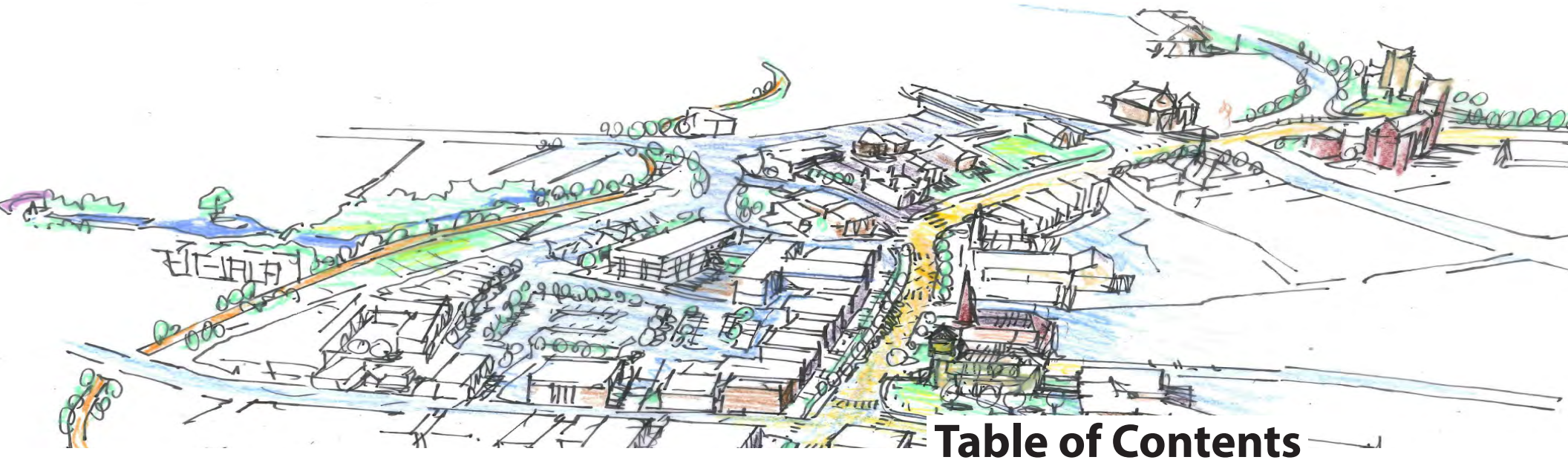
Climate Adaptation & Mitigation

Northampton, MA SDAT Report

AIA Communities by Design

ENVISION. CREATE. SUSTAIN.



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INTRODUCTION

In December of 2014, Northampton, MA submitted a proposal to the American Institute of Architects (AIA) for a Sustainable Design Assessment Team (SDAT) to assist the community and its citizens in addressing key issues facing the community. The issues included resiliency, green infrastructure, and energy. The AIA accepted the proposal and, after a preliminary visit by a small group in May 2015, recruited a multi-disciplinary team of volunteers to serve on the SDAT Team. In September 2015, the SDAT Team members worked closely with local officials, community leaders, technical experts, non-profit organizations and citizens to study the community and its concerns. The team used its expertise to frame a wide range of recommendations, which were presented to the community in a public meeting.

The Sustainable Design Assessment Team (SDAT) Program

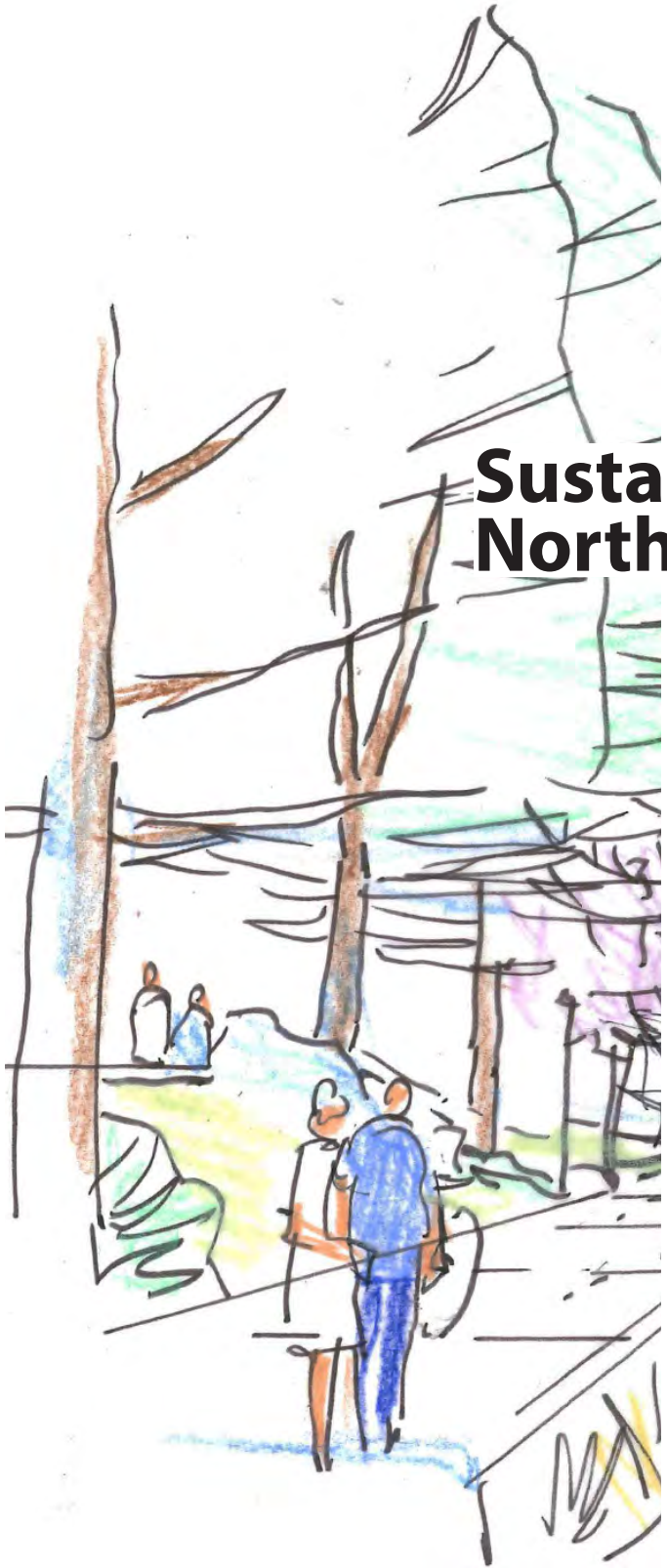
The Sustainable Design Assessment Team (SDAT) program focuses on the importance of developing sustainable communities through design. The mission of the SDAT program is to provide technical assistance and process expertise to help communities develop a vision and framework for a sustainable future. The SDAT program brings together multidisciplinary teams of professionals to work with community stakeholders and decision-makers in an intensive planning process. Teams are composed of volunteer professionals representing a range of disciplines, including architects, urban design professionals, economic development experts, land use attorneys, and others. Today, communities face a host of challenges to long-term planning for sustainability, including limited resources and technical capacity, ineffective public processes and poor participation. The SDAT approach is designed to address many of the common challenges communities face by producing long-term sustainability plans that are realistic and reflect each community's unique context. Key features of the SDAT approach include the following:

- **Customized Design Assistance.** The SDAT is designed as a customized approach to community assistance which incorporates local realities and the unique challenges and assets of each community.
- **A Systems Approach to Sustainability.** The SDAT applies a systems-based approach to community sustainability, examining cross-cutting issues and relationships between issues. The SDAT forms multi- disciplinary teams that combine a range of disciplines and professions in an integrated assessment and design process.
- **Inclusive and Participatory Processes.** Public participation is the foundation of good community design. The SDAT involves a wide range of stakeholders and utilizes short feedback loops, resulting in sustainable decision-making that has broad public support and ownership.
- **Objective Technical Expertise.** The SDAT Team is assembled to include a range of technical experts from across the country. Team Members do not accept payment for services and serve in a volunteer capacity on behalf of the AIA and the partner community. As a result, the SDAT Team has enhanced credibility with local stakeholders and can provide unencumbered technical advice.
- **Cost Effectiveness.** Through SDAT, communities are able to take advantage of leveraged resources for their planning efforts. The AIA contributes up to $15,000 in financial assistance per project. The SDAT team members volunteer their labor and expertise, allowing communities to gain immediate access to the combined technical knowledge of top-notch professionals from varied fields.

The SDAT program is modeled on the Regional and Urban Design Assistance Team (R/UDAT) program, one of AIA's longest-running success stories. While the R/UDAT program was developed to provide communities with specific design solutions, the SDAT program provides broad assessments to help frame future policies or design solutions in the context of sustainability and help communities plan the first steps of implementation. Through the Design Assistance Team (DAT) program, over 500 professionals from 30 disciplines have provided millions of dollars in professional pro bono services to more than 200 communities across the country.

The following report includes a narrative account of the Northampton project recommendations, with summary information concerning several principle areas of investigation. The recommendations are made within the broad framework of sustainability, and are designed to form an integrated approach to future sustainability efforts in the community.

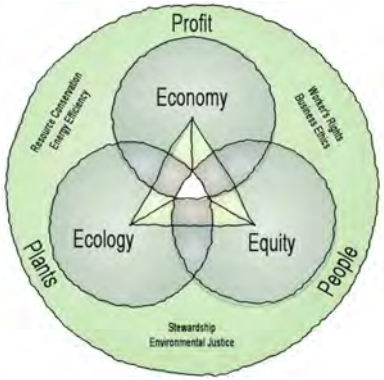


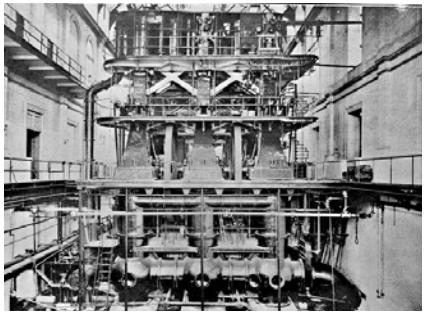
Sustainable Northampton

A SUSTAINABLE NORTHAMPTON

Where Northampton distinguishes itself from other communities is in its forward thinking. Few communities have recognized the importance of planning for a future involving a changing climate, and even fewer have gone so far as to explicitly link planning and sustainability. This recognition that we can, that we *must*, plan for a more sustainable future as we decide how to help our communities grow and prosper places Northampton in rare and privileged company.



One notion that our team embraced as we began our analysis was that we would take a very broad perspective when discussing sustainability. Rather than simply focusing on reducing environmental impact, reducing energy consumption, or enhancing stormwater management, we recognized that our broader mandate is to leave our planet in better condition for our children than we inherited from our parents.



Baltimore, MD sewage lift station.

One area where we see an opportunity to enhance Northampton's built environment is by celebrating the flood control infrastructure that has kept Northampton safe for over half a century. The adjacent historic images are of a sewage lift station in Baltimore, MD. One could not find a more prosaic piece of civic infrastructure, and yet the community committed to making this a thing of beauty and civic pride.

Similarly, we believe there is an opportunity for Northampton to celebrate its flood control infrastructure. The pumping station adjacent to the floodwall is nice, but hidden away from public view. The floodgates that are vital in securing the community's safety are totally invisible when entering into town.

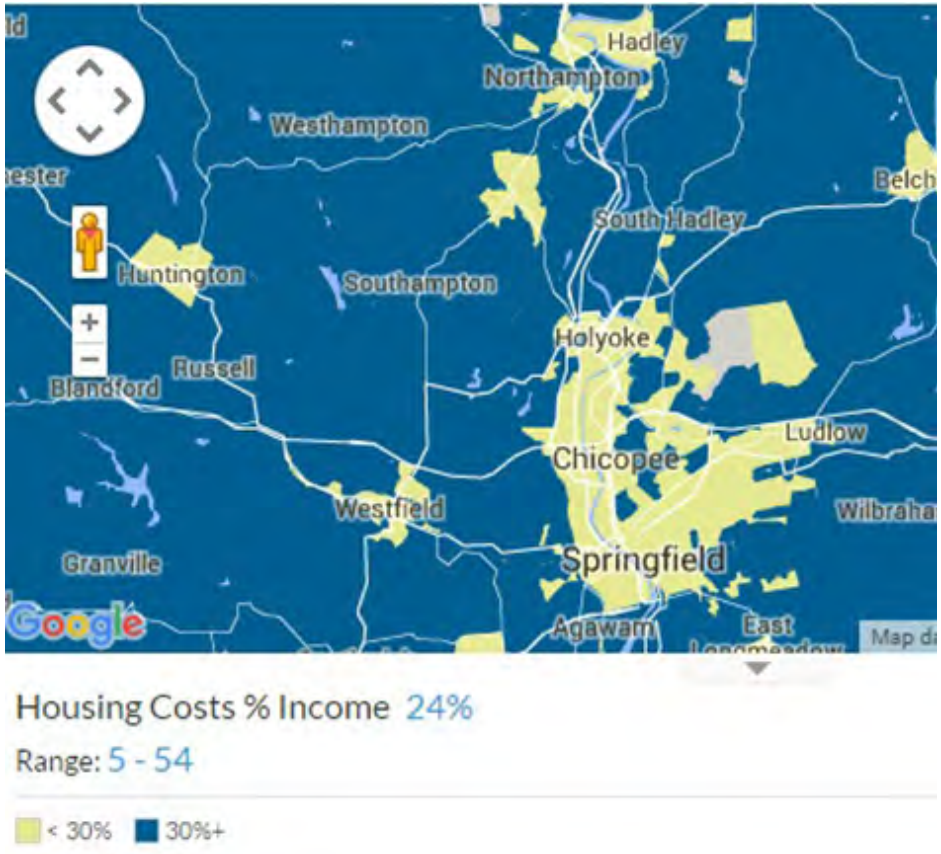
Northampton has seen a number of historic floods in the past. However, it was the devastating flood of 1936 that finally spurred the community into action, diverting the river away from the middle of town and constructing the dikes, floodwalls and pumping apparatus critical to keeping the community from flooding during major storm events.

Image from the 1869 flood.

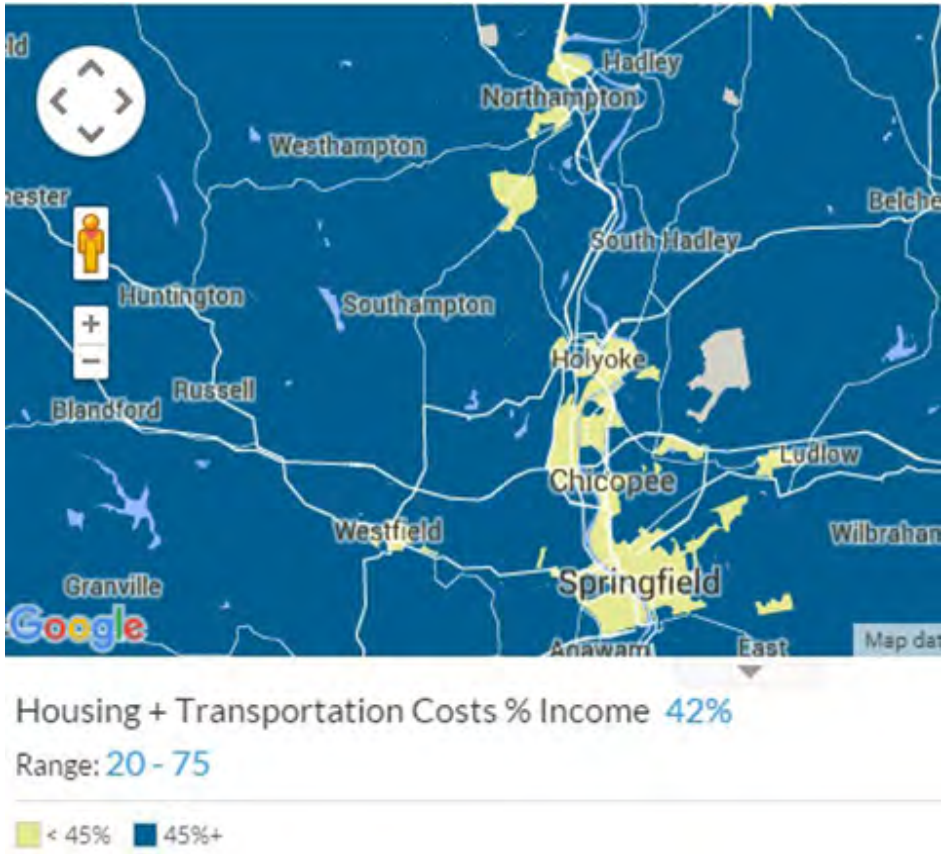
Images from the 1936 flood.

One attribute of a sustainable community is affordability – can one afford to live in the community on an average income? A common measurement of affordability is if housing costs exceed 30% of the area median income, or if housing and transportation costs exceed 45% of the area median income.

As you can see by these graphics from the Center for Neighborhood Technology (yellow is 'affordable' and blue is 'unaffordable'), the Northampton region in general has to wrestle with creating and maintaining an affordable community.



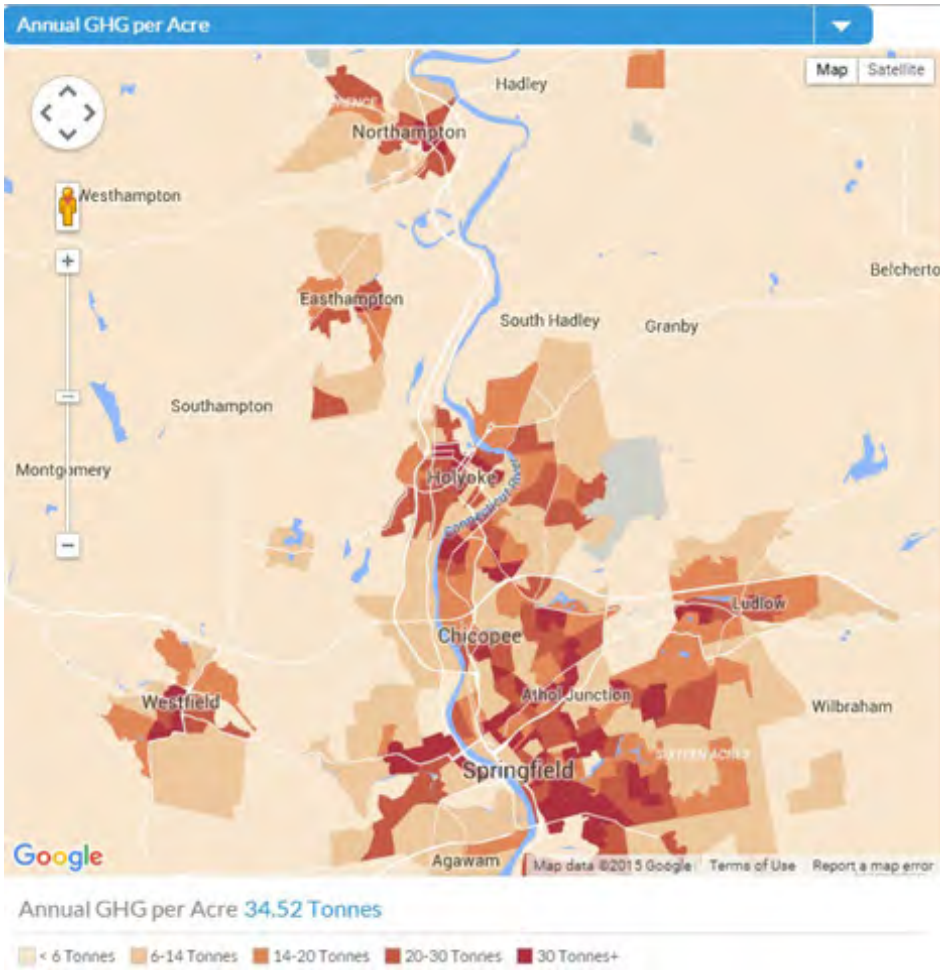
Housing costs.



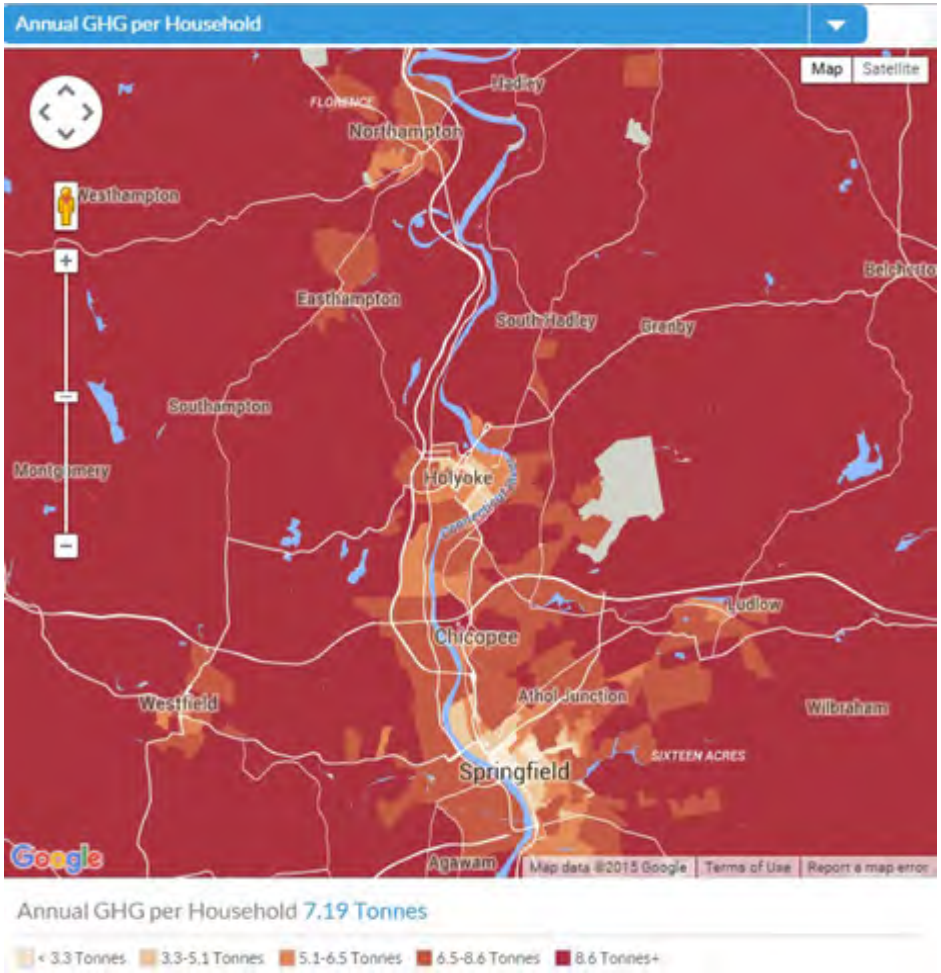
Housing and transportation costs.

Greenhouse gasses are one of the primary contributors to global climate change, and one key tenet of sustainability is to reduce anthropogenic (human produced) greenhouse gas emissions. It is important to establish an appropriate frame of reference. The graphics mapping greenhouse gas emission per acre in the Northampton region (lighter colors = lower emissions, darker colors = higher emissions) would indicate that the more urban, denser regions are sources of larger amounts of greenhouse gasses, and this is correct.

However, when analyzing greenhouse gas emissions per household it is the denser, more developed areas that have lower greenhouse gas emissions per household – and this is the more important metric. What this indicates, in essence, is that the further away from urban centers one lives, and the less dense the development, the more time (and miles) one spends driving around, emitting greenhouse gasses. This validates the notion that living in closer community has demonstrable environmental benefits.

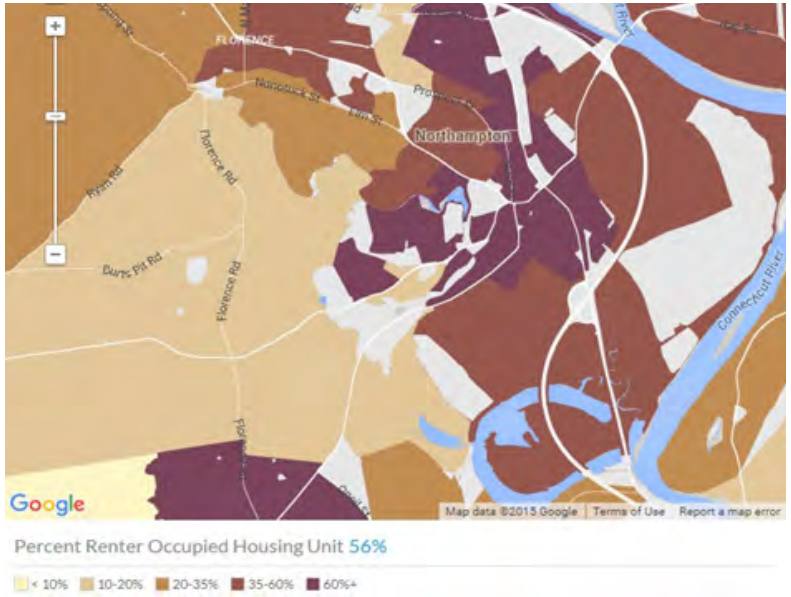


GHG emissions per acre.

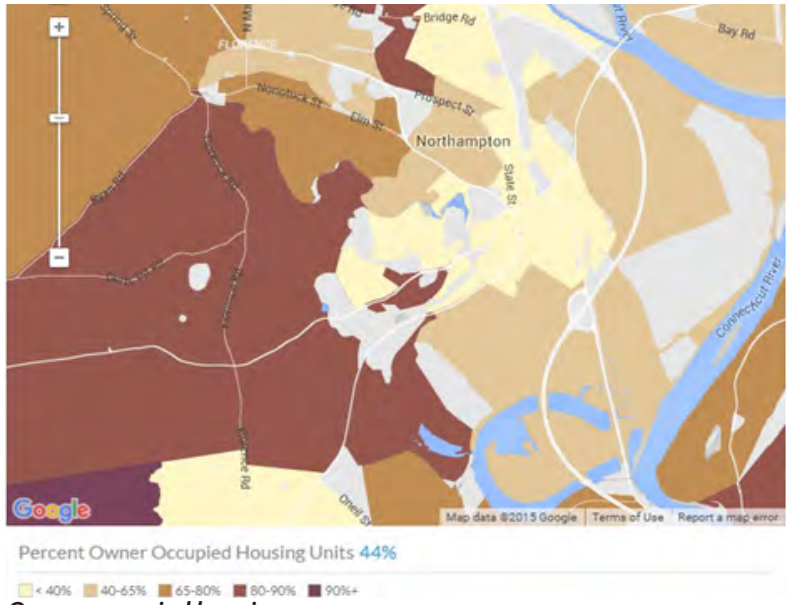


GHG emissions per household.

Another interesting observation is that some renter-occupied housing tends to be in areas of the community that are older, denser, and closer to some areas that have flooded in the past than owner-occupied housing. Echoing the prior observations about renter-occupied versus owner-occupied housing, the older areas of the community tend to have higher Compact Neighborhood Scores.

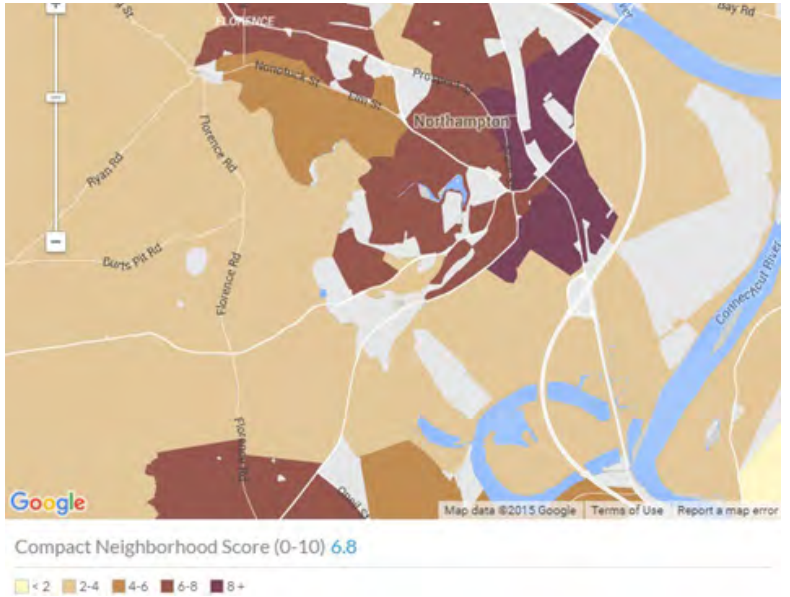


Renter-occupied housing.



Owner-occupied housing.

These higher scores closely correlate with lower Annual Vehicle Mile Traveled per household. This validates the inverse relationship between density and connectivity with vehicles miles traveled (one tends to drive less in denser, more connected, communities).



Compact neighborhood score.

Annual VMT.

One of the often-cited challenges to creating denser, more pedestrian friendly communities is the fear of lack of parking. However, this fear frequently outstrips the reality of parking demand. The first figure below includes the outline of all buildings in Northampton's Central Business District. What is apparent is a relatively fine-grained urban fabric, comprised primarily of many small scale, modest height structures, with a few larger structures interspersed throughout the urban fabric.

Overlaying Northampton's street grid, the fine grain of the community is made more explicit. The street grid extends throughout the community, without any large areas lacking access and few dead end streets.

When one overlays all of the parking areas in Northampton, it becomes evident that there is a great deal of parking, and that parking is evenly distributed throughout the downtown. However, improved transit, bike, and pedestrian access would alleviate any strains on existing parking, and would create opportunities for additional infill to create greater density and connectivity throughout central Northampton.

Another way to reduce greenhouse gas emissions is to provide other means to get around besides single occupant automobile trips. Creating a more walkable community reduces the need to drive, and promoting bicycle infrastructure (which Northampton has already invested a significant effort in) further reduces the need to drive everywhere.

Walkable communities.

Bicycle infrastructure.

One area that the Northampton region could improve upon is access to a broad, diverse and reliable public transportation network, consisting of bus, light rail, and heavy rail. Any public transit component should emphasize alternative or renewable energy resources, such as the Hydrogen Fuel Cell powered bus shown in the image above.

Parking demand can also be reduced by utilizing car sharing programs such as zipcar (currently available in three Norhtampton locations with additional locations planned)

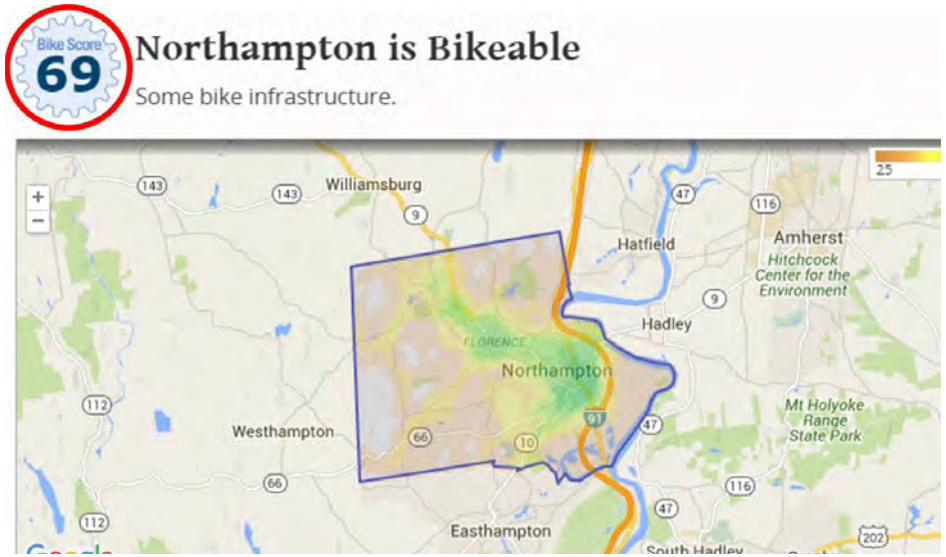
Central Business District (CBD) building footprints.

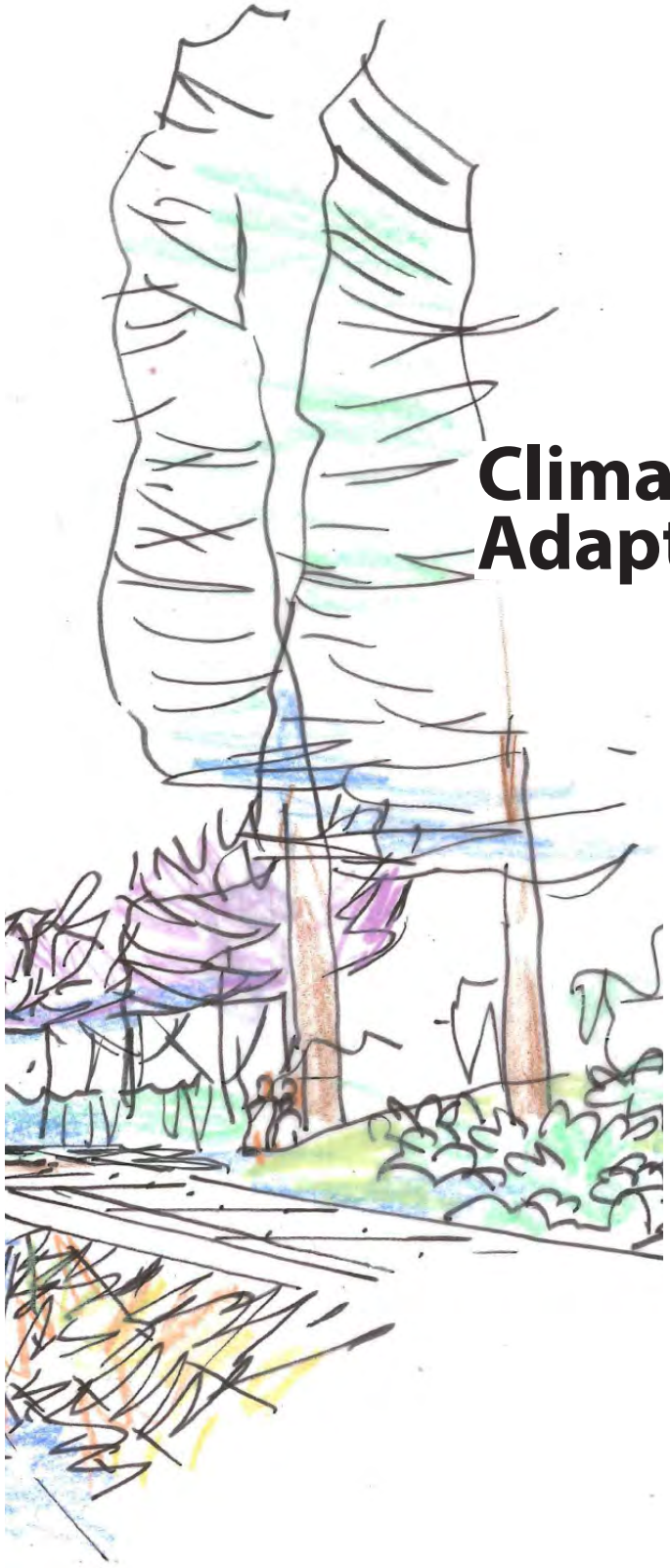
CBD building footprints with street grid.

CBD with parking overlay.

and in the very near future autonomous vehicles will likely provide a platform that will be capable of delivering individuals to locations on demand without the need for individuals to park and maintain their vehicles in close proximity to their destination. We need to make sure that planning for the future takes into account and can accommodate new means of transportation.

Walkscore (www.walkscore.com) is a great way to judge the walkability of a community. It involves a series of consistently applied metrics that rate on a scale of 1 to 100 how car dependent a community is. Overall, Northampton receives a Walkscore of 39, which indicates that most errands require a car. However, Northampton is considered more bikeable, with an overall community Bikescore of 69. Certain locations within Northampton have much higher walkscores. For example, City Hall has a Walkscore of 94 and a Bikescore of 97, rating this location as both a walker's and a biker's paradise. Some areas, such as those around the senior center, rate as very walkable (Walkscore of 80) and very bikeable (Bikescore of 79), but not quite as much as the area around City Hall. Some areas, less dense and more remote, yet in close proximity to the bike trail network, have lower walkability scores (Walkscore of 61) yet high bikeability scores (Bikescore of 91). And some areas, such as those near the reservoir, are fundamentally unwalkable (Walkscore of 6, Bikescore of 41).





Climate Adaptation

CLIMATE CHANGE & NORTHAMPTON

Climate change is already affecting natural resources, the economy, and infrastructure in the Pioneer Valley region. Over the last century, temperatures have increased nearly 2˚F in the Northeast United States, and over the last 40 years, the region has experienced a 70% increase in heavy precipitation (Horton et al. 2014). These changes are projected to become more frequent and intense over time should global carbon emissions continue unabated; even with significant cuts in greenhouse gas emissions, the region will still experience increased warming and more frequent and intense weather events, such as winter storms and flooding. Changes in air temperature and precipitation patterns will cause increased heat waves, flooding, drought, and fire risk, as well as alter the timing of blooms and pollen production and increase the fitness of some species, such as disease-bearing insects.

Responding to Climate Change

There are two responses to climate change – mitigation and adaptation. Mitigation refers to efforts to reduce greenhouse gas emissions or increase carbon storage potential (e.g., planting trees and vegetation that can absorb carbon) (IPCC 2014a). Adaptation refers to efforts to respond to and prepare for the changes we are already experiencing and/or expect to experience (IPCC 2014b); this includes both reducing negative effects and taking advantage of potential opportunities afforded by climate change. A truly comprehensive climate response strategy will include both mitigation and adaptation responses.

There are a lot of examples of climate response frameworks available. In general, an effective framework will include the following steps:

The City of Northampton has taken strides to address some of these steps, but not in a cohesive, comprehensive effort to date. For example, the city's updated Hazard Mitigation Plan identifies several climate impacts of concern to the region; conducting a more comprehensive planning effort would enable the city to identify not only what the effects of climate change are/will be, but also allow for the identification and prioritization of climate-vulnerable resources, infrastructure, and underserved communities in the city. This would also enable a more targeted approach to implementing solutions that can reduce risk and enhance the overall sustainability of Northampton.

A Climate Adaptation Framework for Northampton

Community Context

One of the focal points of the discussions with community members on the first day of this effort included identifying Northampton's strengths, challenges, and key sectors or resources. There is a strong recognition in Northampton that climate change will not only create new problems, but it will also magnify existing issues, such as existing income gaps and housing. Coordinating efforts throughout the city and the Pioneer Valley region were identified as key needs, as well as open and clear communication with the public. Community members identified several key elements upon which climate change may have significant effects, encompassing the built, natural, and social environments:

Built Environment	**Natural Environment**	**Social Environment**
Buildings	Wetlands/Riparian Areas	Economy
Residential Housing	Parks & Open Space	Governance
Transportation Infrastructure	Groundwater/Surface Water	Education & Public Knowledge
Water Resources	Agriculture/Food Supply	Public Health
Energy Systems		Emergency Services

Recommendation: Build and maintain support for action

- Designate the Energy and Sustainability Commission as the community Climate Champion in order to generate and sustain community support over the long term.
- During the SDAT, the team recommended that Northampton sign the Compact of Mayors, an accomplishment that occurred immediately following the conclusion of the SDAT. This agreement formally commits Northampton to abide by the compact's expectations of:
    - Inventorying greenhouse gas emissions and climate-related hazards;
    - Creating vulnerability reduction targets; and
    - Creating an action plan with both mitigation and adaptation measures.

Recommendation: Inventory assets and scope climate impacts on major sectors

It is important to understand what assets and sectors are at risk from climate change, as well as the resources available to effectively reduce those risks.

Inventory Northampton's assets

- Physical infrastructure (e.g., bridges, tunnels, buildings), telecommunications, and emergency services facilities, among others.
- Technical assets, such as institutional capacity (e.g., city staff, scientists, engineers) and information (e.g., spatial data).
- Policy resources, such as model codes and ordinances that may support climate response efforts (e.g., hazard mitigation policies, emergency plans).
- Studies and reports documenting observed damages from past weather events as well as estimates of future risk and damage.

The catalog of these resources will help 1) prioritize which assets to assess for climate risk, and 2) identify resources that Northampton has at its disposal to effectively address climate change.

Scope climate impacts on major sectors

- Collect and review important climate information with respect to its effects on key city sectors, including both observed and projected impacts.
    - How has climate change changed already and with what consequences? How is climate expected to change?
    - What effect have these changes had on Northampton's key sectors? What are the consequences of projected future changes?

A climate impact-by-sector matrix may be helpful in identifying the range of observed and projected effects of climate change on Northampton's sectors. Below is an example of such a matrix:

Climate Impact	***Emergency Services***	***Public Health***	***Infrastructure***	***Wetlands/ Riparian Areas***	***Energy***
Extreme weather events (e.g., storms, heat)	↑Demands on emergency responders	Heat-related stress, especially for elderly, poor, and other vulnerable populations	↑Potential in damage or destruction to critical infrastructure	↑Erosion	↑Disruption in service
Increased air temperatures		↑Vector-borne illnesses (e.g., Lyme disease)		Shifts in species ranges and distribution	↑Demand for cooling
Increased flooding		↑Waterborne diseases	↓Potential effectiveness of dikes ↑Demands on stormwater systems	↓Habitat quality	↑Risk to power infrastructure

There are a number of resources available on climate change impacts in Massachusetts; some highlights include:

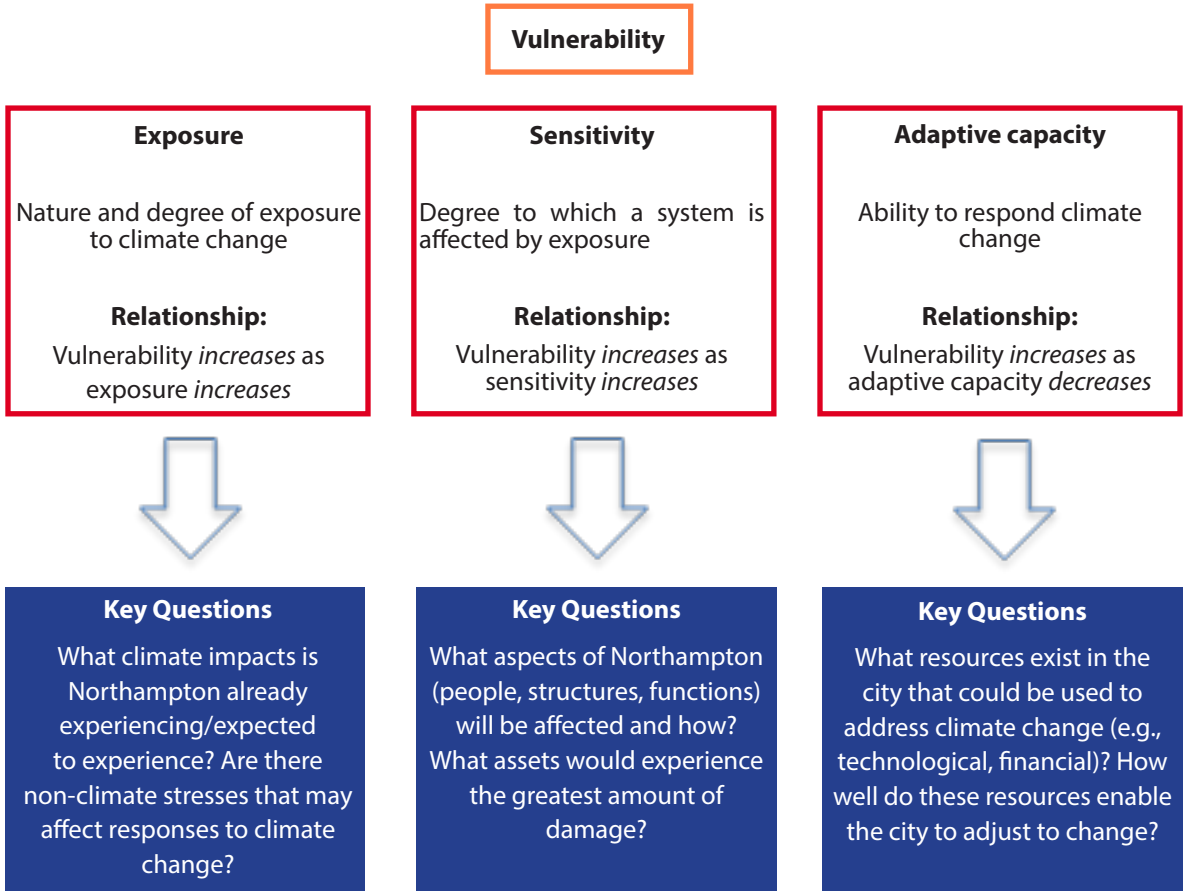
- National Climate Assessment: Northeast Region (2014) http://nca2014.globalchange.gov/report/regions/northeast
- Northeast Climate Impacts Assessment (2007) http://bit.ly/NECIA2007
- Bryan et al. 2015 – Ch. 1 of the Northeast Climate Science Center report, Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans https://necsc.umass.edu/sites/default/files/Chapter%201%20Climate%20Changes.pdf

Recommendation: Conduct a community vulnerability assessment.

Vulnerability refers to the extent to which a resource, asset, or community is susceptible to harm from climate change. Vulnerability assessments can help communities identify what things are most vulnerable and why they are vulnerable. These assessments are tools that can help (Kershner 2012):

- Prioritize resources to target for management
- Develop strategies to address climate change
- Efficiently allocate resources

There are three components to effective vulnerability assessments: exposure, sensitivity, and adaptive capacity.



As part of this step, it may be important to spatially define these vulnerabilities. Identifying and mapping the areas at greatest risk from climate change and overlaying these with city infrastructure, natural resources, and socially vulnerable populations can help with prioritizing specific areas for management.

Recommendation: Prioritize vulnerabilities to address and develop mitigation and adaptation responses.

Once these vulnerabilities are identified, it is time to develop strategies to reduce them. There are a lot of challenges to developing strategies to help limit or eliminate climate vulnerabilities. In general, it is best to utilize a portfolio approach in order to spread risk and resources across a range of actions (Aplet and Gallo 2012); this may include strategies the city is already undertaking, those that could be implemented better or with some modification, and those that have not even been thought of yet. Some guiding questions to help identify, evaluate, and prioritize strategies for implementation include:

- Review the results of the vulnerability assessment.
  - What assets and sectors are most vulnerable?
  - Are there issues that are more urgent than others to address in the city?
- Aim to identify no-regrets/win-win strategies.
  - Are there current problems that need to be addressed and are expected to get worse with climate change?
  - How can we prioritize actions that benefit the city regardless of how climate change plays out?
  - Can we develop strategies that maximize both mitigation and adaptation (e.g., open space conservation, green infrastructure)?
- Prioritize the "low-hanging fruit."
  - Are there actions that are particularly low cost and/or quick to implement?
  - Are there existing mechanisms (e.g., policies, laws) that can specifically integrate climate change considerations?
- Pay attention to the costs of action and inaction.
  - How much funding is required to implement these actions?
  - What actions can be integrated into existing programs funds?
  - What are the costs of not implementing these strategies?

Examples of some mitigation and adaptation strategies by sector include:

- **Natural resources (wetlands, riparian areas, open space)**
  - Targeted land acquisition by the city and other groups, such as land trusts, should:
    1. Incorporate climate-vulnerable lands
    2. Consider the amount and type of land cover (e.g., healthy, intact forests provide more mitigation and adaptation benefits than soccer fields)
    3. Protect and maintain wetland/riparian buffers that reduce water temperatures and filter pollutants
    4. Plant flood-tolerant species that can accommodate changes in water levels due to heavy precipitation
  - Encourage climate-friendly gardening (e.g., pollinator-friendly species, recycling yard waste) among city residents.
  - Monitor invasive plants, pests, and diseases through collaboration with local colleges and universities as well as trained citizen scientists.
- **Agriculture/Food supply**
  - Develop a food security plan that identifies strategies for maintaining access to local food supply during extreme events.
  - Review crop planting to accommodate potential extended growing seasons (e.g., apples).
  - Facilitate research on crop survivability and diversity under changing climatic conditions. Crop survivability may be an issue for other species such as sugar maples as these trees may migrate northward.
  - Increase presence of and access to places to purchase fresh, local food.
  - Incentivize water conservation measures by residents and local farms.
  - Provide technical and financial support for small-scale farming.
  - Encourage the adoption of best management practices to control runoff that degrades water quality and adjacent habitats (e.g., pesticides, nutrients)
- **Public health**
  - Use the "buddy system" to build social capital to make social systems more resilient.
  - Encourage public utilities to voluntarily refrain from shutting off service during extreme heat events.
  - Encourage mass transit use on low air quality days (e.g., provide free rides).
  - Research and test the feasibility of planting hypoallergenic trees within the city limits.
  - Install green roofs and plant trees to provide natural shading and cooling.
  - Increase presence of and access to public cooling centers.

Recommendation: Develop and implement climate response plan.

Effective climate response plans include specific actions associated with timelines, responsible parties, and available and needed resources, as well as plans for implementation and evaluation. This last piece is especially important in order to identify successes and failures to pinpoint where adjustments to the actions or the plan as a whole need to be made.

Elements to include:

- Plan contributors: Local government officials and staff, External agencies and partners, Community members
- Planning process: description of planning team, resources used, and public engagement
- Observed and projected climatic changes: description of regional and local changes
- Community vulnerabilities: description of vulnerabilities identified during the assessment, along with ranking of priorities
- Mitigation and adaptation measures linked to vulnerabilities, including costs, benefits, effectiveness, and feasibility
- Implementation plan with associated timelines and responsible parties for each action
- Monitoring and evaluation plan to track successes, failures, and unexpected outcomes

Resources available to support the development of climate action plans include:

- Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments, University of Washington Climate Impacts Group: http://cses.washington.edu/db/pdf/snoveretalgb574.pdf
- Model Standard of Practice for Climate Change Planning, Canadian Institute of Planners: https://www.cip-icu.ca/Files/Resources/CIP-STANDARD-OF-PRACTICE-ENGLISH.aspx
- Changing Climate, Changing Communities – Guide and Workbook for Municipal Climate Adaptation, ICLEI: http://www.icleicanada.org/resources/item/3-changing-climate-changing-communities
- Climate Adaptation Knowledge Exchange (CAKE): www.cakex.org

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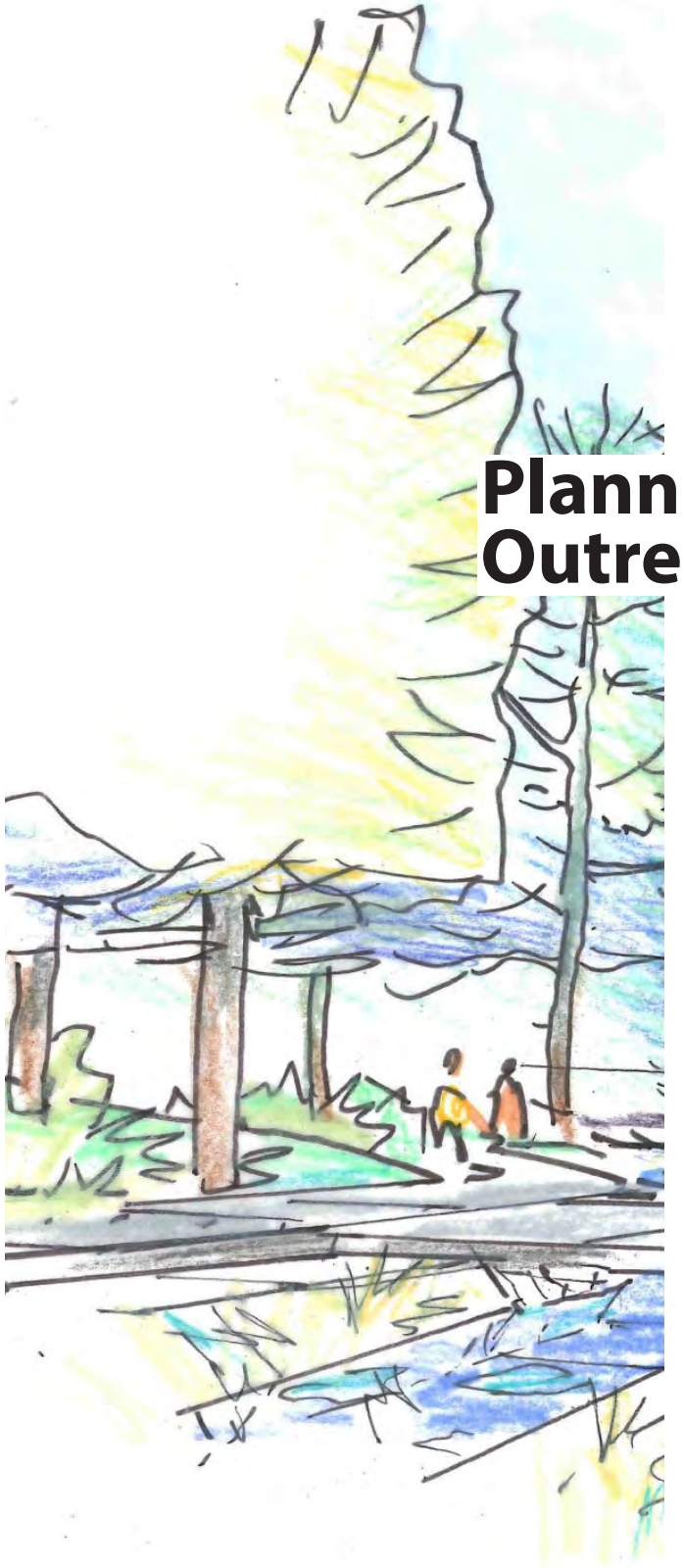


Planning & Outreach

CLIMATE ADAPTATION PLANNING & ENVIRONMENTAL QUALITY

To develop a plan for Climate Adaptation and Environmental Quality, Northampton needs four things:

1. Common understanding of the issues and the options,
2. Clear sense of vulnerabilities across the board (climatic, environmental, public health, social, economic),
3. Strategic Action Plan for Climate Adaptation that can be a model for a regional response, and
4. Healthy competition to build recognition of those who go all out for this effort.

The community should build the priorities for moving forward, so understanding the issues and recognizing the steps to address the vulnerabilities is the essential foundation of ultimate success. Once the top issues are addressed, people will embrace the Strategic Action Plan for Climate Adaption and welcome the opportunity to work on additional issues. The key is to ensure that progress is visible and to feel confident that the community controlled the list.

Through conversations with residents, the SDAT heard about the wonderful and beloved aspects of Northampton: there are great schools and residents feel safe. Northampton governance is progressive and responsive. The community recognizes the benefits of diversity – both in terms of the environment and the people who call Northampton home. Residents have a connection to the land and their gardens, and they appreciate the presence of wildlife such as deer, bears, and moose walking down the streets.

Preparation for the future means other issues need to be part of the common knowledge base, with an understanding of the issues and options. The community input from the SDAT visit illustrates the importance of approaching Climate Adaptation as a collective effort – incorporating public health impacts, social equity, economic sustainability and the climate issues altogether and across all sectors of the community. In addition, it's necessary to look at how climate changes will impact the local food systems.

Planning for Resiliency

The first step is to clearly distinguish between climate change mitigation and climate change adaptation. Northampton conceivably faces disasters from flooding, hurricanes and snowstorms. Communication with emergency management is critical to being adequately prepared for the future. The emergency management team has a new prediction model and they will be launching it soon. It will help to anticipate the potential disasters and plan for collective response on the part of the community – where neighbors help each other and the EMTs work with the community to ensure the safety of everyone.

An inventory of local resources should be compiled as part of the resiliency plan: farmland, the Connecticut and Mill Rivers, the bikeways, the open space, historic structures, the business district and housing opportunities. It will also be valuable to host discussions on key issues: farming, allergies, local actions in the context of regional issues and local food production. The Buy Local Movement builds pride in the community, so it's a good focus of a community-wide discussion.

Social Resilience

There are groups within the community that face multiple levels of risk. There is a need to both understand their circumstances and think about how to best deal with these risks. Community members need to work together to come up with responses and strategies that will get you through the critical times and beyond those to a stronger happier community on the other side. Certain populations face multiple risks; the most vulnerable residents are the very old and the very young and those with existing health concerns such as diabetes and other illnesses. Climate change will exacerbate the effect on vulnerable populations.

It is likely that there will be erratic and intense weather patterns in the future and Northampton must learn to expect those – and respond as a community. It is important to develop a "survivor" mind-set and look ahead in order to cope with the future once the crisis has passed. Social resilience of neighborhoods is fundamental. Many instances of "just in time organizing" are available to help develop a community response to disaster management.

Given the likelihood of residential growth in coming years, it is crucial to plan for that influx of new residents and to treat that growth as the asset that it is. The goal is for a community and an economy that respects the range of skill sets and assures work opportunities for everyone. A solid economic base is key for families to survive and thrive.

Resilience in the population is necessary. A "Resilience Mentality' occurs when people understand they will survive and can focus on how to manage their lives going ahead. It also goes beyond resilience as it strengthens the community without a crisis so they are ready and consequently suffer less from the critical weather conditions. It's about an attitude of the collective protective: which happens when a community of people talks to each other and watch out for each other in critical times. When they are proactive and engaged they focus on being forward-looking.

Leadership in Northampton matters, and Mayor David Narkewicz, Northampton City Councilors and Office of Planning and Sustainability Director Wayne Feiden have done an excellent job overseeing the adoption of cutting edge ordinances. The staff is committed and forward-thinking and ready to move ahead.

It is also important to recognize the values people hold in Northampton; there is a highly educated population, good and progressive governance, and a desire to provide goods and services and benefits to all sectors. The business community should be engaged as they will be key leaders to promote locally grown food and water quality as assets that add to the stability as they seek to attract future businesses. They will also need to be part of a workforce development initiative that builds on existing skills and talents but also describes the needs for the future.

Natural Systems

The municipality has made great progress toward Climate Resilience and has made impressive strides in the reduction of the carbon footprint through alternative transportation and alternative renewable energy programs. Northampton has explored carbon sequestration through the tree canopy, and should continue this work by examining other examples of this process and looking at a regional approach through collective preserved lands. One factor is certain: maintaining vegetation helps and the quality of the soils is affected by the presence of root systems and the movement of nutrients through the system by plants. Forest conservation will also continue to be important. Residents clearly appreciate the high level of lands preserved and the bounty of nature in this community. The large tracts of land are also necessary to ensure the survival of wildlife.

Plants are major factors in maintaining the quality of life for Northampton; certain trees and plants are highly useful to pollinator species and they need to top the list of preferred planting species. This is also a factor in public health as certain species of plants and trees release more pollen and for more extensive periods. Promoting an appropriate selection of species could ultimately reduce the effect of pollen on public health.

Healthy trees are a concern in Northampton; the average life-span of trees in Northampton is 8 years because of the environmental conditions. A tree canopy that could offer shade for energy reduction, and function as a Stormwater management strategy would require bigger (older) trees in the city. A report is being developed on the urban tree inventory and the benefits of the canopy. The Tree Commission is also working on a grant to build this into a plan for the city. It will be useful to have a common understanding of the benefits of trees so the Office of Planning and Sustainability can consider what building specs will be needed for the future. One suggestion was to create a template for a life-cycle analysis so the impacts could be maximally beneficial.

The Northampton Tree Commission wants a cover canopy over the streets but the power lines restrict the opportunity to enhance the streets with trees. It will be important to involve the utilities in discussions so both needs can be met. It may mean creating a new 'tree zone' on the streets. Narrower streets are possible – and have been shown to calm traffic as well.

To get a permit from the Northampton planning board, applicants are required to replace any mature trees that come down during renovations. However, if the renovations are self-managed, the reported numbers may not reflect the entire community; it may be important to enact legislation to tackle the situation as individual homeowners may not comply. In any event, it is key to have a shared understanding of what role the trees play. This is particularly an issue regarding the installation of solar panels given the perspective of taking trees down to create clear pathways for solar absorption. It is important to understand the role of the tree canopy/value of shade (and the allergen output); exactly where is the "sweet spot" between the two benefits? In terms of tree health, ecosystem health and public health, there is a need to look at pollinator species so that the plantings selected foster pollinators. Certain types of trees attract no pollinators, yet others are highly desirable for this purpose.

The Office of Planning & Sustainability should offer multiple ways of approaching this topic. One method involves workshops. Consider asking the mayor to host a quarterly meeting of leaders from local organizations, churches and schools where these topics are discussed and the common base of knowledge is built. A second way to approach the topic involves hosting online resources – Kestrel Land Trust is about to put a "climate change" button on their website, for example. A third approach is to create a list-serve that links everyone and provides a means of sharing valuable information.

Agriculture

Northampton should continue to build upon their success with Agricultural Preservation Restrictions (APRs). To date, Northampton has protected nearly 1,000 acres. This program essentially pays farmland owners the value of the land (minus the fair market value) for its agricultural use – and results in a permanent deed restriction to maintain the land for farming. This in conjunction with programs to promote consumption of locally grown produce is a key means of securing local food resources.

Transit and Transportation Infrastructure

Northampton has planned a microgrid for the hospital, DPW, and emergency shelter. Another key factor in Northampton's future is an improved use of the local bus service. While transportation is generally inhibited by extreme weather events, buses would be the priority means of transportation along with walking and biking. Impact to roadways (such as blown out culverts) severely reduce local transportation options and this constraint should be anticipated and prepared for accordingly. University of Massachusetts is going forward with a culvert safety model that will result in enhanced public safety during emergencies. Other actions may include a commitment to zero waste so it doesn't have to be transported out of town, but the mobility of emergency vehicles and the provision of emergency response are critical to address in the planning process.

Health Issues

Other health issues are from the possible growth of communicable disease, tick borne illnesses and allergies. New type of tick borne disease, Borreliosis Miyamoto, is mistakenly diagnosed as Lyme and consequently isn't well managed for patients. Rocky Mt. Spotted Fever from ticks has been reported in the region so there are concerns about health impacts as well as increased vulnerability to allergens. The migration of pest species will require a regional solution and a common understanding of the hazards from those pests. There is also the potential for an increase in communicable diseases which will be the subject of a holistic involvement of the medical community.

Community Engagement

Overall, there is a need major community organizing. There should be a shared understanding of how fees affect certain communities, with an outreach effort that honors all residents. A quarterly meeting with leaders from organizations (e.g., Ward 3 Neighborhood Association, Civic Organization, Bay State Village), churches and schools can facilitate development of a common understanding of the issues and the strategies. These leaders will help through formal and informal means to develop a human structure for change and foster communication between neighbors. They will also find ways to address it visually so it engages the broader community.

Street fairs and competitions involving students are both good ways to highlight the effort and bring in the community. For students, competitive opportunities can range from photos of natural resources, art projects, and adaptation focused science fairs. This will create incentives for them to become part of the solution. High school

students could compete for adaptation awards, and could create films, displays and various works of art to illustrate the concept and the need to plan together. Middle School students could have an Adaptation Science Fair, an essay contest and art works.

In addition to events, people learn from seeing the approach online and hearing stories about the effort. Collectively, the challenge is to create a community response without an immediate threat – so when the crisis hits, the community responds without hesitation and gets past the critical period. Being prepared is essential to moving forward.

Vulnerability Assessment

A Vulnerability Assessment will be a major means of establishing priorities and planning as Northampton moves forward. With the Mayor convening quarterly meetings with organizations, and those organizations create forums to share it with their colleagues, a sense of shared purpose and a unified commitment to move ahead with climate adaptation will develop. The University of Massachusetts developed a vulnerability study with the Northeast Climate Science Center that looks at vulnerability – specifically at resources that are underutilized, need protection (e.g., Barrett Street Marsh or the Meadows) and are highly vulnerable. A vulnerability assessment will:

- Catalog key assets and capabilities (resources);
- Assign quantifiable values and importance;
- Identify vulnerabilities and potential threats to resources;
- Mitigate or eliminate the most serious vulnerabilities to the most serious resources;
- Use analysis to drive the risk management process.

Northampton will need to work with a survey expert who can help ensure the goals are met by the questions asked. It needs to be highly rigorous and seen as useful by the community.

A local Hazard Vulnerability Assessment is done annually but it's too technical. It needs to look forward and be seen as useful by the community. It needs to be written in plain language. The Pioneer Valley Regional Planning Commission sees Northampton as a willing participant to model the measure for other communities. The key is that the assessment needs to be multi-dimensional with a "regional' focus on risks and hazards.

Another key factor is Risk Assessment; what will be the local response to risks from disturbances, and how does that reflect the community's values? The assessment needs to focus on what is it that creates pride in this community. The risk assessment

will need to address issues of critical importance to all members of the community, especially those that are most vulnerable.

Economic issues are also key to the assessment. Take employment vulnerability as an example: how do you grow your economy so people at all levels have job opportunities? How do you create affordability in your housing stock?

Conclusion

In summary, the overall effectiveness of the Climate Adaptation Plan will depend on the quality of education and outreach. Ask the mayor to convene quarterly meetings with leaders from local organizations. Create forums to make it real.

Finally, a strong Vulnerability Assessment needs to include Economic, Health and Social Vulnerabilities; it needs to be multi-dimensional and regional and focus on risks and hazards. The Plan will need to look at:

1. Climate
2. Overall environmental quality
3. Social vulnerability
4. Economic sustainability
5. Hazards
6. Limitations to growth
7. Current regulation
8. Future legislation

Costs are complex and actions are expensive, so the community needs to look at a proactive approach in terms of how it benefits the whole community. Fortunately, the system provides for waivers and credits to address the limited resources of certain residents.

The Northampton Stormwater Utility is working and will be the source of funding for future retrofits to the city's stormwater management system, but this, too, is tied to many other factors. A leak discovered on the Mills River was probably caused by erosion, so it's necessary to be mindful of the interconnection between various elements of environmental quality and climate adaptation planning.

Energy

NORTHAMPTON POTENTIAL LOCAL ENERGY SUPPLY

Introduction

The city of Northampton has come a long way in planning for mitigation of climate change. The community leaders in the public and private sectors should work together to refine development of a vision for how the community could fulfill the future energy needs and simultaneously reduce greenhouse gas emissions (GHG). To achieve these important goals of the city, there should be future consideration of the integration of various technologies that will help businesses, citizens, and visitors use energy more efficiently, utilize local and renewable resources, and establish a showcase for smart and sustainable community energy systems.

Specific goals for the next 10-15 years should be established, and the effort should seek a well-known champion in the community (e.g. the Mayor) that can continue to guide these efforts.

The strategies included in this report are focused on the long-term energy goals for the city. They represent a range of technology options that are currently market ready and would be feasible for implementation over the next 5-10 years. An initial analysis has revealed that the option of a low-temperature district heating and cooling system has not been included in any previous studies. A low-temperature district energy system could utilize recovered energy from the local wastewater system as its primary source. Typically wastewater has a fairly constant temperature of 60-70 F over the year with sources such as shower, dish, and laundry water. When compared to the least-cost, stand-alone system options for buildings, this approach could be economically feasible and produce less GHG emissions.

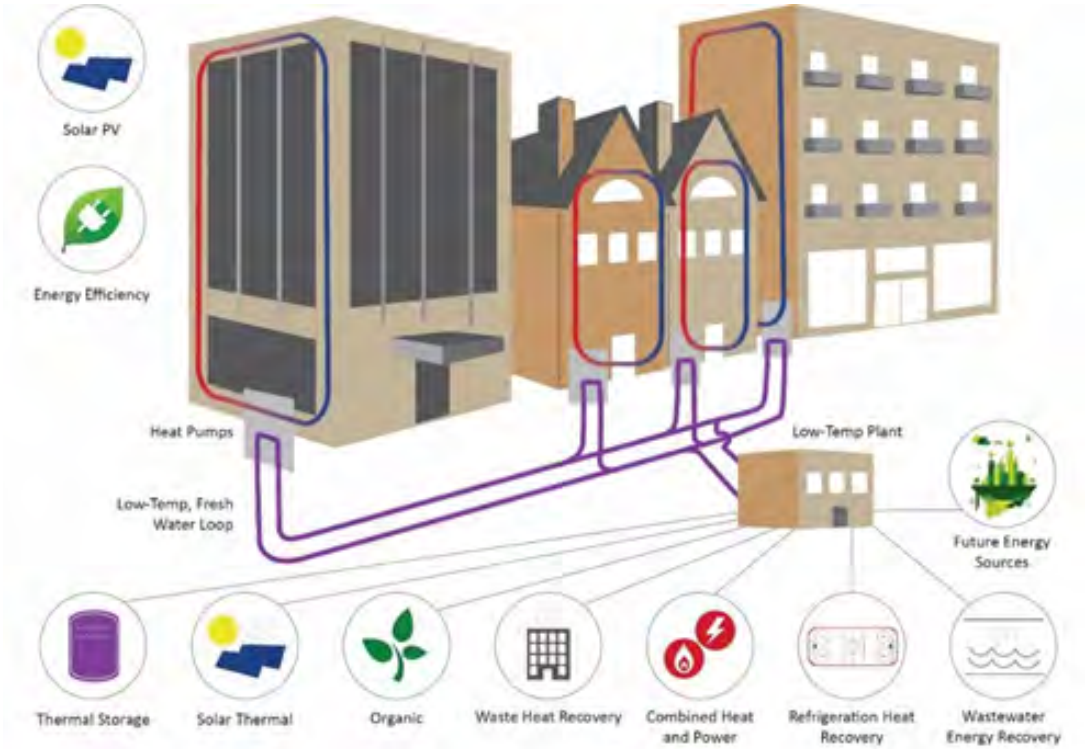
The longer-term energy vision for the city should include the addition of other renewable solutions, thermal storage, and demand-side energy efficiency options, including solar photovoltaic and solar thermal technologies. The implementation of an energy vision has the potential to significantly reduce GHG emission and make the community more resilient with a local and diversified energy supply. A low-temperature district energy system lays the groundwork for the incorporation of additional sustainable technologies to be implemented in the future, creating an opportunity to advance common community interests and initiatives. It is important that the local neighbors and businesses participate with this system implementation in order to advance their sustainability and economic resilience goals.

Background

Current sources to meet heating needs are light oil, natural gas, wood, and electricity. Air-conditioning is generally met by electric-driven cooling equipment. There is currently a moratorium on expanding the use of natural gas, because the local distribution system is fed from a single transmission line making natural gas exposed to single failure and volatile seasonal prices. The moratorium makes use of wood and electricity more likely for heating, even if the price is relatively high. The existing electrical system does not have capacity problems, but it still is exposed to weather related blackouts. Some smaller scale electric production exist in the city, like at Smith College that uses an efficient combined heat and power process meeting the electric and thermal needs of the campus. Locally produced energy will increase reliability and resiliency and are promoted by the city.

The Roadmap for a Community Energy System

To achieve these important goals of the city, there should be future consideration of the integration of various technologies that will help businesses, citizens, and visitors use energy more efficiently, utilize local and renewable resources, and establish a showcase for smart and sustainable community energy systems. One efficient way to achieve this integration is to install a community energy system based on district energy technology. A community energy system can be an urban model for sustainability, resilience, partnership, innovation, and economic development.



A community energy system based on district energy and integrating local and renewable technologies.

Local Energy Source and Technology Solution

Achieving the city's energy goals involve the integration of a diverse portfolio of sustainable energy sources to meet the needs of current and future buildings in the area. There is an influx of energy solutions entering the market and a proven slate of technologies that have been used in community energy systems throughout North America and around the world. This report outlines seven key strategies to support the long-term roadmap for the city.

The strategies included in this report are focused on the long-term energy roadmap for the city. They represent a range of technology options that are currently market ready and would be feasible for implementation over the next 5-10 years. As noted previously, the stakeholders will need to be diligent in considering integration of new solutions as they are found to be technically feasible, financially viable, and environmentally advantageous. It will be important to revisit opportunities as technology solutions become market-ready, as the local utilities integrate additional efficiency and renewable options.

1. Low-Temperature District Energy System integrated with a Wastewater Energy Capture – A low-temperature district energy system would be ideal for meeting energy needs of buildings implementing energy-efficient design.
2. One of the best resources within the city can be found underground through wastewater energy capture. The wastewater system runs through the city with temperatures that are ideal for withdrawing energy to heat and rejecting energy to cool buildings. This energy is not currently utilized at any other point in its distribution system and can potentially meet the base energy needs of the city depending upon where it is accessed. Pending appropriate approvals, this energy opportunity is ready for implementation in the city.
3. Energy Efficiency Standards - Implementing energy design standards and developing more efficient buildings in the area is critical to incorporating other renewable and efficiency technologies. These technologies are more financially viable and effective when the building load is consistent and demand is more predictable. Higher efficiency buildings will also serve as a better fit to a low-temperature district energy system and reduce the overall energy profile for the area. For existing buildings, there should be targeted resources made available to help building owners and tenants consider lowering their energy usage and determine whether they can be connected to the district energy system.
4. Combined Heat and Power – Combined heat and power systems are efficient mechanisms for meeting simultaneous electric and thermal loads in an area. A combined heat and power facility could be located in the city to offset local electrical and natural gas consumption used for heating. The system also has the potential to feed into the low-temperature loop as a redundant source of energy during peak demand days or for periods of low wastewater flow. Combined heat and power systems elevate the efficiency of power production from approximately 40% to approximately 75%.

5. Thermal Storage – Thermal energy storage to store water for the heating and cooling needs of the area. This would work like a battery, which would be charged during non-peak energy hours and then discharged during peak energy usage times to balance out the energy profile for the area.

6. Solar Thermal – The rooftop space or ground surface mounted collectors could be utilized for the installation of a solar thermal array. When combined with thermal storage, this is an efficient and environmentally sustainable approach for providing redundancy to the district energy system.

7. Solar PV - There is open rooftop space on several buildings within the city. Solar PV implementation could also be ground surface mounted which will reduce the installation cost considerably. Solar PV implementation in the city could potentially allow residents to subscribe to a localized renewable electricity source.

It is also important to work closely with the electric and gas utilities to find short and long-term strategies that support the city's vision. The opportunities presented within this study expand the scope of traditional utility services in order to achieve the city's goals and vision. This can be enhanced with continued collaboration with these utilities, as well as the other technical stakeholders that will influence or deliver the next generation of energy solutions to the city.

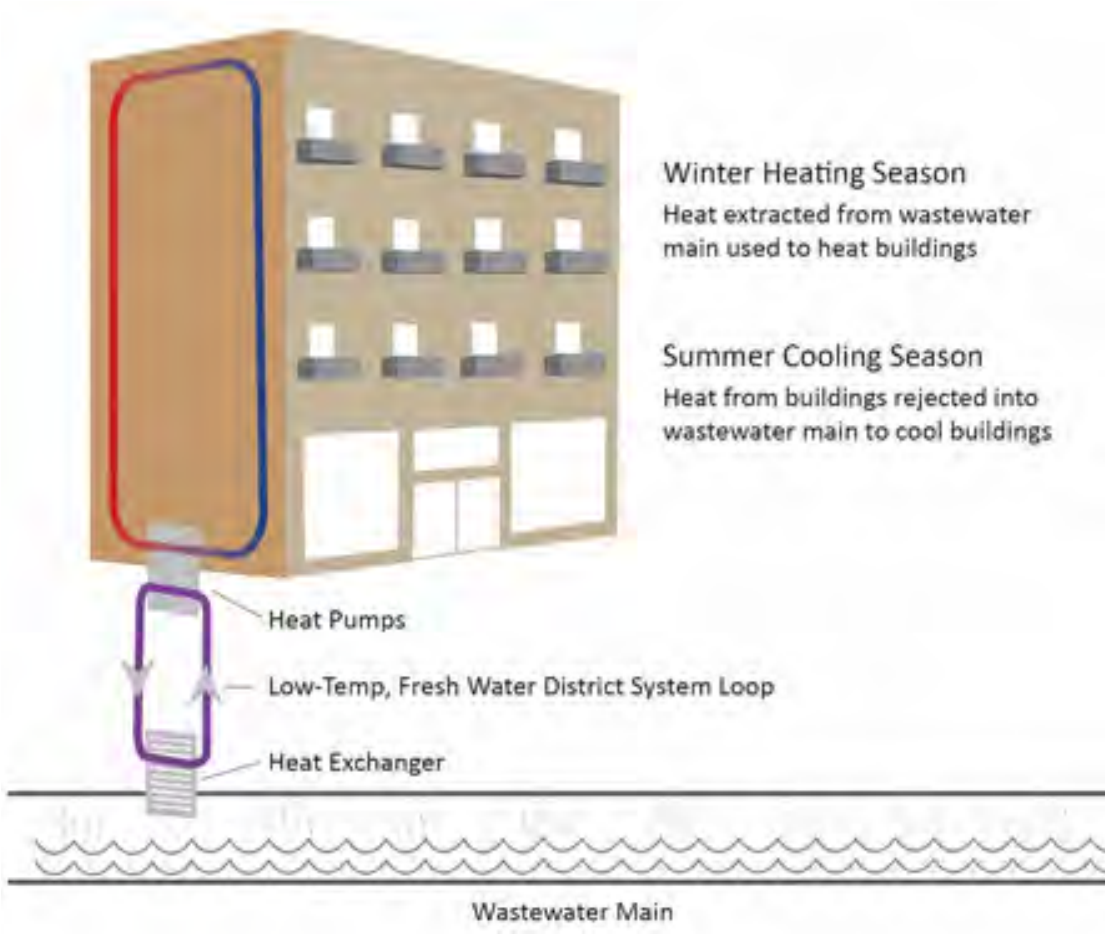
Wastewater Energy Capture

The wastewater energy recovery solution is based on the city's untapped source of renewable energy, which can be found in the wastewater system running beneath the streets of Northampton. The wastewater flowing through the system in this area can retain an immense amount of energy that is not currently being utilized at another point in the system. This latent energy can be withdrawn from the wastewater system and transferred (via a heat exchanger that separates the loops) into a low-temperature district energy system. This energy is then carried through the low-temperature district energy system to the end users where the water temperature is raised or lowered to be used for heating or cooling. The amount of energy that is available for capture is dependent on two factors, the flow rate of the wastewater, and the amount of energy that can be extracted or rejected into that flow rate.

An example of this type of energy capture is provided in the image on the next page. This type of system has been used effectively and successfully in other locations in the United States and internationally.

Wastewater flow typically varies based on the season, the time of day, and the type of buildings connected to the main. A connection near the initial customers will keep

distribution system costs at a minimum. It will also be important to determine the optimal location to tap into the wastewater main. The wastewater energy recovery process would not interfere with the existing wastewater system. Rather, it is a closed-loop process that does not expose the wastewater to the surrounding environment.



Wastewater main energy capture system.

Distribution System

The low-temperature distribution loop would consist of plastic piping. Plastic piping provides corrosion resistance and is less expensive than conventional steel piping.

Building Connection

Water-source heat pumps can be utilized to transfer energy from the district energy loop to the individual buildings.

Environmental Benefits

The incorporation of a low-temperature district energy system will enable the City to set its greenhouse gas emission profile well below the average user or community. By incorporating thermal storage or another renewable-based peak-managing energy source to the system, the carbon reductions of the system would increase.

Frequently Asked Questions

Is this like geothermal?

Wastewater energy capture is similar to geothermal in the sense that it captures energy from a latent, below ground resource, and because it is a low-carbon solution. It is not the same as tapping a source of energy within the ground's surface. True geothermal systems require very deep wells and can require additional land for development.

Has this been done before?

Yes, there is a very successful wastewater energy capture project in Vancouver, British Columbia[1] serving the False Creek neighborhood. Systems have also been developed in Chicago, Illinois, Lincoln, Nebraska[2], and Philadelphia, Pennsylvania[3]. This technology has also been utilized throughout northern Europe for over 40 years. Read more in the National Geographic profile "Waste Wattage: Cities Aim to Flush Heat Energy out of Sewers."[4]

What is a low-temperature district energy system?

A low-temperature district energy system connects buildings to a common energy loop fed by lower grade (or temperature) energy sources. In this case, the low-temperature water is between 60 degree F and 70 degree F. By using a low-temperature distribution system, it is easier to integrate lower intensity fuel and technology sources, such as wastewater energy recovery, waste heat from combined heat and

[1]False Creek, Vancouver, British Columbia http://vancouver.ca/home-property-development/false-creek-neighbourhood-energy-utility.aspx
[2]Lincoln, Nebraska http://newsroom.unl.edu/releases/2013/09/27/City%2C+UNL+partner+on+Nebraska+Innovation+Campus+renewable+energy+syste
[3]Philadelphia, Pennsylvania http://www.waterworld.com/articles/print/volume-28/issue-6/editorial-features/heat-pump-systems-use-wastewater-to-lower-hvac-costs.html
[4]Kaufman, Rachel, "Waste Wattage: Cities Aim to Flush Heat Energy Out of Sewers," National Geographic, December 2012. http://news.nationalgeographic.com/news/energy/2012/12/121211-sewage-heat-recovery/

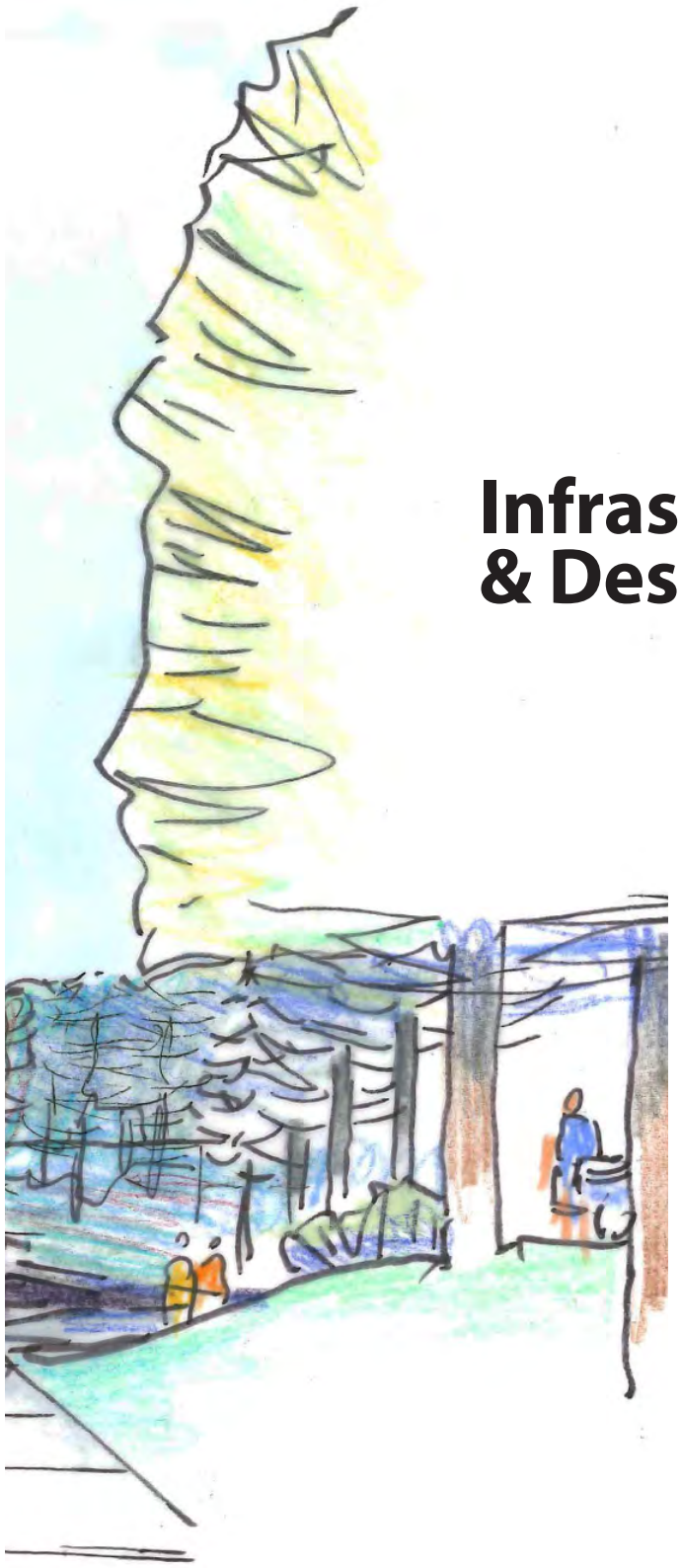
power and industrial processes, and solar thermal.

What are the environmental benefits?

Using alternative sources of energy and technologies to meet the energy needs of the community will improve energy efficiency in the city. Saving energy throughout will help reduce the amount of fossil fuels needed to sustain activity within the district. The district will be able to reduce its greenhouse gas emission.

What are some of the overall benefits of a district approach to energy?

A smarter electric system and use of a thermal grid allows for a more adaptable system over time. This means more technologies can be introduced and the system can adapt to newer technologies.



Infrastructure & Design

GREEN INFRASTRUCTURE & URBAN DESIGN

Green infrastructure is defined by Wikipedia as "...a network providing the "ingredients" for solving urban and climatic challenges by building with nature". This description of green infrastructure captures the essence of how the Northampton SDAT team considered the effects of climate change on the urban center of Downtown Northampton.

The US Environmental Protection Agency (EPA) further defines Green Infrastructure as "...a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits...green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits." EPA's definition is generally considered to be more focused on stormwater management than other benefits, and for purposes of this report, we will use the term **Green Infrastructure (GI)** and **Green Stormwater Infrastructure** (**GSI**) interchangeably to describe this approach.

While understanding terminology is critical, defining clear lines between GI and GSI are not important. What is important is that Northampton seriously consider GI/GSI development models for planning, designing and implementing climate adaptation strategies that will provide social, economic and environmental resiliency for the Town.

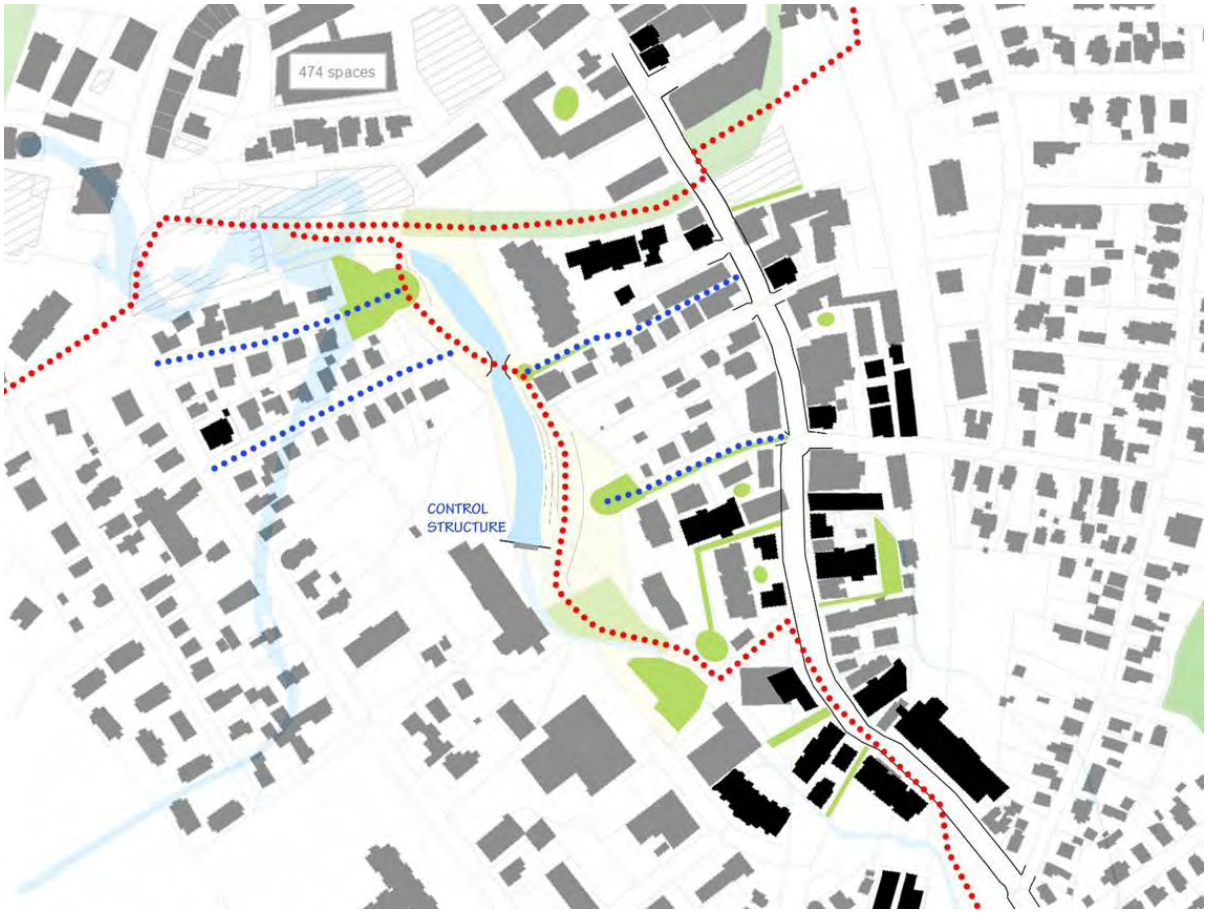
Why Green Infrastructure and Urban Design?

The SDAT explored strategies for modifying and enhancing the urban fabric of downtown Northampton as models for improving peoples' experience in the town. Already beautiful and thriving, Downtown Northampton will be in need of infrastructure improvements in the future. Additionally, proposed developments have the impact of changing Downtown "one bit at a time". Unified urban design planning that incorporates green infrastructure would have the effect of incrementally improving the downtown experience (through individual development projects) and increasing the economic base while adding ecosystem benefits that were displaced by the current developments. The SDAT Team proposed several strategies for this approach through sketches and narratives that articulate GI values and benefits. These strategies include the following:

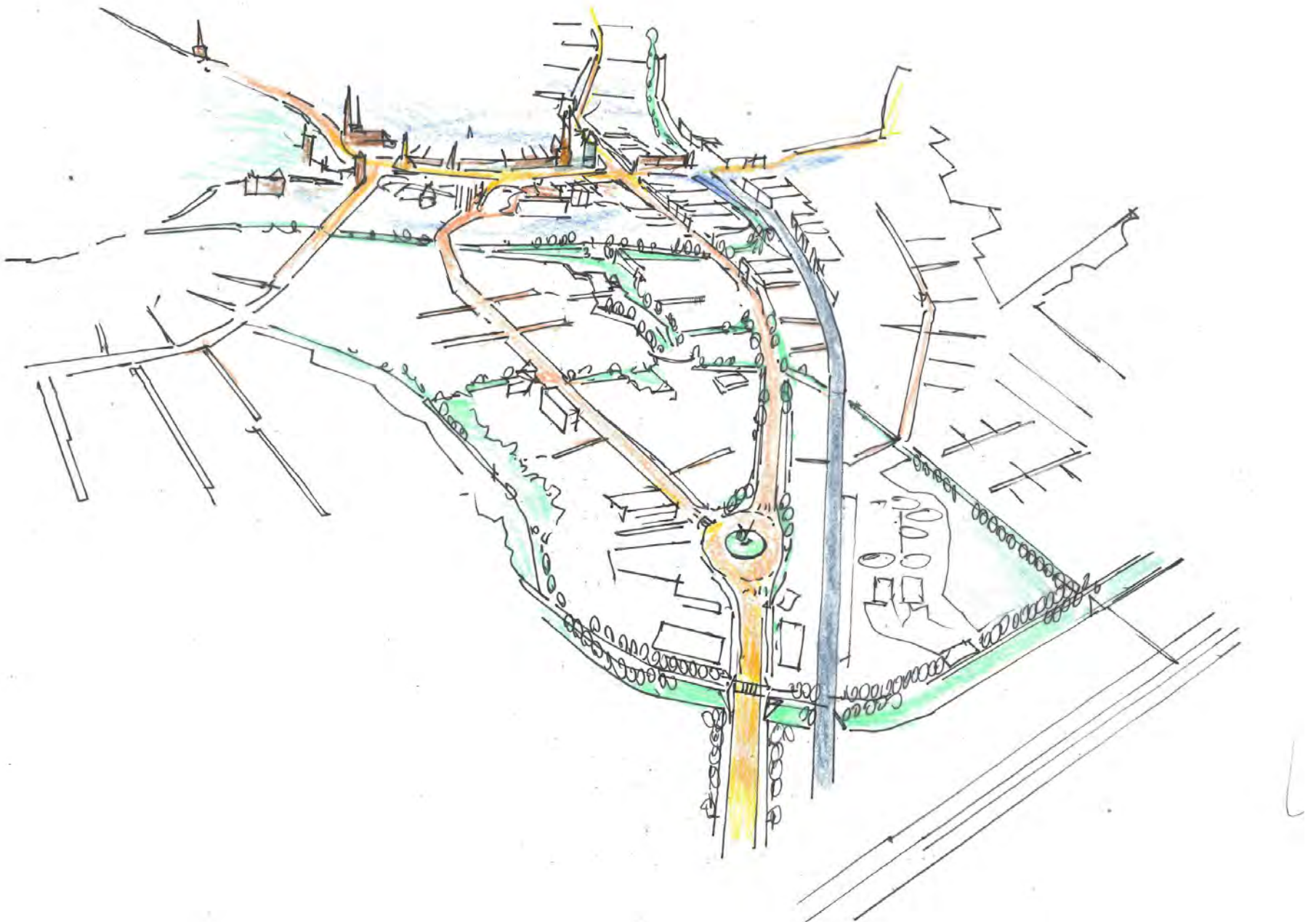
- **Road Diets,** or the narrowing of paved traffic areas to accommodate the needed traffic while eliminating unnecessary pavement.
- **Shared Streets**, where the traveled way is carefully designed to allow bicycles, pedestrians and motor vehicles to safely co-exist within the same space.
- **Design of Streetscapes** using GI/GSI techniques such as water receiving landscapes and biofilters to manage rainwater.

The SDAT Team created sample concept design illustrations that demonstrate many of these concepts. The following locations were illustrated:

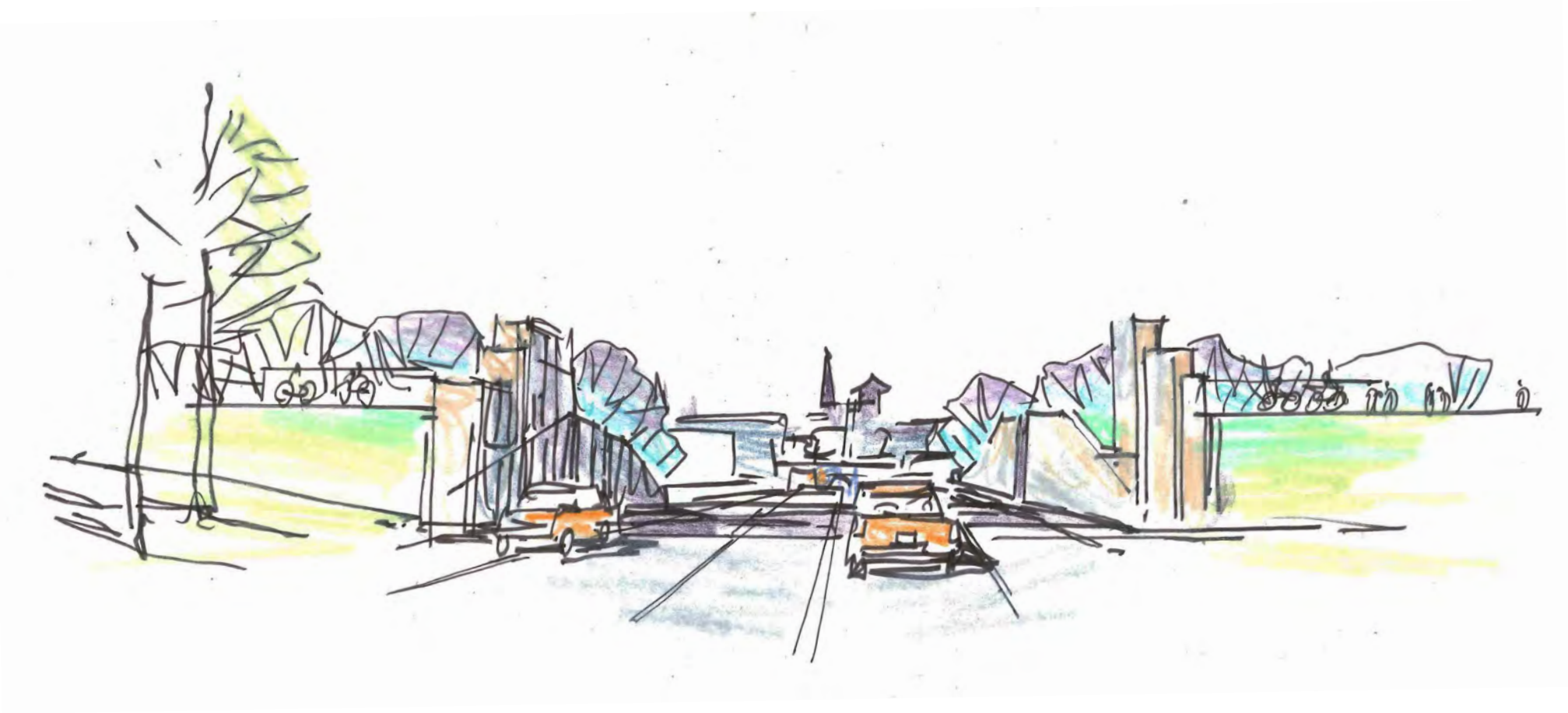
- South Gateway
- Main Street gateway
- Farmers Market



South Gateway Green Infrastructure.



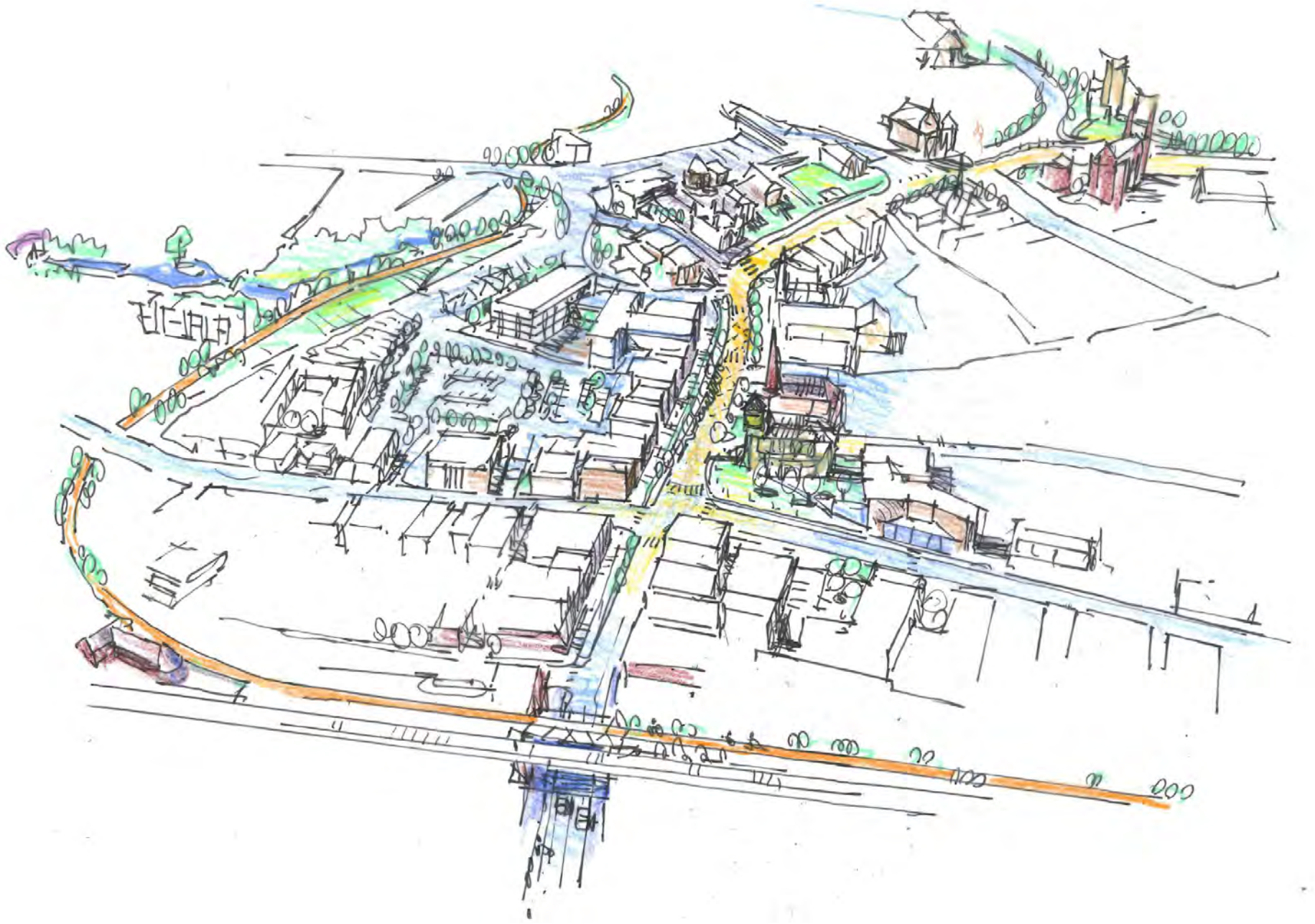
South Gateway: This aerial sketch of Northampton from the south illustrates how infrastructure improvements to the drainage structure and bike network might be strategically organized from the town-center, through a new open space and then to the city edge at the dike.



South Gateway: The Mill River dike forms a natural southern gateway to the city and could easily be enhanced with landscape features and a southern extension to the bike path system. The Mill River dike forms a rare opportunity to enhance a clearly defined city edge and a highly memorable gateway to the city that few American cities can claim. This could be the first step or easy win among the SDAT physical design proposals.

South Gateway: The ROW planning on Pleasant Street includes a new roundabout and reveals some of the potential to catalyze investment in affordable and market rate housing and mixed-use commercial structures. The conceptual section-perspective suggests a "complete" Pleasant street with landscape and drainage infrastructure as well as walking, biking and traffic lanes.

South Gateway: The Forbes library is representative of the many historic architectural and cultural resources that contribute to Northampton's importance as a tourist and regional destination. It reinforces the need to combine energy concerns with those of careful preservation.



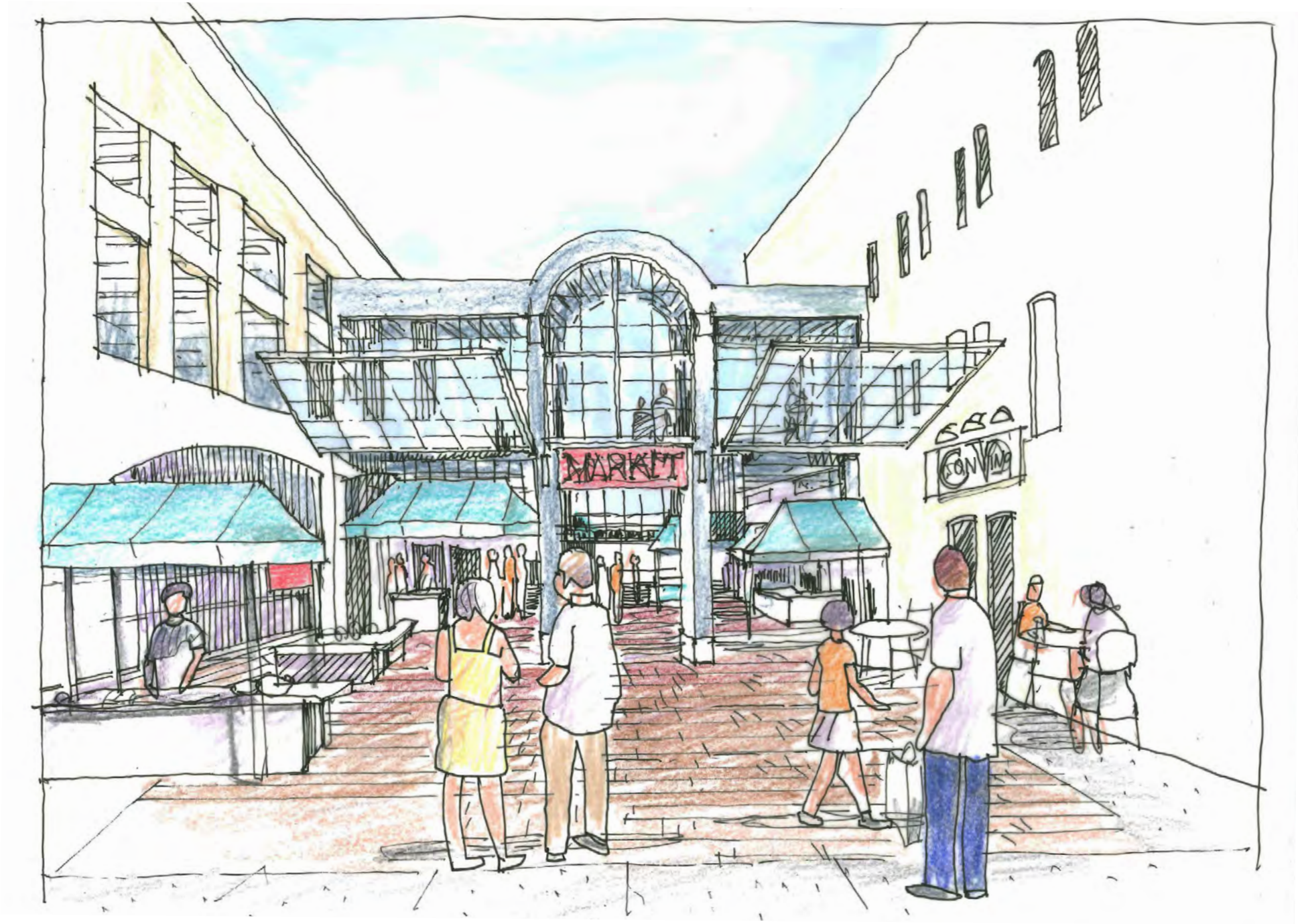
Main Street Gateway: The aerial sketch of Main Street presents an intricately inter-woven fabric of churches, banks, retail and public buildings that, with Smith College, form a rich townscape of steeples, towers and grand porches. The architectural richness, detail and topography profiles make the pedestrian experience vivid and memorable, enhancing Northampton's walkability.

Main Street Gateway: Main street with an enlarged central landscaped safety island and City Hall in the background.

Main Street Gateway: Commercial sidewalk design solutions need not be elaborate but are best when integrated with drainage infrastructure improvements, advanced street tree irrigation techniques, and careful attention to pedestrian crossing zones.

Farmers Market: Conceptual Plan of Downtown Farmers Market Canopy that preserves the shade trees and flag. Fresh food markets sustain a denser walkable city core. The farmers market could extend its season with a +/- 20' canopy at edges of the main parking structure and the Thornes building.

Farmers Market: Sketch of Farmers Market with weather enclosure canopy.



Farmers Market: Sketch of entry to Farmers Market with weather enclosure panels.

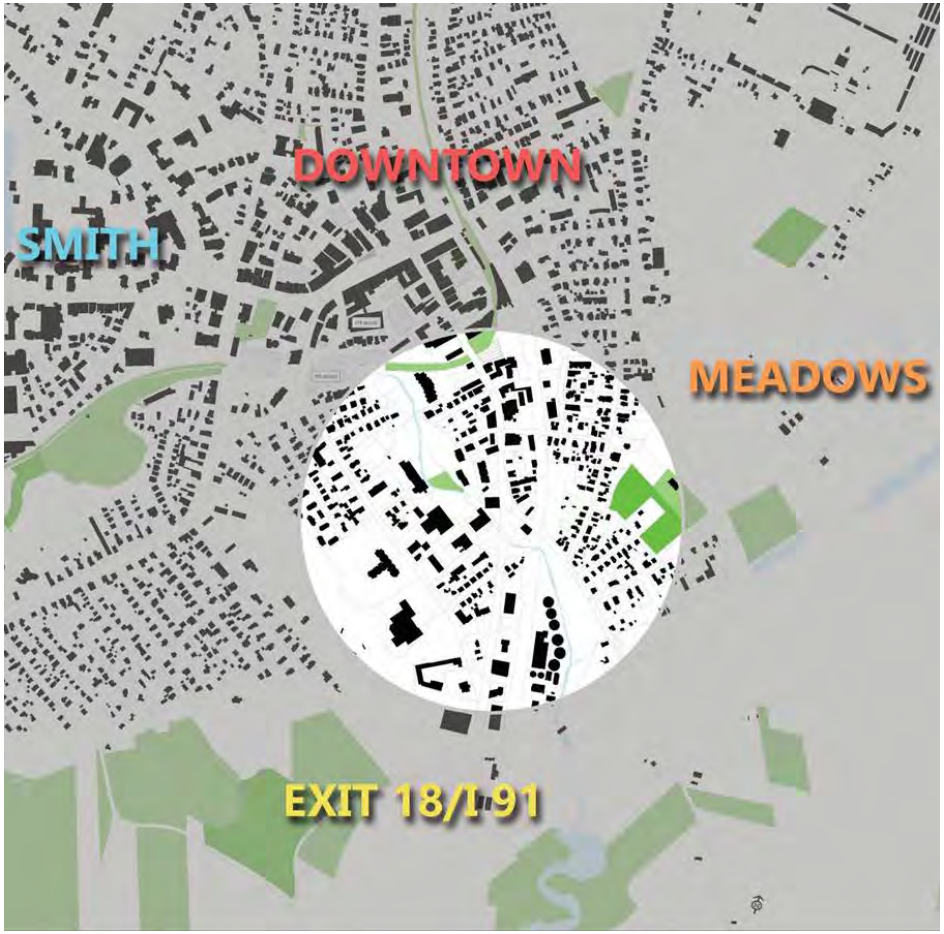
Note that these illustrations should be considered examples of how the GI/Urban Design approach can be used. This approach can be applied town-wide in other locations using similar means.

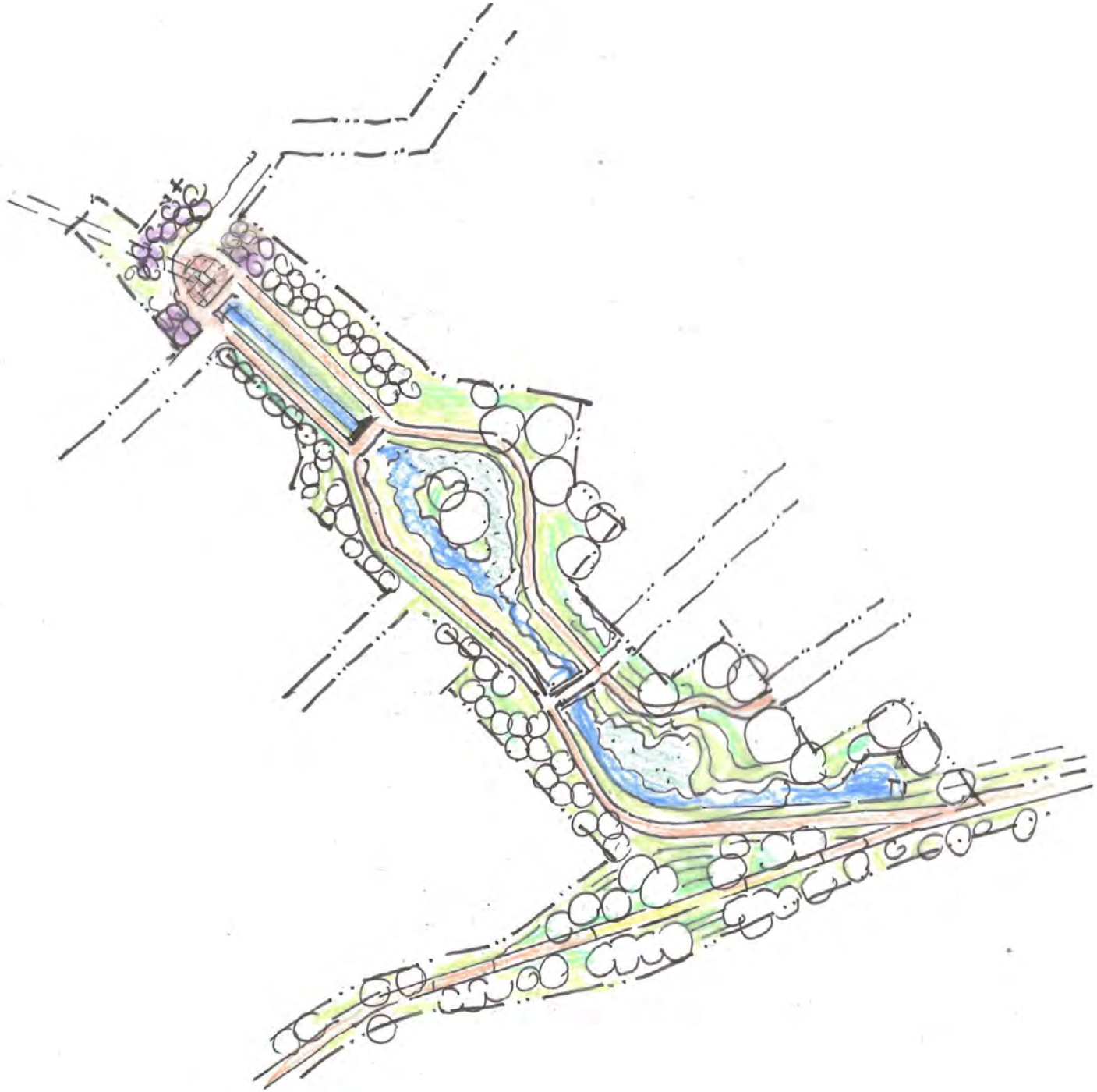
While these illustrations show how the urban design fabric can be modified in a general way, the SDAT Team focused on one alternative in more detail: the Old Mill River Park.

Old Mill River Park

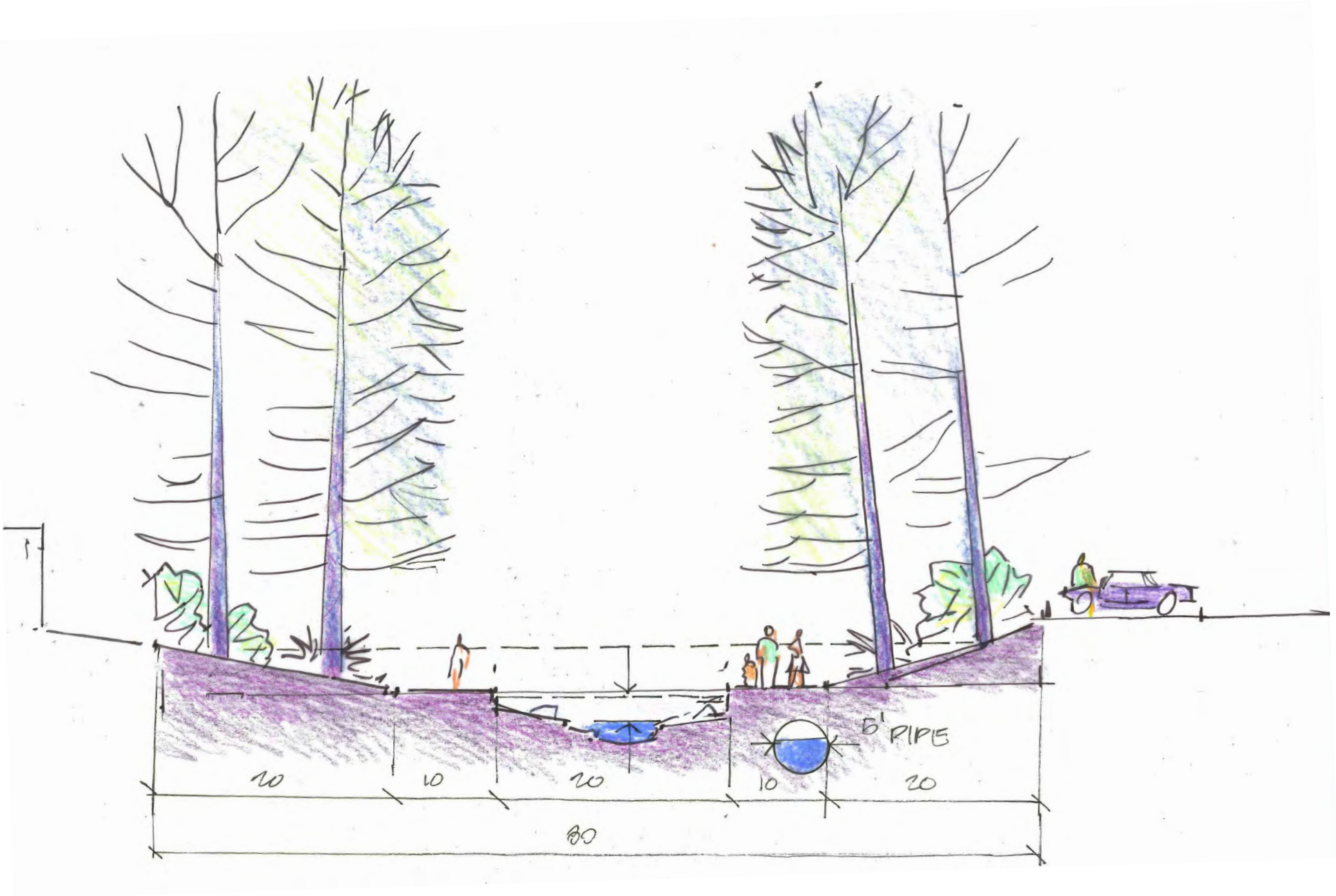
Located south of Main Street, between Conz and Pleasant Streets, Old Mill River Park would be created along the banks of the remnant of Mill River that Mill was "cut off" when the Army Corps of Engineers flood control project diverted the River mainstem around downtown Northampton.

This portion of Mill River is generally hidden from public view, but still serves as a receiver for stormwater pipes that discharge from Downtown and the surrounding environs. By using this area to provide stormwater storage, a careful GI design could transform this area into a wonderful new Park that would also significantly contribute to stormwater management from the Downtown area. If designed as a centerpiece, Old Mill River Park could feature a fluctuating water surface for a wide range of storm events, thus reducing the stormwater burden on the flood control station located downstream at the flood control dike.

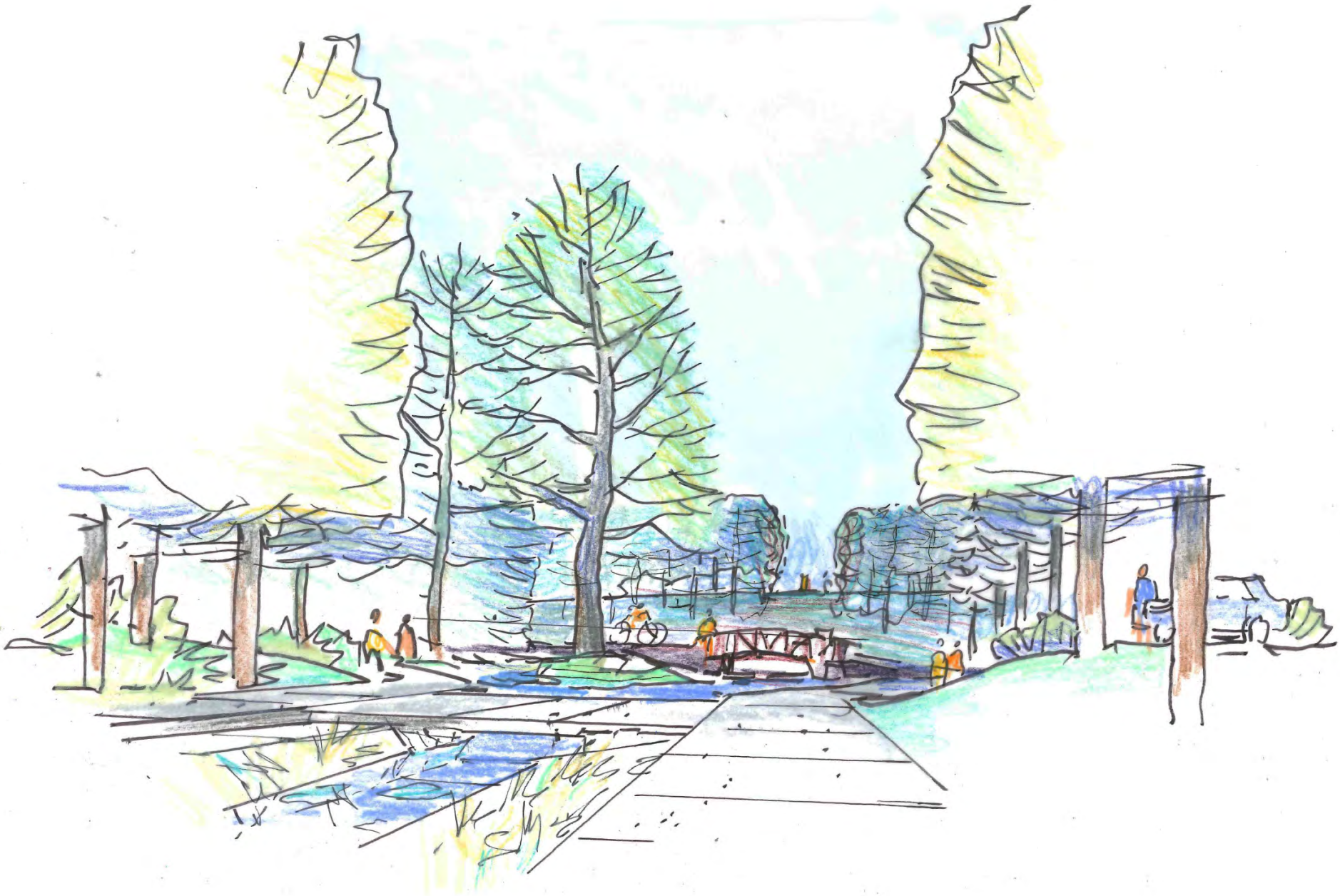




The concept of a Mill River Park reinforces the idea of "beautiful infrastructure" that links bike paths and adjoining street ROW's while providing three retention levels to increase capacity and slow excess runoff.



The conceptual cross-section of Mill River Park as a steep valley suggests a shade garden with conifer edges that block views to adjacent properties while increasing the parks retention capacity.



An attenuated park vista looks north to an ornamental bridge structure.

Park vista looks south to a more formal drainage pool that is terminated by a pylon and grove of ornamental trees.

Infrastructure Policy for Adaptation Planning

Based on interaction feedback obtained in the stakeholder meetings, the SDAT developed specific policy strategies and recommendations for implementation. These strategies are detailed below:

Increase in frequency of storm events

Climate change brings a change in the pattern of storm events. The first change we considered was the increase in frequency of storm events, or more simply stated, there will be more rainfall than in the past. This will require the Town to review and re-evaluate its current stormwater management policies and regulations to expand stormwater management and flood storage practices.

Recommendations:

1. Use green infrastructure to increase "water storage" capacity of watershed (thereby creating less runoff!) by including GI in urban design projects. The water holding capacity of the site can be increased by promoting soil water retention and plant Evapotranspiration.
2. Distribute GI solutions throughout the watershed to reduce the overall burden in the system. By spreading GI throughout the town, underground water-bearing soil (known as aquifers) are recharged, ensuring replenishment of stream and river base flow and groundwater recharge.
3. Re-invest in existing stormwater management infrastructures. The stormwater piping system as well as the COE flood control infrastructure is aging and will be in need of incremental replacement. Consider how GI can offset the need for large single investments in traditional urban infrastructure. As an example of this idea, if GSI is implemented within a watershed, it would result in lower stormwater discharges downstream, thus minimizing the need to upgrade the stormwater piping system.
4. Optimize existing infrastructure investment. Northampton has a well-developed stormwater (and flood water control) infrastructure. Identification of key critical elements of these infrastructures can result in lower total investment if the Town takes the approach of reinforcing what works and supplementing it, rather than a total replacement strategy. Making strategic investments in the most critical system upgrades would provide the best bang for the buck.

Increasing storm intensity

Another impact of climate change is the increase in intensity of precipitation, that is to say the rate at which it falls. Stormwater intensity affects the sizing of stormwater storage and conveyance (piping) systems.

Stormwater piping design today uses rainfall criteria that was developed in 1961 and derived from 25 years of records in the US Weather Service's publication Technical Paper 40. In addition to using a narrow 25-year window of rainfall data, the definition of the "100-year storm" was extrapolated from these data. That is to say that the design criteria in use today uses data that is outdated and perhaps fundamentally flawed in its projections.

Recommendations:

1. In order to more effectively adapt to an increase in storm intensity due to climate change, the Town should adopt updated design criteria that would be used for development projects as well as the Town's infrastructure upgrades. By adopting updated design criteria that promotes green infrastructure, Northampton can help prepare for the future changing climate and adapt "on the fly".
2. The Town should critically evaluate its current use of rainfall data from USWS TP-40 and consider alternatives. Sustainable design rating systems such as LEED and SITES promote the use of the most current 30-years of daily rainfall records, ensuring that the most current data sets are used in the design process. This approach was not possible several years ago due to a lack of available data and processing capabilities, but today with suitable precipitation data readily available and the processing power of even the most modest PC, this new approach is quite feasible.

Long-term effect of climate change on natural systems

As climate changes, the natural systems such as vegetation slowly adapt over time. Depending on changes in temperature and precipitation patterns, natural systems will adapt to the conditions that present themselves. In a naturalistic setting this evolution is not a problem, but in an urban setting the effect can be devastating. For example, street trees of a species that thrive today may now live under stressed climate conditions in the future. More resilient species are needed to be suitable for the expected conditions. Further, by promoting a range of vegetation, biodiversity can be planned, ensuring that more species can thrive under future conditions.

To promote biodiversity and healthy ecosystems, the SDAT recommends that the following measures be undertaken.

Recommendations:

1. Research, evaluate and adopt urban tree plant species that are adaptable to future conditions. Consider plant species that thrive in warmer, wetter climates.
2. Assess vulnerability of current tree inventories and create a priority list for their replacement. In addition to assessing current public tree inventories, the Town should evaluate the remaining likely life span of trees given increased

environmental stress due to climate change.

3. Identify and manage invasive species, including current and future species migration threats. With climate change, invasive species may become persistent in new areas not previously seen. Research and develop an invasive species plan that anticipates migration to the Pioneer Valley of invasive species typically found in warmer, wetter climates to the south.
4. Once these measures are researched and understood, the Town should commit to updating its land use controls for development projects as well as its own street tree planting and management program.

Concern	Response	Action
Increasing frequency of storm events	Expand stormwater management and flood controls	Increase water storage capacity of watershed. Reinforce/ reinvest in existing infrastructures
Increasing storm intensity	Prepare more rigorous and contemporary design response	Adopt updated design criteria that promote green infrastructure
Climate effects on natural systems	Provide resilient species for expected conditions and promote biodiversity for redundancy	Research species adaptability to create preferred plant palette.

Conclusion

FINAL THOUGHTS

While each member of our team brought a specific perspective and area of focus to our efforts, there are a common set of themes that are woven throughout our individual findings:

What Are We Doing Here?

As noted in the introduction to this report, an SDAT has a very specific purpose and structure. Northampton identified a specific challenge that needed further investigation – the impact of global climate change on the historic resources in Northampton. From that, the American Institute of Architects' Communities by Design program identified a team of experts from across the country who could begin to address those challenges. The limited time we were able to spend in Northampton, coupled with the fact that we are not from the community, means that our role is limited to further refining the challenge statement and generating a couple of ideas about potential solutions to the challenge. These potential solutions are not intended to be final proposals, but rather a starting point- a couple of notions- of what could be. It's up to Northampton to further refine what is right for the community, and what will be.

Talk Amongst Yourselves

Where you go from here is very much up to you. Northampton is blessed with an engaged, progressive community with competent political leadership and a talented administration that has already started to implement multiple visionary projects. It is important that everyone continue to communicate as both the vision of a better, more sustainable Northampton, and the execution of that vision are further refined and implemented. Your community is one of your greatest resources.

Waste = Food

One of the fundamental tenants of sustainability, derived from nature, is that there is no waste in nature. What is cast off by one organism becomes food for another organism. This is also called 'Yankee thrift' – one does not throw something away, one finds a way to repair or repurpose something that is broken or obsolete. Northampton already has a strong record of repurposing obsolete items as it has remodeled and reconfigured the city over time by making use of the existing infrastructure and architecture. One area in which our team really sees potential is to convert Northampton's storm water issues into assets. By celebrating the infrastructure that has kept the community safe for the better part of a century, and seeing the water flowing through the community during clement weather as a beautiful, natural element instead of a danger that must be eliminated, Northampton can gain a greater appreciation of the community's unique history and a perceived liability can be converted to an asset.

Celebrate Green Infrastructure

When Northampton invests in new green infrastructure the community can either choose to hide these improvements, placing them out of sight, or these improvements can be thoughtfully designed and celebrated as community assets. Engaging the community to identify what makes Northampton special can help provide additional depth and resonance to improvements that will need to be made anyway.

Go To Zero

Northampton has already made great strides in reducing the communities reliance on large scale infrastructure outside of the community by focusing on energy and water conservation and creating an institutional microgrid to provide power for critical services when the primary electric grid fails. Continually moving closer and closer to a net zero impact community (net zero water, net zero electric, and ideally net zero waste) will create a more and more resilient community that will become less and less reliant on outside support in the face of increasingly intense storms predicted by climatologists. Northampton will be able to stand alone, as a community, when circumstances require it.

Those Who Cannot Remember the Past are Condemned to Repeat It

It is important that Northampton not suffer a collective amnesia regarding the devastating floods that regularly ravaged the city up until the dike was constructed. Plans to revitalize the Mill River should be tempered with the memory of why the current flood protection measures were constructed well over a half century ago. Learn from the past to make a better future.

Long Life, Loose Fit

The future is inherently uncertain, but we do know that change is inevitable. Therefore, it is critical that future flexibility is built into projects. One of the key reasons that Northampton has continued to grow and thrive is that it has been able to adapt to changing times. The older structures in town have proven to be particularly adaptable, able to support functions and needs that were inconceivable a century ago. It is imperative that new projects are not so specifically programmed that they cannot change and adapt over time, so that today's new structures can evolve and change, as Northampton's historic structures have, to meet the evolving needs of the community.

Double Duty/Triple Duty/Infinite Duty

Another key tenant of sustainability is that things should serve multiple purposes, rather than a single, occasional purpose. Several of the ideas our team came up with

reinforce this fact – rather than a big concrete pipe buried in the ground, why not design a storm water system that supports street life and trees and then can become a wonderful linear park along the course of the (now diverted) Mill River? How about redesigning the floodwall and floodgates to become a bike trail and sculptural gateway signaling entrance into the city of Northampton? The opportunities are endless, once one starts thinking in this fashion. Northampton's ability to take advantage of these opportunities is limited only by the depth and breadth of your vision and imagination.

Team Roster & Thanks

TEAM ROSTER

Tom Liebel, FAIA, NCARB, LEED Fellow, Team Leader

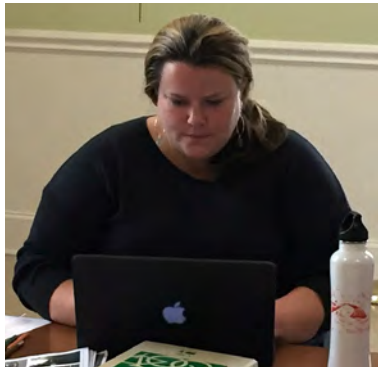
As one of the first 25 LEED Accredited Professionals in the country, Tom Liebel, FAIA, LEED Fellow has been involved in integrating sustainable design principles into a variety of ground-breaking adaptive use and historic preservation projects over the past twenty years. Projects Tom has worked on have received multiple local, state and national awards for design, smart growth, sustainable design and historic preservation. Author, critic and mentor, Tom has consulted on green projects nationally and internationally and has recently authored a chapter on sustainable design for the National Trust for Historic Preservation's Main Street Program publication, Revitalizing Main Street: A Practitioner's Guide to Comprehensive Commercial District Revitalization, as well as Industrial Baltimore, an illustrated history of Baltimore's industrial legacy. Tom currently serves as chair of Baltimore City's Commission on Historical and Architectural Preservation (CHAP) and previously was chair of the Maryland Green Building Council.

Steve Benz, PE, Hon. ASLA, LEED Fellow

Steve Benz is founder of SITEGreen Solutions and former Partner at OLIN, a landscape planning and design studio. In his role as Strategic Consultant for green infrastructure, he helps landscape architects and civil engineers develop sustainable landscape solutions. A licensed civil engineer, Steve has contributed to several award winning green infrastructure design commissions including the LEED® Platinum-certified Kroon Hall at Yale University in New Haven, Connecticut and the Massachusetts Institute of Technology Ray and Maria Stata Center in Cambridge, Massachusetts. More recently, Steve drove many of the environmental strategies for Washington Canal Park, a 3-star certified pilot project for the Sustainable Sites Initiative (SITES™).

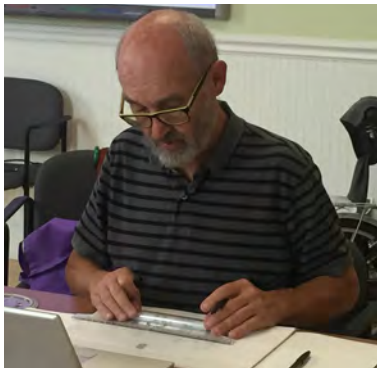
Steve recently co-led two competitions with other OLIN partners exploring ways to approach implementing scalable green infrastructure strategies within urban environments. OLIN's winning entries in both the Infill Soak it Up! Design Competition and the Living City Design Competition demonstrated targeted, achievable solutions that show how various stakeholders can come together to realize change–developers, city governments utility companies, designers and residents alike.

Steve was recently named an honorary member of the American Society of Landscape Architects and a LEED Fellow by the U.S. Green Building Council in recognition of his contribution to the understanding and practice of performative landscapes. He is past Chair of the U.S. Green Building Council (USGBC) Sustainable Sites Technical Advisory Group (TAG) where he led the development of site sustainability criteria within the LEED program. He was also two-term and founding Chair of the Massachusetts Chapter of the USGBC, and currently serves on the Sustainable Sites Initiative's Technical Core Committees.



Rachel Gregg, MMA

Rachel Gregg manages EcoAdapt's State of Adaptation Program and serves as the Content Editor for the Climate Adaptation Knowledge Exchange (CAKE); her primary responsibilities include finding and developing examples of climate change adaptation, building a network of individuals and organizations engaged or interested in adaptation, developing guidance to support decision making and management in a changing climate, and conducting outreach to advance the field. In addition, she provides support to the Awareness to Action and Adaptation Consultation programs. She is an environmental specialist with experience in the application of natural and social science and policy. She has a background in ecology, marine biology, oceanography, and natural resources law, policy, and management. Her education and work experiences have been primarily focused on management strategies for natural and human influences, including water quality degradation, coastal hazards, environmental justice, and climate change. Prior to joining EcoAdapt in 2009, Rachel worked with the University of Washington, Washington Sea Grant, the National Park Service, and the San Juan County Marine Resources Committee. Her previous work includes examining nearshore processes and functions in Washington State, co-writing a guidance document to assist coastal counties in implementing shoreline management policies, investigating the environmental implications and economic viability of the coastal recreation and tourism industry in Washington State, examining the status of coastal water resources in Olympic National Park and Lewis and Clark National Historical Park, and analyzing projected and actual threats to the marine and coastal environment of the San Juan Archipelago. She earned her undergraduate degree from Smith College in Government and Marine Science, and a Master's in interdisciplinary marine science and policy from the University of Washington. Rachel lives in Seattle and enjoys traveling, painting, camping, the All Blacks, and Liverpool FC.



Thomas Laging, FAIA, NCARB

Professor Laging has recently served as the director of the Architecture Program at the University of Nebraska and as the Killinger Distinguished Professor of Urban Design and Architecture. His teaching specialties include urban design and architectural representation. He has taught or been an invited critic at numerous universities–– including the Isthmus School in Panama in 2013 and Tianjin University in 2008. He was a Fullbright Scholar at Simon Bolivar University in Caracus.

As a skilled environmental visualizer Professor Laging has informed his teaching though an urban design consulting practice. He has been involved with numerous mixed-use urban retail projects, town center planning developments and campus-planning efforts. Laging was the 2013 Chairman of Nebraska State Board of Engineers and Architects where he has served for over twelve years and was a member of the NCARB education committee. He is a charter member of the Nebraska Capitol Environs Commission a member the Centennial Mall design team. He was elevated to fellow in the AIA for his service to communities. He holds a Masters Degree from The Harvard Graduate School of Design.

Anders Rydaker

Anders Rydaker is the executive vice president of Sustainable Energy Solutions for Ever-Green Energy. He served as president and CEO of District Energy St. Paul and its affiliate companies from 1993 to August 1, 2010. A native of Sweden, he spent more than 15 years holding numerous management positions at the Uppsala power and district energy utility. He also introduced district cooling to the Swedish market in 1990 and successfully developed the innovative cooling system for Stockholm, Sweden, using deep lake water cooling. Rydaker's commitment to renewable energy resulted in the development of the biomass-fired combined heat and power plant that became operational in 2003. He has authored numerous papers and is an active member and former Chair of the International District Energy Association, as well as IDEA's 2007 Norman R. Taylor Award recipient. Under his leadership, District Energy St. Paul was awarded the IDEA System of the Year Award in 1993 and 2010. In his new role at Ever-Green Energy, his efforts are focused on cultivating the company's growing list of business opportunities, including emerging technologies, and mentoring the next generation of energy leaders.

Judy Shaw, Ph.D., PP/AICP

Dr. Shaw conducts research related to various aspects of regional environmental planning, including her most recent work with FEMA and flood mitigation in the Raritan Valley. She recently published her first book, The Raritan River: Our Landscape Our Legacy, with the Rutgers University Press, which covers the region focusing on active organizations and opportunities to restore and protect the region's natural resources. Since she joined the University in 2008, she has worked on a wide variety of research projects including brownfield redevelopment (Building Capacity for Brownfields Redevelopment in Community-Based Organizations and Measuring Brownfield Success in New Jersey: How Data Increases Our Competitive Edge). She managed the New Jersey Guide to Green Building project for the Rutgers Center for Green Building, and has worked on multiple projects with the Center for Transportation Safety, Security and Risk. She has also worked on lead poisoning prevention through the Center's Healthy Homes project with the NJ Department of Health. Dr. Shaw joined the Center after a career in public service with the New Jersey Department of Environmental Protection and the Department of Community Affairs. While there she rose from her role as a researcher in risk communication, urban environmental planning and public participation to become the Department's Urban Coordinator and later Administrator of the newly formed Office of Brownfield Reuse, which she oversaw for two years. She also served as Deputy Director of the Office of Neighborhood Empowerment for the Department of Community Affairs from 1996-1998. Prior to coming to the Bloustein School, she led the Office of Community Relations and chaired the Public Participation in Site Remediation Task Force. A certified planner, Dr. Shaw is active in the New Jersey Chapter of the American Planning Association and serves on the Burlington County Agricultural Development Board. Judy was the recipient of the 2011 Elwood "Woody" Jarmer Award for Environmental Achievement. This award is given to a professional planner, elected official or citizen planner that has demonstrated exceptional creativity in balancing environmental concerns with the realities of real estate development.

AIA STAFF

Joel Mills- Senior Director, Center for Communities by Design

Joel Mills is Director of the American Institute for Architects' Center for Communities by Design. The Center is a leading provider of pro bono technical assistance and participatory planning for community sustainability. Its processes have been modeled successfully in the United States and across Europe. The Center has been the recipient of a numerous awards recognizing its impact. In 2010, the Center was named Organization of the Year by the International Association for Public Participation (IAP2) for its impact on communities and contributions to the field. In 2013, the

Center received a Power of A Award from the Center for Association Leadership, and a Facilitation Impact Award, given by the International Association of Facilitators.

Joel's 22-year career has been focused on strengthening civic capacity and civic institutions around the world. This work has helped millions of people participate in democratic processes, visioning efforts, and community planning initiatives. In the United States, Joel has worked with over 100 communities, leading participatory initiatives and collaborative processes that have facilitated community-generated strategies on a host of issues.

Erin Simmons - Senior Director, Design Assistance

Erin Simmons is the Director of Design Assistance at the Center for Communities by Design at the American Institute of Architects in Washington, DC. Her primary role at the AIA is to provide process expertise, facilitation and support for the Center's Sustainable Design Assistance Team (SDAT) and Regional and Urban Design Assistance Team (R/UDAT) programs. In this capacity, she works with AIA components, members, partner organizations and community members to provide technical design assistance to communities across the country. Through its design assistance programs, the AIA has worked in over 250 communities across 47 states. In 2010, the Center was named Organization of the Year by the International Association for Public Participation (IAP2) for its impact on communities and contributions to the field. In 2013, the Center received a Power of A Award from the Center for Association Leadership, and a Facilitation Impact Award, given by the International Association of Facilitators. In 2015, the Center received the Outstanding Program Award from the Community Development Society.

Erin is a leading practitioner of the design assistance process. Her portfolio includes work in over 100 communities across the United States. A frequent lecturer on the subject of creating livable communities and sustainability, Erin contributed to the recent publication "Assessing Sustainability: A guide for Local Governments". Prior to joining the AIA, Erin worked as historic preservationist and architectural historian for an environmental and engineering firm in Georgia, where she practiced preservation planning, created historic district design guidelines and zoning ordinances, conducted historic resource surveys, and wrote property nominations for the National Register of Historic Places. She holds a Bachelor of Arts degree in History from Florida State University and a Master's degree in Historic Preservation from UGA.

ACKNOWLEDGMENTS

Our SDAT Team would like to thank the community of Northampton for their enthusiastic participation in the SDAT process, as well as their support and hospitality. We would like to specifically thank Mayor David Narkewicz for supporting both the SDAT and the implementation of our team's recommendations – we hadn't even left town before we received notice that the mayor had signed on to the Compact of Mayors, making Northampton the 55th city in the world to commit to reduce greenhouse gas emissions, track progress, and prepare for the impacts of climate change. Many thanks to Wayne Feiden, Northampton's Director of Planning and Sustainability, for leading the efforts to bring the SDAT process to Northampton and coordinating the resources our team needed to make our visits a success. We would also like to thank Northampton for sharing Wayne Feiden with the broader world, as Wayne has participated in over twenty Design Assistance Teams over the past 10 years. And of course we would like to thank the members of the Western Massachusetts Chapter of the American Institute of Architects for volunteering their time and talents in helping the SDAT team develop our findings and produce this report.