



Mystic Avenue Corridor

Green Infrastructure Plan

Prepared for the Town of Medford by the Metropolitan Area Planning Council
June 2017



Introduction

Large amounts of impervious surfaces absorb and radiate heat in the warmer months of the year. This process, known as Urban Heat Island (UHI) effect, typically impacts denser urban environments without street trees or greenspace to block the sun and trans-evaporate rain water back into the air, thus cooling the environment. As climate change increases the number of severely hot days, mitigating the impacts of UHI should be seen as a public health priority for the areas cities and towns.

To address the issue of UHI in the Boston Metro Area, the Metropolitan Area Planning Council and the Trust for Public Land released an RFP to the cities within the Metro Mayors Climate working group for proposal ideas that would improve the conditions of a UHI area within their city. The two projects selected as successful respondents to the RFP were the Mystic Ave corridor in Medford and the Elle Pond watershed in Melrose. The strategies developed will reflect the use of green infrastructure and natural systems to manage heat, as opposed to built structures such as shading shelters, or pervious pavement.

Medford's Mystic Avenue is a segment of Massachusetts State Highway Route 38. This major thoroughfare connects Downtown Medford on the southern side of the Mystic River with Somerville. The route itself extends north to Lowell and south to Sullivan Square in Boston. Running parallel to both Route 16 and I-93, Mystic Ave is a heavily trafficked commercial / industrial district home to approximately 252 businesses and close to 2,500 employees. The business composition includes a large cluster of auto related firms along with a mix of construction, wholesale, and manufacturing firms. It is also home to several community facilities and social service organizations.

UHI is an environmental justice (EJ) issue as it disproportionately impacts low income and communities of color. The Metropolitan Area Planning Councils census data mapping has identified three clusters of EJ communities in and around the Mystic Ave corridor, including concentrations in nearby public housing at the Willis Ave Houses in Medford and Mystic Ave Apartments in Somerville.

To address the challenge of UHI on Mystic Ave this report has three distinct goals:

1. Quantify the impacts of UHI on populations in and around the Mystic Ave study area
2. Evaluate existing conditions of the built environment for green infrastructure opportunities
3. Recommend policy and programmatic interventions that would allow for the implementation of green infrastructure on Mystic Ave.

Limitations and Considerations

While this report strives to detail the strategies that could be used to implement green infrastructure along Mystic Ave it does not go into site-specific detail for where and how green infrastructure could be installed. That process would require detailed site specific analysis, including an evaluation of utilities that might interfere with tree survivability such as gas

infrastructure and leaks¹. This report aims to provide information regarding what the opportunities for green infrastructure installation are that would be effective in addressing UHI and the policies that could spur on that installation.

Beyond the recommendations of this report, there is a need for a coordinated effort between the Medford city agencies, MassDOT, and potentially the City of Somerville to plan for the future of Mystic Ave. A holistic plan that evaluates current and future needs of transportation, development, business growth, housing demand, social equity, and sustainability on Mystic Ave will be critical to addressing any of the challenges facing the avenue as they are all interrelated. MassDOT owns and operates the right of way south of Hancock St on Mystic Ave, and would need to be consulted in any planning related to the public realm along the corridor. As Mystic Ave leads into Somerville and acts as a major conduit into the city, engaging the Somerville planning, transportation, and environmental sustainability departments around the future of Mystic Ave would be beneficial to a cohesive planning process.

Methodology

The project team selected to use two study areas, a primary and secondary, to conduct the analysis of impacts of UHI on Mystic Ave and opportunities to combat it. The primary study is defined by the parcels fronting Mystic Ave in South Medford along with the industrial zoned parcels in the northern section that do not directly face the avenue but are on small side streets leading towards the Mystic River to include the Police and Fire Station as well as the city's Department of Public Works site. The secondary study is defined as South Medford as a whole, using the city's boundaries south of the Mystic River. The primary study area will be the focus for recommendations regarding the mitigation of identified UHI effect through the integration of green infrastructure. The secondary study area will be used to provide context for any proposed actions taken in the primary study area.

Demographic analysis for this study was done using the American Community Survey's 2011 – 2015 5 year aggregation. Analysis of parcels (size, ownership, permeability) was done using the City of Medford's tax assessed data, last updated in 2012. InfoGroup USA was used for business and employment analysis.

Identification of heat zones was completed using landsat imagery in conjunction with Landsat TRS Tools, a peer-reviewed ArcGIS toolbox (Walawender, Hajto, and Iwaniuk 2012).".

Structured interviews were conducted with directors their staff of the Department of Public Works, Engineering Department, Tree Warden, Department of Energy and Environment, and Department of Community Development to understand the City administrations perspective on green infrastructure. See Appendix B for interview questions.

¹ Fixing Our Pipes Report, MAPC, HEET, <http://fixourpipes.org/report/>

Setting up the Issue

All of Mystic Ave is Within an Identified Hotspot Zone

A land surface temperature analysis from July 13, 2016 revealed that Mystic Ave displays surface temperatures in the top 5% of the whole Metropolitan Area Planning Council Region. As Map 1 reveals, the majority of Medford does not experience the same surface temperatures as the Mystic Ave corridor on very hot days, however there are additional hot pockets in the city, specifically around the Fellsway Shopping plaza and the West Medford Commuter Rail station.

These hot areas correlate with a lack of tree canopy or other vegetation to block the sun and provide cooling capacity. Site visits to the study area revealed very little vegetation on either privately owned property or the public right of way.

A concentrated effort to add continuous green spaces along Mystic Ave is needed to address UHI. While smaller less intensive interventions such as bioswales and rain gardens may be effective in managing stormwater runoff, to tackle UHI larger, mature trees with significant canopy cover would be needed to provide cooling capacity.

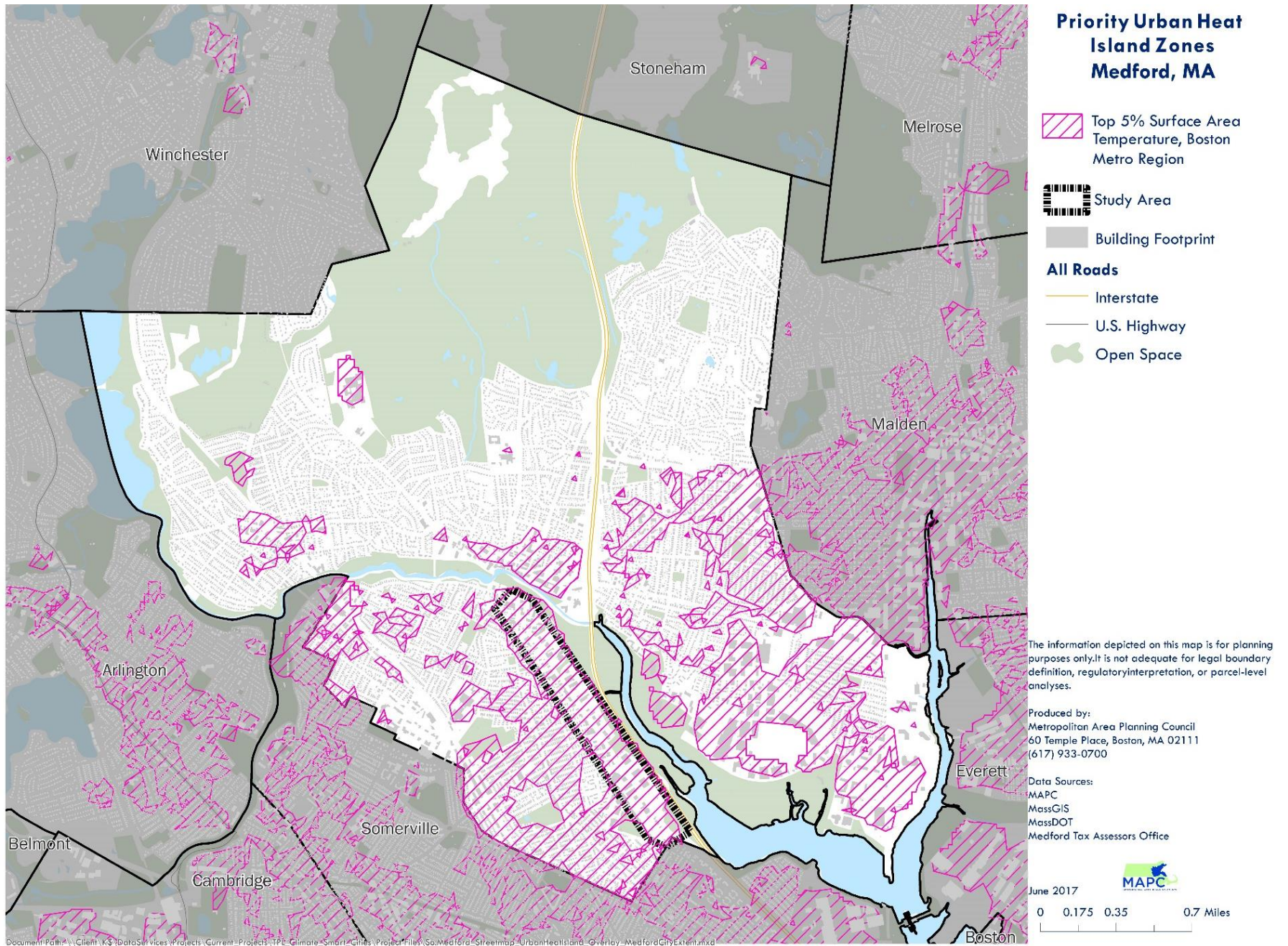
As New England's seasonal climate is expected to change, the selection of trees to be installed should reflect an understanding of the changing climate. The Climate Change Response Network has published an Adaptation Workbook that could be referenced by Medford's Tree Warden when selecting trees that will be resilient to a changing climate.



Image 2 Street Conditions on Mystic Ave



Image 1 Street Conditions on Mystic Ave



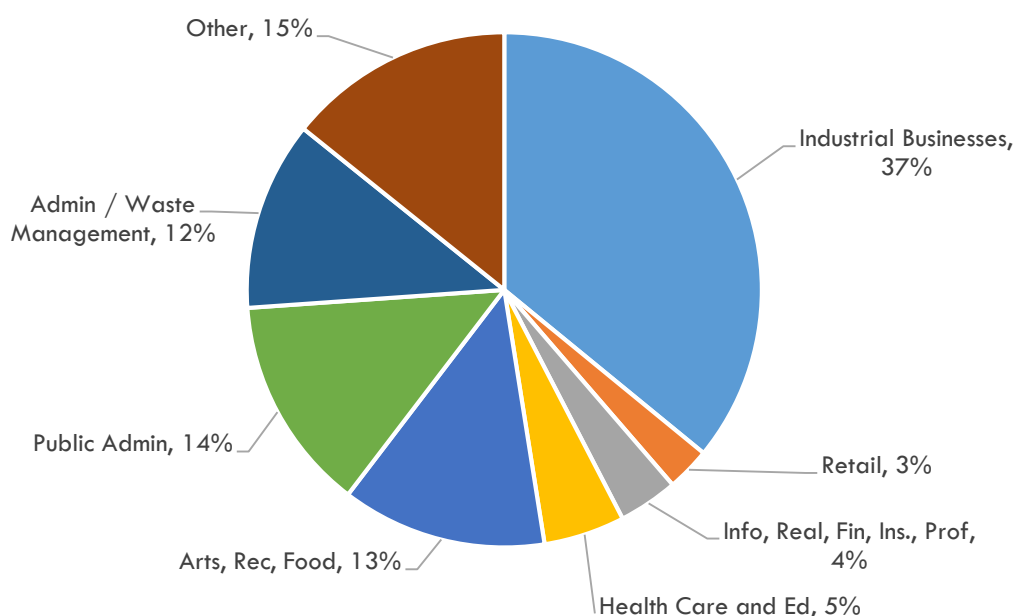
Mystic Ave is Vulnerable to Air Pollution

Mystic Ave is directly adjacent to RT 16 and I-93, both heavily trafficked highways that run on ground level while parallel to Mystic Ave. Mystic Ave itself is home to 252 businesses, 13% of which are auto related and an additional 24% that are categorized as other industrial sectors (construction, manufacturing, wholesale trade, transportation)². Auto businesses attract large numbers of vehicles for servicing as well as heavy trucks that may be towing disabled or wrecked vehicles. Other industrial sectors rely on trucks for the transportation of materials, products and equipment. All of this auto traffic increases emissions and particulate matter in the immediate environment.

Mystic Ave Businesses by Type

N = 252

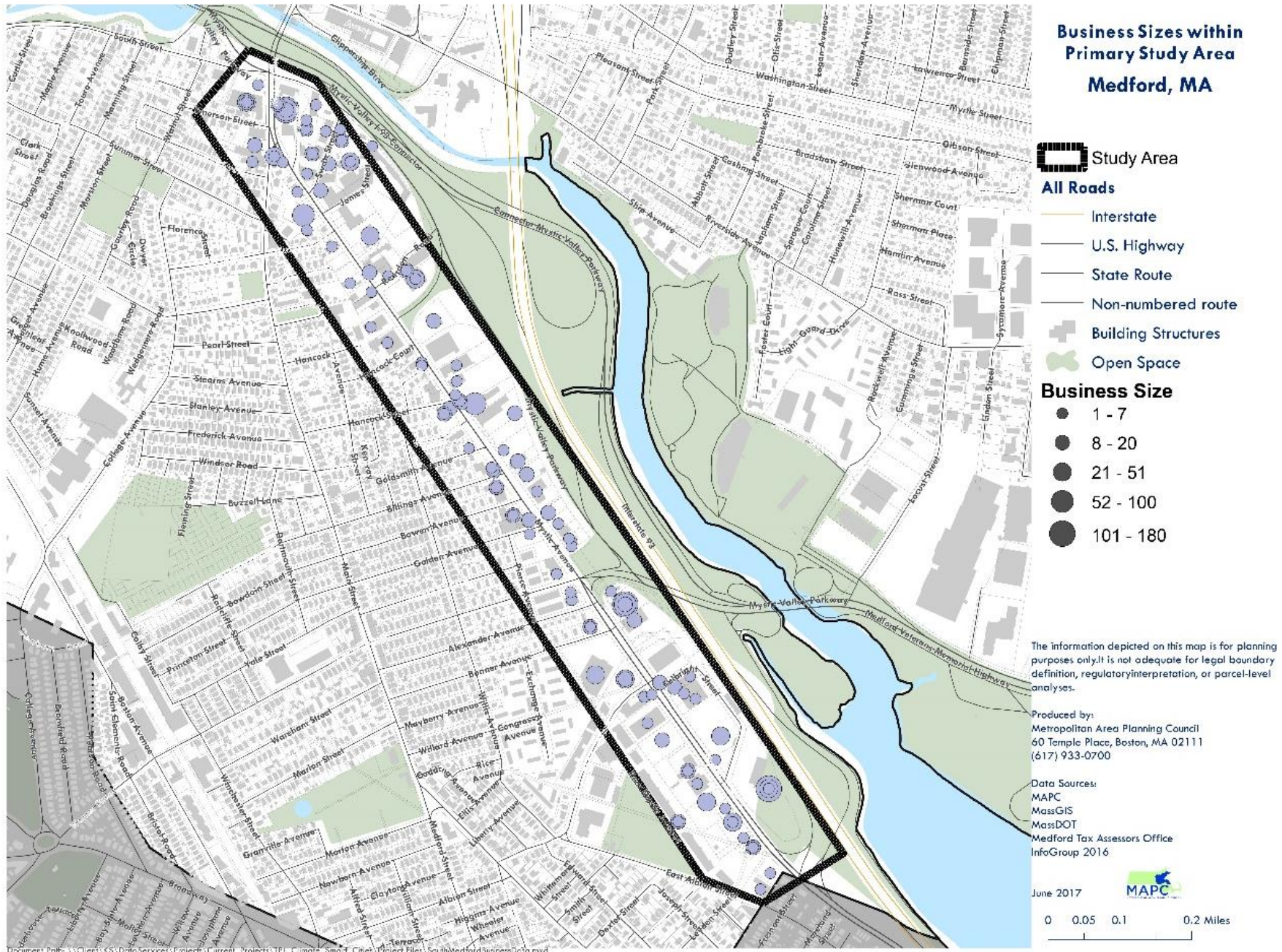
Source: InfoUSA 2016



In addition to the industrial businesses along the avenue there is a small cluster of health and social assistance businesses including a dialysis treatment center and a new facility for the Walnut Street Center (an organization that provides services for adults with developmental disabilities) located at 291 Mystic Ave.

In total, there are 2,500 employees working on the avenue who may be subject to the impacts if UHI. These existing businesses and employees are key stakeholders in addressing UHI on Mystic Ave. Finding innovative ways to integrate green infrastructure into private property and street right of way while balancing the operational requirements of the industrial businesses will be a challenge. Creating an opportunity for the City of Medford to engage with these businesses in a conversation about their operational needs to better understand how they may be able to implement green infrastructure on their property as well as improve the environmental practices of their business could yield new and innovative ideas as to how industrial corridors can be more environmentally sound areas.

² InfoGroup USA and authors site visit research and notation.



It should be noted that while the industrial users along Mystic Ave may be reliant upon heavy trucks that use diesel fuel, they are also good job providers for populations that may not have access to higher education or English language skills. In fact, more than a quarter of the workers on Mystic Ave have only a High School diploma or lower educational attainment³.

Further, heat compounds the impacts of air pollution, such as emissions from vehicle. Hotter temperatures can transform existing pollutants such as nitrous oxide (NOx) and volatile organic compounds (VOC's) into ozone. Ozone is a dangerous gas when inhaled and can lead to and worsen respiratory diseases like asthma, especially in young children. More than 50% of days with temperatures over 90 in Massachusetts were days associated with high ozone content⁴. Heat also directly impacts adults over the age of 60 and poses health risks for those have unhealthy weights, those with heart disease, and those with diabetes. Climate change is expected to increase the number of very hot days with temperatures over 90 degrees. The Cambridge Climate Change Vulnerability Assessment predicts that by 2030 there will be 3 times as many days over 90 degrees⁵. That number is expected to rise to 6 times by 2070.

Urban Heat Island Effect Impacts Multiple Populations, Including Low-Income and Communities of Color

Urban Heat Island along Mystic Ave impacts three identified environmental justice communities representing about 3,401 people or 13% of the total population within the secondary study area of 24,902.⁶ There are two public housing developments directly adjacent to Mystic Ave, the Willis Ave Development in Medford and the Mystic River / Mystic View Developments in Somerville. These housing complexes provide 615 units of affordable housing to the surrounding community.⁷

Mitigating the impacts of UHI and poor air quality on Mystic Ave could have direct benefits to vulnerable populations such as the environmental justice communities who may work on the corridor, use it for transportation to job centers, or visit any of the community services on Mystic Ave such as the senior center or dialysis treatment facility.

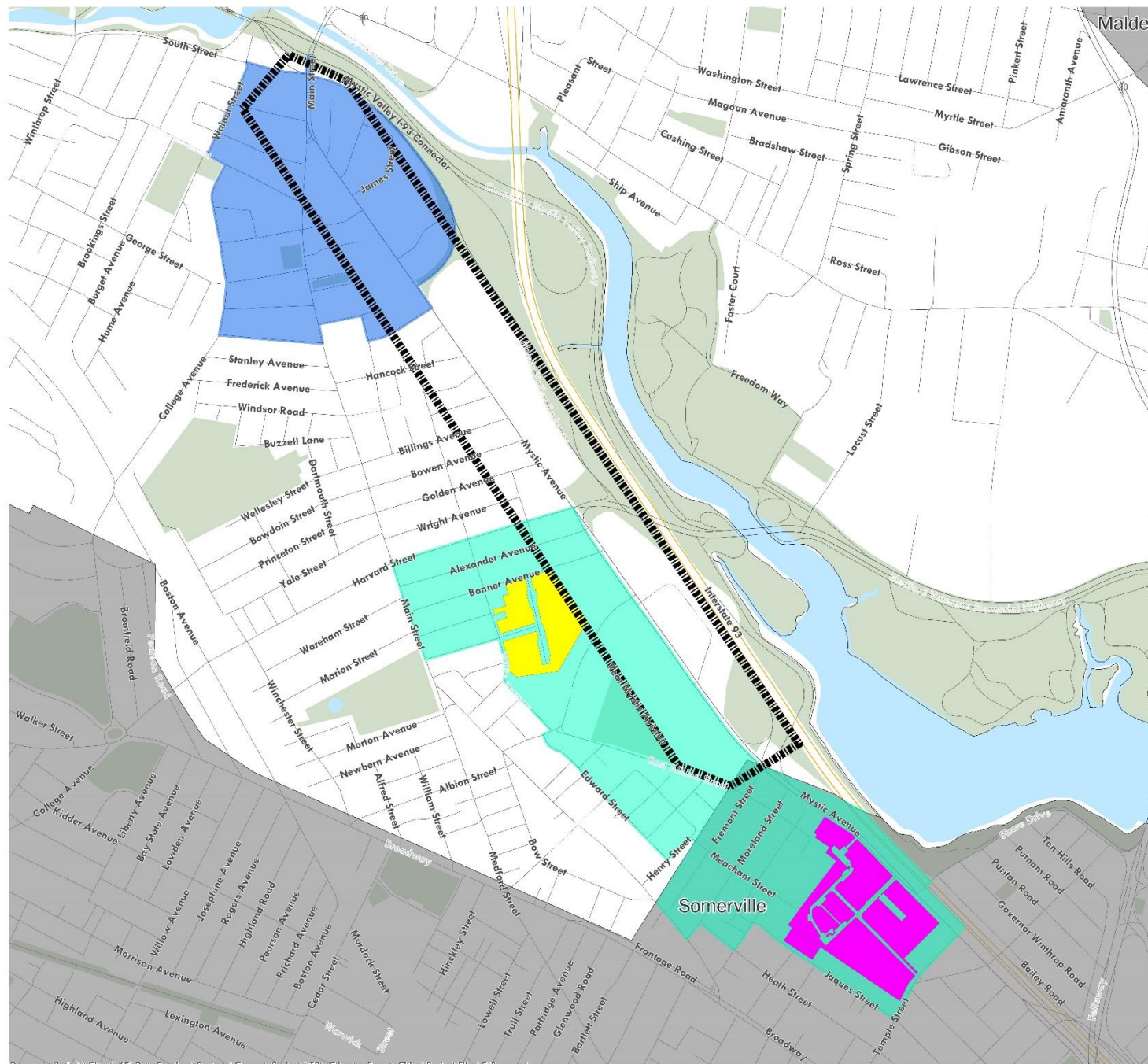
³ US Census LEHD 2014 accessed via On the Map for primary study area.

⁴ Mass Dep of Public Health Extreme Heat Presentation

⁵ Cambridge Climate Change Assessment, 19,
<http://www.cambridgema.gov/cdd/projects/climate/~media/307B044E0EC5492BB92B2D8FA003ED25.ashx>

⁶ US Census 2010 SF1

⁷ Medford Housing Authority, Somerville Housing Authority



Environmental Justice Populations and Public Housing Medford, MA

- Primary Study Area
- Mystic Apartments
- Willis Houses

All Roads

- Interstate
- U.S. Highway
- State Route
- Non-Numbered Route
- Open Space

Environmental Justice Populations

- Community of Color
- Low Income and
Community of Color

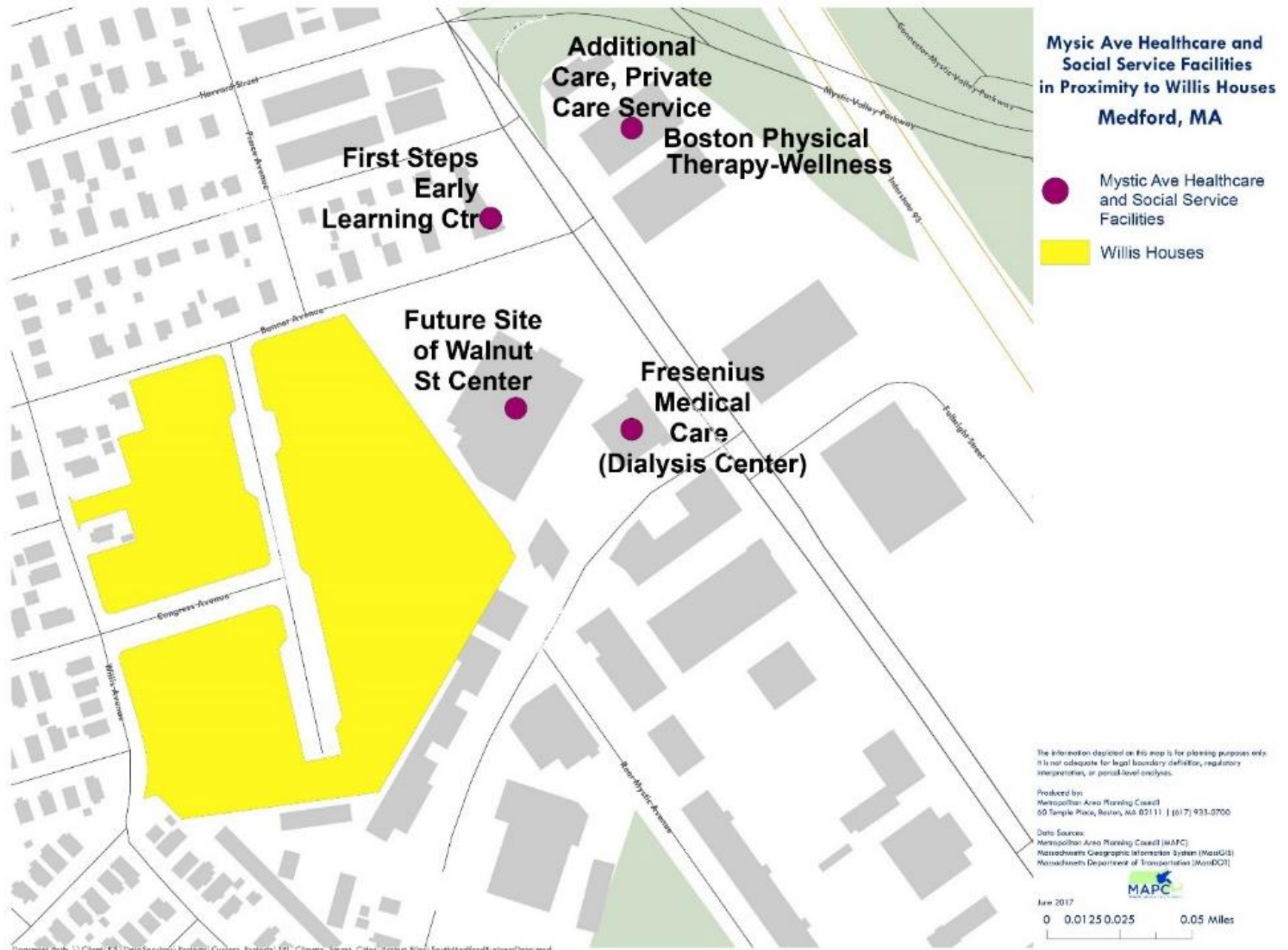
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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Data Sources:
MAPC
MassGIS
MassDOT
Medford Tax Assessors Office



June 2017
0 0.05 0.1 0.2 Miles



Mystic Ave is a Key Transit Corridor

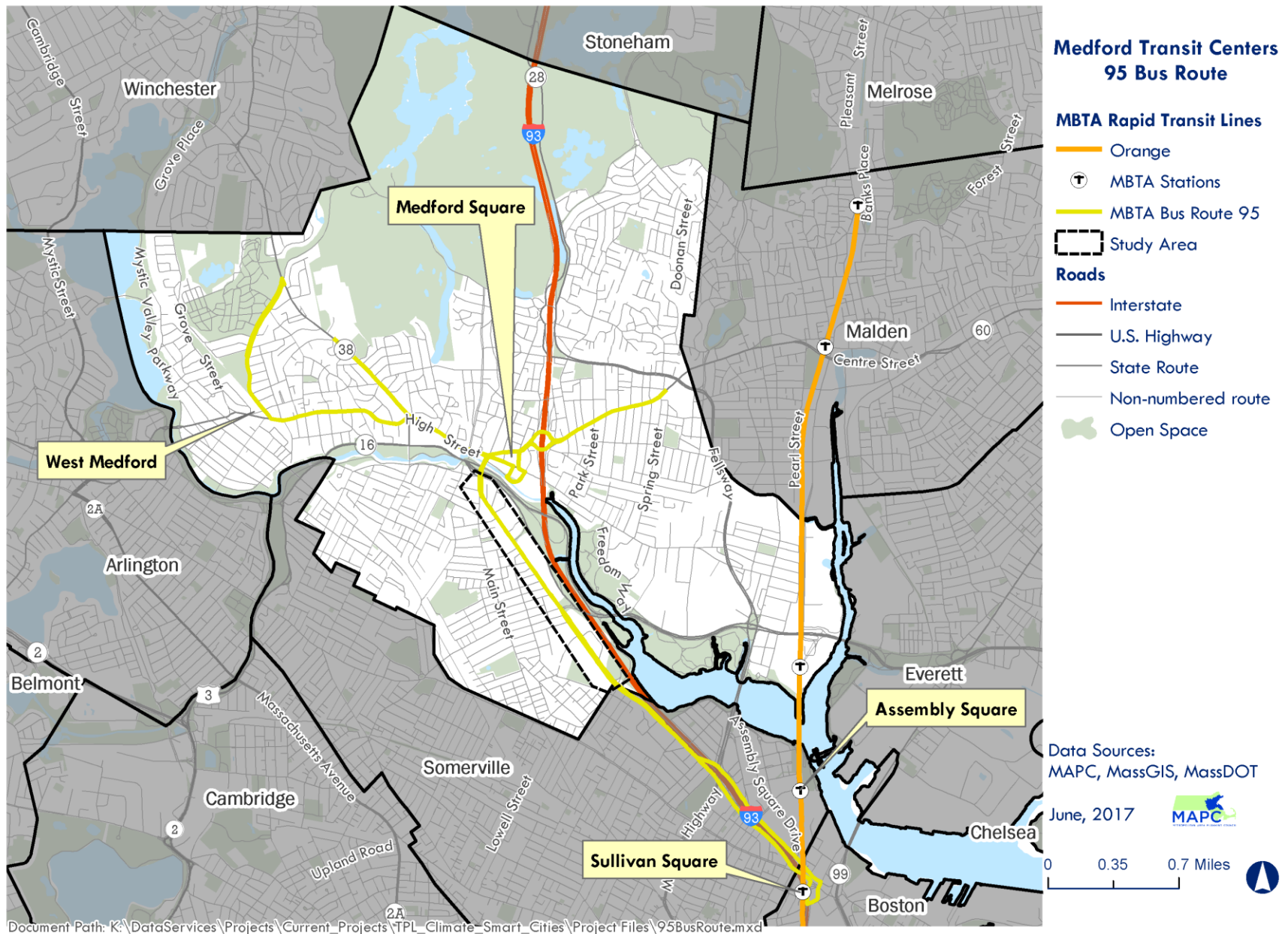


The 95 bus connects West Medford, Medford Square, Assembly Square, and Sullivan Square. It is the only bus that travels directly between Sullivan Square and Medford Square, making it a key link for those needing to travel from downtown Medford to Boston. Only one of the bus stops along Mystic Ave was observed to have any kind of natural shading element. No MBTA bus shelters were observed along the corridor, however there was a private bus shelter located at the Century Bank building in the southern end of the study area.

The City should engage with the MBTA to identify opportunities for improvements to the commuter experience along the 95 bus route. This could include integrating tree plantings at bus stops. The City should also consider approaching the business community along Mystic Ave to financially support additional bus shading which may benefit employees and customers.

Additionally, Mystic Ave was identified as a key bicycle route connecting Medford with Somerville in the city's cycling master plan. There are currently no bike lanes along the heavily-trafficked avenue, making it an intimidating and unsafe route for cyclists. Bicycle riders were observed riding on the sidewalks instead of on the road, creating an unsafe environment for both pedestrians and cyclists.

Green infrastructure could be used as a tool to leverage the improvement of the transportation experience for cyclists, pedestrians, and public transportation users along the corridor. Any future transportation study of the corridor should prioritize integration of green infrastructure and natural systems into capital improvements.



Map 1

Opportunities

The Mystic Ave corridor lacks infrastructure that could provide natural cooling and resilience to the adverse impacts of Urban Heat Island affect. However, the large lot sizes along Mystic Ave present an opportunity for investments in green infrastructure and increased cooling capacity through the absorption and trans-evaporation of storm water. The sum lot area of all 136 parcels within the primary study area is approximately 3.5 million square feet, or about 80 acres. 57% of that lot area is represented by parcels 40,000 sq ft and larger. These larger lots typically feature a built area accounting for 30%⁸ of total lot area with the remaining space primarily composed of parking or unused landscaping – see VFW case site on the following page. On average, the percent impervious surface of these lots is 92%, indicating that about 3.2 million square feet of land in the corridor has no vegetation⁹.

1" of rainfall over the entire primary study area would generate about 23,936,000 gallons of water, enough water to fill five Olympic sized swimming pools. Under current conditions most of this water is directly discharged to the Mystic River through stormwater drains. However, if this



stormwater was instead captured and evaporated through natural systems it could provide the Mystic Ave corridor with significant cooling capacity, about the equivalent of 725,333 tons of air conditioning or enough air conditioning to cool four Prudential Centers.¹⁰

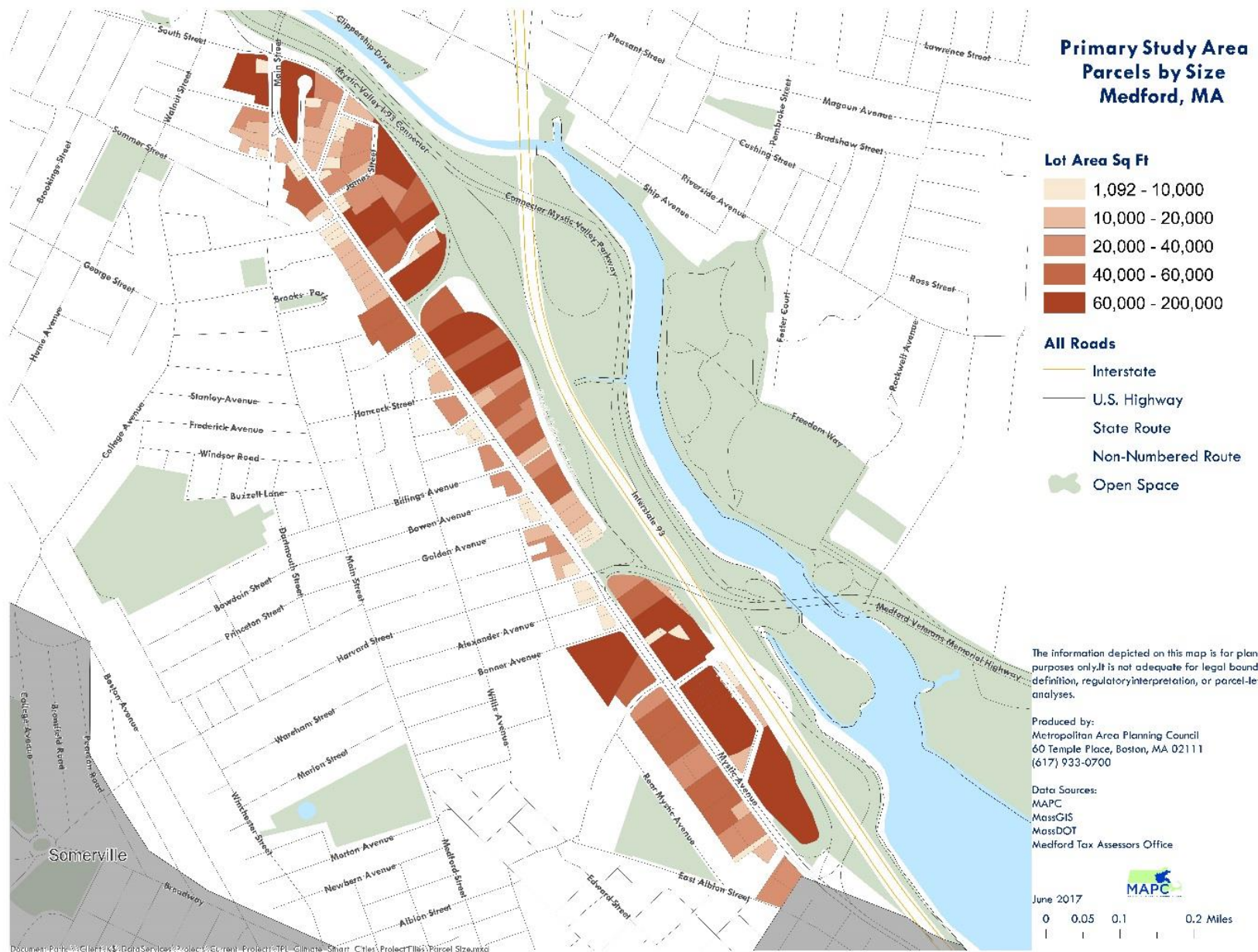
Harnessing the available space and runoff potential from the lots on Mystic Ave will be a key way to generate cooling capacity for the corridor and reduce the negative impacts of Urban Heat Island.

Image 3 Potential Site for Green Infrastructure at Hancock St and Mystic Ave

⁸ Medford City Assessor Data

⁹ Not accounting for Right of Way

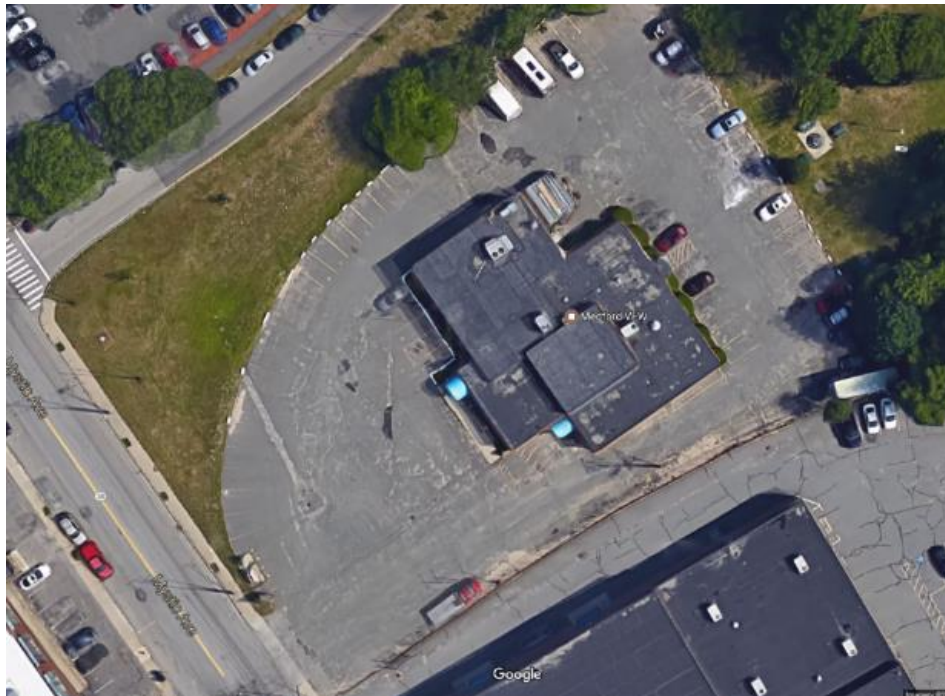
¹⁰ Calculations derived from *Green Roofs and Local Temperature*, Mankewicz, 23



Map 2

VFW Case Study

The VFW site located at 114 Mystic Ave provides an excellent opportunity for envisioning how green infrastructure could be worked into existing private property along Mystic Ave to address UHI. The 1.3 acre parcel is largely dedicated to parking, most of which was observed to be unused during the daytime hours aside from several food trucks stored on site. While the eastern end of the lot has a forested buffer separating the lot from Route 16, the lawn area that faces Mystic Ave is completely void of tree planting or other landscaped features. The space available may be able to support several mature trees that could provide cooling capacity, shade, and improve air quality along Mystic Ave itself.



Built in 1954,¹¹ the VFW building appears to be of sound structure with a large unobstructed roof area which may be able to support a green roof. As a facility that caters to special events, parties, and community meetings an investment in the on-the-ground conditions of Mystic Ave could send a strong signal to its users and the surrounding

community that the operators care about the environment and are committed to leading an effort to improve the community, which may motivate others to act as well.

Land Consolidation

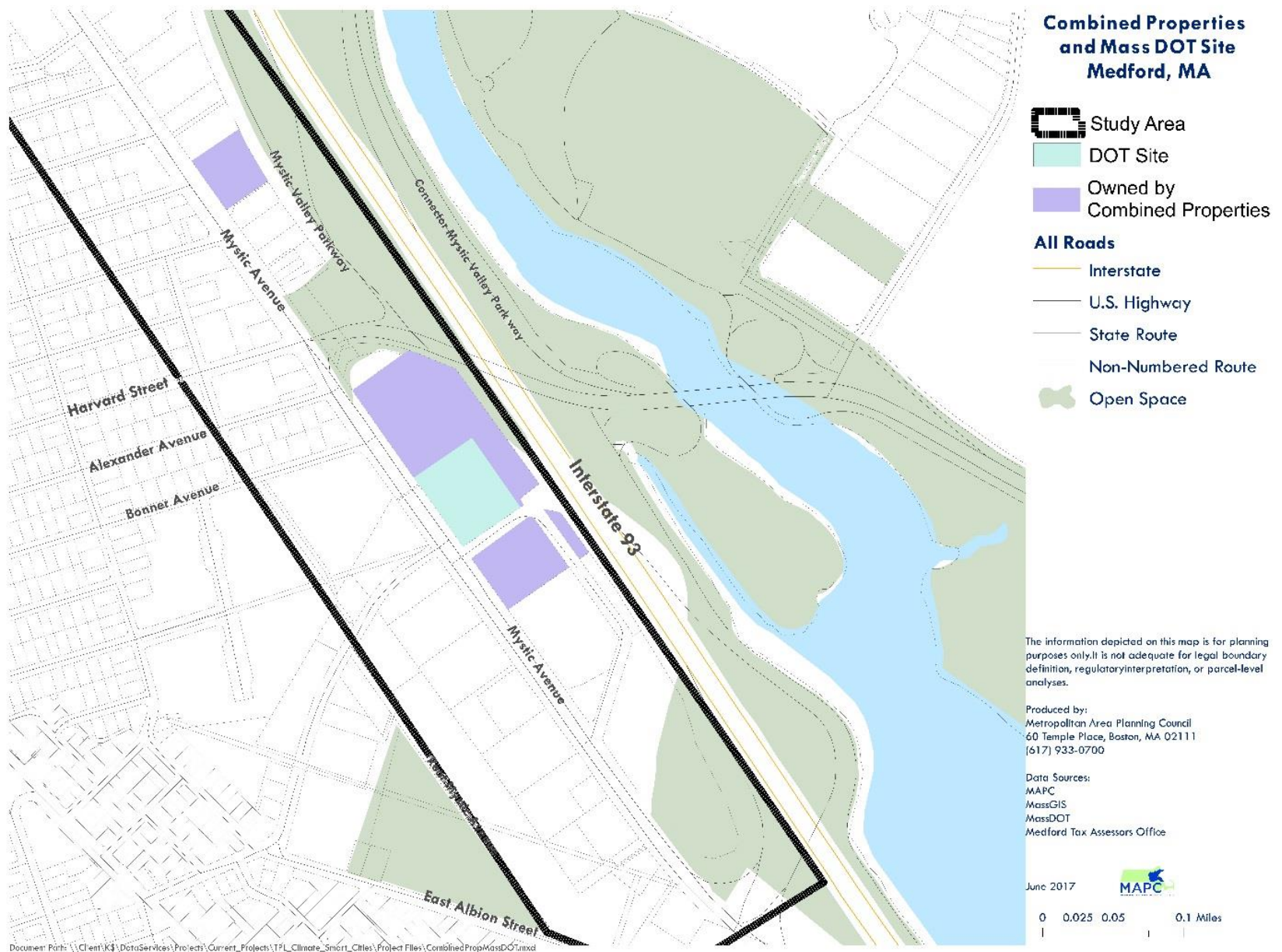
New development is planned for Mystic Ave through land consolidation, and could open an opportunity for institutionalizing significant green infrastructure investments.

Combined Properties owns 4 large parcels in the central section of the study area just south of the RT 16 on ramp.¹² MassDOT just released a 75,000 sq ft property that separates two of Combined Properties existing parcel holdings. ¹³ If Combined Property acquires this site they would own approximately 10% of the entire Mystic Ave corridor.

¹¹ Medford Assessors Data

¹² Medford Assessors Data, parcel data indicates that some parcels are broken into several smaller sections but they appear on the street as continuous lots.

¹³ MassDOT, Mass Open for Business



Map 3

These sites are strategic development sites as they are currently underbuilt, some with no existing structures at all. Any new development occurring on these parcels should be encouraged to incorporate green infrastructure to combat the negative impacts of UHI. The Case Studies included in this report detail specific intervention strategies that could be applied to new development along with policies that are designed to institutionalize the incorporation of green infrastructure into new development.

The MAPC Low Impact Development¹⁴ toolkit also outlines strategies for environmentally sound development that could be referenced in any conversations with developers as Mystic Ave begins to grow and change.

City-Owned Property

Within the primary study area, there are two city owned facilities: the joint Police / Fire Station, and the Department of Public Works building and yard.

The Department of Public Works building was recently completed and there are now plans to redevelop parts of the police and fire station. Any redevelopment of these properties should incorporate green infrastructure design elements and could be designed in coordination with the Engineering Department and Tree Warden. City leadership in integrating environmental measures on public property will be critical in encouraging private property owners along Mystic Ave to participate in efforts to address UHI.

Right-of-Way and Utilities

The City of Medford and MassDOT share ownership of Mystic Ave. The City owns and operates the right of way from Main St to Hancock St and MassDOT assumes control from Hancock St to the Medford / Somerville border. Mystic Ave also switches from a two lane road to a four lane road width at the transition of jurisdictions between MassDOT and the City.

As MassDOT is the operator of the right of way in this area, they should be actively engaged in planning for improving the negative effects of UHI in the area. MassDOT's Complete Streets Program could be leveraged to improve both traffic and environmental conditions along the corridor. Medford has successfully applied for Complete Streets funding in several other areas and should consider applying to improve conditions along Mystic Ave as part of a comprehensive plan for the avenue.

Eversource is planning on installing a new transmission main under Mystic Ave that will run the length of the corridor. While the timeline for installation may be in the short term, this kind of utility construction may also present an opportunity to think about new road improvements to Mystic Ave in coordination with MassDOT and the City's Engineering Department in the future.

¹⁴ <http://www.mapc.org/low-impact-dev-toolkit>

Agency Interviews

To inform our recommendations, MAPC conducted five interviews with key municipal stakeholders that play a role in implementing green infrastructure in Medford. Interviews were conducted with the directors of the Department of Energy and Environment, Department of Public Works, Department of Community Development and Planning, Medford's Tree Warden, and the City Engineer. These interviews shed light on existing municipal collaboration for green infrastructure projects, each department's role in supporting green infrastructure, and challenges and opportunities to implementing green infrastructure on along the Mystic Avenue corridor. From this qualitative analysis, it became clear that municipal staff share many of the same perspectives on green infrastructure.

Several respondents emphasized that Medford's municipal departments understand the value of implementing green infrastructure and voiced that there is internal support for green infrastructure. Municipal departments often collaborate to integrate green features into their existing projects. For example, the Tree Warden regularly consults with the Department of Public Works when they are conducting road maintenance and she shares guidance on the preservation of street trees. Several departments mentioned following the charge of the Department of Energy and Environment, when it comes to implementing best practices and policies on the ground for green infrastructure. While there is frequent collaboration between departments, it was voiced that there was no structured format for this collaboration to occur and there were likely instances where agencies worked on green infrastructure projects individually.

Municipal staff also regularly coordinate with external stakeholders, such as MassDOT, the Department of Conservation and Recreation, and National Grid. For instance, the Tree Warden works with National Grid to remove trees that threaten utility infrastructure. This informal partnership provides major cost savings for the city and benefits for the company, as National Grid assumes the cost of removing trees before they have a chance to cause substantial damage to infrastructure. Although existing internal and external coordination is informal, it has been effective. A citywide policy on green infrastructure may streamline and improve coordination if it establishes priorities and mechanisms and delegates responsibilities amongst municipal departments.

Municipal staff were also in consensus about some of the barriers to green infrastructure. The two biggest challenges to green infrastructure implementation were maintenance and public acceptance. Maintenance is a challenge because it is very costly for the city. Maintenance costs are decreased when green infrastructure is supported by the stewardship of private landowners. However, businesses are often reluctant to take on these maintenance costs because it effects their operations and bottom line. The general public also has mixed opinions on green infrastructure. Some of their concerns include obstructed views, blocked signage, parking, uplifted sidewalks, and plant debris. These are valid concerns, and there should be targeted efforts to address these concerns and give the public the buy-in they need to support green infrastructure initiatives.

In addition, the interviews shed light on challenges specific to the Mystic Avenue Corridor. One interviewee acknowledged the substantial length of curb cuts along the corridor and concerns that

businesses have about customer's access to their parking lots. Simultaneously, the City has experienced challenges in past attempts to plant street trees along the Mystic Avenue corridor. These trees did not survive due to damage from vehicles and irrigation issues. The corridor poses significant challenges to the survivability of trees because the roadway has a lot of utility infrastructure, signage, impervious surfaces, and drainage/flooding issues. The site specifications of Mystic Avenue must be taken into account to ensure that resources are used efficiently and that green infrastructure improvements along the corridor will be viable in the long-term. The City has established a tree list for that promotes the use of hardy trees in forestry initiatives that can withstand extreme temperatures, salt damage, and that can adapt to a changing climate.

This qualitative analysis underscores the need to undergo a coordinated plan for Mystic Avenue. This planning process should engage residents and businesses and provides an opportunity for learning exchange between municipal staff and the general public. The general public can learn about the benefits of green infrastructure, while municipal staff can get feedback on proposed green infrastructure programs and policies that address resident's concerns. This effort should also engage external stakeholders, such as MassDOT, who play a key role along the corridor.

The interviews flagged additional planning needs along the corridor that should be addressed in concert with a green infrastructure plan for the corridor. Since Mystic Avenue is a critical transportation corridor, it is important to conduct a parking and traffic study to determine how existing conditions will influence green infrastructure investments. Furthermore, Mystic Avenue could benefit from a beautification project that incorporates sidewalk and roadway improvements, which provides an opening for green infrastructure, and spurs economic activity along the corridor. A coordinated effort could also help the City to identify diverse funding mechanisms for green infrastructure. A Mystic Avenue visioning process could result in a coordinated plan that addresses existing needs and concerns, while mitigating the urban heat island effect and bolstering climate resiliency.

Recommendations

As stated in the introduction, this report aims to make recommendations regarding ways the City of Medford can address the issues of UHI on Mystic Ave. While there are short term actions the city can take to mitigate UHI, there is a need for a longer term comprehensive vision and plan for Mystic Ave as a whole. Evaluating the avenues needs in terms of land use, social equity, health services, housing, economic activity, transportation, and sustainability in a holistic manner will create an opportunity to integrate all of the avenues needs and challenges, including mitigating UHI. Coordination with MassDOT and MBTA as well as the City of Somerville as relevant stakeholders will be necessary to executing a plan that is actionable.

Similarly, there is a need for the City to coordinate a green infrastructure plan and policy between the various agencies involved with green infrastructure in the city. A plan that outlines priority areas for increased tree planting to address UHI, or increased permeability to address stormwater flooding along with a framework of roles and responsibilities for implementation would greatly increase the effectiveness of the agencies individual efforts.

To address the identified issue of UHI on Mystic Ave in the short term, the city should do the following:

- 1** Focus efforts along Mystic Ave on incorporating green infrastructure strategies such as extended tree pits with mature trees, continuous plantings, and green roofs to address heat island, as opposed to smaller interventions like raingardens or bioswales which will have less cooling capacity.
- 2** Coordinate an effort between the Departments of Community Development, Energy and Environment, and Tree Warden to engage with the existing businesses and property owners within the primary study area to identify appropriate opportunities for green infrastructure that do not interfere with business operations.
- 3** Focus on opportunities to implement green infrastructure around the healthcare and social assistance facilities located at the intersection of Mystic Ave and Route 16 to mitigate the negative impacts of UHI on vulnerable populations who may be users of these facilities.

4

Incorporate green infrastructure requirements into new zoning to ensure development is leveraged toward improving environmental conditions on Mystic Ave.

5

Leverage its own assets for investment in green infrastructure to showcase how green infrastructure can be incorporated into site design and display leadership from the city in addressing environmental issues.

6

Coordinate with Mass DOT and the MBTA around right of way improvements, including evaluating ways to improve shading at bus stops, potentially leveraging the Complete Streets program.

7

Create management and upkeep plans for any green infrastructure installed in the public right of way.

Conclusion

Urban Heat Island Impact is a real and documented threat to many communities and constituents around Mystic Ave, including residents of public housing, transit riders using the 95 bus, 2,500 employees working on the corridor, and customers and clients of the 252 businesses operating on the corridor. To address the increasing issue of UHI as a result of climate change the city must work to align the various agencies green infrastructure initiatives and bring additional stakeholders like MassDOT and the City of Somerville to the table to discuss a cohesive vision for the Mystic Ave corridor. Further, the city must create opportunities for meaningful engagement with business owners, landlords, and community residents in the process of planning for a green Mystic Ave. Engaging in a process to identify and address the corridors challenges will be a strong step towards addressing UHI for the City of Medford.

Green Infrastructure Case Studies

Chicago Green Permits Initiative

In Chicago, the municipal code enables the Department of Buildings to administer the Green Permits Initiative, which incentivizes developers to incorporate green infrastructure and sustainable building design into new construction and substantial rehabilitation projects. The initiative establishes two opt-in programs which expedite the permitting process for incorporating green elements into designs. The Green Permit Benefit Tier Program offers an expedited permit process and possible reduction of permit fees for commercial or residential projects that earn LEED or Green Globes certification and incorporate additional green technologies such as geothermal systems, green roofs, photovoltaic panels, solar thermal panels, wind turbines, and rainwater harvesting systems. The Green Permit Program is also available for any project, not certified by LEED or Green Globes, which incorporates green technologies and similarly provides developers with an expedited permitting process.

Green Infrastructure Features:

- Green Roofs
- Rain Gardens
- Bio-swales
- Stormwater Planters
- Retention Ponds

Departments Involved:

- Buildings

How it Works

Developers meet with the Department of Buildings Project Administrator to discuss project eligibility, scope of work, permit timeline, and permit fees. The applicants work closely with the Project Administrator to load necessary documents, including outline of green elements, to the Department of Building's application portal. The Project Administrator then reviews applications for completeness and begins the internal review process to ensure consistency with zoning and other regulations. Applicants receive feedback on their applications and must remedy outstanding comments and submit corrections to the Department of Buildings through the online portal. Applicants also request variances through the Project Administrator during this phase. Taking their green technology usage into account, the Project Administrator has a final meeting with the developer to finalize paperwork and fees for their project.

Successes & Caveats

At the time this legislation was enacted in 2009, the Chicago Department of Buildings was notorious for having a long and tedious permitting progress. The Green Permits became widely attractive to developers because it enabled them to obtain a building permit in less than 30 days. The program enables the City of Chicago to gain more support for green building amongst

developers and for further policies to promote it at the municipal scale. The program spurred projects that incorporated sustainable building design and green infrastructure across the entire city and helped to spur development outside of the Downtown Chicago.

Permit-incentives may be most successful in municipalities where there is limited municipal capacity to process building permits efficiently or within municipalities where there is high development demand and backlog of building permits. As the City of Chicago began to streamline internal processes to speed up the general permitting process, the incentive to apply for developers to a Green Permit has waned. Both municipal capacity and the development landscape should be carefully analyzed to assess whether a permit-incentive program would be successful in Medford.

Project Spotlight

Testa Produce is a produce distribution center and warehouse located seven miles outside of Downtown Chicago. In 2011, Testa Produce constructed a 91,300 square foot facility through the Green Permits Initiative. The facility was the first industrial building ever to receive a LEED Platinum certification. It has many green infrastructure components including a 764,000 gallon



water retention pond that collects rainwater to be used on site; a 140,000 gallon bioswale system that borders the property; a 45,650 sq. ft. green roof; and hundreds of square feet of permeable pavement. This project additionally incorporated clean energy elements including a 750 kilowatt wind turbine and 180 solar panels. The Green Building Permit program enabled the developers of this project to gain access to both expedited permitting and fee reductions.

Seattle Green Factor Code

The Seattle Green Factor is a code-based policy that requires green landscaping for all new development within designated residential, commercial, industrial, and mixed use zones. The Green Factor Code applies to new development projects with more than four dwelling units, greater than 4,000 square feet of commercial properties, or more than twenty new parking spaces. The code is designed in a way that gives developers and designers flexibility in how to increase green landscaping in efficient and cost-effective ways, based on the unique characteristics of a project.

The ordinance requires that 30% of a given parcel be vegetated. The Seattle Green Factor provides a menu of options for adding vegetation to a parcel including plantings, green roofs, vegetated walls, and rain gardens. Developers are encouraged to consider multiple layers of vegetation, including increasing the tree canopy. There are caps on the usage of permeable pavement and vegetated walls; and the credit is greater for the usage of trees instead of shrubs. Developers can receive bonus points if they use drought tolerant plants, place landscaping adjacent to a public way, or provide open space.

How it Works

Developers work closely with designers and architects to draft a site plan that incorporates items from the menus of options on the Green Factor worksheet. The team selects appropriate items based on the project's unique site characteristics and budget. They quantify the quantity and square footage of landscaping strategies and use the Green Factor worksheet to calculate their green factor score. The amount of landscaping required is dependent on the zone in which the project will be built. Projects in designated commercial, industrial, and mixed use zones; as well as projects near Downtown Seattle and the Yesler Terrace public housing development are required to achieve a minimum green factor score of 0.3. Projects in multifamily residential zones are required to have stricter landscaping requirements by achieving a minimum green factor score between 0.5-0.6. The project team verifies that they have achieved or exceeded the minimum green factor score for their project site and submits the site plan and worksheet to the Planning Department as a part of their building permit application.

Successes & Caveats

The Green Factor code has allowed the City of Seattle to influence the quality of landscaping to manage stormwater runoff and the urban heat island effect. The program has helped to increase the tree canopy on private property as well as make green infrastructure more accessible to the public. Since the code was first implemented in 2007, it has been updated and revised four times to reflect lessons learned from program evaluation and emerging best practice in green

Green Infrastructure Features:

- Green Roofs
- Vegetated Walls
- Rain Gardens
- Permeable Pavement
- Landscaping
- Tree Plantings

Departments Involved:

- Construction & Inspections
- Planning & Community Development

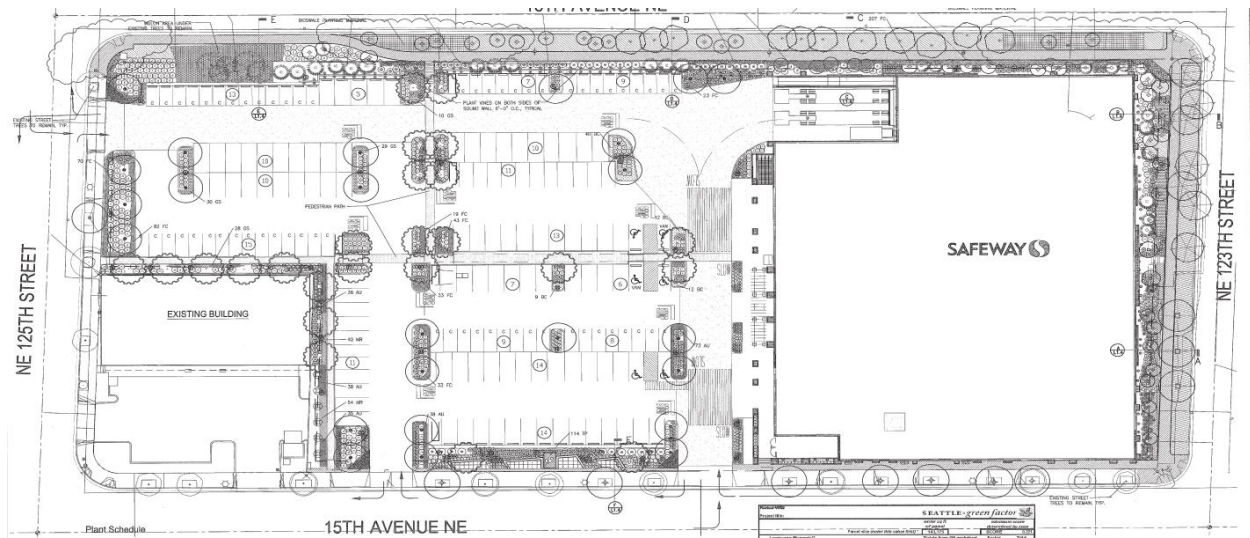
infrastructure design. This has allowed the code to remain relevant and targeted to achieve its intended outcomes.

Code requirements are sometimes critiqued for prohibiting development, particularly in places where land values are high or where there are limited incentives to spur development. The Green Factor's menu of options helps to curb some of the financial barriers that may arise with meeting the code. Code requirements must carefully consider land values and development trends to inform where they should be implemented. Potential development disincentives could be mitigated by establishing geographic boundaries in which the code will be applied. Additionally, code requirements can be paired with other financial incentives to encourage developers to go beyond minimum requirements.

Project Spotlight

The Pinehurst Safeway Grocery Store is located on a 143,175 square foot parcel. The approved development had a green factor above the minimum required by the ordinance. The landscaping contained over 3,000 square feet of ground cover, approximately 2,000 perennial shrubs, and over 100 trees of various sizes. The development also incorporated over 550 square feet of vegetated walls and over 17,000 square feet of permeable pavement. The development gained bonus points for utilizing drought tolerant plants, native species, and captured rainwater for on-site irrigation, landscaping visible/accessible to the public, and providing landscaping that can also be used for the cultivation of food.





Sacramento Parking Lot Shading Requirement

The City of Sacramento established a Parking Lot Shading Requirement in 1983 through its municipal code to mitigate the impacts of the urban heat island effect. The ordinance applies to development projects which create new parking lots or which expand existing parking lots. The ordinance requires that the parking lot be landscaped to provide 50% shading to the parking lot surfaces with 15 years. The following parking areas are exempt from the ordinance: single family/two-family residential parking areas, parking structures, truck loading/maneuvering areas, vehicle display/service/storage areas for automobile businesses, and covered parking areas/garages. All development projects with parking are required to submit a shade plan which is reviewed, and ultimately approved, by the City of Sacramento Landscape Architect. The shade plan indicates the location of trees, tree types, the quantity of trees, and proposed shade areas in relation to the parking lot surface area and required shading.

Green Infrastructure Features:

- Landscaping
- Tree Plantings

Departments Involved:

- Parks & Recreation
- Public Works
- Community Development
- Planning Division

How it Works

The City of Sacramento provides a Parking Lot Shading Design and Maintenance Guide that lists approved tree species that can be used to satisfy the requirements of the ordinance. This list has a standard estimate of tree crown coverage based on each species. Credit is received based on the percentage of the tree crown that covers the parking lot area. Trees that are planted in close proximity and that have overlapping tree crowns are not allowed to be counted twice. However, the portion of a tree crown that does not overlap may be credited. Developers must create a site plan which indicates the proposed location of trees and the location of each tree's crown. The site plan must be accompanied by a shade plan which calculates shaded area based on tree type, tree quantity, surfaced areas, shade area required, shade area proposed, and shading credit for each tree based on the guidelines. The preservation of existing street trees and on-site trees can be credited towards fulfillment of the ordinance.

Successes & Caveats

The Parking Lot Shading Ordinance has been successful in mitigating the urban heat island effect on properties with large parking lots. It is an ambitious code that applies to commercial, residential, public, and industrial properties which provide parking. Although this ordinance was created to mitigate the urban heat island effect, it can also be used to meet the requirements of the city's stormwater management ordinance (as recommended in the accompanying guidance document).

In addition to the caveats of code requirements, parking lot ordinances have additional caveats that are important to consider. A research study has shown that trees in Sacramento's parking lots are not actually meeting the tree canopy targets that are outlined in the ordinance. This is likely due to maintenance issues or environmental conditions that are not monitored or enforced within

the ordinance. Instead of forecasting tree canopy cover within 15 years, some other parking lot ordinances are written to mandate a number of trees to be planted per parking spot.

Project Spotlight

The Progressive Church of Christ, built in 1992, is located in the Meadowview neighborhood of Sacramento, ten miles outside of Downtown Sacramento. The church is located between two bus stops which provide access to three different bus routes on Meadowview Road. The parking lot features mature trees and numerous vegetated swales, which provides shading benefits and stormwater infiltration. Many of the property's trees are planted on the side of the lot that borders the heavily trafficked Meadowview Road, providing shading benefits to the public sidewalk.



Appendix B

Agency Interviews

Questions:

1. Can you describe your department's jurisdiction, where and how do you work?
2. Does your department currently interact with green infrastructure in any way (design, planning, and installation)? If so, please describe (If no, skip to **NO** section):
3. From your position what are the biggest challenges your department faces when working with green infrastructure?
4. Who is implementing green infrastructure in the city? City or State agencies, non-profits, community-based groups, etc.
5. What other agencies do you coordinate with around green infrastructure? What does that coordination look like?
6. Are there any current regulations or policies that are driving green infrastructure implementation in the city?
7. What do you think would be necessary to facilitate the implementation of green infrastructure on Mystic Ave?
8. Who is currently paying for green infrastructure projects in the City?
 - a. Where do these funds originate and do you feel well educated on how project funding works?

If no to question 2:

1. Based on what we've told you about Green Infrastructure how do you think it relate to the work you do?
2. How could you see yourself best working to implement green infrastructure, what role could you play?
3. What would be necessary to implement GI on Mystic Ave?