CLIMATE RESILIENCE

OVERVIEW

Granby started work on a comprehensive plan in 2008. The plan has been updated numerous times since then and this update integrates climate resilience into the plan. This work was funded by the Commonwealth of Massachusetts Municipal Vulnerability Preparedness (MVP) Action grant program managed by the Executive Office of Energy and Environmental Affairs (EOEEA). Given the magnitude of climate change impacts on the natural environment, development and infrastructure, economy, and public health, municipal level strategies to adapt to the impacts of climate change are necessary. In addition to mitigating the causes of climate change (decarbonization or transitioning away from fossil fuels to clean safe sustainable energy thereby reducing GHG emissions that are accelerating climate change), local governments need to 'adapt' or make changes to prepare for, respond to and minimize the impact of the increasingly severe and unpredictable weather and related impacts already happening.

The Commonwealth's MVP program is designed in part to provide towns and cities the opportunity to identify their own resilience needs. In Granby it is flooding and extreme heat that is causing damage to the town's infrastructure and threatening people's safety. Flooding is caused by the sudden and sustained downpours overwhelming undersized culverts and other stormwater infrastructure, pointing to needed improvements including using nature-based solutions and green infrastructure as well as right-sizing existing culverts. Addressing extreme heat includes improving usage of existing emergency communications networks and assuring access to back-up electricity in the event of extended power outages. The actions proposed in this chapter will enhance resilience and reduce the vulnerability of residents, businesses, and the ecosystems upon which the town depends.

The primary goal of this Climate Resilience Chapter of the Granby Master Plan is to integrate the resilience actions that emerged out of the Town's community resilience building workshop into the Towns' Master Plan. We reviewed up to date data from the Commonwealth's Resilient MA website, the MA Hazard Mitigation and Climate Action Plan and Granby's 2019 MVP Statement of Findings report on climate change and its projected impacts, reviewed the Town's MVP planning statement of findings, re-visited the town's master plan, studied the stormwater related green infrastructure recommendations that were the additional element of work funded by the EOEEA through the town's MVP action grant, to present these recommendations for Granby to reduce its vulnerability to climate impacts for this and future generations while meeting the long range Vision established by the citizens of Granby.

PUBLIC OUTREACH AND ANALYSIS

Residents and stakeholders were involved in the MVP workshops and community meeting that took place in 2019. In addition to this engagement, the Town also surveyed community members in 2022 via an on-line survey. While only eight people responded to the survey, the responses do show a high level of awareness of the climate crisis, including experience with flooding and its related impacts such as failing septic systems as well as good familiarity with nature-based solutions and support for action, especially for the importance of trees on public property. One respondent suggested that residents could benefit from guidance from the town on what trees they should plant on their property given how the climate is changing. The full survey report is included in the Appendix.

GRANBY CLIMATE STRESSORS

In 2019, Granby achieved Municipal Vulnerability Preparedness (MVP) certification after completing the MVP planning process funded by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). Municipal officials, residents and business leaders worked with the Pioneer Valley Planning Commission, to assess the town's vulnerabilities to the impacts of climate change and developed recommendations for actions to improve local resilience. The MVP planning process was guided by new state-wide climate projections, downscaled to the county and watershed level, describing with more certainty than ever the extreme weather and related impacts to be expected in the coming century. A summary of those projected impacts for the Connecticut River Basin, the geographical region best positioned to represent Granby's conditions, are presented below.

Summer highs may increase by 2.8 °F to 7.5 °F by 2050 (3-9% increase) and 3.8 °F to 13.4 °F (5-17% increase) by 2100

The CT River basin is expected to experience an increase in average temperatures, and in minimum and maximum temperatures, throughout the 21st century. Summer and fall temperatures are expected to see the greatest increases - summer highs may increase by 2.8 °F to 7.5 °F by 2050 (3-9% increase) and 3.8 °F to 13.4 °F (5-17% increase) by 2100. The average temperature increase in the fall could be 3.7°F to 7.2°F (6-12% increase) by 2050, and 4.2 °F to 12.2 °F (7-20% increase) by the end of century. The flip side of that is there will be fewer days below 32° and 0°, with the greatest changes to be seen in the fall (10-16 fewer days below 32° by 2050) and spring (6-14 fewer days).

Even a very small rise in average temperatures can cause major changes in other factors, such as the relative proportion of precipitation that falls as rain or snow, affecting species and

ecosystem health. New species, that may become invasive, will be entering, or have already entered the region due to climate change. As a result, species hierarchies in ecosystems will change, and climate-induced stress in those ecosystems will facilitate more invasive pathways. Fewer very cold days may impact the life cycle of certain insects and other species, such as ticks. Tick-borne diseases, such as Lyme disease, will continue to increase, or, in the case of tick-borne encephalitis and Crimean-Congo hemorrhagic fever viruses, have changed their geographical distribution. Changes in temperature and precipitation can lead to increases in mosquito populations, with subsequent transmission and outbreaks of diseases like West Nile virus and triple E.

The flip side of that is there will be fewer days below 32° and 0°.

Warmer winters will lead to earlier insect emergence expansion in the geographic range and population size of tree pests such as the hemlock woolly adelgid, emerald ash borer, and southern pine beetle. Unusually warm winters will impact agricultural operations leading to early release from dormancy in perennial plants and potential damage from late winter or spring cold. In 2016, peach crops in the northern half of the Northeast were affected in this way as farmers experienced almost total losses. Farmers with grapes, apples, cherries, and other fruit crops in this same region suffered widespread losses following cold conditions after warm winters in 2010 and 2012. The warming trend may also indicate an increase in the frequency of the freeze frost cycle, something that Pioneer Valley small towns have seen in recent years wreaking havoc on highway departments and leading to increased maintenance needs and costs in anti-icing measures in areas that previously rarely had mid-winter thawing and freezing.

Even a very small rise in average temperatures can cause major changes in other factors, such as the relative proportion of precipitation that falls as rain or snow, affecting species and ecosystem health.

New species, that may become invasive, will be entering, or have already entered the region due to climate change.

Beyond this general warming trend, projections show increases in the number of days with extreme heat throughout the century, with the number of days with extreme heat rising dramatically under high emissions scenarios. Granby and its neighboring municipalities will see an increase in days with daily temperatures over 90°F, 95°F, and 100°F. Extreme heat is considered to be over 90 °F, because at temps above that threshold, heat-related illnesses and mortality show a marked increase.

The 1971-2000 baseline data indicates that the CT River Basin sees roughly 6 days per year over 90°F. Recorded temperatures at the Barnes Muni Airport in Westfield hit 90 °F 10 times in July 2020, alone, indicating that our region is already seeing these changes in real time. Climate

change projections show increases of 10 to 35 more 90 °F + days per year by mid-century, and 15 to 76 more 90°F+ days by 2100.

Why is this important? Heat waves can lead to illness and death, particularly among older adults, the very young, economically disadvantaged groups, and other vulnerable populations such as those in outdoor occupations. The general warming trend coupled with more frequent extreme high temperatures will drive an increase in cooling degree days when air conditioners are turned on. This will change patterns of energy use and increase net electricity demand.

Annual precipitation in in the CT River Basin is expected to increase by +1.3" to +6.2" by 2050 and by up to 8.3" by the end of the century. Rainfall is expected to increase in spring and winter months in particular. Understanding that both winter precipitation and winter temperatures could increase in future decades, we can expect more of this precipitation to fall as rain instead of snow. There are all sorts of human and environmental impacts that could result from this change including reduced snow cover for winter recreation and tourism, less spring snow melt to replenish aquifers, higher levels of winter runoff, and lower spring river flows for aquatic ecosystems. Interestingly, this may leave some infrastructure more vulnerable to damages from deep freezes. Pipes are especially vulnerable to freezing if they are exposed to outside air. "Wind chill" can play a major role in accelerating ice blockage, and thus bursting, in water pipes. With a few feet of snow on the ground, those pipes are better insulated from the wind.

One of the most pronounced changes in climate in the north east—more than any region of the U.S. - during the past several decades has been a **71%** increase in the frequency of **extreme** precipitation events since the mid-1990s. The climate projections suggest that the frequency of high-intensity rainfall and storm events will continue to trend upward. Again, the CT River Basin will see the greatest changes in the spring and winter. The winter season is expected to experience the greatest seasonal increase both in total precipitation and the frequency of heavy downpours, or days receiving precipitation over one inch.

Flooding from a single intense downpour can cause widespread damage to property and critical infrastructure. High-intensity rainfall events mobilize pollutants such as sediments and nutrients and pose a threat to surface water quality. Other effects of more intense downpours include more inland flooding as soils become saturated and stop absorbing more water; rise in creek and river flows; and failure of storm water systems as their capacity is exceeded.

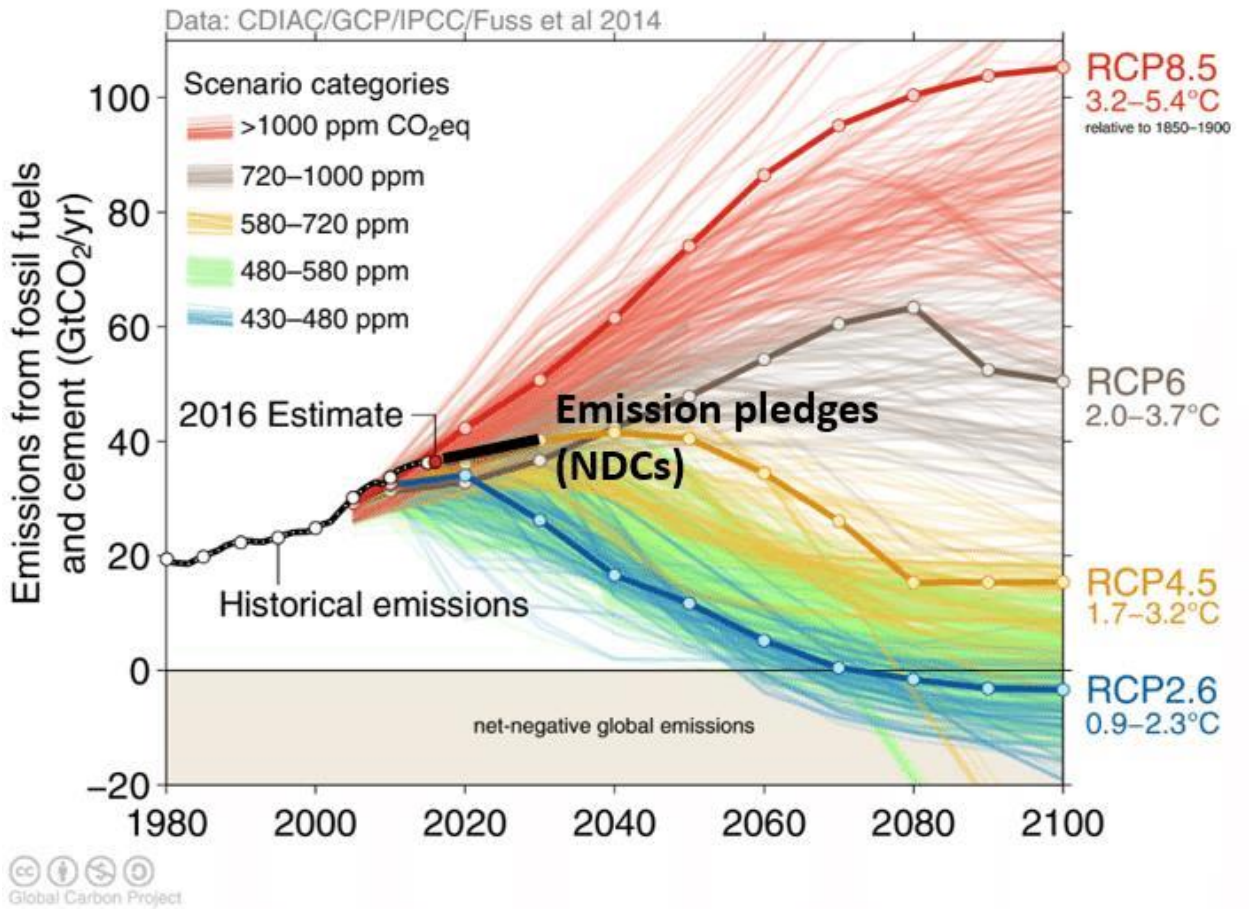
There are all sorts of human and environmental impacts that could result from this change including reduced snow cover for winter recreation and tourism, less spring snow melt to replenish aquifers, higher levels of winter runoff, and lower spring river flows for aquatic ecosystems.

Finally, while rainfall is expected to increase in spring and winter, we will

see an increase in consecutive dry days in summer and fall. More of these dry periods in the summer could combine with higher temperatures to increase the frequency of episodic droughts, like the ones experienced across the Commonwealth in the summers of 2016 and 2020. More frequent droughts could exacerbate the impacts of floods by damaging vegetation that could otherwise help mitigate flooding impacts. Droughts can also weaken tree root systems, making them more susceptible to toppling during high wind events.

It is important to note that these climate projections are based on the International Panel on Climate Change's (IPCC) data on future emissions. The IPCC considers a range of scenarios of how emissions change in the future based on different representative concentration pathways (RCP), or the cumulative measure of human emissions of GHGs from all sources, expressed in Watts per square meter.

As shown in the chart below (from the Global Carbon Project), the climactic impacts of these scenarios become vastly different as we look further out towards the end of the century, from the extremes of approximately 0.9 – 2.3°C (33.6–36.1°F) of warming under the lowest emissions scenario RCP2.6 that assumes all countries deliver on their GHG reduction pledges by 2100, to between 3.2 – 5.4°C (37.8 – 41.7°F) under an RCP8.5 scenario where no countries implement emissions reduction policies. This variability tells us that mitigating our current contributions to GHG emissions is tremendously important to help shape a less disastrous future, even as we take important steps to adapt and become more resilient to the climate change impacts that have already become a reality.


Data: CDIAC/GCP/IPCC/Fuss et al 2014
Scenario categories
>1000 ppm CO_2eq
720–1000 ppm
580–720 ppm
480–580 ppm
430–480 ppm
2016 Estimate
Emission pledges
(NDCs)
Historical emissions
net-negative global emissions
Emissions from fossil fuels and cement ($GtCO_2$/yr)
100
80
60
40
20
0
−20
1980
2000
2020
2040
2060
2080
2100
RCP8.5
3.2–5.4°C
relative to 1850–1900
RCP6
2.0–3.7°C
RCP4.5
1.7–3.2°C
RCP2.6
0.9–2.3°C
Global Carbon Project

GRANBY CLIMATE VULNERABILITIES

The Town of Granby faces multiple challenges related to the impacts of climate change and natural hazard-related weather events. In recent years, the Town has experienced a series of disruptive and dangerous weather events including the severe snow and ice storms of 2009 and 2011, and the arctic cold weather in the winter of 2017/2018. Impacts from storms are exacerbated by increasingly weakened forest and tree health due to influxes in harmful pests in local forests. Unhealthy trees and their limbs are more likely to be brought down onto powerlines by the weight of snow, ice, or water and under the force of wind, leading to more prolonged power outages and elevating risks to residents and infrastructure. The magnitude and intensity of these events over the course of just a few years has increased awareness of natural hazards along with climate change and motivated communities like Granby to comprehensively improve resilience at the individual and municipal level.

Granby's MVP workshop participants were generally in agreement that the Town and region are experiencing more intense and frequent storm events, the impacts of which affect the daily activities of all residents. There was also common concern about the challenges of being prepared for future severe weather events, including the ability to shelter residents close to home; the resilience of the transportation network to changing weather and temperature fluctuations and the need for the system to remain operational for emergency travel, at a minimum; and the desire to become energy independent for increased resiliency during system-wide power outages. Furthermore, participants established a common directive to improve the efficiency and efficacy of communication systems throughout town, both in times of emergency and in day-to-day operations.

Impacts from storms are exacerbated by increasingly weakened forest and tree health due to influxes in harmful pests in local forests. Unhealthy trees and their limbs are more likely to be brought down onto powerlines by the weight of snow, ice, or water and under the force of wind, leading to more prolonged power outages and elevating risks to residents and infrastructure.

Transportation

By numerous local accounts, Granby has seen more flooding in recent years, sometimes jeopardizing residents' ability to move safely on roads throughout the community. In areas where rainwater used to be absorbed in the hours after heavy rains, like Dufresne Park, water now stands like a pond for several days. In 2019, Granby experienced flooding on State Route 202 near School Street and the MacDuffie School. The incident was unique in that the flood

waters seemed to be flowing overland towards Turkey Hill Brook, rather than from it, something that had not occurred previously. A 2011 study by University of Massachusetts Amherst geoscientists suggested that soil moisture and the water table have been rising over the past 10 years across the region due to changes in subsurface water storage over the longer term. Higher groundwater levels impact the amount of rainfall that can be absorbed into the ground, and likely contribute to flooding issues in Granby.

Granby's flood problems are impacted not only from changing weather patterns but also by aging infrastructure. Nearly all of the town's culverts are undersized or in disrepair and cannot handle the increased intensity rainfall events now common in the region which is why culvert assessment and replacement is included as a high priority recommendation. Massachusetts now requires upgraded or new culverts to meet state stream crossing standards, which increases the upfront investment but will reduce damages to infrastructure and the environment in the long run. Even so, the financial hurdle has resulted in few projects being implemented, and the existing culverts continue to age, deteriorate, and lead to flooding.

Increasing flood risk due to projected precipitation pattern changes could have serious impacts to Granby's emergency response capabilities, especially in areas where the town's roadway network lacks redundancy. Roads such as Amherst Street with single points of access are most vulnerable. Navigating around these primary thoroughfares would take considerable time from emergency responders. Already, many of Granby's private roads are difficult for emergency vehicles to access due to steep slopes and lack of maintenance. Coupled with the risk of future flooding, these conditions could inhibit efficient and effective emergency operations to some properties in town.

Electricity

Electricity is one of the most critical pieces of infrastructure in modern societies, and electrical service outages in Granby can be caused or impacted by changing climate stressors including severe storms and extreme heat. The many residents in town that are mobility-limited or health impaired are particularly vulnerable to the secondary impacts of a power outage, including prolonged exposure to extreme cold or heat. The town needs to assure back-up power for housing complexes where older adults live as well as where people with medical conditions that require electricity live. Electricity is also part of mitigation as electricity could be generated by clean safe sustainable sources versus relying on the 80-20 ratio of fossil fuels to renewables provided by current compliance with the Renewable Portfolio Standard (RPS) and delivered to the town by their utility provider, National Grid. Three communities in the region, Amherst,

Northampton and Pelham, have just created Valley Green Energy, a community choice aggregation initiative that plans to switch users to 100% renewable energy and Granby should consider joining this effort.

Granby is served by National Grid, who collaborates with the Town on preventative tree maintenance around power lines. Granby has an opportunity to continue doing its part to reduce GHG emissions as it did when it permitted several large scale solar photovoltaic installations that generate megawatts of clean safe sustainable solar energy by responsibly considering how to add more solar while balancing the needs for open space, farmland, pastureland and for forested areas to enjoy nature and provide corridors and connections for wildlife. Some MVP workshop participants encouraged the investigation of the viability of the town starting its own municipal utility. And the town should continue to implement its 20% Energy Reduction Plan (ERP), maintaining Green Community certification and working toward net zero energy as the Commonwealth is committed to.

Dams

There are four dams in Granby and one dike - three of the dams are publicly owned and one is owned by private citizens (Aldrich Lake Dam). The Aldrich Lake Dam and Forge Pond Dam and Dikes have been identified by the Massachusetts Department of Conservation and Recreation as "Significant Hazard" dams, requiring an emergency action plan and routine safety inspection every five years. The Aldrich Dam is currently listed in "Satisfactory" condition; however, the Forge Pond Dam and Dike and the Dufresne Farm Pond Dam are in "Poor" condition. The Quenneville Dam is not currently holding water but is considered "Unsafe." While maintenance costs and inspection requirements can be expensive, it is important that the dams be brought into safer conditions so they do not fall deeper into disrepair leaving them more susceptible to failure, a risk only heightened by the increased intensity rainfall events brought about by a changing climate.

Communication

In addition to equipment and infrastructure challenges, Granby stakeholders noted a need to increase education about and use of existing communication channels that serve residents during emergencies. The Town subscribes to a reverse 911 system that can distribute information to any resident who signs up for alerts, but it only helps those residents who know about it and sign up. Various stressors associated with climate change can add to the social

isolation that ensues from residents aging in place without close neighbors. The local senior center provides a small gathering place for aging residents, but other gathering spaces in town are limited. The town has a Wellness Check program for isolated individuals, but like the reverse 911 it is an opt-in system, and residents may not know about it.

Drinking Water

90% of the residents of Granby access their drinking water through private wells. Groundwater contamination from previous and current land uses has been an issue in Granby, and climate projections suggest an additional urgency to the need to protect both quality and quantity of the local water supply. Some of the specific challenges are:

- Local officials report that wells along Route 202 have been impacted by salt traced to winter road maintenance by Mass DOT along that route. Upgrades to modernize and in some areas widen Route 202, combined with the increase of high intensity winter storms projected as an impact of climate change, necessitate the need for non-salt alternatives and monitoring of the wells.

- According to local officials, Granby has the highest number of horses per capita in Massachusetts. Without proper measures for waste disposal and animal containment, what might otherwise be seen as an asset for the town could become a source of contamination of drinking water and local surface waterbodies. Higher intensity rainfalls will transport loose material from pastures to streams and ponds much more quickly than lighter rains.

- For numerous small lots in Town the distance between on-site private wells and septic systems may not be adequate given rising groundwater and the frequency of higher intensity precipitation events and saturation of soils.

- Testing at the well for the East Meadow Elementary School--located on grounds used previously for firefighting training activities--showed the presence of perflourinated compounds. As a result, the well was dug to tap into supply at a far greater depth. The Town reports that the well is now regularly tested, and results are reported to Mass DEP.

Residents are supportive of expanding public water lines and voted at a special town meeting to support a $1.2 million project to extend water infrastructure from South Hadley into Granby up Highway 202. This was the first of a multi-phase, long-term project, that could build greater resilience into the town's drinking water system.

SOCIETAL VULNERABILITIES

Older adults comprise the majority of Granby's vulnerable population. According to American Community Survey 2013-2017 estimates, approximately 24.3% of Granby's population is over the age of 60. The greatest concerns with this population are loss of power resulting in isolation during a winter power outage or prolonged exposure to extreme heat in summer months. Power outages, especially when concurrent with extreme temperatures, leave some elderly and medically vulnerable populations at extremely high risk. Other vulnerable populations include those who live in the handful of group homes scattered throughout the town who have developmental disabilities or mental health challenges, those who are low-income, and those who do not speak English as a first language. The town needs to strive for 100% participation in reverse 911, especially among the population of older adults 80+ and other vulnerable populations. It is also important that those in at risk of power outages be signed up for wellness checks.

SMART GROWTH AND OTHER ACTIONS FROM LAND USE CHAPTER

Throughout the Master Plan Granby has committed to smart growth—concentrating development where there is infrastructure to support it and encouraging mixed uses to facilitate walkable centers. All the existing smart growth recommendations in the Master Plan can also be considered climate resilience work because actions that reduce the need to drive and make buildings closer together use less energy, which means fewer GHG emissions. These also include acting on the proposed priority development areas and the priority protection areas. Recommendations to protect open space, conserve farmland, assure trails and ecological corridors are also climate resilience actions and are important to implement as part of Granby's work to being a resilient community.

GOALS AND STRATEGIES

Goal 1. Assure Resilient Infrastructure

Strategy A. Hold joint DPW Con Comm meeting to review stream crossings (culverts and bridges) and prioritize for repair and funding, comparing notes on condition, public safety, and habitat values.

Strategy B. Increase funding for infrastructure maintenance to address failing and under-sized culverts including funding to design and construct new culverts as needed, starting with Amherst Street and addressing all culverts within two-year timeframe.

Strategy C. Ensure higher design standards for managing storm water and impervious surfaces and assure compliance with standards.

Strategy D. Add sewer to parts of Town where especially vulnerable populations live, tapping into USDA and State Revolving Loan Fund (SRLF) grants and loans.

Strategy E. Install a water and sewer system along Route 202 to provide amenities to residents and businesses along this route. Services should be available to all, especially vulnerable populations ad extend to the location of the MacDuffie School.

Strategy F. Work with DCR Office of Dam Safety and local dam owners to do whatever the town can to improve the safety of all dams, including studying options for the future of Forger Pond dam and whether it needs to be removed.

Strategy G. Analyze private roads and assess whether solutions to ongoing problems are possible

Strategy H. Assess Granby's electricity needs and municipal energy use reduction plan and determine of the town should work toward a municipal utility and/or if it should consider joining regional collaborations such as the new Valley Green Energy Community Choice Aggregation (CCA) initiative.

Strategy I. Conduct a water quality and drinking water study to identify problem areas and cause while educating the public, particularly vulnerable populations who may not know about the dangers of not testing.

Strategy J. Adopt advanced stormwater management standards because of the detrimental impact that improperly designed and managed stormwater disposal can have on water quality, both recreational and potable. The town should encourage and require Low Impact Development design standards for the stormwater management of project including roadway improvements. In addition, the town should consider adopting stormwater management and illicit connection bylaws to meet NPDES standards.

Strategy K. Review and update the Granby Subdivision Regulations

Strategy L. Maximize use of design solutions (permeable surfaces, green areas, water retention areas) that can cope with and also reduce the dependency on public infrastructure such as stormwater systems.

Goal 2. Protect Vulnerable Populations

Strategy A. Assure 100% sign up and use of reverse 911 and the wellness check program for older adults so all residents can be effectively communicated with to prepare for and respond in the event of an emergency and also so older adults who need extra care receive it.

Goal 3. Enhance Emergency Response Due to Likelihood of Greater Need/Demand

Strategy A. Strategically place cisterns throughout town for use by firefighters as needed.

Strategy B. Conduct a study of emergency road access to ensure that emergency vehicles can access all parts of town safely.

Goal 4. Reduce GHG Emissions

Strategy A. Continue to host megawatts of clean GHG emissions free solar energy while balancing need to preserve farmland and pastureland for Granby's horses and forested land to assure trees that clean the air.

Strategy B. Continue to be an active member of the Green Communities certification program and continue to implement the Town's 20% energy reduction plan, working toward net zero emissions by 2050 or sooner.

APPENDICES

- Community Survey Results