CLIMATE RESILIENT CARLISLE:
ISSUES AND RECOMMENDED ACTIONS

Prepared for

Town of Carlisle
Municipal Vulnerability
Preparedness Core Committee

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EXECUTIVE SUMMARY

The Climate Resilient Carlisle project and this report represent a significant step in Carlisle's ongoing effort to become a more climate resilient community. It reflects both Carlisle's existing conditions and future anticipated challenges and conditions due to climate change. Carlisle's existing landscape and infrastructure include low-density residential development of generally large single-family homes on two or more acres that are reliant upon individual private wells and septic systems. Carlisle has an aging population, is significantly forested, and contains large areas of floodplain and wetlands. The town has already begun to experience the impacts of climate change, including greater annual rainfall, higher intensity rain events, longer periods of drought, more intense storms, and warmer winters and warmer summers.

The Climate Resilient Carlisle project builds on work Carlisle has previously undertaken through various planning processes, including its Master Plan, Housing Production Plan, Open Space and Recreation Plan, Hazard Mitigation Plan, Path to Zero Emissions Report, as well as efforts led by the Environmental Sustainability Committee. The topics raised through the process are varied and touch upon all aspects of living in Carlisle, including issues related to public town infrastructure and town properties, natural resource protection, private utilities, housing, flood and fire risk, and more.

The core of this report is nineteen actions the town may pursue to address climate resilience. They advance a variety of resilience goals identified in previous processes and synthesized through this project by the Core Committee. Each action may be advanced through tools and methods, such as changing town codes or policies, developing a town initiative or program, or educating staff or the public. Because resilience is inherently interdisciplinary, a single recommended action may target more than one goal, and one goal can be addressed by multiple recommended actions. There is not a one-to-one relationship between goals and recommendations.

The recommendations are grouped around six main themes:

1. Eco-Landscapes
2. Fire Protection
3. Flood, Drainage, and Wetlands
4. Homes and Buildings
5. Infrastructure
6. Social Resilience

To aid in implementation, the description of each action includes the goals targeted by the action, the tools or method employed in the action, the responsible parties, and the timeframe expected to implement the action.

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INTRODUCTION: PLANNING FOR RESILIENCE IN CARLISLE

The Climate Resilient Carlisle project and this report represent a significant step in Carlisle's ongoing effort to become a more climate resilient community. Initially, this project aimed to identify opportunities within the Town's bylaws, regulations, and policies where the Town could improve local resilience to the impacts of climate change. This charge is very broad, and this process does not come with a template. The Town obtained a Municipal Vulnerability Preparedness Action Grant from the Commonwealth of MA, and engaged a consultant, the Horsley Witten Group (HW), to support this work. HW worked with Julie Mercier, Town Planner; Sarah Wasserman, Land Use & Sustainability Coordinator; Carlisle's MVP Core Committee and Local Emergency Planning Committee (both comprised of staff and volunteers); Carlisle municipal boards, commissions, and committees; and the public to identify resilience concerns and develop draft recommendations to address them.
We learned quickly during this effort that many of the resilience concerns identified by the town could not be adequately or appropriately addressed by revisions to the municipal code alone. Zoning and land use decisions guide what does and does not get developed, where, and how. These aspects of the built environment are a large portion of what determines a community's level of risk. However, in a community where development and redevelopment occur at a relatively slow, incremental pace, municipal codes do not effect change quickly. There are some resilience concerns that require actions on the part of different Town Departments, boards, commissions, and committees to change policies, develop plans or guidance information, implement projects or activities, or improve education of local officials, volunteers, and the general public. As such, the scope of the recommendations in this report differs somewhat from what was originally envisioned and is broader in its application than just the municipal regulatory framework.

This project builds on work Carlisle has previously undertaken through various planning processes, including its Master Plan, Housing Production Plan, Open Space and Recreation Plan, Hazard Mitigation Plan, Path to Zero Emissions Report, as well as efforts led by the Environmental Sustainability Committee. The Planning Board initiated this project. More details can be found in those plans.

This report is organized as follows:

- Introduction
  - Existing Conditions and Trends
  - Climate impacts
  - Process to date
- Resilience Goals
- Implementation Tools, Methods, and Responsible Parties
- Recommended Actions
- Appendix: Suggested Code and Policy Changes

EXISTING CONDITIONS AND TRENDS

The following existing conditions and trends were most relevant in assessing the town's present and potential future vulnerabilities:

- Carlisle is heavily forested and has significant floodplains and wetlands. The flood hazard district[1] occupies roughly 20% of the town's land area.[2]
- Most of Carlisle's land is zoned residential for single-family homes on two or more acres.
- The large majority (92%) of all housing units in Carlisle are detached single-family homes. The homes are large: more than 90% of housing units in Carlisle have three or more bedrooms, and nearly two-thirds have four or more.[3]
- Carlisle's residents rely on private wells for drinking water and septic systems for wastewater management.
- Carlisle is aging. The share of Carlisle's population that is older than 65 doubled from 8.4% in 2000 to 17.5% in 2018,[4] and has since increased to 21.1% in 2022.[5] More than a third of the population is projected to be over 60 by 2030.[6]

In addition, Carlisle became certified as a Climate Leader Community in Massachusetts in May 2025. This voluntary state program helps municipalities reduce their emissions through electrification and energy efficiency.[7] To become a Climate Leader Community, a community must:

- Be a Green Community in good standing (the predecessor program)
- Have an Environmental Sustainability Committee, or similar
- Commit to eliminating on-site fossil fuel use by 2050 (in municipal buildings and operations)
- Create a municipal decarbonization roadmap
- Adopt a Zero-Emission Vehicle first policy
- Adopt the Specialized Opt-In building code

ANTICIPATED IMPACTS OF CLIMATE CHANGE

This memorandum also builds on work Carlisle has undertaken through its participation in the Massachusetts Municipal Vulnerability Preparedness (MVP) Program. Carlisle explored and documented its risks and vulnerabilities in the MVP Workshop report and Hazard Mitigation Plan, created together in 2021. In addition, the Commonwealth of MA has undertaken a Massachusetts Climate Change

[1] Currently called the Wetlands/Flood Hazard District, though we have recommended separating the wetlands requirements from the flood hazard zones.
[2] Carlisle Master Plan, Appendix C: Land Use and Zoning
[3] In comparison, 54% of housing units in Middlesex County have three or more bedrooms, and under a quarter have four or more.
[4] Carlisle Master Plan, Appendix A: Demographics Existing Conditions Report
[5] ACS Census, 2018 – 2022 5-year estimate. Table DP05
[6] Carlisle Master Plan, Appendix E
[7] The Climate Leaders Community program focuses on reducing emissions to reduce Carlisle's contribution to climate change. The Municipal Vulnerability Planning program works to enhance Carlisle's resilience and reduce the impacts of climate change. However, these are intimately connected efforts and many participants in this process discussed both sets of issues.

Assessment (2022) and a Statewide Hazard Mitigation and Climate Adaptation Plan (2023 ResilientMass Plan). These documents can be reviewed for a more detailed discussion of the climate change impacts anticipated in Carlisle.

Carlisle will be experiencing climate change in the coming years and decades in the form of:

- Greater annual rainfall
- Greater intensity of rainfall events
- A shift in rainfall events from spring and summer to fall and winter
- Longer periods of drought
- More intense storm events, with greater winds
- Warmer winters and warmer summers

See the 2022 Massachusetts Climate Change Assessment for more detailed discussion of anticipated changes and impacts. These general impacts and trends were considered as a backdrop during this project as we considered municipal climate resilience.

THE RESILIENT CARLISLE MVP PROCESS

The Resilient Carlisle Process was conducted over 18 months, from January 2024 through June 2025. It started with a public forum in February 2024 to introduce the project to the public and facilitate a discussion about resilience goals and concerns. HW met with a variety of town boards, committees, and commissions in spring 2024 and then again in winter 2024/2025 to distill resilience goals and discuss potential actions to achieve the specific goals identified throughout the project. The following local boards, committees and commissions were engaged:

- Select Board
- Planning Board
- Board of Health
- Local Emergency Planning Committee
- Conservation Commission
- Zoning Board of Appeals
- Affordable Housing Trust
- Historical Commission
- Environmental Sustainability Committee
- MVP Core Committee
    - Representatives of: Planning Board, Select Board, Board of Health, Environmental Sustainability Committee, Conservation Commission, Council on Aging & Human Services, and 1-2 Interested Citizens
    - Staff: Town Planner, Town Administrator, Land Use & Sustainability Coordinator, Health Agent, Conservation Administrator, Building Commissioner, Fire Chief, Police Chief, DPW Director, and COAHS Director

In addition, HW reviewed Carlisle's codes and ordinances and various town plans and policies. These are listed in the Tools and Methods section.

RESILIENCE GOALS

The topics raised through the Resilient Carlisle Process are varied and touch upon all aspects of living in Carlisle, including issues related to public town infrastructure and town properties, natural resource protection, private utilities, housing, flood and fire risk, and more. We have reframed the concerns raised as goals. Discussion of each goal is provided briefly below.

Note to Readers: *The order of the goals, themes, and recommendations in this report is not intended to imply importance or priority, but rather to serve as a structure within which residents can easily navigate the large amount of material.*

ECOSYSTEM PROTECTION

In addition to their inherent value, healthy ecosystems and natural resources make Carlisle more resilient to the impacts of climate change. Healthy forests reduce flooding and erosion. Healthy soils are more resilient to both drought and flood, and they store carbon. On a street scale, natural resources reduce stormwater runoff, improve water and air quality, and reduce the impact of extreme heat.

Ecosystems and natural habitats are healthiest when they are contiguous, unpolluted, native, and diverse. Carlisle's existing land development codes have provisions for preservation of open space. However, they are more focused on the aesthetic and potential recreational value of open space than on ecosystem services. Clustering development and reducing sprawl allow more space for meaningful natural areas that retain their ecosystem functions. Carlisle's existing housing stock has large fields, lawns, and meadows, some of which are treated with high levels of fertilizer and/or pesticides and herbicides. These can pollute the surrounding natural environment and reduce ecosystem services. The actions that advance ecosystem protection in this report are aimed at reducing harm to Carlisle's natural environment and strengthening it as much as possible. This was identified as the top priority by Carlisle residents during the Master Plan development process, which included a public survey.

WATER RESOURCE PROTECTION

Climate change has and is expected to increase risks to water quality through increasingly frequent and severe flooding and droughts, as well as increased temperatures. Floodwaters bring pollutants with them, especially during "flashy" storms when much of the waters run off into wetlands and streams. Droughts concentrate pollutants in surface water and groundwater. Higher temperatures (both through heatwaves and steadily increased day and night temperatures) allow more biological and chemical activity and raise the risk of toxic algae and other water pollution.

These changes to the environment impact water resources and the habitats and people who depend on them. Carlisle contains lots of wetlands and sensitive habitat. All of Carlisle's water is from private wells, and all of Carlisle's wastewater is managed through private septic systems. This diffuse and privately managed infrastructure requires public attention to ensure the sustainability and resilience of natural resources. The actions that advance water resource protection are aimed at reducing water pollution, keeping natural resources and habitats strong, and ensuring the safety of Carlisle's drinking water.

FLOOD MITIGATION

As the climate changes, severe storms are becoming more severe and more frequent, leading to more flooding. Carlisle's MVP workshop participants discussed the increasing risks:

> *Carlisle workshop participants noted the increasing frequency and intensity of storms, including nor'easters that bring damaging winds and snowfall and heavy rain events… Large rain events result in flooding in several locations; the Hazard Mitigation Plan identifies about two dozen of these areas of local flooding.*

Many communities and state and federal agencies are looking into ways to incorporate a larger floodplain into regulations and policies. FEMA's new Federal Flood Risk Management Standard (FFRMS), for example, requires that infrastructure built with federal funding use a higher standard of flood risk by incorporating climate projections, adding extra freeboard to the 1% annual chance floodplain to create a buffer, or using the 0.2% annual chance floodplain instead of the 1% annual chance floodplain.

The actions that advance flood mitigation are consistent with state and federal guidance to prevent development in the expanding floodplain and use natural systems to manage stormwater to the greatest extent possible.

FOREST FIRE PROTECTION/MITIGATION

Roughly 70% of Carlisle's land is forested. This is an asset: Carlisle residents listed open space and natural resources as the quality they value most about the town.[8] However, it also comes with risks and vulnerabilities. The community was once much less forested, and the predominant land use was agriculture. Carlisle's forests are second and third growth, and many stands are mature, but fairly uniform in age.

Carlisle's land use pattern of mature forest interspersed with houses is a prime example of the wildland urban interface, where wildfire risks to people and property are highest. As the climate changes and droughts, warmer temperatures, and invasive species become more common in the northeast, the forest may become vulnerable to wildfire.

[8] Carlisle Master Plan, 2022

EMERGENCY RESPONSE

As storms, intense heat, and forest fires grow more frequent and more severe, emergency response will need to be more robust. This project does not focus on emergency management—resilience is about reducing risks in the long-term, across all stages of the disaster cycle. However, strong emergency response is part of building a resilient community, and it should not exist in a silo apart from other areas of planning and sustainability. Many of the actions that advance emergency response also advance other goals as well and/or reflect ways to incorporate emergency response into other community concerns and operations.

SOCIAL RESILIENCE

Social resilience is a critical component of climate resilience.[9] Communities with strong social ties between residents suffer fewer casualties and recover more quickly and more completely from hazard events. Neighbors who know each other often serve as informal first responders, assisting those who have limited mobility or medical needs during a disaster event. Communities that are better connected with each other have an easier time advocating for their needs both internally and with state and federal programs.

Various social and land use factors can raise the risks of hazards and social isolation. Carlisle's sense of community is strong. Community members have robust and occasionally tense conversations on the best ways to prioritize and meet community needs.[10] However, Carlisle's spread-out land use pattern and auto dependency raise risks of both hazards and social isolation. It is harder to get to know your neighbors (including their potential needs in the event of a disaster) when they live two acres away and neighborhoods are spread out.

Carlisle's population is aging. Older adults are disproportionately impacted by disasters: two out of three deaths during Hurricane Florence and three out of four deaths during Hurricane Katrina were older adults (60+).[11] As Carlisle ages, the Town will need to find ways for its members to age in community, while remaining safe and connected.

HOUSING RESILIENCE

The relationship between housing diversity and affordability and resilience may not seem immediately obvious. However, zoning and land use decisions guide what does and does not get developed, where, and how. These aspects of the built environment are a large portion of what determines a community's level of risk.

A resilient community is one where the worst impacts of hazards are prevented by keeping people out of harm's way, and where all community members are able to access the help they need during and

[9]Aldrich, (2018) The Right Way to Build Resilience to Climate Change, Current History. 117(795); Townshend et. al. (2014) Social cohesion and resilience across communities that have experienced a disaster, Natural Hazards

[10] Carlisle Master Plan (2022)

[11] FEMA and AARP, Guide to Expanding Mitigation Making the Connection to Older Adults, 2022

following a disaster.[12] Communities with a mix of housing options in walkable, safe areas are more resilient to most hazards than sprawling, car-dependent communities.[13] Loss of electricity is a particular vulnerability for Carlisle, since residents rely on private wells for drinking water and on Wi-Fi for communication. Additionally, Carlisle's housing stock of large homes on multiple floors may pose challenges for heating and cooling.

Housing issues are crosscutting. Many of the issues that relate to housing can also advance ecosystem protection, social resilience, and other goals. Sprawl contributes to degradation of natural resources, increases the wildland urban interface where wildfires are most dangerous, and leads to car dependency. Depending on a car to meet one's basic needs is a more fragile and hazardous position than being able to access groceries, medical care, and community through public transportation or walking, biking, and/or rolling. As Carlisle's residents age, many will be faced with the choice between increasingly unsafe driving and social isolation.

CARBON EMISSIONS REDUCTION/EFFICIENCY

The Climate Resilient Carlisle project focuses on resilience—how can Carlisle respond to the evolving impacts of climate change? These actions are broadly considered "adaptation" to climate change. However, many of our discussions included actions that reduce, or "mitigate," greenhouse gas emissions. These concepts are linked: fossil fuel sources are often less reliable and more vulnerable to disasters than renewable energy sources. In addition, many actions that reduce emissions will always or can easily incorporate resilience elements. For example, street design projects that add bike lanes can also include green stormwater elements that reduce flooding.

As a car-dependent suburb, there is a certain level of greenhouse gas emissions baked into living in Carlisle. However, the community and its residents can make choices to make it easier to use public transportation, reduce building waste and embodied carbon emissions, allow upgrades to historic structures, and reduce energy usage in large homes.

RESILIENT ENERGY SYSTEMS

Energy infrastructure is critical infrastructure. This is especially true in Carlisle, where residents are dependent on electricity to pump their well water, heat and cool homes, and maintain cell service, Wi-Fi, and other forms of communication. As climate change increases the frequency and severity of extreme storms, Carlisle needs to consider how to minimize interruptions to its external energy supply, as well as increasing self-generated renewable energy and storage at both residential and municipal scale.

[12] FEMA defines resilience as "the ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions" (National Resilience Guidance, 2024).
[13] Brody, S. (2013) The Characteristics, Causes, and Consequences of Sprawling Development Patterns in the United States. Nature Education Knowledge 4(5):2; Chapple, Olshansky, et. al. (2021) Rebuilding for a Resilient Recovery: Planning in California's Wildland Urban Interface. UC Berkeley Center for Community Innovation.

As technology evolves, renewable energy sources and storage solutions can have different risks that Carlisle needs to consider.

MULTI–MODAL TRANSPORTATION

Walkability and access to public transportation are climate issues. Driving contributes to greenhouse gas emissions. Roads can get flooded or become impassable.

Carlisle's Master Plan (2022) notes that "the organic and unplanned evolution of the town's transportation system contributes to a road network that is constrained by its surroundings and local land use decisions." It also states that there are limited transportation options for residents who do not drive, especially those who are not also seniors.[14] Carlisle's survey from the master planning effort revealed that 79% of respondents viewed "identifying opportunities to improve walkability and connectivity of Carlisle's pathways, trails, and roadways" as important or very important. Identifying those opportunities is goal 10 of the plan, and goal 11 is to support the transportation needs of non-driving residents.

Carlisle is revisiting its Complete Streets plan, which can help address some of these concerns. It is also an opportunity to consider ways to build stormwater management (including green infrastructure, such as bioswales) into complete streets projects for flood resilience. Additionally, as Carlisle electrifies its fleet as part of the Climate Leader Communities program, the Town should consider additional ways to bolster electric charging infrastructure.

LOCAL FOOD/FARMING

Carlisle's Master Plan (2022) describes the community as having "long been proud of its iconic status as a formerly agrarian town that has evolved into a desirable country suburb" with "farms that raise horses, cows, pigs, chickens, bees, and produce." Agriculture is an important part of Carlisle's past and present. As the climate changes, farms will be impacted by increasing temperatures, more frequent drought, and extreme weather. Farms can serve roles in protecting the environment by absorbing stormwater and providing edge habitats. They can also pose risks during extreme weather events, such as when manure, fertilizers, pesticides and herbicides run off into streams or wetlands.

Food security is also tied to increasing Carlisle's social resilience. Carlisle can continue building upon existing community programs like the farmer's market and the Council on Aging and Human Services' participation in the Meals on Wheels program. However, there is room to increase the amount of local food sourced in supporting vulnerable residents. In addition, local food can be increasingly integrated into the Carlisle Public School food service programs.

Many of these concerns are beyond the scope of this report. However, since farms and farming are so important to the community both culturally and as a land use, this report gives special attention to ways agriculture can support community resilience.

[14] Carlisle Council on Aging and Human Services offers transportation services by advance appointment for older adults and residents with disabilities. They also offer a van to the Market Basket in Westford on Fridays.

TOOLS AND METHODS

There are a variety of ways Carlisle may want to advance the resilience goals listed above. The Climate Resilient Carlisle project was initiated with the premise of focusing on codes and regulations as a means of improving the Climate Resilience of Carlisle. However, as we engaged with the community and had conversations with the committees, boards, and town staff, it became evident that many of the actions that would advance resilience were not regulatory in nature. In response, we broadened the scope of the tools and methods considered under this project to include not just code revisions but also changes in town policies and plans; education; town initiatives, programs, or actions; and the development of geographic information. These categories are more fully described below:

CHANGE IN LOCAL CODE

Local codes are laws, ordinances, and regulations enacted by town boards, committees, and commissions that have the force of law. Local codes govern land use and other issues specific to the Town. HW reviewed the following codes as part of the Climate Resilient Carlisle project:

General Bylaws
Zoning Bylaws
Planning Board Rules and Regulations:

- Subdivision of Land
- Development Standards (Attachment A, Subdivision Rules and Regulations)
- Application Procedures for Accessory Apartment Special Permits
- Conservation Cluster Special Permits
- Residential Open Space Community Special Permits
- Senior Residential Open Space Community Special Permits
- Site Plan Review
- Scenic Roads

Board of Health Rules and Regulations

- Review of Subdivision Plans, Conservation Cluster, and Senior Residential and Residential Open Space Community Special Permits
- Water Supply
- Manure Management
- Storage of Petroleum
- Sewage Disposal Systems

CHANGE IN TOWN POLICY

Town policies shape decision making and actions. Policies may be explicitly written out as the “Town of Carlisle X Policy” or as part of a town plan or other guidance document. In some cases, policies may not be explicit or written, and the recommendation here is to clarify and spell it out. HW reviewed the following Town plans and policies as part of the Climate Resilient Carlisle project:

- Carlisle Master Plan (2022)
- Carlisle Municipal Vulnerability Preparedness Report (2021)
- Hazard Mitigation Plan Update (2021)
- Open Space and Recreation Plan (2020/2021)
- Path to Zero Emissions Report (2020)
- Housing Production Plan (2022)
- Complete Streets Policy (2018)
- Tree Removal and Mitigation Policy (2022)
- Environmental Sustainability Committee Work Plan

EDUCATION

Many of the recommendations have an educational element. In some cases, it is to educate local residents and community members. For example, an action about encouraging resilient landscaping will require education for landowners (and possibly landscaping companies). In other cases, the education is for town committees and boards or town staff. For example, increasing green infrastructure may require education for the Conservation Commission and Environmental Sustainability Committee as well as Public Works staff.

TOWN INITIATIVE, PROGRAM, OR ACTION

Some of the actions are just that: actions that the Town can implement on its own. In general, these are actions to increase the resilience of town lands, advance social connections, and social resilience, or improve emergency management. For example, adding more green infrastructure to roadways and town properties and increasing the number of firefighting water tanks across town are both actions that the Fire Department, Public Works, and/or other town staff can implement.

GEOGRAPHIC INFORMATION SYSTEMS MAPPING AND SPATIAL DATA DEVELOPMENT

Geographic Information Systems (GIS) allow people to understand data spatially. GIS tools are invaluable in developing answers to questions like “which areas are most vulnerable to flooding as storms become more severe?” or “where is our community’s forest and street trees, and how does it differ across neighborhoods with different demographic profiles?” GIS data and tools are also critical for mapping infrastructure and assets such as firefighting tanks and culverts.

Carlisle has been working on strengthening its GIS infrastructure and capabilities. This public resource will only become more important given the challenges posed by climate change. While data (spatial or otherwise) cannot make change on its own, it is a prerequisite for many of the recommended actions. It became clear through our review

and discussions that many of the actions start with a map or require some form of spatial analysis.

RECOMMENDED ACTIONS

The recommended actions described below are aimed at assisting the Town of Carlisle in becoming a more resilient community by addressing the resilience goals (or issues) identified through this project. To provide some logical organization for the reader to digest these recommendations, we have grouped them around six main themes:

1. Eco-Landscapes
2. Fire Protection
3. Flood, Drainage, and Wetlands
4. Homes and Buildings
5. Infrastructure
6. Social Resilience

The order in which these themes and the recommended actions are presented does not suggest any priority or ranking of importance for the community. Furthermore, the reader will no doubt note that the themes and actions are somewhat interrelated, such that each recommendation likely results in implications or considerations for one or more other themes.

For each action presented below, we have identified the goals targeted by the action, the tools or method employed in the action, the responsible parties, and the timeframe for implementation. Short-term is intended to mean approximately the next 1-2 years, medium-term is the next 3-5 years, and long-term is 6-10 years. A single recommended action may target more than one goal, and one goal can be addressed by multiple recommended actions. As a result, there is not a one-to-one relationship between goals and recommendations. In addition, due to the interconnections across the community goals and themes, it is worth noting that the recommended actions presented here are certainly not black and white. Some recommended actions may raise conflicts with other climate resilience goals or other community goals and will require thoughtful future consideration of tradeoffs to find an effective and acceptable balance.

THEME 1: ECO–LANDSCAPES

1. *Ensure that open spaces required by various development approvals are ecologically valuable, connected, and considerate of wildlife corridors*

Tools/methods: Change in local code, change in town policy, education, GIS
Goals advanced: Ecosystem protection, flood mitigation, water resource protection
Responsible Parties: Planning Board, Conservation Restriction Advisory Committee
Timeframe: Short to Medium-Term

The existing land development codes in Carlisle governing residential subdivision approval include requirements for the preservation of open space. However, those requirements are not sufficient to fully ensure that the preserved open space is ecologically valuable, connected to adjacent open space, or contributes to the overall connectivity of habitat and open space in the region. One tool that can be used to assess these characteristics is BioMap, created by the Massachusetts Division of Fisheries and Wildlife.

Different types of subdivision approval use varying definitions for open space and contain varying priorities for how that open space is identified. Carlisle residential land development codes that contain open space preservation provisions include:

- Subdivision Rules and Regulations
- Residential Open Space Community (ROSC) Zoning Bylaw and Regulations
- Senior Residential Open Space Community (SROSC) Zoning Bylaw and Regulations
- Conservation Cluster Zoning Bylaw and Regulations

The Subdivision Rules and Regulations can be considered the traditional approach to residential development. The other three residential subdivision development approaches are governed by a Special Permit process and a specific set of Regulations. Each of these three Special Permits allows for a greater number of residential units to be developed compared to a traditional subdivision in return for preserved open space. Neither the regulations for traditional subdivisions nor the Special Permit options include a specific criteria or requirements for ecosystem health or contiguity of the open space within the development and/or to adjacent open space or paths. As a result, the Town has approved Open Space Communities that preserve the requisite amount of open space but resulted in open space that is isolated or provides less than ideal value for ecosystem and/or passive recreation connectivity within and to the development.

The **Massachusetts Division of Conservation Services** defines open space as, “conservation land, forested land, recreation land, agricultural land, and amenities such as green buffers along roadways or any other predominantly undeveloped area that is owned by an agency or organization dedicated to conservation or recreation.”

The Subdivision Rules and Regulations includes Article III Design Standards, and there is no specific design standards that clarifies a definition for open space. Section 1.E. Parks states:

> *(1) Before approval of a plan the Board may also in proper cases require the plan to show open space(s) for a park or parks suitably located for playground or recreation purposes or for providing light and air. The open space shall not be unreasonable in area in relation to*

the land being subdivided and to the prospective uses of such land, but generally not less than five (5) percent of the land to be subdivided, depending on the location and quality of the land being set aside. The minimum area acceptable for set aside shall be three (3) acres. Land designated for open space purpose shall not include wetlands, ledge or other land unsuitable for recreation purposes. The Planning Board may by appropriate endorsement on the plan require that no building be erected upon such open space for a period of three (3) years without its approval.

(2) As an alternative for the set-aside for parks and open spaces, the Applicant may offer to provide other suitable benefits or amenities acceptable to the Board, such as retaining a maximum amount of the Lot in its natural condition, retaining other natural features within the Subdivision, or providing a no-build buffer area adjacent to the public Road(s).

Attachment A Development Standards, which is attached to Subdivision Rules and Regulations and is intended to be applied to all four types of developments cited above, includes some guidance to 'maximize, to the extent possible" the (e) Connections via publicly accessed trails to and between protected open space and other trails; (f) Buffers for and connections among existing protected open spaces; and (g) Wildlife corridors. However, the evaluation by the Planning Board, project applicants, and the public as to how well these elements have been maximized remains somewhat subjective and open to differentiation between the different sets of subdivision development regulations.

Attachment A does include a Section F. Open Space, which states:

F. Open Space: Consistent with the requirements of the Carlisle Zoning Bylaws and regulations, including, but not limited to the Subdivision Rules and Regulations, the SROSC Regulations, the ROSC Regulations, and Conservation Cluster Regulations, ***as applicable****, all developments should to the extent possible set aside, for perpetual protection, sufficient open space to serve the needs of the project residents and ensure that the proposed project is integrated within the existing neighborhood. Open Space is defined as land that is not covered with buildings, roadways, parking or any other structure or impervious surface. Open Space should be selected to provide for recreation purposes and/or to maximize the value of wildlife habitat, should be contiguous to the extent required to preserve significant habitat, should be configured to maximize and preserve large blocks of undisturbed land and should encourage passive recreational opportunities for residents and the public where possible. Open Space should predominantly be left in a natural, undisturbed state. Landscaping of Open Space areas should utilize native vegetation to the extent practical, and should complement the values and functions of the natural resources on the site. In any developments proposed to be denser than underlying zoning would otherwise allow, Open Space is critical to protect the private water sources exclusively relied upon by residents in Carlisle.*

However, this definition above is only applied to each set of regulations 'as applicable' and then the individual regulations apply differing sets of standards and requirements for open space.

The Residential Open Space Community Special Permit regulations require that open space meets one of five criteria:

> *(1) it preserves some component of the Town's farm community, (2) it preserves areas of open meadow, woodland, water bodies or ecotone, (3) creates or preserves vistas or buffer areas (4) it preserves valuable habitat for identifiable species of fauna and flora, or (5) it preserves an artifact of historic value.*

The Senior Residential Open Space Community Special Permit regulations requires that the open space meet the same five criteria, although they are identified in a different order:

> *(1) it preserves some component of the Town's farm community, (2) areas of open meadow, woodland, water bodies or ecotone, (3) valuable habitat for identifiable species of fauna and flora, or (4) an artifact of historic value, or (5) creates or preserves vistas or buffer areas.*

The Conservation Cluster Special Permit regulations define open space as:

> *"Open Space" shall mean any land within the Conservation Cluster which is not designated as a building lot and encompasses the Natural Resource, as previously defined, for which preservation would be accomplished by the grant of a Special Permit hereunder.*

Recommendations:

The Town can incorporate consistent language into the open space definitions and requirements associated with all subdivision approvals that requires open space be contiguous to other existing open space, particularly protected open space and high-quality ecosystem habitat areas, with the goal of creating and extending connected habitat and passive recreational areas.

2. *Encourage drought-resistant and other resilient landscaping and ecologically sensitive practices for residential, public, and other properties*

Tools/methods: Change in town policy, education, town action
Goals advanced: Ecosystem protection, flood mitigation, forest fire protection/mitigation, water resource protection
Responsible Parties: Environmental Sustainability Committee, Conservation Commission, Land Stewardship Committee, Town staff
Timeframe: Medium-Term

The landscaping decisions individual landowners and managers make for their properties can impact their resilience and the resilience of the lands and built environment around them. Resilient landscaping can contribute to the following Carlisle resilience goals:

- Reduce runoff and help stormwater sink in to reduce flooding
- Protect water quality
- Protect habitats
- Support landscapes to flourish even during drought conditions, reducing or eliminating the need for irrigation
- Reduce energy usage and noise pollution through using electric lawn equipment

These goals can be advanced through legislation and policy or through softer methods, such as education and modeling on town-owned sites.

Recommendations:
The recommendations for encouraging resilient practices in landscaping and lawn maintenance in Carlisle are to develop the following regulations, policies, projects, and educational materials:

- Publicity and education around alternatives to the use of pesticides, including herbicides and rodenticides, and alternatives to gas-powered yard and lawn maintenance equipment.
- Town policy that calls for a reduction in use or environmentally friendly alternatives to pesticides, including herbicides and rodenticides, on Town property.
- A town policy that restricts the use of certain gas-powered yard and lawn maintenance equipment by Town staff and Town contracted entities (e.g., municipal facilities maintenance, Carlisle Public School, Public Works) in support of electric equipment, which is quieter, emits less pollution in the form of exhaust, and can be powered from renewal energy sources.
- A town policy that supports the implementation of green stormwater infrastructure to manage stormwater on public land and to serve as a model for other properties.
- A town regulation that prohibits the introduction of non-native invasive plants on properties within the town.
- Education and homeowner outreach encouraging native plantings and providing helpful information on how to properly manage harmful invasives.
- A set of pilot projects on public property or in partnership with private property-owners to demonstrate resilient landscaping methods and educate the public.

- A set of educational materials for property owners about how to include pollinator friendly plantings within their landscapes and other sustainable gardening practices.

Green infrastructure, also known as “green stormwater infrastructure” or “nature-based solutions,” refers to interventions that allow precipitation to soak into the ground near where it falls rather than running off the land surface and carrying pollutants into receiving waters such as streams, wetlands, or ponds. These practices help a developed landscape mimic natural process, reducing the hydrologic impacts from impervious surfaces that typically comprise our developed landscape. Practices such as bioswales, rain gardens and bioretention areas can be integrated into the landscape to reduce stormwater runoff and can be used effectively on public or commercial property as well as private residential properties.

Resources:

- FEMA Nature-Based Solutions Handbook
- MA CZM Stormwater Solutions for Homeowners Fact Sheets (how-to documents for homeowners on vegetated buffers, green lawns and gardens, rain gardens, reducing impervious surfaces, and more)
- EPA Green Infrastructure landing page with links to many resources, including on green infrastructure and climate resilience

3. Encourage preservation of trees on public and private property.

Tools/methods: Change in local code, education, town action
Goals advanced: Ecosystem protection, flood mitigation, water resource protection
Responsible Parties: Environmental Sustainability Committee, Conservation Commission, Planning Board, Local Emergency Planning Committee
Timeframe: Short to Medium-Term

In Massachusetts, there is a long-established tradition of protection of public shade trees, established through the Public Shade Tree Law MGL Chapter 87, which also allows each municipality to designate a Tree Warden. In Carlisle, the Tree Warden is the Superintendent of the Department of Public Works. The Tree Warden has a responsibility for advising on the maintenance of public shade trees in the public right of way and on public properties.

Under the Scenic Road Bylaw, the Carlisle Planning Board's approval is required for cutting (including trimming of major branches) or removing trees within the public right-of-way of any road designated as a Scenic Road.

The Carlisle Conservation Commission has a Tree Removal and Mitigation Policy that guides compliance with regard to tree removal under the MA Wetlands Protection Act and Carlisle Wetlands Bylaw. As such, it applies only to jurisdictional areas, which are:

- Wetland Resource Areas, defined as 100-year floodplains, wetlands, streams, Bank, ponds, and marshes.
- Riverfront Areas - Land within 200 feet of a perennial stream.
- Certified Vernal Pools.
- Buffer Zones - Land within 100 feet of a Bordering Vegetated Wetland or Bank.

Within these areas, tree removals must be approved by the Conservation Commission, or, if fewer than 5 small trees or 3 medium trees, by the Conservation Commission staff following a streamlined review and approval by the Conservation Commission within its regular public meeting. Mitigation by planting additional trees may be required, and guidelines for the tree replacement are provided in the policy. Importantly, this policy does not apply in areas outside of Conservation Commission jurisdiction.

Together, the Bylaws above protect trees that are on public lands, within public rights-of-way, or within the jurisdiction of the Conservation Commission. This establishes a significant network of areas where trees are protected across the landscape in Carlisle. Nonetheless, residents have raised concerns about trees being cut in the following areas:

- along roadways, primarily as a result of clearing for power lines or out of concern for safety from falling limbs, and
- on private property where trees can be removed without oversight from the Town that could consider the ecological, cooling, and hydrologic impacts of such cutting on the subject property as well as adjacent areas.

The concerns above highlight two different settings with different sets of interests: one is the public roadway right of way, and the other is private property.

Recommendations:

A general bylaw for the purpose of tree protection on both public and private property would allow the Town to define standards for tree maintenance, removal, protection, planting, and timing of such that considers wildlife (i.e., nesting). These types of bylaws typically establish certain characteristics that define a tree worthy of protection (size, type, heritage, etc.) on private property in particular, to limit the Town's jurisdiction over trees on private property.

Alternatively, the Town could consider focusing only on public trees by developing a Tree Protection Policy for public properties and rights-of-way that could be implemented by the Tree Warden in their decision-making process.

The Town Tree Warden together with the Conservation Commission, Environmental Sustainability Committee, Planning Board, and other committees could develop educational materials on the benefits of having healthy and well-maintained landscapes to counter a trend (perceived or actual) that large trees are being cut at an accelerated rate due to fears of trees falling and structural property damage. In addition, homeowners should be encouraged to make mindful decisions. This would be based on the fire prevention benefits of clearing dead trees and underbrush from areas near structures, and the importance of maintaining the health of trees that are in proximity to structures.

Resources:

- MA DCR Guide to Local Tree Bylaws for Communities in Massachusetts. March 2021.
- Tree Protection Ordinance of the City of Cambridge
- Laws and Policy Governing Trees in Dover, MA (similar regulatory framework as Carlisle)

THEME 2: FIRE PROTECTION

4. *Work with large landowners and conservation organizations to develop forest management plans for forest fire mitigation*

Tools/methods: Town action, education, GIS
Goals advanced: Housing resilience, forest fire prevention/mitigation
Responsible Parties: Fire Department, Environmental Sustainability Committee, Local Emergency Planning Committee, town staff
Timeframe: Short-Term

The risk of wildfires impacting Carlisle is expected to increase with climate change. Carlisle is a heavily forested community, with a relatively small number of large landowners controlling the majority of that forestland. Recent wildfires around the country, including those sparked by drought conditions in greater Boston and throughout eastern Massachusetts in recent years, have focused more attention on wildfire risk in the community.

In general, fire is a natural element in a healthy forest ecosystem. However, in the past, naturally occurring brush fire has been suppressed in forests in the interest of protecting private property and structures. This fire suppression can unfortunately result in a less healthy forest ecosystem and a buildup of available fuel in the forest, causing the risk of fire to increase even while fire prevention is the public safety goal. In addition, non-native invasive species that can be inadvertently introduced to local forests through landscaping practices can complicate the fire risk. They can be difficult to manage, and may have a different proclivity to survive and thrive in the fire suppressed conditions.

Recommendations:
In the interest of protecting properties from fire damage, Carlisle could undertake the following recommended actions to reduce forest fire risk:

- Convene a forest management working group, comprised of owners of large forest lands in Carlisle (individuals and organizations) and pertinent committees and staff, to develop guidelines or common practices to better manage forests to balance ecosystem health and the public safety risk from forest fires, and to ensure ecological and habitat protection.
- Develop a Community Wildfire Protection Plan, working with a committee that includes representatives from the Fire Department, Police Department, Recreation Department, Planning Department, Public Works Department, Local Emergency Planning Committee (if not already represented in previous departments), Environmental Sustainability Committee and others.

Resources:
- FEMA Creating a Community Wildfire Protection Plan (2020)
- Barnstable County Community Wildfire Protection Plan
- Northeast Region Cohesive Wildland Fire Management Strategy
- Northeast Wildfire Preparedness Resource Guide
- Massachusetts Report of the Climate Forestry Committee: Recommendations for Climate-Oriented Forest Management Guidelines

5. Educate homeowners on forest fire risk and mitigation options

Tools/methods: Town action, education
Goals advanced: Housing resilience, forest fire prevention/mitigation
Responsible Parties: Environmental Sustainability Committee, Local Emergency Planning Committee, Building Inspector, town staff
Timeframe: Medium-Term

In addition to managing forests to reduce wildfire risk, the risk of fire to structures can be mitigated through certain landscaping and maintenance practices by homeowners. New Englanders, typically, are not as familiar with such practices as residents of the southwest and western United States but increasing awareness of forest fires and the rising risk of wildfires in this region is raising interest among residents. The risk to homes can be mitigated through the choices of materials, the location of vegetation, the awareness of risks, and the availability of water.

The recommended action is to improve education among homeowners, developers, builders, and landscapers about the design choices they can make to reduce the risk of damage from wildfires. In Massachusetts, the Building Code is adopted at the state level for uniform application across the state; the Town of Carlisle does not have the ability under state law to institute additional building standards. However, homeowners can choose to implement building practices on their own property that may be considered more protective than the state building code, as well as practices that are outside of the purview of the building code, and may choose to do so if they are educated on the issue and potential risk reduction.

With wildfire risk continuing to grow around the country, more resources are being developed, and more research is being undertaken to evaluate building materials, building practices, mechanical and electrical systems, and approaches to landscaping, fencing, and outbuildings in response to wildfire. It would also serve the Town's goals to consider educating new homeowners with resources about backyard/forest management.

Recommendations:
The Building Inspector together with the Fire Department could prepare informational fliers for homeowners and could host informational sessions in town to highlight risk reduction practices, particularly any that have been installed in town. The Town could also collaborate with other towns in the region, and with professional builders' associations or businesses to share the information and identify examples.

Homeowners may be interested in accessing trainings or onsite assessments of their property to learn what they could do to be more prepared and reduce their property's risk to forest fire. A program similar to the "Request a Coach" program model used by the Heat Smart Alliance (www.heatsmartalliance.org) could be a helpful way to provide one on one support to homeowners looking for assistance. The Heat Smart Alliance works in Massachusetts, including in Carlisle, to help people learn more about sustainable heating and cooling options through a network of coaches. A "coach" could be trained to visit properties in Carlisle and talk with owners about their specific site conditions, vegetation, water sources, etc., in a way that could be more effective than general guidance. While these types of fire smart considerations could potentially result in home insurance credits, MA is

not one of the 14 states that require property insurers to reduce premiums on properties that have protection against disasters (Ellfeldt, 2024).

6. *Promote safe installation and use of onsite energy storage batteries as well as electric vehicles and electric bikes and scooters.*

Tools/methods: Town action, education, GIS
Goals advanced: Housing resilience, forest fire prevention/mitigation, resilient energy systems
Responsible Parties: Fire Department, Local Emergency Planning Committee, Building Inspector, Environmental Sustainability Committee, town staff
Timeframe: Short-Term

Many households in Carlisle are already using new battery technologies, including household energy storage batteries, electric and hybrid vehicles, and electric bikes and scooters. From a climate resilience perspective, these technologies are a beneficial shift from technologies that generate carbon emissions. They are generally even more beneficial in reducing the community's carbon footprint if the electricity used to power them is generated using renewable energy sources. As these battery powered technologies are adopted more widely, it is important that users of these technologies are informed about and prepared to address the risks associated with the lithium ion and other batteries that they use. Furthermore, as battery technology continues to evolve and improve, new installations would benefit from improved formulations that have a lower fire risk.

As we have seen in recent news stories associated with wildfires as well as local incidents, lithium-ion batteries have unique fire safety risks. These risks are being documented through experience and fire safety experts continue to work to develop firefighting approaches as well as fire safety building materials and practices to reduce the risk of fire from these batteries.[15] The fire from lithium-ion batteries burns hotter and faster than other fires, such as fire in a wood structure. They also leave behind toxic chemicals that require specialized cleanup. The Massachusetts Building Code is regularly updated by adopting and amending the International Construction Codes, and those codes are continually working to incorporate fire safety elements to keep up with new technologies. But the code is always at least a little behind the technologies. The ability for the Fire Department to effectively and safely fight a lithium-ion battery fire can be elevated significantly if they are properly prepared for this unique situation by knowing the location of such battery technologies.

Recommendations:
There are several recommendations to address this issue, all centered around education and awareness.

Local Fire Department Registry: Develop a local registry for the Fire Department documenting what homes have energy storage batteries, electric and hybrid vehicles, and electric scooters. This registry could be maintained in the GIS system so that locations can be mapped, and that mapping can be referenced when fires occur. Installation of a home energy storage battery requires a permit from the building inspector, and therefore the location of the installed battery can be tracked by the Town upon installation. This is already underway in Carlisle through the Fire Department and could be expanded to other technologies. Tracking of registered vehicles is less straightforward and should be investigated with the Department of Motor Vehicles and the tracking of Excise Taxes to

[15] See https://www.nfpa.org/education-and-research/home-fire-safety/lithium-ion-batteries.

determine if the registered location of hybrid and electric vehicles can be legally deciphered from those sources. This effort would be undertaken by the Fire Department in conjunction with the Building Inspector, the GIS staff, and the Local Emergency Planning Committee.

Public Education Campaign: A public education campaign could foster a system of voluntary registration of lithium-ion battery technologies at individual homes in town. The campaign would let people know of the benefits for safely and effectively fighting fires if the Fire Department is aware of potential risks before arriving on scene. The National Fire Protection Association (NFPA) maintains a website full of safety materials about lithium-ion battery safety, including lesson plans, social media cards, press release templates, safety tip sheets and more, which can be easily accessed on the NFPA website (https://www.nfpa.org/education-and-research/home-fire-safety/lithium-ion-batteries.

Home Window Notification Stickers: Stickers placed on a home window could be used to indicate to first responders that there is an electric car, home energy storage battery, electric scooter, or other lithium-ion device in the home or particular room that could require special attention in firefighting. This could be approached similarly to Tot Finder and Pet Alert fire safety window stickers in use over many years.

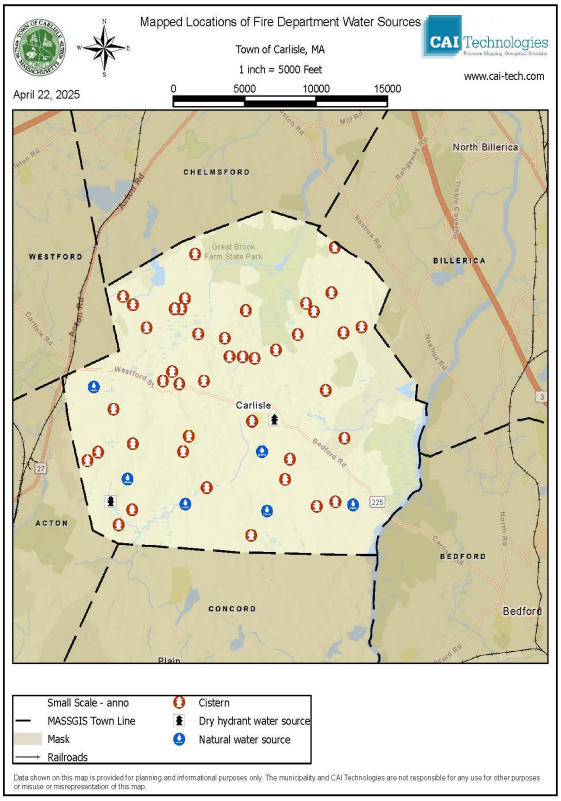
7. Map, analyze service areas, and increase the number of firefighting cisterns and other water sources throughout town

Tools/methods: Change in town policy, education, GIS
Goals advanced: Housing resilience, forest fire prevention/mitigation
Responsible Parties: Environmental Sustainability Committee, Local Emergency Planning Committee, Selectboard, town staff
Timeframe: Short-Term: Mapping and Analysis (in Progress); Long-Term: Installation of cisterns

Carlisle has been working to eliminate areas of town that are beyond the reach of a fire hose attached to an existing water tank or cistern. The Town currently has 42 cisterns located throughout town to assist with firefighting, along with two dry hydrants and six natural water sources available to the Fire Department (next.axisgis.com/CarlisleMA/). When a new subdivision is developed, the developer is required to consult with the Fire Department and install a cistern for firefighting if needed. The Fire Department maintains a list of the cistern locations and is beginning to locate them in the Town's GIS for mapping reference. However, there can be challenges to a fire truck accessing a given cistern or determining the most efficient access to a cistern for any given fire, due to the length of the hose, the street configuration, and the route to the cistern and the fire.

Recommendations:

Carlisle is currently building a centralized GIS system to map and track town infrastructure, resources, and other geographic information. A primary recommendation to improve resiliency is to map the locations of each of the firefighting cisterns in town, noting the size of the cistern and any other pertinent details that would assist the Fire Department in preparing to use that cistern. Within ArcGIS, but using an additional extension to the Town's GIS software, the town has begun to analyze the service area of each cistern based on the length of available hoses and the fire truck access routes. The sources of water for each cistern can also be located and assessed to track the availability of water for refreshing the cisterns as needed. Once cistern locations, service areas, and water supplies are mapped, the Town can assess and prioritize areas of town that may need additional fire fighting water tanks installed. This can also assist the Fire Department in reviewing proposed subdivisions for fire safety needs. In addition, the installation of cisterns can potentially benefit homeowners through lower insurance rates as well as a better ability to assess their own fire safety risk.



THEME 3: FLOOD, WETLANDS, AND DRAINAGE

8. *Separate wetlands from floodplains in the Zoning Overlay District as a first step toward strengthening floodplain and wetland protections.*

Tools/methods: Change in local code
Goals advanced:
Responsible Parties: Planning Board, Zoning Board of Appeals, Conservation Commission **Timeframe**: Short-Term

Floodplains often contain wetlands, and wetlands are often found within floodplains. However, the legal frameworks for defining and protecting each have distinct goals. Floodplains are typically defined and delineated by FEMA as part of the National Flood Insurance Program (NFIP), with the purpose of identifying areas of flood risk to structures. These maps, called Flood Insurance Rate Maps (FIRMs) primarily serve to differentiate areas of different flood risk in order to set flood insurance rates. However, these maps and the Flood Hazard Zones depicted on them are typically used in MA (and elsewhere) to regulate development and protect the functions of floodplains in the environment.

In order for a community to participate in the FEMA NFIP, a community must have a local floodplain management regulation intended to protect structures, infrastructure, and people against damage and injury due to floods. Carlisle has a zoning overlay district called the Wetlands/Flood Hazard Overlay District for this purpose. Note, however, that wetlands are included in the zoning district.

In Massachusetts, wetland regulations at the state and local jurisdictional level are focused on the natural environment and protecting the unique natural resources and ecosystem services provided by wetlands. The boundaries of wetlands are determined in the field by a scientific delineation method and reflect the current conditions (recognizing seasonal variation). In contrast to the FEMA FIRM floodplain boundaries, they are not mapped across the entire town at one unique point in time and do not reflect a statistical risk of inundation. Wetlands are delineated for each unique location as part of a particular land development (and associated land protection) process and delineation approvals are granted by the local Conservation Commission in response to applications. Therefore, there is not a single reference map that can be used to determine wetland boundaries–they can change. The purpose of wetland protection regulations is primarily to protect the wetland system from infringement by development, not to protect the property or structure from infringement by the wetland.

Despite these distinct goals, because wetlands and floodplains overlap geographically, Carlisle (and many other communities) include floodplain issues in their wetland regulations and wetland issues in their floodplain zoning. This creates confusion and is not entirely logical. In Carlisle, floodplain management is achieved through the “Wetlands/Flood Hazard Overlay District” within the local zoning code. The boundary of this zoning district is actually defined, however, by the floodplain boundary. The wetlands are almost entirely ignored in the zoning district code. In addition, wetlands are protected separately in Carlisle through the MA Wetlands Protection Act and Regulations, implemented by the Conservation Commission, and through the Carlisle Nonzoning Wetland Bylaw. Under these codes, wetlands are delineated on a case-by-case basis associated with land alteration applications. Because the wetlands are not a mapped district, the inclusion of wetlands within the Wetlands/Flood Hazard Overlay District is needlessly confusing. Confusing regulations are harder to enforce.

Recommendations:

Therefore, the recommended action is to remove all references to wetlands from the Flood Hazard Overlay District so that it can focus uniquely on protecting property from flood damage by keeping development out of the floodplain. The state and local wetlands protection codes can protect wetlands for purposes of preserving ecosystem services, including flood mitigation benefits, provided by wetlands.

9. Strengthen flood protection by expanding the flood boundary in all local regulatory codes

Tools/methods: Change in local code
Goals advanced: Flood mitigation, housing resilience, ecosystem protection
Responsible Parties: Planning Board, Conservation Commission
Timeframe: Short-Term

Carlisle has experienced and is expected to continue experiencing more frequent and more severe storms due to the impacts of climate change. This will result in more inundation (higher floodwaters) as well as a more spread out/wider floodplain. Carlisle relies on FEMA mapping to determine the locations of the floodplain, but the maps are inherently backward looking and generally outdated. Carlisle's FEMA FIRM maps were issued in 2014. They rely on modeling and statistics representative of past conditions and past risk, not current and future risks. FEMA maps do not represent risk of flooding in the future as a result of climate change, nor do they consider how risks may change after they are adopted. The science of climate change projections, including precipitation changes and floodplain changes, is continuing to evolve and improve, as is the extent of floodplains themselves.

Carlisle's codes and policies reference the floodplain for regulatory purposes in a variety of different codes using a variety of different terms, including the "FEMA floodplain" or the "100-year floodplain." Flood hazard or the floodplain is addressed in the following Carlisle codes and regulations:

- Zoning Wetlands/Flood Hazard Overlay District
- Water Supply Regulations
- Wetland Protection Bylaw
- Board of Health Regs for Review of Subdivision, CC, ROSC, and SROSC
- Subdivision Rules and Regulations

The Subdivision Rules and Regulations (Article II, Section 6.B.1.I) actually require that a Definitive Plan include the boundary of the 100-year floodplain as well as the 500-year floodplain, although there is no guidance for how the 500-year floodplain is evaluated by the Planning Board or used to regulate the development plan.

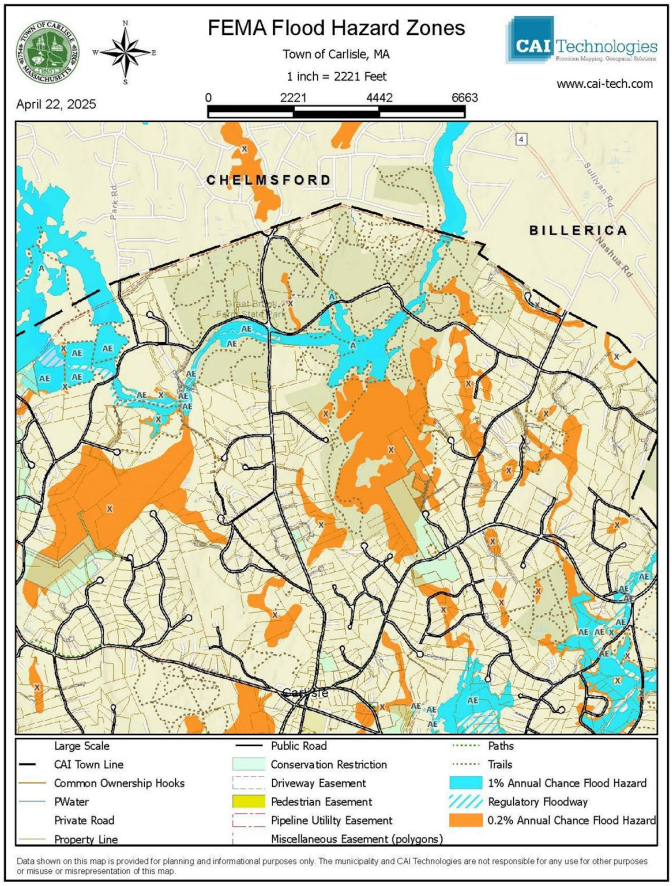
Recommendations:
We recommend that Carlisle create a single standard floodplain definition for use across all codes in order to create clarity and consistency for all users of the code. In addition, a single definition referenced by all codes will make it simpler to update that definition in the future as climate science and projections improve and become more readily useful.

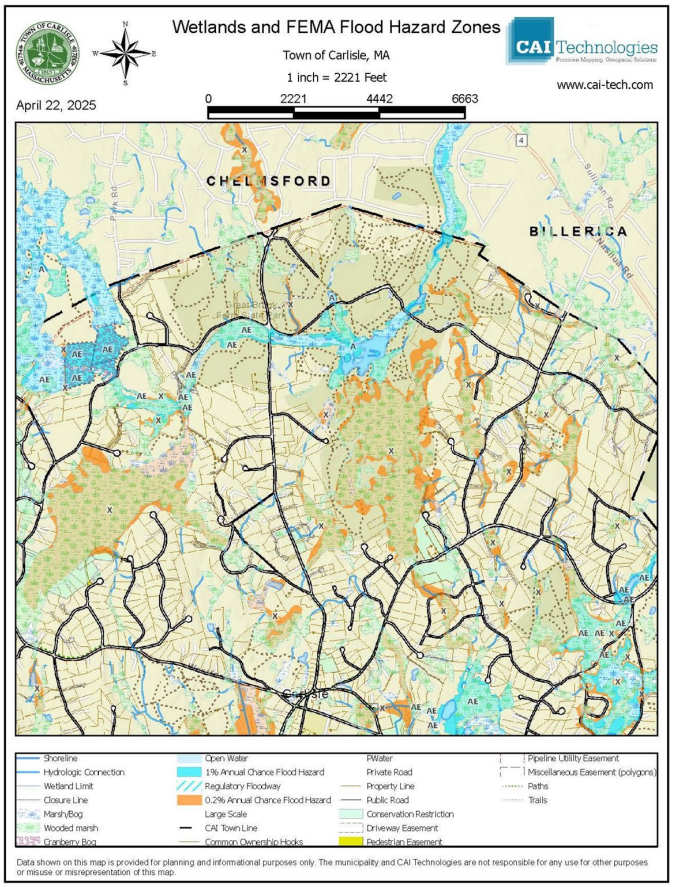
For the current day, we recommend that Carlisle consider adopting the FEMA 0.2% annual chance floodplain as the definition for floodplain (colloquially known as the 500-year floodplain). This expands the boundary of the floodplain beyond the 1% annual chance floodplain (colloquially known as the 100-year floodplain) to recognize that the current mapped floodplain underestimates current conditions. FEMA has recently begun mapping the 0.2% annual chance flood for the purpose of informing users about how the floodplain is likely to expand. Using the 0.2% annual chance floodplain will restrict

development in existing vulnerable areas and in areas that are becoming more vulnerable due to climate change.

This approach is consistent with FEMA's approach through the Federal Flood Risk Management Standard (FFRMS) policy,[16] which identifies additional protections for flooding when constructing projects with federal grant funding. Using the 0.2% annual chance floodplain is one of the methods for determining how to consider where to build given increased risks.

The 0.2% annual chance floodplain is very similar to the estimated extent of wetlands mapped by the MA DEP Wetlands data layer. This is logical given that this is the area that forms the floodplain under





extreme wet conditions. The difference in the total composite area that is regulated as either floodplain or wetland does not change significantly when the floodplain is defined by the 0.2% annual chance flood instead of the 1% annual chance flood. However, the area can now be better protected from development to preserve the wetland habitat and flood attenuation purposes it serves, and development on adjacent properties can also be better protected from flood damage.

[16] FFRMS was established by executive order in 2015, rescinded in 2017, reinstated in 2021 (and both FEMA and HUD went through rulemaking processes to establish their procedures for it), and rescinded again in 2025. While the executive order is no longer active, the FEMA and HUD rules currently are. The science behind the FFRMS analysis is still useful, even if it is no longer required per executive order.

10. Provide enhanced protection for wetlands

Tools/methods: Change in local code
Goals advanced: Ecosystem protection, flood mitigation, water resource protection
Responsible Parties: Conservation Commission, Planning Board, Board of Health, Town staff
Timeframe: Short-Term

The Conservation Commission implements the local Wetlands Protection Bylaw and has the authority to adopt regulations to implement the bylaw. In addition, the Conservation Commission also implements the MA Wetlands Protection Act and Regulations. Currently, the local wetlands bylaw protects the same resource areas and buffer areas that are protected by the state. The Commission could consider including stronger protections against alteration within the buffer area (generally 100 feet from wetland resources) and riverfront area (the 200-foot protected resource area adjacent to each side of streams and rivers). While these areas are regulated and therefore proposed alteration within these areas is reviewed, significant alterations are still permitted under current regulations.

The Commission could include provisions to more strongly restrict alteration in the portions of the buffers that are closest to the wetland or stream. These areas provide water quality filtering benefits and sensitive habitat areas.

In addition, the Commission could strengthen the water quality protection of the local wetlands bylaw and regulations by strengthening the stormwater management requirements implemented through these codes. Stormwater management in compliance with the MA Stormwater Standards and Handbook is required for discharges to protected wetland resource areas for projects that fall within the applicability framework.

Notably, "The Stormwater Management Standards shall not apply to:

(1) A single-family house;
(2) Housing development and redevelopment projects comprised of detached single-family dwellings on four or fewer lots provided that there are no stormwater discharges that may potentially affect a critical area;
(3) Multi-family housing development and redevelopment projects with four or fewer units, including condominiums, cooperatives, apartment buildings and townhouses, provided that there are no stormwater discharges that may potentially affect a critical area; and
(4) Emergency repairs to roads or their drainage systems.

The Stormwater Management Standards shall apply to the maximum extent practicable to the following:

(1) Housing development and redevelopment projects comprised of detached single-family dwellings on four or fewer lots that have a stormwater discharge that may potentially affect a critical area;
(2) Multi-family housing development and redevelopment projects, with four or fewer units, including condominiums, cooperatives, apartment buildings, and townhouses, that have a stormwater discharge that may potentially affect a critical area;

(3) Housing development and redevelopment projects comprised of detached single-family dwellings on five to nine lots, provided there is no stormwater discharge that may potentially affect a critical area;
(4) Multi-family housing development and redevelopment projects with five to nine units, including condominiums, cooperatives, apartment buildings, and townhouses, provided there is no stormwater discharge that may potentially affect a critical area;
(5) Marinas and boat yards, provided that the hull maintenance, painting, and service areas are protected from exposure to rain, snow, snow melt, and stormwater runoff; and
(6) Footpaths, bike paths and other paths for pedestrian and/or nonmotorized vehicle access."

As a result, the MA Stormwater Standards are actually rarely applied to development through the state Wetlands Protection Act and local Wetlands Bylaw in Carlisle.

Recommendations:

The Conservation Commission could include a provision in the local wetland protection bylaw to apply the MA Stormwater Standards more broadly to require improved stormwater management on certain additional projects. One consideration may be to require compliance with some or all of the stormwater management standards for projects that create or redevelop over a certain square footage area of impervious cover and discharge to a wetland, regardless of project type. This can help to protect groundwater and wetlands from pollution and erosion. However, this recommendation should also consider that stormwater runoff from a residential home rooftop and driveway is likely to contain less pollution than runoff from a commercial parking lot, for example.

Stormwater management is regulated through the Definitive Plan process under the Carlisle Subdivision Rules and Regulations. Article II, Section B.1(x) requires that, "Storm drainage runoff calculations used to show stormwater drainage design shall conform to the Mass DEP Massachusetts Stormwater Handbook (latest edition)." However, as noted above, this handbook (which is now updated to the MA Stormwater Standards) does not apply to small subdivisions. The Carlisle Planning Board could consider updating the Subdivision Rules and Regulations to specify a smaller minimum size subdivision for which the MA Stormwater Standards would be applied.

In addition, Carlisle could require stormwater management designs to reference more up to date precipitation statistics for Carlisle, based on NOAA Atlas 14 Precipitation Frequency Estimate, Volume 19 (2019), rather than the 1961 USGS Technical Paper 40 statistics, which is referenced currently under the MA Stormwater Handbook. The newer statistics reflect a larger and more modern timeframe, so that recent changes in precipitation patterns are captured in the statistics. The Town could consider going further to essentially buffer the design storm volumes to recognize that anticipated future design storms will be larger. MA DEP is currently considering such an approach in draft revisions to the MA Stormwater Standards, which have been under review for several years. Carlisle could consider adopting the approach under review or await approval at the state level, which would automatically apply to Carlisle.

Resources:

MA Stormwater Advisory Committee Meeting Presentations. https://www.mass.gov/info-details/massachusetts-stormwater-management-updates-advisory-committee See Presentation from Meeting 7 (Jan 9, 2024)

11. Clarify ownership and implement maintenance program for roadside agricultural ditches/swales

Tools/methods: Change in town policy, town action
Goals advanced: Ecosystem protection, flood mitigation, and local food/farming
Responsible Parties: Conservation Commission, Agriculture Commission, Public Works Department, Local Farmers, Town staff
Timeframe: Medium-Term: Convene discussions

Many older New England communities are home to farms that are both iconic and face challenges. As development has evolved around older farm properties, the farms sometimes struggle to maintain their historic agricultural practices in concert with suburban growth. In response, Carlisle, like many other communities, has established itself as a 'Right to Farm' community with a Right to Farm Bylaw that works to alleviate regulatory and development growth challenges to farming. One issue that is not entirely resolved in this relationship with farming in Carlisle is in the maintenance of drainage ditches along the edge of agricultural fields, which also happens to be along the edge of public roads. In these cases, a question arises as to who has the responsibility or the authority to maintain the ditch, and what the allowed maintenance practice is. This may sound simple, but it can quickly get complicated in the face of wetland protection codes, agricultural exemptions, and public works drainage responsibilities.

These drainage ditches can often present as wetlands that meet the definition of a wetland resource area under the Wetland Protection Act and local bylaw. As such, it can be difficult to legally "maintain" the ditch, since cleaning out debris and sediment to clear a ditch would essentially be alteration of a wetland. Lands in agriculture have exemptions under the Wetlands Protection Act and regulations, but only if they meet certain requirements.[17] If the ditch is not actually on the farmland but rather on the town right-of-way, it is difficult to obtain the agricultural exemption. Over time, the lines between roadside drainage ditch and agricultural field ditch become blurred, as do the boundaries between old farm fields and road rights of way. This leaves the farmer and the Town uncertain about maintenance responsibility, permissions, and costs. A similar uncertainty can arise along residential properties as well, but the focus here is on farmland for now.

Protecting and facilitating the continued success of farmland in Carlisle contributes to Carlisle's resiliency by maintaining local food and open space, as well as cultural heritage. During discussions related to this project, support for local, sustainably produced food and the local economy was expressed, with an emphasis on an improved relationship between the Town / Carlisle Public School and Clark Farm.

Recommendations:
The recommended action is for the Town's Conservation Commission, Agricultural Commission, Public Works Department and farm stewards to convene for discussions to clearly delineate the problem areas, determine ownership, understand applicable regulations, and develop an approach to maintenance that meets the farmers' needs, the Town's drainage needs, and the applicable legal standards for this work.

[17] Farming in Wetland Resource Areas, A Guide to Agriculture and the Massachusetts Wetlands Protection Act. Commonwealth of Massachusetts. July 2005. www.mass.gov/files/documents/2016/08/nq/farman.pdf

THEME 4: HOMES AND BUILDINGS

12. *Facilitate a process that supports updates to historic structures that aim to improve energy efficiency, renewable energy, and climate resilience while preserving historic value.*

Tools/methods: Change in town policy, education, town action
Goals advanced: Social resilience, housing resilience, flood mitigation, carbon emissions reductions/efficiency, resilient energy systems
Responsible Parties: Historical Commission, Environmental Sustainability Committee , Planning Board, Building Inspector
Timeframe: Medium-Term

Carlisle is home to many historic buildings, a historic district, and many old houses that may or may not be considered historic. There are several resilience and sustainability goals[18] to consider with these buildings, including updating/retrofitting buildings to enhance energy efficiency and climate resilience and maintaining structures and building materials to the greatest extent possible.

Carlisle's Historic District and Historical Commission are authorized by Article 9 of the Town's General Bylaws. The Rules and Regulations of the Carlisle Historical Commission (CHC) state that the CHC was established in 1969 to manage the Historic District. In 1976, the Town voted to expand the powers of the CHC to include "advisory responsibilities for the historical resources of the entire town." However, the CHC Rules and Regulations only refer to the Historic District and do not provide guidance on how the CHC shall implement those advisory responsibilities. As a result, the CHC's responsibilities in guiding the preservation of historic resources outside the Historic District are vague and without regulatory power.

Historic preservation has traditionally meant keeping structures and neighborhoods as close as possible to what they looked like at a given period in time. However, as the climate changes, strict preservation without adaptation may lead to more damage and destruction than making thoughtful changes. Older homes and structures no doubt have challenges with energy efficiency and traditionally rely on older plumbing, heating, and electrical systems that can be challenging to update without certain structural and other changes to the building. As a result, updating these structures with energy and resource efficient systems, insulation, and finishes can be a challenge, and can be quite costly. Furthermore, challenges related to flood resilience and moisture can also cause major concerns in older structures, which can require significant investment.

While the CHC maintains an advisory role outside the small Historic District, it could support resource efficient and resilience improvements in these historic structures by recognizing this challenge and assisting homeowners in implementing improvements that are sensitive to and aim to preserve the historic value of their home, without restricting the ability of the property owner to improve their resilience.

Nearby Reading, MA recently adopted a Policy Regarding New Technology within the Historic District. This policy states upfront that, "The Commission recognizes the importance of and encourages the use of energy efficient technologies and their use within the District." It goes on to provide some guidance on how the Commission should evaluate proposed technology installations including HVAC mini-splits

[18] There are also aesthetic values and historic preservation goals, but here we are focusing on the resilience and sustainability aspects.

and EV charging stations. Solar installations on rooftops are protected under state law (M.G.L. Chapter 40 Section 3), but other technologies and upgrades are not.

Recommendations:

We recommend that the Carlisle Historical Commission adopt a policy on climate change and historic properties, stating in effect that climate impacts are threatening historic places, and efforts to protect against those risks are positive changes and in keeping with the values of historic preservation. This policy should specifically consider incentives and pathways to allow upgrades to historic homes.

In addition to the policy, the Carlisle Historical Commission should explore whether, through funding from the Community Preservation Act, they could establish a small grant program to assist homeowners by offsetting a portion of the cost of energy efficiency and climate resilience upgrades to historic structures. This program could prioritize upgrades needed to allow senior citizens or other vulnerable populations to stay in their homes or age-in-place safely and comfortably, which promotes historic preservation and social resilience goals.

Resources:

There are many resources available on how to protect historic properties from flooding and other hazards, including:

- Concord, MA: Sustainability Guide for Historic and Older Homes
- Reading, MA: Historic District Commission Design Guidelines, including Policy Regarding New Technology
- National Park Service:
  - Guidelines on Flood Adaptation for Rehabilitating Historic Buildings
  - Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings
- National Advisory Council on Historic Preservation: Climate Change and Historic Preservation Policy Statement
- FEMA: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning
- House of Seven Gables – 30 Year Plan: Climate Resiliency - The House of the Seven Gables

13. *Preserve embodied carbon and reduce carbon emissions by preserving and reusing existing structures and building materials.*

Tools/methods: Change in town policy, education, town action
Goals advanced: Housing resilience, carbon emissions reductions
Responsible Parties: Environmental Sustainability Committee , Historical Commission, Planning Board, Building Inspector
Timeframe: Long-Term

The term "embodied carbon" refers to the greenhouse gas emissions arising from the manufacture, transportation, installation, maintenance, and disposal of building materials. (In the building sector, this contrasts with "operational carbon," or emissions from building energy consumption.) Embodied carbon can be preserved by reusing buildings and building materials rather than building new. This is emphasized in the 2020 Path to Net Zero Report: "given the magnitude of embedded emissions associated with new construction, [Carlisle] can lower emissions significantly if we factor them into reuse versus replace decisions for Carlisle's homes and buildings" (page 17). Carlisle is now familiar with this idea, having successfully recycled over 90% of the materials from the former Greenough Barn in the summer of 2024.

In contrast to demolition, which destroys a property without concern for its components, deconstruction is a process that pulls a structure apart to preserve its components so they can be reused. This essentially aims to preserve the embodied carbon in the structure. Some communities are promoting this deconstruction process by requiring deconstruction plans for certain demolition projects and requiring materials to be properly recycled and diverted from landfills. For example, all demolition projects in Boulder, CO must complete a Sustainable Demolition Plan, which requires 75% of the materials by weight to be diverted from the landfill. Austin, TX has a Construction and Demolition Recycling Ordinance that requires that 50% of the construction and demolition debris from commercial and multifamily demolition over 5,000 square feet be diverted from a landfill, or limits the landfill disposal of construction and demolition debris to no more than 2.5 pounds per square foot of permitted floor area.

These approaches rely on a recycling and reuse ecosystem in their metropolitan areas that can support these requirements. The Greater Boston area is a more challenging setting to employ these recycling and reuse requirements, but the available landfill disposal facilities are also growing ever more limited in the region. Additionally, these approaches have typically been employed for larger projects at institutions, commercial facilities, and large multifamily projects. They can be more challenging at the smaller individual home scale because of the smaller scale of the financial benefits achieved.

Article 4.3 of Carlisle's General Bylaws states that all construction and demolition projects require a permit:

> No building within the limits of the town, other than a one-story building for poultry or other farm purposes having a floor area of not more than twelve (12) by fifteen (15) feet, shall be erected, razed, moved, added to or altered in any way, nor the roof thereof reshingled or repapered, until the commissioner shall have issued a permit therefor.

Recommendations:

The existing building permit process would be a logical mechanism to use in implementing deconstruction and recycling plan requirements in Carlisle. A bylaw or policy could be developed to require, or require consideration of, deconstruction, waste management, or recycling/reuse in projects that otherwise aim to demolish a structure. However, more study is needed to understand the full waste stream that is or would be generated in Carlisle and the options available for reuse and recycling in the Carlisle area.

The Carlisle Historical Commission is currently working through the local process for adoption and implementation of a demolition delay bylaw, which could dovetail with or be a test case for this recommendation. A demolition delay bylaw – whether applied strictly to an inventory of historic properties or more broadly to a 50-year rolling clock of properties - could incorporate requirements for deconstruction as a mechanism to reduce or release the delay. The Historical Commission should also consider safeguards or provisions for elderly people who want to make changes to their homes that will enable them to age-in-place, without undue costs and barriers.

14. Reduce the environmental footprint of large homes and large landscaped yards

Tools/methods: Change in local code, education
Goals advanced: Ecosystem protection, housing resilience, water resource protection, carbon emissions reductions/efficiency
Responsible Parties: Planning Board, Conservation Commission, Environmental Sustainability Committee, ZBA,
Timeframe: Long-Term

All other things being equal, a larger home and a larger landscaped yard area will have a proportionally larger environmental footprint than a smaller home. Homes use building materials that have to be procured, produced, and transported to the site, all of which takes energy and uses natural resources. Once the home is built and occupied, it must be heated and cooled, which also takes resources. The occupants must have access to water and a way to dispose of wastewater. A conventionally landscaped yard often means a yard with less dense and more manicured vegetation, often supporting little or no beneficial fauna, which can use power equipment, irrigation water, and added chemicals in its maintenance. The length and configuration of a driveway is often determined by preference to access a home's front door and garage and buffer one's home from neighbors, and increasingly to provide additional parking for family cars and visitors, turnaround areas, and even basketball or pickleball sport areas. All of these facets of residential living are common and can be adjusted to increase or decrease the overall environmental footprint. By default, a large, landscaped yard and home typically require a tradeoff between developed area and vegetated, undeveloped areas.

Recommendations:
Carlisle could explore the possible use of a size limit or review requirement for large single-family residences and lowering the allowable limits on lot coverage on residential lots. Currently, the Zoning Bylaw states (Section 4.4), "Lot Coverage. No building shall be erected to cover, together with all other buildings on the lot, more than twenty-five per cent (25%) of the total area of the lot if in General Residence A or B Districts, or more than seventy-five percent (75%) of the total area of the lot if in Residence District M or a Business District." For a one-acre residential lot, this allows a structure or structures to occupy almost 11,000 square feet, and for a two-acre lot, almost 22,000 square feet. Further, impervious driveway size could be limited or requirements for stormwater management for those impervious areas could be applied to driveways and rooftops, as discussed earlier under Recommended Action #2 for resilient landscaping.

Examples for MA communities that are trying to manage the increasingly large size and impact of residences include:

Wellesley Large House Review (Section 5.9 of the Zoning Bylaws): Homes that are proposed to be above certain square footage of living area plus garage space are required to go before the Planning Board for review and compliance with a set of design criteria that address preservation of landscape, scale of buildings, lighting, open space, drainage and circulation. Specific limits apply to different districts and lot sizes.

Needham Large House Review Study Committee: Needham has convened a study committee to evaluate the issue of increasingly large homes replacing smaller homes, and to develop a warrant article for consideration by October 2025.

Weston Residential Site Plan Approval for Large Homes: Weston requires Site Plan Review for homes with a residential gross floor area greater than 3,500 square feet and greater than 10% of the lot area, and all homes with a residential gross floor area greater than 6,000 square feet regardless of lot size. The Planning Board has developed a set of guidelines that addresses landscape buffer, materials, new landscaping, lighting, stormwater, septic and drainage structure siting, house and driveway siting, and other features.

Other communities including Cohasset, Edgartown, Scituate, Truro, and Chilmark also have large home review processes.

THEME 5: INFRASTRUCTURE [19]

[19] The power, water, and wastewater actions in this section are all infrastructure. However, unlike in many communities in Massachusetts, in Carlisle, water wells and septic systems are all privately owned and managed. Therefore, the actions and responsible parties are different in Carlisle.

15. Evaluate power line problem areas, and assess the potential to install power lines underground, starting in strategic locations

Tools/methods: Change in town policy, town action
Goals advanced: Housing Resilience, Resilient Energy Systems, Emergency Response
Responsible Parties: Local Emergency Planning Committee, Planning Board, Select Board
Timeframe: Short-Term: Engage EverSource; Long-Term: Underground targeted power lines

As the climate changes, Carlisle can expect more frequent and more severe storms with strong winds. Carlisle is a heavily forested community, and much of that forested area abuts roadways and electrical infrastructure. Heavy winds and powerful storms can knock down tree limbs and entire trees, which can take power lines down. This type of power outage is quite frequent throughout Carlisle, as was expressed widely in discussions with residents, staff, and local boards and commissions throughout this project. The town is particularly vulnerable to power outages because residents rely on electric pumps to access water from their private water wells. Therefore, a power outage of any significant time period also means a water emergency. In addition, downed tree limbs and downed power lines can also cut off access routes to individual homes and neighborhoods following storm events. Power outages and restricted access have become somewhat routine during storm events in Carlisle, and residents have come to expect these challenges. Reducing these incidences of and impacts from downed power lines would improve the resilience of the community immensely.

A long-term measure to reduce downed power lines is to install the power lines underground so that they are no longer exposed to falling trees and limbs. However, during recent conversations the Town has had with Eversource and their arborist, staff have learned that undergrounding electrical wires can damage the roots of trees and initially require an equal if not greater amount of tree removal than is typically proposed to minimize impacts to overhead wires. Moreover, undergrounding electrical wires is prohibitively expensive to implement ($1-$1.5 million per mile) across an entire town and also highly complicated due to wetlands, narrow rights-of-way, ledge, and other site-specific conditions. Carlisle does have a requirement in Section 5.K. of Article III. Design Standards of the Subdivision Rules and Regulations that new developments should have underground electricity. It states, “Electricity, cable television and telephone services and other utilities shall be installed beneath the ground in the Subdivision in accordance with accepted power, cable television, and telephone company practice, except where geological considerations, in the opinion of the Board, make such installation impractical.” While this addresses new subdivisions, it does not apply to existing developed areas or existing power lines.

Recommendations:

The recommended action to address this issue is to work with the Town’s electrical utility, Eversource, to continue identifying locations where power lines are particularly vulnerable during storm events, based on past experience. Following consideration of tree trimming, the Town should work with Eversource to explore whether undergrounding wires for some limited areas could be helpful to reducing power outages. Eversource has a community liaison that serves each of its client communities, and that person should be engaged regularly on this topic.

As part of this discussion, consideration should be given to the frequency of downed lines, the extent of outages resulting from downed lines in a given area, the vulnerability of the population that experiences the power outages, and the impacts to physical access to and from nearby neighborhoods as a result of past downed power lines. In addition, consideration should be given to the physical, habitat, cooling, and flood mitigation tradeoffs between undergrounding power lines and cutting adjacent limbs or buffers of trees in order to protect the power lines[20]. The Town's GIS system could be used to map these locations and assess the service areas that are accessed through these locations. Areas that experience more frequent or longer duration outages and that serve more vulnerable populations should be assessed in more detail to explore infrastructure improvement options as well as maintenance options. This effort could be coupled with the Town's roadway improvements schedule to address common needs and minimize disruption.

[20] At the time of drafting this report, Eversource had approached the town with a request for permission or notification to cut over 600 trees on municipal land and another 600 trees on private land as part of its power line maintenance program.

16. Better define and understand the protections offered by and constraints created by local septic system and well standards

Tools/methods: Education
Goals advanced: Ecosystem protection, housing resilience, water resource protection
Responsible Parties: Board of Health, Planning Board, Town staff
Timeframe: Short-Term

Development in Carlisle is dependent on private water from individual private onsite wells and private onsite wastewater treatment and disposal through onsite septic systems. The design and construction of this infrastructure is regulated by the Carlisle Board of Health, under state and local regulation. This reliance on private onsite wells and septic systems makes groundwater protection and hydrogeology very important in the town of Carlisle. Understandably, town residents and staff are acutely concerned with ensuring that wastewater disposal does not contaminate drinking water and surface waters and that the drinking water supplies at individual wells remain adequate to support the development that depends on them. Climate change places an added pressure on water resource protection, as precipitation patterns change, groundwater tables shift, temperatures increase, and flood frequency increases.

Although there appears to be a general and accepted heightened concern for resource protection, the tools used to manage water supply and wastewater management in the local regulations are not as well understood across the community. The community is being asked to make decisions about resilience and adaptation to changing environmental conditions in the face of climate change, and it is increasingly important that the citizenry of Carlisle understand the implications of Carlisle's local drinking water and wastewater regulations. A better understanding of the basic science and methodology behind the standards can lead to more informed decisions around development approvals and municipal planning and policy.

Why is this important in the realm of climate resilience? Standards that protect the community's water resources into the future can increase the resilience of the community. Standards that allow for a variety of housing types and that allow for some housing to be constructed close together can create more housing options for those in Carlisle that need or want to maintain social connections. All of these elements contribute to increased resilience in the face of climate change, including chronic changes and acute stressors.

Discussion of Drinking Water Quantity Standards for Private Wells

Drinking water wells for residential use are regulated by the Carlisle Board of Health through the Carlisle Water Supply Regulations. These regulations include requirements for submitting well development data and information to the Board, but they do not specify how the Board is supposed to assess the suitability of the well for the intended use. The state has issued Model Regulations (see Resources below) that include a method for calculating the peak demand and average household daily demand for a given residence based on bedrooms (surrogate for number of people) and number of bathrooms (plumbing fixtures creating demand). This provides a target for the well development to ensure that the well can actually provide enough water supply to sustainably serve the residence. The current Carlisle

regulations do not include this calculation requirement. In addition, the Carlisle codes do not require that well testing at a development site occur before site clearing or construction occurs; this work is therefore done at the owner's risk and with potential needless destruction of natural habitat. The state's Model Regulations include provisions to ensure well testing is completed and approval is issued prior to issuance of a building permit. The Carlisle Board of Health is currently considering updates to the Water Supply Regulations that consider the provisions in the state's Model Regulations.

Discussion of Septic System Design Flow Standards

Title 5 of the State code regulates the design and sizing of onsite wastewater disposal systems. The design flow to which a residential system must be designed is defined in Title 5 based on the number of bedrooms. Generally, the design flow per bedroom is 110 gallons per day (GPD). The number of bedrooms is used as a surrogate building block to estimate the amount of wastewater flow that would be generated. Obviously, a bedroom does not generate wastewater; rather the people that inhabit that bedroom generate wastewater. The use of a bedroom as a measuring unit is predicated on assumptions about the number of inhabitants per bedroom (2 people), and reflects the wastewater generated by those inhabitants through the various sources in a home, including toilet, shower, sink, and kitchen sources. As such, the number of kitchens and bathrooms is not relevant to the estimated design flow, nor is the number of units to which the bedrooms are assigned. In addition, the estimated wastewater flow of 110 GPD/bedroom was developed decades ago and predates many low-flow and water-efficient plumbing fixtures that have come into common use since then. Therefore, it is logical that the design flow of 110 GPD/bedroom is an overestimate of the actual flows generated by two residential inhabitants. In addition, Title 5 requires a minimum design flow equivalent to three bedrooms (330 GPD) for individual residential systems. The number of people in a household can routinely be lower than 6 people (2 per bedroom).

The Carlisle Supplementary Regulations for Sewage Disposal require greater design flows per bedroom than Title 5 for single unit dwellings and additional greater design flows per bedroom for multi-unit dwellings. The Carlisle design flow requirements per bedroom are 50 percent greater than Title 5's 110 GPD/bedroom, for the first three bedrooms and then incrementally less/bedroom as the total number of bedrooms increases. As depicted in the table below, the design flows in the local regulations are more conservative than the already conservative design flows in Title 5, and treat bedrooms in multi-unit dwellings differently than bedrooms in single unit dwellings. Functionally, if an additional unit such as an ADU were to be added to residential parcel, the additional bedroom of the ADU would be required to meet the 165 gpd/bedroom flow rather than the lower flow rate of 110 or 125 gpd, if it were actually the 5th or 6th bedroom in a home on the parcel. The implication of these conservative standards is that wastewater disposal costs for multi-unit dwellings are greater, both due to the cost of the system and the cost of the necessary land to accommodate the system.

15.203: System Sewage Flow Design Criteria

Single Unit Dwelling must meet the following design flow requirements:

# Bedrooms	*Design Flow/Bedroom (GPD*)*	*Total Design Flow (GPD)*
*3 Bedrooms***	*165*	*495*
4 Bedrooms	*150*	*600*
5 Bedrooms	*125*	*625*
6 Bedrooms	*110*	*660*
>6 Bedrooms	*110*	*110/bedroom*

Multi-Unit Dwelling must meet the following design flow requirements:

# Bedrooms	**Design Flow/Bedroom (GPD)**
New Construction	*165*
Housing for the Elderly	
1 bedroom	*165*
2 Bedrooms	*165*
>2 Bedrooms	*165*
Accessory Apartment	
Apartment	*165*

* GPD is Gallons Per Day

** The Minimum Design Flow requirement is 495 gpd.

A 2016 review[21] of the design flow of 165 GPD/bedroom design flow used by Carlisle evaluated the elevated design flow as a means of protecting water in a private drinking water well directly down gradient of a leach field. The mechanism of protection was noted as the enhanced nitrogen removal provided by increased contact time of leachate with the biofilm underlaying the larger leach field. However, this analysis also necessarily simplified the assumptions of the analysis by considering the well to be directly downgradient of the leach field, and that the contributing recharge to the well comes from overlying unconsolidated deposits. This is not always the case. All of this suggests that the complexities and inherent assumptions incorporated into the wastewater design flows required by the Carlisle Board of Health should be more clearly articulated, discussed with applicants, and adjusted as appropriate when they inadvertently hinder housing opportunities.

[21] Memorandum from Scott Horsley, Principal, Horsley Witten Group, to William Risso, Chairperson, Town of Carlisle Board of Health, Board of Health Regulation – Septic Systems and Protection of Drinking Water. March 14, 2016.

Resources:

- Model BOH Regulation for Private Wells, Guidance for BOH in Using the Model Regulations (February 27, 2023)
- Sewage Rules Create Gap in Housing Supply in Massachusetts. A Report Prepared for the Massachusetts Housing Partnership. Joe Peznola, July 2015.

17. *Explore the mechanisms for maintenance of septic systems, such as development of a septic system utility to maintain and report on all on-site wastewater systems*

Tools/methods: Town Program
Goals advanced: Ecosystem protection, housing resilience, water resource protection
Responsible Parties: Board of Health, Select Board, Planning Board, Environmental Sustainability Committee
Timeframe: Mid-Long-Term

Proper functioning wastewater treatment in Carlisle is integral to the long-term resilience of the community, given that the community relies on clean groundwater sources for drinking water. There is no public wastewater service in Carlisle. Instead, wastewater in Carlisle is managed primarily by on-site conventional septic systems that collect and treat wastewater from individual homes. The solids settle out in a septic tank and the liquid effluent is discharged into the soil below the ground surface through a leach field that allows the effluent to recharge into the ground. These systems are relatively simple but do require a certain level of maintenance, including regular pump-outs of the septic tank, to ensure that they work as designed. Increasingly, as a means of obtaining approvals for development or expansions, properties in Carlisle are employing alternative, innovative septic systems that provide increased levels of treatment for the wastewater and discharge lower concentrations of harmful nutrients in the effluent. These systems are beneficial but are also more mechanized and require a more regimented maintenance program to function properly. These systems, like all septic systems, are only as effective as the maintenance they receive to keep them operating properly. With more complicated systems becoming more common in Carlisle, the town has noted that system failures have occurred and centralized tracking of system maintenance is challenging.

An innovative approach to ensuring that onsite wastewater systems are maintained properly is to employ the model of a public utility, also referred to as a responsible management entity (RME). Put simply, homeowners would pay a service fee to an RME that would in turn provide regular maintenance service for the life of the septic system. The ”utility” itself can be structured in a variety of ways, including as a department of the town similar to a sewer department, a third-party utility similar to an electric supplier or private water company, or simply a town enterprise fund that would be used to employ a private service provider. This approach is not widely employed by any means, but it is being explored and implemented in Barnstable on Cape Cod through the Septic Utility Program (https://www.masstc.org/rme) at the Massachusetts Alternative Septic System Test Center (MassTC). The US EPA has also developed resources about RMEs targeted toward supporting Tribal communities with management of onsite wastewater systems.

Recommendations:
Carlisle should explore the framework and logistics for establishing an RME for septic systems (traditional, alternative, or all types) in town. The MassTC SUP Program Manager and MassTC Director would be valuable practitioners to meet with, if possible, to begin exploring this idea. Additional resources are provided below from MassTC as well as EPA and other sources.

Resources:

- MassTC Septic Utility Program Website: https://www.masstc.org/rme
- The Falmouth Enterprise newspaper article from June 14, 2024 about the Septic Utility Program: https://www.capenews.net/falmouth/news/septic-utility-program-what-is-it-and-how-can-it-help-with-i-a-systems/article_b1c47db5-70b9-5803-ada2-be7069ba3c28.html
- What is Responsible Management Entity (RME): https://www.masstc.org/rme/basics/what-is-an-rme
- EPA: Using an RME to manage tribal onsite (septic) wastewater treatment systems: https://www.epa.gov/septic/using-responsible-management-entity-rme-manage-tribal-onsite-septic-wastewater-treatment
- Business attributes of successful responsible management entities. Yeager, et al. 2006. Paper funded by USEPA and Water Environment Research Foundation. https://decentralizedwater.waterrf.org/documents/04-DEC-4SG/04DEC4SG.pdf

THEME 6: SOCIAL RESILIENCE

18. Explore a variety of housing options to support family and social connections, and promote a balanced higher-density approach in relation to ecological impacts and climate resilience

Tools/methods: Change in local code, education
Goals advanced: Social resilience, housing resilience, carbon emissions reductions/efficiency
Responsible Parties: Planning Board, Affordable Housing Trust, ZBA
Timeframe: Short-Term

Most of Carlisle's land is zoned residential for single-family homes on two or more acres. There are also small business districts in the town center and along Bedford Road. The flood hazard district[22] occupies roughly 20% of the town's land area.[23] The large majority (92%) of all housing units in Carlisle are detached single-family homes, and an even larger proportion (95%) of all housing units are owner-occupied. The median price of a single-family home was more than $1.3 million in 2022.[24] These large homes are located near flood hazard zones and forested areas.

At the same time, Carlisle's population is aging. The portion of Carlisle's population that is older than 65 grew from 8.4% in 2000 to more than 20% in 2022. More than a third of the population will be over 60 by 2030.[25] These demographic changes lead to increased vulnerabilities.[26] For the aging portion of the population, the ability to downsize their homes while also maintaining their social and family ties in the community is increasingly important and increasingly difficult. Additionally, as Carlisle's residents age, their large,[27] often multi-level houses may prove hazardous. Sustaining social and family ties is extremely important in strengthening a person's resilience in the face of challenges such as severe storm events and other disasters.

The social resilience section further into this document describes the importance that community connections play in the resilience of a community or population. However, hosting "block parties" and getting to know your neighbors (including learning their potential needs in the event of a disaster) is harder to do when homes are separated from one another on large lots. In addition, taking care of a large home and large lot becomes more difficult as people age.

One way to help people age in community is through having more housing options that are smaller, physically accessible, and located near other people or near amenities and social services. Clustering housing units closer together and allowing or building smaller housing units can help to achieve this community. This can be done while preserving the remainder of the lot or lots as open space, which promotes a healthy balance between the creation of new housing and the preservation of ecological and natural resources. Carlisle's town center is characterized by small lots with historic properties clustered around a historic green and small rotary, with sidewalks/paths connecting many of the sites.

[22] Currently called the Wetlands/Flood Hazard District, though we have recommended separating the wetlands requirements from the flood hazard zones.
[23] Carlisle Master Plan (2022), Appendix C: Land Use and Zoning
[24] Carlisle Housing Production Plan Update 2022
[25] Carlisle Master Plan (2022), Appendix E
[26] AARP Disaster Resilience Tool Kit, 2022
[27] More than 90% of housing units in Carlisle have three or more bedrooms, and nearly two thirds have four or more. In comparison, 54% of housing units in Middlesex County have three or more bedrooms, and under a quarter have four or more.

Though there are challenges to additional development – small lots, no municipal water or sewer, historic district regulations, ledge and wetlands, to name a few – and the development pattern quickly spreads out ¼ mile out of the center – housing diversity located near walkable downtowns and services can benefit an aging population.

The Massachusetts Affordable Housing Act allows landowners to build ADUs by right (that is, without requiring a special permit or other discretionary zoning approval). The law went into effect on February 2, 2025, and allows ADU's to be sized up to half the floor area of the principal dwelling, or 900 square feet, whichever is smaller. On May 18, 2025, Carlisle Town Meeting approved an Accessory Dwelling Unit (ADU) Bylaw that aligns with the State law and replaces Carlisle's long-standing Accessory Apartment Bylaw.

Allowing/promoting ADUs within residential districts can also help to provide smaller homes located within proximity to family and can help facilitate this needed social connection. ADUs can be located within a single-family home in a converted basement or attic, for example, or attached as an addition, or completely detached. ADUs advance housing and social resilience by providing options for housing that are safer and easier to maintain for people with disabilities or who are aging. ADUs allow community members to downsize and remain in community, or to have caregivers live with them in their current homes. They can allow more housing without using more land, which preserves the natural environment and its associated ecosystem services. ADUs are smaller than the primary homes, so they use fewer resources for heating and cooling, thereby reducing carbon emissions, While there may be an increase in water use and onsite wastewater discharge due to an ADU on a property, the water use that is essentially budgeted for within the water and wastewater design requirements is based on the total number of bedrooms rather, which may not actually increase when an ADU is created within an existing building.

Recommendations:

Carlisle should continue to review and update the ADU Bylaw as needed and explore modifications to its conservation cluster zoning to provide additional housing choice for everyone.

19. Cultivate community and social connections to strengthen social resilience

Tools/methods: Education, town action
Goals advanced: Social resilience, emergency response
Responsible Parties: Local Emergency Planning Committee, Carlisle Cultural Council, Council on Aging and Human Services Board, Town Staff
Timeframe: Medium and Long-Term

As noted above, social resilience is a critical component of a community's resilience to extreme hazards. Social resilience refers to the ability of social capital, such as trusted social connections, shared values, and local community knowledge to contribute to the resilience of a community in adapting to change. Carlisle can expect more frequent and more severe storms, floods, extreme heat, and other hazards due to climate change. Carlisle's landscape of relatively spread-out homes, forested lands, quiet rural roads, and inherent auto dependency, while often the draw for those who chose to live in town, also can create risks of social isolation, especially for older adults who are unable to drive. Loss of electricity is a particular vulnerability for Carlisle since residents rely on wells for drinking water and on Wi-Fi for communication.

Social resilience remains difficult to formally measure[28], but is becoming increasingly recognized in the climate resilience and adaptation space as an important contributor to community resilience[29]. One way to strengthen social ties is to encourage neighborhoods to work together to host events and social gatherings to build social connections before disaster events. For example, this has been done in San Francisco and Portland with an explicit focus on disaster resilience. Boston and Cambridge also have grant programs for block parties.

The Town of Carlisle also supports several key community and cultural events through the Cultural Council, Environmental Sustainability Committee, schools, the Youth Commission, the Council on Aging and Human Services, the Gleason Public Library, and other committees, and works with other local partners including local church communities. The largest town event is Old Home Day, but there are many other, smaller events. Carlisle's Cultural Council provides small grants for community events, including Route to Sustainability Day (sponsored by the Environmental Sustainability Committee), Multicultural Tea Tasting (Carlisle Public Schools Cross Cultural Club), Spring Concert (Carlisle Chamber Orchestra), trail and nature public walks (Carlisle Trails Committee and Environmental Sustainability Committee), Center Park activities, Carlisle Conservation Foundation, Garden Club, Community Gardens (Conservation Commission) and others. Carlisle could consider incorporating an explicit 'social resilience' element into the grant making process for community events and/or developing a separate small grants program to help build social and neighborhood connections.

[28] Copeland, Samantha. Tina Comes, Sylvia Bach, Michael Nagenborg, Yannic Schulte, Neelke Doorn. Measuring social resilience: Trade-offs, challenges and opportunities for indicator models in transforming societies. International Journal of Disaster Risk Reduction. Vol. 51 (Dec 2020). https://www.sciencedirect.com/science/article/pii/S2212420920313017

[29] The body of work by Dr. Daniel P. Aldrich, Professor of Resilience at Northeastern University, focuses on the importance of social capital in climate resilience. Much of his work can be found here: https://www.researchgate.net/profile/Daniel-Aldrich

Many past and ongoing efforts in the town reflect a desire to build community and could be strengthened or threaded more permanently into the resilience planning efforts in town. The town could build from the Kitchen Conversations approach that was used during the last update to the Master Plan, in which a kit was developed and community members invited each other into their homes and facilitated conversations on topics of interest.[30] During the COVID-19 pandemic, a group formed the Carlisle Cheer Project to bring support and positivity to the community during a difficult time by offering "simple, inclusive, ageless activities to the Town of Carlisle, to provide safe opportunities for residents to come together for lighthearted fun.[31]" The Carlisle Cultural Council grant awards[32] reflect a very rich cultural calendar in the town, all of which helps to support community connections. Augmenting these events and activities with block parties and neighbor-to-neighbor events can help to support the networks that strengthen community resilience in the face of disasters and problems.

Recommendations:

Carlisle should continue to support, and augment support, for neighborhood gatherings and neighborhood networks that allow people to actively meet neighbors and build community across generations through grants.

[30] This approach is described in the minutes of the March 10, 2020 Board of Selectmen meeting here: https://carlislema.gov/AgendaCenter/ViewFile/Minutes/_03102020-2328.

[31] https://www.carlislema.gov/908/Carlisle-Cheer-Project

[32] https://www.carlislema.gov/409/Grant-Recipients

APPENDIX A: SURVEY RESULTS

Feedback: Written (Survey and Submitted)

Theme 1: Eco-Landscapes

While trees are important to me, we should make it easy for people to remove trees that pose a threat.
Encourage drought resistant native landscapes, limited use of irrigation systems in developments and in town in general.
Tree Management (we should be able to trim and/or cut down dangerous trees)
Designing residential landscapes that stops run offs to other properties.
Nice work. Are you watching invasive species too?
We already have vastly more land and wetlands on a % basis than any other town. We have relied on this to maintain our confined aquifer. Other than this we do not manage those assets it a reasonable way. The Town Forest is comprised of mostly very flammable species (red and white pine) . There is no feasible way to assess the risk in order to develop a plan to mitigate a fire. The town does not have a revenue stream large enough to cover the cost of prevention.
Dealing with invasive species is extremely important. Our town is getting overrun by them which is making it harder for our native plants, trees and animals to survive.
Carlisle has many that are at or near "end of life" and create a threat to buildings and people when they fall. They need to be judiciously removed.
I really like the idea of encouraging residential eco landscapes. I would like to see more education, workshops, and literature on what to plant where so that it makes compliance more attainable for residents. You talk about making resources in a video and I'm thrilled to get some guidance.
A focus on protecting ecosystems is key for both climate change adaptation and mitigation
It struck me as odd that the most important – because it is listed first – is Ecosystem Protection. Somehow this misses the point that protecting the people and their homes should be first. This is different than Ecosystem Protection. When water is encroaching on my home near a wetland, I am a little less worried about the ecosystem and more worried about my home being seriously damaged.
Regarding trees --- Under the Scenic Road Bylaw, the Carlisle Planning Board approval is required for cutting (including trimming of major branches) or removing trees with the public right-of-way of any road designated as a Scenic Road. *However, this only works if residents know they live on a Scenic Road and what the rules are – I do not believe there is a process to tell existing or new homeowners. I*

have seen trees cut down on such roads out of ignorance. Consider a notification of new homeowners and a reminder mailing to existing homeowners on scenic roads.

Regulating the trees on private property is a terrible idea. The town cannot even manage to regularly inspect homes in Carlisle. How would you ever manage control over cutting down of trees on everyone's properties? Leaving it to the homeowner to comply is not a workable plan unless you can verify to a significant extent.

Theme 2: Fire Protection

It's unclear why onsite energy storage is grouped with Fire Protection. Is this because of the fire risk associated with some energy storage systems and EVs?

We have 2 plug-in Hybrid cars and batteries for garden equipment in our garage. We also have an inflatable hot tub in our back yard.

Promote the safe use of all fossil fuel appliances as well.

The volume of water to fill cisterns would need to be provided by stormwater runoff and not nearby groundwater pumping. Using groundwater (over pumping) can become a health issue for abutters as described in Town Counsel's 11/2014 letter to MassDEP (Long Ridge Road 40B project).

Educating homeowners on fire resistance of siding and roofing materials so they can make informed choices when replacing.

I question reference on reliance on FEMA recommendations as our president is suggesting FEMA should be eliminated. I believe that the forest management committee must be willing to compromise in order to reduce forest fuel loads, esp. in draught periods.

Under Forest Fire – I actually view this as our nearest term risk. One issue not mentioned is that as our forests have aged, the amount of deadfall and combustible material has grown. This appears to be a risk and some management of our conservation land is needed. Natural events allowing fires to do this are not a great idea.

Forest Fire risk – Good section but you could explicitly state that the Fire Department should provide a document that recommends best practices for improving response to forest fires.

Theme 3: Floods, Wetlands, and Drainage

I don't have the background to evaluate many of these recommendations. (Perhaps I should read the report!)

East St. has a section of road that floods regularly

Is there a plan or schedule published on swale and culvert maintenance/cleaning?

Carlisle has difficulty in making informed decisions based on health and environmental risks. We spent $1M on a dam we did not need at Greenough. The dam ensured that nitrous oxide and methane emissions would generate more GWP than all other municipal efforts to reduce GWP. ConsCom and Sustainability Committee were aware before the funding for the dam was approved. On another health risk issue. How do you trade off mosquito borne diseases with need for more wetlands. My experience with ConsCom and BoH is that neither department is willing to discuss the tradeoffs (catch stormwater to breed more mosquitoes?) ConsCom as the popular department says YES, and BoH as the red-headed step child is ignored)

Many roads lack adequate drainage leading to ponding. The town should consider installing storm drains or other drainage solutions in problem areas.

Climate change is cited to mean more severe storms and increased flooding. But Carlisle has seen a decrease in severe storms and flooding in the last 15 years. How are these data resolved?

I agree that we should rely on 500-year flood plains. This seems entirely focused on prevention, but I don't see a lot about emergency response plans.

Changes to regulations such as stormwater control need to brought forward to town meeting and not left to the purview of individual committees – too important for a small audience.

Under floodwaters and increased rainfall, the report does not discuss the issues of beaver dams exacerbating the effects of increased rainfall by backing the water up into abutters of conservation land. This is a big issue for the Greenough drainage and elsewhere. There should be a recognition somewhere of the issue and that the beavers do not overrule reasonable homeowner risk mitigation.

Theme 4: Housing and Buildings

Cost and practicality must weigh heavily into the decision to repair/renovate vs. tear down and re-build. Also, sometimes tearing down and rebuilding is the most environmentally sound approach. It depends on how much work the existing structure needs.

I am very supportive of compliance plans for MBTA zoning, particularly plans that actually support modest development over the next 5-10 years

Be careful not to over impose regulation and governance on private homeowners.

My suggestion is that all homeowners make the most of their existing homes by converting the McMansions to 2 and 3 family units wherever possible. It takes 50 to 80 Gt of carbon to build a new house and 20+ years to offset that carbon through efficiencies. Current science (not watered down IPCC consensus) dictates we collectively must stop all carbon emissions before 2027 at the latest. Most of this Resiliency survey is a distraction and very much like the Carlisle Action Plan I helped create a dozen years ago. WE know what the problem... It's us and our bad habits that most expect will be solved by others... like our kids and their kids. Oops too late !

Encouraging homeowners to create "wild zones" on their properties, plant natives and preserve trees. The "Home-Grown National Park" movement should be encouraged.

The recent Historical Commission proposal to list all pre-1960's homes as historical is overkill and makes no sense.

Focusing on improving efficiency of historic structures feels like something that has a relatively high cost and a small return on terms of overall energy efficiency. I would not want to see tax dollars put towards that. But if this is required to preserve the historic buildings, I would feel different.

Theme 5: Infrastructure

Explore a public entity around public water supply wells and private wells, to better understand and protect ground water and aquifer health.

The problem with imagining that new standards or regulations along with public awareness can protect the groundwater is that we do not enforce the vast majority of the regulations we have. (I'm currently working with the BoH on the issue of Adverse Impacts of overpumping of our confined aquifer by ADUs and MFCCs citing existing unenforced and underutilized regulations). The Planning Board's charter is adulterated by their self-appointed power to enforce "values" that often conflict with their primary, state-authorized function to protect all residents' health, safety and welfare. Many developers know that the bylaws to protect habitat or abutters rights can be skirted by delay and/or bringing the issues to the PB or ZBA where for the sake of unknown, undefined values or expediency the development can proceed in spite of being non-compliant. The Mosquito archives are full of examples.

The major issues with septic systems have come from approvals by the BOH to "modern" systems connected to dense housing. There is little to no evidence of a town-wide concern.

A septic utility might be very helpful but I am skeptical that it would succeed on a volunteer basis.

Under Water Resource protection the web of wells and septic systems is noted as essentially a potential risk to our natural resources and needs public attention. I agree. I have often been surprised that there is no town-wide sampling of well water and of septic system proper functioning.

I strongly recommend we look at moving the septic regulations to be inline but not greater than title 5. This is too much conservatism. Also, please do not give the BOH more control and authority by having them run a system of septic control systems. They are too unresponsive to homeowner needs.

Theme 6: Social Resilience

It depends what kind of connections you promote - I'd rather see if based on neighborhood networks rather than town-wide, because it's the people nearby we have to rely on in disasters.

Social resilience is frosting on the cake. When we learn how to define and protect the cake during the next 2 or 3 years then we can add the frosting.

I strongly believe that a path to a connected community comes from activities like this. I met many new faces at the RTSD. We've made friends from these activities and I introduced my mother to community members, branching out the Carlisle community. I would be in favor of investing in community events and even infrastructure to boost community gatherings in winter months.

I believe that this is a very important element of climate resilience and emergency response. You refer to strong neighbor connections but you don't say how you measure this. What do you compare this to? Givin that the community is made up of so many large homes on large lots, I am sure there are many vulnerable people who are not closely connected with their neighbors. Gathering information on these people also raises questions on invasion of privacy.

I found the social resilience section a bit condescending (a lecture in what someone thinks is the goal rather than what the town clearly wants). Carlisle is what it is and it is not useful to say it would be better if you could walk everywhere to … what? There are no stores and so forth. If one does not want to rely on a car, you should not live in Carlisle. Understood that if you have a denser housing environment it might make many resilience concerns easier to deal with and that is a reasonable option but it will always be a small percentage of homeowners. I have no issue with building some higher density areas, but that won't change the overall state of Carlisle housing.

Having some sort of local public transportation is a worthy experiment – if the goal is to keep an aging population in oversized homes or if there were few morning/evening commute routes that made sense.

Survey Feedback: Multiple Choice

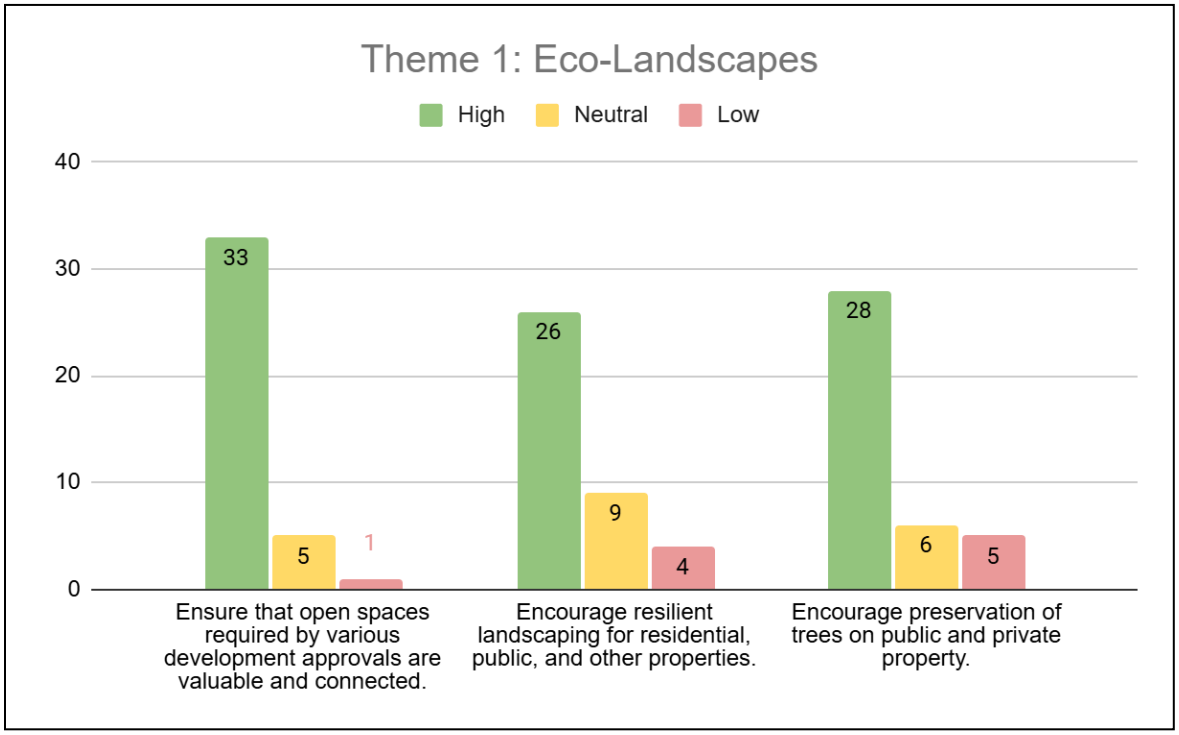
Survey participants were asked to choose the statement that aligned best with their views for each recommendation. The statements were as follows:

This is a high priority to me (High)

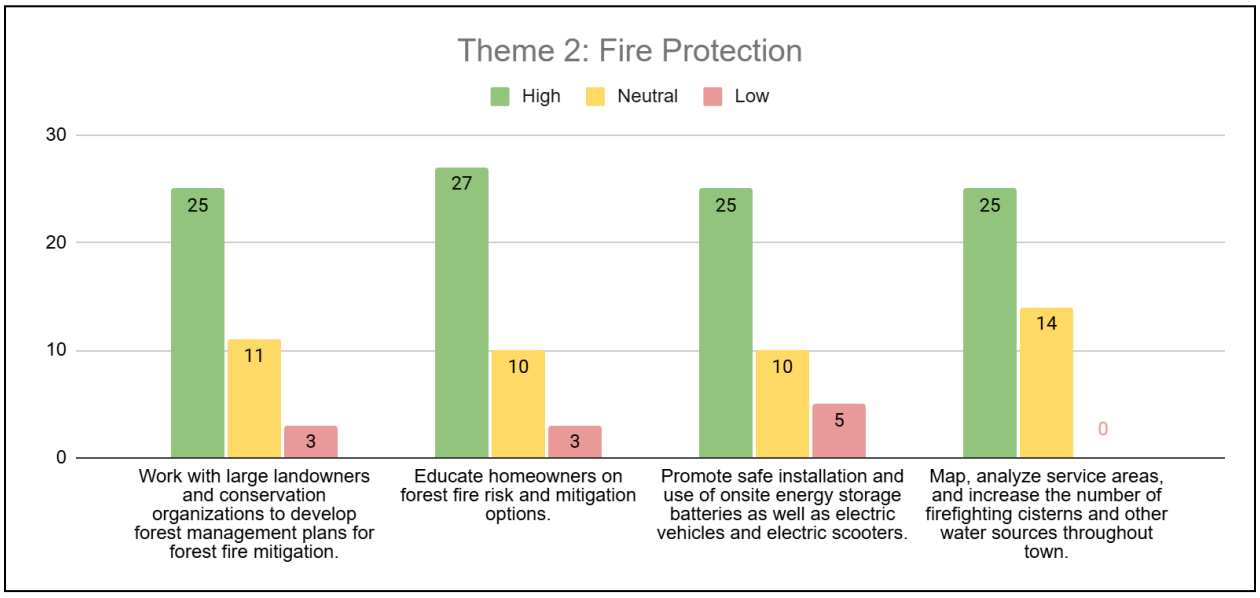
I don't have a strong opinion about this (Neutral)

This is not something I consider a priority (Low)

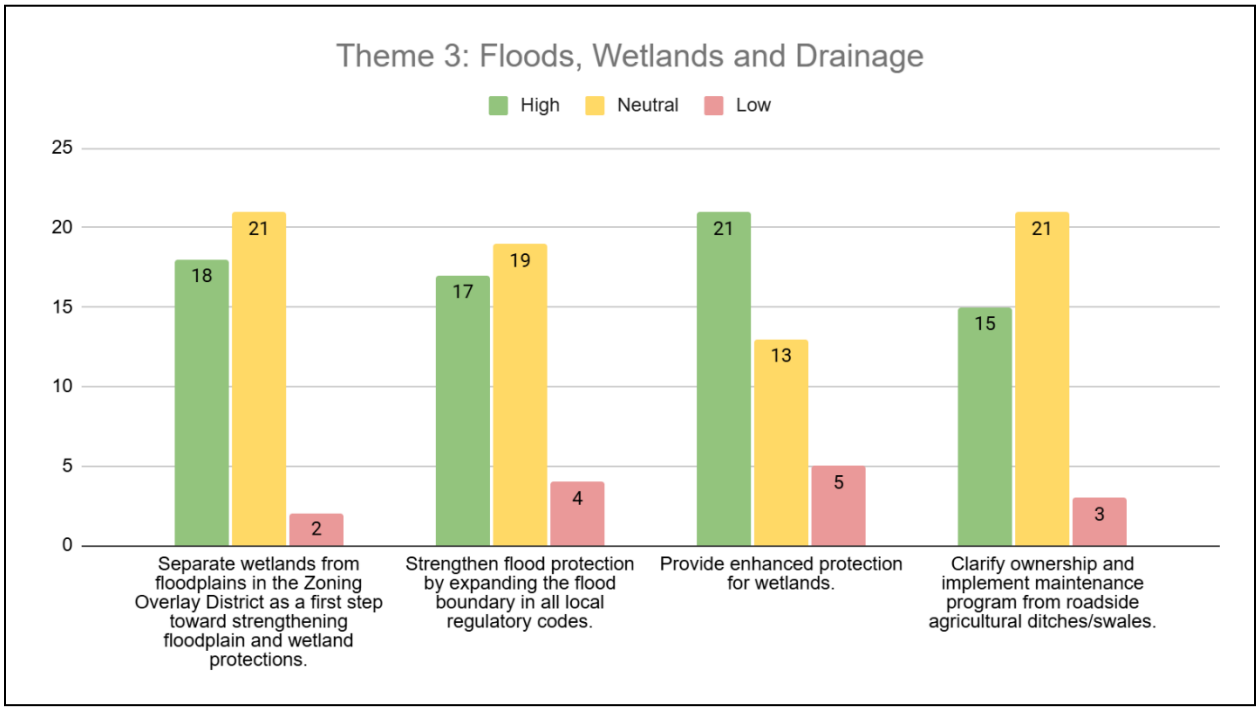
Theme 1: Eco-Landscapes	High	Neutral	Low
Ensure that open spaces required by various development approvals are valuable and connected.	33	5	1
Encourage resilient landscaping for residential, public, and other properties.	26	9	4
Encourage preservation of trees on public and private property.	28	6	5



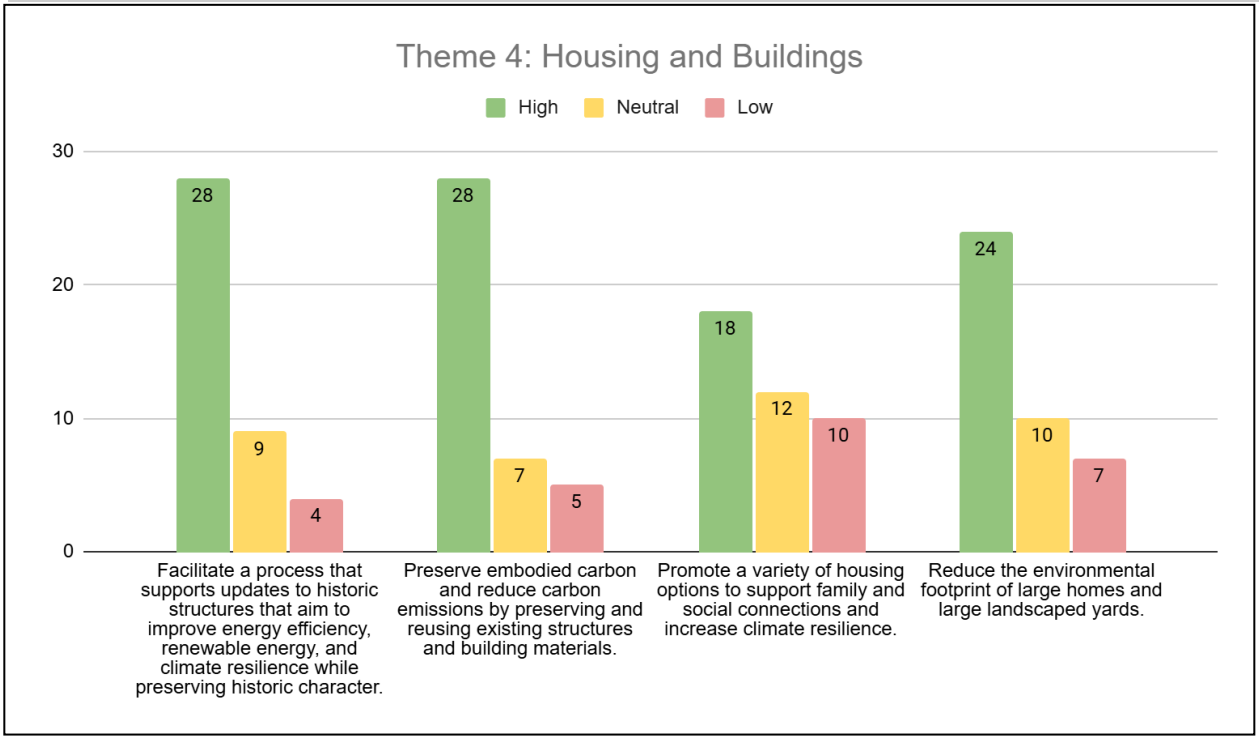
Theme 2: Fire Protection	High	Neutral	Low
Work with large landowners and conservation organizations to develop forest management plans for forest fire mitigation.	25	11	3
Educate homeowners on forest fire risk and mitigation options.	27	10	3
Promote safe installation and use of onsite energy storage batteries as well as electric vehicles and electric scooters.	25	10	5
Map, analyze service areas, and increase the number of firefighting cisterns and other water sources throughout town.	25	14	0



Theme 3: Floods, Wetlands, and Drainage	High	Neutral	Low
Separate wetlands from floodplains in the Zoning Overlay District as a first step toward strengthening floodplain and wetland protections.	18	21	2
Strengthen flood protection by expanding the flood boundary in all local regulatory codes.	17	19	4
Provide enhanced protection for wetlands.	21	13	5
Clarify ownership and implement maintenance program from roadside agricultural ditches/swales.	15	21	3

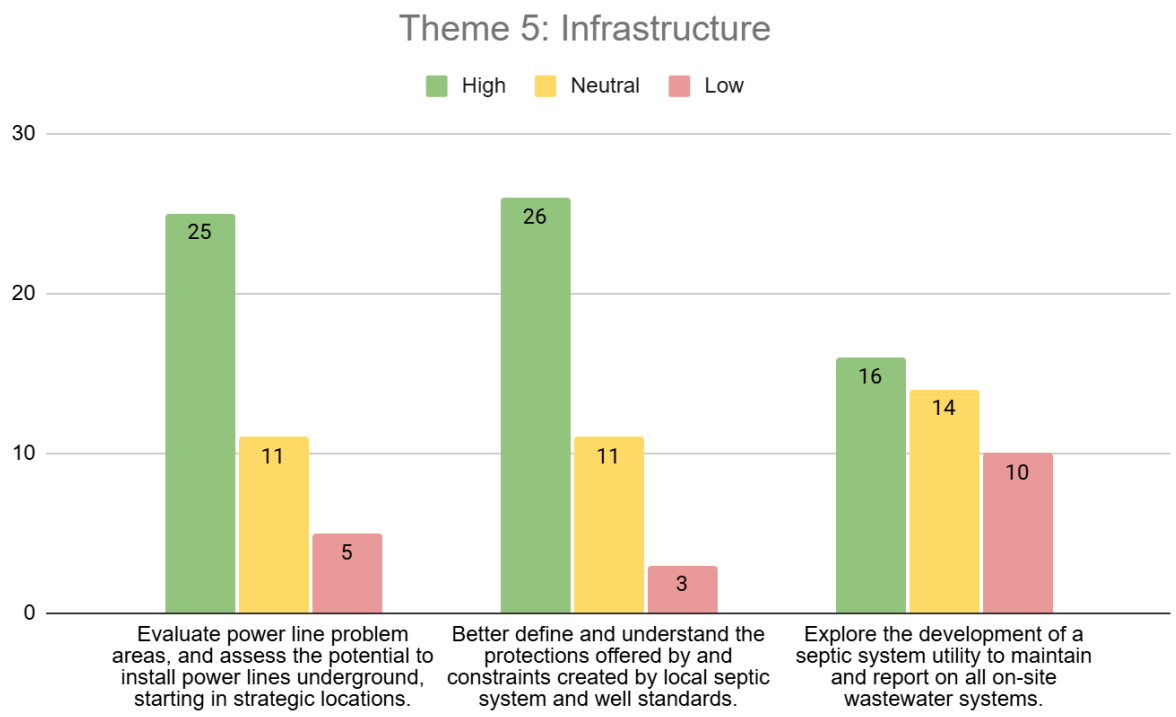


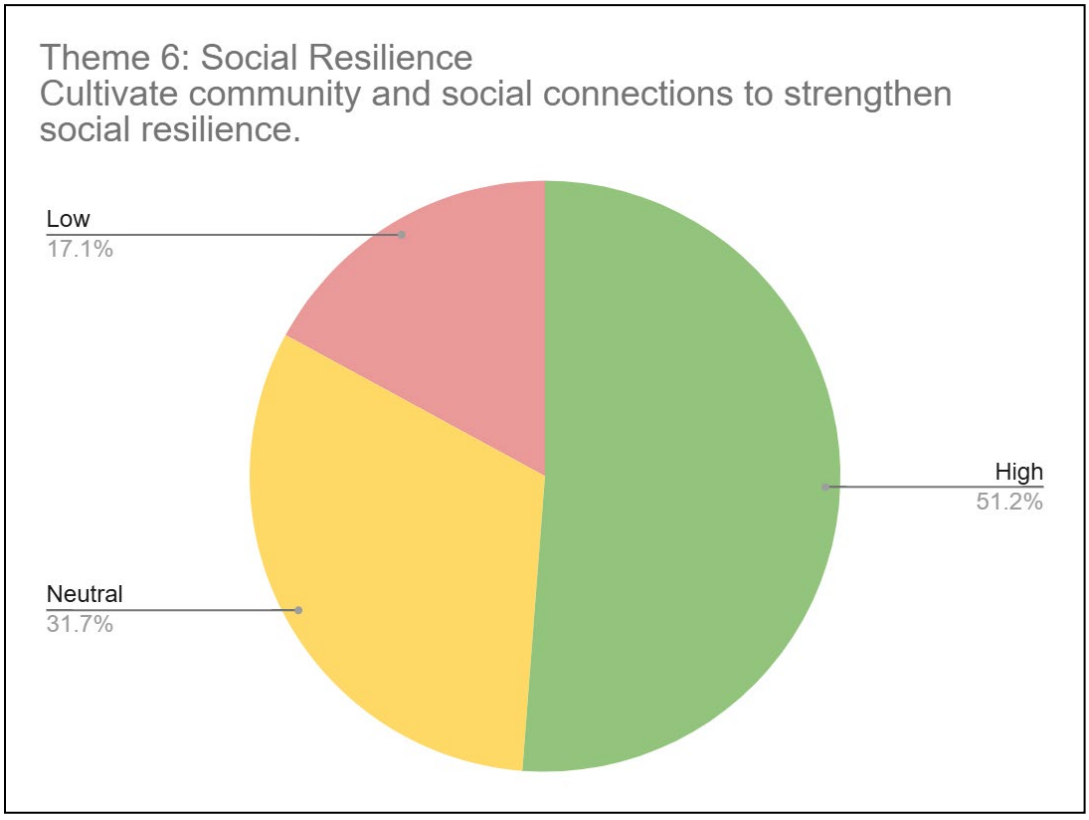
Theme 4: Housing and Buildings	High	Neutral	Low
Facilitate a process that supports updates to historic structures that aim to improve energy efficiency, renewable energy, and climate resilience while preserving historic character.	28	9	4
Preserve embodied carbon and reduce carbon emissions by preserving and reusing existing structures and building materials.	28	7	5
Promote a variety of housing options to support family and social connections and increase climate resilience.	18	12	10
Reduce the environmental footprint of large homes and large landscaped yards.	24	10	7



Theme 5: Infrastructure	High	Neutral	Low
Evaluate power line problem areas, and assess the potential to install power lines underground, starting in strategic locations.	25	11	5
Better define and understand the protections offered by and constraints created by local septic system and well standards.	26	11	3
Explore the development of a septic system utility to maintain and report on all on-site wastewater systems.	16	14	10

Theme 6: Social Resilience	High	Neutral	Low
Cultivate community and social connections to strengthen social resilience.	21	13	7




Theme 6: Social Resilience
Cultivate community and social connections to strengthen social resilience.
Low
17.1%
High
51.2%
Neutral
31.7%

APPENDIX B: BOARD OF HEALTH COMMENTS ON CLIMATE RESILIENT CARLISLE REPORT (JUNE 27, 2025)

Town of Carlisle
Office of
BOARD OF HEALTH
66 Westford Street
Carlisle, MA 01741

Tel.: (978) 369-0283
Fax: (978) 369-4521
boardofhealth@carlislema.gov

MEMORANDUM

To: Municipal Vulnerability Stakeholder Committee
From: Board of Health
Date: June 27, 2025

In Re: Board of Health Comments on Climate Resilient Carlisle Report

The Board of Health discussed the above draft report at their meeting of June 11, 2025 and voted to request that the following points be added as an Appendix to the Report.

> In light of Carlisle's unique hydrogeologic conditions such as high water table, poor soils and ledge, it is imperative that additional study of potential environmental impacts be conducted prior to implementing some of the recommendations in "Theme 5:Infrastructure".
>
> The Town of Carlisle is 100% dependent upon private wells and onsite septic systems. The Town is unlikely to have the ability to finance a municipal water supply or waste disposal system now or in the near future since the Town is supported only through a residential tax base. Protection of the drinking water supply is the reason that the Carlisle Board of Health takes a conservative approach on septic system design flow requirements and setbacks. Title 5 is a statewide Code but also authorizes individual communities to enact more stringent local regulations as the need demands. When enacting supplementary local regulations, the Carlisle Board of Health not only considers the state's recommended flow rates but takes a comprehensive look at all potential health risks, community growth and development, and the protection of natural resources.

APPENDIX C: ADDITIONAL REPORT OF COMMENTS FROM CARLISLE FIRE CHIEF

Comments received by Julie Mercier, Carlisle Town Planner, via email from Carlisle Fire Chief Sorrows on June 30, 2025:

"As outlined in this report, with climate change comes more extreme weather events. These include rain, wind, water, lightning, heat and cold events. These events include ice storms, hurricanes, tornados, wildfires and flooding with significant safety and property damage situations. The weather events are often regional with the emergency services in surrounding towns fully deployed in their own communities limiting the ability for a mutual aid response to our town.

While the Fire Department can help prepare the town for these extreme weather events by encouraging residents to landscape and build appropriately and encourage the utilities to prune trees near power lines, it is also important for the emergency services to be ready to respond to multiple issues at once. The town should continue to support the dynamic (on-call) staffing model which allows for this flexibility and has numerous community members trained to respond during emergencies. The town should also continue to provide the equipment for the Fire Department and Department of Public Works to respond to severe weather emergencies.

As an example, during drought a wind driven wildfire can quickly grow or even become several wildfires. A wildfire of 40-50 acres in Carlisle can lead to 10+ homes burning. Most of Carlisle consists of contiguous wooded areas at least this size. The ability to deploy multiple crews with appropriate equipment will be essential to contain a situation like this.

While Carlisle has significant exposures to emergency situations caused by severe weather, there are a number of factors in their favor. Many residents are more self sufficient than those in more urban areas. The lack of a hydrant system actually means that there is not a single point of failure. Each cistern is independent, and with a Fire Department equipped to move water it can mitigate the most severe weather emergencies. In addition, having town residents trained and "on-call" to respond as needed allows the department to increase their staffing dynamically as the situation requires."