



# Town of Lenox

## Environmental Management System



Columbia | SUMA

***Report Provided by:***  
***Sustainability Management Net Impact (SUMA Net Impact)***  
***Columbia University in the City of New York***

***13 April 2018***

**SUMA Net Impact:**  
Megan Ross (Project Manager)  
Abbigael Foster  
Claudene Petricca  
Fernando Ortiz  
Karl Knotoff  
Rodrigo Castro  
Shiyi Zheng  
Shruti Deshpande



## TABLE OF CONTENTS

<b>FOREWORD</b>	<b>Page 01</b>
<b>INTRODUCTION</b>	<b>Page 03</b>
Sustainability Concepts in Lenox's Long-term Planning	Page 03
Lenox's Environmental Values	Page 04
How to Read this Document	Page 04
<b>SUSTAINABILITY PLANNING</b>	<b>Page 06</b>
Purpose and Outcome of Long-term Sustainability Planning	Page 06
Methodology	Page 06
Roles and Responsibilities of Sustainability Office	Page 07
Stakeholder Identification and Engagement	Page 08
<b>KEY AREAS</b>	<b>Page 10</b>
Climate Change	Page 10
Climate Change Mitigation	Page 10
Climate Change Resilience	Page 14
Utilities Management	Page 17
Wastewater Treatment	Page 17
Water Supply & Management	Page 20
Land Management	Page 22
Housing Development	Page 22
Trail Networks	Page 24
<b>SUSTAINABILITY NEXT STEPS</b>	<b>Page 27</b>
Replication & Scalability	Page 27
Additional Resources	Page 27
<b>CONCLUSION</b>	<b>Page 29</b>
<b>APPENDIX I - GHG INVENTORY FOR THE WATER SUPPLY PLANT</b>	



## I. FOREWORD

As the Town of Lenox prepares to update its Master Plan in 2018, town representatives have expressed an interest in incorporating values of sustainability into the official planning documents. At this time, Lenox does not have a defined process by which to consider environmental, equitable, or economic sustainability in its long-term planning, but its representatives have expressed an intent to protect the town's natural beauty and cultural heritage while furthering its economic opportunities and quality of life for its residents. Town representatives have demonstrated a readiness and intention to explore and implement sustainability-focused initiatives, and they enlisted assistance in their preparations to do so.

Toward that end, this report and its accompanying materials were prepared for the Town of Lenox, Massachusetts, by representatives of SUMA Net Impact, a consulting group of graduate students at Columbia University in the City of New York. SUMA Net Impact is a student chapter of Net Impact administered under the Sustainability Management graduate program at Columbia University, offering pro bono sustainability consulting services for a fixed scope and time period. SUMA Net Impact representatives conducted a site visit to the Town of Lenox and heard comments from representatives of the Town Planner's office, the Planning Board, the Department of Public Works, and the Environmental Committee. The site visit also oriented the SUMA Net Impact team to Lenox's key attractions and public services.

Deliverables within this package include:

- **Environmental Management System Presentation:** This PDF slideshow provides a high-level look at sustainability planning practices recommended for the Town of Lenox as well as an overview of targets and metrics for key areas of focus.
- **Environmental Management System Report:** This PDF document is a technical report offering detailed recommendations for sustainability planning. Three key areas of long-term planning are assessed from a viewpoint of sustainability, with identified objectives, strategies, targets, and metrics for program implementation.
- **Metrics Dashboard:** This Microsoft Excel spreadsheet is a resource for recording and tracking data for the recommended metrics described in the Environmental Management System.
- **GHG Inventory:** This Microsoft Excel spreadsheet is a template for calculating greenhouse gas emissions according to an established methodology described in the Environmental Management System.



Sustainability planning for the long-term is an important responsibility that will benefit the Town of Lenox for generations to come. The Environmental Management System will enable the planning department and other representatives to consider economic, social, and environmental values when developing any program for the town management and governance.

As an example of in-depth, sustainability-focused planning, this report will examine Lenox's sustainability opportunities of these three areas:

1. Climate change mitigation and resilience
2. Utilities management, regarding wastewater treatment and water management
3. Land management, regarding housing and trail networks.

SUMA Net Impact is pleased to have served the Town of Lenox in the development of these materials for sustainability planning. We hope the town and its residents are empowered and encouraged by the vision that its representatives shared with us: that Lenox is a place with deep roots and rich history, inspired to lead the region into a sustainable future.



## **II. INTRODUCTION**

### **Sustainability Concepts in Lenox's Long-term Planning**

The Town of Lenox is a vibrant community surrounded by a beautiful natural environment, and sustaining its core values throughout its future growth will honor its rich history and legacy. Town planning that incorporates sustainability strategies will enable the town to meet its present needs without compromising its future generations' ability to meet their own needs. Lenox can sustain its community for the long term by focusing on the environmental quality and health of the region, the equity of its citizens, and the economic development and opportunities of the town.

As the Town of Lenox prepares to revise its Master Plan in 2018, including sustainability perspectives in the development of the Master Plan will provide opportunities for integration of priorities across economic, social, and environmental objectives. Envisioning a sustainable future should include specific, achievable targets in a short- to medium-term timeline (approx. 5-10 years) and defining broader targets for a long-term timeline (approx. 10+ years). This process of visioning and goal-setting can be applied to any town planning activities, whether intra-departmental or across departments.

Sustainability initiatives and plans can span many categories, and it may be helpful to conceptualize these within existing categories used in the town's master plan: economic and business development, transportation, housing, energy use, land management, etc.

During conversations with representatives of the Town of Lenox, three key areas arose as especially important for the town's current circumstance. This report will take a close look at Lenox's sustainability opportunities of these three areas, and two aspects of each area:

1. Climate Change
  - a. Mitigation
  - b. Resilience
2. Utilities Management
  - a. Wastewater Treatment
  - b. Water Supply and Management
3. Land Management
  - a. Housing Development
  - b. Trail Networks



## Lenox's Environmental Values

During an interactive workshop with representatives of the Town of Lenox and SUMA Net Impact, town leaders expressed broad and specific values for environmental sustainability. The resulting Environmental Value Statement defines the overarching values of the Town of Lenox and is intended to guide sustainable development and implementation of its planning initiatives.

*The Town of Lenox is committed to upholding its environmental quality by:*

- 1. Preserving and restoring the natural beauty & historic character of the region,*
- 2. Ensuring the long-term resilience of the community and land, and*
- 3. Sustaining quality of life and opportunities for future generations.*

## How to Read this Document

This document serves as an Environmental Management System (EMS): a framework by which the Town of Lenox can envision town planning through the lens of sustainability, considering its growth strategies and town management practices with the long-term in mind. This is intended to be a living document which can be used as a tool when interpreting a variety of different situations that the town may face.

Sustainability Planning describes strategies for incorporating a long-term sustainability vision into the development of any town planning documents or into day-to-day management activities. These strategies are based in planning methodology, human resource responsibilities, and stakeholder outreach.

Three Key Areas of sustainability initiatives, as they relate to the Town of Lenox's master plan, are examined as examples of how sustainability planning can be enacted. Using these key areas as guides, Lenox can repeat the process demonstrated in this EMS to extend sustainable practices to any issue or planning category.

To examine each Key Area, we define Objectives to describe what the town is trying to achieve, from a broad perspective.

Subsections of each Key Area refer to Boundaries, which describe the extents and limitations of the EMS discussion of the subsection issues, and Methodologies of Assessment, which describe which data or practices were used to create the assessment in this EMS. From that assessment, the following recommendations are offered:



- Strategies identify overarching approaches to achieving the defined objectives.
- Targets identify specific recommendations that align with strategies to achieve goals. These are typically quantitative and determined by particular timelines:
  - Short-term targets are recommended to achieve by 2020: initial assessments, developing baseline data, and creating systems.
  - Medium-term targets are recommended to achieve by 2030: program development and implementation.
  - Long-term targets are recommended to achieve by 2040: higher-intensity goals or ideas to consider depending on new growth.
- Metrics are used to track progress toward the target(s). Monitored at regular intervals, metrics can indicate the pace and direction of how the town is trending in relation to its goals and can quantify overall change in comparison with an initial baseline. Metrics should be relevant, meaningful, objective, consistent, and actionable.



### **III. SUSTAINABILITY PLANNING**

#### **Purpose and Outcome of Long-term Sustainability Planning**

The world's changing climate is affecting every corner of the globe, and communities are facing changing weather patterns, environmental risks, resource scarcity, and other challenges. Long-term sustainability planning will enable Lenox to take action to mitigate its contributions to global warming and to adapt to the regional effects of climate change. By doing so, Lenox can establish its commitment to grow responsibly and conscientiously with respect to the environment and the residents of the town. By prioritizing resilience in its growth initiatives, the town can respond to changing conditions without compromising its services or quality of life, and the economy of the region can retain stability.

Lenox has enduring appeal, but its population is aging, and many residents are seasonal or otherwise impermanent. Strategic planning with sustainability in mind can improve Lenox's ability to remain competitive with other communities in the region and to attract residents that will contribute to the economy and stability of the town. Adopting sustainable practices that contribute to cleaner air, more access to open spaces, and a more integrated community will improve Lenox's ability to serve its residents with a stronger quality of life.

#### **Methodology**

Planning for sustainability should begin with an assessment of the strengths and weaknesses of the town as well as the risks and opportunities it is likely to face in the context of planning. Looking to the example of similar towns and communities may help to identify best practices, but assessing the unique needs of the Town of Lenox will be the best indicator of the actions that Lenox is best suited to take. When assessing the town's key aspects from a long-term sustainability perspective, it will be important to include:

- Population and demographic trends
- Local economic development
- Growth opportunities and constraints
- Community values





The town's goal should be to enhance any positive opportunities and to reduce or avoid any potential risks presented by future changes to the region. Identifying synergies between different systems is an important part of identifying risks and opportunities; for example, addressing emissions reductions from town-owned vehicles may improve air quality and also save money for the town in the long-term due to reduced fuel costs. In determining initiatives for improvement, the town should consider which impacts are the most serious to address and which initiatives are likely to have the greatest mitigation influence against those impacts. Lenox must also ensure that any actions comply with or exceed the regulatory requirements of governing bodies to which the town is subject.

The "Plan-Do-Check-Act" model offers a structured way to integrate environment-related and sustainability-related perspectives into everyday operations or specific achievement plans.

- The Plan phase involves identifying and analyzing impacts of organizational actions. During this phase, it's important to consider the legal constraints or compliance requirements related to proposed actions and to set meaningful and realistic goals.
- The Do phase involves implementing programs and processes to achieve objectives defined during the Plan phase. Training employees to adjust to new protocols and establishing operational controls are important aspects of this phase.
- The Check phase involves monitoring progress toward objectives using relevant metrics. Monitoring can be achieved by performing internal audits, benchmarking, and taking corrective actions as needed.
- The Act phase involves reviewing achievements and improving the planning process for the next project phase. Conducting management reviews and implementing lessons learned are effective methods for improving future actions.

## **Roles and Responsibilities of Sustainability Office**

The utilization of human capital is an important strategy for institutionalizing sustainability planning. Sustainability planning should become integrated into every town department and office, but for this to become standard, leadership is critical. The importance and integrative nature of sustainability should be understood and valued by those at the management level and should be accessible to those at all levels.

Including a Sustainability Officer within the town workforce is a simple way to ensure that sustainability concepts are prioritized during day-to-day operations and are extended through medium- and long-term programming. Some towns or municipalities have found it useful to establish this position in a department that is ratepayer-supported rather than taxpayer-supported, because it protects the position from fluctuating impacts of budget cuts. For



example, this method might steer the position into a utilities or energy management department. This departmental alignment would be an excellent platform from which to address energy-related sustainability initiatives, which typically have a significant impact on climate change mitigation and adaptation efforts.

Regardless of where the position is housed, or whether it is a full-time unique position or attributed as a portion of another position's responsibilities, the Sustainability Officer should focus on tasks including, but not limited to:

- Assessing risks and opportunities from climate change and other regional changes
- Collaborating across departments and agencies to integrate sustainability strategies and identify synergies between initiatives
- Developing and implementing projects to achieve sustainability objectives
- Collecting data on a consistent basis to support progress monitoring using established metrics
- Reporting on programs and projects to determine lessons learned.

## **Stakeholder Identification & Engagement**

The objective of identifying stakeholders is essentially to evaluate and include benefits that maximize the shared value created for the community. Depending on the economic role of various stakeholders in the community, this report broadly classifies them as permanent residents, seasonal residents, business owners, visitors, government organizations, regulatory and compliance organizations, and community partners such as the nearby towns of Lee and Pittsfield.

While both the seasonal and permanent residents benefit from preserving the environmental and cultural heritage of the town, the permanent residents have a higher involvement in the town's economic interests, and many of them are also business owners. Business owners include large institutions as well as small locally-owned businesses. There exists a symbiotic relationship between the small and large businesses, as the former serve the living needs of the tourists that are drawn by the latter recreational avenues.

The role of governmental organizations is all-encompassing, to preserve the cultural and environmental heritage of the town and to ensure that resources and planning issues that are critical to local residents and businesses, such as the availability of water and in instances to provide funding or grants for the planning processes, are effectively addressed. In addition, the community also needs to actively engage with regulatory and compliance authorities as well as with the neighboring towns of Pittsfield and Lee to ensure higher collaboration on jointly owned



and managed resources. All stakeholders should be actively engaged in planning to ensure a balanced plan that is comprehensive and workable. The first step would be to identify all stakeholders using a simple stakeholder analysis framework.<sup>1</sup>

Once stakeholders have been identified, regular outreach programs need to be conducted to address and to bring together all stakeholders to holistically address the concerns of the community. A suggested approach is to use formats that are informal, such as “open house” events, to record a cross-section of public opinion. During discussions with representatives of Lenox, it was determined that typical “town hall forum” events do not always reach all stakeholders. Providing childcare options at community outreach events, holding events at different times of the day or week, and providing real-time or any-time internet-based feedback platforms would be methods that could increase the accessibility of stakeholders and improve the participation rate.

The desired fallout of these outreach programs is the identification of cooperative and competing interests that can be addressed to avoid areas of conflict and to ensure that all stakeholders are benefited equitably.

Other educational and research entities, such as the University of Massachusetts Amherst Climate Research Center, could be considered stakeholders or partners if they are engaged as resources for climate change risk identification and mitigation. Large institutions may be willing to develop a relationship that is mutually beneficial for data collection and research.

---

<sup>1</sup> As an example: “Upgrading Urban Communities: A Framework.” World Bank Group. 2001. Link: <http://web.mit.edu/urbanupgrading/upgrading/issues-tools/tools/Ident-stakeholders.html> Accessed 9 April 2018.



## IV. KEY AREAS

### Climate Change

Cities and towns face a growing range of adversities and challenges in the 21st century, particularly the effects of climate change. Resilience is what helps cities and towns adapt and transform in the face of these challenges, helping them to prepare for both the expected and the unexpected.

Building resilience requires looking at Lenox holistically: understanding the systems, interdependencies, and risk factors that affect the town. By strengthening the underlying fabric of the town and better understanding the potential shocks and stresses it may face, it can improve its development trajectory and the well-being of its citizens.

The Commonwealth of Massachusetts is committed to doing its part to mitigate and adapt to climate change, recognizing the necessity of engaging in adaptation planning today and taking a close look at strategies that could help Massachusetts become more resilient and adaptive.<sup>2</sup>

#### Objectives

- Reduce the town's contributions to climate change.
- Increase the town's capacity to respond and adapt to a variety of chronic stresses and acute shocks.

### Climate Change Mitigation

Extensive discussions with representatives of the Town of Lenox indicate that the town wants to contribute positively to global climate change mitigation efforts and be able to demonstrate climate leadership. A key way to demonstrate leadership is by supporting the mitigation goal of

---

<sup>2</sup> Commonwealth of Massachusetts. "Climate Change in Massachusetts and Its Impacts." 2018. Link: <https://www.mass.gov/service-details/climate-change-in-massachusetts-and-its-impacts>. Accessed 25 March 2018.



the Commonwealth of Massachusetts, committing to reduce greenhouse gas (GHG) emissions to 80% below 1990 levels by 2050.<sup>3</sup>

Currently, the Town of Lenox does not have a GHG emissions baseline from which to set a reduction target. Similarly, a solar array installed by the town is coming online soon, and no assessment related to GHG emissions reductions exists.

However, a basic GHG emissions inventory for the water supply plant was made for this report as an example that can be replicated to scale up the GHG inventory. The emissions calculation tool can be adapted to the town's needs.

The emissions accounting process follows the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC),<sup>4</sup> which is the most widely-used framework by cities and towns. This framework serves as a methodology for understanding and assessing the impacts of emissions within the Town of Lenox and for identifying areas for improvement.

The GPC includes tools to develop a comprehensive and robust GHG inventory, which will help to provide a baseline, identify opportunities for improvement, and support climate action planning in the coming years. This will enable Lenox to align its climate change mitigation efforts with the state's standards, set a target that supports the state's goal, and pursue a pathway towards carbon neutrality.

## Boundaries

The boundary for the limited GHG emissions inventory aligns with the geographical perimeter of the water supply plant. The time period assessed was from January through December 2017, and the assessment included all GHG<sup>5</sup> required by the GPC.

The boundary for future emissions inventories should include all properties owned and operated by the Town of Lenox, including stationary energy, transportation, and waste sectors. Inventories should be assessed annually and should include all required GHG.

---

<sup>3</sup> Commonwealth of Massachusetts. "Global Warming Solutions Act Background." 2018. Site: <https://www.mass.gov/service-details/global-warming-solutions-act-background>. Accessed 11 April 2018.

<sup>4</sup> World Resources Institute, C40 Cities Climate Leadership Group, and Local Governments for Sustainability (ICLEI). "Global Protocol for Community-Scale Greenhouse Gas Emission Inventories." 2014. Link: <http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>. Accessed 25 March 2018.

<sup>5</sup> Please refer to Appendix I for information regarding the GHG required for accounting.



## Methodology of Assessment

### *GHG Emissions Sources*

According to the GPC, GHG emissions from the water supply plant were categorized based on sector and scope. This assessment was made following the BASIC reporting level, which is suggested for cities and towns starting a new GHG inventory, and which covers Scopes 1 and 2 emissions from stationary energy and transportation sectors, as well as Scopes 1 and 3 emissions from the waste sector.<sup>6</sup>

- **Scope 1:** GHG emissions from sources located within the town boundary.
- **Scope 2:** GHG emissions as a result of grid-supplied electricity, heat, steam, and/or cooling within the town boundary.
- **Scope 3:** All other GHG emissions that occur outside the town boundary as a result of activities taking place within the town boundary.

### *Data Quality and Quantifications*

The water supply plant identified the following activity data that was used to calculate GHG emissions:

**Table 1: Activity data from the water supply plant**

Sector	Scope
Stationary Energy	
Commercial and institutional buildings and facilities	
Fuel combustion - amount paid in \$USD for fuel, by type	1
Grid supplied energy - electricity consumed in kWh for entire period	2
Transportation	
Fuel combustion - miles traveled by vehicle type	1
Waste	
Disposal of solid waste generated within the boundary - amount in weight by waste type and disposal type	3

---

<sup>6</sup> A brief description of the sectors and subsectors, as well as the scopes they fit within, is provided in Appendix I.



The calculation of GHG emissions is explained in Appendix I.

## Strategies

- ***Establish a process for information collection and monitoring***

Activity data should be collected and monitored on a regular basis (i.e. monthly) by establishing a process that allows for the centralization of information. This process should be implemented with the consideration of information management processes that are already established, so it could be built upon those existing processes.

- ***Identify “low-hanging fruit”***

The main sources of emissions will provide an understanding of the potential opportunities for action, but they may not be cost-effective to implement. Therefore, every measure suggested to reduce GHG emissions should not only account for its mitigation potential, but also its cost-effectiveness. This will allow a better selection of measures, aiming at those with low-cost and high-mitigation potential.

- ***Identify synergies with other programs***

At the local, state, and federal government levels, there could be synergies that would either enhance the opportunities for reducing emissions or that would hinder the ability to do so. Identifying such relationships will facilitate the management of actions with the potential to reduce GHG emissions as well as the provision of resources for such actions.

## Targets

### *Short-Term: 2018-2020*

- Develop a comprehensive GHG inventory process for all town-owned GHG sources using the GPC BASIC reporting level.
- Establish a GHG emissions baseline aligned with the Massachusetts Global Warming Solutions Act (1990).

### *Medium-Term: 2020-2030*

- Commit to a town carbon reduction goal that is aligned with the state goal.
- Form a climate action commission consisting of business and civic leaders to develop shared strategies from diverse and comprehensive viewpoints.
- Develop a climate action plan.

### *Long-Term: 2030-2040*

- Track and report publicly on performance against the emissions reduction target.



## Progress Monitoring

All emissions should be estimated consistently over time, which means that to the greatest extent possible, the series should be calculated using the same methods, data sources, and boundary definitions in all years.<sup>7</sup>

## Metrics

- Annual town-wide GHG emissions, total;
- Annual town-wide GHG emissions, per sector (stationary, transport, and waste), absolute and as a percentage of total GHG emissions

## Next Steps

- Review data used to calculate the GHG inventory for the water treatment plant.
- Define and categorize all GHG from town-owned sources.
- Identify the necessary data required for GHG calculations.
- Develop a process to collect data and calculate the GHG inventory.
- Adapt the calculation tool to data availability.

## Climate Change Resilience

The Commonwealth of Massachusetts' state agencies and authorities, as well as its cities and towns, must prepare for the impacts of climate change by assessing vulnerability and adopting strategies to increase the adaptive capacity and resilience of infrastructure and other assets. In this sense, the Town of Lenox has expressed a desire to enhance its resilience and its ability to mitigate potential damages from relevant climate hazards.

The Berkshire Regional Planning Commission (BRPC) categorized the Town of Lenox's hazards into three levels of risk:

1. HIGH risk of flooding, winter storms (blizzards, snow, ice storms), and severe storms (thunderstorm, wind, hail, lightning);
2. MODERATE risk of dam failure, tornadoes, hurricanes and tropical storms, extreme temperatures, drought, and wildfire; and
3. LOW risk of landslide, earthquakes, and ice jams.

Representatives of Lenox have also noted that food security, invasive species, and water supply are issues of concern.

---

<sup>7</sup> Appendix I provides recommendations to develop a robust GHG inventory process.





The Commonwealth of Massachusetts is developing a statewide Climate Adaptation Plan. If the Town of Lenox were to be proactively involved in the development of the statewide adaptation strategy, this participation would enable the town to communicate its interests at the state level. The involvement would also enhance the town's ability to develop a robust climate action plan of its own to protect life, property, natural resources, and the economy from climate change impacts and extreme events.

Being aware of regional climate trends will enable the town to recognize large-scale shifts over time that could have an impact (whether social, economic, or environmental). Monitoring precipitation amount and frequency can assist the town in recognizing and predicting the occurrence of floods and droughts. Measuring days of extreme heat can help indicate rising temperature trends, but they are also an indicator of public health risk exposure.

## Boundaries

The assessment is based on risks relevant within the geographic perimeter of the Town of Lenox.

## Methodology of Assessment

The multijurisdictional hazard mitigation plan developed by the BRPC was considered in this assessment. This was complemented by a visit to the Town of Lenox that provided an understanding of the town's unique situation and needs, as well as by research of the Commonwealth of Massachusetts progress on climate change adaptation.

## Strategies

- Coordinate with state and federal partners on climate adaptation and resilience programs.
- Develop capacities in the tools provided by the Executive Office of Energy and Environmental Affairs.<sup>8</sup>
- Be actively involved in the development of the Commonwealth of Massachusetts State Hazard Mitigation and Climate Adaptation Plan.
- Incorporate climate resilience in design, engineering, construction, and maintenance standards.

---

<sup>8</sup> Commonwealth of Massachusetts. "Climate Change." 2018. Link: <http://www.mass.gov/eea/air-water-climate-change/climate-change/>. Accessed 24 March 2018.



## Targets

### *Short-Term: 2018-2020*

- Review and provide inputs to the Draft 2 version of the natural hazard and climate change risk assessment developed by the Commonwealth of Massachusetts before April 20, 2018.<sup>9</sup>
- Request technical assistance from the Executive Office of Energy and Environmental Affairs to complete vulnerability assessments.
- Develop a monitoring process of key climate parameters, like precipitation and temperature.
- Assess the cost-effectiveness of the required infrastructure to reduce flood risk.

### *Medium-Term: 2020-2030*

- Use the Municipal Vulnerability Preparedness grant program (MVP)<sup>10</sup> to begin the process of planning for climate change resilience and implementing priority projects.
- Develop capacities to use the Massachusetts Climate Change Clearinghouse (CCC), to plan and prepare for climate change impacts.
- Ensure that emergency response systems are in place for all typical and climate-related hazards.

### *Long-Term: 2030-2040*

- Reassess climate risks and natural hazards that threaten the Town of Lenox and develop resilience strategies based on updated findings.

## Progress Monitoring

Lenox will need to prioritize the measurement of the identified impacts guided by the following questions:

- What impacts can be measured now, based on best available data?
- How can gaps in data and research be filled?
- What methods can be employed to improve the measurement of future impacts?

## Metrics

- Monthly amount of precipitation, in inches
- Monthly frequency of precipitation (greater than or equal to 0.01 inches), in days
- Monthly number of extreme heat days (greater than or equal to 90°F)
- Exposure to flood risk

---

<sup>9</sup> Commonwealth of Massachusetts. "Massachusetts State Hazard Mitigation and Climate Adaptation Plan - Updates." 2018. Link: <https://resilientma.com/updates/>. Accessed 24 March 2018.

<sup>10</sup> Commonwealth of Massachusetts. "Municipal Vulnerability Preparedness Program." 2018. Link: <https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program>. Accessed 24 March 2018.



- per area (in acres),
- per residents affected (by individuals and by households), and
- per type of infrastructure (monetized)

## Next Steps

- Use data from the Pittsfield, MA, weather station<sup>11</sup> to start monitoring precipitation and temperature.
- Evaluate the cost-effectiveness of developing systems for water recovery from precipitation.
- Assess infrastructure options to reduce potential flooding: i.e. detention basin (underground as a tank to store water; above ground as a park, can be a green open space for recreation during the days without flooding), river flood defenses, green infrastructure (plant vegetation, terracing hillsides, construct floodways).
- Evaluate access to the Municipal Vulnerability Preparedness grant program.

## Utilities Management

The supply of fresh and clean potable water to the Town of Lenox and the safe and effective treatment of its wastewater is vital to ensuring that Lenox's quality of life is sustained, its natural beauty is preserved, and the long-term resilience of its community is supported.

### Objectives

- Reduce and/or repurpose the operational process waste byproducts
- Ensure operational capacity is sufficient to meet demand now and in the future
- Increase operational efficiency to reduce overall environmental impact

## Wastewater Treatment

Drinking water and wastewater treatment plants are the largest energy consumers in many towns and cities, often accounting for 30-40% of total energy consumed by the municipality. A large portion of the facilities' operating costs goes toward energy bills, making it vital to find ways to reduce costs.

---

<sup>11</sup> National Weather Service: Albany Weather Forecast Office. "Observed Weather Reports." 2014. Link: <http://w2.weather.gov/climate/index.php?wfo=aly>. Accessed 24 March 2018.



Lenox wants its utility facilities to be self-sufficient and to grow in lockstep with future development, particularly that of the growing tourism industry. The current wastewater treatment plant is suitable for the current population, but the facility is aging. Its upgrade should support potential growth while aligning with or exceeding the projected EPA requirements.

## Boundaries

This assessment covers wastewater generated within the Town of Lenox which is processed by the town's wastewater treatment plant as well as the operations of the treatment plant itself.

## Methodology of Assessment

Information is sourced from wastewater treatment data measured by Lenox's Public Works Wastewater Division, as well as from Synagro of Connecticut which removes biosolid sludge for incineration.

## Strategies

- Turn to innovative, energy-efficient technologies and operational improvements to help reduce costs.
- Eliminate the use of chemical disinfectants in favor of alternative methods that satisfy environmental requirements and customer expectations.
- Repurpose biosolids following processing operations to reduce the amount transported off-site for landfill disposal or incineration.
- Consider using methane generated from anaerobic digestion of biosolids as an energy resource.
- Collaborate with local experts to construct a modern, sustainable wastewater facility which is custom to Lenox's needs and which purifies, beautifies, and educates.

## Targets

### *Short-Term: 2018-2020*

- Current Facility:
  - Determine baseline energy use using third-party energy audits or self-assessments such as that provided by the EPA.<sup>12</sup>
  - Assess possible repurposing uses for biosolids such as on agricultural sites, forestry, reclamation sites (e.g., Superfund and brownfield lands), or park land.
  - Conduct a cost-benefit analysis of implementing UV disinfection and decide on a course of action.

---

<sup>12</sup> U.S. Environmental Protection Agency. "Energy Use Assessments at Water and Wastewater Systems Guide." 2016. Link: <https://www.epa.gov/sites/production/files/2016-01/documents/energy-use-assessments-at-water-and-wastewater-systems-guide.pdf>. Accessed 9 April 2018.



- New Construction:
  - Select an ecological design firm with which to establish collaborative development plans.

#### *Medium-Term: 2020-2030*

- Current Facility:
  - Incorporate energy-efficient practices into wastewater plant operations.
  - Decommission chlorine disinfection and implement UV disinfection (according to results and outcome of cost-benefit analysis).
- New Facility:
  - Analyze any current and projected EPA regulations so the new facility can exceed them.

#### *Long-Term: 2030-2040*

- Current Facility:
  - Replace chemical assistance of wastewater treatment with non-chemical methods.
  - Supply 100% of WWTP energy from renewable sources.
- New Facility:
  - Ensure treated water is of suitable quality to be trickled back into surrounding environment.
  - Initiate a program to distribute reclaimed water for use in sinks, toilets, and showers within facility and as irrigation for agriculture or public lands.
  - Influence and educate neighboring towns on sustainable solutions for wastewater.

## **Progress Monitoring**

Review data collected by Lenox Public Works Wastewater Division such as Lenox WWTP Effluent Data & Lenox WWTP Metals Data.

## **Metrics**

- Energy intensity of the WWTP process (kWh by gallon treated)
- Percent dewatered sludge used for purposes other than disposal, of total sludge produced
- Average daily wastewater flow, per month (in gallons)

## **Next Steps**

- Determine whether a third-party energy audit or self-assessment is preferred.
- Begin research on UV disinfection and other alternative disinfection methods.



- Determine an evaluation process and criteria for selection of an ecological design firm to support construction of the new WWTP facility.

## **Water Supply & Management**

Clean, potable water is vital to the Town of Lenox. An adequate, self-sufficient supply of water ensures quality of life and long-term resilience for the Town of Lenox. Water supply is complicated by the advancing effects of climate change, in which the risk of droughts will become increasingly elevated.

At this time, water is typically purchased from the Town of Pittsfield during usage periods in which Lenox's demand for water exceeds its available supply. The long-term demand of water usage has not been projected. Also, water is chemically treated and its sludge byproduct is thus unsuitable for organic reuse; sludge is removed for landfill disposal.

Ensuring a sufficient water supply entails assessing the future demand for water from residents, tourism, other business interests, and town government. Developing an understanding of which type of end users are the largest consumers of water will help to project which types of town growth will have the strongest impact on water supply and management. Additionally, addressing the chemical use in the water treatment process will further contribute to the town's quality of life and address the impact of the wastes generated during the treatment process.

## **Boundaries**

This report's assessment focuses on operations of the Lenox Water Division, water supplied by the Lenox Water Division, and the end users of supplied water.

## **Methodology of Assessment**

Water use and demand data is sourced from the Lenox Water Division and population and commercial facility information from the Lenox Water Division and the Town of Lenox. Process waste disposal information is sourced from the Lenox Water Division regarding disposal locations and alternative uses.

## **Strategies**

- Address water supply concerns by monitoring consumption habits and attempting to adjust the habits of the largest consumers first.
- Consider increasing the capacity of water storage to increase resilience of supply when demand is high.



- Develop a long-term plan to eliminate chemical treatment of water, enabling the return of water treatment sludge byproduct back to the natural environment.

## Targets

### *Short-Term: 2018-2020*

- Complete an assessment of end user types (residential, tourism, commercial, industrial, town-owned) to determine water consumption habits.
- Complete an assessment to determine non-chemical methods for water treatment.

### *Medium-Term: 2020-2030*

- Implement educational or policy-oriented interventions to reduce the water consumption of the largest user types, based on end user assessment.
- Determine future demand for water based on existing demand and projected growth of town population, tourism, and commercial or industrial development.
- Implement 100% chemical-free water treatment.
- Pursue and implement repurposing of water treatment sludge byproduct instead of sending to landfill.

### *Long-Term: 2030-2040*

- Supply 100% of Town of Lenox water from the Lenox Water Division indefinitely.

## Progress Monitoring

The water and water treatment chemical use data should be reviewed annually.

## Metrics

- Water consumption by end user group (residential, tourism, municipal, commercial, industrial).
- Average daily per-capita demand (in gallons), per month.
- Gallons sourced annually per, source (i.e. Lenox, Pittsfield, or other).

## Next Steps

- Establish a consistent process for tracking and reporting daily, monthly, and cumulative water usage.
- Establish clear guidelines for categorizing end users (residential, tourism, municipal, commercial, industrial).



## Land Management

The land that surrounds and encapsulates the Town of Lenox is an asset to its residents, and the preservation of healthy communities and open spaces is vital to its enduring future.

### Objectives

- Improve the affordability of housing for Lenox residents
- Ensure the accessibility of natural areas to residents and visitors
- Prioritize land resilience in development practices

## Housing Development

Lenox's housing market is currently unaffordable for many people who fall within three critical population segments: aging Lenox residents seeking to downsize their homes, young families interested in living in Lenox, and workforce participants such as public service employees or seasonal workers whose jobs are based in Lenox. Residents who spend more than 30% of their monthly income on housing are considered cost-burdened, and those who spend more than 50% are considered severely cost-burdened.<sup>13</sup> Lenox should consider the cost-burdened metric as a guideline for balancing housing costs with the types of jobs available in Lenox.

A comprehensive Housing Production Plan (HPP) was developed for Lenox in 2017. This plan contains a robust assessment of the town's housing needs as well as several approaches to meet those needs. One important aspect of the HPP is the strategy to address the Chapter 40B requirement for 10% of year-round housing units to be deed restricted affordable housing by establishing 60 new affordable housing units by 2021.<sup>14</sup> Lenox can build on this goal throughout the term of its master plan by reassessing its plan for compliance with the law over the long term.

Considering the HPP through the additional lens of sustainability can address other social and environmental concerns for the Town of Lenox. Green building strategies can help make housing more affordable by reducing the cost of utilities associated with housing and thus allowing households to spend less. Green building strategies benefit residents of all backgrounds and income levels, and they support the resilience of the overall community by reducing resource consumption requirements.

---

<sup>13</sup> U.S. Department of Housing and Urban Development. "Affordable Housing." 2018. Link: [https://www.hud.gov/program\\_offices/comm\\_planning/affordablehousing/](https://www.hud.gov/program_offices/comm_planning/affordablehousing/) Accessed 7 April 2018.

<sup>14</sup> RKG Associates, Inc., & Barrett Planning Group, LLC. "Lenox Housing Production Plan, 2017-2021." 30 June 2017.





## Boundaries

The housing market and needs of residents of Lenox and Lenox Dale are considered in relation to local and state regulations.

## Methodology of Assessment

Discussions with Lenox representatives and residents were complemented by review of demographic data and housing assessments in the HPP.

## Strategies

- Restore and reuse large historical residence and structures for housing development.
- Create temporary homes for seasonal use such as yurts or shipping container homes.
- Create multi-use structures usable for housing in the summer and other purposes in the winter.
- Encourage energy-efficiency, water efficiency and passive house technology in new housing developments to lower energy cost for future residents.
- Use sustainable materials in new housing developments such as recycled materials or non-toxic materials.

## Targets

### *Short-Term: 2018-2020*

- Create a detailed plan for achieving the goal of creating 60 housing units as described in the HPP.
- Pursue federal and state grants for funding of affordable housing production.

### *Medium-Term: 2020-2030*

- Expand the plan for creating 60 new housing units to realign with the 10% affordable housing units requirement of Chapter 40B.
- Explore implementation of temporary and multi-use housing options.
- Update the HPP and include a Green Housing Strategies Plan.

### *Long-Term: 2030-2040*

- Ensure that new housing developments have an annual average of 20% affordable housing units to exceed the requirements of Chapter 40B.



## Progress Monitoring

Data should be collected directly by the Town of Lenox whenever possible using methods those are consistent over time. Annual demographic data not created directly by the town may be sourced from the American Community Survey.<sup>15</sup>

## Metrics

- Percentage of the 60 planned affordable housing units created
- Percentage of existing affordable housing units, of total year-round housing units
- Percentage of households subject to housing cost burden

## Next Steps

- Identify temporary home and green building methods with greatest potential for success in Lenox
- Identify federal and/or state grant options for funding of affordable housing development.

## Trail Networks

Trails bring a wide range of benefits to the community, including better health and higher property values as well as increased business by attracting visitors for recreation. Building an effective trail network entails connecting recreational resources and natural systems and providing public access to visitors and residents. This will not only improve the quality of life of the residents but is an integral way of building a connected community. Improving trail connectivity can also support a low-carbon lifestyle when human-powered travel is enabled between multiple points of interest.

Lenox has a strong network of trails, which serve as an example of its character and amenities, and the town is prioritizing new trail development. Focused maintenance and expansion of the trail networks should continue to be a priority, and enhancing trail services such as mapping and signage will increase the resource value to residents and visitors, providing Lenox with a year-round attraction that will benefit the economic stability of the town.

---

<sup>15</sup> American Community Survey. "American Community Survey (ACS)." 2018. Link: <https://www.census.gov/programs-surveys/acs/>  
Accessed 9 April 2018.



## Boundaries

The assessment considers trails within the geographic boundary of the Town of Lenox and the listed resources that are owned or conserved by the Town of Lenox, or those that are co-owned or shared through collaborations with the Commonwealth, conservation agencies and trusts, private establishments, and neighboring towns.

## Methodology of Assessment

Trail development and connectivity is addressed based on baseline data available in the Lenox Open Space and Recreation Plan, 2015.<sup>16</sup> The suggested strategies and targets build on this data using metrics and best practices prescribed by the Massachusetts Recreational Trails Program<sup>17</sup> and the Department of Conservation and Recreation Trails Guidelines.<sup>18</sup>

## Strategies

- Develop and expand trails to connect with systems within the town, in neighboring towns, and in the Berkshire region.
- Use trails to link community facilities and residential areas as a low-carbon travelway.
- Provide public-facing resources such as trail maps, signage, conditions reports, and parking availability.
- Increase recreational potential by providing greater uninterrupted trail travel distances.
- Increase trail utility by connecting people to more desired locations.

## Targets

### *Short-Term: 2018-2020*

- Determine critical points of interest (e.g. public service facilities, tourist attractions) for priority trail access.
- Determine evaluation system for trail services to identify isolated networks, conditions of existing trails, and areas where public-facing resources would be most valuable.
- Train and utilize citizen volunteers to map and evaluate existing trail networks.
- Update trail map brochures for public distribution.

---

<sup>16</sup> Town of Lenox. "Open Space and Recreation Plan." 2015. Link:

[http://www.townoflenox.com/Public\\_Documents/LenoxMA\\_WebDocs/Lenox%20OSRP%20June%201.pdf](http://www.townoflenox.com/Public_Documents/LenoxMA_WebDocs/Lenox%20OSRP%20June%201.pdf) Accessed 11 April 2018.

<sup>17</sup> Commonwealth of Massachusetts. "Recreational Trails Program." 2018. Link: <https://www.mass.gov/guides/recreational-trails-program> Accessed 11 April 2018.

<sup>18</sup> Massachusetts Department of Conservation and Recreation. "Trails Guidelines and Best Practices Manual." 2014. Link: <http://atfiles.org/files/pdf/MA-Trails-Guidelines-Best-Practices.pdf> Accessed 11 April 2018.



### *Medium-Term: 2020-2030*

- Create an interactive, web-accessible GIS map of trail system for public use.
- Expand the use and visibility of trailhead markers, signage, and parking amenities.
- Manage trail usage across high-use areas to prevent resource damage, such as wildlife conflicts, littering, erosion, and trail braiding.
- Expand multi-use designation of trails to encourage off-season use (only 25% of trails to be single-use).

### *Long-Term: 2030-2040*

- Consider strategies for trails to serve as alternative travel paths to roads.
- Maintain trail conditions for 50% of trails (by length) to comply with Massachusetts DCR Universal Access Program's Summary of Guidelines for Accessible Trails.<sup>19</sup>

## **Progress Monitoring**

All metrics should be recorded and reviewed annually.

## **Metrics**

- Number of critical points of interest that can be accessed through the trail system, of total points identified
- Overall trail density (trail miles per acre of town-protected land)
- Number of people who live within 0.5 mile (walkable) of any trailhead, of total residents
- Ratio of miles of trail to miles of road

## **Next Steps**

- Assess best methods of data collection on the trail systems.
- Recruit volunteers for trail mapping and management.
- Consider collaborations with universities or independent programs that can help with statistics, surveys, or other technical efforts such as GIS mapping.

---

<sup>19</sup> Massachusetts Department of Conservation and Recreation. "Trails Guidelines and Best Practices Manual." 2014. Link: <http://atfiles.org/files/pdf/MA-Trails-Guidelines-Best-Practices.pdf> (p. 28) Accessed 11 April 2018.



## V. SUSTAINABILITY NEXT STEPS

### Replication & Scalability

The structures and methodologies presented in this document can be replicated in any planning process. The process of identifying broad objectives and drilling down from those toward specific initiatives and metrics is scalable for a variety of program levels.

### Additional Resources

In addition to the resources mentioned previously in this document, there are several regional and large-scale resources that the Town of Lenox may find useful during its sustainability planning.

#### *Berkshire Regional Planning Commission<sup>20</sup>*

This is an excellent resource for local sustainability assessments and initiatives. Because the BRPC has no governing authority over the county or its towns, its programs and plans can be used freely as advisory documents or benchmarks from which to draw relevant information and ideas. The 2014 Sustainable Berkshires Plan contains eight elements comprising a broad look at regional sustainability in the face of climate change and regional economic trends. It was used as a reference for this report and will serve as a valuable resource for assessing different elements of the Town of Lenox's planning strategies. The Berkshire Communities Green Network is a coalition of energy committees in towns throughout Berkshire County with opportunities for networking and collaboration.

#### *U.S. Dept. of Interior, Northeast Climate Science Center, at University of Massachusetts Amherst<sup>21</sup>*

The Northeast Climate Science Center (NE CSC) is part of a federal network of eight Climate Science Centers (CSCs) created to work with natural and cultural resource managers to gather

---

<sup>20</sup> Berkshire Regional Planning Commission. 2018. Link: <http://berkshireplanning.org> Accessed 1 April 2018.

<sup>21</sup> University of Massachusetts Amherst. "NECSC." 2016. Link: <https://necsc.umass.edu/about-us> Accessed 1 April 2018.



the scientific information and build the tools needed to help fish, wildlife, and ecosystems adapt to the impacts of climate change.

*University of Massachusetts, Climate System Research Center*<sup>22</sup>

This research facility is focused on the climate system, climatic variability and global change issues, from contemporary climate variations, their causes and consequences, to paleoclimatic and paleoenvironmental changes.

*U.S. Climate Resilience Toolkit*<sup>23</sup>

Find information and tools to help you understand and address your climate risks. Regional case studies document how communities, businesses, and individuals are taking action to document their vulnerabilities and build resilience to climate-related impacts.

*STAR Communities*<sup>24</sup>

Nonprofit organization that works to evaluate, improve, and certify sustainable communities. It helps cities, towns, and counties achieve a healthy environment, a strong economy, and well-being for their residents.

*Rebuild by Design*<sup>25</sup>

Rebuild by Design convenes a mix of sectors - including government, business, non-profit, and community organizations - to gain a better understanding of how overlapping environmental and human-made vulnerabilities leave cities and regions at risk. Rebuild's collaborative research and design approach is helping cities around the globe achieve resilience.

---

<sup>22</sup> University of Massachusetts Amherst. "Climate System Research Center." 2016. Link: [https://www.geo.umass.edu/climate/?\\_ga=2.170662248.93552374.1517902311-1420411900.1517902241](https://www.geo.umass.edu/climate/?_ga=2.170662248.93552374.1517902311-1420411900.1517902241) Accessed 1 April 2018.

<sup>23</sup> National Oceanic and Atmospheric Administration. "U.S. Climate Resilience Toolkit." 2018. Link: <https://toolkit.climate.gov/> Accessed 1 April 2018.

<sup>24</sup> STAR Communities. 2018. Link: <http://www.starcommunities.org> Accessed 1 April 2018.

<sup>25</sup> Rebuild by Design. 2018. Link: <http://www.rebuildbydesign.org/> Accessed 1 April 2018.



## **VI. CONCLUSION**

Establishing sustainable practices in organizational decision-making is not a one-size-fits-all model, and it is not a one-and-done process. Sustainability involves a continuous reshaping and refinement of practices to reflect the best technologies and methodologies we are able to espouse for each situation. Now that the Town of Lenox has the tools and resources to develop sustainable approaches to their town planning, they have the opportunity to implement new and innovative ideas that work best for their community and their needs while supporting the needs of generations to come.



## **APPENDIX I - GHG INVENTORY FOR THE WATER SUPPLY PLANT**

This Appendix refers to the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC). The GPC was developed by the World Resources Institute, C40 Cities Climate Leadership Group, and Local Governments for Sustainability (ICLEI). Please refer to <http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities> as needed.

### **Boundary - GHG Accounting**

The GHG included in the water supply plant inventory are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Even though GPC requires accounting for hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF<sub>6</sub>), and nitrogen trifluoride (NF<sub>3</sub>),<sup>26</sup> these GHG were not generated by the plant.

### **Methodology**

#### *GHG Emissions Sources*

Greenhouse gas emissions are categorized based on sector and scope. Such sectors include: stationary energy, transportation, waste, agriculture, forestry, and land use.

Activities taking place within the town can generate GHG emissions that occur inside the town boundary as well as outside the town boundary. To distinguish between these activities, the GPC also groups emissions into three categories based on where they occur, as follows:

**Scope 1:** GHG emissions from sources located within the town boundary.

**Scope 2:** GHG emissions as a result of grid-supplied electricity, heat, steam, and/or cooling within the town boundary.

**Scope 3:** All other GHG emissions that occur outside the town boundary as a result of activities taking place within the town boundary.

---

<sup>26</sup> For more information, please see Chapter 3 of the GPC framework.





For the purposes of this assessment, we followed the BASIC reporting level, which is suggested for towns starting a new GHG inventory. It covers Scopes 1 and 2 emissions from stationary energy and transportation, as well as Scopes 1 and 3 emissions from waste.<sup>27</sup>

Table 2 shows the sectors and scopes for which Lenox should account if it pursues the development of a town-wide GHG inventory following the BASIC reporting level.

**Table 2: GHG emissions sources covered in the BASIC reporting level for Lenox**

Sector	Sub Sector	Scope 1	Scope 2	Scope 3
Stationary Energy	Residential buildings	✓	✓	
	Commercial and Institutional buildings and facilities	✓	✓	
	Manufacturing Industries and Construction	✓	✓	
	Energy Industries (Energy Generation supplied to the grid)	✓		
	Agriculture, forestry and fishing activities	✓	✓	
Transportation	On-road	✓	✓	
	Off-road	✓	✓	
Waste	Solid waste disposal	✓		✓
	Biological treatment of waste	✓		✓
	Wastewater treatment and discharge	✓		✓
Agriculture, Forestry and other Land Use	Livestock	✓		
	Land	✓		
	Aggregate Sources	✓		

Source: Based on the GPC framework.

<sup>27</sup> For more information on the sectors and sub-sectors, as well as the scopes they fit within, please see Figure 4.1. of the GPC framework.



The sectors that should be included in a complete BASIC GHG inventory were determined based on the actual activities that occur within the town. However, if Lenox only develops a GHG inventory for town-owned facilities, it should only account for sub-sectors highlighted in green, because those are the only ones that relates to town-managed activities.<sup>28</sup>

### *Data Quality and Quantifications*

As determined by the Intergovernmental Panel on Climate Change guidelines,<sup>29</sup> the formula to calculate GHG emissions is as follows:

GHG Emissions = Activity Data x Emission Factor (EF) x Global Warming Potential (GWP)

- **Activity Data**

In most cases, emissions are able to be calculated based on true values (i.e. kWh consumed), but some will require estimations based on the activity being measured (i.e. amount paid for fuel to estimate fuel consumption). Activity data represents the quantitative measure of the level of activity causing GHG emissions in the given time period (in the case of this assessment, throughout 2017), and the EF is a measure of the mass of GHG emissions relative to a unit of Activity. Those two elements along with the GWP, which is the amount of greenhouse gas that gets trapped in the atmosphere, helps compile the total greenhouse gas emissions.

Activity data is a very important component of the calculation but is usually quite difficult to properly measure, thus we recommend either hiring an external company to facilitate its management, or train a specific person within the town to lead this, as it should be someone's full-time responsibility to gather, process, and monitor the information. It is also essential that a person not related to calculating the GHG inventory verifies both the information and estimation of such inventory. The reason is to ensure no biased measurements.<sup>30</sup>

Part II (Chapters 5 through 10) of the GPC framework explains the type of activity data that is required for each sector and how to obtain it. It also describes how to calculate the GHG emissions from each type of activity data required.

---

<sup>28</sup> For more information on the description and what is accounted in each sector, please refer to Chapters 6 through 10 of the GPC framework. Also, Table 4.3 of the GPC framework provides a summary of what should be included in each sector by scope.

<sup>29</sup> Intergovernmental Panel on Climate Change. "2006 IPCC Guidelines for National Greenhouse Gas Inventories." Link: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>. Accessed 25 March 2018.

<sup>30</sup> For more information on the description and what is accounted in each sector, please refer to Chapters 6 through 10 of the GPC framework. Also, Table 4.3 of the GPC framework provides a summary of what should be included in each sector by scope.



The water supply plant identified the following activity data:

**Table 3: Activity data from the water supply plant**

Sector
Stationary Energy
Commercial and institutional buildings and facilities
Fuel combustion - amount paid in \$USD for fuel, by type
Grid supplied energy - electricity consumed in kWh for entire period
Transportation
Fuel combustion - miles traveled by vehicle type
Waste
Disposal of solid waste generated within the boundary - amount in weight by waste type and disposal type

- **Quantifications**

The following paragraphs will describe the quantification of GHG emissions generated by the activities identified in the water supply plant. To see the actual quantifications please refer to the attached Excel document.

For all calculations, GWP were taken from the IPCC: 2013, IPCC Fifth Assessment Report: Climate Change 2013. All GHG emissions were calculated in tons of carbon dioxide equivalent (CO<sub>2</sub>e), using the respective GWP for each GHG's EF.

- **Stationary Energy**

- Fuel combustion

The amount of fuel was estimated using the using the average monthly price (\$USD per gallon) provided by the EIA.<sup>31</sup> It was assumed that everything that was bought was also consumed. The EF (CO<sub>2</sub>e ton per gallon) used was estimated by the EPA,

---

<sup>31</sup> U.S. Department of Energy. "Petroleum and Other Liquids: Data." 2018. Link: [https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=W\\_EPLLPA\\_PRS\\_SNY\\_DPG&f=W](https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=W_EPLLPA_PRS_SNY_DPG&f=W). Accessed 24 March 2018.



in its “Greenhouse Gas Inventory Guidance. Direct Emissions from Stationary Combustion Sources. 2016.” It is shown in table A-1.

- **Grid-supplied energy**

The amount of kWh consumed from January to October 2017 was taken from the Eversource electric bill of October 2017. November and December consumption was estimated as a weighted average between kWh consumed and amount paid per kWh.

The EF (CO<sub>2</sub>e ton per MWh) was taken from the EPA, Emissions & Generation Resource Integrated Database (eGRID), corresponding to the sub-region named NPCC New England.

- **Transportation**

- **Fuel combustion**

Estimation for each type of pickup (diesel and gasoline) was provided by the plant. The EF for diesel was taken from the IPCC Emission Factors Data Base (EFDB). CO<sub>2</sub>e ton per mile was calculated as a weighted average of “DIESEL, Uncontrolled EF for US Diesel Passengers Cars.” It is the sum of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O EFs, multiplied by their respective GWP. Similarly, the EF for gasoline was taken from the IPCC Emission Factors Data Base (EFDB). CO<sub>2</sub>e ton per mile was calculated as a weighted average of “GASOLINE, Three-Way Catalyst Control EF for US Gasoline Passenger Cars.” It is the sum of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O EFs, multiplied by their respective GWP.

- **Waste**

- **Disposal of solid waste generated in the town**

The amount of freeze-dried sludge disposed to landfill was provided by the plant. The EF (CO<sub>2</sub>e ton per waste ton) was estimated using both Equation 8.3, Methane commitment estimate for solid waste sent to landfill, and Equation 8.4, Methane generation potential, L, from the GPC framework.

## *Results*

Table 4 summarizes the GHG emissions generated by the water supply plant by sector and scope.



**Table 4: GHG emission from the water supply plant - 2017**

Sector	metric ton CO2e		
	Scope 1	Scope 2	Total
Stationary Energy	46.31	73.97	120.28
Commercial and institutional buildings and facilities	46.31	73.97	
Fuel combustion	46.31		
Grid-supplied energy		73.97	
Transportation	7.90	-	7.90
Fuel combustion	7.90		
Waste	194.43	-	194.43
Disposal of solid waste generated in the town	194.43		
<b>Total</b>	<b>248.64</b>	<b>73.97</b>	<b>322.61</b>

It can be seen that most GHG emissions are generated by the disposal of solid waste (freeze-dried sludge) generated in the plant, accounting for 60% of the total emissions, followed by GHG emissions generated by the energy consumption in the plant with 37%.

Also, most GHG emissions are generated from sources located within the town boundary (Scope 1), accounting for 77% of the total emissions.