Section 4: Environmental Inventory and Analysis

This inventory of Newton's environmental and cultural resources will inform the goals and objectives that will help to protect the biodiversity, ecosystems, and ecological integrity of Newton.

A. Geology, Soils, and Topography

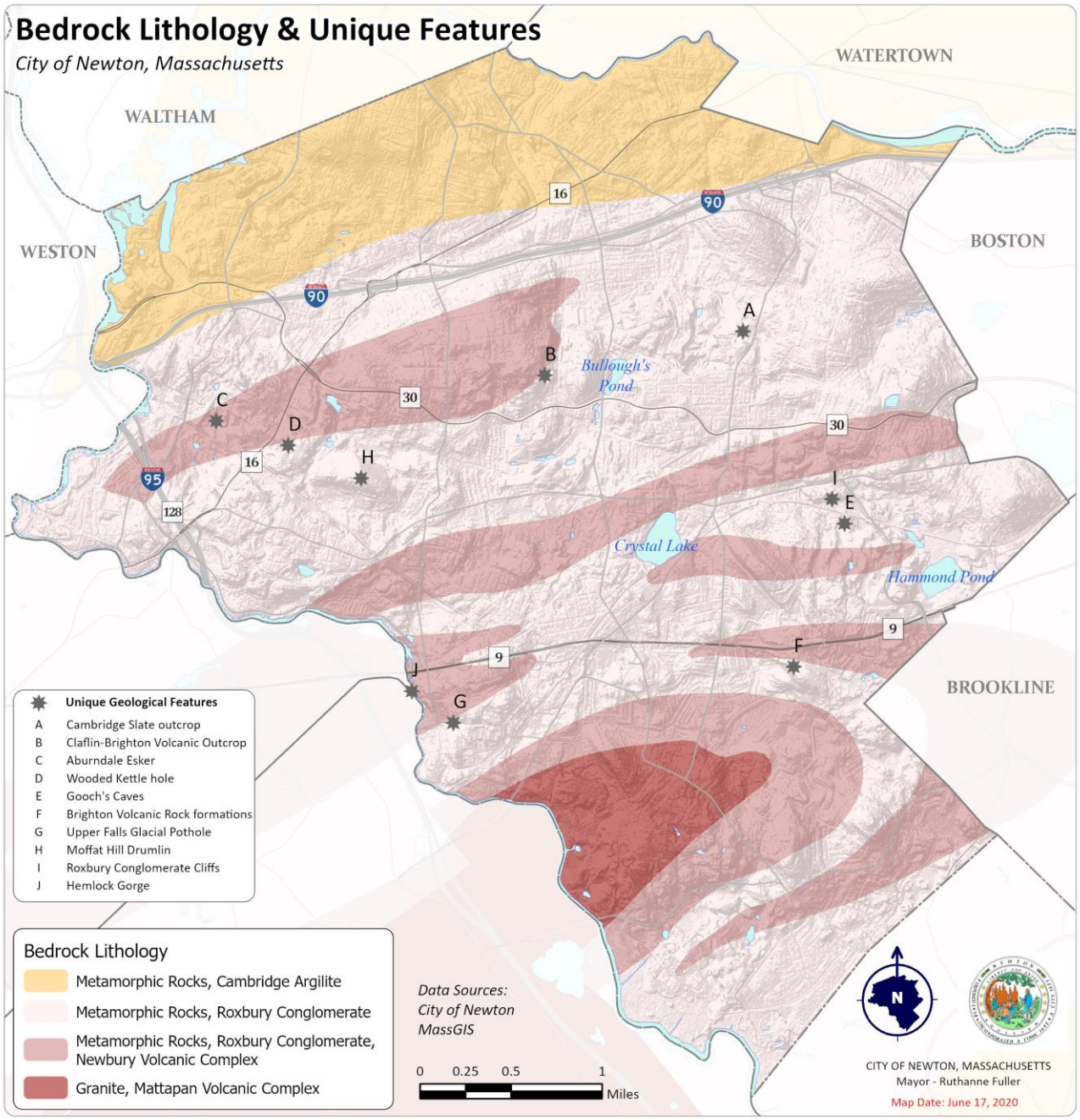
Geology

Newton lies within the Boston Basin, a topographic lowland surrounded by a ring of hard rock hills, from the Middlesex Fells to the north, inland to the Belmont Hills and Newton Highlands to west, and around to the Blue Hills to the south. Bedrock deposits that underlie the Boston Basin include the Roxbury Conglomerate (the famous "puddingstone"), sandstone, the Cambridge Argillite or slate, and the Brighton and Mattapan Volcanics. These formed about 585-550 million years ago along the northern margin of the large southern continent of Gondwana, at about 60º south latitude in an intravolcanic basin. The source of these sediments was largely erosion of the volcanic and granitic highlands surrounding the basin at this time producing both marine and non-marine deposits. The courser pebbles and cobbles formed the Roxbury Conglomerate and the finer-grained sand and clay fragments washed offshore forming the Cambridge Argillite. Volcanic rocks are present in Newton as lava flows, pyroclastic deposits and sub-volcanic shallow intrusions that make up the Brighton and Mattapan Volcanics. Via plate tectonics, the area that included the Boston Basin gradually moved across the ancient Iapetus Ocean and collided with the edge of North America, then called Laurentia, about 425 million years ago forming the northern Appalachian Mountains. Magma welled up in cracks some 250-150 million years ago, during the opening of the modern Atlantic Ocean to form intrusive basaltic (dark colored) dikes seen in Newton that cut through the earlier sedimentary rocks. All these rocks were deeply buried and hardened. Throughout most of Newton these either form bedrock outcrops or are found close to the land surface. Where bedrock is exposed at the surface, the term "outcrop" is used. Outcrops are valuable educational and aesthetic resources. See **Figure 20.**

The surficial deposits in Newton are made of sand, gravelly till and alluvial soils largely resulting from the extensive Laurentide glacial ice sheet that periodically covered the area by over 1/2 mile of ice during the Pleistocene epoch, starting about 2 million years ago until the last ice retreated about 14, 000 years ago. This ice retreat left many types of glacial deposits seen in Newton such as glacial hills, eskers and drumlins and glacial outwash stream deposits in the valleys. The glaciers more easily eroded the softer sedimentary deposits while the harder igneous rocks tend to make up the hills, particularly to the south and west.

The eastern quarter of the City's landscape is undulating, with multiple glacial drumlin deposits. The western hills are more isolated, in a north-south pattern, broken by lower flatlands that include Newton's limited prime farm soils.

Figure 20. Geologic Features: Bedrock Lithology and Unique Features



Varying topography and glaciation caused multiple environments to form, from outwash plains and alluvial deposits, to well-drained productive soils, to bony and rocky drumlins and outcrops. Each has its own unique ecology, and each helped shape development of the City of Newton. The flat, well-draining sand and gravel deposits offered ideal conditions for building railroad and automobile transit corridors between hills and paved the way for the sprawling residential land use that Newton exhibits today. The wetter lowlands, where glacial meltwater formed perennial streams and kettle ponds, were less ideal for building or farming, and so became the first parks and open spaces.

There are several scenic and unique geologic features that offer Newton's residents recreational and educational value, including:

- A small but rare Cambridge Slate outcrop south of Colby Street
- A Brighton Volcanics outcrop with glacial scratches at the former Claflin School*
- The Auburndale Esker at the Woodland Golf Course
- A wooded kettle hole at 93 Stanton Ave.
- Gooch's Caves in the Webster Conservation Area*
- Brighton Volcanic Rock formations at 85 Dudley Road
- Roxbury Conglomerate and a Brighton Volcanic lava flow at the Webster Conservation area (the so called "ledges" near the intersection of Hammond Pond Parkway and Beacon St.)
- Mattapan Volcanics along Winchester and Nahanton Streets near Nahanton Park, as well as within Nahanton Park
- The Upper Falls Glacial Pothole on Sullivan Avenue at Elliot Street
- The Moffat Hill Drumlin in the Brae Burn Golf Course
- Roxbury-Conglomerate cliffs at 600 Beacon Street (Webster Conservation Area)*
- Hemlock Gorge*

** bedrock formations in public ownership*

Soils

Newton's land surface has been heavily influenced by glacial action. The last glacier receded from this area about 14,000 years ago leaving many different forms of surface deposits. The higher hills (up to 300 ft.) are drumlins: deposits that were formed under glacial ice, the long axis of which indicated the general direction of glacial movement (Oak Hill and Baldpate Hill). Another surface form is the esker: snake-like layered outwash deposits formed in crevasses or in streams under the glacier (Edmands Park, Woodland Golf Course). The two formations which cover the greatest surface area are outwash plains, formed in front of the glacier by the meandering melt water streams and hardpan, formed of the till (material carried in the ice) which was deposited by the glacier as it melted and receded. The youngest deposits have been formed since the last glacier. These alluvial deposits include peat and stream deposits.

The surface deposits of Newton comprise three types of soils: 1) stratified soils, formed by melt water in front of ice flows (or Kame deposits formed by melt water from super glacial streams or from streams within the glacier); 2) unstratified soils, formed by glacial erosion of bedrock, and 3) alluvial soils, formed by post-glacial stream deposits.

Stratified soil types most prevalent in Newton are Hinckley and Merrimac Gravelly Sandy Loam, Merrimac Sandy Loam, and Merrimac Fine Sandy Loam. These soil types are composed of granite, gneiss, quartz, and slate, are of moderate to high permeability, and become droughty during prolonged periods of dryness.

The most common unstratified soil types in Newton are Coloma Loam and Rough Stony Loam. These soils are composed of glacially eroded sandstone, slate, or conglomerate, and are of high to moderate permeability. Alluvial soil types most common in Newton are Muck and Peat. Muck is comprised primarily of decomposed organic matter, while Peat is characterized by partially decomposed organic matter. Alluvial soils are identified by their spongy, unstable quality and the presence of standing surface water during most of the year.

Newton, like many urban and suburban environments, is dominated by "urban" soils resulting from dredging, filling, leveling, compaction, and removal. However, undeveloped areas still contain a variety of other soil types, including prime farmland soils. The conversion of agricultural land to residential development is a nationwide trend, and Newton is no exception. Just 2.6 acres of agricultural land remain in Newton, and support a popular vegetable Community Supported Agriculture (CSA) farm and two community gardens, both with long waiting lists. Community gardens and small community farms offer a host of unique

benefits to urbanized environments, including improving the health and wellbeing of people, building community connections, strengthening food security, and increasing pollinator habitat and stormwater infiltration. Many of Newton's remaining farmland soils are found within existing open spaces. In particular, Woodland Golf Club and the Brae Burn Country Club are both primarily composed of prime or important farmland soils, and include soils considered less ideal for development due to steep slopes and poor drainage. See **Figure 21**.

Well-drained soils on low-to-moderate slopes are ideal for development and most such areas have already been built upon. Therefore, many, but not all, of Newton's open spaces are in areas that are not ideal for development, such as poorly drained areas. Athletic fields and trails in these areas are often challenged by flooding and may need improvements to address poor drainage (**Figure 22**). Many of Newton's open spaces also contain soils designated as prime or important farmland. While there is not much farming in the area, it may be worth considering conserving some of these lands for conversion to community farms, gardens, or forests.

Topography

The eastern and central parts of Newton are punctuated by a scattering of large hills. Taking advantage of topography, the east-west-oriented Boston-Worcester Railroad (now the MBTA line and Mass Pike corridor) was laid along the flat land just north of the hills. Likewise, Route 9, also running east-west, skirts the hills around Newton Upper Falls, Newtonville and Thompsonville. In this way topography influenced the major transportation corridors and worked to shape the development of Newton. See **Figure 23.**

Though the distinct hills that are scattered across the eastern and central parts of the City have remained unchanged, the topography of Newton has undergone substantial remodeling over the past 130 years. In the 1890s, extensive draining and filling of wetlands occurred to accommodate housing development and mitigate the risks of mosquito-borne illnesses. At the time, most homes had their own septic systems and leaching fields, but as more homes were built, the capacity for the soil to manage the waste was strained. "In 1889, the Health Department reported that much of Newton's soil was of no use in purifying sewage, although it recognized the need of continuing to rely on cesspools until financing allowed for extending the sewage system. By the early 1890s, the sewage issue had become serious enough that the mayor recommended the City devote all its extra expenditures to sewage and drainage" (*Landscaping the Garden City,* Spires, 259). By 1892 the City had permission to connect to Boston's sewage line, and by 1900 the City required all houses on a sewer line to connect to it (Spires, 260). Despite the filling and draining of wetlands, flooding continues today in historic wetland locations. Many historic wet areas unsuitable for building are where Newton's open space resources exist today. The few remaining wetlands in Newton are preserved in state and municipal conservation areas. Many of the City's athletic fields are where wetlands used to be, and so suffer flooding, especially during spring rains (**Figure 22**).

B. Landscape Character

From a forested wetland serving as a home to Native American fishing villages, to agricultural clearing in the 1700s by European settlers, to suburban village development beginning in the 1830s, Newton's landscape has experienced considerable change in the past 400 years. (For more detail on the history of Newton, see Section 3, Part B "History of the Community.") Newton is now a City of primarily single-family homes, with street trees, mowed lawns, and pruned hedges, around 13 village centers and several mixed-use zones.

The Charles River wraps around the City for 12 miles and is able to be accessed by trails, bike paths, bridges, and boat launch sites. The large highways of Interstate 90 and state Route 9 transect the City on their way to Boston; Interstate 95 cuts through the western corner of Newton Lower Falls. The highest density of development is around the northern villages in the I-90 corridor (Auburndale, West Newton, Newtonville, Newton Corner, and Nonantum), and in the south-west corner of the City (Newton Upper Falls), where Newton experienced industrial mill growth near the natural falls of the Charles River.

Figure 21. Slope and Soils (by quality of drainage)

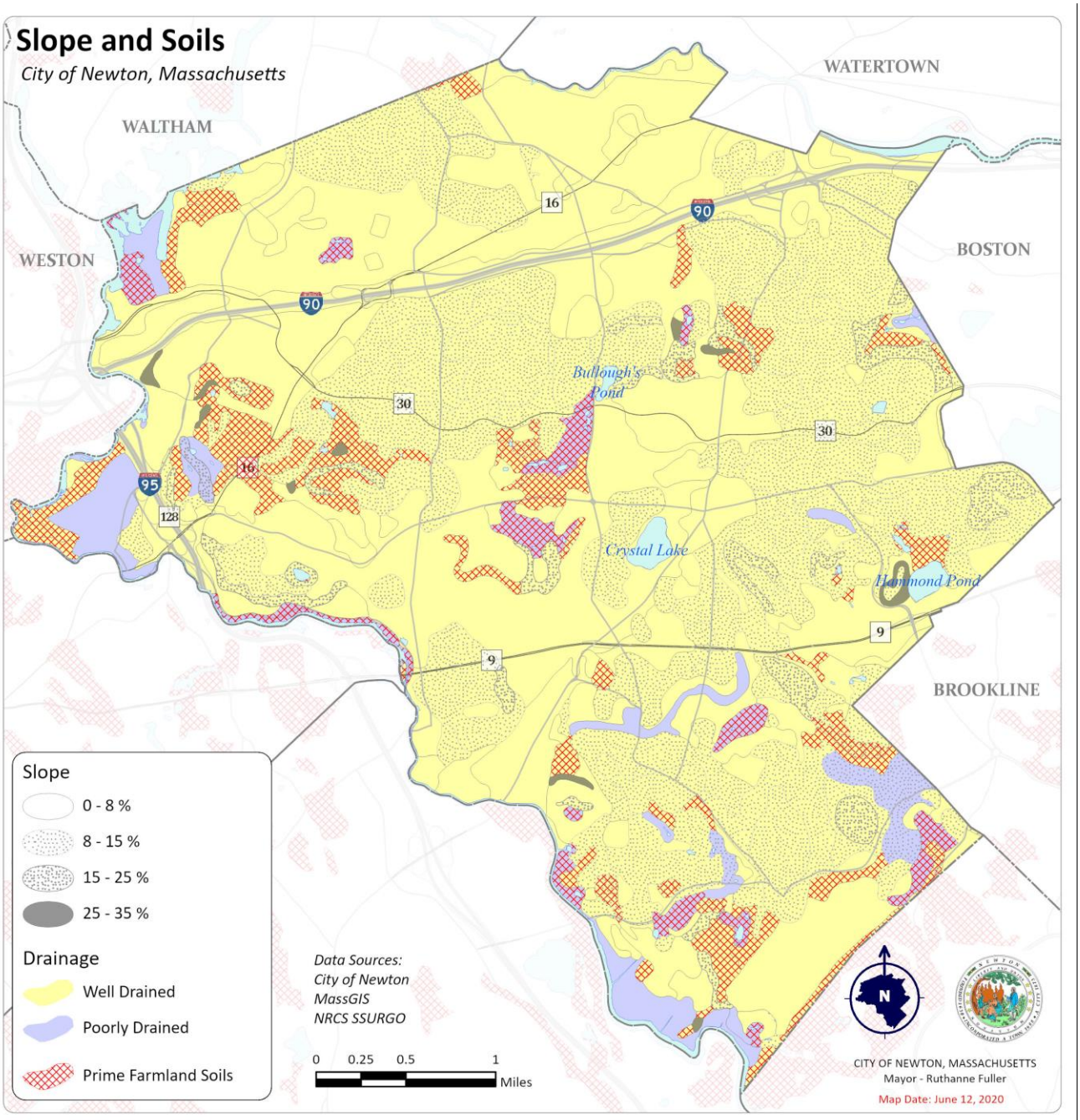


Figure 22. Athletic Fields and Historic Wetlands

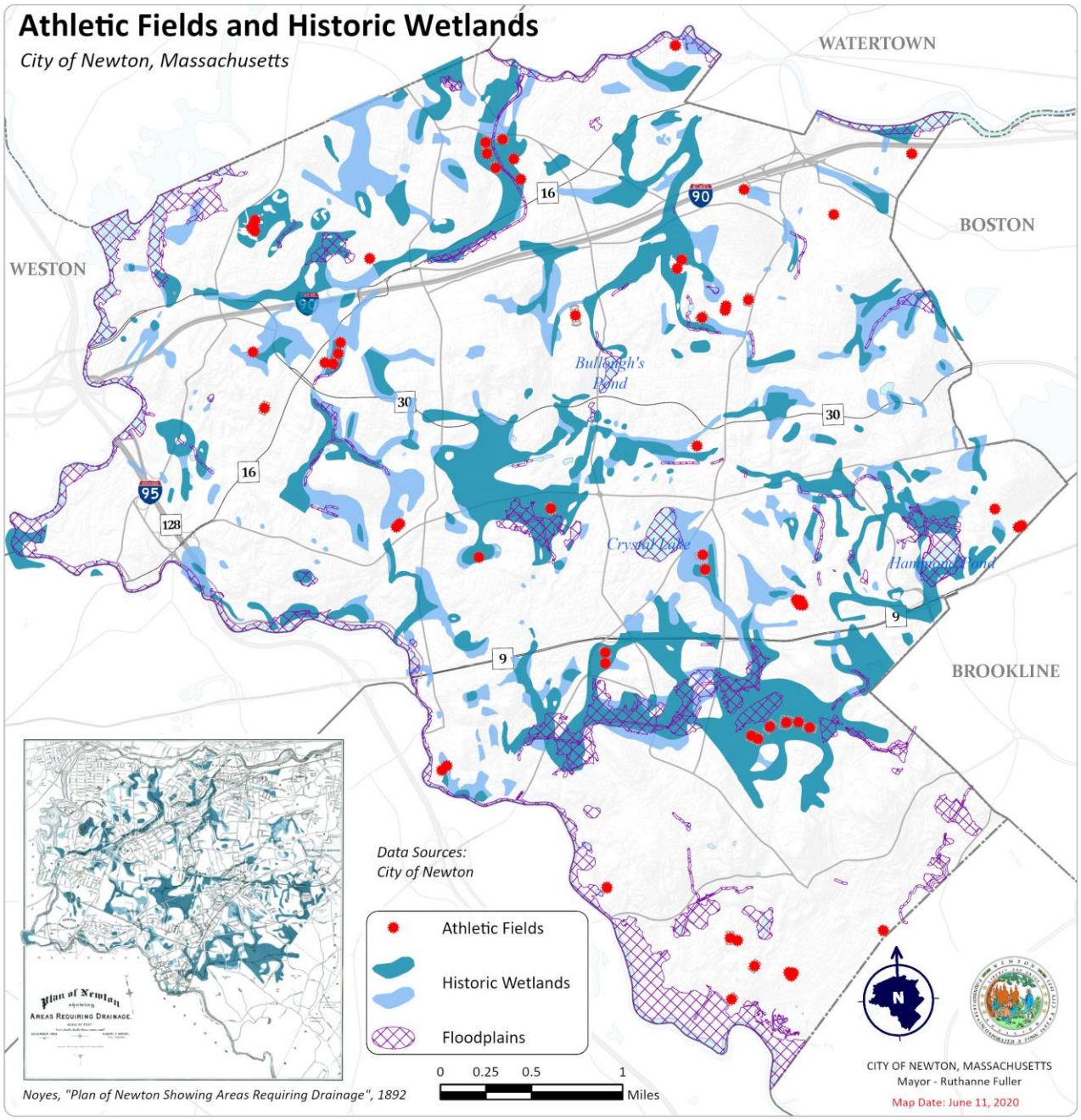
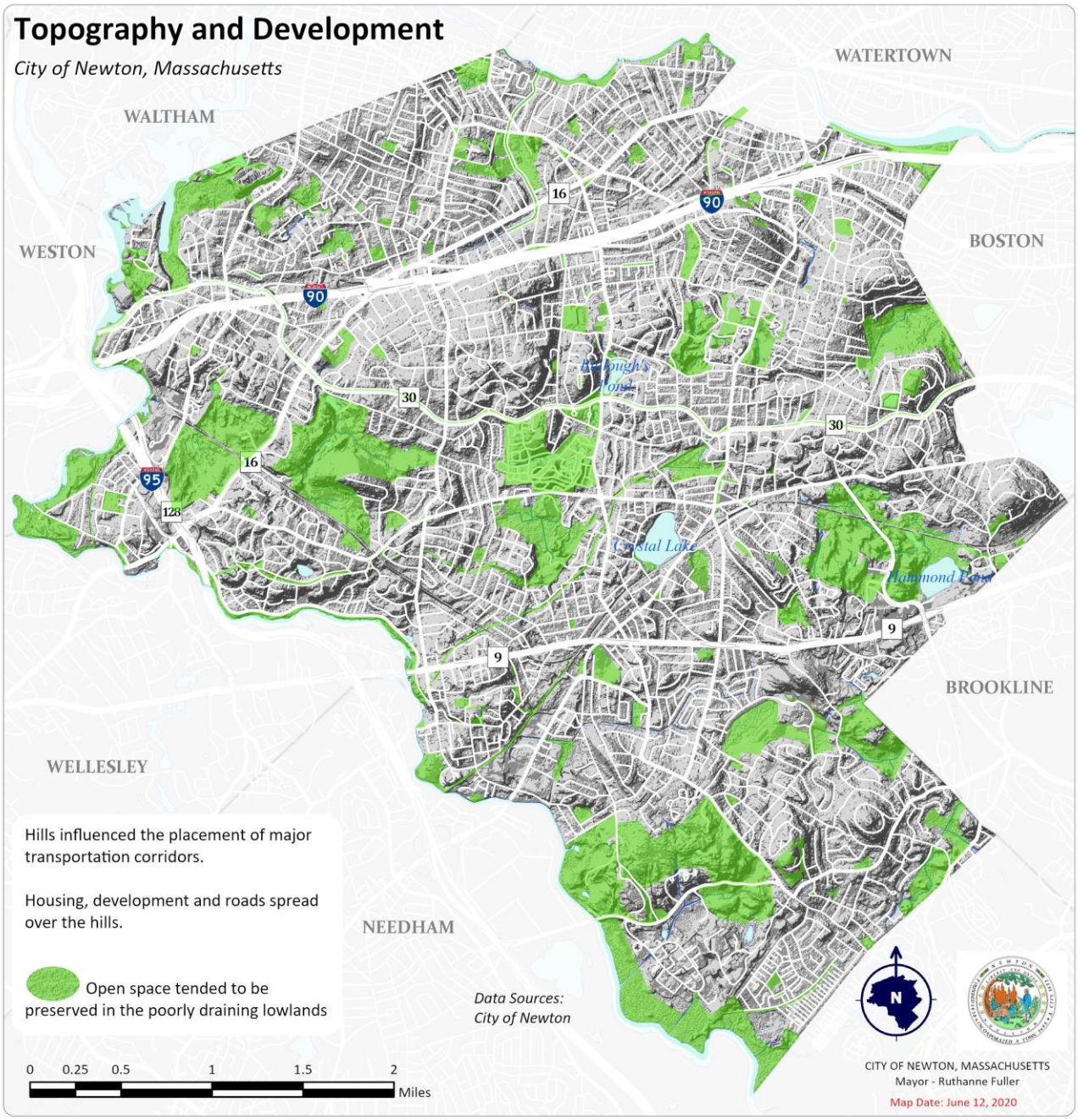


Figure 23. Topography and Development



Open space resources are scattered throughout the City, with the largest parcels located in the central and southern parts of the City, where the last expansion of housing development occurred. The only remaining farm in Newton is the 2.6-acre Newton Community Farm (once the Angino Farm), which is now protected in perpetuity.

Given its developed state, Newton is fortunate to have a range of natural resources. All told, roughly 20% of the City is open space, that is, not buildings, streets, parking lots, etc. That open space includes natural areas (woods, wetlands, lakes, ponds, and streams) as well as golf courses, cemeteries, athletic fields, parks and large lawn areas.

In 2010, Newton's Planning and Development Department, in conjunction with the Newton Community Preservation Committee, created a report titled, *"Newton's Heritage Landscapes: A community heritage report"*. Heritage landscapes are places and spaces identified by residents as having value to the community. The report explains that the "goals of the program are to identify a wide range of landscape resources and to provide strategies for preserving these landscapes, especially those that are most valued by the community" (1.) Many of the open space heritage resources are large, unfragmented parcels in the central and southern parts of Newton. Water resources were recognized as having special importance to residents. Scenic roads run primarily in north-south branches off the arterial east-west corridors, and skirt around hills and scenic Heritage Landscapes. The scenic road designation provides limitations for development along roadsides, to preserve desirable aesthetic and historic character.

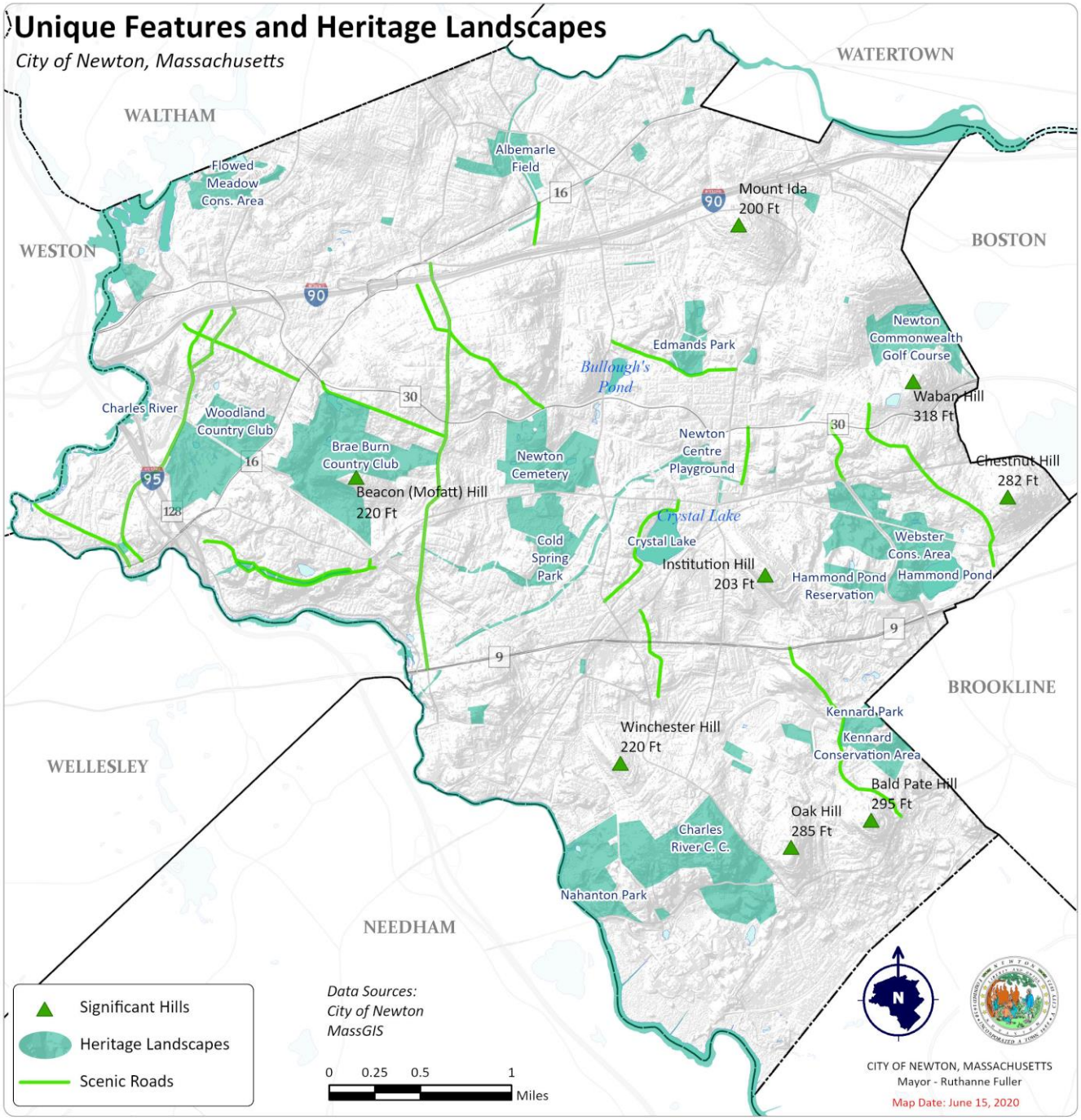
Waterways and waterbodies and their associated landscapes that received significant attention in the report (pages 8-11, 47-51) were the following.

- Charles River Corridor
- Cheesecake Brook
- Crystal Lake

Other natural areas, parks, and recreation areas described in the report as having significant meaning for the community are listed below. See **Figure 24.** **Note that private golf courses are neither publicly owned nor protected from development.*

- Northern Newton open spaces (north of I-90) (approximately 205 acres)
    - Albemarle Park
    - Auburndale Playground
    - Coletti-Magni Park
    - Flowed Meadow Cons. Area
    - Forte Park
    - Lowell Park
    - Norumbega Conservation Area
    - Pellegrini Park
    - Stearns Park
- Central Newton open spaces (between I-90 and Rt 9) (approximately 787 acres)
    - Brae Burn Country Club*
    - Chaffin Park
    - Claflin Playground and School
    - Cochituate & Sudbury Aqueducts
    - Cold Spring Park
    - Commonwealth Golf Course
    - Crystal Lake
    - Edmands Park
    - Farlow Park
    - Hammond Pond Reservation
    - Houghton Garden
    - Kendrick Park
    - Newton Centre Common
    - Newton Centre Playground
    - Ordway Park
    - Washington Park
    - Webster Conservation Area
    - Woodland Golf Club*
- Southern Newton open spaces (south of Rt 9) (approximately 344 acres)
    - Charles River Country Club*
    - Hemlock Gorge Reservation
    - Kennard Park & Conservation Area
    - Nahanton Park
    - Newton Highlands Playground
    - South Meadow Brook Wetlands
    - Upper Falls Greenway
    - Upper Falls Playground

Figure 24. Unique Features, Scenic Roads, and Heritage Landscapes



C. Water Resources

Overview

Open water in Newton totals 276 acres and amounts to 2.4% of the total City area.

Newton's water resources include the Charles River, which borders Newton for 12.3 miles; 22 streams and brooks; 14 lakes and ponds totaling 167 acres (the largest being Crystal Lake, Hammond Pond, and Bullough's Pond) and 268 acres of wetlands that account for 2.3% of the City's area.

Newton's primary aquifers underlie the Charles River corridor along the western boundary of the City. These aquifers are the Charles River's primary water source during the summer low-flow period, when the river receives its heaviest recreational use. While some of Newton's aquifers are overlain by publicly owned open space, other portions are overlain by commercial and industrial uses with attendant large impervious areas, and still other portions are affected by stormwater from impervious areas outside of the aquifers' boundary.

Most wetlands in Newton were drained and filled in the late 1800s, and many of those that were not drained of filled were incorporated into public open spaces. Wetlands provide flood attenuation, water quality filtration and enhancement, and wildlife habitat.

FEMA-designated 100-year and 500-year floodplains border the Charles River, the South Meadow Brook and Saw Mill Brook. These areas have a 1-percent-annual-chance (once in 100 years) and 0.2-percent-annual-chance (once in 500 years) of experiencing flood events. In the 100-year floodplain, development is regulated and flood insurance may be required by mortgage lenders. Flooding affects more than just these federally designated floodplains; Newton routinely experiences flooding in areas outside designated flood zones. During heavy rain events, roadways can flood; playing fields can become unusable; basements can flood; and stormwater can carry pollutants into Newton's waterways. See **Figures 25** and **26.**

The Charles River

The Charles River runs for 12 miles along Newton's western and northern borders. It passes through 4 counties and 23 towns (**Figure 2**) and is a key ecological corridor. Although Newton does not rely on the Charles River for its own water supply, both upstream and in adjacent towns, the Charles River and its associated groundwater system are primary sources of drinking water for several communities. Water quality impairments are discussed below in Subsection I: Environmental Challenges.

The City of Newton is entirely in the Charles River Watershed, which is 308 square miles. Newton has five major drainage sub-basins, including South Meadow Brook, Country Club Brook, Cheesecake Brook, Laundry Brook, and Hyde Brook, all of which drain into the Charles River. However, being an urbanized community with well-developed stormwater infrastructure, topographic drainage basins can be misleading. **Figure 16** depicts the City's stormwater drainage system.

Along the Charles River in Newton is a significant amount of publicly owned and accessible open space. Wildlife habitat is abundant. Trails along the river are well used by people on bike and foot; scenic vistas and passive recreation opportunities are numerous.

Figure 25. Floodplains and Wetlands

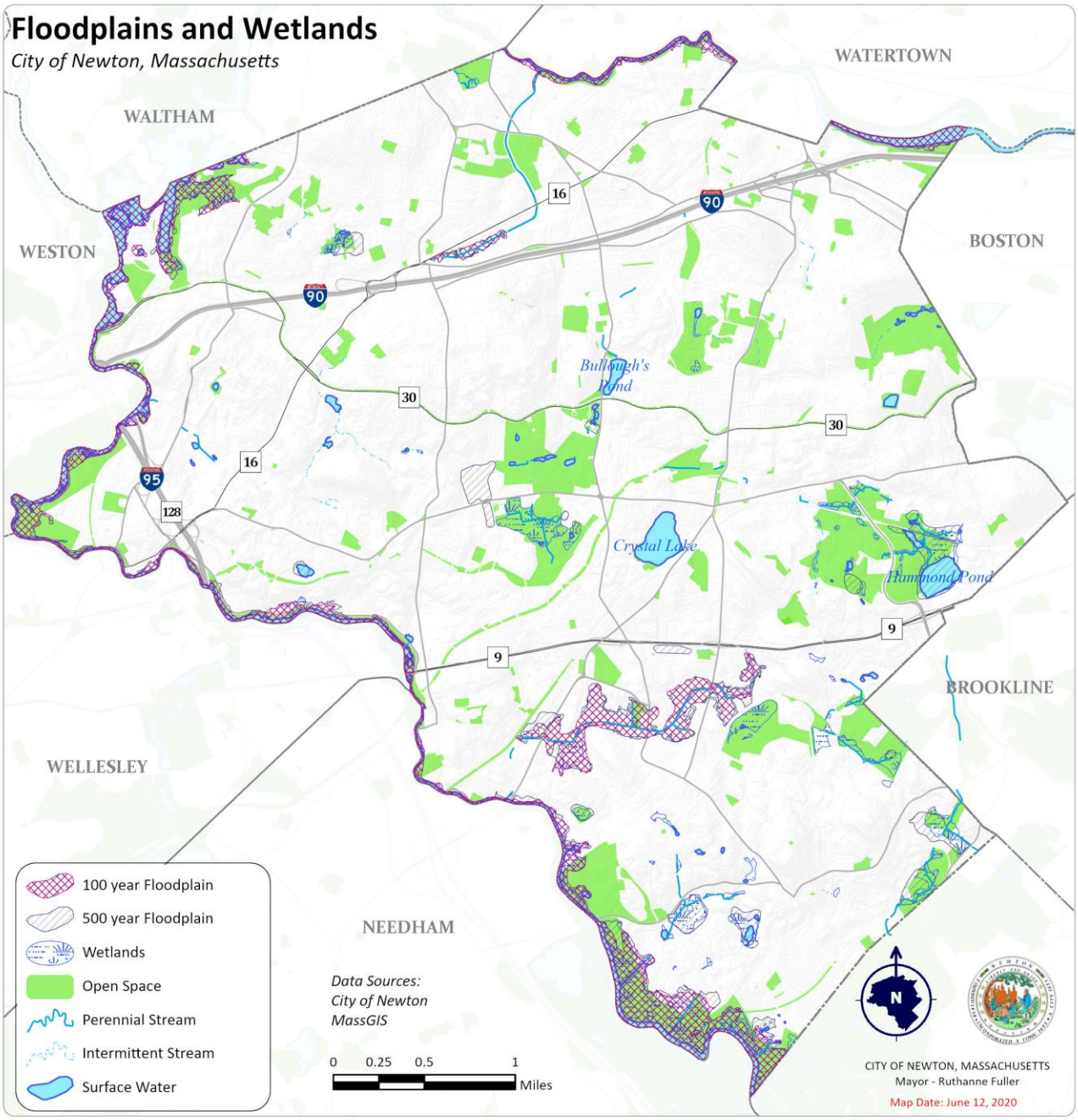
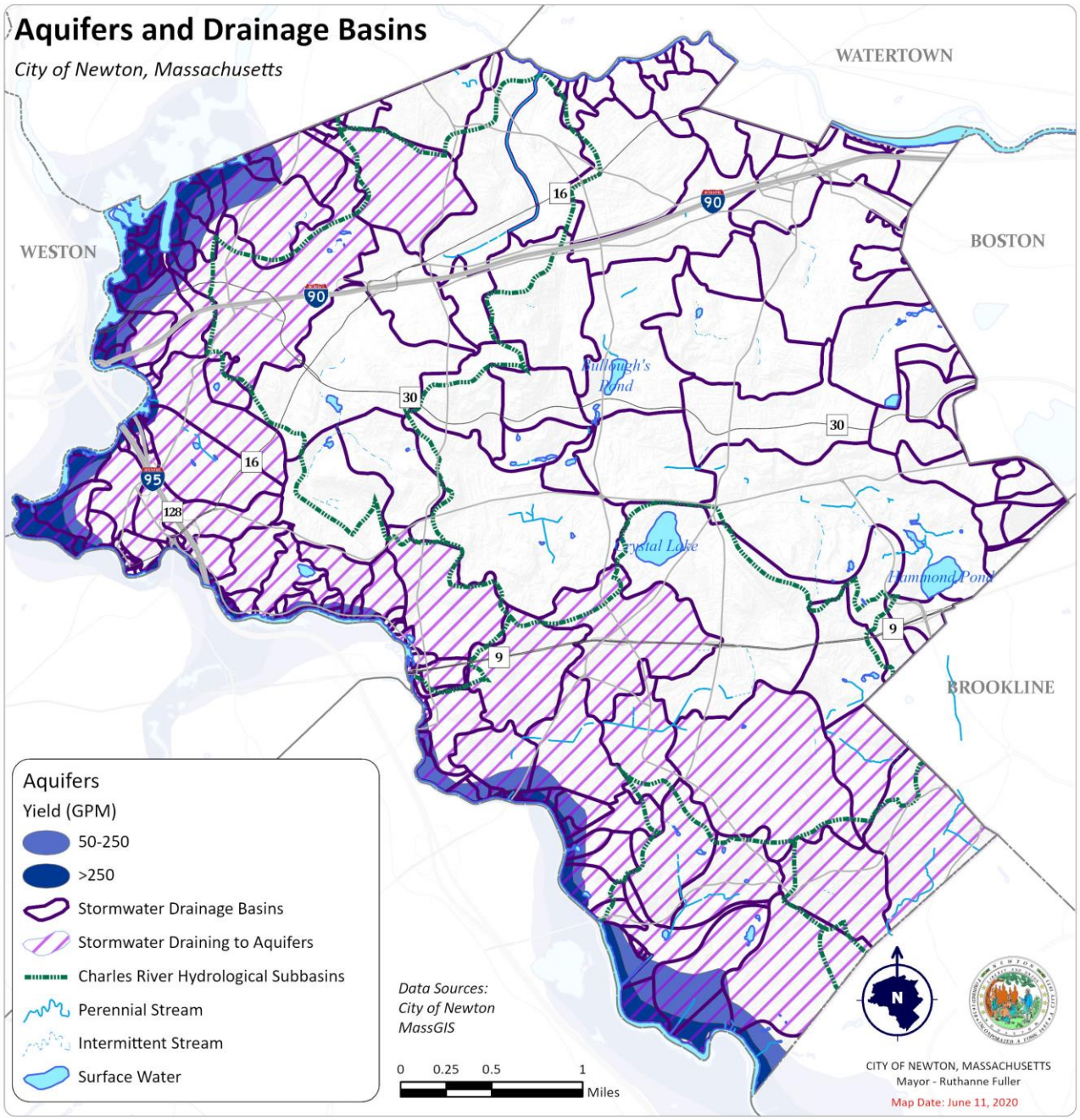


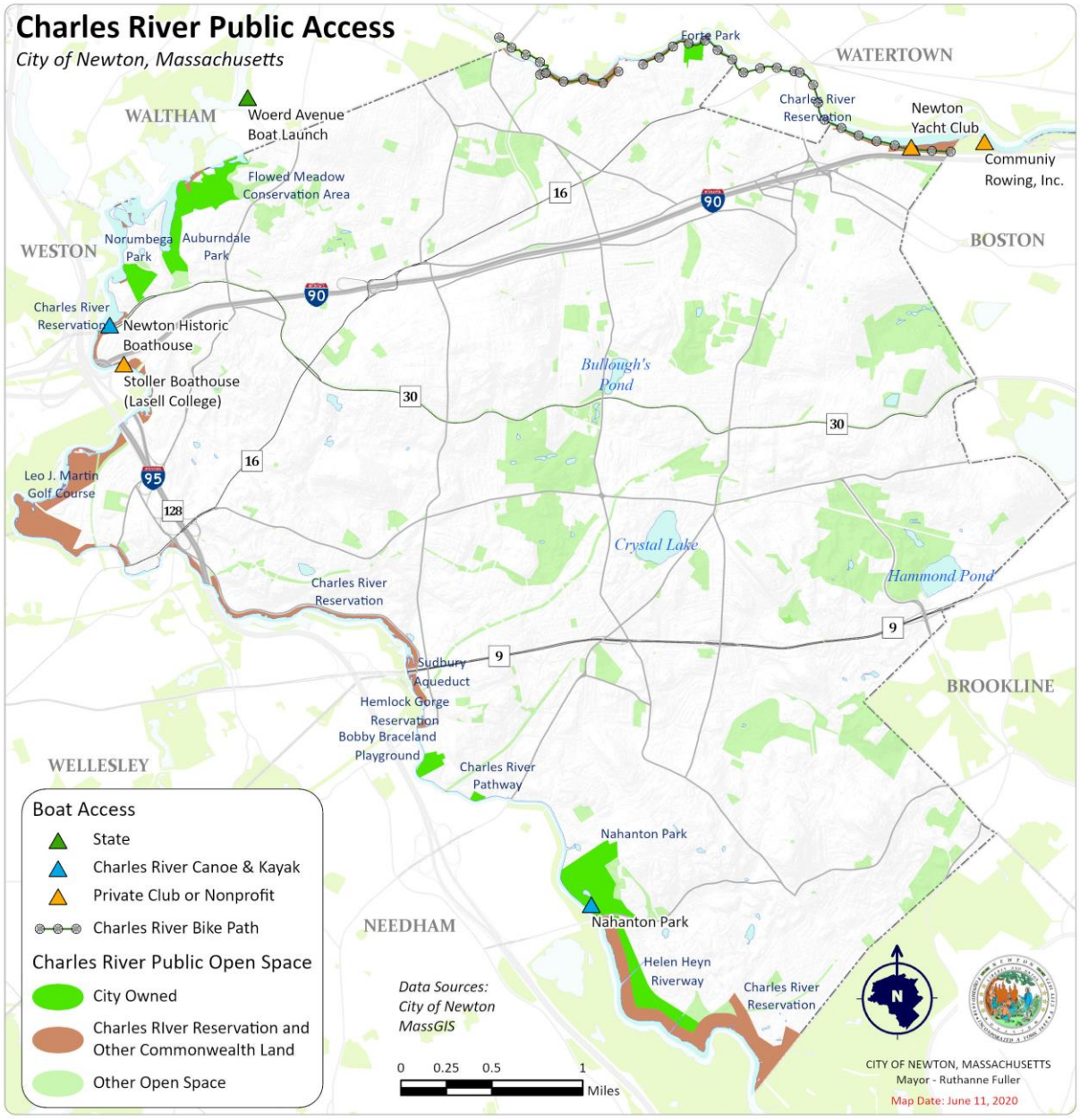
Figure 26. Aquifers and Drainage Basins



Public Access along the Charles River

Land along the river is owned and managed by state, municipal, and private entities. As stated in *Newton's Heritage Landscapes (11),* many significant open spaces border the river, and are cared for by a multitude of groups. These spaces provide views, walking trails, canoe and kayak access to the river, as well as important ecological habitat **(Figure 27)**. Traveling "downstream" the open spaces within Newton are listed below.

Figure 27. Charles River Public Access



The Charles River Reservation: The Massachusetts Department of Conservation & Recreation (DCR) owns a 20-mile expanse of parks along both sides of the Charles River, from the 600-acre Cutler Reservation in Needham and protected lands in the southern tip of Newton to the Boston Museum of Science. These DCR-owned lands bordering the river alternate with City and privately owned land. In some places the DCR-owned corridor is barely 25-feet wide; in others it is up to 300-feet wide. It includes a range of trails, bike paths, athletic fields, pedestrian bridges, and boat launches.

- **Helen Heyn Conservation Area:** Acquired in 1997 by the Newton Conservation Commission and sandwiched between a DCR parcel bordering the Charles River and the commercial lots along Wells Avenue, this 30.5-acre area is part of the Great Plain Marsh, a forested floodplain associated with the Charles River. The parcel is crossed by two streams, the larger of which is Country Club Brook originating on the Charles River Country Club. A pathway meanders through the Helen Heyn Conservation Area and continues through DCR land to Millennium Park in Boston.
- **Nahanton Park:** This 57-acre City-owned parcel that borders the Charles River is managed by Parks, Recreation & Culture (PRC) and is accessed from Nahanton Street or Winchester Street. The area includes a short section of an accessible trail known as Florrie's Path. A canoe and kayak rental is managed by Charles River Canoe & Kayak.
- **Newton Conservation Commission's Charles River Pathway Conservation Area:** This 1.5-acre wooded parcel is managed by the Newton Conservation Commission. lt has a trail along the river that leaves the Conservation Commission area, continues along a conservation easement and ends at the southern terminus of the Upper Falls Greenway.
- **Upper Falls Playground (Officer Bobby Braceland Playground)**: Located on Chestnut Street, sloping down to the river, this park includes an off-leash dog park, a fenced-in playground, athletic fields, and tennis courts. It is managed by PRC.
- **The Falls, Echo Bridge and Hemlock Gorge**: This area is part of the Charles River Reservation, including Hemlock Gorge, which was set aside in 1895 by the Metropolitan Park Commission (predecessor to MDC, now the Department of Conservation and Recreation). The Falls, which is above Echo Bridge, provided power for industrial mills; Echo Bridge was built in 1876 to carry the Sudbury Aqueduct over the river. Today the bridge features a pedestrian pathway linking Newton and Needham. Two canoe/kayak launches are located on the western bank of the Charles (not shown on map).
- **Quinobequin Road**: After passing under Route 9, the river flows the length of this DCR-owned parkway. Quinobequin Road and the wooded land between the road and the river is owned and managed by the DCR.
- **Leo J. Martin Golf Course**: After flowing under I-95, the Charles River winds around the village of Newton Lower Falls, passing through Lower Falls Reservation and the DCR-owned Leo J. Martin Golf Course, which sits astride the river in Newton and Weston.
- **Riverside Reservation:** This DCR park is in Weston and Newton. The Pony Truss Bridge, rehabilitated in 2014 as a pedestrian bridge, and the Lasell Boathouse Bridge, soon to be rehabilitated, connect the two municipalities. The reservation features a canoe launch at its northern end.
- **Newton's Historic Norumbega Boathouse**: Located on the north side of Commonwealth Avenue, owned by DCR and managed by Charles River Canoe & Kayak (Paddle Boston), this boathouse and associated features remain from the days when Norumbega Park was a hugely popular destination travel location for the greater Boston community.
- **Norumbega Park Conservation Area**: A 13-acre remnant of the old Norumbega Park with pleasant river views and trails is managed by the Conservation Commission.
- **Auburndale Park, Lyons Park (accessed from Commonwealth Avenue), and Forest Grove Path at Ware's Cove**: The 37-acre Auburndale Park was acquired by the City in 1893 and developed in the 1930s

into a multi-use park. It is accessed from West Pine Street. A small portion of river frontage within the larger Auburndale Park area is owned and managed by DCR and includes the Forest Grove Path, part of the Charles River Blue Heron Pathway.

- **Flowed Meadow Conservation Area**: This 28-acre parcel of woods, wetlands, and a kettle hole adjacent to the river and connecting to Auburndale Park is a haven for wildlife. It is managed by the Conservation Commission.
- **Cheesecake Brook Greenway**: This is an important tributary and associated green corridor that enters the Charles River near the DCR pedestrian bridge.
- **Bemis Dam Site**: These are remnants of the dam at the site of the 18th-century Bemis Mills and include traces of the 1778 raceways (not shown on map).
- **DCR's Charles River Pathway, Daly Rink, and Daly Field**: DCR maintains a bicycle and pedestrian trail along the the Charles River in Nonantum, parallel to Nonantum Road, but winding along the river's edge. This trail passes through the Daly Rink and Daly Field sites, DCR-owned recreational facilities (not shown on map).

Given the mix of local, municipal, and state organizations caring for the lands along the river, coordination and communication efforts are important. Pollution, stormwater runoff, and public access for canoeing and kayaking are all issues that need management and planned improvement. In addition to the owners and custodians of these parcels and amenities, additional watershed partners include the Charles River Watershed Association, New England Water Environment Association, and The Boston Harbor Association, who are all working for improved water quality.

In 1996, the Massachusetts enacted the Rivers Protection Act, acknowledging the unique role rivers play in wetland ecosystems. The act regulates development within 200 feet of all perennial streams in most communities, to ensure that a proposed project will have no significant adverse impact on the stream. Given the disparate levels of legal protection afforded different parcels along the river, the Rivers Protection Act has provided needed regulatory protection for the 12.3 miles of riverfront in Newton.

Streams

Newton's river and streams all once flowed freely. Today, all of Newton's river or streams are at least partially restrained by dams or culverted. To make way for development, most of Newton's streams have been culverted and filled over for the majority of their length, severely limiting their value as wildlife habitat, recreation areas, or aesthetic contributors.

- Brunnen Brook
- Cheesecake Brook
- Cold Spring Brook
- College Brook
- Country Club Brook
- Cranberry Brook
- Dolan Brook
- Edmands Brook
- Hahn Brook
- Hammond Brook
- Hyde Brook
- King Brook
- Lacey Brook
- Laundry Brook
- Paul's Brook
- Runaway Brook
- Saw Mill Brook
- Saw Mill Brook, south branch
- South Meadow Brook
- Stearns Brook
- Strong's Brook
- Thompsonville Brook

Floodplains

FEMA's mapped 100-year floodplains are found primarily on the edges of the Charles River corridor, along the southern end of Cheesecake Brook, and along the South Meadow Brook corridor. Flood-prone areas, however, are more broadly dispersed. Regulated floodplains are located along the Charles River and several of its major tributary streams are under Newton's Floodplain/Watershed Protection Ordinance Section 22−22. Areas defined as floodplains under the state Wetlands Protection Act are also defined as floodplains under Newton's Ordinance. Newton's Ordinance protects additional flood-prone areas surrounding smaller

streams and wetland resources from alteration by filling, dredging, building, or dumping. FEMA maps were developed in June 2010 for a 100- and 500-year flood and regulate construction within those zones. City floodplain maps (2010), developed by City engineers, are more accurate than the FEMA maps in terms of where flooding is likely to occur. A map showing City mapped floodplains can be seen in **Figure 25**.

Newton's 2017 *Climate Change Vulnerability and Assessment Action Plan* also identifies areas of potential flooding due to future sea level rise. According to the plan, Newton will not see affects from sea level rise through 2030, but by 2070 would experience flooding along the Charles River due to overtopping of the Charles River and Amelia Earhart dams during extreme storms. For more details on specific areas vulnerable to flooding and sea level rise, please see the *Action Plan, pages 35-50*

Lakes, Ponds, and Other Waterbodies

Newton contains several prominent lakes/ponds, of which Crystal Lake and Hammond Pond are the largest. Crystal Lake and Hammond Pond are defined as "Great Ponds" under state law since they are greater than 10 acres and so have a guarantee of public access. It should be noted that the Commonwealth of Massachusetts, through an act of the state legislature (Chapter 243 of the Acts of 1924), gave extensive responsibility over Crystal Lake to the City of Newton.

Newton's other significant lakes and ponds include:

- Bullough's Pond (an impoundment of Laundry Brook)
- The City Hall Ponds (impoundments of Laundry Brook)
- The Waban Kettle (a kettle hole pond)
- Longfellow Pond
- Waban Hill Reservoir (a man-made now-decommissioned drinking water reservoir)
- Houghton Pond (an impoundment of Hammond Brook)
- Bare Pond (a vernal pool)

The City also has numerous small ponds in its golf courses, school campuses, and cemeteries.

Crystal Lake, with 29-acres of rain fed surface water, is a much-loved community resource where generations of children have learned to swim, and countless visitors have found relief from summer heat. According to the Dept. of Parks, Recreation & Culture (PRC), Crystal Lake receives 35,000-40,000 check-ins over the seven-week summer swimming period and is used by eight summer camps. In addition to swimming, there is also a walking trail, fishing, and a seasonal dock with boat launch at Crystal Lake. Crystal Lake receives seven outfalls from Newton's stormwater system. Impaired water quality from stormwater runoff is an ongoing concern monitored by DPW, PRC, the Crystal Lake Conservancy, Friends of Crystal Lake, and the Crystal Lake Working Group. Excess nutrients lead to toxic algal blooms and overabundant vegetation growth and declines in dissolved oxygen. Paul's Brook is Crystal Lake's only outlet.

The 22-acre Hammond Pond is owned by the DCR. It is bounded to the south by commercial development on Route 9, to the west by a parking lot, to the north by protected conservation land, and to the east by private residential development. Hammond Pond is a favorite spot for fishing. It has two outlets: Hammond Brook and Saw Mill Brook. Water quality impairments are further discussed below in Subsection I: Environmental Challenges.

Vegetated Wetlands

Wetlands provide water storage capacity; acting like a sponge, they hold water during and after rain events and slowly release it during drier periods, thereby reducing flooding and erosion. Wetlands supply water to streams during periods of low flow and help control sedimentation and pollution by trapping organic and inorganic sediments from street runoff. In addition to improving water quality and reducing flood hazards, wetlands provide excellent wildlife habitat, a resource interest which was included in the State's Wetlands Protection Act, G. L. Ch. 131.

Newton has several wetland types, including Wooded Swamp, Shrub Swamp, Shallow Marsh, Seasonal Flood Basin, and Deep Marsh, but Newton's wetlands have been dramatically reduced in extent from about 1,470 acres in 1897 to 268 acres today. Large expanses of wetlands are found in Cold Spring Park, Webster Conservation Area/Woods, Helen Heyn Conservation Area, and Flowed Meadow. The only remaining wetland of significant size that is not part of public open space or covered by a private conservation restriction is the Longfellow Pond wetland area on the campus of the University of Massachusetts-Amherst/Mt. Ida Campus.

Newton's water and wetland resources are all within the jurisdiction of the Conservation Commission, which reviews project proposals under the Massachusetts Wetlands Protection Act (MGL Ch. 131, s. 40) and the Wetlands Regulations (310 CMR 10.00). In addition, the Commission administers the City's Floodplain/Watershed Protection Ordinance #22-22, which regulates development or activities which may interfere with these resources.

Water Supply

Newton receives its drinking water from the Massachusetts Water Resources Authority's Quabbin Reservoir, which was built between 1930-1939. The MWRA "City Tunnel" comes from the west, around the intersection of I-90 and I-95, and heads straight east to Brookline, where it splits at the Chestnut Hill Reservoir (MWRA, Integrated Water Supply Improvement Program, 2018). From there, the Dorchester Tunnel heads south-east, and the City Tunnel Extension heads north-east. See **Figure 28**.

Figure 28. MWRA Water Supply System

Aqueducts

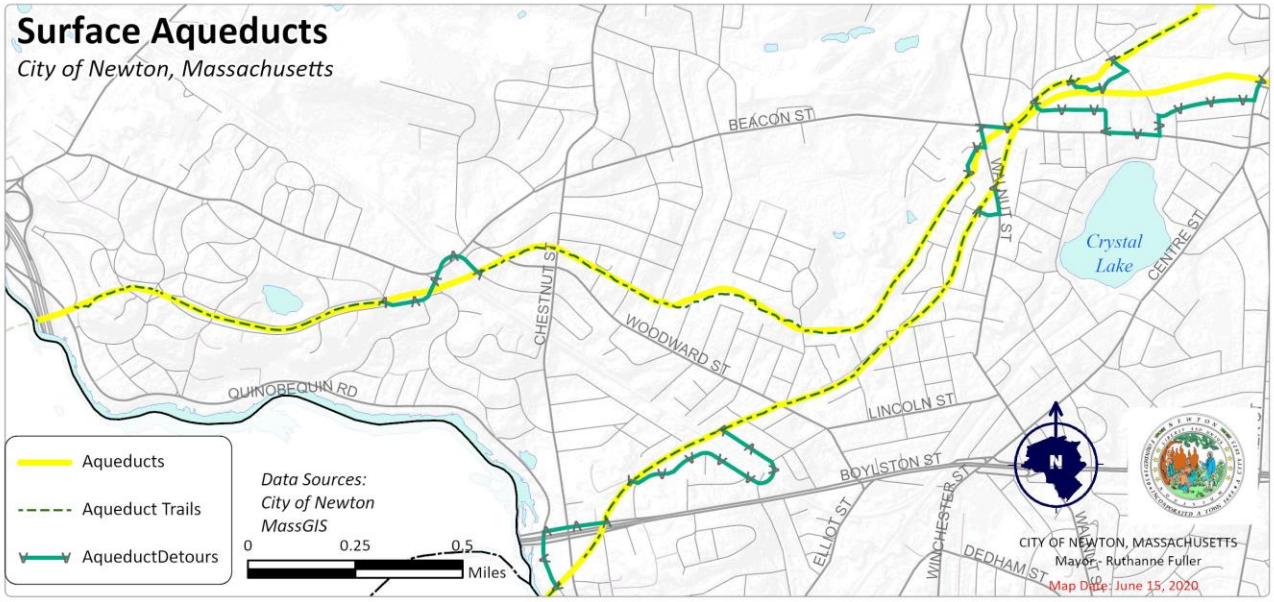
There are two historical aqueducts that run close to the surface of the land in Newton, the Cochituate Aqueduct and the Sudbury Aqueduct. These aqueducts run through much of the southwestern and central parts of the City and run south-west to north-east (**Figure 29**).

From 1848-1951 the Cochituate Aqueduct was part of Boston's water supply, carrying water from Lake Cochituate, an impoundment of a tributary to the Sudbury River, to the Brookline Reservoir (MWRA, "Metropolitan Boston's Water System History", 2015). In 1951 the use of the Cochituate Aqueduct was discontinued, and parts of it were sold by the MWRA to Newton and are now considered a part of Newton's publicly owned open space. However, sections of the Cochituate Aqueduct remain on private property (see the inventory in Section 5 for a list of aqueduct properties).

The Sudbury Aqueduct began carrying water from the Sudbury River to the Chestnut Hill Reservoir in Brookline in 1878. The Sudbury Aqueduct and Chestnut Hill Reservoir system are still used as a back-up source of water for Boston. The MWRA recently allowed for the creation of public trails on the surface of its decommissioned and back-up aqueducts (*Cochituate and Sudbury Aqueducts*, The Newton Conservators).

Both aqueducts currently act as trail systems that pass between public and private properties, and though they are interrupted by road and rail crossings, they offer a wonderful cross-City trail resource. More mapping, signs and private easements are required to make this trail system more user-friendly.

Figure 29. Surface Aqueducts



Aquifers

Newton's aquifers are a potential supplemental water supply and are a primary source of water for the Charles River and other wetland systems during low flow periods. If groundwater is not available during dry periods, the Charles River, streams, and wetlands become stagnant and/or desiccated. Newton's aquifers also feed the man irrigation wells used throughout the City for irrigation of athletic fields, golf courses, and private gardens. Installation of irrigation wells is regulated by the Health and Human Services Department. Further study would be needed to locate the wells and monitor their effects on the aquifers.

Newton's primary aquifers are located along the Charles River, on the western boundary of the City at Auburndale, Leo J. Martin Memorial Golf Course, Quinobequin Road, Newton Upper Falls, and Wells Avenue (**Figure 26**). Weston has Interim Wellhead Protection Areas that lap into the northwest corner of Newton, in the vicinity of the Route 30/Mass Pike corridor. The major aquifers in Newton are areas with induced infiltration flow of greater than 50 gallons per minute. The Leo J. Martin Memorial Golf Course, Quinobequin Road, and Wells Avenue aquifers are adequately protected from development by public ownership and floodplain and wetlands ordinances. The Auburndale aquifer is partially protected by public ownership and floodplain and wetlands ordinances, while the remainder of the aquifer is overlaid by single- and two-family dwellings and the Marriott Hotel. Between Newton Upper Falls and Oak Hill, the Charles River Country Club Golf Course and portions of Nahanton Park function to protect the aquifer bordering this reach of the Charles River.

Although the MWRA drinking water system is reliable, care should be taken to protect Newton's aquifers, because they are potential supplemental water supply sources and because they protect the quality and flow of the Charles River and its tributary streams and wetlands. Protection of certain parcels may be

warranted to increase protection of aquifers, such as the northern peninsula of the Marriott Hotel land, the estate at 122 Islington Road, and portions of the Charles River Country Club. MassDEP's snow disposal guidelines discourage dumping of snow in Wellhead Protection Areas and high and medium-yield aquifers where it may contaminate groundwater.

D. Native Vegetation and the Urban Forest

Natural Wooded Areas

Approximately 38% of Newton is covered by tree canopy.

Newton is in the southern edge of the transition zone between the northern hardwood association and the Oak-Hickory association, with oaks being the dominant species. The dominant oak woods are characterized by a forest floor with shrubs such as low bush blueberry, sheep laurel, viburnum, witch hazel and herbaceous plants such as Canada mayflower, Solomon's seal, bracken fern, whorled loosestrife and pink lady's slipper orchids. Other trees found in the upland woods are maple, hickory and beech. Occasionally, stands dominated by a species other than oak are found, as in the beech groves in the Webster Conservation Area, the hemlock groves in Hemlock Gorge and Norumbega Conservation Area, and the white pine remnants in Norumbega Conservation Area. Wetter areas are characterized by trees such as red maple, willow, black tupelo, and swamp white oak; shrubs such as alder, high bush blueberry and sweet pepperbush; and ground flora such as skunk cabbage, cinnamon fern, sensitive fern, cattails and reeds.

These trees, shrubs, and herbaceous ground covers provide several economic, environmental and aesthetic benefits including improving the quality of air and water, controlling erosion, providing shade and moderating air temperature, absorbing carbon, reducing noise, and contributing to landscape character.

The Chestnut Hill area of Newton has a significant amount of wooded land (over 100 acres) in the Webster Conservation Area, Hammond Pond Reservation, and the recently preserved Webster Woods land. In the south of the City, over 50 acres of public wooded is made up of Kesseler Woods (land protected through the City's joint purchase of East and West Kesseler Woods together with Cornerstone Realty in 2004) and the adjacent Saw Mill Brook and Bald Pate Meadow Conservation Areas. Auburndale Park and Flowed Meadow in Auburndale also offer significant amounts of wooded public open space, as does the Dolan Pond Conservation Area, in West Newton.

Unfortunately, many of the wooded portions of Newton suffer from significant densities of non-native, invasive plants, trees, shrubs, and groundcovers.

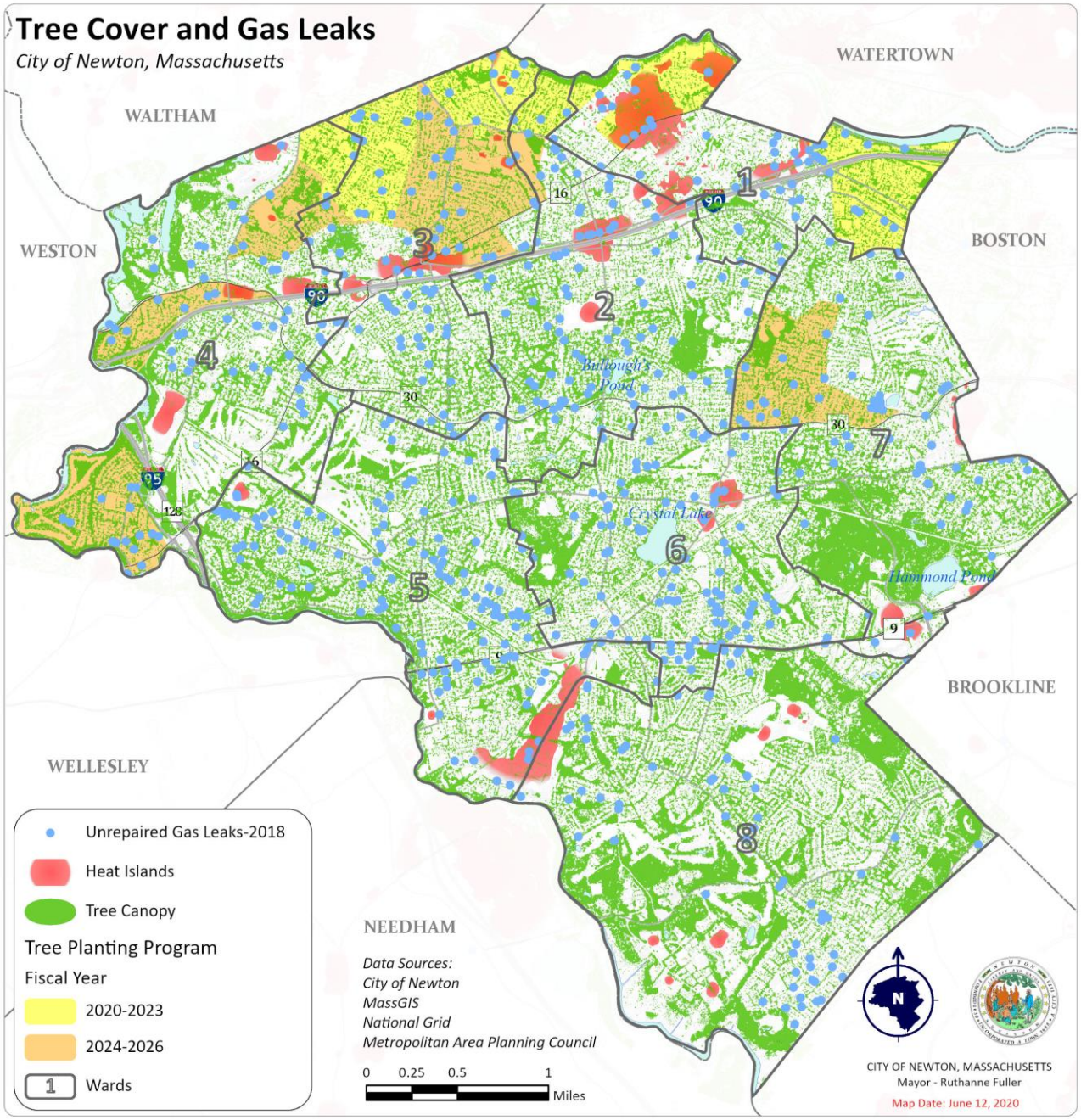
Street Trees

A portion of Newton's overall canopy coverage is provided by the roughly 20,000 street trees and hundreds of trees in the City's parks. The street trees in Newton are considered Public Shade Trees and are protected under Massachusetts General Law Chapter 87.

Street trees provide the same economic, environmental, and aesthetic benefits as natural woodland trees and can contribute to the value of adjacent properties.

Street trees grow along the public rights-of-way in Newton. The groundcover under street trees is usually mowed lawn, or even metal grating, and though street trees do not provide the same habitat resources as forests, they offer major ecological and public health benefits to the City. The Division of Urban Forestry has created a Five-Year Planting Plan that, using tree canopy coverage data, specifically focuses on increasing canopy coverage in those parts of the City with heat islands and low canopy coverage (**Figure 30**).

Figure 30. Tree Cover and Gas Leaks (and Potential Street Tree Planting Plan)



Newton's public street trees are predominantly Norway Maple (an aggressive, exotic species), followed by Sugar Maples, Red Maples, and White Oak. Over sixty other species are also represented, including Linden, Honey Locust, Pear, Ash, Lilac, Plane tree, and Crab Apple. Selections for new tree plantings should consider native species where possible, and species that are well-adapted to a climate shifting toward hotter summers, increasing droughts, and more severe storm events.

The City's street trees are managed to increase longevity and to decrease possible hazards. The trees are managed through an array of practices including watering, mulching, pruning and removal when necessary. Over 70% of the City's street trees are rated as being in "fair" or "poor" condition and require work to maintain shaded, "green," and safe streets. The work is overseen by the Division of Urban Forestry

under the direction of the City's Tree Warden. The Division of Urban Forestry is part of the Department of Parks, Recreation & Culture, and was established in 2013 to bring tree care back into City oversight, after many decades of outsourcing the work.

The current 20,000 trees bordering Newton's streets represent a significant decline from a prior population of 40,000 trees in the early 1970s, an overall loss of 50 percent. According to the Division of Urban Forestry, the current rate of tree loss is 800 to 1,000 trees per year, meaning an additional 10,000 trees could be lost to the next generation of Newton residents. Due to limited staffing,

The Division of Urban Forestry can plant approximately 650 trees a year; an additional 100-200 are planted in coordination with the Newton Tree Conservancy. The Newton Tree Conservancy is a non-profit organization established in 2008 that assists with the restoration and protection of City trees through fundraising, volunteer planting opportunities, and educating the public on the value of trees. Working in conjunction with the Division of Urban Forestry, they plant and nurture street and park trees for the benefit of future generations and raise funding for their work. In 2017 they began a tree nursery for the benefit of the City at the Community Gardens in Nahanton Park. See **Figure 30** for the anticipated areas of concentrated planting.

Tree Protection

Trees in Newton are covered by a Tree Preservation Ordinance, which promotes a diverse, healthy and sustainable urban forest. The ordinance sets out measures to protect trees located on City property and on public rights-of-way from construction and other preventable damage; to establish conditions for long-term preservation and expansion of the urban forest; to extend protections afforded by the Tree Preservation Ordinance to privately-owned trees and supplement Chapter 87 of the Massachusetts General Laws. Trees on private properties can be removed by landowners, but Newton's Tree Preservation Ordinance places requirements for the protection and replacement of trees in certain circumstances, such as construction (Newton City Tree Regulations).

Endangered Vegetation

Historically in Newton there were threatened, endangered, and species of special concern, including adder's-tongue fern, pale green orchid, Britton's violet, linear-leaved milkweed, Long's bitter-cress, Andrews' bottle gentian, long-leaved bluet, toothcup, the wild senna, and the New England blazing star, but there have been no documented findings since 1936.

E. Fish and Wildlife Habitat

Wildlife

Newton contains a limited number but varied range of wildlife habitats which include forest, field, wetland, and open water habitats. Large wooded parcels such as Webster Conservation Area and Cold Spring Park provide oak‑hickory, beech, coniferous and swamp red maple forest habitats; the Newton Community Farm, the golf courses, and Kennard Park, Nahanton Park, and Norumbega Park provide field habitats; Flowed Meadow, Hammond and Winchester swamps and the Sawmill Brook wetlands provide wetland habitats; and Hammond Pond, Crystal Lake, the Charles River and associated tributaries provide open water habitats. These habitats support a variety of native and introduced species of birds, mammals, amphibians, reptiles and fish. Newton's mammal population comprises indigenous species of squirrels, rabbit, raccoon, skunk, woodchuck, beaver, muskrat, fox, white tail deer, and coyote. Newton's wetlands support indigenous species of frogs (e.g., green, bull, and peeper), fish (e.g., pan fish, carp, catfish, and bass), turtles (e.g., painted), salamanders (e.g. redbacked and spotted) and non-venomous snakes (e.g., garter).

Historically, there were threatened, endangered, and species of special concern in Newton. These included the Barrens dagger moth, Henslow's sparrow, and golden-winged warbler. The most recently observed

species that is of special concern is the blue-spotted salamander, which has not been observed in the City since 2009.

Massachusetts, through the Natural Heritage and Endangered Species Program (NHESP) has mapped core habitats throughout the Commonwealth that are significant for conserving biological diversity. This project, called BioMap2, identifies core habitat as areas necessary to ensure the long-term persistence of species of conservation concern across the Commonwealth. These core habitats have intact ecosystems and contain exemplary natural communities. (**Figure 31**). The most significant wildlife habitat in Newton lies along the Charles River. Considered Core Aquatic Habitat, it is identified by the Massachusetts state Natural Heritage and Endangered Species Program as important for conservation.

Wildlife Corridors

A wildlife corridor can be defined as vegetated open spaces that connect habitats to one another and provide passage of wildlife populations. Newton's wildlife habitats are significantly fragmented and poorly connected, challenging existing wildlife populations and populations that may need to migrate in response to climate change or development. Newton has areas of open space that can be utilized by wildlife as corridors. The largest of these areas are the wildlands along and around the Charles River and the Sudbury and Cochituate Aqueducts. Smaller corridors pass through the Charles River Country Club and Nahanton Park to the Charles River; and through Lyons Field, Auburndale Park, and Flowed Meadow to the Charles River. Still smaller corridors exist within individual large parcels of open space.

Vernal pools

Newton has thirteen certified vernal pools, with most located in Cold Spring Park, near DCR's Charles River Reservation, and in Webster Woods (**Figure 32**). Vernal pools are also known as ephemeral pools, autumnal pools, and temporary woodland ponds. They typically fill with water in the fall or winter due to rainfall and rising groundwater and remain ponded through the winter, spring and early summer. The unique ephemeral environment of vernal pools provides habitat for numerous rare plants and animals that survive and thrive in harsh conditions. Common vernal pool species include yellow and blue spotted salamanders and fairy shrimp (Vernal Pools, EPA, 2018). Blue spotted salamanders are currently endangered and have not been observed in the City since 2009. While the needs of individual vernal pool species vary, many vernal pool species require upland habitat for large portions of their life cycles and require anywhere from 200-1000 feet of abutting forested upland habitat with minimal human disturbances (Pennsylvania Natural Heritage Program).

The City's acquisition of 17 acres of Webster Woods in 2019 through an eminent domain taking from Boston College, resulted in the protection of the City's largest vernal pool, Bare Pond and will help protect its many amphibians and other wildlife.

Certified vernal pools are afforded some protection under the Massachusetts Water Quality Certification regulations (401 Program), the state Title 5 regulations, and the Forest Cutting Practices Act regulations. Because vernal pools are highly ecologically valuable, and because they are threatened by development of associated upland areas, the City should locate and certify, then seek to protect upland areas around its vernal pools.

Figure 31. BioMap 2: Core Habitat

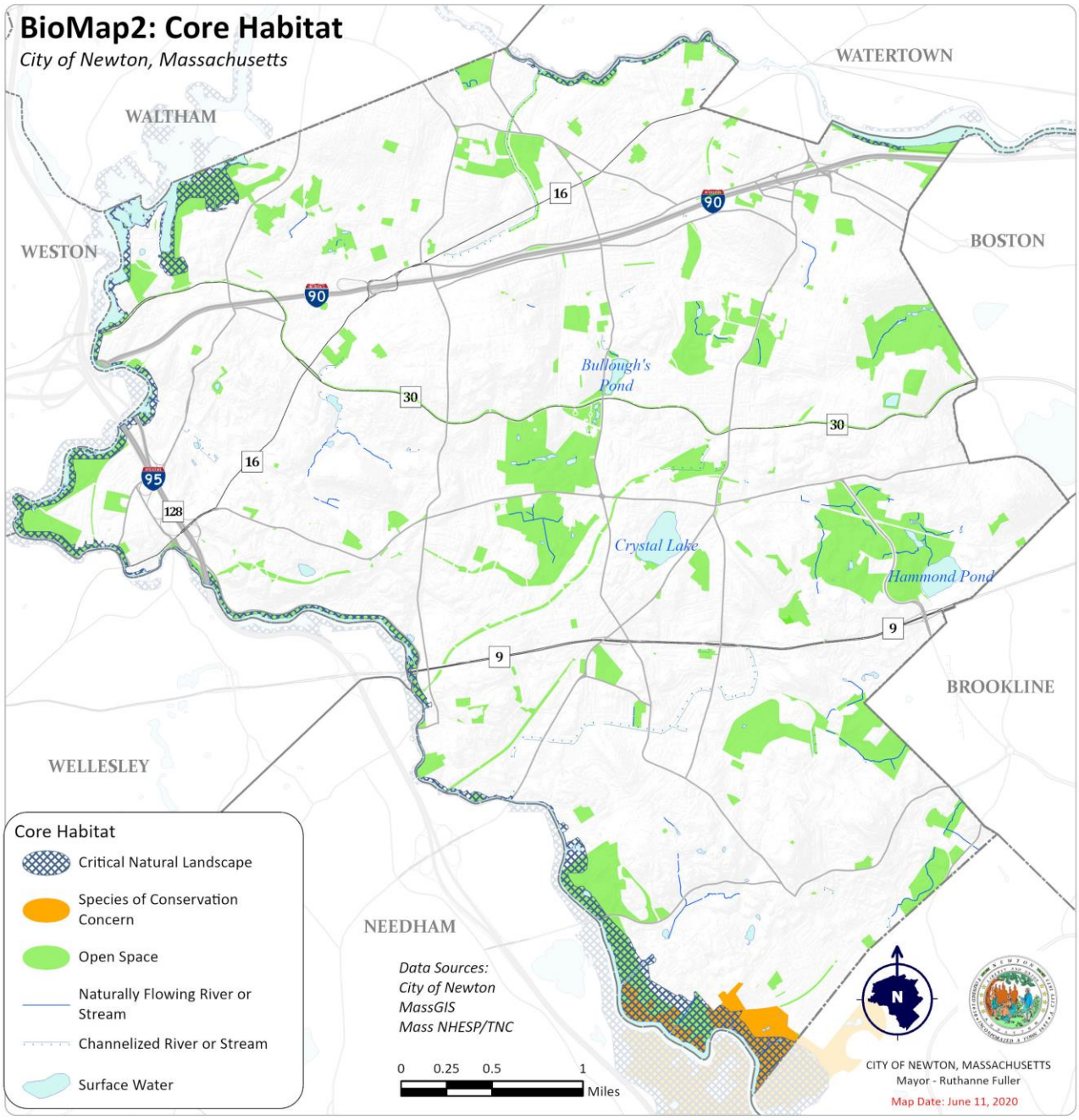
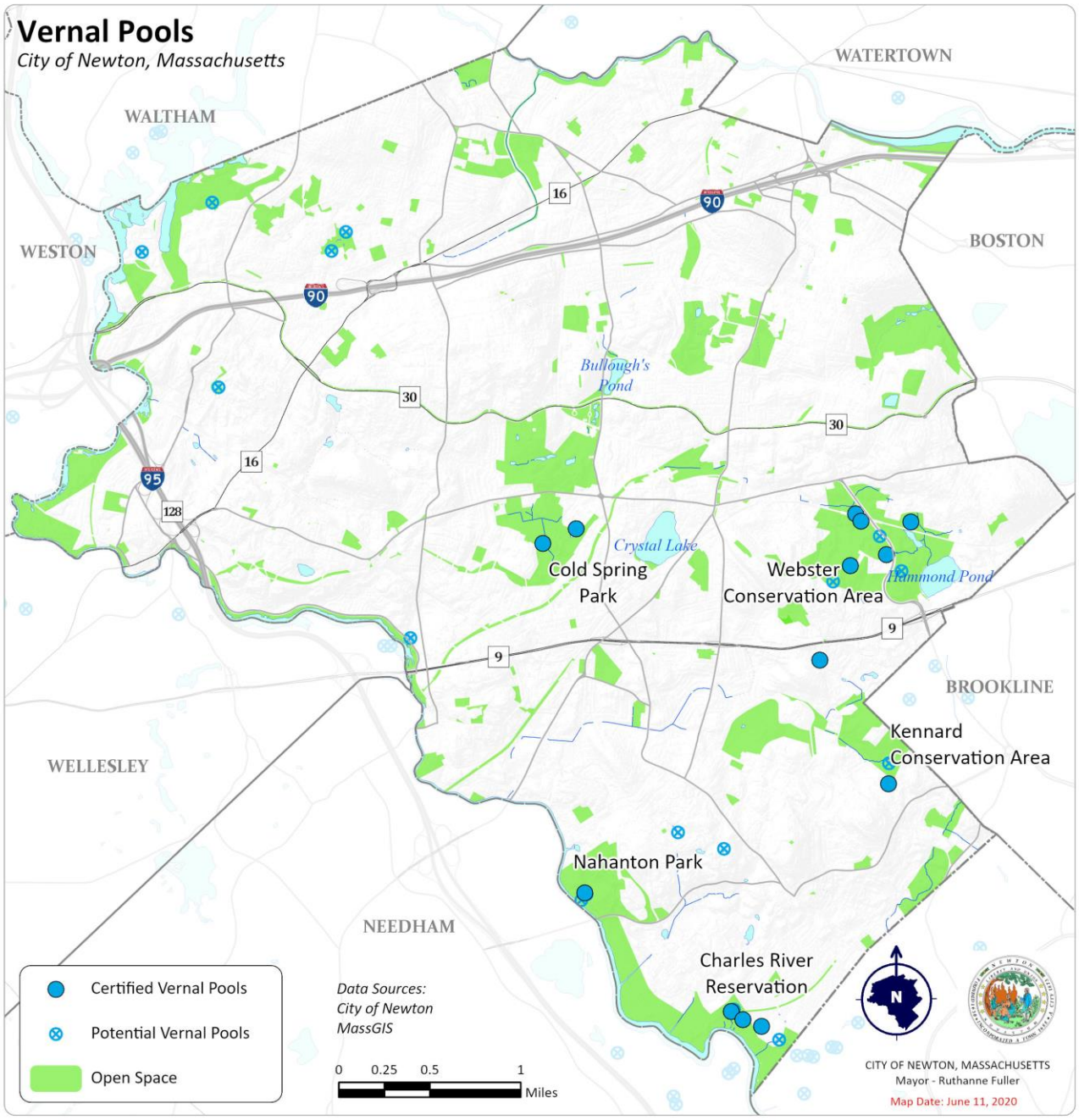


Figure 32. Vernal Pools in Newton



F. Scenic Resources and Unique Environments

Overview

Newton's varied topography, vegetation, and settlement patterns have resulted in many unique aesthetic elements such as hilltop vistas, scenic roads, scenic lakesides, water views, and tree-lined streets. These features are aesthetic resources integral to the City's character. To maintain such scenic vistas, it will be important to identify and map their locations, maintain present rights of access, and implement, development controls to protect them.

Visual corridors

Newton's 2011 *Comprehensive Plan* (7–6) identifies the major visual corridors as:

- Commonwealth Avenue
- Watertown Street
- The Washington Street Railroad/Massachusetts Turnpike Corridor
- Beacon Street
- Boylston Street
- Needham Street

In the face of development, these important visual corridors need thoughtful plans, such as Newton's 2018 *Needham Street Vision Plan*, to ensure that site-planning standards and reviews will result in appropriate incorporation of street trees, green infrastructure, and open space. Short-term actions described in the *Needham Street Vision Plan* (13) to promote low-impact design to protect wetlands and waterways (South Meadow Brook passes under Needham Street) include:

- Updating requirements in the zoning ordinance with respect to pervious/impervious coverage, landscaping, low-impact stormwater management, and erosion/sedimentation controls
- Increasing native plantings to address heat island effects, provide stormwater management, add shade where needed, create habitat, and increase aesthetic appeal
- Setting standards for stormwater management in any new public streets/public spaces

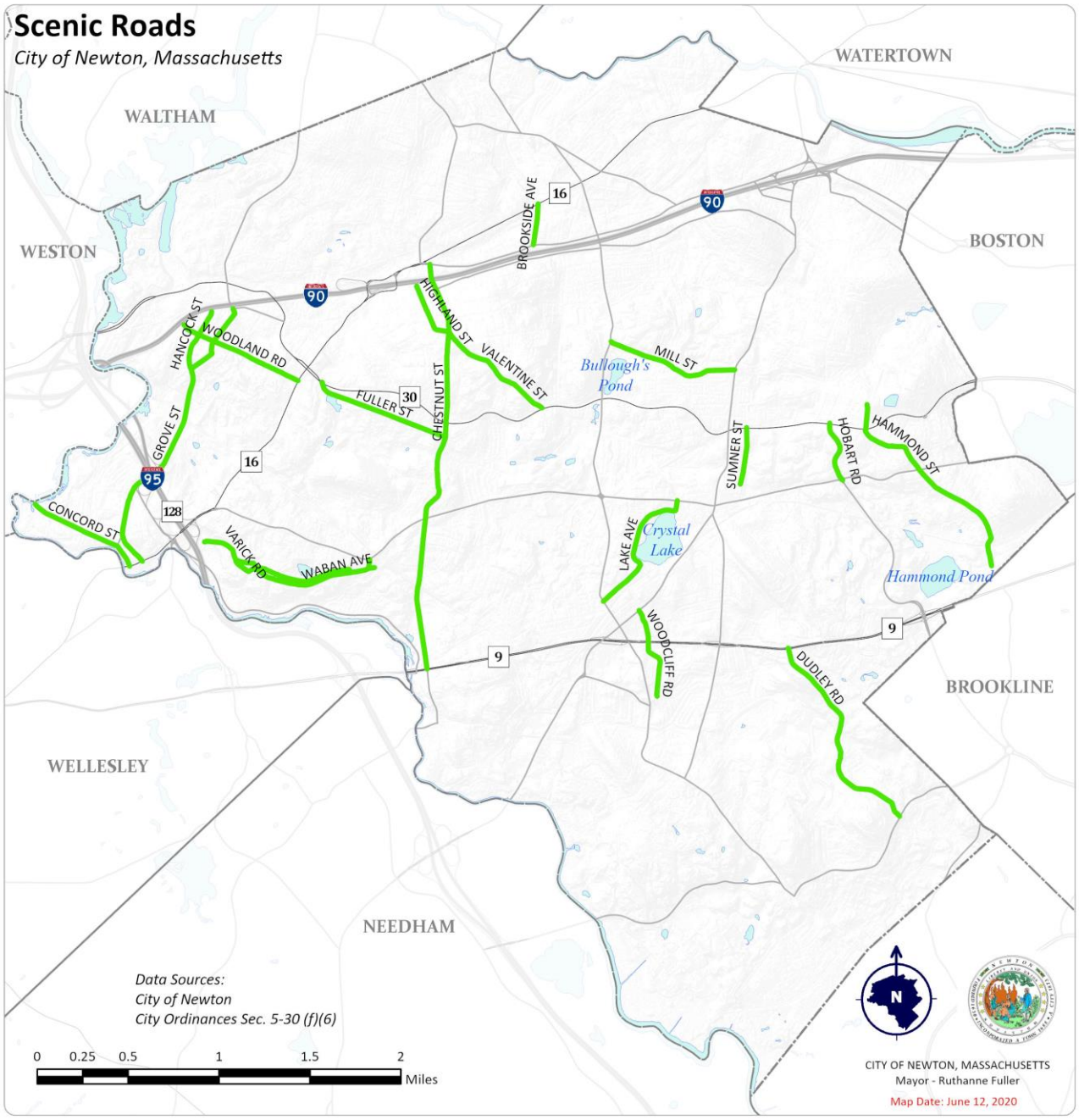
Scenic Roads

The 1973 Scenic Road Act, Mass. General Laws, Chapter 40, Section 15C, provided the City with a mechanism to designate scenic roads. Currently, there are 17 designated Scenic Roads in Newton. They are clustered in the central part of Newton, where many of the wealthy neighborhoods and community heritage landscapes are located. (**Figure 33**).

- Brookside Avenue
- Chestnut Street
- Concord Street
- Dudley Road
- Fuller Street
- Grove Street
- Hammond Street
- Hancock Street
- Highland Street
- Hobart Road
- Lake Avenue
- Mill Street
- Sumner Street
- Valentine Street
- Waban Avenue
- Woodcliff Road
- Woodland Road

On June 21, 2010 the Board of Aldermen (now the City Council) approved an amendment to the City of Newton Ordinances relative to regulation of scenic roads. For all designated scenic roads, road work which involves removal of trees and stone walls in the rights-of-way requires Planning Board review and approval following a public hearing. Further amendments could identify additional scenic roads for protection.

Figure 33. Scenic Roads



Farms

Although at one time Newton's primary land use was agricultural, today the only remaining farm in the City is the Newton Community Farm. In 1995 and 2003, the Open Space Plan identified the Angino Farm as an important community resource. In 2005, the City purchased the land. The Farm is now managed by a City-contracted nonprofit organization under the oversight of the Newton Farm Commission. Although the Farm is not certified organic, it adheres to sustainable agricultural methods and the produce from the farm is distributed through Community Supported Agriculture (CSA), an on-site farm stand, and at farmer's markets. Due to this acquisition, the last 2.26 acres of agricultural land in Newton have been preserved.

Cemeteries

Interest in historic burying grounds and memorials continues to develop. Completing the restoration, interpretation of, and public access to Newton's three historic burying grounds (East Parish, West Parish and South Parish), would add to the diversity of passive recreational amenities in Newton Corner, Newton Highlands, and West Newton.

Community Preservation Act funds were secured in 2018 to restore and replace the historic wrought iron fencing of the Newton Cemetery and Arboretum. The Newton Cemetery and Arboretum, which is across Beacon Street from Cold Spring Park, is an accredited Arboretum with the Morton Register of Arboreta and is a valuable wildlife habitat and resource for walkers and bird watchers. Education and outreach about this resource is conducted by the Newton Cemetery and Arboretum, a private, non-profit that manages the cemetery, Historic Newton, and the Newton Conservators.

Calvary Cemetery in the northern part of Newton is large and a significant contributor to Newton's open space inventory. There are several other cemeteries in the City including: Common Street, Saint Mary's, and Holyhood.

Golf courses

There are five golf courses in the City, which provide recreational opportunities and ecological benefits such as improving air quality, filtering stormwater runoff, and lowering surface air temperatures. The 5 golf courses in the City are:

- **Newton Commonwealth Golf Course** (Newton Corner): owned by Newton and leased to a private company to run. This course is protected in perpetuity by a Conservation Restriction.
- **Leo J. Martin Memorial Golf Course** (Newton Lower Falls/Weston): owned and managed by DCR, also used for cross-country skiing in the winter.
- **Brae Burn Country Club** (West Newton): Private.
- **Woodland Golf Club** (Auburndale): Private.
- **Charles River Country Club** (Oak Hill): Private.

Golf is declining in popularity throughout the country, but there is no indication that any of the public or private golf courses are suffering declining use or are considering transitioning or developing. Should this change, it is a high priority for the City to work to ensure that any disposition or development includes an appropriate component of open space preservation (see also Chapter 7).

G. Open Space Resources of Regional Significance

The Commonwealth Avenue Carriageway

The Carriageway is a wide boulevard that parallels Commonwealth Avenue with a wide grassed and treed swath that separates the two roads. The Carriageway runs for approximately 6 miles from near the western border of the City east to Brookline. The central green space is routinely used by joggers and walkers. The Carriageway permits only slow, one-way car travel and so serves as a popular bicycle and pedestrian way. Bike Newton, a bike advocacy group in Newton, writes, "A number of tragic accidents in recent years, though, has made it clear that the carriageway is not perfect. Though walking, jogging, and biking in both directions has become a tradition, the street is marked as one-way, and there are no signs or markings to indicate this common practice. Many streets crossing the carriageway have no stop signs or signals. The carriageway stops abruptly at some street crossings, and linking paths often force bicyclists to enter traffic." Improvements to the Carriageway would enhance valuable east-west bike and pedestrian connectivity.

The Charles River Trail System

A long-range goal for several planning agencies including DCR, the Metropolitan Area Planning Council (MAPC), Newton's Conservation Commission, the Conservation Commissions of Boston and Brookline, is to build an uninterrupted bike and pedestrian path along the Charles River. Much progress was made in years past and momentum is building to complete connectivity through state and local efforts.

The volunteer Riverside Greenway Working Group has been securing state grants to improve existing trails and create new connections and an expanded trail network along the Charles River. Gaps remain, but the goal of a complete trail and appropriate connections is getter to closer to fruition.

Significant features that are or will soon be connected by pedestrian and/or bicycle trails include:

- Leo J Martin Golf Course, which functions as a Nordic ski center in the winter. The unused rail bed running between the recently State-renovated Concord St. bridge over the Charles River Route 95/128 near the Riverside MBTA station has the potential to become a recreational and commuter corridor with a multi-use path. Further work is needed to better understand the opportunities and challenges involved.
- The Newton Lower Falls and Wellesley Lower Falls river paths, scenic areas, and commercial areas.
- Norumbega Conservation Area, Lyons Field, Auburndale Park, Wares' Cove, Flowed Meadow Conservation Area.
- Quinobequin Road trails
- Echo Bridge and Hemlock Gorge Reservations.

The East Coast Greenway

The East Coast Greenway is an in-progress walking and bicycle route that will stretch 3,000 miles from Florida to Maine. It is roughly one-third complete. Portions of the trail pass through the northern portion of Newton on the DCR Blue Heron pathway that runs parallel the Charles River on its way to Boston. The project is sponsored by the East Coast Greenway Alliance, in coordination with the Heritage Conservation and Recreation Service/Department of the Interior.

Inter-City Connections

There are trail connections between Newton's Kennard Conservation Area/Kennard Park, the DCR Lost Pond Reservation, and the Conservation Commission land in Brookline. There are also trail connections between Newton's Auburndale Park and the DCR Forest Grove area in Waltham.

H. Historic Resources

Archeological Resources

There are 21 pre-contact Native American archaeological sites and another 71 historic archaeological sites recorded within Newton. These sites contain artifacts from the Middle Archaic Period (6,000 to 8,000 years ago) to 19th and early 20th century historic industrial sites. These sites indicate the availability of resources such as water (and later waterpower), game, and arable soils to past communities. These sites are precious and delicate links to our past. A recent excavation of the Durant-Kenrick Homestead uncovered remains of the City's agricultural past including remains of a barn and a previously unknown structure believed to have been a 19th century dairy. Should our open spaces be modified or altered, the City needs to exercise care to leave these ancient sites intact for future archaeologists or, if necessary, ensure careful excavation so that the valuable information they contain is not lost forever. To protect sensitive sites, information on the exact location of pre-contact Native American sites is kept confidential by the Newton Department of Planning and Development and the Newton Historical Commission. The City of Newton City-Wide Archaeological

Reconnaissance Survey: Public Education Report was conducted in 2011 and can be found on the City website.

Historic Landscapes

Newton has a variety of historic landscape forms from colonial era burial grounds to historic gardens and community spaces. In general, these places can be divided into two categories: those which are important due to their significance as a designed landscape and those which are significant due to the activities which took place there. Two examples are Crystal Lake and Houghton Garden. These properties are all listed on the National Register of Historic Places, but for different reasons. Houghton Garden, created by Martha and Clement Houghton as part of their early 20th century estate, is an example of a designed landscape, with noted landscape architects Warren Manning and Wayne Stiles contributing to its creation, which means it provides historic significance to the Chestnut Hill historic district. The area around the Crystal Lake Bath House and the lake itself has significance for its place in community history as the site of recreational activity for over 100 years. Newton's first park, Farlow Park, is also included on the National Historic Register as part of the Farlow and Kendrick Parks Historic District. Designed by George Meacham, designer of the Boston Public Gardens, its pond and pedestrian bridge were recently restored using Community Preservation Act and Community Development Block Grant funds.

Some properties combine aspects of community space and historic design such as the City's historic burying grounds and City Hall. The historic burying grounds are the final resting places for many of Newton's early settlers and prominent citizens and provide both historic architecture with the tombs and headstones as well as community history, and historical information through inscriptions. An important site is that of the First Meeting House in Newton at the corner of Centre Street and Cotton Street, built in 1660. The landscape around the current City Hall (the Georgian-style building built in 1932), the seat of Newton City government for more than 85 years, was designed by Fredrick Law Olmsted's landscape architecture firm, the country's preeminent landscape architecture firm at the time of construction. Newton Centre Playground was the City's first playground; it, too, was originally designed by Olmsted Brothers firm in 1890.

Preservation of these and other historic landscapes adds to community character by providing beauty, educating the public about the community's history, presenting historic design, and continuing past traditions. Presently, certain historic open spaces are protected, such as Houghton Garden with its preservation restriction maintained by the Massachusetts Historical Commission, but most have little if any historic preservation protection. While there are certain requirements through the Community Preservation Act and Massachusetts Historical Commission that require preservation as part of the appropriation of funds, in general it is the stewardship of these spaces by the City that will ensure their preservation.

The 2008, *Newton's Heritage Landscapes: A Community-Based Reconnaissance Report* introduces those places deemed, by public input, important to the community. The report also provides preservation planning recommendations for historic landscapes including documentation of properties to determine historic significance, cooperative stewardship of landscapes among multiple stakeholders, preservation of these spaces through appropriate maintenance or restoration, education through historic walking tours, and applying preservation regulations. The *Heritage Landscapes* report and other reports such as the preservation plan for the City Hall landscape are important tools available to guide and inform the planning, care of, or alteration of the City's open spaces having historic or cultural significance.

I. Environmental Challenges

Climate Change Challenges

Overview
Climate change is happening now, and its impact will continue to intensify over the next century and beyond. Predictions vary over the exact nature and amount of change that the warming of the planet will bring to Newton, but there is no doubt that change will come. Newton's 2018 *Climate Change Vulnerability Assessment and Action Plan* enumerates two major risks that Newton, like much of New England, is facing: rising temperatures and increased frequency and severity of storm events. Newton's 2019 *Hazard Mitigation Plan* assesses the potential impacts to the City from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought and identifies a number of mitigation measures that would serve to reduce the City's vulnerability to natural hazard events. Newton must strive to maximize the City's ability to cope with climate change, in part by designing and maintaining open space facilities with changing temperature regimes and changing precipitation and flooding patterns in mind.

Heat
According to the *Climate Change Vulnerability Assessment and Action Plan*, rising temperatures will lead to higher incidents of ground-level air pollution and allergens, increased rates of heat stroke, asthma and hypertension, and higher surface ground temperatures, especially for those in areas already mapped as "urban heat islands". Vegetation, particularly shade trees, has a cooling effect on ground-level temperatures. "According to the EPA, suburban areas with mature trees are 4-6 degrees cooler than new suburbs without trees. Shaded surfaces can be 25-40 degrees cooler than the peak temperatures of unshaded surfaces (*Climate Change Vulnerability Assessment and Action Plan*, 30)."

Flooding
Flooding of streets, basements, first floors, and landscaped areas will continue to worsen as climate change brings more severe storm events. Many citizens at one time or another have already experienced the effects of flooding; many more will in the future. The Charles River is dam-controlled so direct flooding from it is has been limited; however, over-taxed stormwater systems, channelized streams, and expanses of impervious areas have caused increasing inland flooding. Areas subject to recurrent flooding are mostly located along the Charles River, South Meadow Brook, and Cheesecake Brook and in areas where historic wetlands have been drained or filled. There are several specific locations within Newton that are designated as flood hazards in the City's *Hazard Mitigation Plan*. To address these issues, Newton developed and adopted a *Stormwater Infrastructure Improvement Plan* (2015) for capital improvement efforts that focus on repairing and enhancing the City's stormwater infrastructure; regularly inspecting and cleaning catch basins; dredging streams and removing debris; and repairing or replacing culverts.

Newton's brooks and streams have been substantially altered from a natural state by culverting, channelizing, filling, and impoundment. These alterations have resulted in a lower water table, increased rate of runoff, and a reduction of the capacity of brooks and streams to store floodwaters and filter pollutants. Although the period in Newton's history of large-scale alteration of water courses has passed, there remains a need to prevent further degradation and to renaturalize, as possible, the City's remaining open brooks and streams.

Water Resource Challenges

Water Pollution
Within Newton the major source of water pollution is from non‐point source stormwater runoff. Stormwater runoff is precipitation (rain or snowmelt) that flows across the land. Stormwater may infiltrate

into soil, discharge directly into streams, water bodies, or drain inlets, or evaporate back into the atmosphere. Stormwater that runs across paved streets, parking lots, and rooftops picks up pollutants such as trash, chemicals, oils, and dirt/sediment that can harm our rivers, streams, lakes, and wetlands. All the streams and ponds in Newton have their sub-basins in Newton; so, all pollution is local pollution. Only the Charles River has sources outside of Newton.

The Massachusetts Department of Environmental Protection classifies the Charles River as Class B waters, suitable for fishing and swimming. The quality of the Charles River often meets these goals during dry weather, but often exceeds pollutant limits for Class B waters during wet weather events.

There are 132 outfalls from Newton's stormwater system that flow untreated into the Charles River, 7 outfalls that drain into Crystal Lake, and 23 that drain into Cheesecake Brook. (*Newton's Stormwater Management Program, 2019*, 8) (**Table 3**).

Newton's 2018 *Climate Change Vulnerability Assessment and Action Plan* (33) explains,

> "As part of compliance with the federal Clean Water Act, Massachusetts must evaluate whether water bodies meet water quality standards. As shown in Figure 15, in the 2014 *Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*, most of the assessed water bodies in Newton do not meet water quality standards for E. coli, phosphorous, and other impairments. Hammond Pond has not been assessed for all uses, but was identified as attaining uses including: Aesthetic, Fish Aquatic and Wildlife, and Secondary Contact Recreation. Crystal Lake was not assessed. Newton's other streams and ponds are not included in the assessment."

Table 3. Water Quality Impairments of Assessed Waterbodies

Water body	Impairment
Cheesecake Brook	dissolved oxygen saturation, E. coli, phosphorous, excess algal growth
South Meadow Brook	dissolved oxygen, E. coli, phosphorous, turbidity
Bullough's Pond	excess algal growth, nutrient/eutrophication
Sawmill Brook	dissolved oxygen, E. coli, organic enrichment (sewage), phosphorous, chloride, turbidity
Charles River	E. coli, nutrient/eutrophication, phosphorous, DDT, PCB in fish tissue, pathogens

To attain the goal of a fishable and swimmable Charles River and comply with the Clean Water Act, Newton's Department of Public Works (DPW) participates in the EPA's NPDES (National Pollutant Discharge Elimination System) Program. Since 2003, the DPW has complied with requirements of the NPDES Small MS4 (Municipal Separate Storm Sewer Systems) permit and administered a wide range of water pollution monitoring, as well as preventive, engineering and educational measures. In addition, the DPW has made significant progress in the detection and elimination of illicit discharges contaminating Newton's bodies of water. In 2015, Newton developed a *Stormwater Infrastructure Improvement Plan* that outlines a storm water pollution prevention strategy. These efforts have led to some improvement in the condition of Newton's waters. Newton has separate sanitary sewers and drainage pipes. The removal of direct and indirect illicit connections has resulted in an estimated 4,500 gallons per day of sewage removed from the City's drains.

Non-point source pollution continues to present a significant challenge for many of Newton's wetlands and waterways. Specific pollution problems which require continual attention are:

- Improper use or overuse of road salt
- Oil spills
- Sedimentation caused by poor land management (and construction site) practices

- Insufficient catch basin maintenance
- Over-fertilization from lawns and golf courses
- Naturally occurring organic matter (especially accumulated leaves in the autumn)
- Improper disposal of dog waste

Management of nutrients and toxicants at the watershed level is critical to addressing water quality problems; "end-of-pipe" strategies alone will not solve the problem.

While collaborative initiatives between the Crystal Lake Conservancy and the Department of Public Works (DPW), including measuring and remediating run-off pollution, have resulted in progress, water quality concerns and summertime beach closures due to blue-green algal blooms persist, indicating the need for further anti-pollution measures. Newton should continue to monitor the water quality of Crystal Lake, work to reduce phosphorous nutrient load, and ensure safe swimming and fishing.

Hammond Pond has been slowly accumulating sediment and vegetation and now has an average depth of four feet (Newton Conservators). Hammond Pond receives stormwater runoff from Route 9 and from the Shops at Chestnut Hill. During the 1970s, the Conservation Commission, with the cooperation of the Metropolitan District Commission, the State Department of Environmental Quality Engineering, the City Department of Public Works, and the owners of the Shops at Chestnut Hill oversaw vegetation harvesting (1973, 1974, 1975, and 1979) in Hammond Pond. More recent improvements have included a stormwater detention facility for the Route 9 stormwater, a sand filter for the Shops at Chestnut Hill stormwater, and a vegetated swale to filter water coming off the parking lot behind The Street-Chestnut Hill.

Bullough's Pond, an impoundment of Laundry Brook, was suffering from siltation, but corrective work was completed in 1993 with financial assistance from the Section 314 Clean Lakes Program. It is a valued visual extension of the Olmsted Ponds on the City Hall site, which were also improved, and plays an important role in flood control on Laundry Brook.

The remainder of Newton's water bodies, although small, contribute to wildlife habitat, to open space, and to Newton's visual quality. Most of these ponds receive sporadic pollution from street drainage, lawns, golf courses, and/or naturally occurring organic matter. The City must remain vigilant and ensure the water quality of these ponds to maintain the quality of wildlife habitat, prevent over-vegetation, and the maintain visual appeal and recreational values of these natural resources.

Climate change will only exacerbate pollution and its effects in Newton's water bodies. The 2018 *Climate Change Vulnerability Assessment and Action Plan* says,

> "The combined effects of washing nutrients into lakes and ponds and warmer summer temperatures may lead to an increase in the growth of aquatic vegetation. Such growth can deplete dissolved oxygen and lead to die-offs of aquatic animals. Additionally, excessive aquatic vegetation can make water bodies unpleasant for recreational use. Algae blooms can also lead to growth in toxic bacteria that makes water bodies unsafe for use by humans and pets.
>
> An increase in summer heat and drought, combined with earlier spring run-off due to warmer temperatures and a shift from snow to rain, can lead to warmer waters and seasonal low-flow or no-flow events in rivers and streams. Shallower waters and warmer temperatures also lead to low levels of dissolved oxygen, with negative effects on fish species. If dry conditions persist, wetlands could shrink in area or lose some of their absorptive capacity and be more prone to runoff and erosion (31)."

It is important to note that trees play a valuable role in mitigating stormwater runoff and water pollution. The Center for Urban Forest Research says, "Recent research has shown that urban trees can retain a sizable volume of annual rainfall in their crowns, delay the flow of stormwater runoff, substantially increase the infiltration capacity of urban soils, and provide transpiration of sequestered runoff for additional stormwater storage. Tree canopy effectiveness is highest during short, low-intensity storms and lower as rainfall volume and intensity increases. While soils are the best medium to store and filter

stormwater, trees may be integrated with other runoff reduction strategies to bring more natural hydrologic processes to urban watersheds by taking advantage of multiple points of retention." (*Quantifying the benefits of urban forest systems as a component of the green infrastructure stormwater treatment network*).

Sedimentation
Wetlands, ponds, and streams are filling in with organic material and mineral sand and sediment running into street drains and into waterways. Street sweeping is conducted by DPW to limit leaves and dirt from entering the City's storm drains. The 2015 *Stormwater Infrastructure Improvement Plan* calls for extensive catch basin cleaning. Removal of sediment from brooks, sometimes called "stream cleaning," is an ongoing effort of the Newton DPW to control flooding. The state is the entity that would undertake maintenance of and near stormwater outfalls along the Charles River. Nature-based solutions to trap organic matter and sediment before it reaches outfalls, wetlands and streams should continue to be executed.

Land Resource Challenges

Street Trees
Newton's street trees have declined 50% in the past 50 years. Urban trees face many challenges, including development activities, overhead wires, road salt, pests and diseases, ice storms, and gas leaks (discussed more below). Climate change will bring even more stressors through increased temperatures, droughts, bigger storms, and pests and pathogens once kept at bay by colder winter temperatures. Retrofitted tree-friendly streetscapes with high-quality (perhaps engineered) soil, appropriately sized beds, and zones free of growth obstructions are needed.

Privately Owned Trees
Newton's canopy is made up, in large part, by trees on private property. As development and redevelopment continue, many mature trees are being lost. The City's Tree Ordinance regulates land developers and requires inch-for-caliper-inch replacement or contribution into the City's tree fund and the state Wetlands Protection Act requires preservation of wetland values and so provides some protection to trees within the jurisdiction of the Conservation Commission, but many private homeowners are not subject to any tree cutting or replacement regulations.

Natural Gas Leaks
Newton suffers and is at risk for increased natural gas leaks from its system of gas pipes. Over 80% of gas lines in Newton are leak prone **(Figure 30)**.Leaks from broken or corroded pipes contribute to climate change (methane is very powerful greenhouse gas), kill nearby trees, and pose a risk to human health and safety. In 2018, Newton had the third largest number of gas leaks of any Massachusetts city, behind only Boston and Worcester. According to HEET (Home Energy Efficiency Team), by the end of 2018 Newton had 201 leaks repaired and 689 leaks that remained unrepaired (Heetma.org). Eversource, the local gas utility, works with the Newton Department of Public Works to coordinate repairs.

Meadows, Fields, and Road Edges
Nationally, there is growing interest in growing plant native plants to provide pollinator habitat. Abandoned fields, open areas along roadways, and residential areas have all captured the attention of proponents. Successful native plant restoration requires reduced mowing and fall to early-winter seeding. Once established, these plantings can be resilient, can help control erosion, and can support pollinators and birds.

Open land in Newton, including tilled and tillable land, meadows and fields, has decreased by over 80% in the last 30 years, so protecting such land, which can provide wildlife habitats and passive recreational opportunities, is very important. To maintain meadows, management plans prescribing selective mowing will be needed (such as the one developed for Woodcock Meadow at Nahanton Park by Mass Audubon and the Newton Conservators). Encouraging residents to convert portions of their lawns to meadows or gardens

would provide habitat, reduce gas-mower emissions, and reduce stormwater runoff. Highly visible landscape restoration projects, such as Levingston Cove at Crystal Lake (which is proposed to include several vegetated bioswales) and restoration of the historic landscape at City Hall, could demonstrate innovative green infrastructure design. Many sites which have traditionally been dominated by large expanses of mowed lawn could be recreated with beautiful vegetated areas that help filter stormwater and provide habitat for native pollinators.

Erosion and Impacts of Development

Erosion is not a significant problem in Newton. Construction sites, one of the largest categories of contributors to erosion and sedimentation in developed environments, are well regulated by the Inspectional Services Department and the Conservation Commission. Site erosion controls are required, catch basin protection is required, and routine City street sweeping is often required to be augmented by the contractor when construction is underway. Other situations where erosion might be a problem in some communities, such as streams subject to flashy flood conditions, are mostly absent in Newton thanks to lined streams, and on-going efforts to increase on-site infiltration.

Because the majority of development in Newton is re-development, not greenfield development, we focus our discussion about the impact of development and the associated community-based challenges in Section 3's Growth and Development Patterns, Figure 11, and Section 7's Summary of Community's Needs.

Environmental Equity and Environmental Justice

Environmental equity refers to the distribution of open space and recreation resources in the City: identifying any areas that are lacking open space and recreation resources and then addressing that need. We focus extensively on the issue of the equitable provision of open space and recreation resources in Sections 5, 6, 7, 8, and 9, the analysis sections and the action plan.

Environmental Justice refers to the quality of the environment in relation to different populations. There are often patterns of poor environmental quality (e.g., land fills, factories, heat islands, etc.) in areas that are populated predominantly by poor people and/or people of color. Newton is fortunate in that it does not have areas or populations that are subject to poor environmental or public health.

Wildlife Habitat Challenges

Overview

Newton's open space is home to a large variety of wildlife including mammals, birds, amphibians, bats, and insects. To best protect native wildlife, habitats must be of suitable size, location, quality, and connectivity. Following regional trends, over the past several years, Newton has seen an increase in certain opportunistic "edge" species, such as coyotes, turkeys, and white-tailed deer. In managing open space for wildlife, the City needs to also plan for increased human-wildlife interactions. Wildlife inventory and monitoring should continue at locations where monitoring has been done in the past, and at new locations for baseline data to understand wildlife populations in the City.

Invasive and Exotic Species

Invasive insects, invasive plants, and new pathogens pose ever-growing threats to Newton's natural habitat.

The Emerald Ash Borer, which kills ash trees, has been identified in Newton as of 2016. The Asian Long-Horned Beetle, which affects numerous species of hardwood trees, has not been observed in Newton but infestations exist elsewhere in Massachusetts, so Newton should monitor for its arrival.

Invasive non-native plants represent a major threat to the ecological value of Newton's open spaces. Such invasions crowd out native species by outcompeting them. Invasive species tend to be prolific seeders with longer growing seasons, are often shade tolerant, and rapidly expand their populations. Native plant species, to which native insects and birds are adapted, are outcompeted and diminished.

Many of Newton's parks and open spaces, which are highly fragmented and so have highly susceptible edges, have significant populations of invasive nonnative plants. Local horticulturist Bruce Wenning estimates that the understory of Cold Spring park is 90% invasive non-native species. Major invasive species in Newton's parks include Japanese knotweed, glossy buckthorn, common buckthorn, burning bush, Japanese barberry, garlic mustard, multiflora rose and bush honeysuckle, but there are many others. The more recent invader in Newton is black swallowwort. Monarch butterflies lay their eggs on its leaves, but the Monarch larvae cannot eat the leaves and so starve to death.

Control and management of invasive plant populations is to be done by City workers, volunteer groups such as Newton Conservators, Friends' groups, scout troops, PTOs, and individual homeowners. Efforts include manual removal (pulling, cutting, digging), chemical treatment, or (when/where available) biological controls. But the efforts are not sufficient to keep up with the spread of invasive plants. The Conservation Commission's published chart of recommended removal methods for the most common invasive species is a good reference guide for removal and disposal techniques. Combining invasive plant pulls with planting of native plants would help slow the spread of invasive species by covering the disturbed soils, thereby leaving the ground less vulnerable to immediate recolonization by invasive species. Please note that invasive plant control work in wetlands jurisdiction requires Conservation Commission approval.

Native Insect Decline

Many insects and pollinators are in decline throughout North America, including many species of bee, butterfly, bat, and bird. These pollinators are important to the health of Newton's natural ecosystems, but are threatened by habitat loss, climate change, and pesticide use. The City has worked to reduce the use of pesticides on municipal properties through its Integrated Pest Management Policy. It has also worked to protect open space and to increase pollinator habitat. The City supports several privately operated apiaries on public open space parcels.

Hazardous Waste Sites

Sites where spills of hazardous materials have contaminated the soil and/or groundwater can be found throughout the City. Such sites are cataloged and tracked by DEP. There are 563 Newton entries in Mass DEP's "Waste Site & Reportable Releases Results" list reflecting several hundred different locations. Most of these entries result from underground fuel tanks, historic dumping, or accidental spills.

Solid Waste Management

Waste management is an ongoing challenge that the City is working to address in several ways. Through its recycling and solid waste management program, the City has reduced waste by educating residents, reducing recycling contamination from non-recyclable materials, and making recycling more efficient by switching from dual stream to single stream recycling. Newton's trash is brought to Wheelabrator-Millbury, a waste-to-energy facility, in Millbury, MA; Newton's recyclables are brought to Waste Management's facility in Avon, MA. Residents are also able to drop off recyclable materials at the City's Resource Recovery Center on Rumford Avenue. In 2019, the City partnered with Black Earth Compost, which collects organic wastes and so will further reduce Newton's solid waste.

J. Summary of Environmental Analysis

Although Newton's landscape is highly altered from its original natural state, there is a great community desire to care for the remaining open space parcels to provide recreation and respite for people and to provide habitat for native plants and animals. Natural areas are threatened by climate change pollution, the pressure of a growing population on limited open spaces, invasive species, ongoing development, and pollution. Preserving the open spaces Newton has, working to reduce the insults to those open spaces and street trees, and increasing the number of native trees, shrubs, and plants should be the primary goals of the City.