Flood and Natural Hazard Mitigation Plan

City of Northampton

Office of Planning and Development

Referred to the Planning Board by the Flood Hazard Mitigation Team November 18, 2003.
Unanimously Adopted by the Northampton Planning Board July 22, 2004.
Approved by the Northampton City Council August 19, 2004 and September 2, 2004.

In response to public comment, this plan does NOT include a Land Use Plan for the Meadows. Instead, as suggested at the public hearings, the City will establish small focus groups of farmers, property and business owners, environmental groups and residents to address concerns raised during the public hearing process.

Project Staff
Gloria McPherson, Conservation and Land Use Planner, Project Manager
Wayne Feiden, AICP, Director, Office of Planning and Development
Carolyn Misch, AICP, Senior Planner

Flood Hazard Mitigation Team

City Representatives:
Tony Patillo, Building Commissioner
Peter McErlain, Heath Agent(retired)
Paulette Kuzdeba, Senior Planner, DPW
Doug MacDonald, DPW Env. Planner
Deputy Chief Duane Nichols, Fire Dept
Melissa Singer, Emergency Manager

Community Representatives:
Alex Ghiselin, Councilor, Ward 5
Maria Tymoczko, Councilor, Ward 3 (retired)
Matthew Nowak, Conservation Commissioner
Karen Simon, Flood Plain Resident
Shirley Rodgers, Flood Plain Resident

Planning Board
Keith Wilson, Chair
Paul Diemand, Vice-Chair
David Wilensky
Julie Hooks Davis (retired)
George Kohout
Francis Johnson
Kenneth Jodrie
Paul Voss

This plan was prepared with financial assistance from the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA). The conclusions and recommendations are those of the City of Northampton and not necessarily those of the Department of Environmental Management, MEMA or FEMA.

CITY OF NORTHAMPTON

MASSACHUSETTS

In City Council, August 19, 2004

Upon the recommendation of the Planning Board

Ordered, that

BE IT RESOLVED

WHEREAS, the Northampton Planning Board recently adopted the *Northampton Flood and Natural Hazard Mitigation Plan* and will oversee implementation; and

WHEREAS, the plan was written consistent with the Federal Emergency Management Agency and the Massachusetts Flood Hazard Management Program guidelines for flood hazard Mitigation Planning; and

WHEREAS, the plan does not include a land use plan or any zoning recommendations but rather recommends a community outreach process for writing such a plan; and

WHEREAS, under the federal Community Rating System (CRS), the current flood hazard mitigation planning process has already led to a 10% discount on all flood plain insurance policies (saving Northampton residents almost $8,000 a year and making it easier for additional residents to obtain flood plain insurance); and

WHEREAS, adoption of this plan will help eventually make the city eligible for a 15% flood plain insurance discount, make the city eligible for additional FEMA funds for flood hazard mitigation measures, including physical improvements, and set the stage for the land planning community involvement; and

WHEREAS, adoption of this plan by City Council does **not** create any obligations to the city;

NOW, THEREFORE BE IT RESOLVED,

City Council adopts the *Northampton Flood and Natural Hazard Mitigation Plan.*

Table of Contents

Public Outreach for Flood and Hazard Mitigation Plan

Informational Meeting/Focus Group	*July 14, 2004*
Flood Hazard Team Meeting	*Nov. 18, 2003*
Public Hearing	*April 2, 2003*
Public Hearing	*Feb. 25, 2003*
Flood Hazard Team Working Sessions	*Jan. 13, 2003 and Feb. 24, 2003*
Flood Hazard Team Meeting	*Dec. 9, 2002*
Public Forum	*June 18, 2002*
Flood Hazard Team Meeting	*April 4, 2002 and May 20, 2002*

Sources of Information Relevant to this Plan

Plan	Available at
Northampton Zoning Ordinance	www.NorthamptonPlanning.org and Paradise Copies
Northampton Open Space and Recreation Plan (2000-2004)-- City of Northampton's goals and objectives regarding the acquisition and management of open space, conservation land, agricultural preservation restrictions, historic preservation restrictions, bikeways and public recreation facilities	www.NorthamptonPlanning.org, Paradise Copies and the Office of Planning and Development, City Hall, 2nd Floor
Floodplain and Floodway Boundaries	www.NorthamptonPlanning.org under "Make Your Own Map"
National Floodplain Insurance Program Information	www.FEMA.gov
Floodplain information	Forbes and Lilly Libraries
Connecticut River Basin in the 1980's: Challenges and Opportunities (1981)-- New England River Basins Commission's report on the management of the Connecticut River basin's natural resources over the years and the need for all levels of government, the private sector, and residents to cooperate to develop natural resource management policies and programs.	Planning and Development
Plan for Flood Plain Management, the Mill and the Connecticut River Flood (1979)-- Analysis of floodplain management techniques, policies and programs and a survey of floodplain residents on perceived effects of floodplain policies. Recommendations focus on land use planning and non-structural management techniques.	Planning and Development
Attitudes Toward Flood Management in Northampton (1978)-- Analysis of demographics, economics and land uses of the floodplain. Includes an extensive survey of residents about their experiences and perceptions with flood hazards and opinions about mitigation alternatives. Respondents tended to see past flooding as worst than present risks and were more critical of non-structural mitigation measures, such as public purchase.	Planning and Development
Flood Insurance Study (1978)	Planning and Development
Water and Related Land Resources of the Connecticut River Region (1978)--Massachusetts Water Resources Commission commissioned study for a plan for the Commonwealth's land and water resources; Identifies problems, needs and alternative solutions in land use, flooding, erosion, sediment and wetlands	Planning and Development
The River's Reach (1976)-- New England River Basins Commission's strategy for compatibility between uses of the floodplain and the river's essential hydrologic functions; Emphasizes non-structural measures, such as flood warning, relocation, development controls and open land acquisition as a long term strategy to decrease susceptibility to flooding.	Planning and Development

Purpose

The City of Northampton has developed this Flood and Natural Hazard Mitigation Plan to address natural and manmade hazards and to plan for the future of areas prone to flooding. Flood hazard areas are found in the Meadows along the Connecticut River and along the Mill and Manhan Rivers. There is also localized flooding associated with the stormwater drainage system.

Northampton has experienced many flood events, resulting in over $1.5 million in damages related to flooding over the past 10 years, including $70 thousand the City spent to repair a fire truck that was damaged during Tropical Storm Floyd in 1999. An estimate of damage from our most recent flooding in September and October 2003, and the costs to the City is as follows:

DAMAGE	***ESTIMATED VALUE/COST***
Pumps	$2,650
Mics. Supplies	1,550
Personnel Costs	12,000
Vehicle Costs (based on hourly rate)	10,800
Subtotal (City Costs)	***$27,000***
Rough Estimate of Observed Damage	40,000
Total Estimate (Public and Private Costs)	***$67,000***

The intent of this plan is to develop a program of mitigation that goes beyond solely reducing hazard vulnerability and protecting property and taxpayers. The Plan also incorporates complementary goals that can help achieve multiple community objectives, such as preserving traditional land use patterns and open space, maintaining environmental health and natural features, and enhancing conservation and recreational opportunities. The Plan emphasizes the need to ensure that the City of Northampton becomes better able to withstand the forces of nature while at the same time improving the overall quality of life.

The following sections of this plan will

- Identify and assess the natural and environmental hazards that pose a threat to people and property in the City of Northampton
- Assess the ongoing mitigation activities in Northampton
- Propose additional mitigation measures that should be undertaken

Background

A natural hazard is defined as “an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.” (FEMA, Multi Hazard Identification and Risk Assessment, 1997) Natural hazards can be exacerbated by societal behavior and practice, such as building in a floodplain and increasing the amount of paving in a watershed.

Northampton can experience flooding in any part of the City. One great misunderstanding is the belief that floods only happen in the floodplain. With sufficient rain, almost any area will experience at least pockets of surface flooding or overland flooding. Overland flooding in rural areas can result in erosion, washouts, road damage, loss of crops and septic system back-ups. Heavy rain in the more urbanized parts of the City with extensive paved and

impervious surfaces can easily overwhelm stormwater facilities resulting in localized flooding and basement damage. Stormwater flooding also contributes to water pollution by carrying silt, oil, fertilizers, pesticides and waste into streams, rivers and lakes.

As the intensity of development continues to increase, Northampton will see a corresponding increase in serious stormwater problems. It is therefore important that the City as a whole, not just residents of the identified floodplain, address the need for mitigation.

Flood and hazard mitigation is any preventive actions a community can take to reduce risks to people and property and minimize damage to structures, infrastructure and other resources from flood or other hazardous events.

Hazard mitigation and loss prevention is not the same thing as emergency response. Some flood loss reduction can be achieved by components of response plans and preparedness plans, such as a flood warning system or a plan to evacuate flood prone areas. However, warning and evacuation deal only with the immediate needs during and following a flood event. Hazard mitigation is much more effective when it is directed toward reducing the need to respond to emergencies, by lessening the impact of the hazard ahead of time. (Massachusetts Department of Environmental Management 1997, 3)

The process of mitigation planning, when ultimately incorporated into a land use plan, has the potential to produce long-term and recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption in mitigation is that current dollars invested in mitigation practices will significantly reduce the demand for future dollars by lessening the amount needed for emergency recovery, repair and reconstruction. There are four types of benefits that can be derived through implementation of a hazard mitigation plan:

1) Reduced public and private damage costs
2) Reduced social, emotional, and economic disruption
3) Better access to funding sources for flood mitigation projects
4) Improved ability to implement post-disaster recovery projects

When integrated into overall city planning goals, mitigation planning will also lead to benefits that go beyond solely reducing the costs associated with hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health and natural features, and enhancing recreational opportunities.

The farmers of the Meadows have, for generations, preserved and maintained as open space thousands of acres in the floodplain. The active agricultural use of the floodplain is particularly compatible with flood hazard mitigation because the broad, open fields preserve the storage and conveyance functions of the floodplain, which in turn minimizes flooding and erosion downstream and to neighboring properties. The support of farming by the City and through State programs such as Agricultural Preservation Restrictions and Chapter 61A tax incentives are crucial to the long-term sustainability of the Meadows.

Mass. Audubon has played a key environmental role in preserving a large amount of floodplain forest and restoring critical grassland bird habitat in the area of the old oxbow of the Connecticut River. They hold approximately 500 acres in the floodplain in Northampton. An additional 80 acres is held jointly with the City. Mass. Audubon's management of the floodplain for conservation, open space and wildlife habitat also reduces the risk of flood and erosion elsewhere in the floodplain.

Developing a Mitigation Plan

Careful and effective natural hazard planning begins with an understanding of existing conditions, concerns and expectations, as well as future trends.

This information can be found in appendices toward the end of this document:
Appendix A provides an analysis of flood hazards in Northampton and includes
Description
Likelihood of Occurrence
Vulnerable Areas and Populations
Table: Significant Flood Events in Northampton
Flood Mitigation Efforts
Remaining Issues and Needs

Appendix B identifies and analyzes environmental limitations and hazards. These include high risk soils, wetland related problems, wildlife habitat, the drinking water supply, local and regional watersheds, and dam failures.

Updates to the Water Resources section of *Northampton Vision 2020* are included in *Appendix C* of this document. Other information can also be found in *Northampton Vision 2020*, which provides relevant background information including Community Setting, Growth and Development Patterns and Population Characteristics, and an Environmental Inventory and Analysis.

Appendix D briefly identifies and analyzes other natural hazards affecting Northampton, including hurricanes, northeast storms, heavy rainstorms, tornadoes and microbursts, earthquakes, urban and wildfires, and drought.

It is necessary to find approaches to reducing flood and natural hazard damage that are simultaneously effective, equitable, economically reasonable and environmentally sound. Adoption and implementation of management strategies will depend on their ability to successfully mitigate environmental hazards while satisfying additional ecological and cultural functions, such as providing wildlife habitat and protecting open space. The City of Northampton can choose from and institute a variety of structural and non-structural hazard mitigation measures.

Structural measures may include drainage modifications, the construction of dams, dikes and other capital improvement projects that protect buildings and infrastructure from the forces of wind and water. Typically they are used to prevent a natural hazard from reaching property. Most structural projects are expensive to build and maintain and have other shortcomings, including the destruction of farmland and wildlife habitat and increased erosion downstream.

Non-structural strategies do not change the natural hazard, but involve preventative actions that improve infrastructure's ability to reduce the damages, or improve coordination of resources. Non-structural measures include building codes and inspections, floodplain zoning, development regulations, acquisition of hazard-prone properties in fee simple or limited rights (such as Conservation Restrictions and Agricultural Preservation Restrictions), setting preferential tax rates for agricultural lands to discourage development in hazardous areas, open space preservation and wetlands protection.

A mitigation plan emphasizing non-structural strategies and wise land use policy can help ensure that Northampton does not increase its vulnerability through inappropriate land uses

and encourage the acquisition, relocation or retrofitting of existing vulnerable structures along with the protection of valuable natural resources.

The City of Northampton began the process of developing a land use plan for the Meadows, an area that contains approximately 4,000 of the 4,800 acres of floodplain in Northampton, as part of a City-wide master planning effort. Because of the complexity of wetlands and zoning issues faced by residents of the Meadows, the neighborhood wanted to continue with the discussion. The land use plan will, therefore, be completed separately.

Goals for Hazard Mitigation

A primary goal of the City of Northampton is to minimize exposure of people and property to flood and other natural hazards to increase public awareness of and responsibility for reducing flood losses. Working toward this goal will help to

- Reduce the costs suffered during floods and other natural hazard events
- Protect the interests of the City and all taxpayers
- Give landowners the opportunity to pay lower flood insurance premiums
- Maintain emergency services for the worst possible event

In order to meet this goal, the City must ensure that flood and natural hazard mitigation is adequately addressed in City regulations, particularly the Comprehensive Plan, Subdivision Rules and Regulations, Zoning Ordinance and Wetlands Ordinance, and that mitigation consideration is included in the evaluation and prioritization of public policy initiatives, such as public land acquisition.

Other City goals defined in *Northampton Vision 2020*, in particular preserving traditional land use patterns, preserving natural and cultural resources, and expanding open space and recreation, are complementary and support the purpose of hazard mitigation.

Ongoing Mitigation Activities

The City of Northampton currently conducts and promotes flood and hazard mitigation through several types of activities and regulations. These are described and evaluated in the "Existing Mitigation Strategies" table on the following pages.

EXISTING MITIGATION STRATEGIES

Type of Mitigation	Description	Area Covered	Effectiveness and/or Enforcement	Options for Improvements or Changes
Federal, State and Local Regulations				
NPDES Phase II	Federal stormwater regulations	Any project within the City with 1 or more acres of land disturbed	In effect since 7/30/03	DPW in process of implementing Phase II Plan
Wetland Protection Act, Northampton Wetlands Ordinance, and Rivers Protection Act	State and local laws regulating development within the buffer zones of wetland resource areas and within the riverfront area	100 foot buffer around wetlands and the wetland resource area itself, and 200 foot resource area on both sides of every perennially flowing river and stream	Effective. Building permits cannot be issued without review by the Conservation Commission	Strengthen Wetland Ordinance; establish a no disturbance area adjacent to wetlands in less developed areas.
Stormwater Management Standards	State regulation under the Wetland Protection Act to regulate Stormwater and other point source discharges	New residential subdivisions; alterations to non-residential structures subject to site plan review; roadway projects	Effective. Enforced by the Conservation Commission and Planning Board	City in process of adopting stormwater management ordinance for DPW administration
Northampton Stormwater Management Ordinance	Local regulation to ensure that erosion and sedimentation is managed and post construction runoff rates and volumes are controlled	Any new development or construction that disturbs over 1 acre of land and will discharge directly or indirectly into the City's stormwater system	In effect since 6/17/2004. Administered and enforced by the DPW.	One of the main purposes of this new ordinance is to minimize damage to public and private property from flooding.
MA State Building Code	Requires flood-proofing of new construction within the 100-yr floodplain	All new or improved structures that require a building permit	Effective. Enforced by the Building Inspector.	Improve outreach to floodplain residents about State regs for property upgrades
Title V Regulations and Northampton Regulations	Minimum requirements for the subsurface disposal of sanitary sewage	Areas of the City not serviced by municipal sewers	Very Effective. Enforced by the Board of Health	Develop policy (Conservation Commission) on compensatory storage requirements for septic system repairs in the floodplain

Type of Mitigation	Description	Area Covered	Effectiveness and/or Enforcement	Options for Improvements or Changes
Local Zoning				
Special Conservancy District, per the current Northampton Zoning Ordinance	Floodplain zoning which regulates development	Majority of the area contained within the floodplain of the Connecticut River (see Appendix A, p. 22)	Very Effective. Enforced by the Building Inspector and the Conservation Commission	Work with residents, land and business owners to develop a land use plan. Discussions should help determine rules for new development that will not damage the resource areas while encouraging investment in existing properties
Watershed Protection Overlay District, per the current Northampton Zoning Ordinance	Overlay District which regulates development.	Land adjoining streams and rivers (see Appendix A, p. 22)	Very Effective. Requires special permit from Planning Board. Enforced by the Building Inspector and Conservation Commission	
National Flood Insurance Program and Community Rating System	Federal Law regulating new and substantially improved construction in the floodplain	100-year floodplain (Zone A) as shown on the Flood Insurance Rate Map	Effective. Enforced by the Building Inspector; CRS participation can reduce insurance premiums up to 45%	Reduce insurance premiums 15% through the CRS by passing Flood Mitigation Plan
Open Space Preservation				
State and local land preservation within the floodplain	APR and CR lands, Arcadia Wildlife Sanctuary, Rainbow Beach (state and city), Shepard's Island, Elwell Island, Ct. River Greenways State Park, Mill River Greenway	1,251 acres within the floodplain	Very Effective, permanently preserves floodplain area	Pursue federal and state grants to buy repetitive loss properties, and APRs and CRs on properties posing environmental risks, and on land with valuable habitat, all on a willing buyer-willing seller basis*****
State, local and non-profit land preservation outside the floodplain	Conservation areas, APR lands, parks, playgrounds, buffer areas	3,134 acres throughout the City	Incrementally effective, limits development in watershed areas	Make land acquisition a priority in the City budget

Here, and throughout the document, it is the intention that all land acquisition should be on a willing buyer-willing seller basis. The Flood Hazard Mitigation Plan does not recommend the use of eminent domain for land acquisition.

Type of Mitigation	Description	Area Covered	Effectiveness and/or Enforcement	Options for Improvements or Changes
Structural Projects				
Dikes	Man-made physical barriers to floodwaters	Surrounding downtown	Extremely Effective up to the 100-year flood level	On-going maintenance
Dam Maintenance	Necessary to prevent dam failure and flooding downstream	Area downstream of each dam	Fairly Effective. Records are kept by the Northampton DPW and OPD and by Mass. Dam Safety	Study the possibility of removing obsolete dams along the Mill River
Water Retention and Detention Ponds	Man-made ponds to collect or diffuse stormwater runoff	New development (commercial, industrial and residential when under subdivision control), City-wide	Effective. Part of site review process. Inspected by DPW (public and private structures).	Improve monitoring and enforcement; develop a design manual for "green" solutions to reducing run-off rates and volumes in new development
Maintenance and repair of City Stormwater Management Infrastructure	Storm drains and sewers	City-wide	Case-by-case as done, could be very effective in certain areas	Ongoing, develop a plan; identify and implement a funding stream, such as a dedicated fee for service

Strategies for Further Mitigation

The actions listed below are divided into eight categories: structural projects, prevention, land use policies, property protection, natural resource protection, public information and education, emergency services, and measures for other hazards.

Structural Projects *(Responsible City Department is DPW)*

- Upgrade the pumps and accessory equipment that allows the historic Mill River watershed to drain without flooding when the Connecticut River is in flood stage
- Evaluate the effectiveness of the City storm drain system and make improvements where necessary.
- Whenever feasible, use landscape solutions, such as broad swales, dry wells and constructed wetlands, to limit run-off rates and volumes to pre-construction levels in all new development.
- Install detention ponds and, where land is more limited, oversized stormwater collection systems in new development as options to increase stormwater capacity and buffering.
- Upgrade or replace the linings of sanitary sewers to protect from stormwater infiltration.
- Maintain dikes

Prevention Actions *(Responsible City Departments are DPW and OPD)*

Participation in the National Flood Insurance Program

- The City of Northampton should maintain zoning regulations in accordance with standards for the National Flood Insurance Program in order to reduce flood hazards and better protect public health and safety, and in order to continue to qualify residents for flood insurance.
- The City should qualify residents for greater flood insurance premium discounts by documenting regulations, policies and outreach that that exceed federal minimum standards through an annual review of strategies under the Community Rating System application.

GIS Mapping to supplement and improve FEMA maps

- Work with property owners to request minor map changes, specifically in the areas of Atwood Drive and Easthampton Road/Route 10.
- Request major watershed analyses of the Mill River watershed to facilitate updating the Floodway and Flood Boundary Maps produced by the Federal Emergency Management Agency to reflect actual conditions.
- Continue to watch for changes in hydrology and geomorphology, such as channel migration, in order to be able to update our maps and expand the Watershed Protection Zoning District as necessary.
- Determine and map the location of the actual floodway.
- Extend GIS to Public Safety & Emergency Operations Center (EOC)

Watershed Management Planning

- Develop a Citywide drainage plan through NPDES Phase II, done on an individual watershed basis, including a description and analysis of the hydrological condition of the City and how future developments may impact drainage systems, streams and wetlands in each sub-watershed.
- Prepare basin plans that estimate the downstream effects of the increased runoff rates and volumes caused when development is designed for rate control.
- Require no net increase in post-development run-off conditions (total volume as well as peak rate), to be controlled by means of “green solutions” and prescriptive standards to be met, such as directing all water from roofs to drywells to be recharged, to reduce flood risks to existing properties from new houses and commercial and industrial buildings (not additions to existing structures) in the floodplain, sensitive ecological areas, and those areas the City has planned for low-density development (the SC, WP, WSP, FFR, and RR zoning districts).
- Provide mobile data for Public Safety personnel

Maintenance and Enforcement

- Study ways to ensure that the wastewater treatment plant and stormwater pumping station will function during flood events.
- Develop a plan to upgrade and improve maintenance to City drainage systems and make them easier to maintain.
- Flag areas where the stormwater system appears to be under stress for the Building Office for special review.
- Improve the floodway maintenance program to ensure that rivers, streams, swales and detention ponds are properly cleaned and maintained.
- Develop a program through the Board of Health to ease disposal of yard waste for residents.
- Improve enforcement of existing regulations by establishing an objective and defensible system of imposing fines for violations and improving follow-up on Conservation Commission permits.

Land Use Policies

The City of Northampton should develop a comprehensive plan/land use plan for the Meadows by working with small focus groups of residents, property and business owners, farmers, environmental groups and other stakeholders.

Prevention of future problems through land-use planning and regulation is far more effective, permanent, and less expensive than trying to correct problems after they have been created. Development in the floodplain creates two types of problems. First, the development itself is at risk from inundation and/or erosion. Second, such development can increase risks to neighboring properties by creating a barrier to the conveyance of floodwaters (thus causing backwater flooding upstream) and reducing the area available to store and slowly release floodwaters (thus increasing velocities and erosion downstream).

Certain types of land uses are more compatible with flooding than others. Land uses that leave wide areas of the floodplain open will help preserve its storage and conveyance functions, minimizing flooding and erosion impacts to neighboring properties. Also, the fewer structures in the floodplain, the lower the potential for damage. Critical facilities such as schools, nursing homes, and police and fire stations should not be built in the floodplain.

The City should support continued farming in the Meadows by exploring ways to promote agriculture, such as through the establishment of an Agricultural Commission and implementation of the commission's recommendations.

The stormwater management programs being established at the Northampton DPW, in response to federal mandates, should slow the increase of stormwater-related flooding problems. All development projects, especially large projects, are going to be responsible to prevent increases in stormwater discharges that could create downstream flooding.

Property Protection Actions *(Responsible City Departments are Building, OPD and DPW)*

- Pursue state and federal grants to acquire and relocate or demolish repetitive flood loss structures from property owners who want to sell (willing seller/willing buyer basis only).
- Elevate flood-prone structures, especially any repetitive flood loss structures.
- Increase outreach so that more residents take advantage of CDBG-funded revolving fund home retrofit program that provides funds for income-eligible residential property owners on a matching basis to help protect properties from floodwaters. These measures may include elevation or relocation of utilities or appliances, foundation improvements and other measures on a case-by-case basis.
- Increase flood storage capacity and buffering through the use of detention ponds and other methods, with a focus on landscape or "green" solutions, rather than engineering solutions in areas where there is sufficient land.

Natural Resource Protection Actions *(Responsible City Departments and Boards are Police, OPD, and newly forming Agricultural Commission)*

- Establish an Agricultural Commission as an official City Board
- Study ways to limit vehicular traffic that is damaging to environmental and cultural resources in the floodplain, especially farmland.
- Increase police enforcement and fines for on and off road vehicle abuse of the Meadows and other environmentally sensitive land, conservation and recreation land, including illegal operation of snowmobiles and ATVs.

- Purchase Agricultural Preservation and Conservation Restrictions in the floodplain to **permanently** preserve open space for flood mitigation, farming, wildlife habitat, and natural resource preservation, but only on a willing buyer/willing seller basis. Because the primary public interest is NOT public access, most of the protected land in the Meadows should be protected by restrictions which keep the property in private hands but ensure its permanent preservation. Fee-simple acquisition should only be used when acquisition of restrictions are not feasible for some reason.
- Preserve the agricultural landscape by encouraging the use of Chapter 61A, 61B and 61 tax incentives to make it feasible for farmers to continue farming the land
- Continue to work with land trusts and preservation organizations to merge mitigation with conservation
- Consistently enforce the Wetlands Protection Act to maintain the integrity of the 200' riverfront area, wetlands and wetland buffer areas
- Support existing state and local exemptions for agriculture and water-dependent uses
- Daylight culverted streams and restore adjacent wetlands, on a funds-available basis, on publicly-owned conservation property throughout the City, but only after neighborhood discussions of all of the issues.
- Restore free-flowing streams on protected open space when possible.
- Promote the use of soil conservation and vegetation management techniques to minimize erosion

Public Information and Education Actions *(Responsible City Departments are OPD and Emergency Services)*

- Develop an education outreach program and brochure about the Community Rating System
- Notify local real estate agents that the City is focusing on flood hazard mitigation and remind them that full disclosure of flooding hazards is required
- Develop a public information program for prospective home buyers and residents of the floodplain, identify sources of information, describe insurance benefits and options, and provide post-disaster recovery information
- Develop a public information campaign for all Northampton residents, emphasizing the long-term cumulative impacts that "negligible" actions, such as raking leaves into a culvert, can have on immediate and adjacent neighborhoods
- Develop a brochure with the Conservation Commission addressing what property owners can do when there is localized flooding caused by beaver activity
- Develop a broad outreach system within the City, involving many different City departments, boards and commissions

Emergency Services *(Responsible City Departments are Emergency Services, DPW and OPD)*

- Enhance the flood warning system
- Exercise all emergency services annually
- Coordinate with Comprehensive Emergency Management Plan (CEMP)

Measures for Other Hazards *(Responsible City Departments are Building, Fire and OPD)*

- New land uses that would present special risks, such as hazardous materials storage facilities, should not be permitted in the floodplain to ensure that hazardous or toxic

substances are not released into floodwaters (Agricultural herbicides and pesticides are regulated by the Department of Agricultural Resources)
- Conduct an environmental assessment of potential chemical or hazardous materials impacts that may arise due to flooding.
- Work with existing grandfathered uses to ensure that there are no hazardous materials releases due to improper storage.
- Require that all above- and below-ground storage tanks be properly secured so that they survive flood conditions.
- Use GIS to catalog underground storage tanks in coordination with the Fire Department permit database.

Prioritization

Floods damage many different types of property and create a variety of hazards. Spending public funds for flood protection may be more appropriate for some types of properties than others. For example, City facilities like roads, bridges, and parks represent a taxpayer investment and are an important part of the public infrastructure. Due to the importance the agricultural landscape to the City and the location limitations of agriculture, such land uses should be afforded some level of protection. Expenditure of public funds to reduce flood hazards to these properties is appropriate.

A large number of public and private properties in Northampton experience flood related hazards and damages. Neither the funding nor the staff will be available to address all these problem sites at once, or perhaps ever. To ensure that new projects are implemented to address the most important problems first, a defensible policy is needed to prioritize problems.

The primary determinant of a problem's priority is the consequences that would result if no project were implemented. Consequences should generally be prioritized in the following order:

1. Threats to public health and safety

Threats to public health and safety include threats to critical facilities (e.g., hospitals, schools, nursing homes, and emergency response facilities) and/or health-related infrastructures (e.g., water supply systems, sewer lines). The presence of deep, high-velocity flows carrying debris through populated areas also constitutes a threat to life and limb.

2. Damage to public infrastructure and developed public property

Public infrastructure and developed public property includes, but is not limited to, roads, bridges, utility systems, public buildings, and parks.

3. Damage to private structures

Occupied residential structures and economically important structures should receive highest priority.

4. Damage to significant natural resources and agricultural land

Significant natural resources are defined to include fish and wildlife species and their habitats that are considered regionally significant. Agricultural land is publicly- and privately-owned land that is actively farmed.

5. Damage to undeveloped public land

Undeveloped public land refers to both publicly owned open space and land for which development rights have been purchased, such as agricultural land.

6. Urgency

Urgency is a measure of how quickly action needs to be taken in order to prevent a problem from growing worse and requiring an increasingly costly solution. For example, the magnitude of an erosion-related problem will generally increase over time if not addressed. In comparing problems where equal consequences would result if no action were taken, the most urgent problem should be addressed first.

7. Opportunity

Although consequences, urgency, and responsibility are the primary factors in determining problem priorities, projects can sometimes present opportunities for meeting multiple objectives. Examples include projects that enhance ecological resources, provide public access to the river system, and/or provide opportunities to cooperate with private landowners or other jurisdictions in funding and implementing the project. The prioritization procedures should allow flexibility to raise the level of priority for projects that meet multiple objectives.

The criteria described above are intended to provide general guidance in prioritizing flood-hazard related problem sites throughout the City. However, detailed basin plans need to be prepared for Northampton's stream and river basins. In many cases, the detailed information compiled for a basin plan may indicate the need for prioritization policies that are tailored to the specific conditions in the basin. Basin-specific modifications to problem prioritization may be made in accordance with the recommendations of adopted basin plans.

Priority Actions

Based on the above prioritization criteria, as well as an analysis of the current social, technical, administrative, political, legal economic and environmental feasibility, the following shall be considered priority strategies for flood hazard mitigation:

- Develop a comprehensive plan/land use plan for the Meadows by working with small focus groups of residents, business owners, farmers and other stakeholders.
- Upgrade or replace the linings of sanitary sewers to protect from stormwater infiltration.
- Maintain dikes
- Improve enforcement of existing regulations by establishing an objective and defensible system of imposing fines for violations and improving follow-up on Conservation Commission permits.
- Consistently enforce the Wetlands Protection Act to maintain the integrity of the 200' riverfront area, wetlands and wetland buffer areas

- Maintain zoning regulations in accordance with standards for the National Flood Insurance Program in order to reduce flood hazards and better protect public health and safety, and in order to continue to qualify residents for flood insurance.
- Develop a Citywide drainage plan through NPDES Phase II, done on an individual watershed basis, including a description and analysis of the hydrological condition of the City and how future developments may impact drainage systems, streams and wetlands in each sub-watershed.
- Require no net increase in post-development run-off conditions (total volume as well as peak rate), to be controlled by means of prescriptive standards to be met, such as directing all water from roofs to drywells to be recharged, to reduce flood risks to existing properties from new development in the floodplain, sensitive ecological areas, and those areas the City has planned for low-density development (the SC, WP, WSP, FFR, and RR zoning districts).
- Prioritize Agricultural Preservation and Conservation Restrictions on a willing buyer/willing seller basis using flood mitigation as an important consideration
- Daylight culverted streams on publicly-owned conservation property throughout the City, wherever there is sufficient land area, and restore adjacent wetlands on a funds-available basis.
- Work with property owners to request minor map changes from FEMA, specifically in the areas of Atwood Drive and Easthampton Road/Route 10.
- Coordinate with Comprehensive Emergency Management Plan (CEMP)

Implementation, Monitoring and Evaluation

The Planning Board shall be responsible for implementation of this plan, working in partnership with the Conservation Commission and other City boards and with floodplain residents, farmers, and business owners. Within the next year, working with the City Council, area residents, farmers, business owners and other stakeholders, the Planning Board shall begin to work on a comprehensive plan for the floodplain and begin implementation of recommended strategies.

The community flood mitigation plan should always be evaluated following a natural hazard. The community should assess how effective the implemented actions have been. The review will provide an opportunity to modify the original plan, priorities, implementation schedule or budget based on actual performance and community feedback. In the absence of natural hazards, monitoring and evaluation of the mitigation plan should be conducted on an annual basis.

For more details, see **Appendix A** *Remaining Issues and Needs*.

APPENDIX A

Analysis of Flood Hazards in Northampton

Description

Federal and local flood programs establish a 100-year floodplain, which is divided into two zones: a "floodway" and a "flood fringe." The "floodway" is defined as the channel of a river or other water course and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water elevation more than one foot. Floodways that are depicted on National Flood Insurance Program maps are more highly hazardous areas. They are areas where, if construction occurs, it places structures at significant risk in terms of depths and velocities of floodwaters. Northampton zoning prohibits structures in these areas.

The "flood fringe" is the area of the floodplain lying outside of the floodway, but subject to periodic inundation from flooding. Development may be permitted in such areas if it satisfies conditions and requirements regarding the height of the structure's first floor above the projected 100-year flood elevation, "flood proof" construction, displacement of flood waters, and related concerns. The State Building Code requires that all new living space be constructed at or above the projected 100-year flood level within the 100-year "flood fringe" area, and that there be equal space for water to come into and go out of a foundation.

Floodplain boundaries are delineated on FEMA's Flood Insurance Rate Maps (FIRMs). This delineation also includes a 500-year flood area. In Northampton, the 500-year floodplain does not generally extend significantly beyond the 100-year flood area. The 500-year floodplain is not subject to local regulation. Major floods, such as those caused by heavy rains from hurricanes, and localized spot flooding can exceed the 100- and 500-year flood levels. In addition, many small streams are not mapped for their flood hazard.

A map of the Flood Fringe and the current FEMA Floodway is included in *Appendix E* of this document.

Likelihood of Occurrence

Flooding is often the direct result of other frequent hazards such as hurricanes and heavy rainstorms. Northampton has suffered both minor and severe floods from the Connecticut River, the Mill River, the Manhan River, and smaller tributaries.

Northampton is susceptible to:

- Riverine flooding, including overflow from a channel, flash flood, ice-jams and dam breaks
- Flooding due to localized stormwater runoff, from fully developed watersheds, such as the Elm Street Brook area, and inadequate sizing or maintenance of storm drains

As local and regional watersheds continue to be developed, the City of Northampton will continue to face seasonal and periodic flooding and the associated problems.

Vulnerable Areas and Populations

A base map of Northampton that shows our mapped floodplains, areas of spot flooding, and repetitive flood loss properties is attached in the map section at the end of this document.

Riverine flooding is the most common and can be the most powerful of flood events. Every river, stream and tributary can potentially flood. With sufficient rain almost any area can experience at least pockets of surface flooding, even areas outside the mapped floodplain. Damaging riverine flooding is most likely to occur along the Connecticut and Mill Rivers. The height of the Mill River is influenced mainly by heavy rainfall within its watershed. The height of the Connecticut River is impacted by snowmelt in Vermont and New Hampshire as well as heavy rainfall throughout the watershed.

In addition to property loss, floods along the Connecticut River can also greatly impact agricultural interests by damaging or destroying crops, outbuildings and equipment. Seasonal flooding of the Connecticut River throughout the ages created some of the richest and deepest topsoil in the country. The past three hundred years of increasingly intensive human occupation, however, have impacted the hydrology of the watershed and today, flooding can result in the erosion of productive soils and the deposition of debris in agricultural areas. Farms throughout the flood area can suffer from direct damages and lost revenues, resulting in increased economic impacts.

Flooding from stormwater runoff is a growing problem in every urbanized area and is caused by large amounts of impervious surfaces and by undersized or poorly maintained stormwater drainage infrastructure, including culverts and detention basins. Development not only creates more impervious surfaces, but it also changes natural drainage patterns by altering existing contours by grading and filling, sometimes creating unexpected stormwater flooding during heavy rains. Recently, the City of Northampton has seen flooding on Elm Street, along Church and Stoddard Streets, Bliss Street and Austin Circle due to undersized pipes and catch basins and lack of upstream detention that caused streams to jump their banks and flood roadways and properties.

Stormwater contributes to water pollution by carrying silt, oil, fertilizers, pesticides and waste into streams, rivers and lakes. Stormwater flooding also has the potential to cause considerable property damage because it occurs in areas of concentrated development. One of the most significant impacts of stormwater and riverine flooding is septic system failures, discharging sewage directly into urban and suburban residential areas. This can cause an immediate and acute public health hazard. Sewer system overflows are not a major problem since the City of Northampton does not have any combined storm and sanitary sewers, however, stormwater does leak into the sanitary sewerage system causing some stress on the system during very heavy storm events.

The Northampton Department of Public Works is currently working on a stormwater management plan for the City, which will address many of these issues.

Significant Flood Events in Northampton

Date	Nature of Event	Affected Areas	Estimated* Damages
9/16/99	Tropical Storm Floyd	Mill River Floodplains, Barrett Street Brook area, localized areas throughout the City	$900,000
3/31/87 - 4/7/87	10-50-year flood	Connecticut River floodplain, the Meadows	$126,000
5/28/84 – 6/5/84	50-year flood	Connecticut River floodplain	$377,000

6/6/82	50-100-year flood	Mill River Floodplain	$104,000
3/15/77	10-year flood	Connecticut River Floodplain	$112,000
4/6/60	10-year flood	Connecticut River Floodplain	$38,000
10/15/55	50-100-year flood	Mill River Floodplain	$48,000
8/19/55	50-100-year flood	Mill River Floodplain	$67,000
3/29/53	10-year flood	Connecticut River Floodplain	$40,000
6/3/52	10-year flood	Connecticut River Floodplain	$38,000
1/1/49	10-year flood	Connecticut River Floodplain	$37,000
3/23/48	10-year flood	Connecticut River Floodplain	$32,000
9/22/38	100-year flood	Connecticut River Floodplain	$81,500
3/13/36	100-year flood	Connecticut River Floodplain	$200,000

**Estimates are not adjusted to current dollars.*

Flood Mitigation Measures

In 1968 the federal government began the *National Flood Insurance Program* (NFIP) as a way to limit future development in the floodplain and thereby prevent additional flood damages. The NFIP, which is administered by FEMA, provides federal flood insurance to residents of communities that adopt minimum floodplain regulations. The City of Northampton adopted these regulations in 1974 in the form of its Special Conservancy Zoning District and its Watershed Protection overlay District.

Land use planning is a necessary and useful tool for addressing flood problems. Prevention of future problems through land-use planning and regulation is far more effective, permanent, and less expensive than trying to correct problems after they have been created.

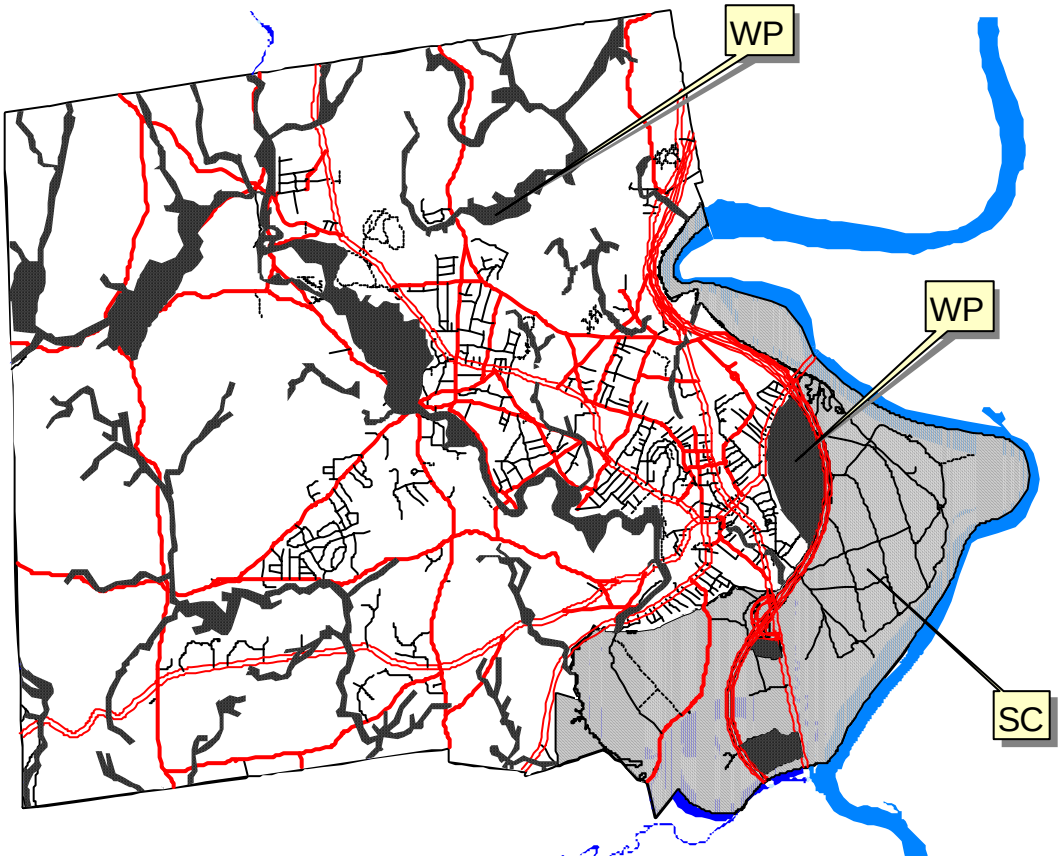
Development in the floodplain creates two types of problems. First, the development itself is at risk from inundation and/or erosion. Second, such development can increase risks to neighboring properties by creating a barrier to the conveyance of floodwaters (thus causing backwater flooding upstream) and reducing the area available to store and slowly release floodwaters (thus increasing velocities and erosion downstream).

Certain types of land uses are more compatible with flooding than others. Land uses that leave wide areas of the floodplain open will help preserve its storage and conveyance functions, minimizing flooding and erosion impacts to neighboring properties. Also, the fewer structures in the floodplain, the lower the potential for damage.

The City of Northampton administers planning requirements and regulations that work to reduce future flood damages by controlling the density, location, construction and type of development that may occur in the floodplain, environmentally sensitive and hazardous

areas. The City also strives, and is seeking to improve, implementation methods that work to mitigate potential hazards.

A primary tool for flood regulation in Northampton is the City's Zoning Ordinance, in particular the Special Conservancy Zoning District (SC), contained in Section 13.0 and the Watershed Protection Overlay District (WP), contained in section 14.0.



The purpose of the SC District, shown in gray on the map above, is to:

- Protect the public health and safety, persons and property against the hazards of seasonal and periodic flooding
- Protect the entire community from individual choices of land use and development that require subsequent public expenditures for public works and disaster relief
- Provide that lands in the City of Northampton subject to seasonal or periodic flooding shall not be used for residential or other purposes in such a manner as to endanger the health or safety of the occupants
- Assure the continuation of the natural flow pattern of the watercourses within the City in order to provide safe and adequate floodwater storage and conveyance capacity
- Protect, preserve and maintain the water table and water recharge areas within the City
- Provide for the continued functioning of the river flood plain and wetlands as a natural system that supports a myriad of living things.

The WP Overlay District, shown in black on the map above, is designed to:

- Preserve and protect the streams and other watercourses in the City of Northampton and their adjoining lands;
- Protect the health and safety of persons and property against the hazards of flooding and contamination
- Preserve and maintain the groundwater table for water supply purposes, and protection of adequate base flows of streams and rivers;
- Protect the community against the detrimental use and development of lands adjoining such watercourses;
- Conserve the watershed areas of the City of Northampton for the health, safety, and welfare of the public.

In order to accomplish the purpose of promoting the public health, safety and general welfare, minimizing public and private losses or damages due to flood conditions, and protecting the natural resources of the City of Northampton, both the SC and WP zones contain methods and provisions for:

- restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;
- requiring that uses vulnerable to floods, including structures which serve such uses, be protected against flood damage at the time of initial construction;
- controlling the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel flood waters.
- controlling filling, grading, dredging, and other development which may increase flood damage; and
- preventing or regulating the construction of flood barriers, including raised roads and driveways, which will unnaturally divert flood waters or may increase flood hazards in other areas.

Remaining Issues and Needs

Critics of FEMA's floodplain management system have pointed out that it has actually led to increased flood damages in the United States. This occurs in part because the program encourages development in the floodplain by providing federally backed flood insurance for damages to houses and property within the floodplain. Financial incentives for developing within the floodplain, along with a false sense of security from regulations that may not be adequate, impose additional costs on property owners and tax payers.

During recent floods, flooding did occur to residences within the City that were not shown on the projected 100-year flood map, primarily along the Elm Street Brook and Barrett Street Brook. This level of flooding occurs with more frequency than a 1% chance in any given year.

Some communities require a higher elevation of the first floor of new structures within the floodplain, prohibit new residential units be constructed within the 100-year floodplain, and/or require that all new dwellings be elevated or flood protected to an elevation of one foot above the flood elevation.

Discouraging new development in areas prone to flooding is a necessary preventative solution to flooding, but this does not solve flooding and erosion problems for structures that

have already been built in hazardous areas. Although these structures and properties receive significant protection from existing measures, including the City's dikes and flood warning and emergency response programs, the overall potential for flood damage remains high.

There are a number of solutions Northampton can choose from in addressing these problems. At a minimum, the City must continue to maintain the dikes, looking for ways to reduce the costs and increase the effectiveness of projects that have already been built. Not properly maintaining the dikes would affect all of downtown in the event of a severe flood.

Additionally, the City could support modifications to the endangered structures themselves (for example, relocating or elevating homes) that make them less susceptible to the hazard. This is usually a permanent solution that eliminates most maintenance costs and can provide many other benefits, such as open space, improved flood storage and conveyance, and wildlife habitat. However, given the large number of structures involved, this may not be the most desirable or cost-effective solution except for those structures at the greatest risk of damage or with demonstrated past damage.

A Comprehensive Land Use Plan for the Meadows can address issues related to the permit process for renovations and upgrades to existing residences. By streamlining the permit process and eliminating redundancies, the City can make it easier for residents to flood-proof their houses as they are upgraded and maintained. There should be more discussion during the public meeting process for the Land Use Plan on what constitutes a major home improvement project that requires flood-proofing, as opposed to maintenance.

The City can continue to provide flood warning and flood fighting assistance, looking for ways to improve monitoring, analysis and dissemination of information, and expanding its flood-fighting abilities. However, while flood warnings are primarily useful in saving lives, they do little to reduce major structural damage, since options for protecting structures and their contents are very limited during the flood event.

Public education regarding flood hazards can be expanded, and the maps and other tools used to implement floodplain regulations improved. Flood control projects, floodplain regulations and other proposals can be developed and reviewed cooperatively by all jurisdictions in a basin, to ensure that problems are not transferred from one site to another.

These options, and many additional alternatives, are not mutually exclusive. The challenge facing the City is to develop a management program that can select from a wide range of ideas and choose the most cost-effective, politically and environmentally acceptable, and permanent to reduce flood hazards. Yet much remains to be done. Some of the policies and actions proposed in this plan will first require additional information and analysis before they can be undertaken. Moreover, it will undoubtedly be necessary to revise this plan as new information and circumstances require.

APPENDIX B

Environmental Limitations and Hazards Identification and Analysis

High Risk Soils

The term ”high risk soils” refers to ground conditions that are not stable over time. This can include mass wasting, such as landslides and mudslides, which are dramatic, yet not a big problem in Northampton, as well as areas of erosion and deposition along rivers. This condition occurs along the Connecticut River, at the easternmost point of the Meadows, where the River’s meander is the widest. Generally, as in this case, the outside of the curve is the area of erosion, and the inside of the curve is the area of deposition, often referred to as the pointbar.

The City should continue to watch for and note changes in hydrology and geomorphology along the Connecticut River, and potentially the Mill River and Marble Brook, in order to be able to update our maps and expand the Watershed Protection Zoning District as necessary.

Wetland related problems

Filled Wetlands

Many areas of the City were developed before the passage of the Massachusetts Wetlands Protection Act of 1972. Historically filled wetlands are commonly related to problems with wet basements, flooding, shifting foundations and failed septic systems.

Development in historically filled wetlands should be discouraged through zoning in order to protect health and safety.

Beavers

Beaver-caused flooding can create valuable wetlands and improve flood storage capacity for certain areas thus acting as a positive factor in flood hazard mitigation. However, when beavers build their dams in areas with greater development and minimal open space, the flooding that results can cause serious public and private property damage, often threatening homes, septic systems, roadways and other public infrastructure.

Improved designs for beaver deceivers and water level control devices help mankind better co-exist with beavers and can avert property damage due to beaver-caused flooding.

The City of Northampton has a very active beaver population. A recent example of flooding in a residential neighborhood due to beaver activity occurred in the vicinity of Winter Street, where a small beaver dam diverted the flow of a stormwater drainage channel onto private property and into the City’s sanitary sewer system.

Instances of problems with beavers should be handled on a case-by-case basis with the Conservation Commission, the Department of Public Works, or in the case of an imminent threat to public health, such as a failed septic system, with the Board of Health.

Wildlife Habitat

Some areas of Northampton contain critical wildlife habitat, including 29 state-certified vernal pools that support a variety of rare and endangered species. There are also 20 identified potential vernal pools.

While areas containing significant wildlife habitat are not considered hazardous in the traditional sense of potential impacts to persons and property, when viewed in the larger context, it is land that is inappropriate to develop because of potentially long-ranging and significant impacts to the biological community and, in turn, to humans who are an integral part of it.

Drinking Water Supply Areas

A map of Northampton that shows the Roberts Hill Reservoir watershed area and areas of aquifer recharge for Northampton and the neighboring towns of Hatfield and Easthampton is included in Appendix E, the map section, at the end of this document.

Aquifers need additional protection from development to prevent long-term pollution of drinking water supplies. Chief among the potential pollutants are leachates from landfills and septic systems, road salt and toxic household wastes. Surface waters are also highly valuable, and intensive development of these areas could have a negative effect on the hydroogy of the watershed in addition to impacting the quantity and quality of the drinking water supply.

Local and Regional Watersheds

Watersheds do not follow jurisdictional boundaries. Actions taken by the City in one part of a drainage basin--whether it be a land-use plan, development permit, or capital improvement project--can affect flood and erosion problems experienced by other jurisdictions within the watershed.

A comprehensive analysis of flooding problems and solutions must look not only at the floodplain, but also at the entire watershed that drains to the floodplain. Watershed features that influence the volume and rate of flow in large rivers include climate, topography, geology, soils and land cover.

Development and clearing in a basin can increase both the peak rate and volume of runoff reaching rivers and streams. This can increase the depth and extent of flooding downstream. It can also intensify erosion, especially during small-to moderate-size events (e.g. 20-and 10-year floods).

Dam Failures

The City of Northampton has eleven dams on both public and private property. Dams are classified as high (class 1), significant (class 2) or low hazard (class 3), depending on the severity of their potential impacts to life and property in the event of a dam failure.

Dam and Location	Ownership	Hazard classification
Middle Roberts Meadow Dam, Leeds	Municipal (DPW)	High
Upper Roberts Meadow Dam, Leeds	Municipal (DPW)	Significant
Lower Roberts Meadow Dam, Leeds	Municipal (Recreation)	High
Fitzgerald Lake Dam	Municipal (conservation)	Low
Howards Ice Pond Dam, Roberts Hill Conservation Area	Municipal (conservation)	Low
Chartpak Dam, Leeds	Private	High
Hotel Bridge Dam, Leeds	Private	Low
Country Club Dam, Leeds	Private	Significant
Pro Corporation Dam, Florence	Private	Low
Yankee Hill Dam, Baystate	Private	Low
Paradise Pond Dam	Private (Smith College)	High
Vaznis Farm Pond Dam	Private	Significant
Button Shop Dams (2)	Private	Significant
Clear Falls Dam	Private (Clear Falls, Inc.)	Significant
Florence Ice Pond Dam	Private	Significant
Vistron Dam	Private (Vistron Corp.)	Significant
Snow Pond Dam	Private	Low
Look Park Dam	Private (Look Park)	Low
Mill River Diversion at South Street	State	Low
Ice Pond Dam, Westhampton Road	Private (Ice Pond)	Low

This inventory of dams in the City of Northampton was provided by the Massachusetts Department of Conservation Resources. DCR oversees the dam safety program, including records of dam inspections, maintenance and hazard classifications. In 2003 the program was largely privatized, giving greater responsibility to dam owners. Currently, the Northampton Department of Public Works keeps records of dam inspections and hazard classifications of dams owned by the DPW; the Office of Planning and Development is responsible, as of July 2003, for records of dams on conservation land. Any proposals to remove existing dams must be accompanied by a detailed analysis of downstream impacts on natural resources as well as property.

APPENDIX C

Note changes from Vision 2020 in Water Resources section

Water Resources

Northampton water resources include open water bodies, wetlands, floodplain, and drinking water supply aquifers and watersheds. These water resources are all sensitive ecological resources, but they also provide some of the best agricultural, forest, open space, scenic, recreation, and wildlife habitat resources for the city's residents.

Water Resource Type	Acreage
WATER BODIES (rivers, streams, ponds)	1,200 acres
FLOODPLAIN (100 year flood)	4,800 acres
WETLANDS (excluding water bodies)	~ 3,000 acres (1,729 acres mapped)
DRINKING WATER SUPPLY WATERSHEDS AND AQUIFERS IN NORTHAMPTON (including water and wetlands)	2,014 acres - Northampton watershed 1,494 acres - Northampton aquifer 2,142 acres - Hatfield aquifer 3,450 acres - Easthampton aquifer

Northampton's primary water supply comes from the Francis P. Ryan Reservoir Complex in Whately and the Mountain Street Reservoir in Williamsburg. The city's aquifer in Florence, and two public wells provide approximately 5 percent of Northampton's water supply, although in an emergency situation, they may provide up to 15 percent. The Leeds/Roberts Meadow Reservoir complex provides an emergency water supply. Part of Hatfield's aquifer is in the Broad Brook area of Northampton. Part of Easthampton's aquifer is located in the West Farms area.

Although never as polluted as the section of the river below the Holyoke Dam, the water quality in the Connecticut River in Northampton has improved since 1972, when the federal Clean Water Act was passed. Improved sewage treatment plants, expansion of areas served by sanitary sewers, and ending of combined sanitary and stormwater sewers (CSOs), have combined to improve water quality in the Connecticut River and Mill River. Northampton's Hockanum Road wastewater treatment plant was upgraded to secondary treatment in the early 1980s and currently services 85-90 percent of Northampton houses. There have also been some improvements in pollution from stormwater runoff. That source, though, remains the most significant threat to water quality.

APPENDIX D

Additional Natural Hazard Identification and Analysis

Hurricanes

Description

Hurricanes are formed over tropical oceans where there are warm waters, humid air and converging winds. It takes a lot of energy for a hurricane to be created, as well as the right conditions. Hurricanes start out as a group of storms that begin to rotate when they encounter converging winds. These storms create violent seas, stirring up even more water into the air in the form of vapor. The water vapor rises very quickly, rotating with the storms, and helping to increase the wind speed. The storms begin to organize, holding themselves together and forming a center rotation point of low pressure. When this occurs, and sustained wind speeds reach 74 mph, the storms become a hurricane.

Likelihood of Occurrence

Virtually every area of New England, especially Massachusetts, has been affected by hurricanes. During the last 100 years, 20 hurricanes have passed within 125 miles of Boston. On average, the City of Northampton can expect a hurricane to pass nearby once every six years.

Vulnerable Areas and Populations

In June 1972, hurricane Agnes produced the most damaging flood up to that date in recorded east coast history. Agnes centered over the mid-Atlantic States, but if Agnes or a comparable storm had centered over western Massachusetts, a tremendous and unprecedented flood would have occurred in the Connecticut River Basin from Montague south. In 1973, the Connecticut River Basin Program, using the Hartford River Forecast Center's flood forecasting model, took rainfall comparable to that experienced during Agnes and extrapolated a flood that would have crested nearly 10 feet higher than the flood of 1936. Areas behind the current dikes in Northampton, including all of downtown, would have been devastated. Many lives would have been lost. Economic damages would have been in the hundreds of millions of dollars, not including the money necessary for emergency measures.

No basin-wide storm of this magnitude has ever been recorded in the Connecticut River basin. The chances of a comparable storm occurring here are infinitesimal, as the recurrence interval of Agnes has been estimated to be 1,000 years.

Analysis

Although the Hurricane Agnes scenario is very unlikely, Northampton is affected to various degrees by hurricanes on a regular basis. Hurricanes generally weaken as they cross over land; however, the heavy rainfall produced by these storms can create severe flooding problems. Flood hazard mitigation measures discussed above will help to reduce impacts of rainfall associated with hurricanes.

Northeast Storms

Description

A northeast storm, or northeaster, is typically a large counter clock-wise wind circulation around a low-pressure center. The storm radius is often as much as 1000 miles, and the horizontal storm speed is about 25 miles per hour traveling up the eastern United States coast. Sustained wind speeds of 10-40 mph are common during a northeaster with

short-term wind speeds gusting up to 70 mph. Storm information is available on weather charts published by the National Weather Service.

Likelihood of Occurrence

Northeasters are a common winter occurrence in New England and have an average frequency of 1 or 2 per year. The comparison of hurricanes to northeasters reveals that the duration of high surge and winds in a hurricane is 6 to 12 hours while a northeaster's duration can be from 12 hours to 3 days.

Vulnerabilities and Analysis

Northeasters repeatedly result in flooding and various degrees of erosion-induced damage to structures and erosion of natural resources. Flood hazard mitigation measures discussed above will help to reduce impacts of heavy and sustained rainfall associated with Northeasters.

Snow and ice are common winter hazards associated with winter northeasters, causing traffic accidents, bringing down utility lines, damaging trees, impeding transportation and taxing the City's capabilities for snow removal. Strategies for reducing vulnerability to winter storms include plowing and sanding roads, maintaining the health of urban trees, especially around utility lines, to minimize damage from ice, and burying utilities at critical and vulnerable junctions to avoid power loss due to downed lines.

Heavy Rainstorms

Description and Likelihood of Occurrence

In addition to flooding from hurricanes and northeasters, Northampton is also susceptible to flooding from severe rainstorms and thunderstorms. The occurrence of significant rain events in the City has been increasing over the past several years.

Vulnerable Areas and Populations

The greatest impact in the City is felt in neighborhoods along rivers and streams. In recent years, heavy rainstorms have caused significant problems in more urbanized areas as increased development inhibits proper drainage and existing or poorly maintained water systems cannot handle increased stormwater runoff.

The most recent example is the flooding following Tropical Storm Floyd, a 100-year storm that occurred in September of 1999 which created severe localized flooding conditions in the small flashy watersheds of the City, especially along the Mill River and the historic Mill River (both within and beyond the mapped Zone A), and along Barrett Street Brook and Elm Street Brook (both outside of Zone A). This storm caused approximately $900,000 in property damage.

Analysis

Much of the damage caused by heavy rains is the same as caused by stormwater and overland flooding. Flood hazard mitigation strategies discussed above will help to reduce impacts of heavy rainfalls.

Tornados and Microbursts

Description

A tornado is a rapidly rotating vortex or funnel of air extending toward the ground from a cumulonimbus cloud. Most of the time, vortices remain suspended in the atmosphere. When the lower tip of a vortex touches earth, the tornado becomes a force of destruction.

Tornadoes occur during a single atmospheric condition, such as a thunderstorm, and multiple tornadoes can be generated by a hurricane or a combination of several thunderstorms.

Likelihood of Occurrence

Approximately 3 tornadoes are spawned by severe thunderstorms each year across the Commonwealth of Massachusetts.

Vulnerable Areas and Populations

As tornadoes are often associated with hurricanes and tropical storms, there is the risk of flooding as well as wind damage to susceptible structures, particularly outbuildings, garages and mobile homes. Crops, trees and utility lines are also at high risk for wind damage. The microburst of 2000 and its associated rain caused flash-flooding on the Mill River and its tributaries in Northampton.

Analysis

Sound construction practices, enforced by the building inspector, are the best protection against wind damage from tornadoes and microbursts. Flood hazard mitigation measures discussed above will help to reduce impacts of heavy rainfalls associated with tornadoes.

Earthquakes

Description and Likelihood of Occurrence

Although it is well documented that the zone of greatest seismic activity in the United States is along the Pacific Coast in Alaska and California, it may be surprising to most people that an average of 5 earthquakes are felt each year somewhere in New England.

New England is located in approximately the middle of the North American Plate. One edge of the North Atlantic plate is along the coast of California and the eastern edge is just past the middle of the Atlantic Ocean. The exact earthquake mechanism is still unknown, however, New England's earthquakes appear to be the result of the cracking of the surface due to the compression and buckling of the North Atlantic plate. The forces on this plate that initiate the buckling include the downward weight of the mountains and the upward stress relief caused by the retreat of the glaciers. Given this information on the geography of New England, and based solely on known past earthquake activity, the three most likely source areas for earthquakes with potential damage are: eastern Massachusetts and the Cape Ann area; central New Hampshire in the Ossipee area; and at the La Malbaie region, Province of Quebec.

Vulnerable Areas and Populations

Between 1924 and 1989, there have been 96 earthquakes in the Northeast with a magnitude of 4.5 or greater on the Richter Scale. Out of these 96 earthquakes, 8 were within the six New England States and the other 88 within New York State or the Province of Quebec. Many of these earthquakes were so strong that they were felt throughout New England.

The last major earthquake to affect Massachusetts was more than 200 years ago in 1755 with an estimated magnitude of 5.75. The epicenter was located off the Cape Ann coast, north of Boston. The area of greatest damaged stretched along the northern Massachusetts coast from Cape Ann to Boston, where chimneys were shattered and objects were flung from shelves. Such an earthquake today, while not of the magnitude of a Pacific Rim quake, could certainly be devastating to the City of Northampton, causing significant damage to unreinforced masonry structures.

The most recent tremor felt in Northampton occurred during the summer of 2002. The epicenter was in upstate New York, however, the tremor was felt throughout New England as well as New York and New Jersey.

In the event of a major earthquake affecting the City of Northampton, the damage would likely be greatest in areas of filled land, which can increase ground shaking intensity, and to the unreinforced masonry buildings dating back to the 19th and early 20th centuries that dominate downtown Northampton. Furthermore, such an earthquake would probably severely impair the operation of medical facilities, emergency public facilities and telecommunications. An additional risk is the potential for fires to sweep through downtown, especially if waterlines rupture in an earthquake. The most devastating aspect of the San Francisco earthquake of 1906 was the unchecked fires that destroyed most of the city.

Analysis

Seismologists have established that the New England epicenters do not follow the major faults of the region, nor are they confined to particular geologic structures or terrain. In general, New England's earthquakes have no known relationship to existing faults. This is in complete opposition to that in California. In New England, unlike the west coast, earthquakes occur all over; no one can say for certain that they will occur in a specific location.

Although it is likely that New England will experience a significant earthquake some time in the future, potentially disrupting the function of critical facilities in Northampton, it is not necessarily reasonable or economically feasible to require the reinforcing of existing structures and infrastructure beyond the standards that already exist in the Building Code.

Wildland and Urban Interface Fires

Description

Fires pose a threat to both urban areas as well as less developed or forested areas. Major urban fires have occurred from time to time over the years, destroying portions of Massachusetts. Forest and brush fires have also historically been a problem in the Commonwealth, where an average of 6,000 fires occurs annually. A forest fire can burn for several days as a result of ready fuel, especially if compounded by drought conditions or steep terrain that can make access difficult. The amount of smoke from a fire may cause air pollution problems and health hazards to residents of Northampton and surrounding communities.

Likelihood of Occurrence and Vulnerable Areas and Populations

Northampton has approximately 2,645 acres of forested land owned by state and local agencies, with an additional 8,595 acres in private ownership. These forests are potential fuels for wildfires. The potential for property damage caused by fire increases each year as more properties are developed on wooded land and increasing numbers of people use forested recreation lands in the City. At particular risk are areas where large forested areas and suburban development interface.

It is, however, very unlikely that the City of Northampton will see the massive destruction of the urban fires of the past, unless these fires are combined with an earthquake where waterlines rupture, limiting the ability to bring them under control rapidly.

Analysis

Strategies for reducing vulnerability to forest fires include promoting awareness of forest and wildfire hazards to promote safe practices and minimize accidental fires during drought or other dangerous conditions and using good forest management practices to minimize fuel loads in forests.

Drought

Description

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. Drought occurs in virtually every climatic zone, yet its characteristics vary significantly from one region to another. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate.

Drought conditions arise from a deficiency of precipitation over an extended period of time, usually two winters or more. This deficiency results in a water shortage that can affect drinking water supplies and cause agricultural losses. Drought also increases the likelihood of forest fires.

Drought should be considered relative to some long-term average condition of balance between precipitation, and evaporation and transpiration in a particular area, a condition often perceived as "normal." It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (i.e., rainfall intensity, number of rainfall events).

Likelihood of Occurrence

Drought is an inevitable and normal part of our climate. The severity of a drought depends not only on its duration and intensity, but also on the regional water supply demands made by human activities.

Vulnerable Areas and Populations

The impacts of drought hit hardest when people place too high demand on the water supply. As the regional population grows, so does the amount of water that people will need, for essential things such as drinking water and growing food, as well as non-essentials such as watering lawns. Northampton’s vulnerability to drought and water shortage will increase along with regional population growth.

Analysis

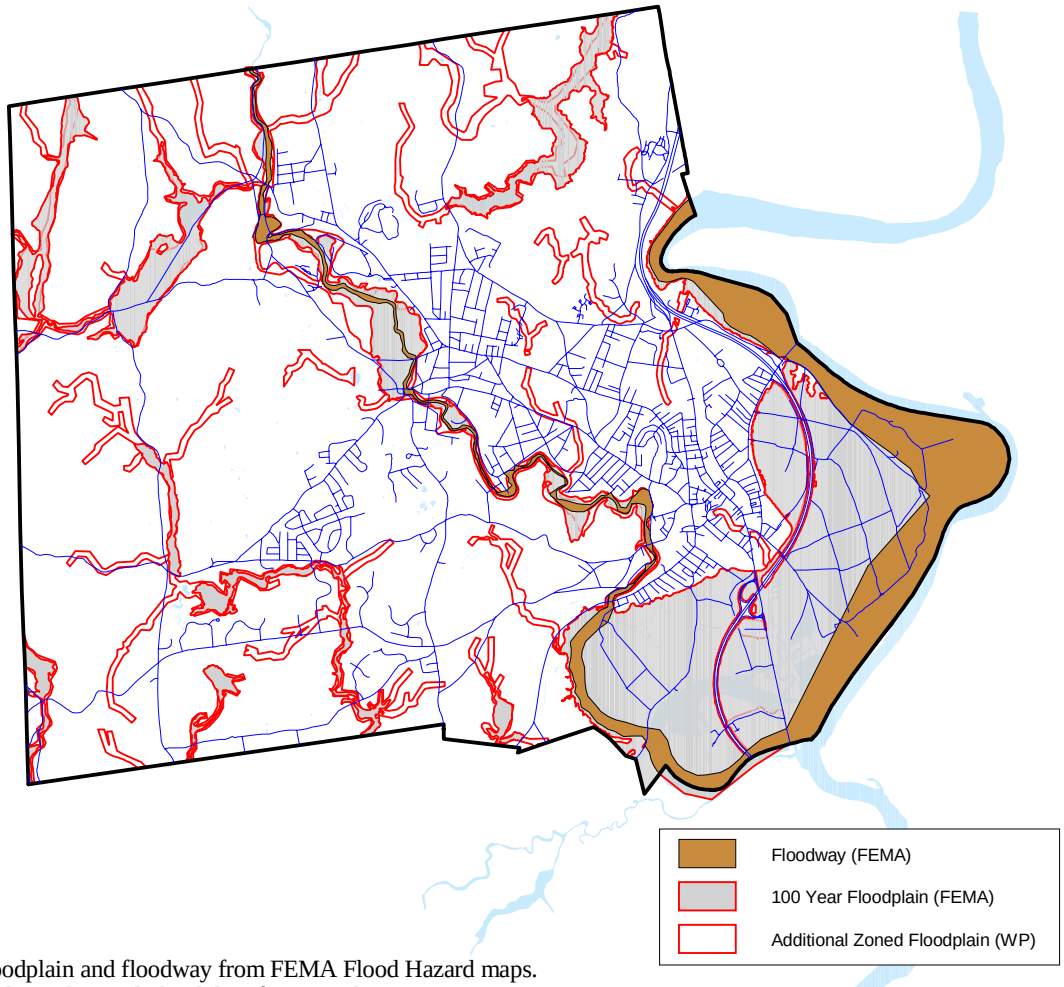
Regulation of development, particularly in areas of aquifer recharge and the surface watershed of the drinking water supply, is the most effective preventative measure to protect the water supply from the impacts of prolonged drought conditions.

APPENDIX E

Maps

- ***Flood Hazard Base Map (including Floodway and Flood Fringe)***
- ***Possible FEMA Floodplain Map Changes***
- ***Critical Facilities and Evacuation Routes***
- ***Structures at Risk in Floodplain***
- ***Wetlands and Surface Waters***
- ***Watersheds and Aquifers***

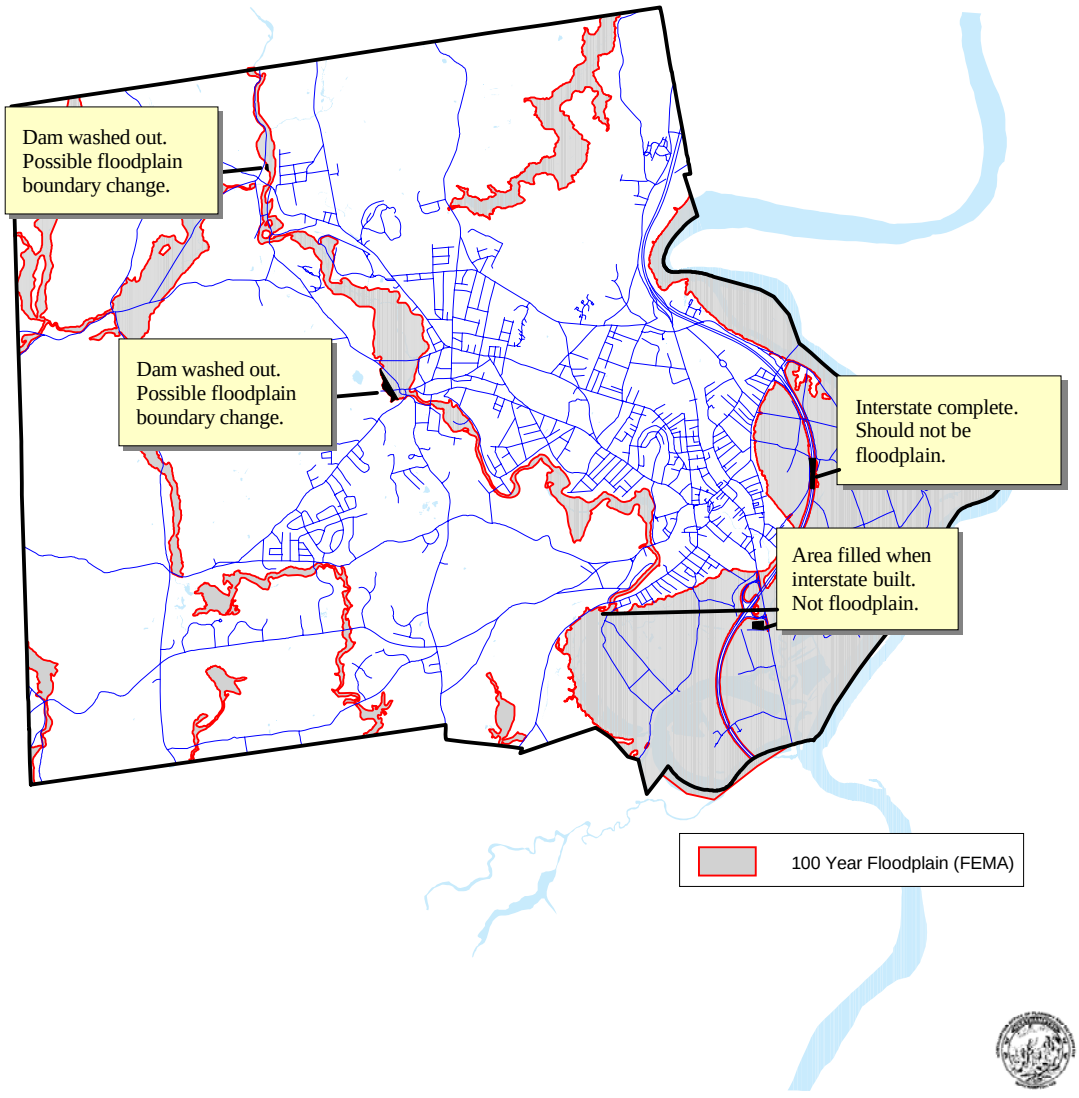
Flood Hazard Base Map
City of Northampton



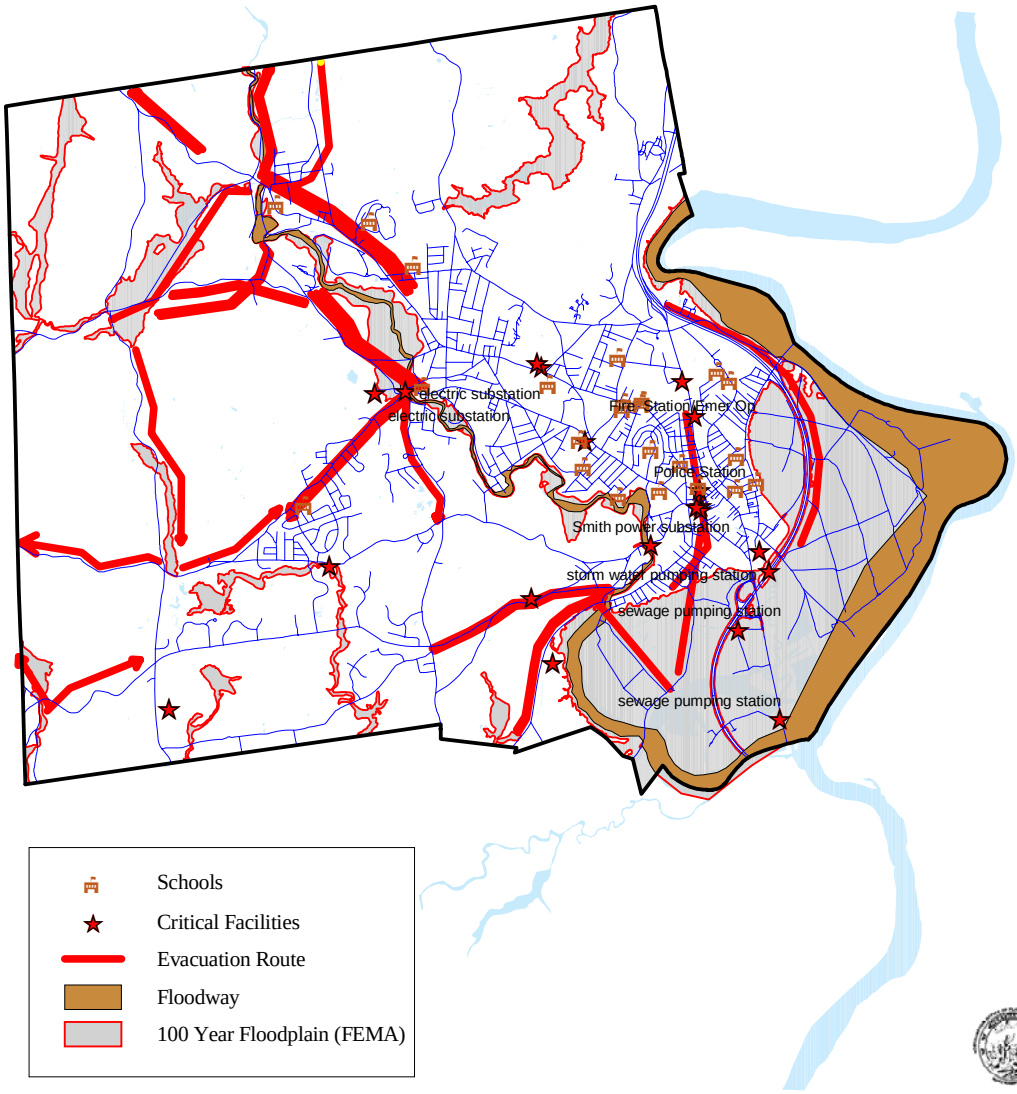
Floodplain and floodway from FEMA Flood Hazard maps.
Additional Zoned Floodplain from Northampton Zoning Map.
Unshaded areas represent minimal flood hazards (Zone B and C).
Localized flooding does occur along other streams, brooks, and natural and man-made drainage ways.

Date: 02-Aug-2004
Author: jt
Revision: 0
File: z:\projects\public\water\fema_firm\fema_firm.apr

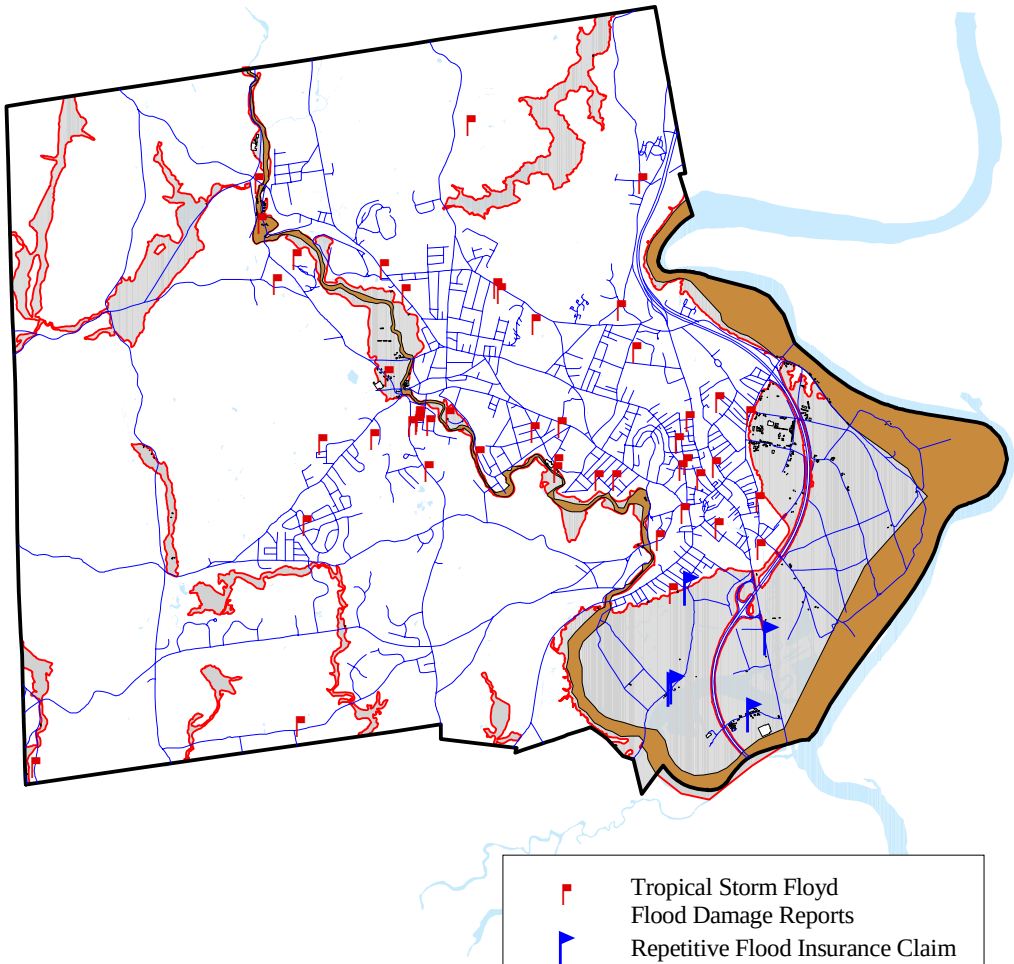
Possible FEMA Floodplain Map Changes
City of Northampton



Critical Facilities and Evacuation Routes
City of Northampton



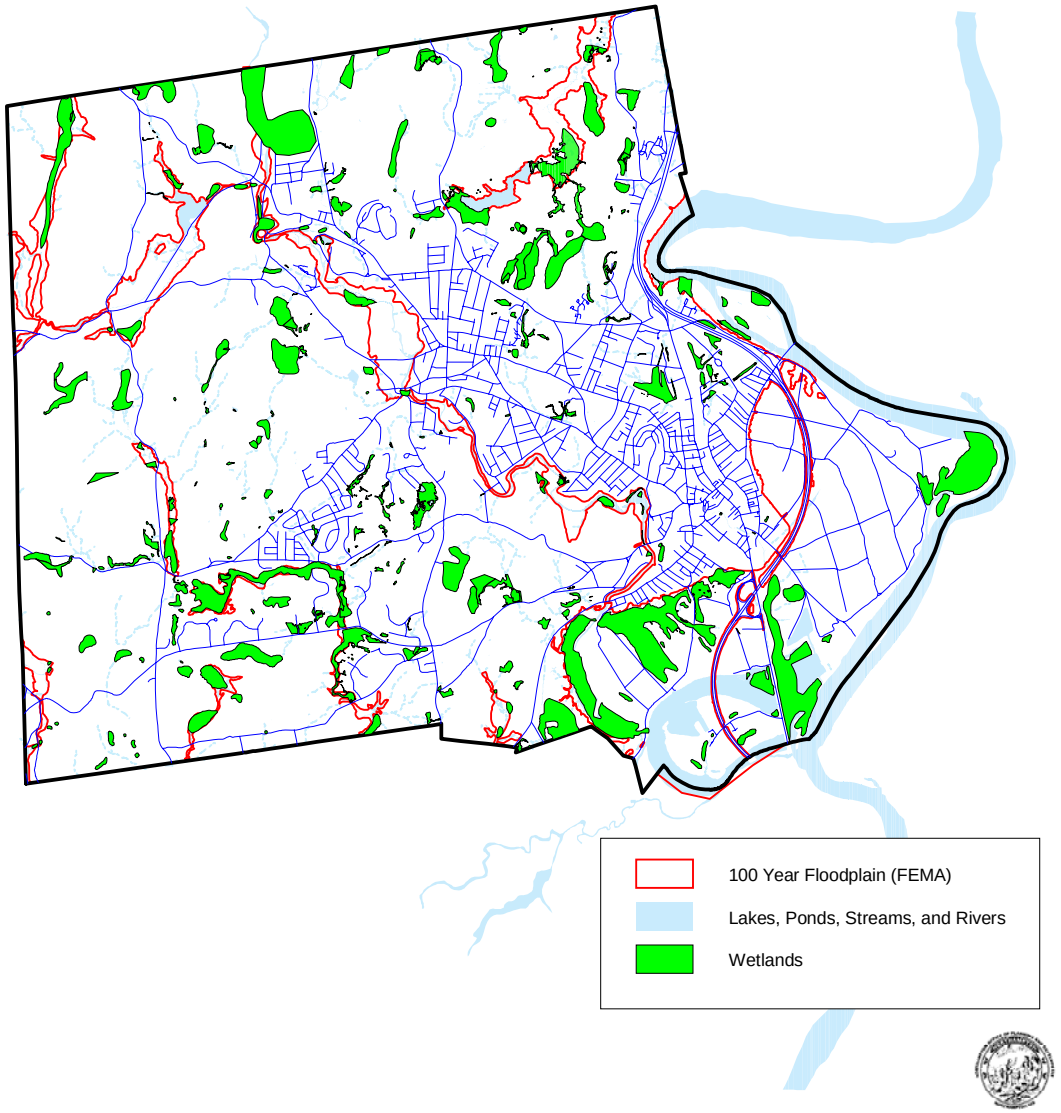
Structures at Risk in Floodplain
City of Northampton



431 structures on 209 parcels
209 (estimated) residential units
30 (estimated) commercial/industrial/institutional structures
192 outbuildings, garages, barns

Date: 02-Aug-2004
Author: jt
Revision: 0
File: z:\projects\public\water\
fema_firm\fema_firm.apr

Wetlands and Surface Waters
City of Northampton



Watersheds and Aquifers
City of Northampton