MEMO

To: Members of Hatfield's Comprehensive Planning Committee

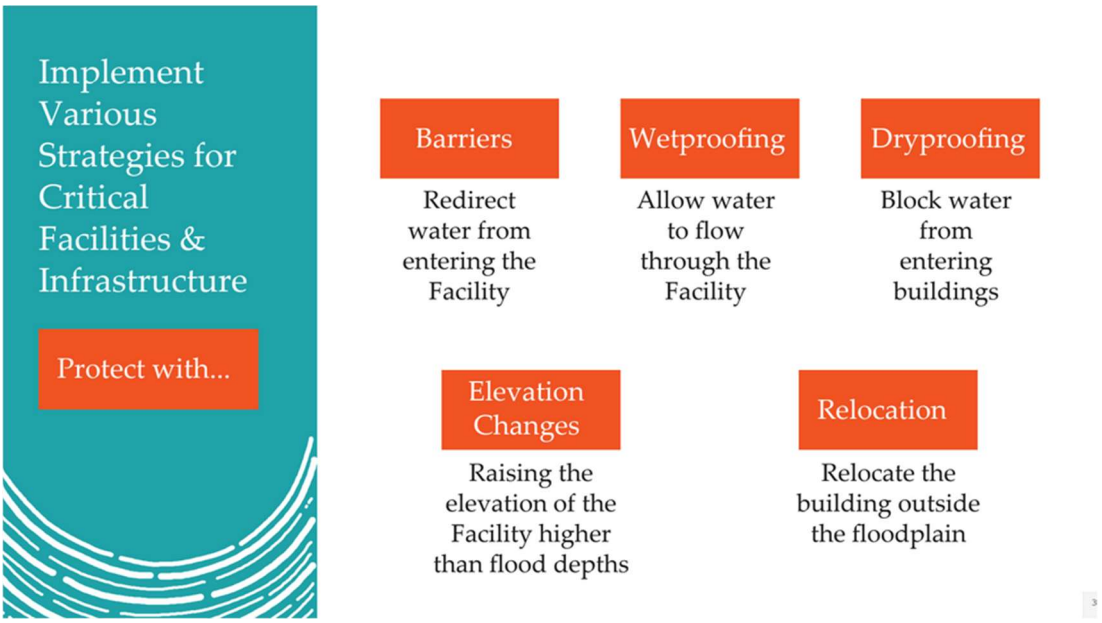
From: Patty Gambarini, Chief Environmental Planner, Pioneer Valley Planning Commission

Re: Examples of climate adaptation approaches to flooding

Date: July 11, 2023

Through much of this first year of the Municipal Vulnerability Preparedness (MVP) funded Climate-Smart Comprehensive Plan project, the Woodard & Curran team took the lead in helping the Comprehensive Planning Committee understand updated-current flood flow risk from the Connecticut River for Hatfield based on the Federal Emergency Management Agency (FEMA) model. Through their work, Woodard & Curran also described end-of-the-century conditions, reflective of a 15% increase of flood flows, a reasoned projection due to climate changes that are recommended in a 2019 UMass-Amherst study conducted for MassDOT.[1]

As part of showing current and future flood flow risks for the Connecticut River in Hatfield, Woodard & Curran also suggests several approaches to mitigating flood impacts. This includes protecting and maintaining the levee, which they note may not offer protection from the 1% event, but will have some protection from the lesser more frequent flood events. To protect critical facilities and infrastructure, shown to be particularly vulnerable in the updated flood model, Woodard & Curran includes a suite of five strategies that are shown in the graphic below.



[1] See: https://www.mass.gov/doc/estimating-future-changes-in-100-year-floods-on-the-connecticut-and-merrimack-rivers-0/download

This memo describes and discusses examples of climate adaptation specific to flooding in keeping with Subtask 4.4 of the PVPC-Town of Hatfield MVP grant contract. The narrative below elevates several additional examples to flooding, drawing from Vermont, where communities mobilized in important ways in the wake of Tropical Storm Irene in 2011, and Louisiana, where communities have been working toward greater resilience in the aftermath of repeated losses due to numerous natural disasters, and Massachusetts, where communities are able to make important advances thanks to funding through the Municipal Vulnerability Preparedness program. The adaptation activities described below build on those suggested to date by Woodard & Curran and are organized into two major categories:

1. increasing natural storage and moving out of harm's way; and
2. updating local land use regulations[2]

Afterword – July 12, 2023

Following the drafting of this memo, a series of summer rainstorms dealt another severe blow to the people of Vermont. Storms are predicted to continue now in the days ahead. With ground that is already saturated, water moves quickly and forcefully, finding new pathways where it must.

The important lessons from Tropical Storm Irene, included here in this memo, and now new lessons from these summer of 2023 events, will continue to inform all of us about best practices to adapting to flooding.

Hatfield seems to have remained relatively safe through these latest rainstorms, though both the Mill River and Connecticut River remain at extremely high flow levels. With precipitation extremes increasing, it makes sense to consider and prioritize adaptation strategies to reduce risk over the long term.

While flooding is a threat to the Town of Hatfield, adaptation activities ought to be considered in context with other important needs and priorities identified during the comprehensive planning effort, including affordable housing, a more robust social network, drinking water and farmland protection, and economic development. Important questions being: Are there ways to combine certain flood adaptation activities with the activities required in meeting other priorities? Which are most mutually beneficial, providing robust co-benefits to the Town? A discussion among Committee members in Project - Year 2 of approaches that are worthy of further exploration seems important.

Increasing natural storage and moving out of harm's way

Preserving and restoring lands that provide natural flood mitigation

Intact floodplains and wetlands can provide key functions that reduce risk of flooding to homes, businesses, and infrastructure by slowing runoff and providing storage. One of the most telling examples of this comes from Vermont and Tropical Storm Irene in August 2011 when downpours caused rivers and streams to overflow throughout much of the state, causing epic destruction

[2] Because PVPC will be working with the Town to make recommendations on local land use regulations during Year 2 of this project, the content under this category is focused on just two areas: flood plains and stormwater management.

with damages totaling more than $730 million, including losses of roadways, bridges, culverts, homes, farmlands, and forests.[3]

The longest river in the state, Otter Creek swelled and flooded the City of Rutland causing heavy damages during Tropical Storm Irene. Middlebury, a town located 30 miles downstream from Rutland, was spared from such damages due to a vast network of floodplains and wetlands that served to slow and absorb Otter Creek's extreme flows before reaching the town. While peak discharge for Otter Creek in Rutland was 15,700 cubic feet per second, peak discharge dissipated to 6,180 cubic feet per second by the time it reached Middlebury.

A 2016 University of Vermont study calculates the economic value of flood mitigation provided by floodplains and wetlands along Otter Creek in terms of *the damages avoided* to the Town of Middlebury during Tropical Storm Irene and 9 other flood events. The study reports:

> …we find that the Otter Creek wetland–floodplain complex reduces downstream flood inundation costs by up to 92% across a range of flood intensities. For Tropical Storm Irene alone, these wetlands and floodplains provided between $627,000 and $2,000,000 in avoided damages. Beyond this one event, the expected annual value exceeds $126,000 and may be as high as $450,000. These values will likely increase under a changing climate, with extreme rain events already becoming more common….Our damage estimates represent only a fraction of the flood mitigation value provided. We focused on avoided damages caused by inundation of buildings in the town of Middlebury, omitting damages to infrastructure, profits lost to businesses, erosion damages (which often exceed those from inundation Vermont Agency of Natural Resources Department of Environmental Conservation Water Quality Division, 1999), insurance costs, agricultural losses, and less tangible impacts on human health. All of these factors may also be mitigated by upstream wetlands and floodplains.[4]

Preserving land that provides natural flood mitigation can take several forms, including identifying locations best suited to providing benefits and then prioritizing projects. Along the Mystic River in eastern Massachusetts, 17 communities are using a watershed-wide hydrological model to identify priority candidate sites to increase wetland capacity in absorbing extreme precipitation. This is referred to as "nature-based, flood resilient open space." Through this work they have identified 120 viable sites for stormwater wetlands and have started to design and construct the first six such facilities.[5]

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[3] For more information on damages from Tropical Storm Irene, see: https://anr.vermont.gov/sites/anr/files/specialtopics/climate/documents/factsheets/Irene_Facts.pdf; https://floodready.vermont.gov/sites/floodready/files/documents/2013-IRO-final-report%20reduced.pdf

[4] Full study at: https://conservationtools-production.s3.amazonaws.com/library_item_files/1634/1822/Watson_et_al._2016.pdf?AWSAccessKeyId=AKIAIQFJLILYGVDR4AMQ&Expires=1688478603&Signature=4qCQaHauIRe0KpBFxNVw7Ls1tsE%3D

A summary of study at: https://floodready.vermont.gov/sites/floodready/files/documents/OtterCreekWetlandsSavedMiddlebury.pdf

[5] Note that the Mystic River group now acknowledges that while restoring and expanding wetlands still has important value, the group found that in such an urbanized environment, wetlands don't seem to be able to do enough to manage stormwater flooding on a regional basis. Projects also seem too slow, expensive, and hard to

Following Tropical Storm Irene, when the Neshobe River swelled to jump its banks and flow through its downtown, the Town of Brandon, Vermont, partnered with certain landowners, and the Vermont River Conservancy to establish river corridor easements. River corridor easements involve the sale or donation of an easement on land adjacent to the river to preserve or restore areas identified as having a key role in the river's natural dynamic functions.

Waters of the Neshobe River swelled beyond the river banks and flowed through downtown Brandon, Vermont, during Tropical Storm Irene in 2011. Source: https://youtu.be/Nxrg9x6KIh0

- In one case, the landowner agreed to a river corridor easement along the Neshobe River where floodplain forest on their land helped to absorb debris and slow the flow, effectively reducing the extent of damage to downstream communities during Tropical Storm Irene. It was acknowledged that the functional value of this floodplain forest will only increase due to climate changes and likelihood of more downpours.
- In another case, farmers agreed to take their land out of production given the damages during Irene when the Neshobe River cut several large channels across their land and deposited sand, rocks, and debris. Rather than go to the trouble of cleaning up their fields, which would likely flood again at some point, the farmers agreed to an easement so that the land might be restored to floodplain forest.

For the Town of Brandon, these projects together represent a total of more than 30-acres and nearly three-quarters of a mile of river protections, an important step in mitigating impacts for the next big storm.[6]

permit. (7-5-23 e-mail from J. Wormser) Being more rural, Hatfield may be in a better place in terms of pursing a strategy of nature-based flood resilient open space, particularly in the Mill River watershed. See work by Franklin Regional Council of Governments in the South River watershed at:
https://storymaps.arcgis.com/stories/b2efe43559ba47f2b1a2fc2c743f1278

[6] See more information about Vermont's River Corridor Easement Program at:
https://dec.vermont.gov/watershed/rivers/river-corridor-and-floodplain-protection/protection

The Town of Brattleboro, Vermont, worked with EPA's technical assistance staff in 2016 to look for flood resilient design solutions in the corridor of Whetstone Brook. The review team noted areas that were channelized, exacerbating flood damage; areas adjacent to the brook that were underutilized or paved over; and areas that were well suited for restoration and flood storage. Remedies included better management of stormwater runoff, a vision for infill development, and reconnecting the brook to nearby neighborhoods as a recreational amenity.

Following a community design charette, the team identified options that included the following: converting a parking lot into a park; removing vertical channel walls along the brook and replacing these with terracing elements to increase flood storage; creating a major flood storage and stormwater management facility on a 12-acre site upstream from downtown; and deploying green infrastructure across the watershed to control stormwater and improve water quality.[8]

"Making Room for the River"

In the Netherlands where some 55 percent of housing was located in areas prone to flooding, the Dutch embarked on a new solution following devastating floods in the 1990s. Their program has focused on creating the space rivers will need in coming decades due to higher discharges forecasted with changes in climate. Rather than continue to invest in their age-old approach to raising the height of dikes, the government decided to enhance floodplain capacity. Major approaches include relocating dikes further from the river thus removing the "bottlenecks" created by dikes, lowering the levels of flood plains, increasing the depth of side channels, and constructing flood bypasses. The program has involved more than 30 projects since 2007.[7]

Moving out of harm's way

Following the devastation of Tropical Storm Irene, the Two-Rivers Ottauquechee Planning Commission in Vermont worked with 48 towns, state agencies, and the Federal Emergency Management Agency to facilitate the buy-out of 150 properties that had been damaged due to flooding. This included damages due to dramatic lateral erosion and movement of local rivers that inundated properties that had seemed high and dry before the storm. The majority of damaged homes, according to the Planning Commission, did not have flood insurance.

The voluntary property buy-outs offered to qualifying residents and businesses, provided pre-flood values of their properties, enabling owners to move out of harm's way and avoid financial ruin. The buyouts ensure that damaged buildings are removed and that future use does not allow

[7] For more information, see: https://www.dutchwatersector.com/news/room-for-the-river-programme

[8] See more information at: https://www.epa.gov/sites/default/files/2017-02/documents/whetstone-brook-corridor.pdf

for rebuilding. The town typically has an easement on the property and in some cases, these properties have been converted to public parks.[9]

In Massachusetts, the Town of Greenfield worked with FEMA on a buyout related to the Wedgewood Gardens mobile home park following 11 inches of rain and flooding from the Green River in 2005 that wrecked 40 trailers. The land, cleared of structures, is now permanently conserved floodplain managed by the City's Conservation Commission.

Accounting for seasonal or episodic flooding around structures could be another way to think about getting out of harm's way. This can include elevating existing buildings, which can be costly, but has been an important adaptation strategy for property owners in low-lying or coastal areas. New Orleans officials talked about the importance of requiring increased "freeboard" as properties are rebuilt after flood events.[10],[11]

This accounting for flooding could also involve moving operations or material, including fuel storage tanks, out of building basements to reduce damages when floodwaters rise. In Hartford, Connecticut, the rowing club project Riverfront Recapture built its facility along the Connecticut River in 2003 with flooding in mind so that boats stored on the facility's 1st floor would be moved as the river approaches flood stage and then moved back once flows normalize.

Upgrading culverts and bridges so as to not impede flow/create backwater flooding

While critical to getting people safely across rivers and streams, culverts and bridges can also become impediments during floods if not properly designed and sized to pass flows occurring with extreme events. In Jeffersonville, Vermont, where the Brewster River would jump its banks during high flows to travel through parts of downtown on its journey to the Lamoille River, the community decided to upgrade an old railroad bridge that was acting as a bottleneck. As part of upgrading the bridge over the Brewster River, the Town also restored floodplain to provide more space for the river during high flows. After a 2019 flood, a local news source reported,

> Recent upgrades intended to mitigate the impacts of flooding on the village of Jeffersonville likely prevented evacuations and significant damage earlier this month. A recently-built bridge and culvert now directs waters away from the village into the Lamoille River, where previously flood waters from Mt. Mansfield often flowed into the village.[12]

UMass-Amherst and MassDOT conducted a pilot project in the Deerfield River basin to develop a methodology that serves to evaluate and prioritize the vulnerability of road-stream crossings to

[9] See more detailed information on the buy-out program at: https://www.trorc.org/wp-content/uploads/2022/04/Final-Irene-buyout-program-report.pdf
Also video on program at: https://www.youtube.com/watch?v=N_ZbLx-lAFo
[10] This discussion about freeboard occurred at a Georgetown Climate Center webinar June 16, 2022.
[11] FEMA defines "freeboard" as: an additional amount of height above the Base Flood Elevation used as a factor of safety (e.g., 2 feet above the Base Flood) in determining the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with state or community floodplain management regulations.
[12] https://www.mychamplainvalley.com/news/local-news/recent-upgrades-likely-spared-jeffersonville-from-significant-flood-damage/

extreme weather and climate change. The methodology also accounts for the crossings in terms of connectivity/disruption of the river ecosystem.[13] Belchertown is among several communities in Massachusetts that have used the Municipal Vulnerability Preparedness Action grant funding to assess and analyze local culverts and bridges. Such an analysis identifies existing and future vulnerabilities and enumerates high-priority projects for culvert/bridge replacement.[14]

Collaborating at a regional scale

Rather than going it alone, joining with other communities to address flooding is increasingly important. There may be upstream opportunities to better manage flood flows that mitigate flood impacts on downstream communities. At the same time, activities in one community seeking to protect itself from flood flows could have negative impacts on adjacent communities. Taking a complete view on a regional basis can get communities working on solutions together that are of mutual benefit. On the Mill River, collaboration with Conway, Deerfield, Whately, and Williamsburg might be possible.[15] And while the Connecticut River is a vast watershed, spanning 4 states, there may be opportunities for collaboration or even united action within the Massachusetts stretch to help reduce flood flow impacts.

The best example to date of such regional collaboration in Massachusetts is the Resilient Mystic Collaborative, a voluntary partnership of 20 communities in the Mystic River watershed. Founded in 2018, the Collaborative effectively secures funding for meaningful regional resilience projects. Communities in the upper watershed are focused on working together to manage stormwater flooding while communities in the lower watershed are focused on working together to "harden" critical infrastructure that could fail during and after major coastal storms. All communities are engaging the region's most vulnerable residents and workers to reduce risk and impacts to health, housing, and livelihood with extreme heat through a program called "Wicked Cool Mystic."[16]

Another example comes from further afield in the state of Louisiana, which has organized for flood resilience based on 9 watershed regions. Launched by Louisiana's governor following historic flooding events in 2016, the Louisiana Watershed Initiative is designed to promote intra- and inter-watershed collaboration to improve flood mitigation. The program does acknowledge the difficulty in overcoming habits of local governments in thinking about physical infrastructure

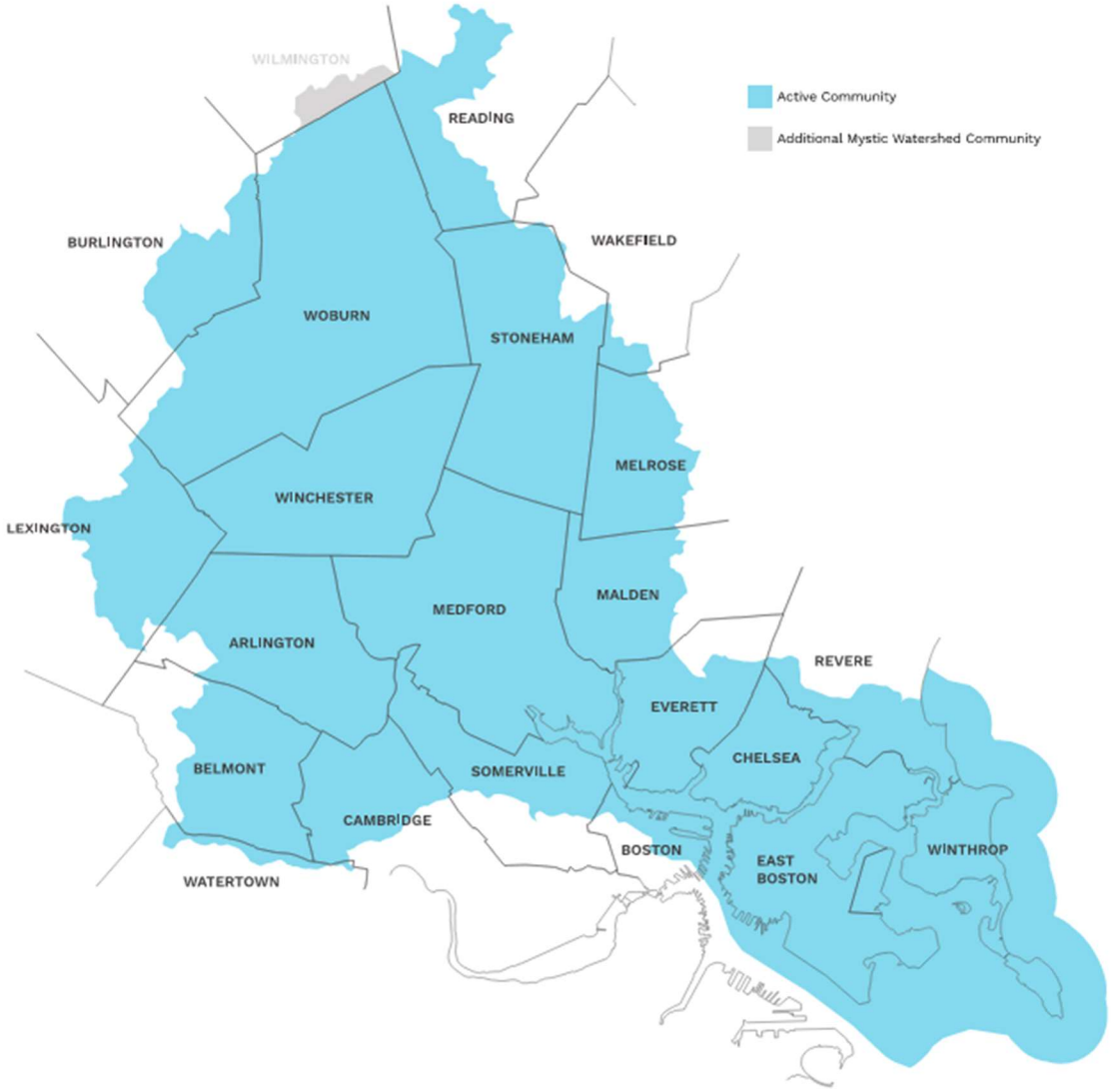
[13] See the 2019 study at: https://www.mass.gov/files/documents/2020/03/13/dot_Vunerability_RoadStream_Dec2019.pdf

[14] See Belchertown study at: https://www.mass.gov/doc/road-stream-crossing-assessment-technical-memorandum/download
See also recent state report at: https://www.mass.gov/doc/massachusetts-culverts-and-small-bridges-working-group-report/download

[15] One first step in a collaboration could involve river corridor mapping along the lines of what Vermont and river communities have done. See: https://www.nawm.org/pdf_lib/member_webinar/river_corridor_mapping_application_vermont_052621_alexander.pdf

[16] For more information about the Resilient Mystic Collaborative, see: https://resilient.mysticriver.org/

investments in terms of what they can do within their own jurisdictional bounds to achieve better outcomes for their communities.[17]



Resilient Mystic Collaborative, a voluntary partnership of 20 municipalities, includes communities that are wholly and partially in the watershed of the Mystic River.

Image source: https://resilient.mysticriver.org/about

[17] See more at: https://watershed.la.gov/watershed-regions Also see the Georgetown Climate Center's description of watershed scale collaboration in Louisiana at: https://www.georgetownclimate.org/adaptation/toolkits/greauxing-resilience-at-home-a-regional-vision/objective-2-1.html

Updating local land use regulations

Legal and policy decisions related to development and land-use patterns, including creation of impervious surfaces, allowing for fill, standards for drainage infrastructure, and more have significant implications for flooding. Limits on creation of impervious surface, for example, can translate to a project that stays as close as possible to a site's natural hydrology, allowing rainfall and snowmelt to soak into soils, or in contrast, a project that sheds storm flows off site to the nearest storm drain and/or stream, creating higher volume and velocity flows that can erode soils and contribute to downstream flooding.

In Hatfield, farmers at a recent project listening session attribute flooding of their crop fields to development projects permitted over the years that allowed for disruption of historic drainage ditches and for fill (which can displace floodwaters onto nearby properties).

Note that Year 2 of this MVP funded project includes regulatory review that is responsive to the Town's climate and resiliency considerations, including floodplain controls, low impact development approaches, and stormwater management. PVPC will be meeting with local boards to talk about major issues and make recommendations within municipal code in up to five areas, including: farmland protection, housing production, floodplain controls, low impact development (LID) standards, and age-friendly elements.

Floodplain management standards

Floodplains naturally provide important functions in slowing down and storing flood waters, which in turn reduces erosion and flood risk. Colonial settlement of land in New England has tended to occur along rivers because flowing waters have historically helped with powering early mills or as in the case of Hatfield, also delivered rich sediments to riparian areas, making for some of the most productive agricultural lands. When it comes to floodplain management, there are several important questions: What existing buildings and uses are in the floodplain? Should these be relocated or how might they be flood-proofed to minimize risk? How might the floodplain change based on more extreme flow regimes and surrounding landform and geology? And, what are the best ways to account for this within regulations and standards?

As a participant in the National Flood Insurance Program (NFIP), Hatfield has had to develop a floodplain management bylaw that meets the minimum federal standards set by the Federal Emergency Management Agency (FEMA) in the Code of Federal Regulations. This includes the FEMA Special Flood Hazard Area (SFHA), also known as the 1% chance or the 100-year flood zone. Hatfield does have standards in its Zoning Bylaw, Sections 2.3 Location of Overlay District; and Section 2.4 Floodplain Overlay District, which applies to those areas within the boundary of the SFHA. The Town also has a 2.6 Riverfront Overlay District, which is intended to protect sensitive natural resources and rural character of the lands adjacent to the Connecticut River, promote the preservation of agricultural lands, and preserve the natural flood control and flood storage characteristics of the floodplain areas.

The floodplain overlay district unfortunately relies on the last Flood Insurance Rate Maps (FIRMs) issued by FEMA that are 43 years old, dating to before 1980. Given what the

Comprehensive Plan Committee has seen from Woodard & Curran's work this past year, it is clear the flood boundaries and elevations have changed significantly and will likely continue to expand given changing climatic conditions.

Currently, FEMA anticipates releasing working FIRMs showing the updated flood boundaries for public comment at an undetermined date. Finalizing the working maps will then take additional time. As part of the development of these new maps, Hatfield will be required to update standards in its zoning based on the new model provided by the Massachusetts Department of Conservation and Recreation (DCR) Flood Hazard Management Program (FHMP), the State's Coordinating Office for the National Flood Insurance Program (NFIP). The model identifies required and recommended language with minimum state requirements (building code, wetlands and others) that apply in the SFHA.[18]

One important question for Hatfield is whether the Town can provisionally adopt the delineations shown in the Woodard & Curran updated maps for zoning purposes rather than wait for FEMA's new FIRM maps and allow additional development to occur in what we know are already new floodplain areas. This would help reduce risk for new and redevelopment projects while also ensuring that flooding issues are not exacerbated with new areas of impervious cover or fill that will only serve to displace flood flows to other properties. It may also be worth exploring whether these new delineations and standards go far enough in providing adequate protection for the Town of Hatfield and local residents and businesses.

The Metropolitan Area Planning Council (MAPC), the planning agency for communities in the Boston area has noted:

> Limitations and restrictions associated with FEMA flood maps and the state building code can make it difficult to craft regulations that will reduce flooding and

Community Rating System

As a participant in the National Flood Insurance Program with 34 properties enrolled for federal insurance coverage, Hatfield could also join in the Community Rating System, which qualifies communities to receive a classification rating that corresponds to insurance discounts. The program essentially provides flood insurance premium discounts for communities that go "above and beyond" the National Flood Insurance Program minimum standards. There are 19 creditable activities, which involve minimizing flood risk for new development, including preserving open space, protecting natural floodplain functions, promoting higher regulatory standards and regulating new development in the floodplain, and regulating development in the watershed.

CRS activities are organized into four categories:

- Public Information
- Mapping and Regulations
- Flood Damage Reduction
- Warning and Response

Twenty-five Massachusetts communities participate and have discounts between 5 and 20%. Northampton is currently the only Western MA community enrolled in the CRS program, getting insurers a 10% discount.[19]

[18] See model at: https://www.mass.gov/doc/2020-ma-model-floodplain-bylaw/download

[19] See more information at: https://www.fema.gov/floodplain-management/community-rating-system#participating; and

> flood damage. Despite the challenges, many communities have gone beyond minimum federal and state requirements to reduce their vulnerability to flooding. Strategies include expanding overlay districts beyond the SFHA, prohibiting construction in the SFHA, requiring special permits for construction, protecting flood storage, and more. As seas rise and precipitation increases, these are important tools for protecting communities and overcoming the current limitations in FEMA flood maps and building code regulations.[20]

Several communities in the Eastern part of Massachusetts have added areas outside the FEMA SFHA to their Floodplain Districts. MAPC continues, "Flood related building code regulations and flood insurance requirements still apply only in the FEMA SFHA, yet municipalities can restrict development or require special permits in flood risk areas they identify."

Stormwater management

There are many opportunities within municipal code to advance standards in practice to ensure that new development and redevelopment projects better manage storm flows. This can start with setting up a process whereby site development occurs through a considered low impact development approach, also referred to as "environmentally sensitive site design."

A well-defined process that promotes such an approach within preliminary plans, site plans, and stormwater management plans, can begin with a pre-application conference. Permitting boards can recommend project proponents do some basic site analysis in identifying existing resources, mapping existing hydrologic soils group, and preparing a concept plan. Discussion about this analysis and board concerns can be raised early in the process before much investment is made by project proponents.

Other elements within municipal code, particularly zoning, and regulations on subdivisions, and stormwater management can set standards to minimize creation of impervious cover, and manage rainfall and snowmelt on site.

Generally, key areas to consider include:

- Protecting site resources, including steep slopes, existing drainage patterns, and large trees
- Limiting clearing and areas of disturbance
- Phasing projects to avoid periods of exposed soils
- Avoiding compaction/preserving permeability of soil to retain a site's infiltration capability
- Limiting impervious cover created with streets, parking, sidewalks,

https://www.fema.gov/sites/default/files/documents/fema_community-rating-system_coordinators-manual_2017.pdf

[20] See MAPC information on Floodplain Overlay Districts: https://www.mapc.org/resource-library/floodplain-overlay-districts/

- Enabling use of notched or "invisible" curbing and other elements that enable flows to reach vegetated areas
- Using materials and vegetation that promote infiltration and healthy landscapes
- Allowing bioretention areas and other such infiltration facilities to be located in setback areas
- Making open space residential design the default approach for subdivisions
- Enabling shared parking for uses with different peak demand periods and reducing parking requirements if shared parking is proposed.

In 2022, PVPC prepared a checklist to assess street design and parking lot standards, as well as to evaluate the feasibility of allowing green infrastructure stormwater facilities in local municipal code. This could be a helpful starting place for Hatfield.

Massachusetts communities that are regulated by the EPA-MassDEP MS4 Stormwater Permit must adopt new standards that advance both low impact development approaches to development and greater stormwater management control requirements to reduce polluted storm flows.[21]

At the same time, MassDEP is planning to issue an updated Stormwater Handbook, which applies to wetlands jurisdictional areas specifically, but brings standards into alignment with the MS4 permit so that standards that apply in wetlands can easily be applied in upland areas. This creates a certain consistency of standards, especially for MS4 permitted communities.

While these updated standards reflect a marked change in control of stormwater flows, with a requirement to infiltrate 1 inch of rainfall from impervious areas, this standard is not aimed at mitigating for flooding.[22] Further, the current rainfall data still widely in use to size stormwater infrastructure dates to 1961 and earlier. Even more recent rainfall data, NOAA's Atlas 14, in use for some projects and meant to be used with Massachusetts' forthcoming new standards has been questioned. In a recent report entitled, *The 8th National Risk Assessment: The Precipitation Problem*, First Street Foundation reports:

> As the standard by which precipitation reports are measured, NOAA's Atlas 14 precipitation frequency estimates have been effectively out of date since their creation by not incorporating climate change's effects in their production. When new infrastructure projects are developed today using Atlas 14, they are instantly decades out of date and unable to adequately protect against current and future flood risks from heavy precipitation events. Additionally, these standards will continue to get worse over time, as they also do not consider future precipitation risk from climate change over an infrastructure project's useful life.[23]

[21] Communities are regulated under the MS4 permit if they have what the United States Census Bureau classifies as "Urbanized Areas," or UAs, based on population density. MS4 stands for Municipal Separate Storm Sewer System.
[22] Some communities in the eastern part of the state are pushing standards to require additional infiltration of stormwater from impervious areas. In its analysis, MAPC notes the following: Dedham (*246*) requires that all projects infiltrate 2 inches x the impervious surface area; and the Boston Water and Sewer Commission requires projects greater than 100,000 square feet to infiltrate 1.25 inches x the impervious surface.
[23] See full report at: https://report.firststreet.org/8th-National-Risk-Assessment-The-Precipitation-Problem.pdf

While Hatfield is not regulated by the EPA-MassDEP MS4 Stormwater Permit, the Town did adopt stormwater standards within its Zoning Bylaw. The Bylaw applies to any development that creates 10,000 square feet or more of new impervious surfaces or results in a disturbance of 1 acre or more of soil. The key performance standard articulated in the bylaw is that new development cannot exceed predevelopment peak stormwater discharge rates from the site. The bylaw notes that the Planning Board can increase the minimum requirements when the proposed discharge may impact a sensitive receptor, including streams, storm drains, combined sewers, roads, and/or buildings.