PROJECT TITLE

Title:	Improving Water Quality in Hartford (Connecticut) Through Community-Led Lot Revitalization
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Summary

The "Improving Water Quality in Hartford Through Community-Led Lot Revitalization" project addressed critical water quality challenges in Hartford, particularly those affecting the Connecticut River and local waterways. Aging drainage systems in the city struggle to manage stormwater, leading to issues like flooding, polluted runoff, and combined sewer overflows. Green stormwater infrastructure (GSI) offers a promising solution, with additional benefits such as reducing urban heat, creating recreational spaces, and fostering community well-being. However, despite municipal support for GSI, progress has been hindered by limited community engagement and concerns about costs and implementation.

This initiative adopted a community-based approach to bridge these gaps. Collaborating with local minority-serving organizations and the University of Connecticut, the project engaged Hartford residents in learning about nature-based solutions and co-designing a revitalized neighborhood open lot. By raising awareness of water quality issues and the potential of GSI, the project not only educated the community but also built partnerships to support future funding and implementation efforts. This collaborative model set a foundation for inclusive, sustainable solutions that align with the community's needs and priorities, paving the way for improved water quality and urban resilience in Hartford.

Introduction

In Connecticut, nonpoint source pollution significantly contributes to the ecological degradation of local waterways (Helton, 2015), prompting statewide efforts to address this pressing issue (CT DEEP, 2020b; CT DEEP, 2022). Despite these initiatives, water quality challenges persist, especially in urban areas like Hartford (CT DEEP, 2020a; Walsh et al., 2005). Dangerous bacterial levels have been recorded in the Connecticut River, exacerbated by polluted runoff and combined sewer overflows, while other surface waters like Trout Brook and the Park River are also impaired, likely due to urban stream syndrome. These conditions highlight the urgent need for solutions that address stormwater runoff and pollution while promoting ecological health.

Hartford has explored green stormwater infrastructure (GSI) as a viable solution, recognizing its potential to mitigate runoff issues, increase vegetation, and enhance urban sustainability. The city has identified nature-deprived areas, calculated plantable spaces, and developed GSI prototypes (City of Hartford, 2020; City of Hartford, 2017; City of Hartford Office of Sustainability, 2018; City of Hartford Office of Sustainability and CIRCA, 2018). These efforts align with broader metropolitan sewer and utility system plans. However, progress has been limited due to barriers such as cost uncertainty, lack of long-term maintenance plans, and insufficient demonstration projects. Most notably, top-down planning approaches have excluded community input, hindering public support and the alignment of GSI projects with the needs of diverse residents (Grabowski et al., 2023; Hardiman & Rodríguez González, 2020; Rodríguez González et al., 2022b).

This project aimed to overcome these barriers by adopting an inclusive, community-driven approach to GSI education and demonstration. Building on Hartford's previous planning efforts, we prioritized the engagement of racial and ethnic minorities in nature-deprived neighborhoods. Participants were involved in envisioning green infrastructure tailored to their community's needs and priorities. They also contributed to the design and planning process, which included feasibility studies, cost-benefit analyses, site selection, and post-implementation monitoring. By emphasizing co-design and cultural relevance, this project sought to advance water quality improvement in Hartford while fostering long-term community support for sustainable green solutions.

Objective(s)

This project aimed to promote the inclusive co-design of nature-based infrastructure, particularly green stormwater infrastructure (GSI), while increasing community awareness and knowledge of local stormwater challenges and nature-based solutions.

Results/Discussion

The proposed project successfully engaged diverse community groups, enhanced understanding of green stormwater infrastructure (GSI) and green infrastructure (GI), and provided actionable data to advance equitable GI planning. Below is a summary of key results, organized in sections pertaining to the education, visioning, co-design, and implementation efforts held.

Education

Our community education efforts focused on building community capacity through green skills training and outreach activities centered on nature-based solutions like GSI. These efforts not only increased community knowledge and engagement but also fostered intergenerational and cultural connections, promoting long-term sustainability and inclusivity in urban greening projects. 100% of participants were recruited via partnerships with minority-oriented organizations.

1. Adult Green Skills Training (Tree Planting and Care): Two cohorts of participants engaged in intensive training programs at KNOX in Hartford, CT.
    - Cohort 1 (March 26, 2024): Included 8 participants, with 75% identifying as BIPOC and 25% Hispanic. The cohort completed 500 hours of instruction over 30 days.
    - Cohort 2 (August 13, 2024): Included 8 participants, with 50% identifying as BIPOC, completing the same training structure.

    These programs included paid traineeships and emphasized skills essential for urban greening, tree planting, and long-term care, preparing participants for green career pathways.
2. Youth Green Skills Training: Green skills training for youth was conducted at the Hartford Public Library's Albany Branch and included the following sessions.
    - Waste Management for Healthy Waterways (May 10, 2024): 20 participants (75% BIPOC).

- Ecological Monitoring for Environmental Justice (May 3, 2024): 17 participants (65% BIPOC, 5% Hispanic).
- Green Jobs and Green Careers (April 26, 2024): 13 participants (62% BIPOC).
  These sessions introduced participants to waste management strategies, environmental monitoring techniques, and pathways to green careers, fostering environmental stewardship among youth.

3. Outreach and Community Engagement: Outreach efforts targeted diverse groups through various events.
   - Youth Outreach (Connecticut Science Center, September 14, 2024): Engaged 152 participants across five stations, showcasing green stormwater infrastructure (GSI) and nature-based solutions (NBS).
   - Adult Outreach (Windsor Public Library, March 20, 2024): Delivered a talk to 16 participants (13% BIPOC, 6% Hispanic) on urban greening initiatives.
   - All Ages (Keney Park Sustainability Project, October, 12, 2024): Delivered the Saukiog Harvest Festival in collaboration with Indigenous groups to close to 70-100 attendees.

Community Visioning

We engaged 71 Hispanic adults through a series of seven one-hour community learning sessions conducted entirely in Spanish. These sessions explored topics such as climate change, tree equity, food sovereignty, nature connections, environmental justice, urban biodiversity, and water issues (Figure 1).

Figure 1. Topics discussed during community visioning sessions in relation to their timeline.

Participants worked in teams to answer open-ended questions using drawing paper and markers, fostering creativity and collaboration (Table 1). Each team shared their insights during group discussions with the broader audience. To deepen engagement, follow-up questions were presented through interactive formats like dyads, triads, and opinion meters, allowing participants to visually or kinetically express their perspectives and prioritize their responses (Figure 2). This dynamic approach is known as sensemaking (i.e., making sense of local challenges), and it not only encouraged meaningful discussions (Figure 3) but also ensured an engaging experience while gathering valuable insights to inform future co-production initiatives.

Table 1. Open-ended prompts and type of follow-up questions used during community visioning sessions.

Topic	Sensemaking Prompts	Sample Follow-Up Prompts	
		Prompt	*Type*
Climate Change	How has climate change impacted your community?	Classify the impacts from your story (socioeconomic, ecological, technological)	Triad
Tree Equity	What would the ideal green space look like for your community?	What would inspire you to participate in a greening project that achieves this vision? (monetary or gift incentives, celebratory event day, educational programming)	Triad
Food Justice	Describe your community's food systems.	How can we help enhance this food system?	Open ended
Nature Connection	What does nature mean to your community?	*No follow-up prompts due to limited time.*	
Environmental Justice	Think about the works case of environmental pollution you have experienced. What would be needed to fix it?	Who is responsible for implementing these changes? (government, community)	Dyad
Biodiversity	What is your favorite type of biodiversity?	Urban biodiversity is an important aspect of my community.	Opinion Meter
Water Issues	What water issues impact your community?	*No follow-up prompts due to limited time.*	

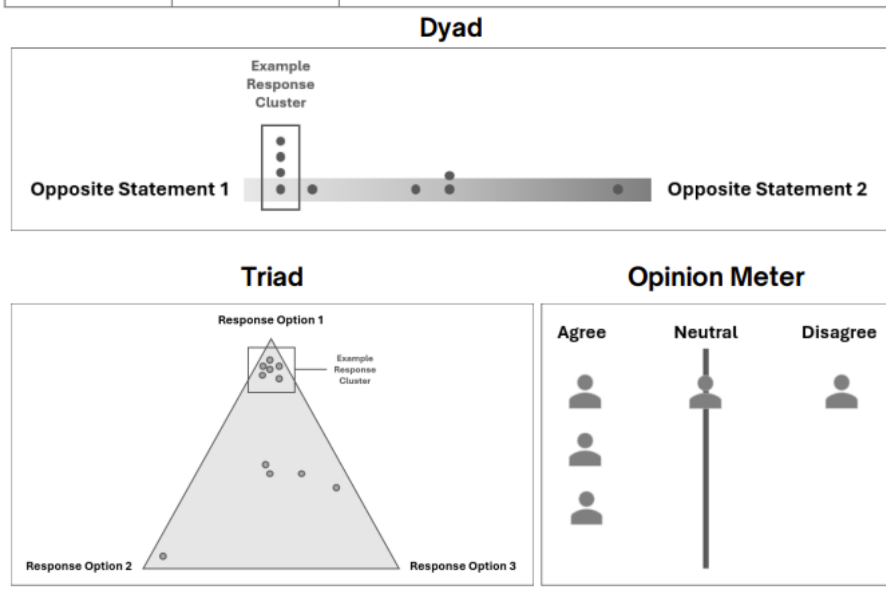

Figure 2. Gradient-based follow-up questions used after open-ended prompts during community visioning sessions.

Figure 3. Community discussions during community visioning sessions.

The community visioning process yielded critical insights that shaped the project's direction, helping to refine key design aspects for the subsequent co-design phase. Additionally, it provided clarity on project priorities, such as identifying suitable partners for the educational components and demonstration projects. The following are the key takeaways from this process:

- Supporting Practitioners and Government in Accounting for Community Needs: In our first sensemaking session on climate change, we had two groups of five to six individuals each. One group consisted of service providers from the Hartford County area, while the other group was made up of community members. This distinct split allowed us to document disparities in perceived community-level consequences of climate change. While service providers focused on big-picture items like animal extinction, inflation, and global statistics on climate change-related deaths, community members shared personal narratives, such as losing their homes to landslides or hurricanes and moving to the United States as a consequence. Practitioners noted that there is an increase in mental health issues within the Puerto Rican community due to eco-anxiety related to hurricanes and earthquakes. When asked who was responsible for climate change, community members predominantly believed the government and large industries were at fault, with one attributing responsibility to the community. The outlier explained they felt responsible because communities vote for municipal officials. Despite the majority not feeling that the community should bear complete responsibility for climate change, in a sensemaking session on environmental justice, none placed full responsibility for maintaining clean neighborhoods on the local government. Instead, many attributed most of this responsibility to residents.

- Assessing and Addressing Disparities: In a separate session on environmental justice, participants rated the natural components of their neighborhoods poorly, expressing dissatisfaction with the amount of trash and a lack of awareness regarding how to dispose of large items. During a session about tree equity, participants further expressed dissatisfaction with the quality of local parks, perceiving them as unsafe and unclean compared to those in high-income, predominantly white neighborhoods.
- Educating Stakeholders: During the water issues session, participants, many of whom may come from countries with unsafe tap water, concentrated on the quality of water from the tap in their Hartford apartments, while urban flooding issues common in certain areas of Hartford were not brought up. Meanwhile, the body of scholarly work indicates that biodiversity is lowest in low-income and racial/ethnic minority neighborhoods. Despite the pressing need to address this disparity, our sensemaking session on urban biodiversity highlighted the disconnect between how decision-makers and researchers discuss biodiversity and how communities do. Although there was some focus on bird biodiversity, community members primarily focused on food production and fruit trees rather than broad biodiversity issues. This was unsurprising, as the nature connections session extensively captured the many ways fruits and vegetables are part of Hispanic culture, from their cuisine to their use in constructing musical instruments. When asked to list their favorite plants, all selected were edible or fruit-producing. This is not to say that community members do not recognize environmental concerns. During the tree equity session, participants brought up habitat degradation and how urbanization has led to humans invading the habitat range of wildlife such as bears, resulting in sightings of the species on busy roads as well as unexpected home visits.
- Assisting with Funding Opportunities: In a food sovereignty session, participants were asked how UConn and local agencies could improve urban food systems. They suggested these organizations support and enhance services provided by community-based groups and local nonprofits through small grant programs. Informal discussions with Connecticut community-based organization leadership revealed challenges in applying for state and federal funds. These included understanding program goals (YWCA, New Britain), lacking upfront funds for reimbursement grant models (Afro-Caribbean Cultural Center, Waterbury), and needing letters of support from tree wardens and city foresters (Roots, New Britain), who were perceived as often non-responsive.
- Engaging Diverse Community Groups: During the tree equity sensemaking session, participants were asked how they preferred to be approached for community enhancement and greening projects. They favored celebratory events with participation gifts and expressed a desire to "feel part of a greater thing" and for "more programs that also engaged their youth." Participants suggested the local Cooperative Extension System could support them by "disseminating knowledge to families and providing seeds and supplies" and "hosting large workshop events." Leadership from the Hispanic Health Council and the Afro-Caribbean Cultural Center emphasized the importance of promoting intergenerational resilience, noting that engaging multiple generations in programming is crucial for cultural learning and community strength.
- Sensemaking as a Method for Social Cohesion and Knowledge Exchange: Sensemaking is a valuable method for fostering social cohesion and facilitating knowledge exchange

within communities. It involves collective processes where individuals interpret and give meaning to complex issues through shared dialogue and reflection. By engaging community members in sensemaking activities, diverse perspectives were brought together, enabling participants to co-construct understanding and generate insights informed by their varied experiences. This collaborative approach not only strengthened social bonds but also promoted both vertical and horizontal knowledge exchanges. Vertical knowledge exchanges occurred naturally when sensemaking teams shared their respective discussions with the facilitator, who was often a domain expert, and the domain expert learned about community experiences while contributing explanations to break down socio-ecological phenomena experienced by the community. Horizontal knowledge exchanges occurred as participants discussed within their own teams. For example, during a food sovereignty session, one participant informed another that they could use their SNAP benefits to purchase seeds or edible plants. As participants shared their stories and knowledge, they built a collective narrative that enhanced mutual understanding and promoted a sense of belonging and validation. Ultimately, sensemaking served as a powerful tool for uniting community participants and fostering inclusivity in discussions of environmental and climate challenges.

Co-Design

Community members connect to nature in diverse ways, often shaped by their cultural backgrounds. By aligning greening projects with these values, we can foster stronger community support and engagement. This cultural alignment cultivates a deeper sense of ownership and pride among residents, enhancing the success and sustainability of our initiatives. To achieve this, we conducted three co-design workshops:

- Online: Teams Meeting, May 21, 2024, 6 participants (67% BIPOC, 17% Hispanic).
- In-person: Keney Park Sustainability Project (Windsor, CT), August 2, 2024, 10 participants (40% BIPOC, 30% Hispanic).
- In-person: Hispanic Health Council's Family Wellness Center (Hartford, CT), September 18, 2024 (delayed to September due to the community partner's schedule), 7 participants (14% BIPOC, 86% Hispanic).

Through these co-design workshops, we worked to integrate community design preferences into nature-based solutions, such as green stormwater infrastructure (GSI), to create greener, healthier, and more equitable urban environments. The outcomes of this collaborative effort included:

- Preliminary development of a community poster (Figure 4) representing key design preferences for urban lot revitalization.
- Identification of a tree and plant palette (Figure 5) based on community preferences.
- Incorporation of these preferences into a professional design (Figure 6) created by a consultant landscape architect.
- Testing aspects of the design in a demonstration plot developed by the Keney Park Sustainability Project and located at The Connecticut Historical Society.

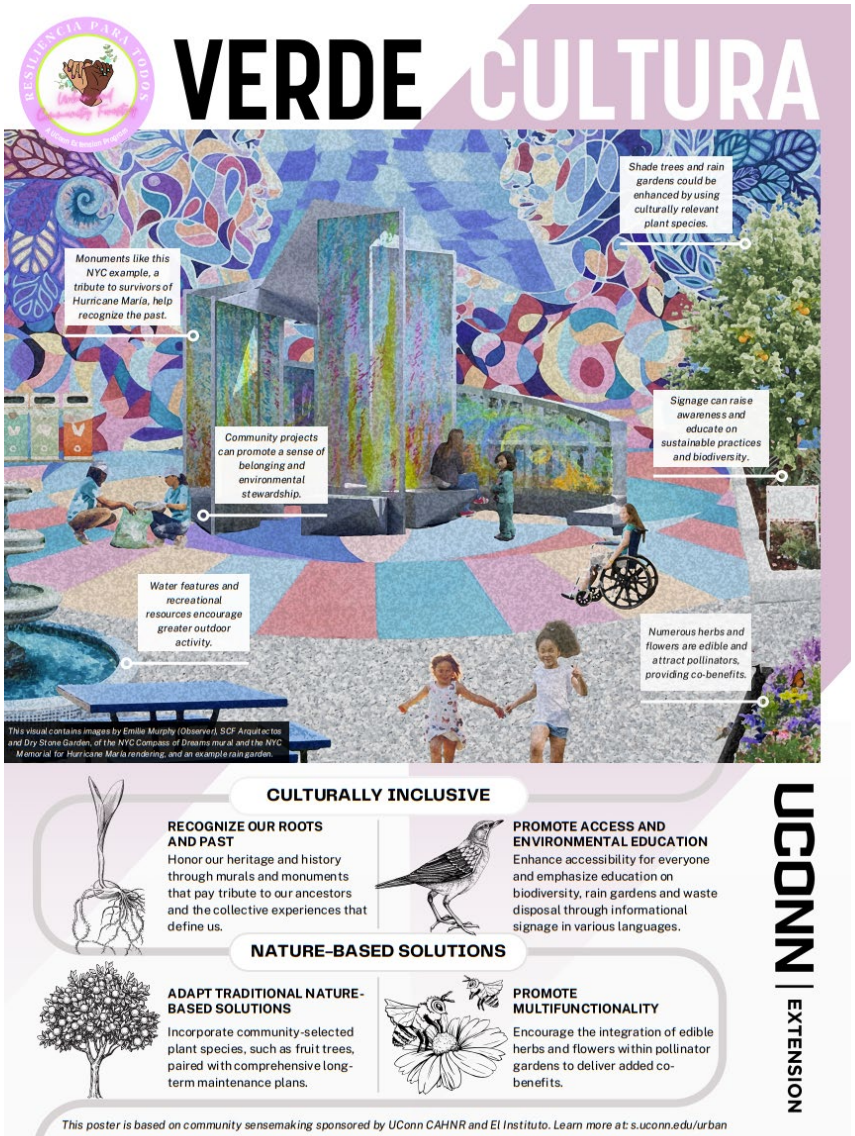

Figure 4. Community preferences for urban lot revitalization.

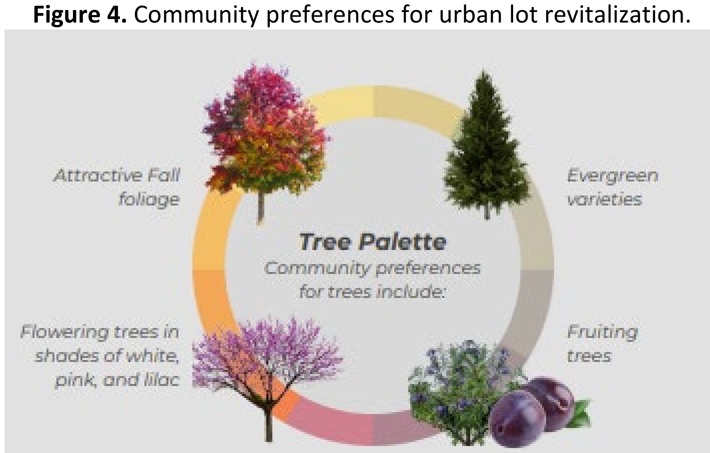

Figure 5. Tree palette, based on community ranking from common tree lists (Eversource 30 under 30 tree list, Urban Forest Council Tall Tree List, etc.).

Figure 6. Professional design for urban lot revitalization.

Towards Implementation

In an effort to advance GI applications in the City of Hartford, a series of spatially represented maps and data layers have been used to demonstrate a selection process that identifies neighborhoods and locations that could benefit from GI installations. During the execution of the project, a series of maps were developed to represent existing environmental and socioeconomic conditions in the City. These maps included:

- 2023 Summer Land Surface Temperatures
- Landcover
- Canopy Cover
- Average Flood Risk Scores
- FEMA Flood Designations
- Race
- Median Income
- Percent of Individuals Living Below Poverty Line
- Rent Burden
- Percentage of Vacant Properties

These maps were developed during the project because of their use in the sustainability field for conveying the existing conditions and some of the challenges faced by the residents in the City; and because they serve as a potential foundation for determining where GI applications may be suitable, appropriate, and beneficial to the community. These maps were helpful to guide the community conversations that occurred during execution of the project.

To further advance the identification of suitable areas for GI applications, the Connecticut Institute for Resilience and Adaptation (CIRCA) Climate Change Vulnerability Index (CCVI)[1] was utilized. The CCVI is a gridded index that has been developed for planning purposes to identify areas throughout Connecticut that are relatively vulnerable to flooding and extreme heat. The CCVI is composed of a number of environmental and socioeconomic factors that contribute most to the components of vulnerability (i.e., exposure, sensitivity, and adaptive capacity). Given that the CCVI is a ranked index, and already includes a number of the same data layers as the aforementioned map series, the CCVI can be used as a reasonable starting point for highlighting GI locations. More information about the theory behind the CCVI and its intended uses can be found on CIRCA's web page for the tool.

The first part of the CCVI spatial analysis was to review some of the factors that the map series and the CCVI have in common to identify trends of more flood vulnerable areas that may benefit for GI installations geared toward reducing flood exposure. The flood CCVI factors identified for review include:

- Soil drainage characteristics
- Impervious surface density
- Areas of pooling
- FEMA-developed and supported flood zones

The extreme heat CCVI was used to identify areas that could benefit from GI given that greening can reduce exposure to extreme heat, often known informally as urban heat island effect. In addition to impervious cover, which contributes to flooding and heat vulnerability, the factors from the heat CCVI reviewed include:

- Tree cover
- Maximum surface temperatures

Socioeconomic data that is used for both the flood and heat CCVI, was also reviewed. Similar data factors between the map series and CCVI include:

- Median income
- Race
- Percent living below 185% poverty level
- Disposable income

However, when considering socioeconomic vulnerability, and when using the CCVI to identify and prioritize locations for GI applications, the CCVI social sensitivity score was used as a whole. This score includes those four factors mentions above in addition to:

- Over 5 with a disability
- Percent over 25 without a high school diploma
- Percent over 65
- Percent under 5
- Percent population unemployed
- Population density

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[1] https://resilientconnecticut.uconn.edu/ccvi/

- Speaks English less than well/not at all
- Over 65 living alone
- Single parent households

In the following pages are a series of maps (Figures 7-12) that represent some of the individual layers or data factors embedded within the CCVI that were used to identify potential locations for GI applications. The maps show the flood and heat factors discussed above, in addition to their ranking of contribution to flood or heat vulnerability.

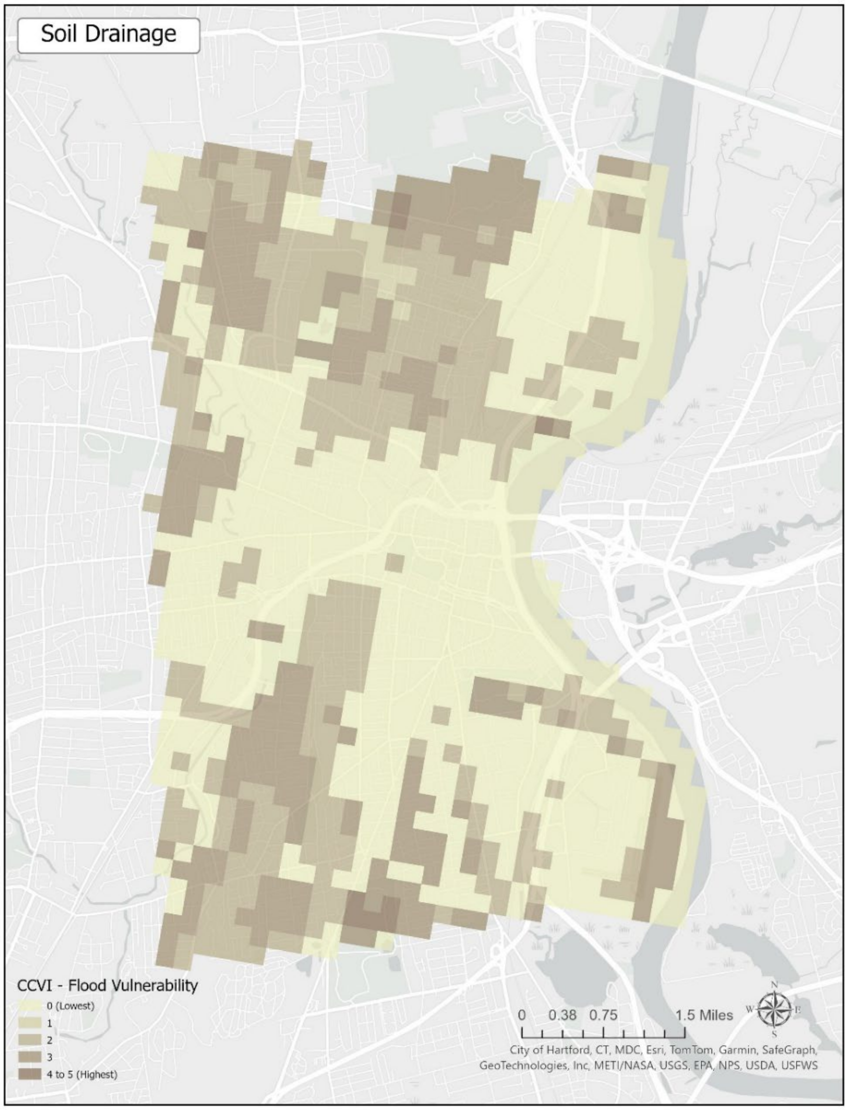

Figure 7. Soil Drainage.

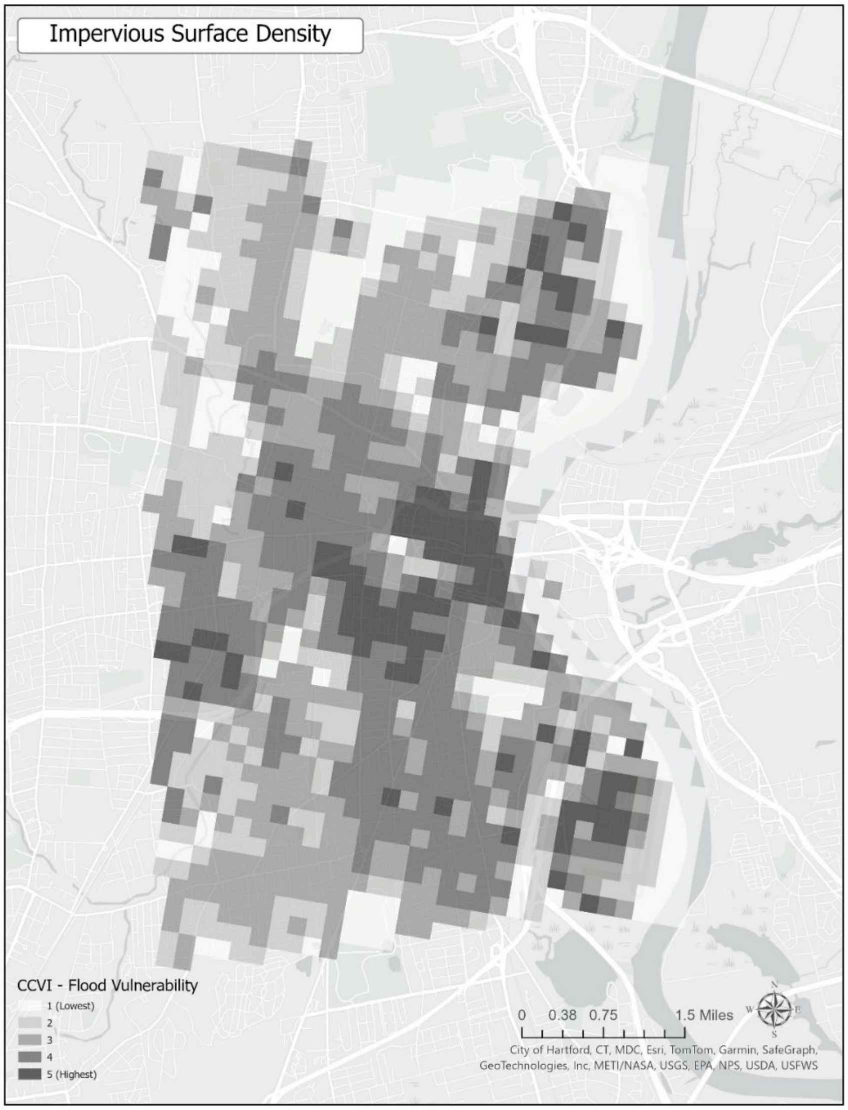

Figure 8. Impervious Surface Density.

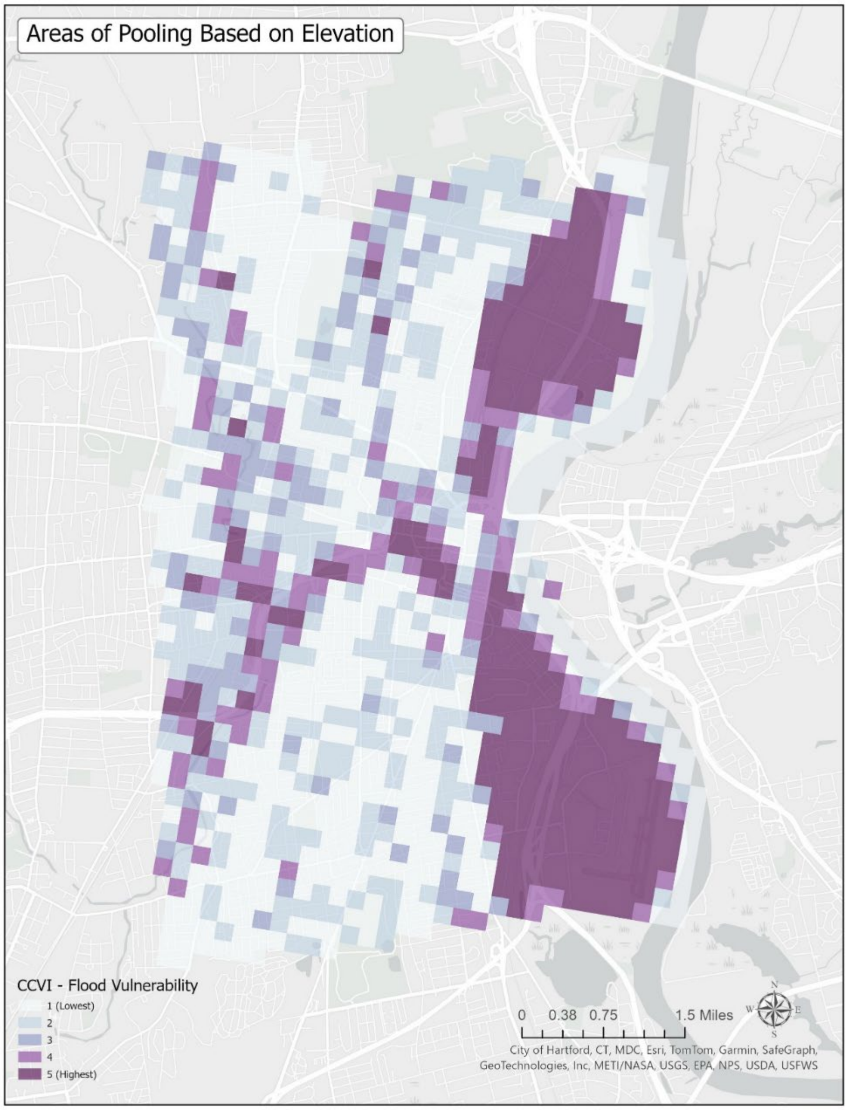

Figure 9. Areas of Pooling Based on Elevation.

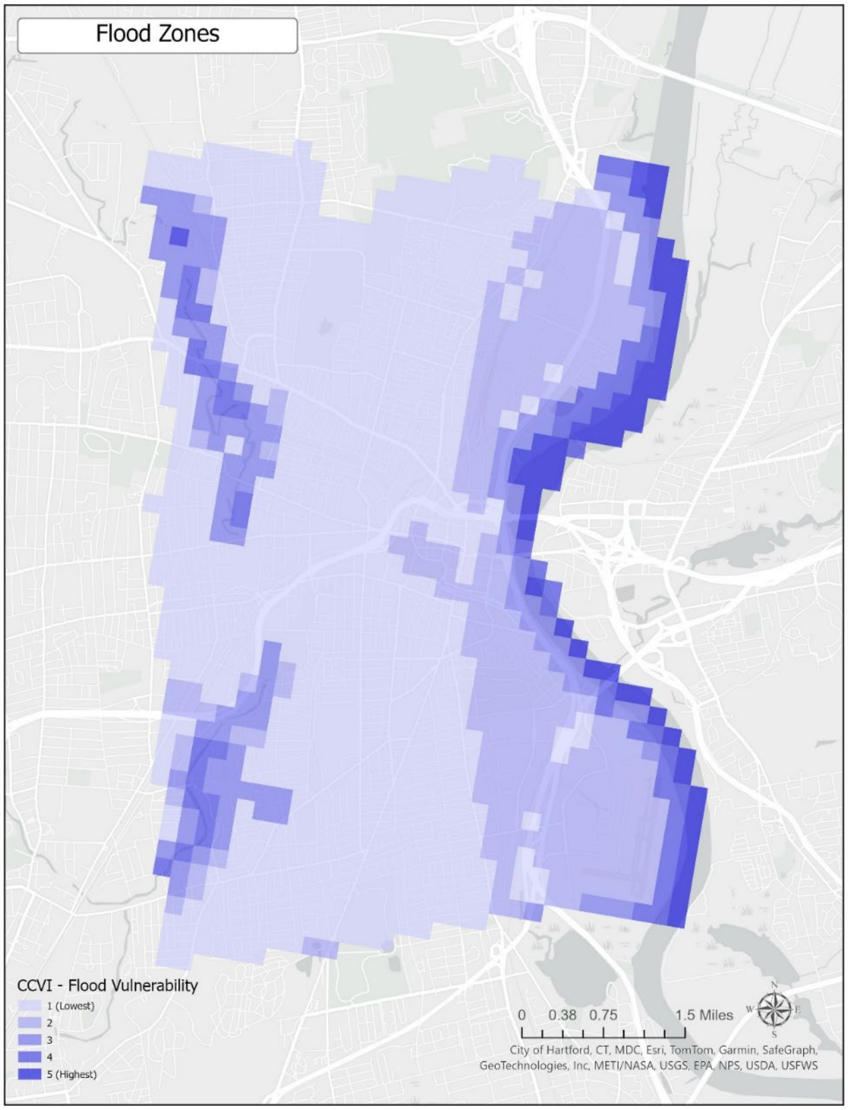

Figure 10. Flood Zones.

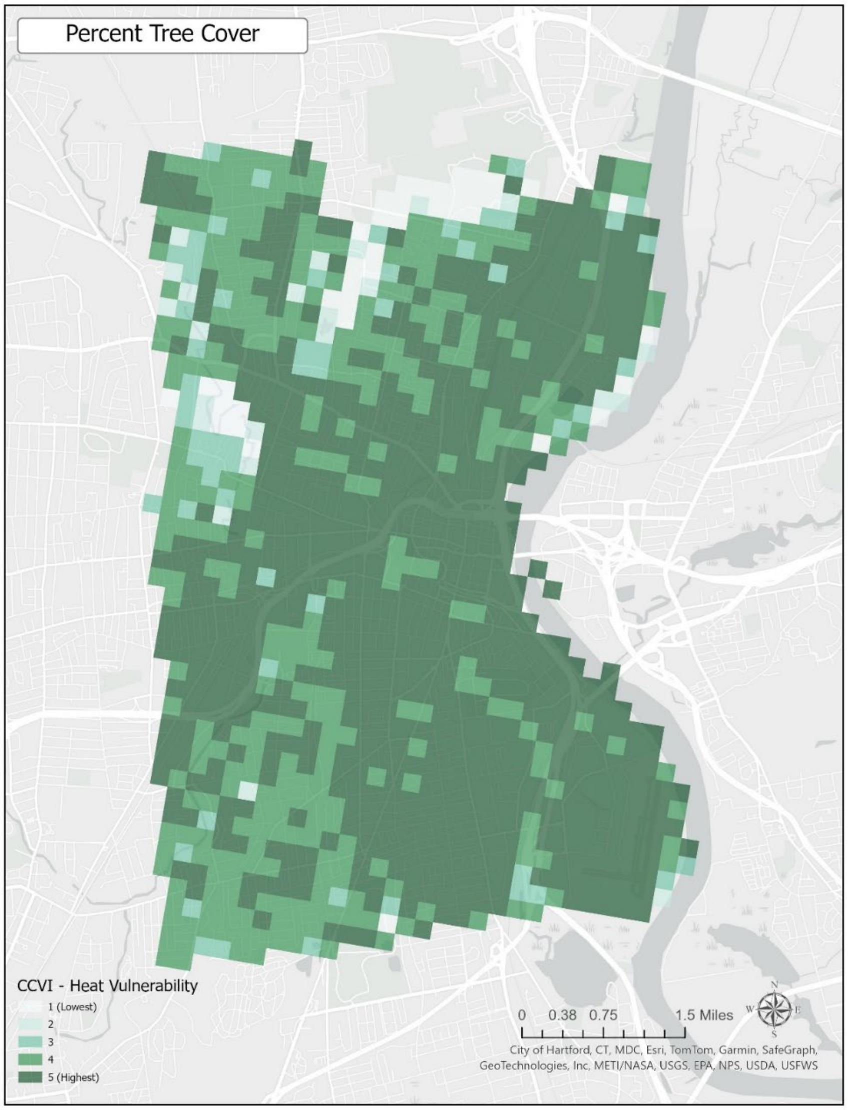

Figure 11. Percent Tree Cover.

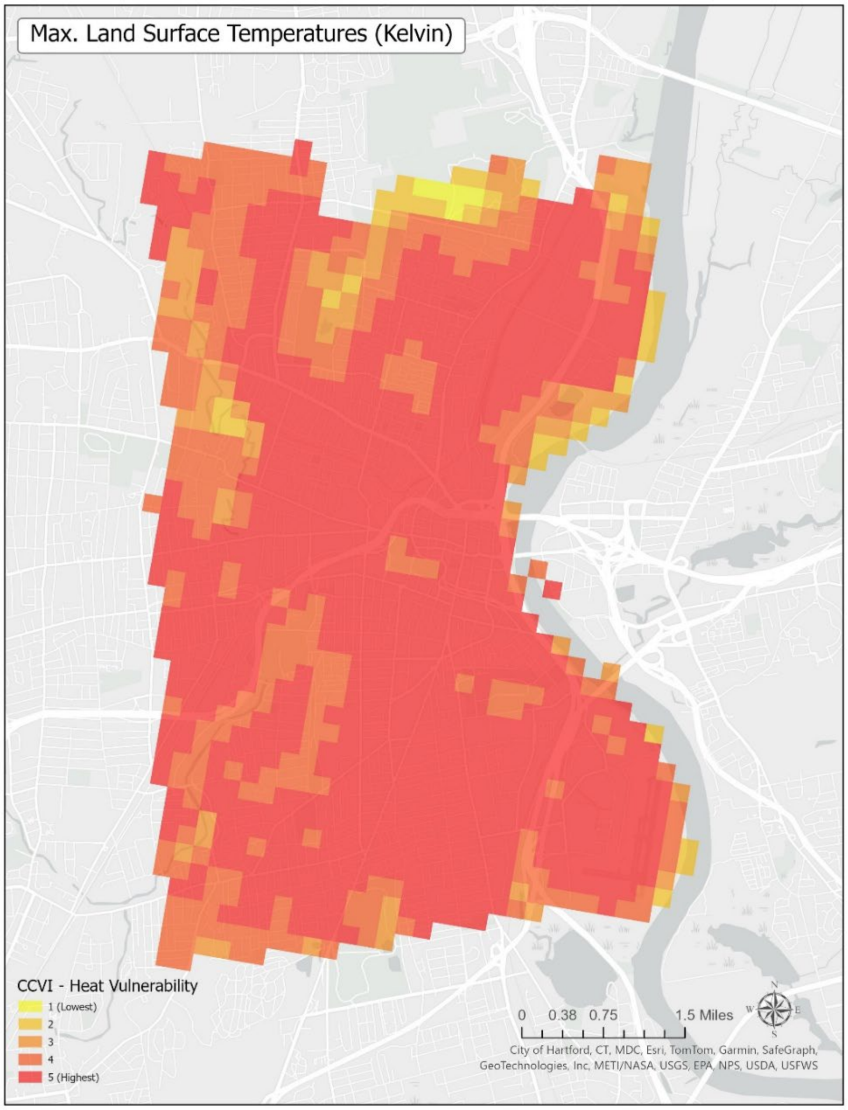

Figure 12. Maximum Land Surface Temperature.

Using the data mapped above and relative rankings, a composite was created to depict areas in Hartford with greater flood vulnerability, heat vulnerability, and social sensitivities to these two climate-driven hazards. While any combination of data could have been used, and still can be used for future identification and prioritization, the use of these identified factors aligns with those in the map series created to display existing conditions in the City.

- The flood vulnerability composite, which consists of soil drainage, pooling, impervious surfaces, and flood zones, highlights areas in the City that contain certain characteristics that may increase the severity of flooding leading to impacts on residents, damage to infrastructure, and poor stormwater quality.
- The heat vulnerability composite, which consists of tree cover and maximums surface temperatures, highlights areas in the city that are experiencing higher temperatures and are less green and therefore may contribute more to extreme heat risks (aka urban heat island effect) and could benefit from the green of GI applications.

An average was taken of the rankings to find those gridded areas with the highest average ranking, ultimately highlighting those areas with highest vulnerability. The first flood composite map (Figure 13) shows grid cells with lowest relative vulnerability in the blue and purple shades, and grid cells with the highest in yellow and orange. The second composite map (Figure 14) is a highlight of just those high areas. The first heat composite map (Figure 15) shows grid cells with the lowest relative heat vulnerability in teal and blue, and the highest in shades of pink. The second heat composite map (Figure 16) highlights only those areas that have the highest relative heat vulnerability.

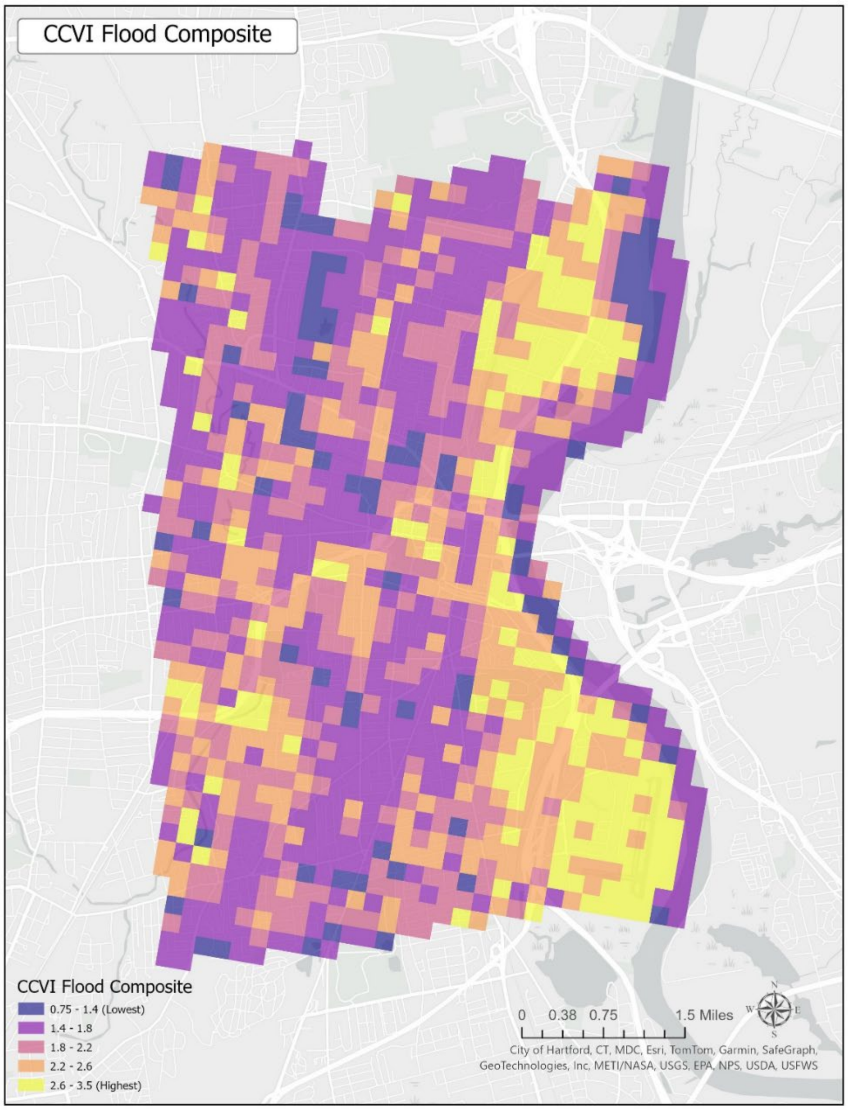

Figure 13. Flood Composite, all areas.

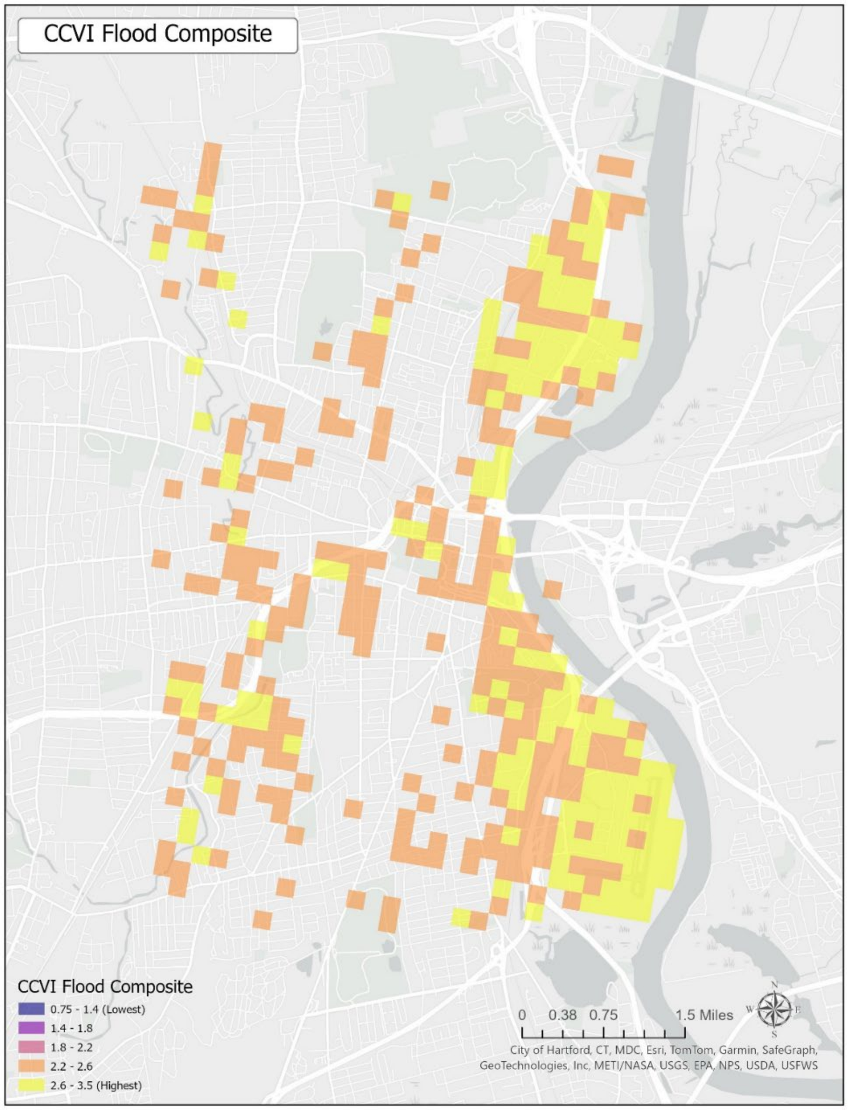

Figure 14. Flood Composite, only high-ranking areas.

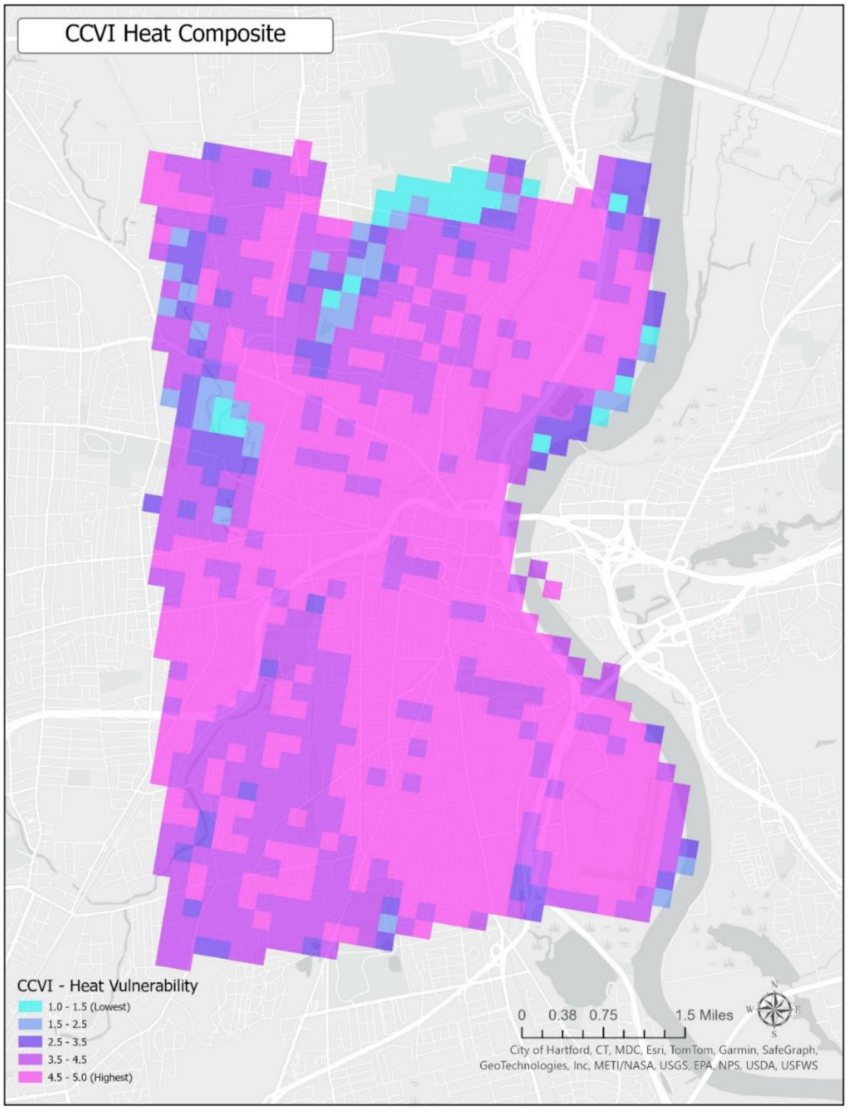

Figure 15. Heat Composite, all areas.

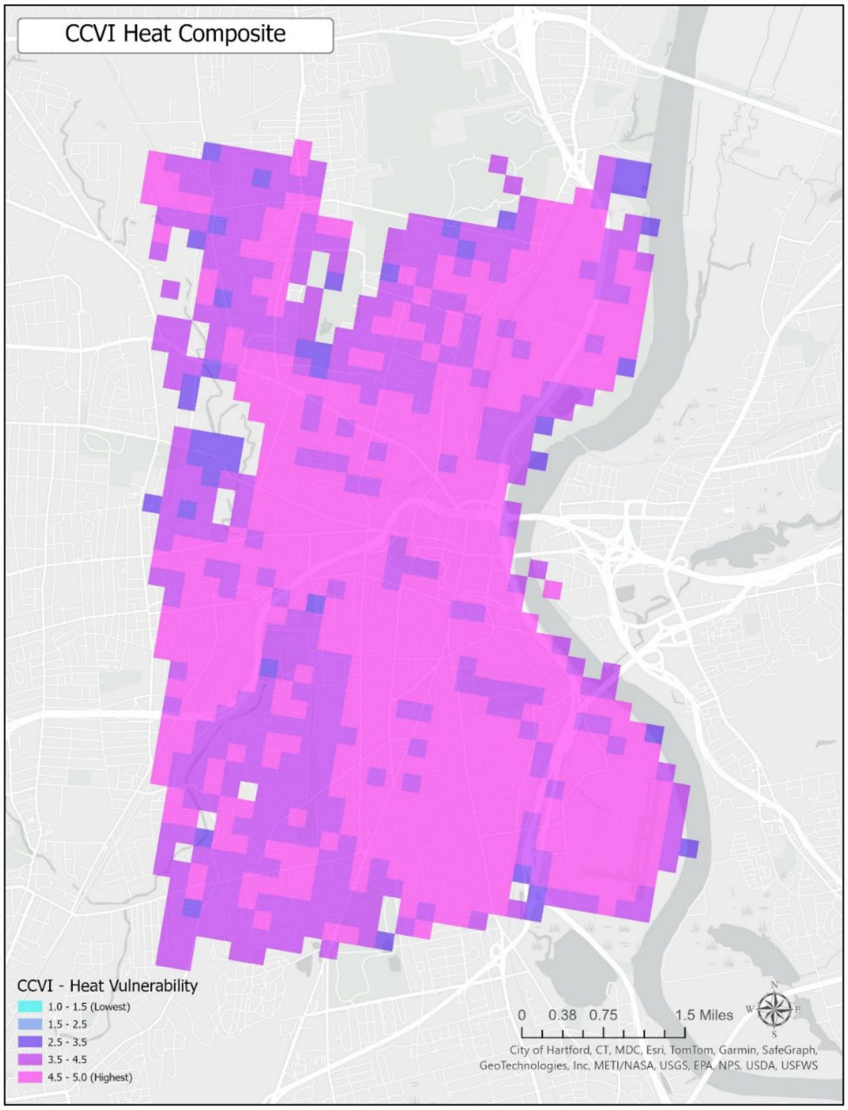

Figure 16. Heat Composite, only high-ranking areas.

Once the highest flood and heat vulnerable locations were identified, these were cross referenced with City owned parcels and Housing Authority parcels to narrow down potential parcel level locations for applications (Figures 17-18). These parcels are in areas of high flood and heat vulnerability, and because they are City or Authority owned, installation may be more feasible in the near future versus working with private property owners.

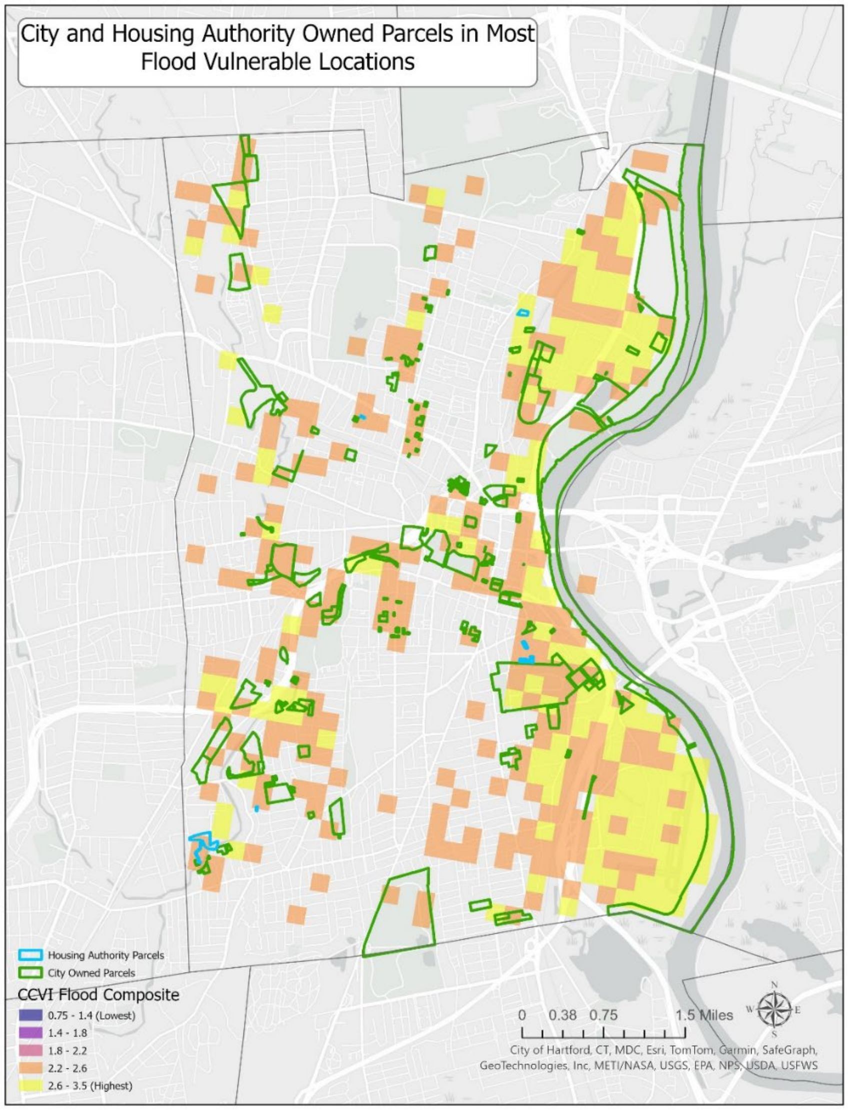

Figure 17. City and Housing Authority Owned Parcels in Most Flood-Vulnerable Locations.

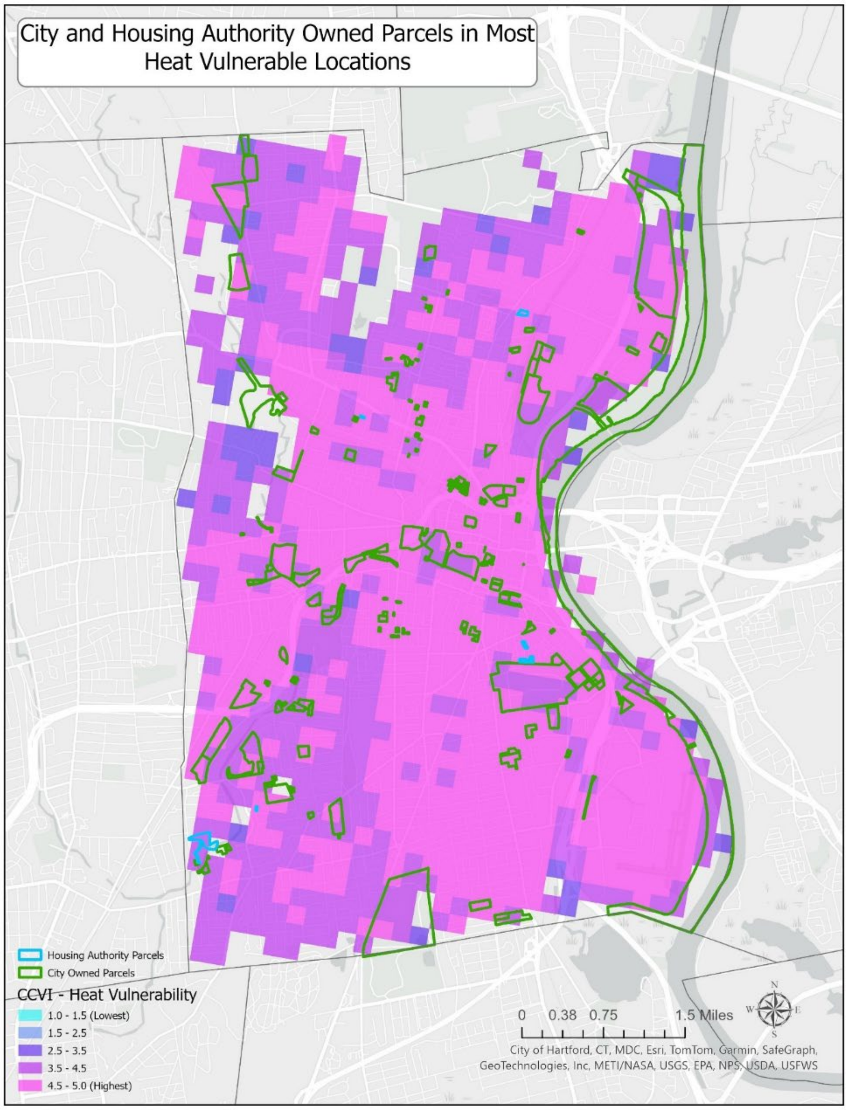

Figure 18. City and Housing Authority Owned Parcels in Most Heat-Vulnerable Locations.

Social sensitivity, which is the CCVI score based on the 12 socioeconomic factors described previously, should be used for prioritization when community conversations are limited. The flood and heat CCVI has informed where GI applications are needed due to climate driven vulnerabilities, whereas the social sensitivity scores may be used to identify where applications may be prioritized. The following is a map showing those parcels that are in the highest flood and heat vulnerability areas (according to the CCVI) in relation to social sensitivity scores throughout the City (Figures 19-20).

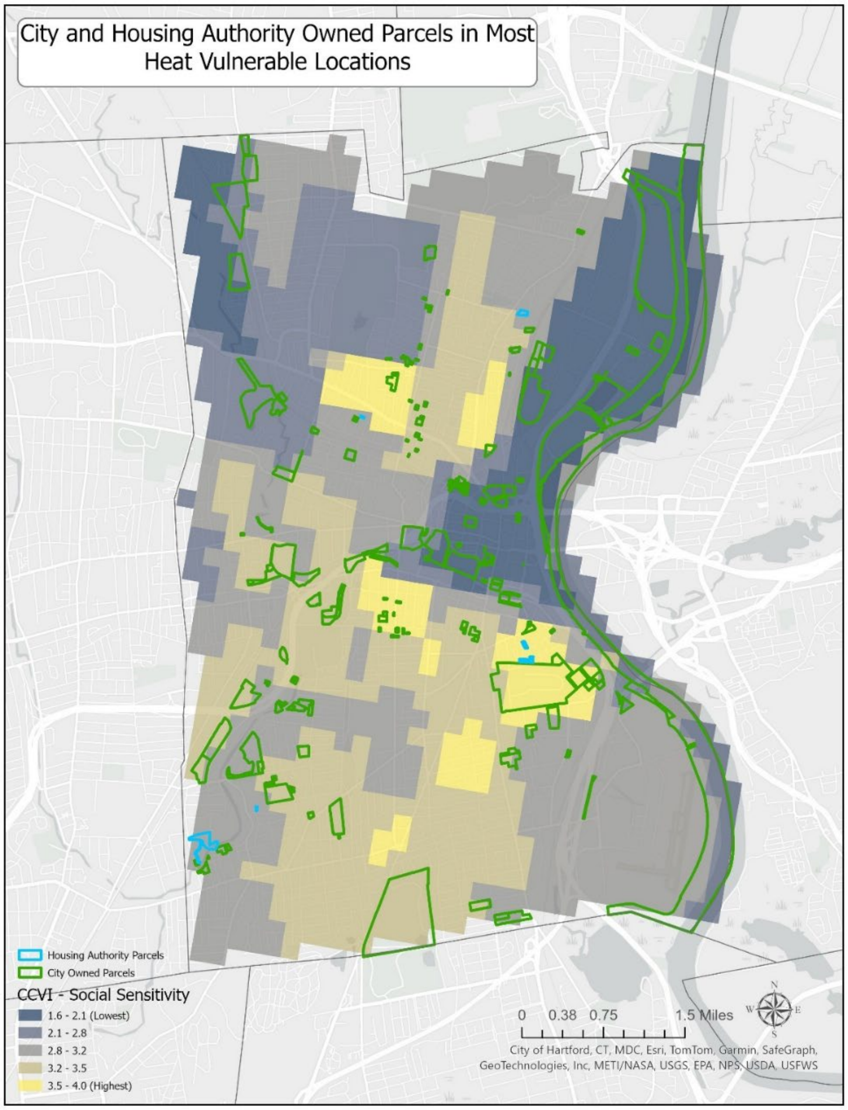

Figure 19. City and Housing Authority Owned Parcels in Most Heat-Vulnerable Locations overlapped with Social Sensitivity score.

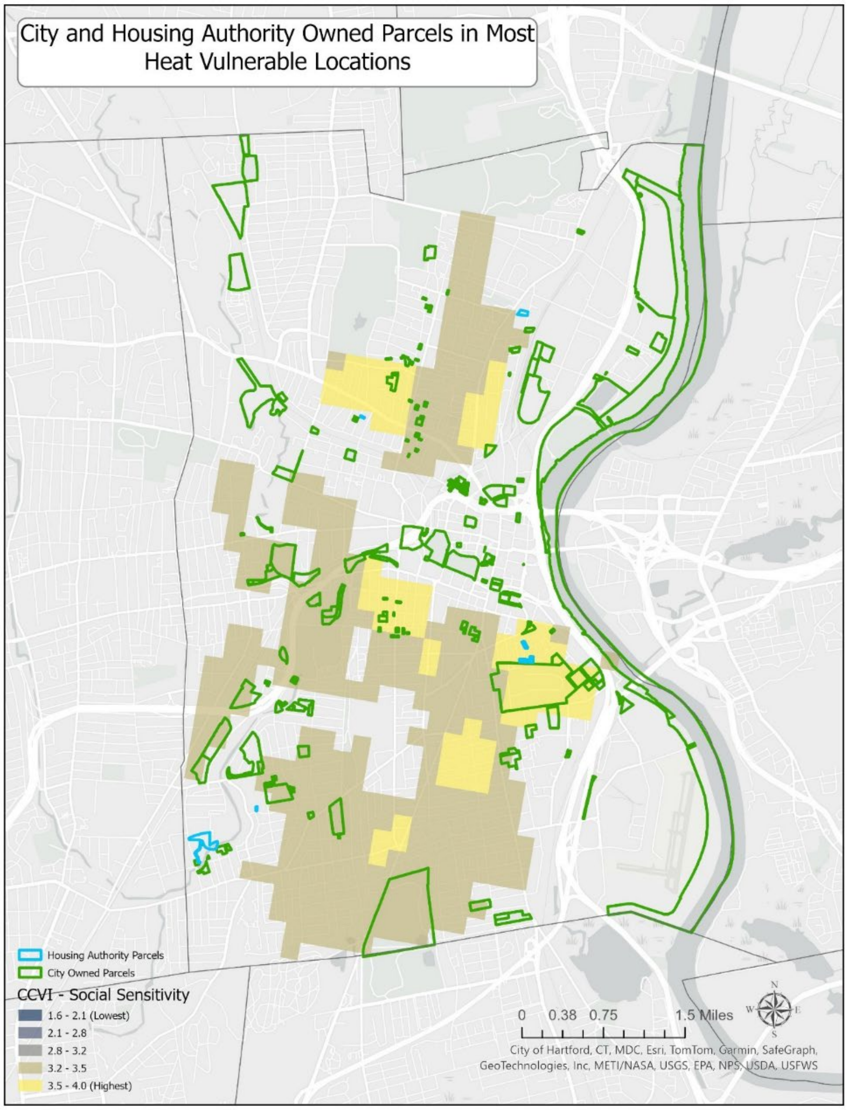

Figure 20. City and Housing Authority Owned Parcels in Most Heat-Vulnerable Locations.

The analysis presented above offers one approach to site selection for Green Stormwater Infrastructure (GSI). However, people are often better equipped to make informed decisions about the locations for GSI when they are provided with clear decision-making criteria and the opportunity to offer their own recommendations. With this in mind, participants in the co-design process were asked to identify priority areas in Hartford for GSI installation. So far, participants have primarily highlighted Hispanic neighborhoods in the Frog Hollow area as needing greening, particularly through tree planting. They have also pointed to North End neighborhoods (majority Black) as requiring other types of interventions, potentially GSI, due to ongoing challenges related to environmental degradation. These comments are congruent with demographic-based analysis of Hartford, where Hispanic residents are the most nature deprived and most exposed to higher temperatures while Black residents are the most exposed to health conditions like asthma that can be worsened by living in poor environmental health.

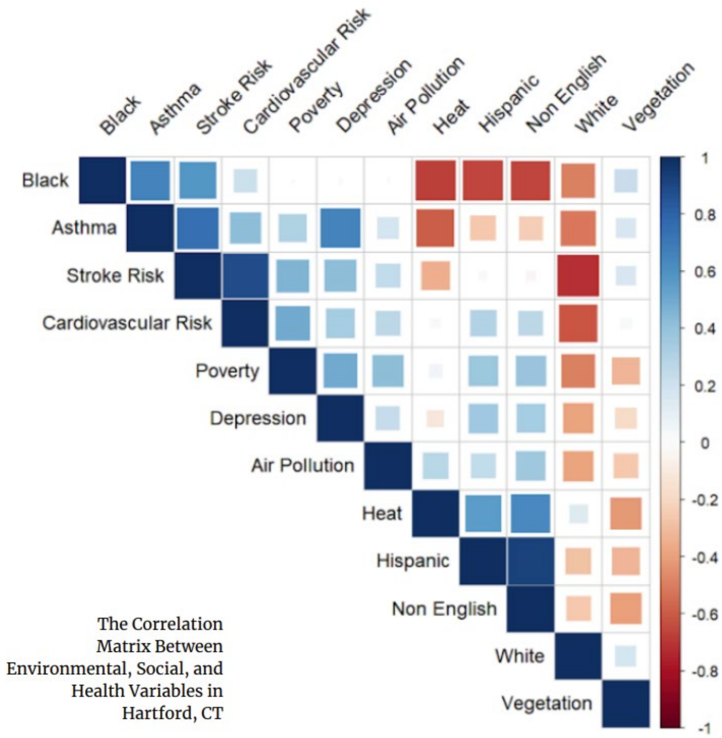

Figure 21. Correlation between various environmental, social and health variables—part of a separate public health study performed by our team (Paula and Rodríguez González, 2024).

While the insights gathered are still preliminary, we believe that with additional follow-up, a more refined list of potential locations can be established.

Conclusions

Implementing Green Stormwater Infrastructure (GSI) requires community buy-in and shared ownership to ensure long-term sustainability. However, planning initiatives in Hartford have predominantly followed top-down approaches, which have created several barriers to GSI adoption in Connecticut. In addition to issues such as cost uncertainty, long-term maintenance plans, and the lack of demonstration projects, the exclusion of community perspectives poses a significant challenge. Without these perspectives, nature-based solutions are less likely to align with the diverse priorities and needs of local communities. The effective and successful co-design of GSI must center local context and address environmental justice challenges, integrating the diverse values and needs of community members.

The "Improving Water Quality in Hartford Through Community-Led Lot Revitalization" project has demonstrated the power of community-based approaches to enhance water quality and urban resilience through GSI. Key findings from the project underscore the importance of incorporating local cultural values into design processes, which fosters stronger community ownership and support for GSI initiatives. Additionally, the project highlighted the need for ongoing education about green infrastructure, as well as the intersectionality of flooding, food production, and community development. To ensure that GSI solutions are both equitable and sustainable, it is recommended that community engagement be further strengthened. This can be achieved by creating more peer-learning opportunities and sharing successful case studies from other cities. Furthermore, addressing the need for improved nature access and stewardship should be a priority. It is essential that public space plans reflect the needs and values of existing communities, ensuring that future green infrastructure projects benefit everyone equitably.

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Anchor Partners

- Keney Park Sustainability Project
- Hispanic Health Council's Family Wellness Center
- Saukiog Harvest Festival Committee

Youth Green-Skills Program Partners

- Leadership Greater Hartford
- Hartford Public Library
- ConnecticutView

Adult Green-Skills Program Partners

- KNOX

Other Partners who Supported the Community Visioning Process

- UConn 4-H
- UConn Natural Resources Conservation Academy
- UConn Extension Urban Agriculture Program

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- Kaleb Garrett, Saukiog Harvest Festival Committee
- Lee Mixashawn Rozie, Saukiog Harvest Festival Committee
- Herb Virgo, Keney Park Sustainability Project

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