equitably across Holyoke and maximizing the benefits that trees provide to all residents will require preservation and care of existing trees and proper planting and maintenance of new trees. The city does not currently have best management practices and specifications in place to guide tree pruning, planting, and maintenance activities. Development of standards and specifications for species selection based on location (right tree, right place), post-planting care and maintenance, and tree pruning, removal, and stump grinding will ensure that trees are planted, maintained, and cared for based on industry standards and best practices.

Action 6.A. Identify urban forest activities that need best management practices (BMPs) including, but not limited to:

- » Species selection, tree diversity, and invasive species
- » Site selection and planting guidelines
- » Resident notification of upcoming activities
- » Resident outreach and engagement regarding forestry activities
- » Establish process for regular urban tree canopy assessment updates
- » Post-planting care procedures and requirements
- » Improving soil quality and increasing soil quantity
- » Tree planting pit design and use of technologies to increase root zone in downtown areas
- » Pruning and maintenance practices
- » Tree removal decision processes
- » Risk management
- » Stormwater management
- » Standard construction details to support trees
- » Tree Inventory update procedures and standards
- » Tree protection and construction impact practices
- » Coordination of practices between city units
- » Coordination between external entities and organization
- » Construction activities: tree root zone protection, and enhancement
- » Sidewalk and root conflicts

6. Establish best management practices for tree planting, tree maintenance, and planning with a focus on equity. (Continued)

Action 6.B. Begin to draft and develop best management practices guidelines and standards for Holyoke.

Utilize list from Action 6.A. to begin researching and developing best management practices.

Implementation Idea:

Utilize faculty and students at local universities and colleges to assist in developing draft best management practices that can be reviewed and adopted by the City of Holyoke.

Action 6.C. Adopt recommended and prohibited tree species list for planting on public property.

Appendix C provides a draft recommended tree species list that Holyoke should review, edit, and adopt.

7. Ensure Holyoke's regulations and guidelines are in place to support tree canopy growth and preservation.

City policies, regulations, and practices communicate and reflect the values and priorities of the community. While the Holyoke community values trees, there are opportunities for the city's policies, practices, and regulations to reflect these values more effectively.

Action 7.A. Review and implement recommendations and suggestions from the following Holyoke plans and studies:

The 2021 low-impact development (LID) and tree-friendly regulatory review conducted by Pioneer Valley Planning Commission on the City's Zoning Ordinance and Subdivision Rules and Regulations.

The 2020 Impervious Surface Mitigation Plan conducted by Milone & MacBroom.

The 2014 Green Streets Guidebooks for the City of Holyoke, MA by The Conway School.

Action 7.B. Review City of Holyoke development and zoning regulations and explore opportunities to incorporate tree protection, approved and invasive tree species lists, and landscape standards into city code.

The City of Holyoke's ordinances currently lack language related to the protection and preservation of trees, approved and prohibited (invasive) tree species, and landscape requirements as part of development. Opportunities should be investigated to add new requirements that would both support and enhance development while providing much needed tree canopy, especially in the downtown Center City neighborhoods.

Implementation Ideas:

Develop a landmark/heritage tree program to designate trees that should be prioritized for protection.

Incorporate language in zoning requiring the replacement of trees removed due to development or redevelopment.

Review the "Guide to Developing a Community Tree Preservation Ordinance" from the Minnesota Shade Tree Advisory Committee.

Landmark/Heritage Tree Programs

Many communities throughout the United States have landmark or heritage tree programs, including City of Ann Arbor, MI; City of Covington, LA; City of Lafayette, CO; City of Monterey, CA; City of St. Paul, MN.

These programs identify specific trees based on species, size and/or historical significance to designate as landmark/ heritage and require specific tree preservation measures.

8. Prioritize and ensure space for trees.

There is a lack of adequate space to plant and grow trees, especially large shade trees in the urban core neighborhoods of Holyoke. While this is an obstacle to growing the overall city canopy, it has a significant impact on densely developed areas with low canopy cover and high equity need.

Identifying opportunities to construct new, or retrofit existing sites to provide adequate space for trees, early in the construction planning and design process, is key to increasing the canopy cover in Holyoke. This action step will require early input from city departments, including Forestry, and the willingness to consider using existing or new technologies to increase soil volume for trees (e.g., structural soil, silva cells); and site-specific alternatives to achieve canopy cover (e.g., street bump-outs, green roofs, planting beyond the right-of-way).

Action 8.A. Evaluate each of the following strategies to identify which ones can be used in Holyoke to ensure there is adequate space for trees to grow and thrive.

Tree Lawn Width. Retrofit existing tree lawns less than four feet wide to provide adequate space for trees to grow and thrive. Utilize suspended pavement technology (e.g., silva cells) and structural soil in areas where expansion of the tree lawn is not feasible.

Narrow Tree Lawn Planting Strategies. Determine strategies for streets with tree lawns less than four feet wide to allow the planting of street trees (e.g., allowing specific small-mature trees; adding tree bump outs along the street).

Capital Improvement Project (CIP) Coordination. Ensure all CIP projects prioritize street trees to ensure that space for adequate growth is considered during the design and construction phases.

City Code Revisions. Review and implement the suggestions resulting from: the low-impact development (LID) and tree-friendly regulatory review conducted by Pioneer Valley Planning Commission in 2021 on the City's Zoning Ordinance and Subdivision Rules and Regulations; the Impervious Surface Mitigation Plan conducted by Milone & MacBroom in 2020; Green Streets Guidebooks for the City of Holyoke, MA by The Conway School 2014.

Planting Beyond the Right-of-Way. Explore options to allow street trees to be planted in the front yard set-back (private property) in areas of the city where the tree lawn is too narrow to accommodate a tree.

Beyond the Right-of-Way Planting

Concord, Massachusetts has a setback tree planting program where the property owner gives the Town permission to plant a tree in the 20-foot setback adjacent to the right-of-way. The Town plants the tree at no cost to the property owner. In return, the property owner is responsible for tree care and watering. The tree cannot be removed without permission from the town.

Table 6. Recommendations

DPW= Holyoke Department of Public Works | OPED/MiM=Holyoke Office of Planning and Economic Development/Mass in Motion		
Recommendation 1. Engage, encourage and support active participation by rental property owners, residents, and neighborhood & partner organizations in tree planting & care.		
Actions	**Timeframe**	**Lead / Supporting City Departments**
1.A. Develop a City Tree Commission.	Immediate/Short Term (0–4 years)	Lead: DPW Supporting: Conservation Office
1.B. Develop Messaging Targeted to Specific Groups.		Lead: Conservation Office, DPW Supporting: OPED/MiM
1.C. Strengthen and Support Existing Relationships and Partnerships.		Lead: Conservation Office, Supporting: DPW
1.D. Policy and Operations Adjustments.		Lead: DPW Supporting: Conservation Office
Recommendation 2. Develop and implement culturally, linguistically, and age appropriate public engagement, outreach, and education strategies around the importance of trees and their care.		
Actions	**Timeframe**	**Lead / Supporting City Departments**
2.A. Develop an urban forestry engagement plan that focuses on different groups.	Immediate/On-Going (0 years)	**Lead:** Conservation Office **Supporting:** DPW, OPED/MiM
2.B. Create or provide access to bi-lingual (English and Spanish) educational materials on tree planting and care based on community needs.		Lead: Conservation Office Supporting: OPED/MiM
2.C. Explore opportunities to compensate and/or provide incentives to increase community participation in urban forestry.		Lead: Conservation Office Supporting: OPED/MiM
2.D. Build on existing efforts to engage Holyoke residents (including youth) in tree planting stewardship activities.		Lead: DPW Supporting: OPED/MiM
2.E. Evaluate opportunities to plant fruit and nut trees in Holyoke Parks and open spaces.		Lead*: OPED/MiM, DPW Supporting: Parks & Rec

Table 6. Recommendations (Continued)

DPW= Holyoke Department of Public Works | OPED/MiM=Holyoke Office of Planning and Economic Development/Mass in Motion		
Recommendation 3. Develop and implement a strategy to maximize investment and resources to meet the desired level of service for the planting, care and management of Holyoke's public trees.		
Actions	**Timeframe**	**Lead / Supporting City Departments**
3.A. Utilize the priorities identified in the Urban Forest Equity Plan to identify short-term and long-term funding needs.	Immediate/Short-Term (0–4 years)	Lead: DPW Supporting: Conservation Office
3.B. Use "Funding Sources to Explore" to identify potential funding sources for the items identified in Action Item 3.A.		Lead: DPW Supporting: Conservation Office
3.C. Create messaging about the value of Holyoke urban forest and its benefits to the community to share with funders.		Lead: Conservation Office Supporting: Parks & Rec., DPW
Recommendation 4. Improve the care and planting of public trees		
Actions	**Timeframe**	**Lead / Supporting City Departments**
4.A. Complete the tree inventory of all of Holyoke's right-of-way and park trees.	Short/On-Going (1–3 years)	Lead: DPW Supporting: Conservation Office
4.B. Develop an urban forest management plan for Holyoke's public trees.		Lead: DPW Supporting: Conservation Office
4.C. Track and report on tree care, planting, and maintenance activities and service requests.		Lead: DPW Supporting: Conservation Office
4.D. Dedicate city staff to support urban forest operations and education.		Lead: DPW, Parks & Rec. Supporting: Conservation Office
4.E. Develop a plan for the City nursery.		Lead: DPW, Parks & Rec. Supporting: Conservation Office
4.F. Increase the city's public tree care and planting capacity.		Lead: DPW Supporting: Conservation Office

Table 6. Recommendations (Continued)

DPW= Holyoke Department of Public Works | OPED/MiM=Holyoke Office of Planning and Economic Development/Mass in Motion		
Recommendation 5. Improve communication & collaboration among city departments and between the city and external organizations.		
Actions	**Timeframe**	**Lead / Supporting City Departments**
5.A. Establish regular meetings between City of Holyoke departments.	Short-Mid Term (1–5 Years)	Lead: Conservation Office Supporting:
5.B. Develop a list of utilities, organizations, and contractors that work in Holyoke.		Lead: DPW Supporting: Conservation Office
5.C. Educate businesses, organizations and contractors on city best management practices and tree related policies		Lead: Conservation Office Supporting: OPED/MiM
5.D. Establish an annual "State of the Trees" summit		Lead: Conservation Office Supporting: DPW, Parks & Rec.
Recommendation 6. Establish best management practices for tree planting, tree maintenance, and planning with a focus on equity.		
Actions	**Timeframe**	**Lead / Supporting City Departments**
6.A. Identify urban forest activities that need best management practices (BMPs)	Short-Mid Term (1–5 years)	Lead: DPW Supporting: Conservation Office
6.B. Begin to draft and develop best management practices guidelines and standards for Holyoke.		Lead: DPW Supporting: Conservation Office, Parks & Rec.
6.C. Adopt a recommended and prohibited tree species list for planting on public property.		Lead: DPW Supporting: Parks & Rec.

Table 6. Recommendations (Continued)

DPW= Holyoke Department of Public Works | OPED/MiM=Holyoke Office of Planning and Economic Development/Mass in Motion		
Recommendation 7. Ensure Holyoke's regulations and guidelines are in place to support tree canopy growth and preservation.		
Actions	**Timeframe**	**Lead / Supporting City Departments**
7.A. Review and implement recommendations and suggestions from City of Holyoke plans and studies.	Mid-Long Term (5–10 years)	Lead: DPW Supporting: OPED/MiM
7.B. Review City of Holyoke development and zoning regulations and explore opportunities to incorporate tree protection, approved and invasive tree species lists, and landscape standards into city code.		
Recommendation 8. Prioritize and ensure space for trees		
Actions	**Timeframe**	**Lead / Supporting City Departments**
8.A. Evaluate strategies to identify which ones can be used in Holyoke to ensure there is adequate space for trees to grow and thrive.	Mid-Long Term (5–10 years)	Lead: Conservation Office Supporting: DPW

Section Four Resource Links

Action 2.B.

Tree Campus K-12:

https://www.arborday.org/programs/tree-campus-k-12/

Project Learning Tree:

https://www.plt.org/network/massachusetts/

Nature Conservancy:

https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/virtual-field-trips/

Trees Are Good:

http://treesaregood.org

Action 2.D.

Greening Projects

https://uri.yale.edu/programs/greenspace

Funding Sources to Explore

Capital Improvement Plan:

https://www.charlottesville.gov/169/Budget

Special Taxing Districts/Assessment District:

https://www.modestogov.com/595/Landscape-Maintenance-Assessment-District

The Fruit Tree Planting Foundation:

https://www.ftpf.org/apply

Community Food Forests:

https://communityfoodforests.com/resources/funding/

Action 4.D.

OSHA Standards:

https://www.osha.gov/tree-care/standards

Urban Forester and Arborist Salaries:

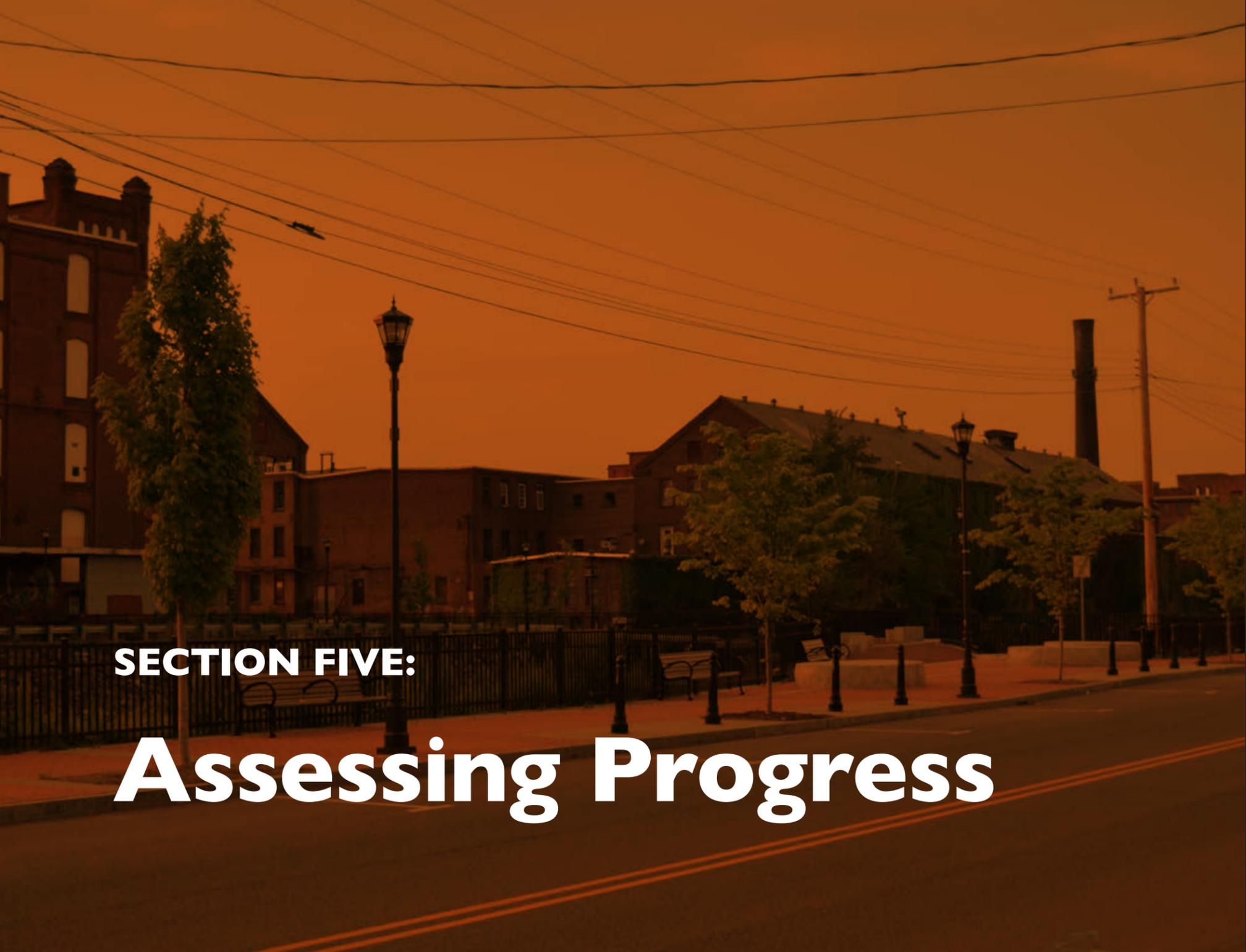govsalaries.com

Action 4.E.

Detroit, Michigan Nursery:

https://www.freep.com/story/news/local/michigan/detroit/2020/03/16/detroit-herman-kiefer-tree-nursery/5022282002

Action 7.B.

Guide to Developing a Community Tree Advisory Committee: http://www.mnstac.org/treeordinances.html

Assessing Progress

Monitoring and Measuring

For the Urban Forest Equity Plan to be an effective tool in equitably growing and enhancing Holyoke's urban forest, it is important that both its implementation and the state of Holyoke's urban forest are regularly monitored and assessed. Progress assessments help to identify successes in implementation and engagement that can be used to build momentum around Holyoke's trees, while identifying emerging opportunities and challenges that need to be addressed.

USING AN EQUITY AND ENVIRONMENTAL JUSTICE LENS TO MEASURE PROGRESS IN TREE PLANTING AND CARE

Tracking and monitoring tree planting, care, and health of trees are important metrics for measuring progress on the health and sustainability of the urban forest. However, to measure equitable access to the urban forest it is important to also study other social metrics. Table 7 shows traditional urban forestry metrics together with environmental justice and equity metrics. Holyoke can utilize the EJ and equity metrics to measure progress in equitably engaging the community.

The information gathered from these metrics could be used to help study resident attitudes towards trees by following residents in a neighborhood over time to see if these attitudes change based on the results of a given activity. It can also be used during analysis of updated tree canopy data to see if these activities have had a measurable impact on the amount of tree canopy cover in areas where work has occurred.

Table 7. Urban Forest Success Metrics for Traditional and Environmental Justice Lenses

Traditional Urban Forestry Metrics	Environmental Justice/Equity Metrics
Number of Trees Planted	» Number of trees planted that fulfill **values** important to residents where planting occurs » Number of trees planted in **locations desired or agreed upon** by residents » Number of additional residents or neighborhoods seeking to engage in tree planting activities
Tree Survivability and Health	» Development of a collaborative stewardship plan agreed upon by residents and City urban forester » Number of residents AND urban foresters involved in tree monitoring and stewardship » Responsiveness of non-profit organizations and city government to residents' reported tree health concerns. » Additional residents seeking to become involved in tree stewardship over time.
Number of volunteers engaged in planting days	» Number of community residents engaged **before**, during, **and after** tree planting days.

TREE CANOPY ANALYSIS

Tree canopy in Holyoke changes over time—as illustrated in the historical change analysis described in Section 3. This change can be gradual due to natural mortality, tree growth, and new tree planting; or suddenly due to significant storms, development activities, or insect/disease pests. Conducting updates of Holyoke's urban tree canopy assessment on a regular basis (every 5–10 years) can provide important data on how and why tree canopy cover is growing or shrinking, and monitor progress towards achieving tree canopy goals. Future Holyoke urban tree canopy assessments should look at the entire community and continue to include a tree canopy change analysis that examines current and previous urban tree canopy data to measure change and identify trends in tree canopy cover. Following any new urban tree canopy assessment update, the UFEP's recommendations and actions should be reviewed to measure progress and ensure any opportunities or issues uncovered during the new assessment are addressed.

TREE INVENTORY UPDATES

As stated earlier in this plan, a public tree inventory provides critical information to manage and maintain the city's trees. It also provides an opportunity to monitor the resource over time. Urban forestry industry standards recommend that municipal tree inventories are updated on a regular, rolling basis as planting, maintenance and removals occur, with a complete **re-inventory being completed every 5–10 years.** As Holyoke's public tree are inventoried and re-inventoried, the city can monitor changes in:

» Tree genus and species composition

» Number of trees

» Size

» Condition

» Maintenance needs

Assessing these changes can help measure progress in implementing UFEP's public tree management and planning recommendations.

CHANGES IN TREE BENEFITS

As described in Sections 1 and 3, Holyoke's trees and urban forest provides many quantifiable benefits to the community. Measuring Holyoke's progress in growing and caring for its urban forest can be done by examining changes in these tree benefits. Did the amount of air pollutants removed increase or decrease over time? Does the canopy intercept more gallons of stormwater? i-Tree—the USDA Forest Service's suite of tools that measures and quantifies the benefits of trees—can be used to measure changes in tree benefits over time. The software tools in i-Tree are routinely updated based on the latest science and research. **To measure changes in benefits over time, both the new and previous urban tree canopy assessment data must be analyzed through the same version of i-Tree.**

INDICATORS OF A SUSTAINABLE URBAN FOREST

To assess the current state of Holyoke's urban forest, the Indicators of a Sustainable Urban Forest, a comprehensive resource and program assessment tool, was used during the UFEP development process. [39, 40]

The Indicators, broadly categorized into three categories—The Trees, The Players, and The Management—use urban forestry industry standards and best management practices to evaluate and rate Holyoke's trees, how they are managed, and the level of community engagement there is around trees and urban forestry activities.

For each indicator, Holyoke's current performance level was rated as low, medium, or high by the Consultant Team based on information, data, and public and stakeholder engagement during the plan's discovery phase. The assessment identified areas where the city's urban forest can be improved and was used in the development of some of the UFEP recommendations. **Appendix B** provides Holyoke's complete indicators assessment.

Holyoke's current overall performance for each component is:

<div align="center">

The Trees: LOW

The Players: LOW-MEDIUM

The Management: LOW

</div>

As the Urban Forest Equity Plan is implemented, periodic assessments (every three to five years) of the Indicators of a Sustainable Urban Forest to see if the results have changed can highlight successes in implementation, identify improvement areas and new program priorities, and establish new recommendations and recommended action steps.

Conclusion

The Urban Forest Equity Plan serves as a guide to provide all Holyoke residents equal access to a healthy and abundant urban forest. It was developed using a lens of equity and is designed to move Holyoke along the road towards an equitable, sustainable, and resilient urban forest.

» The Introduction (**Section 1**) highlighted the important benefits trees provide, the climate challenges facing Holyoke and the four target neighborhoods, and how trees and the urban forest can be part of the solution to address them.

» **Section 2** examined community and stakeholder values around trees and the urban forest. It identified the priorities and themes which set the foundation and direction of the plan.

» **Section 3** presented the current state of Holyoke's urban forest to establish a baseline of where the city is today.

» The recommendations and actions were presented in **Section 4**. They focus on ensuring an equitable urban forest in Holyoke through engagement, planning, and management.

» **Section 5** provides ways that Holyoke can monitor and measure progress in equitably and meaningfully engaging the community in growing and improving Holyoke's urban forest.

Let's get started!

Appendices and References

Appendix A: Observations, Reflections, and Lessons Learned from the Community Engagement Process

Community engagement was a key component in the development of the UFEP and will be equally important for its implementation. Our goal was to reach and involve those most impacted by the recommendations of the plan so that they would have an opportunity to help shape the plan recommendations. We used many strategies to gather input and feedback from the community; some of these strategies were more successful than others.

When evaluating the success of the strategies it is important to take into account the impacts of COVID. COVID-19 disproportionately affected the residents we were trying to reach in terms of the percentage of infection and transmission rates within families, decreased work opportunities, and remote schooling further limiting resources in the community. When one's family is experiencing food insecurity, has a lack of internet access or other social and economic factors it is difficult to pay attention to a planning process.

Additionally, the pandemic significantly affected both the outreach (for example, we couldn't use community bulletin boards in community centers, local grocery stores, and restaurants) but mostly prohibited us from meeting in person. It is difficult to predict how participation would have been affected had we been able to meet in person in a community location that people know and trust and provided them with child-friendly activities and culturally relevant food. Another alternative would have been to piggyback onto an existing event, meeting people where they were already gathered to ask people for their input and feedback.

The pandemic also limited our options for attracting attention to the process by and the opportunity to hold events, for example, a city-sponsored family-oriented tree planting spring festival.

It is also not possible to know whether the day/time of day selected for the forums affected attendance. These were selected in consultation with community leaders, but perhaps holding one of the forums on a weekend afternoon could have resulted in higher attendance.

The need to use technology, which assumes both internet access and ownership of a laptop or a cell phone account which supports virtual platforms meant that several barriers—above and beyond those usually encountered—had to be overcome.

As Holyoke embarks on implementation of the UFEP, here a few ideas based on the experience of the UFEP that should be considered:

- » All outreach materials should be **bi-lingual** (English/Spanish).
- » Meetings should provide **simultaneous interpretation**; Spanish only meetings were not well attended (it is not possible to know whether this was due to COVID, Zoom or difficulty in event recruitment).
- » Providing a **raffle prize** seemed to increase participation, especially for the survey.
- » Working with **community leaders** and offering them a stipend for their consultation and help with outreach was useful; perhaps allocating more funding towards this would help these individuals to commit more time to the effort.
- » Disseminating a survey to reach a broader group of stakeholders was very useful; having **hard copies** in addition to the online version was critical in reaching those most impacted.
- » Having the promotional materials and survey **distributed at existing tables** set up for other purposes was quite successful in reaching individuals who otherwise might not have participated; doing this in more locations would have been beneficial. Also door-to-door canvassing by community leaders may have been more effective but not possible due to COVID.

- » **Streaming the public forums to Facebook Live** provided those without access to a zoom account and/or a laptop to participate in albeit a limited way, from their telephone. While there were not many individuals who chose to participate in this way, it is the most equitable way to offer the opportunity.
- » Streaming the meetings on **Holyoke Public Access TV** might have helped to reach more people.
- » In addition to the barrier created by having to hold meetings on virtual platforms, there were other technological challenges such as how to make joining a meeting as simple as possible. After trying various options it seems that **creating a registration on Eventbrite** and re-sharing that on the city's various social media sites created the simplest and most direct option. Also having a **Facebook Event page**.
- » The **Selfie Contest** on social media did not capture much participation, but the submittals were beautiful. Participation could have been improved if "local celebrities" such as the Mayor and City Councilors had been asked to participate and promote.
- » **Involving youth** could have led to increasing the visibility of the process, but was impossible due to COVID.

Appendix B: Indicators of a Sustainable Urban Forest

THE TREES

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Urban Tree Canopy	Achieve the desired tree canopy cover according to goals set for the entire city and neighborhoods. Alternatively, achieve 75% of the total canopy possible for the entire city and in each neighborhood.	**LOW-MEDIUM:** UTC for Holyoke's Environmental Justice Areas conducted in 2014 established a 30% tree canopy goal by 2044.		
Location of Canopy (Equitable Distribution)	Achieve low variation between tree canopy and equity factors citywide by neighborhood. Ensure that the benefits of tree canopy are available to all, especially for those most affected by these benefits.		**MEDIUM:** Greening the Gateways City are focusing on planting trees in the low tree canopy high equity areas.	
Age of Trees (Size and Age Distribution)	Establish a diverse-aged population of **public** trees across the entire city and for each neighborhood. Ideal standard: » 0-8" DBH: 40% » 9–17" DBH: 30% » 18–4" DBH: 20% » Over 24" DBH: 10%	**LOW:** Tree inventory has not been completed for the entire city. In the four target neighborhoods (Churchill, Downtown, South Holyoke, The Flats) the age distribution trends with the ideal distribution.		

THE TREES (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Condition of Publicly Managed Trees (trees managed intensively)	Possess a detailed understanding of tree condition and potential risk of all intensively-managed, publicly-owned trees. This information is used to direct maintenance actions.		**Medium:** A partial inventory of the four target neighborhoods (Churchill, Downtown, South Holyoke, The Flats) was completed in 2021. Majority of trees in the fair to good condition class.	
Trees on Private Property	Possess a solid understanding of the extent, location and general condition of trees on private lands.	**Low-Medium:** UTC of EJ areas conducted in 2014,—limited data on private trees in other areas of the city.		
Diversity	Establish a genetically diverse population of publicly-owned trees across the entire city and for each neighborhood. Tree populations should be comprised of no more than 30% of any family, 20% of any genus, or 10% of any species.	**Low-Medium:** A partial inventory of the four target neighborhoods (Churchill, Downtown, South Holyoke, The Flats) was completed in 2021.—5 species make up ~60% of the population.		

THE TREES (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Climate Resilience/ Suitability	Establish a resilient tree population suited to the urban environment and adapted to the region. Suitable species are gauged by exposure to imminent threats, considering the "Right Tree for the Right Place" concept and invasive species.	**Low-Medium:** A partial inventory of the four target neighborhoods (Churchill, Downtown, South Holyoke, The Flats) was completed in 2021.—5 species make up ~60% of the population.		
Space and Soil Volume	Establish minimum street tree soil volume requirements to ensure adequate space and soil for street trees to thrive. Minimum soil volumes by mature size:1000 cubic feet large trees; 600 cubic feet medium trees; 300 cubic feet for small trees	**Low:** Minimum soil volumes for street trees have not been established.		

THE PLAYERS

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Neighborhood Action	Citizens understand, cooperate, and participate in urban forest management at the neighborhood level. Urban forestry is a neighborhood-scale issue		**Medium:** Greening the Gateway program engages residents in tree planting and care. Limited City engagement.	
Large and Private Institutional Landholder Involvement	Large, private, and institutional landholders embrace citywide goals and objectives through targeted resource management plans.	**Low:** Large landholders are not engaged.		
Green Industry Involvement	The green industry works together to advance citywide urban forest goals and objectives. The city and its partners capitalize on local green industry expertise and innovation.	**Low:** No involvement with the green industry.		
City Department and Agency Cooperation	All city departments and agencies cooperate to advance citywide urban forestry goals and objectives.	**Low:** No formal process in place for coordination and cooperation.		.

THE PLAYERS (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Funder Engagement	Local funders are engaged and invested in urban forestry initiatives. Funding is adequate to implement a citywide urban forest management plan.		**Medium:** City has been very successful in acquiring grant funding.	
State Engagement	State departments/agencies are aware of and vested in the urban forest and cooperates to advance citywide urban forest goals and objectives.		**Medium:** City is very engaged with Commonwealth of Massachusetts Department of Conservation and Recreation (i.e. MVP grants; Greening the Gateway program).	
Developer Engagement	The development community is aware of and vested in the urban forest and cooperates to advance citywide urban forest goals and objectives.	**Low:** Developers are not engaged in urban forestry. There are no development policies/ordinances in place to preserve/protect and the landscape standards do not specify the number of trees to be planted on site.		

THE PLAYERS (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Public Awareness	The general public understands the benefits of trees and advocates for the role and importance of the urban forest.		**Medium:** Community understands tree benefits and values trees.	
Regional Collaboration	Neighboring communities and regional groups are actively cooperating and interacting to advance the region's stake in the city's urban forest.		**Medium:** There is regional cooperation led by the regional planning organization, Pioneer Valley Planning Commission.	
Maintenance Program of Publicly-Owned Trees (trees managed intensively)	All intensively-managed, publicly-owned trees are well maintained for optimal health and condition in order to extend longevity and maximize benefits. A reasonable cyclical pruning program is in place, generally targeting 5- to 7-year cycles. The maintenance program is outlined in the management plan.	**Low:** Holyoke's urban forest management program is reactive—focusing the removal of dead and dying trees. Tree planting is conducted by the DCR Greening the Gateway program.		

THE PLAYERS (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Planting Program	Comprehensive and effective tree planting and establishment program is driven by canopy cover goals, equity considerations, and other priorities according to the plan. Tree planting and establishment is outlined in the management plan.	**Low:** Holyoke has been utilizing the DCR Greening of the Gateway program to conduct public tree planting. This program is going to be ending in 2021.		
Tree Protection Policy	Comprehensive and regularly updated tree protection ordinance with enforcement ability is based on community goals. The benefits derived from trees on public and private property are ensured by the enforcement of existing policies.	**Low-Medium:** Chapter 94 provides public tree protection. There are no protection ordinances in place for trees on private property or development projects.		
City Staffing and Equipment	Adequate staff and access to the equipment and vehicles to implement the management plan. A high level urban forester or planning professional, strong operations staff, and solid certified arborist technicians.	**Low:** There are no dedicated Forestry staff other than the City Forester, and that employee has other responsibilities that extend outside of tree care.		

THE MANAGEMENT

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Tree Inventory	Comprehensive, GIS-based, current inventory of all intensively-managed public trees to guide management, with mechanisms in place to keep data current and available for use. Data allows for analysis of age distribution, condition, risk, diversity, and suitability.		**Medium:** Partial inventory of the four target neighborhoods of Churchill, Downtown, South Holyoke and The Flats.	
Canopy Assessment	Accurate, high-resolution, and recent assessment of existing and potential city-wide tree canopy cover that is regularly updated and available for use across various departments, agencies, and/or disciplines.		**Medium:** Urban tree canopy assessment of the Environmental Justice neighborhoods completed in 2014 (based on 2012 aerial imagery).	
Management Plan	Existence and buy-in of a comprehensive urban forest management plan to achieve city-wide goals. Re-evaluation is conducted every 3 to 5 years.	**Low:** No urban forest management plan.		

THE MANAGEMENT (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level—City of Holyoke		
		Low	Medium	High
Risk Management Program	All publicly-owned trees are managed for maximum public safety by way of maintaining a city-wide inventory, conducting proactive annual inspections, and eliminating hazards within a set timeframe based on risk level. Risk management program is outlined in the management plan.	**Low:** No risk management program.		
Maintenance Program of Publicly-Owned Trees (trees managed intensively)	All intensively-managed, publicly-owned trees are well maintained for optimal health and condition in order to extend longevity and maximize benefits. A reasonable cyclical pruning program is in place, generally targeting 5- to 7-year cycles. The maintenance program is outlined in the management plan.	**Low:** Holyoke's urban forest management program is reactive—focusing the removal of dead and dying trees. Tree planting is conducted by the DCR Greening the Gateway program.		
The Funding	Appropriate funding in place to fully implement both proactive and reactive needs based on a comprehensive urban forest management plan.	**Low**: Limited forestry funding.		

THE MANAGEMENT (CONTINUED)

Indicators of a Sustainable Urban Forest	Overall Objective or Industry Standard	Performance Level: City of Holyoke		
		Low	Medium	High
The Funding	Appropriate funding in place to fully implement both proactive and reactive needs based on a comprehensive urban forest management plan.	**Low**: Limited forestry funding.		
Disaster Preparedness & Response	A disaster management plan is in place related to the city's urban forest. The plan includes staff roles, contracts, response priorities, debris management and a crisis communication plan. Staff are regularly trained and/or updated.	**Low:** There is not an urban forestry disaster preparedness plan in place. The city has the 2016 Natural Hazards Hazards Mitigation Plan Update. It mentions tree damage caused by natural disasters but there is no planning for prevention or mitigation of tree damage.		
Communication	Effective avenues of two-way communication exist between the city departments and between the city and its citizens. Messaging is consistent and coordinated, when feasible.	**Low:** No formal avenues of two-way communication exist.		
Best Management Practices/ Standards	Comprehensive manual of tree care, planting and maintenance best management practices and standards for use by city staff, contractors, residents, developers or anyone engaged in tree related activities.	**Low:** There are no documented best management practices in place.		

Appendix C: Recommended Tree Species List

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is offered to assist all relevant community personnel in selecting appropriate tree species. These trees have been selected because of their aesthetic and functional characteristics and their ability to thrive in the soil and climate conditions throughout Zone 6 on the USDA Plant Hardiness Zone Map.

DECIDUOUS TREES

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer rubrum[d]	red maple	Red Sunset®
Acer saccharum	sugar maple	'Legacy'
Aesculus flava*	yellow buckeye	
Betula alleghaniensis*	yellow birch	
Betula lenta*	sweet birch	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
Carya illinoensis[d]*	pecan	
Carya lacinata[d]*	shellbark hickory	
Carya ovata[d]*	shagbark hickory	
Castanea mollissima*	Chinese chestnut	
Celtis laevigata[s]	sugar hackberry	
Celtis occidentalis[d]	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
Diospyros virginiana[ds]*	common persimmon	
Fagus grandifolia*	American beech	
Fagus sylvatica*	European beech	(Numerous exist)
Ginkgo biloba[ds]	ginkgo	(Choose male trees only)

Large Trees: Greater than 45 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Gleditsia triacanthos inermis[ds]	thornless honeylocust	'Shademaster'
Gymnocladus dioicus[ds]	Kentucky coffeetree	Prairie Titan®
Juglans nigra[ds]*	black walnut	
Larix decidua[s]*	European larch	
Liquidambar styraciflua[s]	American sweetgum	'Rotundiloba'
Liriodendron tulipifera*	tuliptree	'Fastigiatum'
Magnolia acuminata*	cucumbertree magnolia	(Numerous exist)
Magnolia macrophylla*	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvaticada[ds]	black tupelo	
Platanus occidentalis*	American sycamore	
Platanus x acerfolia	London planetree	'Yarwood'
Quercus alba[s]	white oak	
Quercus bicolor	swamp white oak	
Quercus coccinea[d]	scarlet oak	
Quercus lyrata[d]	overcup oak	
Quercus macrocarpa[ds]	bur oak	
Quercus montana[d]	chestnut oak	
Quercus muehlenbergii	chinkapin oak	
Quercus palustris[ds]	pin oak	
Quercus imbricaria	shingle oak	
Quercus phellos[ds]	willow oak	
Quercus robur[s]	English oak	Heritage®
Quercus rubra[ds]	northern red oak	'Splendens'
Quercus shumardii[d]	Shumard oak	
Styphnolobium japonicum[d]	Japanese pagodatree	'Regent'

DECIDUOUS TREES (CONTINUED)

Large Trees: Greater than 45 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Taxodium distichum[s]	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
Tilia × euchlora	Crimean linden	
Tilia tomentosa	silver linden	'Sterling'
Ulmus parvifolia[d]	Chinese elm	Allée®
Zelkova serrata	Japanese zelkova	'Green Vase'

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
Alnus cordata	Italian alder	
*Asimina triloba**	pawpaw	
Cladrastis kentukea	American yellowwood	'Rosea'
Corylus colurna[d]	Turkish filbert	
Eucommia ulmoides	hardy rubber tree	
Koelreuteria paniculata[ds]	goldenraintree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	amur corktree	'Macho'
Pistacia chinensis	Chinese pistache	
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	

Medium Trees: 31 to 45 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
*Sassafras albidum[d]**	sassafras	

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer buergerianum	trident maple	Streetwise®
Acer campestre[s]	hedge maple	Queen Elizabeth™
Acer cappadocicum	coliseum maple	'Aureum'
Acer ginnala	amur maple	Red Rhapsody™
Acer griseum	paperbark maple	
Acer nigrum	black maple	
*Acer pensylvanicum**	striped maple	
Acer triflorum	three-flower maple	
*Aesculus pavia[s]**	red buckeye	
Amelanchier arborea	downy serviceberry	(Numerous exist)
Amelanchier laevis	Allegheny serviceberry	
*Carpinus caroliniana**	American hornbeam	
Cercis canadensis[d]	eastern redbud	'Forest Pansy'
Chionanthus virginicus[s]	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus kousa	Kousa dogwood	(Numerous exist)
Cornus mas	corneliancherry dogwood	'Spring Sun'
Corylus avellana	European filbert	'Contorta'

DECIDUOUS TREES (CONTINUED)

Small Trees: 15 to 30 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Cotinus coggygria*	common smoketree	'Flame'
Cotinus obovata*	American smoketree	
Crataegus phaenopyrum[d]*	Washington hawthorn	Princeton Sentry™
Crataegus viridis[d]	green hawthorn	'Winter King'
Franklinia alatamaha*	Franklinia	
Halesia tetraptera*	Carolina silverbell	'Arnold Pink'
Laburnum × watereri	goldenchain tree	
Maackia amurensis	amur maackia	
Magnolia × soulangiana*	saucer magnolia	'Alexandrina'
Magnolia stellata*	star magnolia	'Centennial'
Magnolia tripetala*	umbrella magnolia	
Magnolia virginiana[s]*	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(Disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	'Pendula'
Prunus virginiana	common chokecherry	'Schubert'
Staphylea trifolia*	American bladdernut	
Stewartia ovata	mountain stewartia	
Styrax japonicus*	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata[s]	Japanese tree lilac	'Ivory Silk'

* denotes species that are **not** recommended for use as street trees.

[d] denotes species that are drought tolerant

[s] denotes species that are tolerant to salt spray, saline soils, or both.

CONIFEROUS AND EVERGREEN TREES

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Abies balsamea	balsam fir	
Abies concolor	white fir	'Violacea'
Cedrus libani	cedar-of-Lebanon	
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica[s]	Japanese cryptomeria	'Sekkan-sugi'
× Cupressocyparis leylandii	Leyland cypress	
Ilex opaca[ds]	American holly	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus strobus[d]	eastern white pine	
Pinus sylvestris	Scotch pine	
Pinus taeda[d]	loblolly pine	
Pinus virginiana[d]	Virginia pine	
Psedotsuga menziesii	Douglas-fir	
Thuja plicata	western arborvitae	(Numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Chamaecyparis thyoides	atlantic whitecedar	(Numerous exist)
Juniperus virginiana[ds]	eastern redcedar	
Pinus bungeana	lacebark pine	
Pinus flexilis	limber pine	
Pinus parviflora	Japanese white pine	
Thuja occidentalis	eastern arborvitae	(Numerous exist)

CONIFEROUS AND EVERGREEN TREES (CONTINUED)

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Ilex × attenuata[d]	Foster's holly	
Pinus aristata	bristlecone pine	
Pinus mugo[ds]	mugo pine	

[d] denotes species that are drought tolerant

[s] denotes species that are tolerant to salt spray, saline soils, or both

ZONE 7 TREES

As climate shifts, there may be opportunities to plant a variety of species that were previously unsuited to Holyoke's climate.

Trees Suitable for Zone 7

Scientific Name	Common Name	Cultivar	Mature Height
Acer nigrum	black maple		>45 feet
Cedrus deodara*	deodar cedar		>45 feet
Chionanthus retusus	Chinese fringetree		15–30 feet
Ilex x[d]	Nellie R. Stevens holly	'Nelly R. Stevens'	15–30 feet
Juglans regia*	English walnut		>45 feet
Lagerstroemia fauriei	Japanese crapemyrtle		31–45 feet
Lagerstroemia indica	common crapemyrtle	(Numerous exist)	15–30 feet
Magnolia grandiflora[s]*	southern magnolia		>45 feet
Pinus echinate[d]	shortleaf pine		>45 feet
Pinus elliottii	slash pine		>45 feet
Quercus hemisphaerica	Darlington oak		>45 feet

Trees Suitable for Zone 7 (Continued)

Scientific Name	Common Name	Cultivar	Mature Height
Quercus pagoda	cherrybark oak		>45 feet
Quercus prinus	chestnut oak		>45 feet
Quercus texana	Texas red oak		>45 feet
Quercus velutina[d]	black oak		>45 feet
Sorbus alnifolia	Korean mountainash	'Redbird'	31–45 feet
Stewartia koreana	Korean stewartia		15–30 feet
Toona sinensis	Chinese toon		31–45 feet

* denotes species that are **not** recommended for use as street trees.

[d] denotes species that are drought tolerant

[s] denotes species that are tolerant to salt spray, saline soils, or both.

Dirr's Hardy Trees and Shrubs (Dirr 2010), Landscape Plants of the Southeast (Halfacre & Shawcroft 1999), and Manual of Woody Landscape Plants (5th Edition) (Dirr 1998) were consulted to compile this suggested species list. Cultivar selections are recommendations only and are based on DRG's experience. Tree availability will vary based on availability in the nursery trade.

Appendix D: Invasive Pests And Diseases

In today's worldwide marketplace, the volume of international trade brings increased potential for pests and diseases to invade our country. Many of these pests and diseases have seriously harmed rural and urban landscapes and have caused billions of dollars in lost revenue and millions of dollars in cleanup costs. Keeping these pests and diseases out of the country is the number one priority of the USDA's Animal and Plant Inspection Service (APHIS).

Although some invasive species naturally enter the United States via wind, ocean currents, and other means, most invasive species enter the country with some help from human activities. Their introduction to the U.S. is a byproduct of cultivation, commerce, tourism, and travel. Many species enter the United States each year in baggage, cargo, contaminants of commodities, or mail.

Once they arrive, invasive pests grow and spread rapidly because controls, such as native predators, are lacking. Invasive pests disrupt the landscape by pushing out native species, reducing biological diversity, killing trees, altering wildfire intensity and frequency, and damaging crops. Some pests may even push native species to extinction. The following appendix includes key pests and diseases that adversely affect trees in Massachusetts, or which are emergent threats for Massachusetts at the time of this plan's development. This list is not comprehensive and may not include all threats.

It is critical to the management of community trees to routinely check APHIS, USDA Forest Service, and other websites for updates about invasive species and diseases in your area so that you can be prepared to combat their attack.

Updated pest range maps can be found at: https://www.nrs.fs.fed.us/tools/afpe/maps/ and updated pest information can be found at: https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/Pest-Tracker.

APHIS, Plant Health, Plant Pest Program Information

www.aphis.usda.gov/plant_health/plant_pest_info

USDA National Agricultural Library

www.invasivespeciesinfo.gov/microbes

The University of Georgia, Center for Invasive Species and Ecosystem Health

www.bugwood.org

USDA Northeastern Areas Forest Service, Forest Health Protection

www.na.fs.fed.us/fhp

ASIAN LONGHORNED BEETLE

Adult Asian longhorned beetle

The Asian longhorned beetle (ALB, *Anoplophora glabripennis*) is an exotic pest that threatens a wide variety of hardwood trees in North America. The beetle was introduced in Chicago, New Jersey, and New York City, and is believed to have been introduced in the United States from wood pallets and other wood-packing material accompanying cargo shipments from Asia. ALB is a serious threat to America's hardwood tree species.

Adults are large (3/4- to 1/2-inch long) with very long, black and white banded antennae. The body is glossy black with irregular white spots. Adults can be seen from late spring to fall depending on the climate. ALB has a long list of host species; however, the beetle prefers hardwoods, including several maple species. Examples include: box elder (*Acer negundo*); Norway maple (*A. platanoides*); red maple (*A. rubrum*); silver maple (*A. saccharinum*); sugar maple (*A. saccharum*); buckeye (*Aesculus glabra*); horsechestnut (*A. hippocastanum*); birch (*Betula*); London planetree (*Platanus × acerifolia*); willow (*Salix*); and elm (*Ulmus*).

BEECH LEAF DISEASE

Dark stripes between leaf veins are an early symptom of BLD.

Beech leaf disease (BLD) was first identified in Ohio in 2012. Since then, it has been found in Pennsylvania, New York, Rhode Island, Connecticut, and most recently in Massachusetts. The first confirmed detection of this emergent disease in the state was made in Plymouth in 2020, but symptomatic trees have been observed in Worcester and Blandford as well. Although it does not yet appear to be widespread in Massachusetts, BLD is an emergent threat to forest health in the state.

The disease complex is associated with a nematode, *Litylenchas crenatae*, and impacts American beech (*Fagus grandifolia*), European beech (*F. sylvatica*), and Oriental beech (*F. orientalis*). Early signs of the disease include dark stripes between the veins of leaves, most noticeable when looking up through the canopy on sunny days. As the disease progresses, leaves become withered, curled, or develop a leathery texture and sections of canopy may die back. Infected trees often appear to have a thin canopy, and the disease can lead to tree mortality. Research into this disease is ongoing, and the method of spread and infection, as well as potential treatments, are not yet known. If you suspect a tree under your care to be infected, report it to the DCR Forest Health Program by emailing nicole.keleher@mass.gov or by calling 857.337.5173.

DUTCH ELM DISEASE

Considered by many to be one of the most destructive invasive diseases of shade trees in the United States, Dutch elm disease (DED) was first found in Ohio in 1930. By 1933 the disease was present in several east coast cities and by 1959 it had killed thousands of elms. Today, DED is present in about two-thirds of the eastern United States and kills many of the remaining and newly planted elm annually. The disease is caused by a fungus that attacks the vascular system of elm trees, blocking the flow of water and nutrients and resulting in rapid leaf yellowing, tree decline, and death. The species most affected by DED is the American Elm (*Ulmus americana*).

There are two closely related fungi that are collectively referred to as DED. The most common is *Ophiostoma novo-ulmi*, which is thought to be responsible for most of the elm deaths since the 1970s. The fungus is transmitted to healthy elm by elm bark beetles. Two species of beetle carry the fungus: native elm bark beetle (*Hylurgopinus rufipes*) and European elm bark beetle (*Scolytus multistriatus*).

Branch death, or flagging, at multiple locations in the crown of a diseased elm.

ELONGATE HEMLOCK SCALE

The elongate hemlock scale (EHS, *Fiorina externa*) was introduced from Japan and was first observed in Queens, NY as early as 1908. It was not considered a major pest until the 2000s when its range and prevalence increased dramatically. This invasive scale insect has been found in 16 states to date, including Connecticut, Delaware, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, Nevada, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, and Virginia as well as the District of Colombia. The insect is thought to have been spread widely on infested conifer products, including holiday wreaths and Christmas trees.

EHS covering the undersides of hemlock needles.

Adult female EHS are soft-bodied, amber, legless, and wingless. They are encased in an 2mm long, brown, waxy scale covered under which they feed and lay around 20 lemon-colored eggs. Males are enclosed in white, 1.5mm scales. While they have wings, they are weak fliers and travel only to mate. They do not feed. Young instars are called crawlers and are yellow and legged. They emerge from May–September and mature to later instars which feed under scales. The scales are a visible sign that a tree is infested with EHS, and needle yellowing, especially on lower branches, premature needle drop, and branch dieback are all common symptoms of EHS infestation.

While these insects can kill trees outright by siphoning away nutrients and water from the tree, more commonly they weaken hosts, leaving them susceptible to other pests or environmental conditions.

EMERALD ASH BORER

Close-up of an emerald ash borer.

Emerald ash borer (EAB, *Agrilus planipennis*) is responsible for the death or decline of tens of millions of ash trees in 14 states in the American Midwest and Northeast. Native to Asia, EAB has been found in China, Japan, Korea, Mongolia, eastern Russia, and Taiwan. It likely arrived in the United States hidden in wood-packing materials commonly used to ship consumer goods, auto parts, and other products. The first official United States identification of EAB was in southeastern Michigan in 2002.

Adult beetles are slender and 1/2-inch long. Males are smaller than females. Color varies but adults are usually bronze or golden green overall with metallic, emerald-green wing covers. The top of the abdomen under the wings is metallic, purplish-red and can be seen when the wings are spread.

The EAB-preferred host tree species are in the genus *Fraxinus* (ash).

EUROPEAN GYPSY MOTH

Close-up of male (darker brown) and female (whitish color) European gypsy moths.

The gypsy moth (GM, *Lymantria dispar*) is native to Europe and first arrived in the United States in Massachusetts in 1869. This moth is a significant pest because its caterpillars have an appetite for more than 300 species of trees and shrubs. GM caterpillars defoliate trees, which makes the host trees vulnerable to diseases and other pests that can eventually kill the tree.

Male GMs are brown with a darker brown pattern on their wings and have a 1/2-inch wingspan. Females are slightly larger with a 2-inch wingspan and are nearly white with dark, saw-toothed patterns on their wings. Although they have wings, the female GM cannot fly.

GMs prefer approximately 150 primary hosts but feed on more than 300 species of trees and shrubs. Many preferred hosts are found in these common genera: birch (*Betula spp.*); cedar (*Juniperus spp.*); larch (*Larix spp.*); poplar (*Populus spp.*); oak (*Quercus spp.*); and willow (*Salix spp.*).

HEMLOCK WOOLY ADELGID

Hemlock woolly adelgids on a branch.

The hemlock woolly adelgid (HWA, *Adelges tsugae*) was first described in western North America in 1924 and first reported in the eastern United States in 1951 near Richmond, Virginia.

In their native range, populations of HWA cause little damage to the hemlock trees, as they are preyed on by natural enemies and possible tree resistance has evolved with this insect. In eastern North America and in the absence of natural control elements, HWA attacks both eastern or Canadian hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*), often damaging and killing them within a few years of becoming infested.

HWA is now established from northeastern Georgia to southeastern Maine and as far west as eastern Kentucky and Tennessee.

OAK WILT

Oak wilt symptoms on red and white oak leaves.

Oak wilt was first identified in 1944 and is caused by the fungus *Ceratocystis fagacearum*. While considered an invasive and aggressive disease, its status as an exotic pest is debated since the fungus has not been reported in any other part of the world. This disease affects the oak genus and is most devastating to those in the red oak subgenus, such as scarlet oak (*Quercus coccinea*), shingle oak (*Q. imbricaria*), pin oak (*Q. palustris*), willow oak (*Q. phellos*), and red oak (*Q. rubra*). It also attacks trees in the white oak subgenus, although it is not as prevalent and spreads at a much slower pace in these trees.

Just as with DED, oak wilt disease is caused by a fungus that clogs the vascular system of oak and results in decline and death of the tree. The fungus is carried from tree to tree by several borers common to oak, but the disease is more commonly spread through root grafts. Oak species within the same subgenus (red or white) will form root colonies with grafted roots that allow the disease to move readily from one tree to another.

PINE SHOOT BEETLE

Mined shoots on a Scots pine.

The pine shoot beetle (PSB, *Tomicus piniperda*), a native of Europe, is an introduced pest of pine (*Pinus spp.*) in the United States. It was first discovered in the United States at a Christmas tree farm near Cleveland, Ohio in 1992. Following the first detection in Ohio, the beetle has been detected in parts of 19 states, including Connecticut, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, and Wisconsin.

The beetle attacks new shoots of pine trees, stunting the growth of the trees. PSB may also attack stressed pine trees by breeding under the bark at the base of the trees. The beetles can cause severe decline in the health of the trees and, in some cases, kill the trees when high populations exist.

Adult PSB range from 3 to 5 millimeters long, or about the size of a match head. They are brown or black and cylindrical. The legless larvae are about 5 millimeters long with a white body and brown head. Egg galleries are 10–25 centimeters long. From April to June, larvae feed and mature under the pine bark in separate feeding galleries that are 4–9 centimeters long. When mature, the larvae stop feeding, pupate, and then emerge as adults. From July through October, adults tunnel out through the bark and fly to new or 1-year-old pine shoots to begin maturation feeding. The beetles enter the shoot 15 centimeters or less from the shoot tip and move upwards by hollowing out the center of the shoot for a distance of 2.5–10 centimeters. Affected shoots droop, turn yellow, and eventually fall off during the summer and fall.

Scots pine (*P. sylvestris*) is preferred, but other pine species, including jack pine (*P. banksiana*), Austrian pine (*P. nigra*), red pine (*P. resinosa*), and eastern white pine (*P. strobus*), have been infested in the Great Lakes region.

SOUTHERN PINE BEETLE

Adult southern pine beetles.

The southern pine beetle (SPB, *Dendroctonus frontalis*) is the most destructive insect pest of pine in the southern United States. It attacks and kills all species of southern white pine including eastern white pine (*Pinus strobus*). Trees are killed when beetles construct winding, S-shaped egg galleries underneath the bark. These galleries effectively girdle the tree and destroy the conductive tissues that transport food throughout the tree. Furthermore, the beetles carry blue staining fungi on their bodies that clog the water conductive tissues which transport water within the tree. Signs of attack on the outside of the tree are pitch tubes and boring dust, known as frass, caused by beetles entering the tree.

Adult SPBs reach an ultimate length of only 1/8 inch, similar in size to a grain of rice. They are short-legged, cylindrical, and brown to black in color. Eggs are small, oval-shaped, shiny, opaque, and pearly white.

SPOTTED LANTERNFLY

Pinned spotted lanternfly nymph.

The spotted lanternfly (SLF, *Lycorma delicatula*) is native to China and was first detected in Pennsylvania in September 2014. SLF feeds on a wide range of fruit, ornamental, and woody trees, with tree-of-heaven (*Ailanthus altissima*) being one of its preferred hosts. SLF is a "hitchhiker" and can be spread long distances by people who move infested material or items containing egg masses. If allowed to spread in the United States, this pest could seriously impact the country's grape, orchard, and logging industries.

Symptoms of SLF include plants oozing or weeping with a fermented odor, buildup of a sticky fluid called honeydew on the plant or on the ground underneath them, and sooty mold growing on plants. The following trees are susceptible to SLF: almond, apricot, cherry, nectarine, peach, plum (*Prunus spp.*), apple (*Malus spp.*), maple (*Acer spp.*), oak (*Quercus spp.*), pine (*Pinus spp.*), poplar (*Populus spp.*), sycamore (*Platanus spp.*), walnut (*Juglans spp.*), and willow (*Salix spp.*), as well as grape vines and hop plants.

WINTER MOTH

Winter moth larva on an oak leaf.

Winter moth (*Operophtera brumata*), a European native, was first detected in North America in the 1930s in Nova Scotia, Canada. It has since been found along Canada's and the USA's western coast and has migrated south from Nova Scotia into coastal New England. Winter moth adults are active during winter months, provided temperatures remain above freezing. Larvae hatch in the spring and are visible as small green inchworms feeding on leaves and buds of oak (*Quercus spp.*), maple (*Acer spp.*), elm (*Ulmus spp.*), ash (*Fraxinus spp.*), crabapple (*Malus spp.*), cherry (*Prunus spp.*), and blueberry (*Vaccinium spp.*), among other plants. Mature larvae balloon down from trees on silk strands to pupate in the soil and emerge as adults in November. Adult male winter moths are small and tan while females are greyish, have reduced wings, and are flightless.

Winter moth outbreaks are destructive due to the defoliation of host species, which causes severe stress to the plants as they are forced to use stored resources to re-foliate. Repeated defoliation frequently results in partial to complete tree death. A biological control agent, *Cyzenis albicans* (a tachinid fly) has been introduced to Massachusetts and other affected areas and appears to be at least partially successful in controlling winter moth populations.

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Image References

Asian Longhorned Beetle:

Photograph courtesy of New Bedford Guide (2011)

Beech Leaf Disease:

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Emerald Ash Borer:

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Hemlock Wooly Adelgid:

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Pine Shoot Beetle:

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Southern Pine Beetle:

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Spotted Lanternfly:

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Winter Moth:

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