CITY OF LAWRENCE

COMMUNITY RESILIENCE BUILDING WORKSHOP

SUMMARY OF FINDINGS

June 2018

CITY OF LAWRENCE

MUNICIPAL VULNERABILITY PREPAREDNESS COMMUNITY RESILIENCE BUILDING WORKSHOP

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OVERVIEW

Temperatures are rising, precipitation patterns are changing, elevated sea levels are threatening coastal areas, and disruptions caused by extreme weather events are occurring more frequently. Climate change is affecting the people and resources of Massachusetts and the Merrimack Valley, and in the years ahead these impacts are projected to grow.

Lawrence is in the forefront of communities developing a pro-active response to hazards made more frequent and intense by climate change. In 2016, Governor Baker issued Executive Order 569 "Establishing an Integrated Climate Change Strategy for the Commonwealth." In addition to organizing state agencies for coordinated action in state-wide hazard mitigation and climate adaptation, the Governor's action provides technical support, guidance and financial incentives for cities and towns to undertake community vulnerability self-assessments and prioritize projects and actions that can make a community more resilient and better prepared to mitigate long-term risks and adapt to climate change impacts. Central to the state's climate preparedness initiative is establishment of the Municipal Vulnerability Preparedness (MVP) Program.

Lawrence is among the first communities in the Commonwealth to participate in the MVP Program. The City was awarded a first round Planning Grant by the Massachusetts Executive Office of Energy and Environmental Affairs and used the planning grant to organize City departments and civic stakeholders in two half-day workshops on April 12 & April 25, 2018. Objectives of the workshops were to:

- Define extreme weather and climate-related hazards impacting Lawrence;
- Identify the City's existing, and future, vulnerabilities and strengths;
- Develop prioritized actions for the City; and
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

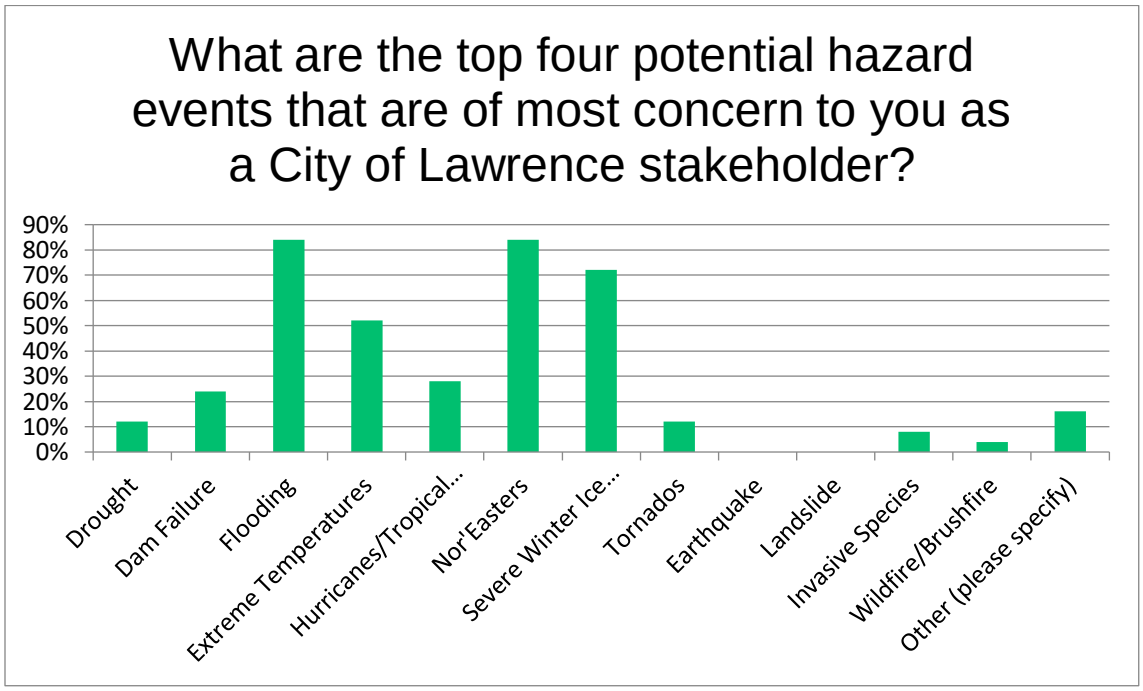
Planners with the Merrimack Valley Planning Commission (MVPC) assisted the City in organizing the planning workshops. Lawrence is a member community of MVPC and the most populous city in the regional planning district of 15 cities and towns located in northern Essex County, Massachusetts.

SUMMARY OF FINDINGS

Top Hazards and Vulnerable Areas for the City of Lawrence

In the weeks leading up to the April 12, 2018 MVP Planning workshop, the planning team conducted a pre-workshop survey of Lawrence stakeholders and asked participants to identify their top natural hazard concerns. Stakeholders were municipal managers and community leaders including representatives of City neighborhood, business and service organizations. Twenty-five people responded to the survey and, as confirmed in the opening half-day workshop, collectively identified the City's top hazard concerns as:

- Flooding
- Extreme Winter/Ice Storms
- Nor'easters
- Extreme Temperatures



Concerns and Challenges Presented by Hazards

We are living through the warmest period in the history of modern civilization, a dramatic change in global climate caused predominantly by human activities, especially emissions of greenhouse gases. According to the 2017 National Climate Assessment, sixteen of the warmest years on record globally have occurred since 1999. In addition to changes in surface, atmospheric and oceanic temperatures, changing climate conditions are manifested in melting glaciers, diminishing snow cover, shrinking sea ice, rising sea levels, ocean acidification and increasing atmospheric water vapor. How do climate change trends impact Lawrence today and how will they in the future?

- WARMER AVERAGE TEMPERATURES FOR LAWRENCE WITH LONGER, HOTTER SUMMERS AND SHORTER, MILDER WINTERS: According to researchers from the Northeast Climate Science Center at the University of Massachusetts (Amherst), the Merrimack Valley region and Lawrence between 1971 and 2000 annually had an average of 7.4 days with temperatures above 90 degrees Fahrenheit. The Center indicates high probability that by the end of this century, Lawrence can expect 13 to as many as 58 days with temperatures above 90 degrees. At the same time, milder winters are projected with 25 to 66 fewer days on average with temperatures below freezing. (The 1971-2000 baseline is an annual average of 148 days below 32 degrees).
- MORE PRECIPITATION IN WINTER/SPRING MONTHS: Winters may be getting milder, but they are also becoming wetter. Northeast Climate Science projects by 2100 average precipitation levels in Winter/Spring seasons will increase between 4% to 35% with greater risk of extreme storms of more frequency and intensity.
- CONSEQUENCES OF MORE EXTREME STORMS and EXTREME TEMPERATURES: Accompanying increasing atmospheric and ocean temperatures are more frequent and more intense weather events. Impacts include risks to public health and public safety, economic disruptions, threats to transportation, water, sewer, stormwater, power infrastructure as well as threats to the City's cultural and natural resources. Damages from hazard events are increasing. According to the National Centers for Environmental Information, 2017 was a record-breaking year in the U.S. with sixteen weather and climate disasters each exceeding $1 billion in damage costs.

Flooding is the primary hazard concern for the City of Lawrence, a densely populated Gateway City with an area of 7.4 square miles and a population of 80,162 people. *(2017 estimate U.S. Census Bureau)* Twenty-five percent of Lawrence's land area is within the 100-year or 500-year floodplain of the three major rivers that run through Lawrence---the Merrimack River and its tributaries the Spicket River and the Shawsheen River. *(MVPC analysis, 2016 Merrimack Valley Natural Hazard Mitigation Plan Update)*

Within Essex County, Lawrence is the community with the highest total value of FEMA-insured flood property loss claims. Since 1978, 312 federal flood insurance loss claims have been filed for damages to Lawrence properties incurred in flood events; the value of those claims exceeds $12 million.

The City's benchmark flood events occurred in March 1936 and in May 2006. The 1936 Flood came after a winter of heavy snowfall and an early Spring thaw. Intense mid-March rainstorms resulted in water levels on the Merrimack reaching a record 48 feet at the Great Stone Dam. The flood devastated the northeast U.S. with damages estimated at $300 million, 400,000 left homeless and 178 deaths. In Lawrence and other cities, the National Guard was called to active duty and martial law declared. Mills closed. Thousands went without heat and water. Officials reported a spike in pneumonia cases and were on alert for potential typhoid and influenza epidemics.

Seventy years later, the Mother's Day Flood of 2006 came after 12 to 17 inches of rain fell in the region over three days in mid-May. The intense rainfall combined with snow melt resulted in river flooding throughout New England with Lawrence among the most impacted communities as water levels rose well beyond flood storage capacity at the Merrimack, Spicket and Shawsheen. Impacts were widespread with damages estimated at $34 million. Streets were closed and evacuations performed in the Arlington neighborhood along the Spicket, in the southeast section of the City along Route 495 and the Shawsheen and along the central City neighborhoods along the Merrimack including the Water Street Corridor and Canal districts as streets were closed, nursing homes and private residences evacuated. City emergency services were taxed to the extreme with access to key routes and facilities closed including the DPW yard at Auburn Street.

The City's Water Treatment plant at Water Street, although located in the Merrimack floodplain, could continue operation, protected by a 15-foot berm built in the late 1930's along the plant's property boundary at the river. Water Dept. personnel reported that the Merrimack elevation came within approximately a foot and a half of breaching the berm.

In the wake of the 2006 Flood and major floods in 2009 and 2010, the City acted to reduce flood vulnerability by amending land use regulation for site review control beyond the 100-year floodplain to include the 500-year floodplain areas. In addition, the City acquired twenty flood-damaged properties along the Spicket, constructed the Spicket River Greenway and Kennedy Park, and installed flood storage stormwater structures as part of the Oxford Park Gateway.

Lawrence workshop participants, in addition to highlighting flooding concerns, also identified risks and challenges caused by intense winter storms and Nor'easters. Focus of concerns were the increasing frequency of extended power outages and the complications posed for emergency management communications to the public; the heightened risk of combined system sewer overflow events resulting from loss of power or high-volume precipitation; and the need for protocols to guide evacuations, street clearances and emergency services. Disruptions were most recently experienced by workshop participants with four March 2018 Nor'easters and the October 2017 Nor'easter that led to school and business closures as well as extended power outages City-wide.

Finally, workshop participants raised concerns of rising temperatures projected for the future and the need to mitigate urban heat island impacts, particularly on vulnerable populations of youth, elderly and the poor.

STRENGTHS & ASSETS IDENTIFIED

Lawrence has a proud legacy from its founding in the 1840s as the nation's first planned industrial city. The massive mill buildings along the Merrimack, the engineering marvel of the Great Stone Dam and canal system, and the beauty and craftsmanship in its architecture, most prominently the Ayer Mill Clock Tower, all highlight a dynamic and resilient community with a rich history and many strengths.

PEOPLE

Lawrence is a dynamic, multiethnic and multi-cultural community. Since its founding in the 1840s, it has continually reinvented itself through economic cycles and successive waves of newcomers. The primary countries of origin have changed and the local economy has gone through structural change, but Lawrence continues to be a Gateway City of industry and immigrants. According to the 2015 American Community Survey, 37% of Lawrence residents are foreign-born, most from Latin America but also many in recent decades from Southeast Asia; 76% of the City's population is of Hispanic or Latino origin.

WATER RESOURCES

Lawrence was built around its rivers and engineered canals. The city's waterways powered the mills that made Lawrence the world leader in the textile industry a century ago. Today, in addition to providing habitat for fish and wildlife, the Merrimack, Spicket and Shawsheen rivers are critical resources for the City's quality of life and offer recreational value to Lawrencians. Properties near the riverfront are prime sites attracting business and residential redevelopment investment. The Merrimack River, the second longest river in New England, has been a plentiful, reliable and high quality public water supply for Lawrence and because of regulatory and cleanup efforts since the 1970s, the river meets the MassDEP and federal Clean Water Act surface water quality standards for a Class B waterway as habitat for fish and wildlife, shellfishing and recreation.

WATER & SEWER SYSTEMS

All households and businesses in Lawrence are served by public water. The City operates a Water Treatment Plant with intake from the Merrimack River via the raw water pumping station at 410 Water Street. The treatment plant, built at its current riverfront location in 2007, has a design capacity of 16 million gallons per day. Supply capacity well exceeds the plant's current average daily production of 6.5 million gallons and summer Peak Daily Demand of 9.5 million gallons.

In addition to the Water Treatment Plant and intake pump station, distribution infrastructure for the Lawrence public water system includes:

- Three booster pump stations (at Marston St., Ames St, and Andover St.; since 2015, the latter two stations have been upgraded by the City with redundant pumps.)
- 154 miles of pipes
- 1,300 fire hydrants
- Five water storage tanks (two at Mount Vernon, Tower Hill, Ames St. and Prospect Hill

The City also operates and maintains 128 miles of sewer mains and 30 miles of stormwater infrastructure. Approximately 64% of the sewer collection system is combined sewer stormwater lines and the remaining 36% is separated sanitary sewer.

The City sewer infrastructure was built in the 19th century and the average sewer main is almost 100 years old. The system includes four sewer pump stations—all upgraded since 2011 and located at Lisa Lane, Pembroke Drive, Pilgrim Road and Route 114 (within the Shawsheen River floodplain). Three of the four sewer pump

stations have backup generators; the Pilgrim Road facility is without backup power. *(Climate Resiliency Analysis, Woodard & Curran, December 2016)*

Lawrence is a member community of the Greater Lawrence Sanitary District which operates the regional Wastewater Treatment Plant at Charles Street in North Andover. GLSD also owns and maintains the sewer interceptor mains which collect wastewater pumped through the City's collection system for conveyance to the Treatment Plant. Average daily flow treated at the plant is 30 million gallons per day; the treatment plant has design capacity to handle 165 million gallons per day without system overflows. *(source: MassDEP and GLSD)*

HOSPITAL AND HEALTH CARE

Lawrence is home to an extensive network of health care facilities and institutions. Greater Lawrence Family Health Center provides service at four neighborhood clinics in Lawrence. Lawrence General Hospital has served City residents for 140 years.

FOOD SECURITY

Lawrence has strong food access despite having only one supermarket within City limits (at Essex St.) The City has numerous smaller, diverse food shops providing quality produce and vegetables. With a poverty rate of 28%, according to the 2015 American Community Survey, the City has many households in need. Through faith-based organizations, non-profits, civic and government partnerships, food assistance is available through 13 food pantries in the City and three soup kitchens at Cor Unum, Lazarus House and Bread & Roses.

SCHOOLS

Lawrence has made significant investments since 2000 in school facilities, including the 42-acre Lawrence High School campus which opened at its current location in 2007. The School Dept. oversees management of 24 buildings which includes schools and administrative buildings. Although there is no formalized emergency shelter, school buildings are accessible to neighborhoods and have been made available as shelters or warming centers in the past.

DAM INFRASTRUCTURE

Lawrence has four dams, the most prominent is the Great Stone Dam, an engineering achievement built in 1848 to harness the Merrimack for hydropower to drive Lawrence's mills. The Great Stone Dam is now privately owned and operated by Enel Green Power. Major upgrades in the dam were made last decade including installation of a rubber bladder system to control Merrimack River water level.

NETWORK OF PARKS

For a City of its size and development density, Lawrence has an extensive and diverse park and open space system. The City manages 48 parks and greenways encompassing 340 acres, and three cemeteries of another 140 acres. The Commonwealth Dept. of Conservation and Recreation owns and manages three parks: Pemberton Park on the Merrimack River downtown, Lawrence Heritage State Park in the North Canal Mill District and Riverfront State Park, which includes the Abe Bashara Boathouse, in South Lawrence.

SPECIFIC VULNERABILITY CONCERNS & CHALLENGES:

DPW YARD

The City's DPW yard at Auburn Street is a critical facility for public works operations and emergency management. It is base for City maintenance equipment and includes fuel pumps for City vehicles. The 3- acre yard is within the floodplain of the Spicket River and during major flood events, including the 2006 Mother Day Flood, flood waters have prevented access to the site and hampered City response. Also of concern are risks of environmental contamination from flooding that could trigger release from chemicals, petroleum, and hazard materials stored at the site.

POWER SYSTEM

National Grid provides electrical power through the regional grid to 20,829 business and residential customers in Lawrence. Summer peak load on the system is 50.3 Megawatts. Major power system facilities include five substations within the City. Electrical load is served by twenty-nine 4 kV feeder lines with transmission underground and above ground, according to National Grid. The system is vulnerable to winter storms, high winds including Nor'easters, and brownouts from extreme summer temperatures generating excessive power load demand. The City in March 2018 and October 2017 Nor'easters, as with most of the Merrimack Valley region, suffered multi-day power outages with some areas being without power for five days. Reported source of the outages affecting Lawrence included downed transmission feeders and substations outside of the City.

VULNERABLE POPULATIONS—

Elderly, Disabled, Youth, Homeless & Mentally Ill

Lawrence has large segments of people who because of age, physical condition or economic circumstances are vulnerable to climate-related or extreme weather events. Communications and coordinating effective emergency response to these groups are challenges. Average age of Lawrencians is among the youngest in the Commonwealth; nearly 40% of the population is under age 24. The school system is the largest in the Merrimack Valley region with 14,000 pupils. And yet, the City's elderly population is the fastest growing in the City; By 2035, according to the UMass Donahue Institute, the City's elderly population is projected to double from 2010. More than 40% of the City's seniors have some former of disability impairment. Many of the elder housing and nursing care facilities are high rises or located in flood zone areas, including Mary Immaculate Housing and Care Facility off Lawrence St. In the 2006 flood, problems in coordinating notifications and evacuations led to delays in safe relocation of residents most prominently at Mary Immaculate. In the wake of the 2006 flood, a temporary inflatable dam was purchased to be deployed upon alert notification of a flood event and hopefully enable more time to evacuate before floodwaters limit access.

Homelessness is a city-wide problem compounded by problems of mental illness and the opioid epidemic. The City has taken steps to monitor and address the problem through the work of churches, non-profits and state and local government. Lawrence's City's Homeless Initiatives Coordinator operating out of Lawrence Planning & Development, reports a Feb. 2018 homeless street count of 114 and an additional 278 pupils in the Lawrence school system without permanent housing.

WATER TREATMENT PLANT & DISTRIBUTION SYSTEM

The City's Water Treatment Plant (WTP), rebuilt at its current location in 2007 on the Merrimack River at Water St., lies within the 100-year floodplain. Equipment storage, electrical switchgear and backup generator are within flood elevation. A 15-foot berm dating to at least the 1930's provides some level of protection. The berm has never been breached, though the 2006 flood came close to within 1.5 feet of the berm top, according to Water Dept. officials. It is unclear with increased precipitation levels generated from climate change whether the berm will be adequate to provide protection in future flood emergencies. Other risks to the City's water system include:

- High turbidity and organics levels in the Merrimack from more frequent heavy precipitation events causing erosion and sedimentation;
- Flood threats to the WTP sewer air gap structure needed for hydraulic disconnect to prevent stormwater/sewerage from backing up into the plant and contaminating drinking water.
- The 50-year old booster pump station at Marston St. lacks redundancy.

SCHOOLS

Lawrence schools were identified as both a strength and vulnerability by workshop participants. Thirteen of the City's twenty schools lack air conditioning and many of the older facilities lack power backup, both vulnerability concerns as the City plans for a future with more extreme temperatures.

LAWRENCE PUBLIC SCHOOL BUILDINGS WITHOUT HVAC SYSTEMS (2018)	
• Adult Learning Center • Breen School • Bruce School • Frost School • Hennessey School • Lawlor School • Lawrence Family Academy	• Leahy School • Oliver Partnership School • Rollins School • SES At Bruce Annex • Tarbox School • Up Academy Leonard Middle School

COMBINED SEWER STORMWATER SYSTEM

Lawrence is one of 772 urban areas across the country with a combined sewer system. CSO communities along the Merrimack River in addition to the GLSD cities and towns are Haverhill, Lowell and the New Hampshire cities of Manchester and Nashua. Under normal conditions, the City's combined sewer system collects rainwater runoff, industrial wastewater and domestic sewage all in one pipe and transports the flows to the regional GLSD treatment facility in North Andover. Heavy rainfall events, however, can overtax system capacity and cause combined sewer overflows, discharges of untreated sewage and street runoff. Discharges of untreated wastewater can carry disease-causing bacterial pathogens and impair water quality through oxygen depletion or overloads of nitrogen and phosphorus. There are five CSO outfall locations in Lawrence at the Spicket and Merrimack rivers, all downstream from the City's Water Treatment

Plant. The frequency of CSO events and their potential environmental and public health impacts are major concerns. Under the terms of the authority's 2007 consent decree with the U.S. EPA., GLSD has been undertaking a $40 million capital investment program in treatment plant and system upgrades. These investments to date have made significant impact in reducing the number and discharge volume of CSO events. In the 1990s, according to MassDEP and GLSD officials, an average of 14 CSO overflows occurred annually; today the frequency of those events has been reduced about 50% from two decades ago with about five to seven such events reported at the GLSD in an average year. This year CSO events following heavy rains, have been reported in Lawrence in January, March and April. After the October 2017 Nor'easter, power outages at the GLSD plant resulted in an 8 million-gallon discharge into the Merrimack. GLSD is planning installation of generators powered by natural gas and biogas produced at the plant, a project that would reduce risk of a CSO event caused by power failure.

HAZARD MATERIALS/BROWNFIELDS

Lawrence's industrial legacy is accompanied by a history of environmental contamination. MassDEP has identified 400 sites in the City with records of chemical or petroleum release. Forty-four companies and organizations use toxic materials at levels requiring filing of emergency response plans and materials inventory under the state's Right to Know Law with the Fire Chief who serves as the City Emergency Management Director. Auto-related businesses including auto body shops and fueling stations are prevalent in areas of the City vulnerable to flooding including the Arlington neighborhood and the Water St. Corridor. Workshop participants raised concerns about the need for education and training in use and storage of toxic materials and Brownfields contamination cleanup to mitigate the potential release of hazard materials caused by flooding or extreme temperatures.

RECOMMENDATIONS TO IMPROVE LAWRENCE'S RESILIENCE TO HAZARDS

Workshop participants identified and prioritized actions the City and partners can take to reduce vulnerabilities to hazards and to reinforce the community strengths contributing to a resilient Lawrence. Top action priorities as defined by consensus at the April 25, 2018 workshop were:

Formalize Emergency Management Communications Protocols & Evacuation Procedures

Establishing formal emergency management protocols involving more than Police and Fire is deemed critical to effective City preparation and response to extreme weather hazards. Workshop participants stressed the need to involve broad-based stakeholders in development and implementation of protocols, including implementation of software systems to be used in emergency alert notifications to residents and businesses. Stakeholders involved should include organizations and departments providing service to vulnerable residents—seniors, youth, physically disabled and residents living in isolation including the poor, homeless and new immigrants who may have language barriers. Focus should include emergency management assessment of high-rise housing complexes and coordination between housing managers and the City's first responders in establishing clear procedures and contacts for conducting site-specific evacuations.

Plan long-term action for DPW Yard Relocation

DPW maintenance yard operations at Auburn Street are compromised by a high-risk location in the Spicket River floodplain. Long-term the City should take steps to plan for relocation of the facility beginning with study of alternative siting options of size and accessibility suitable to serve as a base for DPW maintenance and operations equipment. Participants recognize the scope, high cost and need for additional planning of a DPW yard relocation make such an initiative by necessity a long-term effort and compel taking measures in the medium and short-term to mitigate existing flood risk at the Auburn Street facility. Participants recommended short-term feasibility study of potential flood-proof measures that could be implemented at Auburn Street and establishment of procedures for moving equipment, materials and chemicals with notice of early warning of pending flood or storm event.

Reduce Combined Sewer Overflow Events

Workshop participants highlighted the need to take regional action to reduce the frequency of CSO events. Recommendations centered on three spheres. First, participants recommended establishing power back-up at the North Andover GLSD

treatment plant and the Riverside pumping station to prevent system overflow discharges caused by system power outages. Planning for this active project is going on now at GLSD and medium-term (3-5 years) implementation is expected. At the same time, participants recognized that most of the CSO events are not caused by power outages but by design capacity limits in handling flows after heavy precipitation.

Second, given the projections of increasing precipitation events, participants recognized a long-term need to identify and assess options for accommodating increased system capacity to manage intense periods of stormwater flows. A conservative estimate of the cost to eliminate CSO events in the GLSD system is $209 million, according to MassDEP and GLSD. Engineering study is recommended to determine the most cost-effective system capacity investments as a long-term action to mitigate CSO discharges and stormwater runoff impacts.

Finally, participants see a compelling need for more public education and outreach about the combined system. Many noted the need for more information and context beyond the media reports that occur after CSO events. Highest priority was given to organization of a public education on the CSO system to promote regulations and development that provide design options including bioswale or rain garden retention and enforcement of the City's Fats Oil and Grease (FOG) permit requirements.

Install Backup Power Generators at Municipal Facilities

Workshop participants ranked power outages among the City's top vulnerabilities. Recommended actions to reduce the City's vulnerability to power loss impacting municipal operations was to plan and prioritize installation of backup power generators at municipal facilities including City Hall, pump stations, and the eleven schools currently without backup power: Adult Learning Center, Breen School, Bruce School, Hennessey School, Lawlor School, Lawrence Family Academy, Leahy School, Oliver Partnership School, Rollins School, SES at Bruce Annex, Tarbox School and Up Academy Leonard Middle School.

A complete summary listing of workshop generated Action Priorities follows in Appendix A Tables of Infrastructure, Societal and Environment profiles attached.

Also attached as Appendix B are copies of maps produced by MVPC for the April workshops.

Workshop Participants

Susan Almono, Merrimack Valley Workforce Investment Board
Randald Bartlett, Enel Green Power Corporation
Paul Brennan, Lawrence General Hospital
Joe Costanzo, Merrimack Valley Regional Transit Authority
Cheri Cousens, Greater Lawrence Sanitary District
Detective Thomas Cuddy, Lawrence Police Dept.
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Katie Darwin, Mt. Vernon Neighborhood
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APPENDIX A

TABLES OF ACTION PRIORITIES

INFRASTRUCTURE

SOCIETAL

ENVIRONMENT

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – INFRASTRUCTURE PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
DPW Yard	V	Flooding	Site Analysis Study of Alternate Locations to Relocate Yard/First Step to Relocation	H	S-Study L-Relo
			Engineering Feasibility Study of Floodproofing Options at Existing Facility; Options include temporary/inflatable dam, Porous pavement improvements; water runoff diversion	H	S
			Dredge Spicket to increase flow storage capacity	L	L
			Prioritize land acquisition plan along Spicket for flood storage capacity	L	L
Power Grid Failure	V	All	Coordinate with Utilities in prioritizing corridors for Vegetative Management, pole maintenance	H	O
			Strategic investment master plan in maintenance and infrastructure upgrade of power grid; Regional Information sharing and improved coordination with National Grid and state agencies to build redundancy & upgrade power infrastructure	L	O
			Install backup generators at all municipal facilities; Develop plan for prioritizing facility implementation schedule	H	S/O
			Install generator for GLSD pump station at Riverside/N. Andover	M	M
			Survey gas stations on back- up power needs as part of emergency plan for continued operation/ fuel access during power failure	L	L

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – INFRASTRUCTURE PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
Lawrence Schools—16 bldgs. w/o AC; Arlington School as shelter; Flooding at Lahey, Leonard & CCHS	V & S	All	Install HVAC systems at all schools	H	O
			Formalize designation of emergency shelter	H	S
			Identify and develop floodproofing mitigation measures for schools vulnerable to flooding.	L	O
			Implement Green Infrastructure measures including green walls, green roofs to reduce heat island effects	M	O
Lawrence General Hospital	V & S	Flooding	Rebuild & repoint sections of retaining walls along Spicket ; action by owners LGH	L	L
			Floodproof Russell Building at LGH	L	L
			Establish alternate parking and shuttle area during flood emergency	L	L
Stevens Pond Dam	V & S	Flooding	Repair dam gate to allow water release prior to major storm events. Coordinate with upstream Spicket River communities Methuen and Salem, NH	M	M

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – INFRASTRUCTURE PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
Water Treatment Plant and distribution system	V & S	Flooding	Three alternatives to be explored in determining preferred action: 1)Relocation of WTP across Water St. away from river; 2) Elevation of equipment/generators and chemical storage above floodplain 3) Reconstruct and elevate existing 15-foot berm at WTP. (engineering review needed to determine appropriate flood abatement elevation for berm under future conditions)	H	L
			Replace Marston St. pump station with redundant pumps and power backup	H	S
			Add redundant electric feeds to supply water treatment plant; explore solar as microgrid backup power	L	L
			Annual review/update of business continuity plan	L	O
			Engagement at regional/interstate level with Merrimack River management	L	O
			Institute incentives to get business/industry to self-identify and report chemical, hazard materials discharge or risks at Merrimack	L	L
Sow Brook culvert	V	Flooding	Land acquisition of approx. 12 properties to address area drainage capacity problem of existing undersized culvert	M	M

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – SOCIETAL PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
Disabled & Elderly	V & S	All	Establish formal communication protocols to public with attention to vulnerable groups; Include issues of medications, pets, generator use, evacuations, Emergency Management Plan, Spicket River flooding.	H	S
			Planning exercises/protocols for vulnerable populations and neighborhoods—Arlington and Water St. Corridor, Lower Tower Hill and Lowe South Common Mill District	M	O
Elderly & LHA	V & S	All	Assessment of all elderly complexes regarding emergency management capabilities and evacuation plans/protocols	H	S/O
Homeless & Mentally Ill	V	All	Training for non-emergency municipal employees including Senior Center, Library, first responders with Police/Emergency officials on security, response events and interaction with homeless, mentally ill and other vulnerable groups.	H	S/O
			Create database of people/providers	M	O

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – SOCIETAL PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
Non-Profits, Organizations & Churches	V & S	All	Training for volunteers	M	O
			Coordinate resources and efforts—mobile kitchens, temporary shelters, shared vehicles, generators	M	O
Communications & Social Media	V & S	All	Develop a comprehensive communications plan & software system to get critical emergency management information to the public, involving more than Police/Fire/ISD	H	S
			Website updates, Reverse 911, Code Red alerts—Assess ongoing efforts	H	O
			Designate staging center and P.O.C. for emergency information	H	O
			Provide emergency info in multiple languages	H	O

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – ENVIRONMENT PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
DPW Yard—Gasoline, Vehicles, Salt Storage	V	FLOODING	Temporary relocation of equipment, materials to alternate site(s) upon notice of pending flood/storm event	L	L
			Training of DPW personnel on toxic material storage and use (TURI funding available)	M	S
			Build larger retaining wall at Spicket	L	L
Power Grid Failure –Temperature Sensitive Impact on Hazard Material Storage	V and S	Winter/Ice Storms, Nor'easters, Extreme Temperature	Tree management/protection of existing infrastructure assets	M	O
			Coordinate with National Grid to prioritize grid segments for burying lines underground	M	L
Fuel/Gas Stations; 400 Brownfield Sites; Tier 2 Chemical Users	V	All	Training & Education outreach on safe use/storage for Tier 2 facilities and gas station/auto body shops	H	M
			ID priority sites for remediation and generator installations; Relocate high-risk sites/uses. (Corridor focuses: Arlington neighborhood, Water St., Jackson St., Route 114)	M	M

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – ENVIRONMENT PRIORITIES

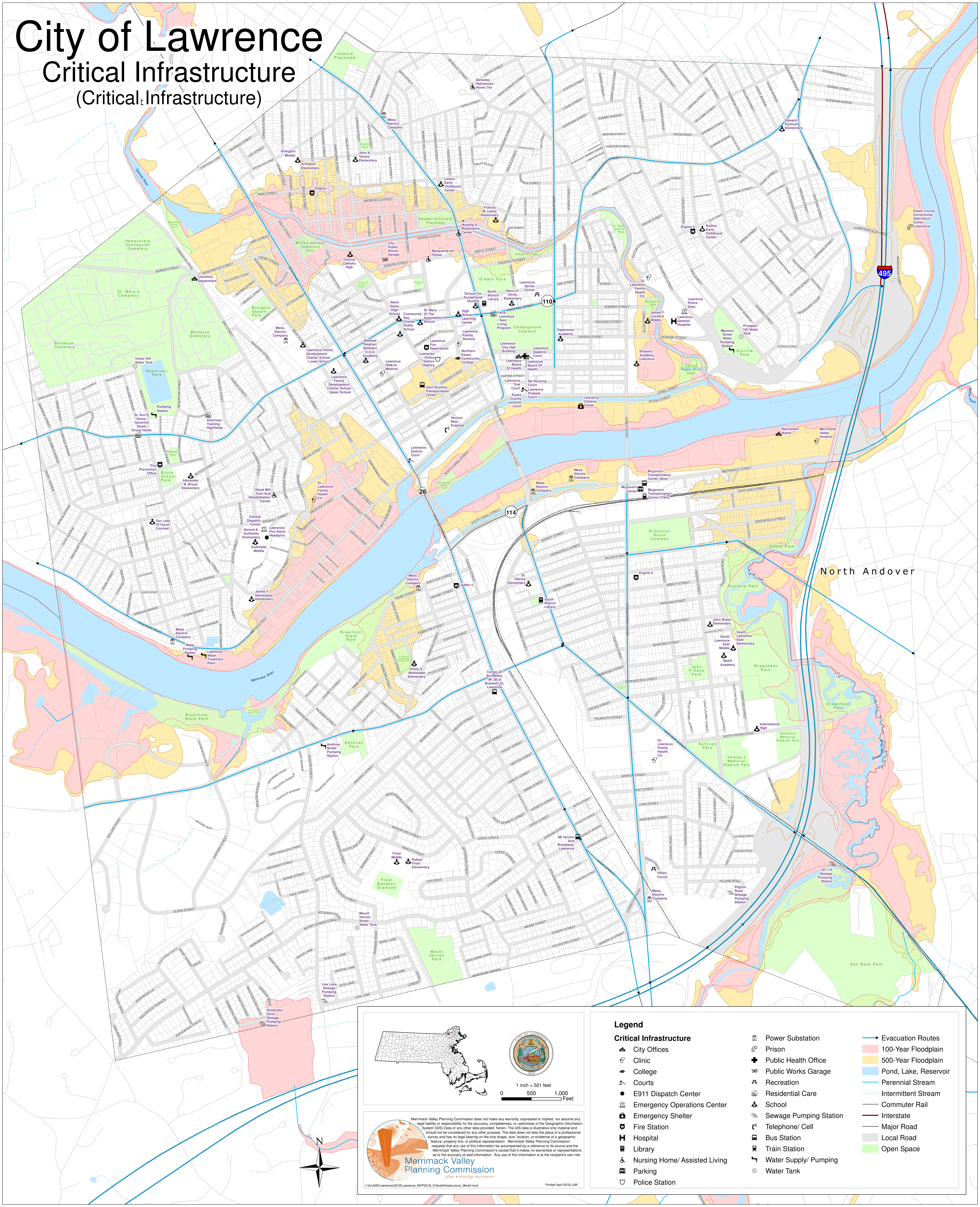
FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
Combined Sewer Overflows-5 locations at Spicket & Merrimack	V & S	Flooding	Install backup power generators at GLSD facilities including at treatment plant and Riverside pumping station	H	S
			Engineering study/assessment of options to increase stormwater system storage capacity or satellite site treatment of wastewater	M	M
			Separation of sewer/stormwater system	M	L/O
			Public education campaign on CSO system and behaviors for individuals/businesses to aid in improved system function and reduction of CSO events (e.g. of Fats/Oil/Grease reduction (FOG), rain gardens & bioswales)	H	O
			Investment in infrastructure upgrades and ongoing maintenance (main lines, canals) to reduce leakage into wastewater system	M	O
			Enforce FOG permit requirements to reduce clogging risk to system lines	H	O

LAWRENCE MUNICIPAL VULNERABILITY PREPAREDNESS – ENVIRONMENT PRIORITIES

FEATURE	Vulnerability Or Strength	HAZARD	ACTION	PRIORITY (High/Med/Low)	TIME (O/S/M/L)
Waterways—Spicket, Merrimack (Syringes & Flooding)	V & S	Flooding	Dredge sections of Spicket River for flow storage	L	L
			River cleanups	M	O
			Regulation and enforcement including dumping controls, stormwater management	M	O
			Hire entity for comprehensive protection/maintenance of Spicket	L	L
			Education and outreach campaign on River management & habitat protection	M	O
			Implement low impact development measures (porous pavement, nature-based design, streetscape plantings)	M	O
			Adopt administrative procedures/zoning update to limit development in floodplain	M	O

APPENDIX B

LAWRENCE MAPS USED IN WORKSHOPS


City of Lawrence
Critical Infrastructure
(Critical Infrastructure)
North Andover
Merrimack River
Spicket River
Shawsheen River
495
110
114
28
Legend
Critical Infrastructure
City Offices
Clinic
College
Courts
E911 Dispatch Center
Emergency Operations Center
Emergency Shelter
Fire Station
Hospital
Library
Nursing Home/ Assisted Living
Parking
Police Station
Power Substation
Prison
Public Health Office
Public Works Garage
Recreation
Residential Care
School
Sewage Pumping Station
Telephone/ Cell
Bus Station
Train Station
Water Supply/ Pumping
Water Tank
Evacuation Routes
100-Year Floodplain
500-Year Floodplain
Pond, Lake, Reservoir
Perennial Stream
Intermittent Stream
Commuter Rail
Interstate
Major Road
Local Road
Open Space
1 inch = 501 feet
0 500 1,000 Feet
Merrimack Valley Planning Commission does not make any warranty, expressed or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of the Geographic Information System (GIS) Data or any other data provided herein. The GIS data is illustrative only material and should not be considered for any other purpose. The data does not take the place of a professional survey and has no legal bearing on the true shape, size, location, or existence of a geographic feature, property line, or political representation. Merrimack Valley Planning Commission requests that any use of this information be accompanied by a reference to its source and the Merrimack Valley Planning Commission's caveat that it makes no warranties or representations as to the accuracy of said information. Any use of this information is at the recipient's own risk.
Merrimack Valley Planning Commission
plan * develop * promote
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N
Lawrence General Hospital
Lawrence Police Dept.
Lawrence Fire Department
Lawrence Police Station Hdqrtrs
Lawrence City Hall Building
Lawrence Superior Court
Lawrence Board Of Health
Lawrence Trial Court
Essex County Juvenile Court
Lawrence Probate Court
Ne Housing Court
Lawrence Citizens Center
Lawrence District Court
Central Dispatch Center
Lawrence Fire Alarm Headqrtrs
Essex County Correctional Alternative Center (Lawrence)
John Buckley Transportation Center
Mcgovern Transportation Center (Bus)
Mcgovern Transportation Center (Train)
Mcgovern Center
Lawrence Water Treatment Plant
Water Pumping Station
Tower Hill Water Tank
Prospect Hill Water Tank
Mount Vernon Street Water Tank
Marston Street Water Pumping Station
Andover Street Pumping Station
Lisa Lane Sewage Pumping Station
Pembroke Drive Sewage Pumping Station
Pilgrim Road Sewage Pumping Station
RT 114 Sewage Pumping Station
Engine 6
Engine 7
Engine 9
Ladder 4
Fire Prevention Office
Central Catholic High
Lawrence High School Learning Center
International High
Den Rock Park
Campagnone Common
O'Connell South Common
Riverfront State Park
Shawsheen Park
Veteran's Memorial Stadium Park
Bellevue Cemetery
St. Mary's Cemetery
Immaculate Conception Cemetery
Reservoir Park
Valley Forum
Verizon New England

City of Lawrence

Critical Infrastructure

(Socioeconomic)

Methuen

Merrimack River

North Andover

Andover

Legend

- Subsidized Housing Locations
- Evacuation Routes
- 100-Year Floodplain
- 500-Year Floodplain
- Pond, Lake, Reservoir
- Perennial Stream
- Intermittent Stream
- Commuter Rail
- Interstate
- Major Road
- Local Road
- Open Space

1 inch = 503 feet

0 500 1,000 Feet

Merrimack Valley Planning Commission

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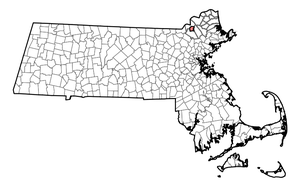
City of Lawrence

Critical Infrastructure

(Environmental)

Howard Playstead
Hayden/Schofield Playstead
William Kennedy Community Park
Immaculate Conception Cemetery
St. Mary's Cemetery
Bellevue Cemetery
Reservoir Park
Bourgoin Square Park
O'Neill Park
Campagnone Common
Immigrants Place
Storrow Park
Oxford Paper Site Park
Bruce School Park
Gagnon Park
Cronin Park
Riverfront State Park
Donovan Park
Frost Baseball Diamond
Mount Vernon Park
O'Connell South Common
Coyne Park
Costello Park
John P Kane Park
Shawsheen Park
Stockton Park
Sullivan Park
Veteran's Memorial Stadium Park
Den Rock Park
Merrimack River
Sticker River
North Andover
Andover
Lawrence



1 inch = 487 feet

0 500 1,000 Feet

Legend

- Oil
- Hazardous Material
- Oil and Hazardous Material
- Unknown
- Evacuation Routes
- 100-Year Floodplain
- 500-Year Floodplain
- Pond, Lake, Reservoir
- Perennial Stream
- Intermittent Stream
- Commuter Rail
- Interstate
- Major Road
- Local Road
- Open Space

Merrimack Valley Planning Commission
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