Water Resources

Town of Newmarket Master Plan

Adopted unanimously by the Newmarket Planning Board following a Public Hearing on November 10, 2020.

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Acknowledgements

The Town of Newmarket is greatly indebted to all who participated either directly or indirectly in the process of developing the 2020 Water Resources chapter. From service on municipal boards to professional technical assistance the input and guidance from so many individuals helped to shape the recommendations and vision presented herein. The town extends a thank you in advance to all who will work to implement this plan and its recommendations in the future.

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The contributions of those identified below are particularly noteworthy.

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Front Cover:
Photograph by Bill Doucet

A special thanks to Bill Doucet and Mike Hickey for all the local photos.

Introduction

The protection and use of water resources are critical concerns to the Town of Newmarket. With virtually all residents dependent upon wells for domestic use, the quantity and quality of available groundwater must be protected from depletion and contamination. Other Town water resources, such as swamps, ponds, streams, and wetlands are important because they are hydrologically related to groundwater, and provide ecological, scenic, and recreational value to residents.

In general, there is a direct relationship between land use and water quality. It is the responsibility of the Town to take reasonable and prudent precautions to protect all water resources from incompatible uses, thus protecting the health and general welfare of the community. Appropriate steps should be taken by the Town to ensure that enough water supply exists for use by Newmarket residents, as well as native wildlife and plant communities. The Town needs to examine and address water supply issues, watershed management, pollution, and potential aquifers/gravel areas.

Vision Statement

Protect all water resources in Newmarket from threats that include but are not limited to contamination, depletion, alteration, and degradation through appropriate policies, regulations, and actions.

Guidance for policies, regulations, and actions that affect Newmarket's water resources derives from the following water resources management objectives and conservation measures.

a) *Protect public health, safety, and welfare*
b) *Maintain high environmental quality*
c) *Ensure that growth minimizes impacts to environmental quality*
d) *Direct development to environmentally suitable areas*
e) *Assure adequate water supply for residents*
f) *Preserve water quality and quantity for future residents*
g) *Educate residents about water resource issues*
h) *Participate in inter-municipal water resources management efforts*
i) *Comply with applicable local, state, and federal regulations*

Overview

The Town of Newmarket covers a total area of 14.2 square miles (9,080.3 acres), with a land area of 12.6 square miles (8,053.5 acres) and a water area of 1.6 square miles (1,026.8 acres). With a population of 8,977 (according to the 2013-2017 American Community Survey 5-year estimates), Newmarket has experienced roughly a 10.6% increase in total population since 2000 (8,027).

The topography of Newmarket is gently rolling, and elevations range from sea level along tidal areas to greater than 280 feet on Bald Hill in the westernmost area of town. Great Bay and the Lamprey River are the town's most significant waterbodies. The Town has many acres and types of water resources, which are summarized in the table below. These resources provide valuable functions and services that benefit the public health and welfare and the environment.

Table 1: Water Resource Statistics

Resource Type	Total Area	% Municipal Area
Freshwater Surface Waters	656.1 Acres	7.2%
Coastal/Tidal Waters	1,061.9 Acres	11.7%
Streams and Rivers (miles)	31.4 Miles	N/A
Freshwater Wetlands	979.3 Acres	10.8%
Prime Wetlands	908.9 Acres	10.0 %
Floodplain (2005)	512.9 Acres	5.7%
Floodplain (2014)	529.9 Acres	5.8%
Stratified Draft Aquifer	657.5 Acres	7.2%

[Sources: NH Hydrography Dataset, National Wetland Inventory, FEMA DFIRMs, NH GRANIT]

Newmarket is positioned in the lowermost reaches of the Coastal Watershed, and within portions of the Lamprey River, Exeter River, and the Great Bay watersheds. It contains both freshwater and tidal rivers and estuarine ecosystems. Tidal influence on the Lamprey River extends to Macallen Dam in downtown near the NH Route 108 crossing. Tidal influence of the Great Bay extends up Lubberland Creek and the Squamscott River, as well as several unnamed tributaries in the southern areas of town.

Water Resource Chapter Update

The original Water Resources Chapter of the Master Plan was developed and adopted by the Planning Board in 2001; an update was completed in 2009. Since that time, social and environmental conditions have changed, including shifts in local development patterns, increases in population, and impacts from changing climate conditions, all of which have placed additional stress on the Town's water resources. As a result, Newmarket has compiled a series of recommendations from multiple reports on the town's water system into one comprehensive Capital Improvement Plan (CIP). The Town is improving their stormwater management through compliance with the EPA's Municipal Separate Storm Sewer System (MS4) program. Newmarket has been a part of several climate adaptation projects, including updates to their hazard mitigation plan, a flooding study in the Moonlight Brook watershed, a climate vulnerability study, and an infrastructure project to replace an undersized culvert on Lubberland Creek. In addition, the Town has collaborated with regional land conservation agencies to protect land containing critical water resources including wetlands, floodplain, streams and rivers, and riparian habitat.

Lamprey River north of the Dam
[Photo Credit: Mike Hickey]

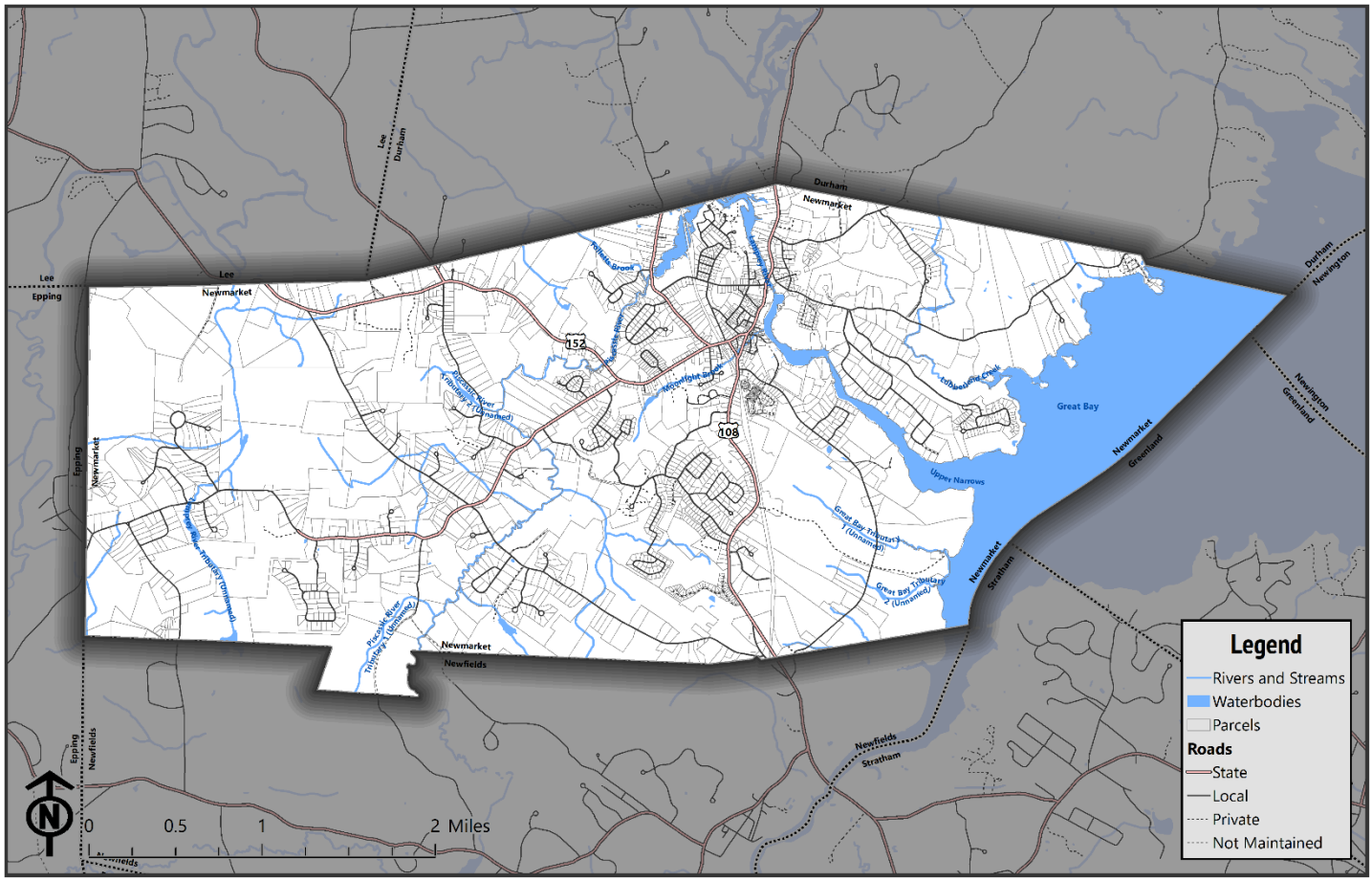
Federal, state, and local non-governmental partners have also conducted significant research, inventories, and evaluation of water resources in the Coastal and Great Bay watersheds. These efforts have produced valuable scientific information about the status, health, and viability of water resources in these watersheds. The results of these efforts have sparked much discussion about future management and sustainability of ecosystems, natural resource functions and benefits, emerging contaminants that are a risk to human health, and drinking water supplies in many communities in the Seacoast.

In 2019, the Town of Newmarket, in partnership with the Strafford Regional Planning Commission, applied for and received funding to update the existing Water Resources Chapter of the Master Plan by incorporating new information to better plan for the management and sustainability of the Town's water resources.

Surface & Groundwater Resources

Surface Water Policy Statement

Reduce the loss of shoreland buffers by minimizing the granting of variances and waivers during the application and permitting process, as well as strengthening enforcement efforts.



Map 1. Newmarket's Surface Water Resources [Source: US Geological Survey (USGS), NH Hydrography Dataset (NHHD)]

Rivers & Perennial Brooks, Creeks, Streams, and Tributaries

According to the New Hampshire hydrography dataset, Newmarket has a total of 24.6 linear miles of streams and rivers, including 23 miles of perennial creeks, streams and rivers and 1.6 miles of intermittent streams and creeks, that provide a myriad of benefits for residents and visitors to the region.

Lamprey River

The portion of the Lamprey River in Newmarket is located at the confluence of the Piscassic River at the Sliding Rock Conservation Area. The river flows south towards the Macallen Dam –where it is tidally influenced— and the downtown waterfront, where there are major access points for boaters and other recreational enthusiasts using

the Great Bay. The total drainage area of the watershed covers almost 214 square miles and includes fourteen towns, making it one of the largest watersheds in New Hampshire. The Lamprey River supports a variety of recreational uses including boating, fishing, swimming in certain areas, and ice fishing and skating in the winter. It is considered to have significant ecological value, supporting some of the most important anadromous fishery habitat in the state, as well as providing aquatic habitat for numerous wildlife and waterfowl species.

The Lamprey River is recognized on both the state and federal levels as a river with outstanding resources, and for that reason, it is afforded protections not normally provided to other rivers. On the federal level, certain sections of the Lamprey are designated as a Wild and Scenic River by the National Park Service and the US Congress. At the state level, the Lamprey and its main tributaries are in the New Hampshire Rivers Management and Protection Program.

Lamprey River at the Macallen Dam
[Photo Credit: Bill Doucet]

Piscassic River

The Piscassic River is a major tributary to the Lamprey River and flows northerly from Newfields through much of the area around Ash Swamp Road, Grant Road and Lang's Lane. The river then flows beneath Route 152, spills over the dam at Packers Falls Road and then joins up with the Lamprey River about one half mile downstream. The lower Piscassic River, below the dam at the former Water Treatment Plant on Packers Falls Road, is often mistakenly considered to be part of the Lamprey River because it is an extension of the impounded waters behind the Macallen Dam that is located downstream. The confluence with the Lamprey River is located just north of the Durham and Newmarket town boundary.

Follett's Brook

Follett's Brook flows southeasterly from Durham and joins up with the Piscassic River just above the Packers Falls Road dam. Only the lower third of Follett's Brook watershed is within Newmarket. Prior to 1990, Follett's Brook was used as the principal municipal water supply source with treatment provided at the Packers Falls Road Water Treatment Plant. The Piscassic River was used as a backup water supply source. In the last ten years, the Town has principally relied on groundwater from several municipal wells for drinking water.

Moonlight Brook

The main channel of Moonlight Brook runs for approximately 1.5 miles from its headwaters to its outlet into the Lamprey River. It is routed under three road crossings before passing under a railroad track near downtown Newmarket. Downstream of this point, Moonlight Brook is routed through a series of culverts and pipes before emerging back into its natural channel just upstream of its outlet to the Lamprey River. During large storm events, Moonlight Brook receives significant inflow from the Piscassic River, which connects to Moonlight Brook at its headwaters. During the 100-year storm event, inflows from the Piscassic River reach an estimated 307 cubic feet per second (cfs), almost doubling the peak flow within Moonlight Brook.[1]

[1] Waterstone Engineering & Horsley Witten Group (2016). *Climate Adaptation Plan for the Moonlight Brook Watershed: Building Resilience to Flooding and Climate Change in the Moonlight Brook Watershed*. [online] Available at: https://www.nhcaw.org/wp-content/uploads/2018/05/13-306-21-Newmarket-Final-Report.pdf [Accessed 27 Dec. 2019].

Lubberland Creek

Lubberland Creek, which runs under Bay Road, is one of several smaller tributaries that drain directly to Great Bay. Lubberland Creek originates in wetlands along Dame Road in Durham and then drains southerly crossing beneath Bay Road and enters the Great Bay along the north side of Moody Point. The lower portions of the Creek contain extensive salt and freshwater wetlands. Much of the watershed associated with this drainage system remains as either open fields or forested areas with sparsely located homes, including a portion of the Gonet Drive subdivision.

Lubberland Creek
[Photo Credit: Bill Doucet]

Significant Unnamed Tributaries

There are several other unnamed tributaries of significance, including the following:

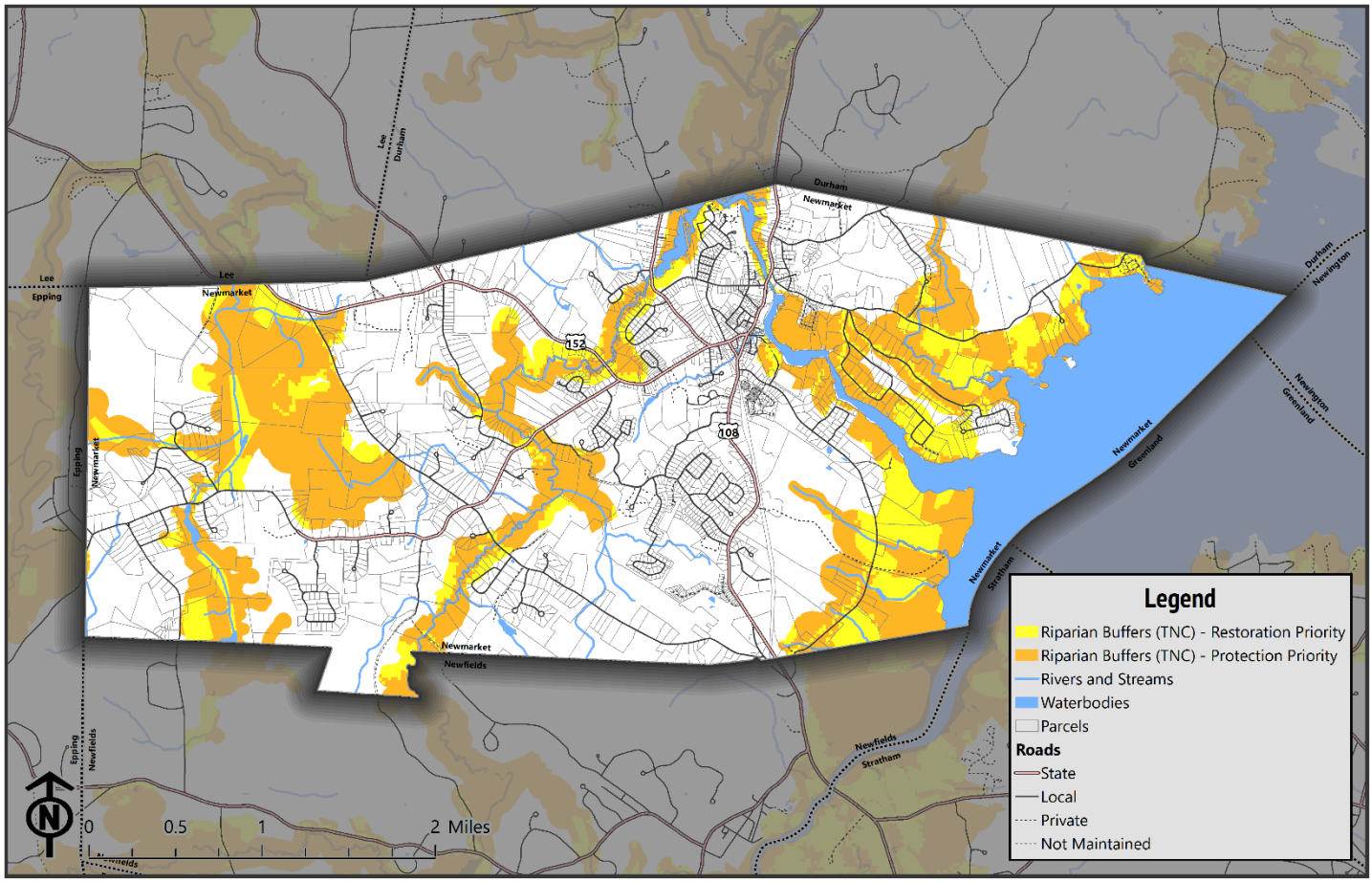
1) Piscassic River Tributary (1): Draining from a large wetland west of Hall's Mill Road in Newfields, this stream flows northeasterly before crossing underneath Neal Mill Road and emptying into the Piscassic River.
2) Piscassic River Tributary (2): Draining from several wetlands southeast of the Wadleigh Falls Road in the vicinity of the gravel pits, this stream flows easterly before crossing Langs Lane just north of Winslow Drive and emptying into the Piscassic River.
3) Lamprey River Tributary: Draining from a series of a large wetlands east of Bald Hill Road, this stream flows northerly before crossing Grant Road, then Doe Farm Lane, and into the Wiggin Farm Conservation Area. It continues north towards the Tuttle Swamp Conservation Area before crossing Wadleigh Falls Road and emptying into the Lamprey River.
4) Great Bay Tributaries: There are two relatively significant unnamed perennial streams that originate behind Newmarket Storage on Route 108 and flow easterly crossing beneath New Road and into Great Bay.

Buffer Functions and Benefits

Buffer Options for the Bay (BOB)[2] defines a buffer as a "naturally vegetated segment of land directly upslope of a water resource, such as a lake, stream, river, pond, estuary, or other wetland type." The value of buffers is diverse; they support wildlife capacity, enhance water views, and help meet water quality standards for municipalities. In New Hampshire, decisions involving buffer lands around waterbodies are often made by communities and individual landowners.

According to GIS data developed by the Nature Conservancy, which was created as part of the 2016 update to the Land Conservation Plan for New Hampshire's Coastal Watersheds, there are several locations identified as priority riparian buffer areas suitable for restoration and/or protection. These locations include: 1) the unnamed Lamprey River tributary (see above for description) and areas surrounding Tuttle Swamp, 2) the mainstem of the Piscassic River, 3) the Lamprey River (both the freshwater portion and tidal portions), 4) Lubberland Creek, and 5) the shoreline of Great Bay.

[2] Buffer Options for the Bay is an informational resource intended to support policy and land use decisions in NH's Great Bay region that involve buffers.



Map 2. Newmarket's Surface Water Resources [Source: US Geological Survey (USGS), NH Hydrography Dataset (NHHD)]

BOB'S "Exploring the Trends, Science, & Options for Buffer Management in the Great Bay Watershed[3]"—an analysis of local factors influencing buffer-related decision-making in the Great Bay watershed—revealed these top four findings:

- Buffer-related decisions are inherently complex, requiring municipalities to balance many factors including property rights, community character, natural resource protection, abutters' concerns, and economic growth.
- People may not understand the individual and social benefits of buffers.
- Buffer oversight and enforcement can be logistically difficult and lack capacity.
- Developers want consistent regulations, flexibility in the review process, and not a 'one-size-fits-all' rule.

Did you know?

Research has shown that the effectiveness of green infrastructure (natural areas like buffers that provide ecosystem services) in reducing pollution is not only comparable to that achieved by gray infrastructure (e.g., constructed stormwater interventions), but that green infrastructure typically costs markedly less.

[3] Flanagan, Shea E.; Patrick, David A.; Leonard, Dolores J.; and Stacey, Paul, "Buffer Options for the Bay: Exploring the Trends, the Science, and the Options of Buffer Management in the Great Bay Watershed Key Findings from Available Literature" (2017).PREP Reports & Publications. 380. https://scholars.unh.edu/prep/380

BOB's "Navigating Regulations: What regulatory options do towns have?" and their "Regulatory options for buffer action" are available to help communities navigate regulations and show different options for buffer action. One other additional resource is the minimum recommended buffer widths for various buffer functions (see Figure 1). These widths are a result of a synthesis of many sources. For more specific information about how these widths were generated, please reference the Coastal Science Literature Review.

As Newmarket continues to grow, increased priority should be placed on increasing buffers for all waterbodies and aquifers with additional steps taken to address septic systems to ensure water quality and shoreland protection.

Figure 1. BOB Buffer Width Recommendations

Water Quality Impairments

According to the DRAFT 2018, Section 303(d) list of impaired waterbodies[4], which is produced by the NHDES Surface Water Quality Assessment Program every two years as a federal mandate under the Clean Water Act, Newmarket has several waterbodies with water quality impairments, including the Lamprey River, Great Bay, Piscassic River, and Moonlight Brook.

Local Water Quality Monitoring

The NH Department of Environmental Services through its Volunteer River Assessment Program (VRAP) maintains a water quality-monitoring program for the Lamprey River and its tributaries. The Lamprey River Watershed Association has undertaken this role and has been doing so since 1999. Long-term monitoring provides a basis for understanding the river's dynamics, or variations on a station-by-station and year-to-year basis. The data also serves as a baseline from which to determine any water pollution problems in the river and/or watershed.

In Newmarket, there are four sampling locations, including the Piscassic River at the Grant Road Bridge, Piscassic River at the Route 152 Bridge, Piscassic River at the Packers Falls Bridge, and the Lamprey River at the Route 108 Bridge. According the 2017 Lamprey River Watershed VRAP Data report, the only measurements not meeting New Hampshire surface water quality standards were dissolved oxygen and pH. Dissolved oxygen is essential for bottom-dwelling organisms and pH affects chemical and biological processes in the water and different organisms flourish within a range of pH levels[5].

Lakes, Ponds, and Great Bay

Lakes, ponds, freshwater/tidal rivers, and Great Bay comprise 1,046.2 acres in Newmarket. This includes Great Bay, which is a 6,000+ acre tidal estuary and represents roughly 84% of the total water area in town, that acts as

[4] Identified waterbodies that are impaired or threatened; not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources; or requires a comprehensive water quality study (total maximum daily load) in order to meet water quality standards.

[5] NH Volunteer River Assessment Program. (Revised 2011). Interpreting VRAP Water Quality Monitoring Parameter: Chemical Parameters. [online] [Accessed 27 Aug. 2020]. Available at: https://www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/vrap_parameters.pdf

the Town's easterly border and is home to upland forest, salt marsh, mudflats, tidal creek, rocky intertidal, eelgrass beds, channel bottom/subtidal and upland field habitats.[6]

Table 2: Surface Waterbodies by Type and Acreage

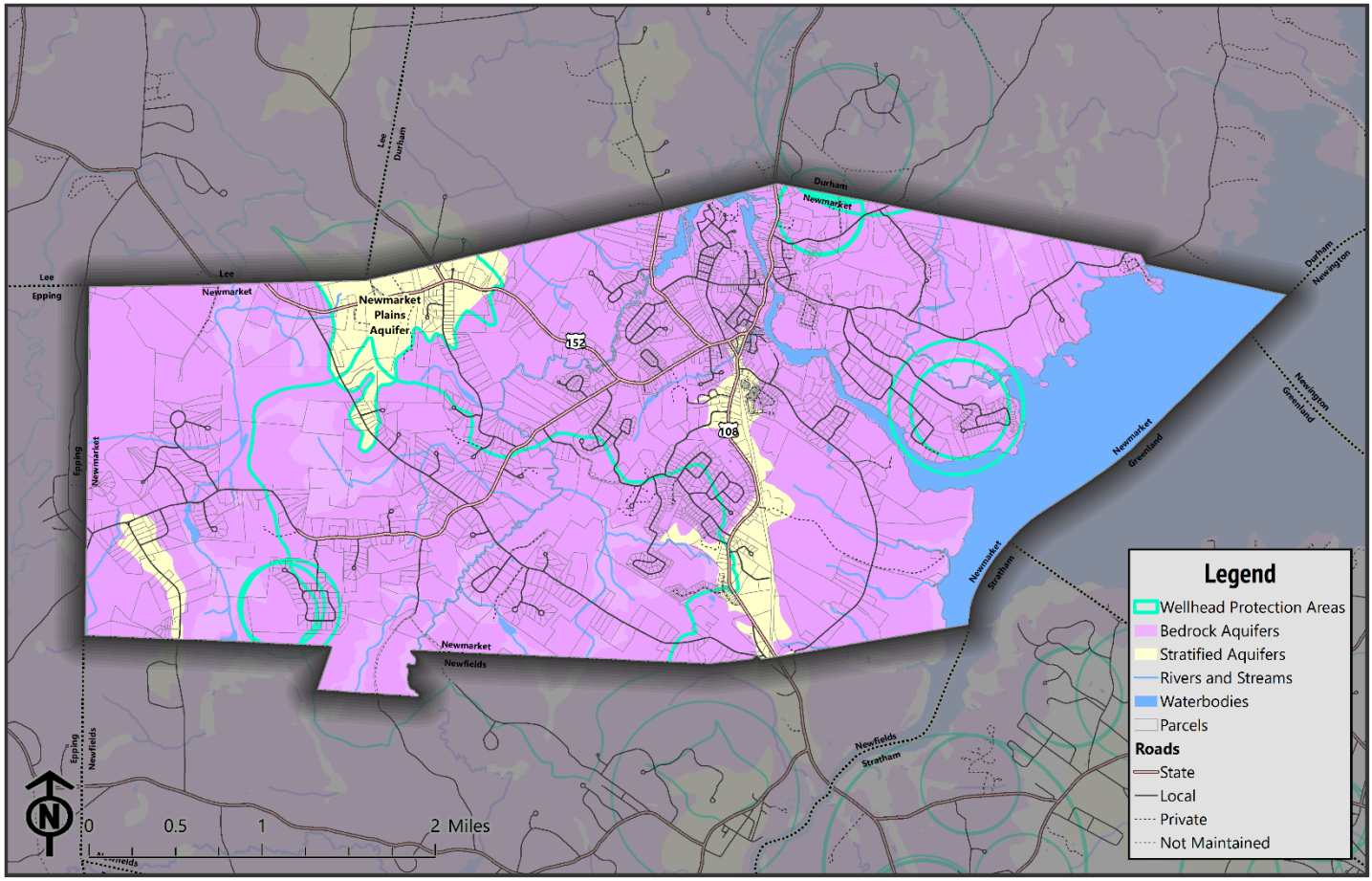
Surface Water	Acreage	% Total Water Area
Lamprey River (Freshwater)	16.8	1.6
Lamprey River (Tidal)	23.1	2.2
Lakes (Impoundments)	33.4	3.2
Ponds	95.2	9.1
Great Bay	877.7	83.9
Total	1,046.2	100

[Source: NH Hydrography Dataset]

Newmarket's many small ponds and other unnamed surface water bodies are typically located within large wetland complexes in low lying areas through which rivers, streams, and small unnamed tributaries flow.

Groundwater Policy Statement

Protect the volume and quality of groundwater resources for current and future sources of drinking water, and to sustain downstream surface waters and wetlands through appropriate policy and regulatory measures.



Map 3. Newmarket's Groundwater Resources [Source: USGS, NHDES]

[6] Great Bay Stewards. (2019). Great Bay Map, NH & ME. [online] Available at: https://greatbaystewards.org/home-page-great-bay-stewards-supporting-great-bay-estuary-greenland-nh/great-bay-map/ [Accessed 27 Dec. 2019].

Stratified Drift Aquifers

Stratified drift aquifers consist of well-sorted sand and gravel deposits that are typically laid out in layers by historic glacial outwash streams and rivers. Depending on the depth and the coarseness of the material, these deposits generally provide good sources of groundwater because of their high capacity to store groundwater over large areas.

Table 3: Acres of Stratified Drift and Bedrock Aquifers

Type	Acres	% of Total Municipal Area
Stratified Drift	657.5	7.2
Bedrock Aquifers	8,127	89.5
Total	8,784.5	96.7

[Source: NH GRANIT]

Newmarket Plains Aquifer

The Town's most productive groundwater resource is a stratified drift aquifer generally referred to as the Newmarket Plains Aquifer located in the northwest part of town along Route 152 near Lee Hook Road. The surficial area of the aquifer is approximately 410 acres (0.64 square miles) and is about 60 to 80 feet deep at its deepest point.[7] The Newmarket Plains Aquifer represents the Town's primary source of drinking water from two municipal wells, the Bennett and Sewall Wells. The Bennett Well was installed in 1974 and is 48 feet deep. The Sewall Well was installed in 1985 and is 83 feet deep. Historically, these two wells were thought to produce a safe yield of 200 and 260 gallons per minute (gpm) of high-quality drinking water that requires minimal treatment. The drought conditions in 2016 resulted in revised safe yield estimates of 110 and 155 gpm, respectively. This is a major reduction in the Town's water supply capabilities.

There are only two other identified stratified-drift aquifer deposits in Newmarket. One exists along Bald Hill Road in the western portion of the town, and the other deposit is situated directly beneath Route 108 and extends from about the Rockingham Golf Course area north to about the railroad crossing. Neither of these deposits are considered to have high water supply potential because these deposits are relatively shallow with depths of less than 20 feet and are also narrow extending out only 300 to 400 feet in width. In addition, the existing development along Route 108 presents a risk of contamination.

Bedrock Aquifers

Bedrock aquifers are composed of fractured bedrock or ledge. Groundwater is stored in voids that are created by these fractures. On average, bedrock aquifers tend to yield smaller volumes of groundwater than wells drilled in stratified drift and finding one sizable enough void or fracture can be a costly procedure. Areas of Newmarket not covered by stratified drift deposits are underlain by bedrock. Typically, most bedrock has variable water yield depending on subsurface conditions (i.e. type of bedrock and the degree of fracturing and connectivity).

In 2016, the Town put the MacIntosh Well on-line. This well has a safe yield of 300 gpm, but due to water quality issues, this well must be blended with water from the other two wells. As a result, Bennett and Sewall Wells must be operating at 100% of their safe yield to pump MacIntosh at 300 gpm. The Town has permitted a fourth well (Tucker Well) but has not developed this well or tied it into the distribution system. This well has a permitted

[7] Richard B. Moore, *Geohydrologic and Groundwater Quality Data for Stratified-drift Aquifers in the Exeter, Lamprey and Oyster River Basins, Southeastern New Hampshire*, USGS, 1990. Available at https://pubs.usgs.gov/wri/1988/4128/report.pdf.

capacity of 275 gpm, but like the Macintosh Well, will likely be limited by water quality issues to less than this capacity unless the water is treated.

Federal/State Protection Measures

Shoreland Water Quality Protection Act
The Shoreland Water Quality Protection Act, originally named the Comprehensive Shoreland Protection Act (CSPA), was enacted into law in the 1991 session of the Legislature. The act establishes minimum standards for the subdivision, use, and development of shorelands adjacent to the state's public water bodies. During the 2011 legislative session, the CSPA was renamed to the Shoreland Water Quality Protection Act and included changes to vegetation requirements within the natural woodland and waterfront buffers, the impervious surface limitations and included a new shoreland permit by notification process.

Alteration of Terrain Permit
The NHDES has jurisdictional review and a permitting process for all land development activities that will disturb an area of more than 100,000 square feet, or 50,000 square feet in locations within 250 feet of a designated public water body, to ensure that adequate erosion control and storm water management measures will be implemented to treat runoff before it leaves the proposed site.

Groundwater Protection Act
The Groundwater Protection Act (RSA 485-C) was passed in 1991. This legislation recognized that a variety of activities involve the use of materials that can, if not properly handled, contaminate groundwater. There have been numerous instances of groundwater contamination in New Hampshire from leaking storage facilities, improper waste disposal, accidental spills, and from normal use of these materials. The Groundwater Protection Act directed the New Hampshire Department of Environmental Services (NHDES) to adopt rules specifying best management practices (BMPs) for the Potential Contamination Sources (PCSs) as defined by RSA 485-C.

NHDES 2015 Model Groundwater Protection Ordinance
This model was created in response to municipal officials requesting more local tools to protect stratified-drift aquifers. The model provides an example of an ordinance that complies with state laws and is consistent with current approaches to groundwater protection.

NH Code of Administrative Rules Part Env-Wq 401 Best Management Practices for Groundwater Protection
These rules apply to all potential contamination sources in the state. The BMPs within the rules are essentially common-sense operating practices that are simple and economical to implement. The purpose of the BMPs is to help prevent a release of regulated substances, as defined under this rule. Regulated substances include oil, as defined under RSA 146-A, III, regulated contaminants established pursuant to RSA 485-C:6, and hazardous substances listed under the Code of Federal Regulation (CFR), within 40 CFR § 302. Cleaning up the release of a regulated substance can be very expensive. Following the BMP rules reduces environmental liability and minimizes potential cleanup costs.

NH Code of Administrative Rules Part Env-Dw 302 Large Production Wells and Wells for Large Community Water Systems
The purpose of these rules is to implement portions of RSA 485, the New Hampshire Safe Drinking Water Act, pertaining to the department's obligation to approve public water systems, by establishing procedures and standards for the development of large production wells for community water systems (CWS) in order to ensure that such wells will be capable of producing an adequate supply of water that meets drinking water quality standards.

Existing Local Protection Measures

Shoreline Protection Overlay District
The Shoreland Protection Overlay District shall include all land within 250 feet of the reference line. The applicable water bodies are designated on the Newmarket Shoreland Protection Overlay District Map, as amended. In Newmarket, these include all tidal waters of Great Bay, the Lamprey River and Lubberland Creek, the non-tidal portion of the Lamprey River, the impoundment above the Macallen Dam, and the Piscassic River. General requirements outline that all primary structures be setback 125 feet from the reference line, while accessory structures shall be setback at least 20 feet from the reference line.

Class A Watershed Protection Overlay District
Septic systems shall be set back a minimum of 150 feet from the reference line of all Class A surface waters. The definition of "reference line," pursuant to RSA 483-B:4(XVII)(d), shall be the ordinary high-water mark. Class A surface waters in Newmarket include the Piscassic River and Follett's Brook. Septic systems shall be setback a minimum of 150 feet from the reference line of all Class A surface waters.

Aquifer Protection Overlay District
The Aquifer Protection Overlay District shall include all land identified as stratified drift aquifer (of any kind) in the vicinity of Newmarket Plains (along NH Route 152, Lee Hook Road, Langs Lane, and Ash Swamp Road) on Plate 6 of the report entitled "Geohydrology and Water Quality of Stratified Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire" (USGS, Water Resources Investigations Report 88-4128, 1990 revised); as well as the wellhead protection area designated by the map: Wellhead Protection Area - WHPA Delineation Map, as contained in a letter report dated October 3, 2006 to the Town of Newmarket entitled "Delineation of Newmarket Plans Aquifer Wellhead Protection Area" (Comprehensive Environmental Incorporated (CEI).

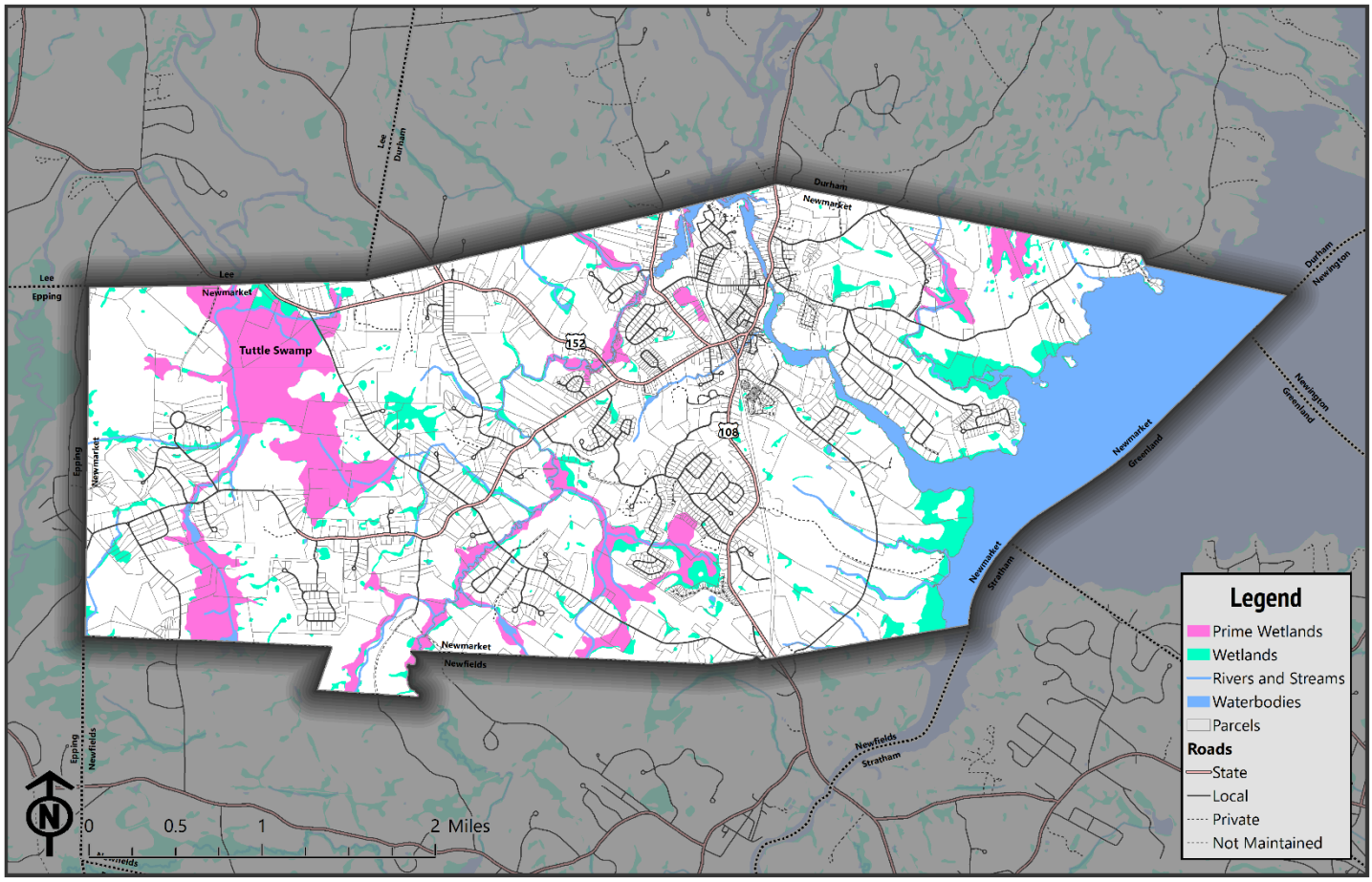
Recommendations

1. Review the current Aquifer Protection Overlay District with the state's updated model ordinance to recommend any necessary revisions.
2. Review all permitted uses within the base zoning districts to ensure that high intensity uses are consistent and in sync with the goals and objectives outlined in the Master Plan.
3. Evaluate the current regulations and ordinances with regards to septic system setbacks to ensure all waterbodies are adequately protected.
4. Continue to support local watershed groups and organizations.
5. Investigate funding opportunities to help pay for the development of watershed-based plans to recommend methods to address specific impairments identified in the 303(d) list.
6. Use resources, such as the NH Statewide Asset Data Exchange System (SADES) crossing database, Resilient Tidal Crossing Assessment, and the C-RiSe climate ready culvert analysis, to identify infrastructure projects for inclusion in the Capital Improvements Plan that would assist with long-term planning decisions regarding the placement, design, and size of new culverts or when upgrades and repairs are being made to existing culverts. Site specific projects include the replacement of the Grant Road and Ash Swamp Road crossings over the Piscassic River to help restore surface waters to natural, free flowing systems, and the replacement of the Route 108 crossing over the northernmost unnamed perennial stream behind the Newmarket Storage that flows easterly beneath New Road into Great Bay to improve wetland function.

Wetlands

Wetlands Policy Statement

Implement comprehensive protection of wetlands, particularly prime wetlands, and their buffers through regulatory, educational, and voluntary efforts to maintain and protect their critical functions and values.



Map 4. Newmarket's Wetland Resources [Source: National Wetlands Inventory]

Overview of Wetlands

New Hampshire State Statute RSA 482-A:2 (X) defines wetlands as an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. According to the New Hampshire Water Resources Primer[8], wetlands share three characteristics:

1) standing water or water at or near the ground surface during some portion of the growing season;
2) soils with characteristics that show they are saturated some of the time; and
3) plants adapted to growing in saturated soils.

[8] All, or individual chapters, of the Water Resources Primer can be accessed and downloaded at the following website: https://www.des.nh.gov/organization/divisions/water/dwgb/wrpp/primer.htm

State jurisdiction of wetlands is found in NHDES Administrative Rules Chapter Env-Wt 100, and states that a jurisdictional area is subject to regulation under RSA 482-A, including but not limited to surface waters, streams, lakes, rivers, ponds, wetlands, banks, flats, shores, sand dunes, upland tidal buffer zones, and duly-established 100-foot buffers.

There is tremendous diversity in the types of wetlands found in the state. Tidal marshes and mud flats, freshwater red maple swamps, bogs, vernal pools, Atlantic white cedar swamps and wet meadows are all wetland types found in New Hampshire.

Wetlands in Newmarket

Wetlands identified by the U.S. Fish & Wildlife Service, National Wetlands Inventory (NWI) are summarized below by major wetland type and acreage. The total area of NWI wetlands mapped in Newmarket is 2,185.84 acres or nearly 24.07% of the Town's total area.

Table 4: Wetlands in Newmarket

Wetland Type	Acres	% of Total Municipal Area
Estuarine and Marine Deepwater	573.71 Acres	6.32%
Estuarine and Marine Wetland	533.34 Acres	5.87%
Freshwater Emergent Wetland	176.81 Acres	1.95%
Freshwater Forested/Shrub Wetland	783.34 Acres	8.63%
Freshwater Pond	78.87 Acres	0.87%
Lake	20.61 Acres	0.23%
Riverine	19.12 Acres	0.21%
Total	**2,185.84 Acres**	**24.07%**

[Source: National Wetlands Inventory]

Most wetlands in Newmarket are in coastal transition zones, where tidal seawater meets freshwater rivers. A large wetland area, known locally as Tuttle Swamp, extends from Lee into Newmarket along the western side of Ash Swamp Road with a smaller area on the eastern side of Ash Swamp Road. This wetland is a major groundwater discharge area that receives drainage from the surrounding upland areas. The northern half of Tuttle Swamp discharges to the Lamprey River in Lee while the southern half and eastern areas of the wetland system discharge to the Piscassic River. This wetland, combined with others in the area, provide flood control during high flow periods.

In addition to Tuttle Swamp, there are extensive wetlands within the Piscassic River and Follett's Brook drainage areas. These wetlands provide for flood control during high flow periods. Other wetland areas of note include the extensive salt marshes along the Great Bay shoreline near New Road and in the north near Lubberland Creek. Aside from water-related issues, these wetlands provide an extensive network of habitat for a variety of flora and fauna.

Did you know?

Given the important functions and values of wetlands described above, there have been several attempts to place an economic value on wetland resources. In 2002, a study by the Clean Water Network estimated the economic value of New Hampshire's remaining wetlands to be approximately $1.2 billion.

[Source: New Hampshire Water Resources Primer: Chapter 5 Wetlands]

Unique and Important Wetland Habitats

Wetlands are important for removing excess nutrients and sediment from the water, slowing and storing floodwaters, promoting groundwater infiltration, and providing habitat for a variety of vegetation and wildlife. In addition, wetlands provide recreational, educational and research opportunities.

Salt Marsh

Salt marshes (Spartina patens and Spartina alterniflora) are intertidal wetlands typically located in low energy environments such as estuaries. They exist both as expansive meadow marshes and as narrow fringing marshes along shorelines. Salt marshes are considered one of the most productive ecosystems in the world due to high rates of plant growth. They provide important ecological functions, including shoreline stabilization, wildlife habitat, and nutrient cycling, and serve as important breeding, refuge, and forage habitats for many species of crustaceans and other invertebrates, and fish.

View of Great Bay salt marsh
[Photo Credit: Bill Doucet]

Salt marshes are important components of the food web base that support all estuarine invertebrates, fish, and birds, and provide important, often essential, habitat for hundreds of other species. The ecological services provided by eelgrass and salt marshes include protection from shoreline erosion, nutrient and sediment trapping, and pollution filtration. Salt marshes are a scarce habitat type, occupying only about 0.1% of the land area of New Hampshire.

The following information was extracted from the Wildlife Action Plan: Appendix B, rising sea levels will likely have the greatest impacts on current salt marsh habitats; however, many scientists believe these systems can keep pace with sea level rise by migrating landward if there is an adequate supply of sediment or peat build up and no natural, or human-made, barriers present. Future sea level rise scenarios predict that, if not able to migrate, much of today's low marsh will be mostly submerged and transformed into mudflats or sub-tidal bays. Current high marsh will change to low marsh, and high marsh will likely migrate upland several feet (if allowed).

According to the Sea-Level Affecting Marsh Migration (SLAMM) model[9], Newmarket is a community within the coastal watershed where current conditions allow for potential salt marsh growth as sea levels rise. In fact, upwards of 170.7 acres of potential salt marsh will have the opportunity to migrate into surrounding upland areas as sea levels rise. The Town may, however, lose approximately 169.9 acres of salt marsh habitat due to coastal inundation (see Table 5).

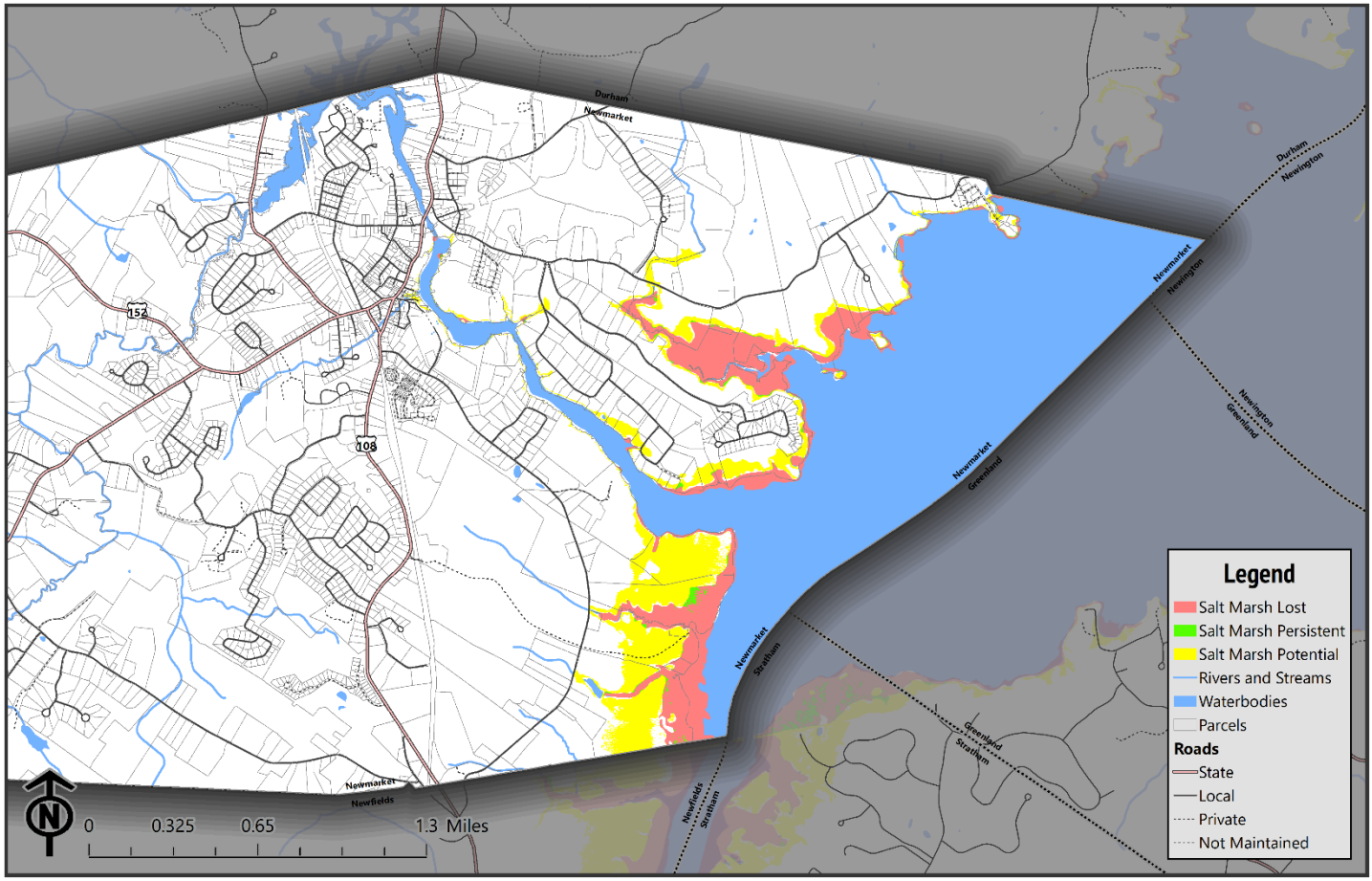
Table 5: SLAMM Results for Newmarket

2100 Timeframe with 6.6 feet of SLR	**Total Acreage**
Salt marsh lost	169.9
Salt marsh persistent	5.7
Salt marsh potential	170.7

[Source: New Hampshire Fish & Game, 2014]

[9] This model simulates the dominant processes involved in wetland conversion and shoreline modification under different scenarios of sea level rise. SLAMM tracks the rise of water levels and the salt boundary in 25-year time steps and predicts changes to wetland habitat based on known relationships between wetland types and tide ranges. This information is available here.

Tidal areas with the highest potential for salt marsh migration are found along the outskirts of the existing marsh system around Lubberland Creek, the tidal portion of the Lamprey River, and the shoreline of Great Bay east of New Road and north of the Squamscott River confluence. Protecting riparian areas through living shoreline efforts and best management practices is likely to retain the functions of these natural systems.



Map 5. Potential Salt Marsh Migration in Newmarket [Source: NH Fish and Game]

Did you know?

In 2019, the Town of Newmarket, in partnership with The Nature Conservancy and NH Coastal Program, completed a tidal culvert replacement project on Bay Road over Lubberland Creek that will support fish passage, salt marsh migration, and reduce ongoing flooding issues in the area.

In May 2019, a report titled "Resilient Tidal Crossing: An Assessment and Prioritization to Address New Hampshire's Tidal Crossing Infrastructure for Coastal Resilience"[10] was published with a focus on enhancing coastal resilience for both human and natural communities. The report identified a culvert on New Road as a high priority for replacement due to the crossing being in poor condition, restrictive, and exhibiting high erosion; however, offers little potential for salt marsh migration.

[10] Weblink here: https://www.des.nh.gov/organization/divisions/water/wmb/coastal/documents/r-wd-19-20-compiled.pdf

Prime Wetlands
Prime wetlands are designated by a municipality according to the requirements of RSA 482-A: 15 and Chapter Env-Wt 700 of the NHDES Administrative Rules. The designation of these wetlands must then be adopted by the municipality by vote of the residents after undertaking a process comparable to the adoption of zoning ordinances. Prime wetlands that were designated between September 11, 2009 and August 17, 2012 are subject to an additional 100-foot buffer; however, Newmarket's prime wetlands were designated in 2006, a period in which no additional buffers were required.

Vernal Pools
Vernal pools are temporary bodies of water that flood each year for a limited time during wet months, typically early spring to mid- or late summer months. Their common characteristics are the absence of fish, temporary flooding regime, and the presence of vernal pool species. The hydrology of vernal pools is maintained primarily by runoff from melting snow and precipitation, and in some cases groundwater flow. Vernal pools usually dry up by mid- to late summer, depending upon climate factors such as the amount of rain and temperature. Species typically found in vernal pools in New Hampshire include: Wood Frog, Spring Peeper, Green Frog or Bullfrog, Spotted Salamander, Jefferson Salamander, Blue-spotted Salamander, Marbled Salamander, Eastern Spotted Newt, Four-toed Salamander, Fairy Shrimp, Spotted Turtle, Blanding's Turtle and Wood Turtle.[11] Except for the Marbled Salamander, these species are present in some of Newmarket's wetlands. The Identifying and Documenting Vernal Pools in New Hampshire is a useful tool that can be used to help train the public to identify and document vernal pool habitat.

Federal/State Protection Measures

NHDES Fill and Dredge in Wetlands
The mission of the Wetlands Bureau is to protect, maintain and enhance the environmental quality in New Hampshire through the powers set forth in RSA 482-A to regulate impacts to those areas wherever the tide ebbs and flows or freshwater flows or stands by requiring a permit for dredge or fill or construction of structures in wetlands or other waters of the state. The law also protects sand dunes and upland tidal buffer zones. RSA-482-A and the rules promulgated under that law require that projects be designed to avoid and minimize impacts to wetlands and other jurisdictional areas.

Existing Local Protection Measures

Wetland Protection Overlay District
The wetlands protection overlay district shall include all areas of land that meet the criteria of the NHDES Wetlands Bureau rules for determination of wetlands, poorly drained and very poorly drained soils (as amended), prime wetlands, as delineated by the Newmarket Conservation Commission and approved in accordance with RSA 482-A:15 (as amended) and associated buffers. Current regulations include:

1) Prime wetlands: There shall be no disturbance of any kind (including but not limited to construction, filling, dredging and the removal of vegetation) within a prime wetland or within a buffer area within 75 feet around the prime wetland. Structures shall be set back a minimum of 100 feet from prime wetlands. On-site septic systems shall be set back a minimum of 125 feet from prime wetlands.
2) Very poorly drained soils (hydric A):[12] Such wetlands shall not be included in the minimum lot size or as part of any lot density calculation as required by any provision of this chapter. There shall be no

[11] New Hampshire Audubon Society, *Conservation Fact Sheet: Vernal Pools*, 1998.
[12] A map (Map #6) of very poorly and poorly drained soils can be found in the Appendix of this chapter.

disturbance of any kind (including but not limited to construction, filling, dredging and the removal of vegetation unless in accordance with the provisions of this chapter) within such wetlands or within a buffer area 50 feet around such wetlands.

3) Poorly drained soils (hydric B): Such wetlands may be used to fulfill up to 25 percent of the area of the minimum lot size or 25 percent of any lot density requirement as part of any section of this chapter. There shall be no disturbance of any kind (including but not limited to construction, filling, dredging and the removal of vegetation unless in accordance with the provisions of this chapter) within such wetlands or within a buffer area 25 feet around such wetlands.

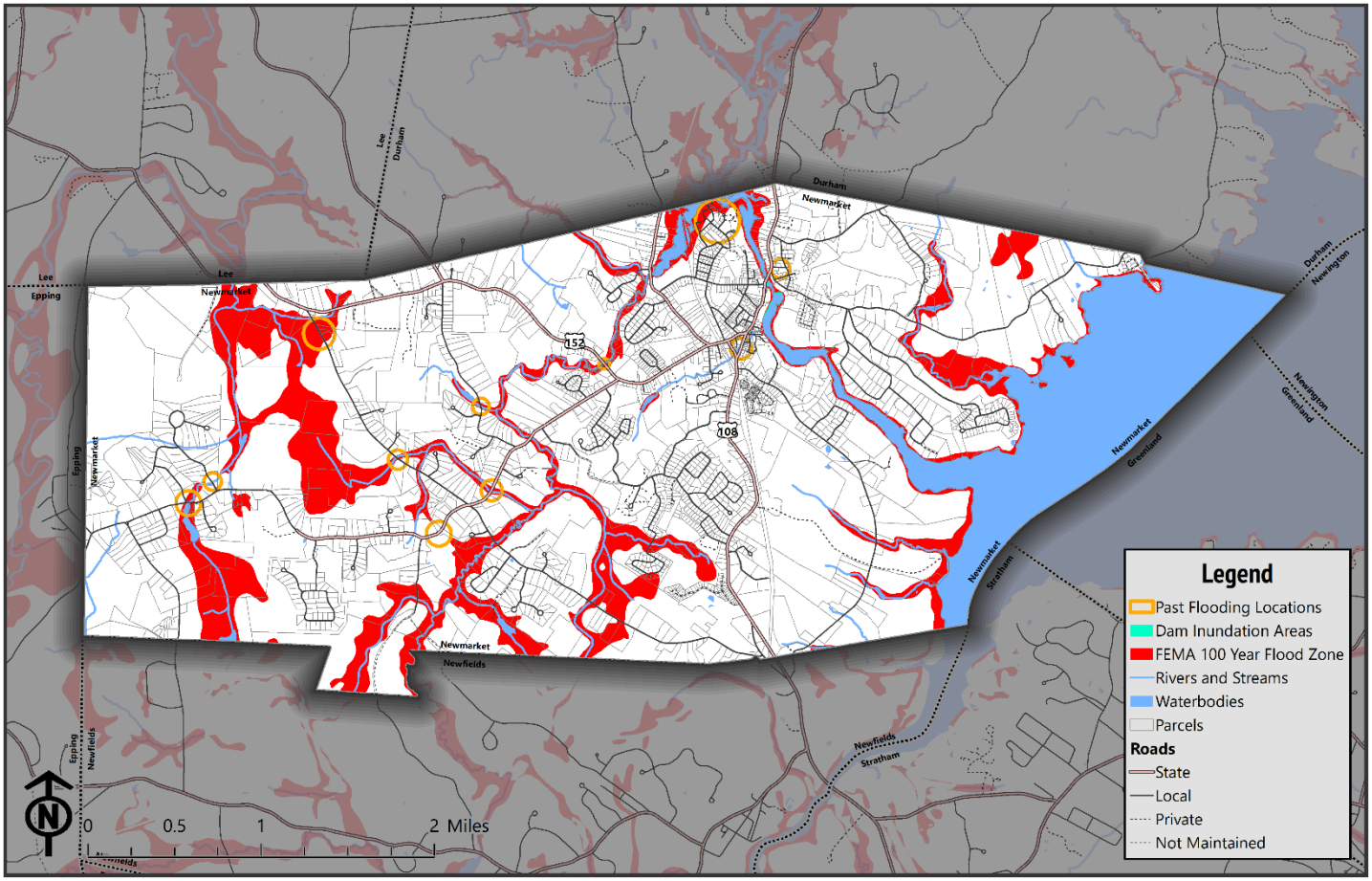
Recommendations

1. Explore funding opportunities to conduct a town-wide vernal pool inventory to locate, document, and map vernal pools in Newmarket.
2. Update the Town's Prime Wetland Maps and associated GIS layers that were completed in 2006 using new available GIS and Lidar data.
3. Compare the existing Wetland Protection Overlay District with new state rules and make necessary revisions to be consistent with jurisdictional areas and other state-level changes.
4. Collaborate with local, regional, and statewide partners to identify other wetland mitigation projects or restoration opportunities.
5. Consider adopting stricter buffer requirements for setbacks to wetlands that include consideration of climate change in order to protect land that allows coastal habitats and populations to adapt to changing conditions and also provides ecosystem services that protect people, structures, and facilities.

Floodplains

Floodplain Management Policy Statement

Implement regulatory, educational, and voluntary measures that incorporate the latest science on climate change to improve resiliency against future events, maintain the natural functions of floodplains, and minimize damage to municipal and private property.



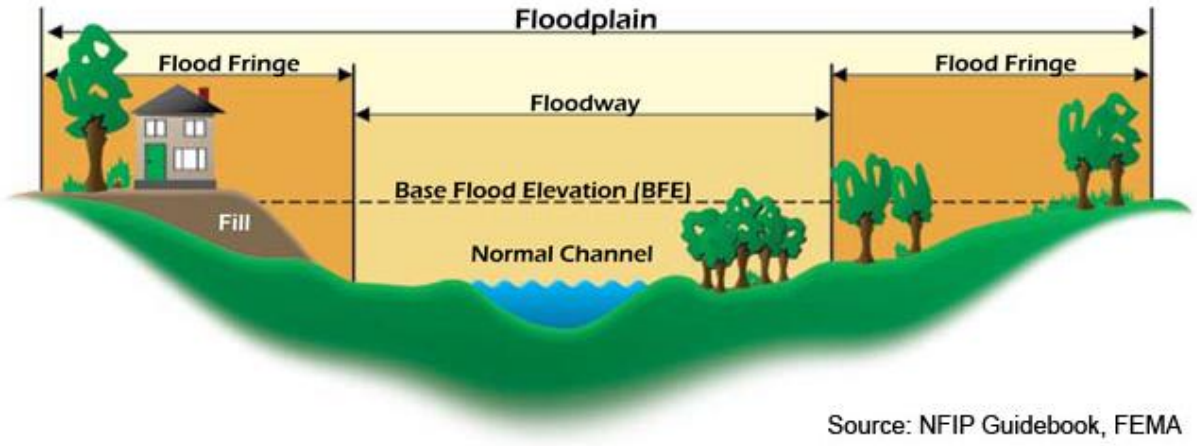
Map 7. Newmarket's Existing Floodplains [Source: FEMA Digital Flood Insurance Rate Map (DFIRM) 2005]

Overview of Floodplains

Floodplains are generally low-lying areas adjacent to rivers, streams, and other surface water bodies, which are susceptible to flooding. Floodplains perform an important water storage function during storm events and periods of excessive water run-off, by storing water temporarily and gradually releasing it back into the drain system or infiltrating floodwater into the subsurface where it is discharged to streams and recharge groundwater.

Refer to the diagram below for the components of a floodplain: normal channel, floodway, fringe, and flood hazard area or 100-year floodplain. The floodway and flood fringe serve as critical floodwater storage areas, and the floodplain vegetation acts to slow the velocity of floodwaters and reduce erosion of the floodplain and adjacent lands.

Figure 2. Characteristics of a Floodplain



Although the flood mitigation capacity of floodplains is relatively well protected by federal and local regulations, other factors can contribute to increased flooding. These factors include: increases in impervious surface coverage, filling of wetlands in the upper watersheds, stormwater management practices that increase peak flow rates, inadequate infrastructure to accommodate current storm flow volumes, beaver dams and less natural dissipation of flood flows through infiltration and interception by trees and vegetation.

Special Flood Hazard Areas

According to the Federal Emergency Management Agency (FEMA), flood hazard areas identified on the Flood Insurance Rate Map are identified as a Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of flooding being equaled or exceeded in any given and a 26% chance of flooding over the life of a 30-year mortgage. In communities that participate in the National Flood Insurance Program, mandatory flood insurance purchase requirements apply to all high-risk zones.

Riverine and Coastal Flooding and Flood Prone Areas in Newmarket

Riverine flooding is the most common natural disaster to impact New Hampshire. Riverine flooding occurs when surface water runoff introduced into streams and rivers exceeds the capacity of the natural or constructed channels to accommodate the flow. As a result, water overflows the river banks and spills out into adjacent low lying areas.[13] Floods are most likely to occur in the spring due to the increase in rainfall and the melting of snow; however, floods can occur at any time of the year because of heavy rains, hurricane, or a Nor'easter.

According to the 2018 Hazard Mitigation Plan Update, Newmarket has approximately 24.0% (2,183.4 acres) of its area in 100-yr. floodplain. It should be noted that this estimation is likely overstated since the FEMA floodplain contains open water. If the tidal portions along the Lamprey River and Great Bay were removed, the approximate acreage may be more accurately depicted as 12.6%. Based on extent of the floodplain, the Town has flooding potential along the Lamprey River and the Piscassic River. The Lubberland Creek, Follett Brook and Tuttle Swamp area, as well as along the tributaries to the Great Bay, also have an expansive floodplain area (1,144.1 acres). Newmarket has no existing man-made flood control measures. The Macallen Dam, originally built in 1887, does have floodgates; however, the dam's primary function is for recreation not for flood control.

[13] FEMA Training Chapter 2 Types of Floods and Floodplains

Coastal flooding is often associated with storm surge, extreme precipitation events, and sea-level rise, and can be devastating to human health and safety, public and private structures and facilities, and the economies of coastal and inland coastal communities. Results of the 2017 C-RiSe assessment report state that the inland coastal portion of Newmarket that is most susceptible to coastal flooding are those areas located south of the Macallen Dam on the west side of the Lamprey River near the downtown, low-lying areas around Lubberland Creek, and low-lying land south of the Lamprey River along Great Bay.

King Tide flooding at pump station on Creighton St.
Photo Credit: Kyle Pimental

Past Flooding Events

During extreme flood events, floodwaters from the Lamprey River overflow NH Route 108 upstream in Durham and are diverted into the Oyster River basin. This diversion of floodwaters reduces peak flood discharges of the Lamprey River by approximately 20 percent before it reaches the town.[14] Between 2016-2018, NHDOT completed major roadway construction on Route 108, which included grade changes and drainage improvements, to construct 4-foot bike shoulders and other miscellaneous safety improvements. According to the Town's consultants, these alterations had little impact on improving or worsening flooding problems along this stretch of roadway; however, a separate project in a similar location in Durham was determined, if built, would negatively impact downstream systems and was redesigned. The Oyster River drainage basin remains an important flood protection and mitigation function for the Town, and regional projects within this sub-watershed should be carefully planned to reduce impacts upstream and down.

Numerous floods have been recorded on the Lamprey River since the U.S. Geological Survey (USGS) installed a gauging station near Packers Falls in Durham in July 1934. Historically, the two largest flood events since 1934 occurred in March 1936 (peak discharge of 5,490 cubic feet per second) and April 1987 (peak discharge of 7,500 cubic feet per second). These events had estimated frequencies of 25 and 100 years, respectively. In recent years, these historical flood events were exceeded in spring 2006 and 2007.

Overturned Jeep on Exeter Street during flooding
Photo Credit: Town of Newmarket

May 2006 Mother's Day Flood Event

From May 11-15 2006, central and southern New Hampshire experienced severe flooding caused by as much as 14 inches of rainfall. In addition to the precipitation volume being exceptional, the month of May 2006 was the second wettest May in New Hampshire on record (based on NOAA data). The U.S. Geologic Survey Lamprey River gauging station located near Packers Falls Road Bridge measured the highest flow ever recorded of approximately 8,970 cubic feet per second (CFS) on May 16. This flood level was estimated to be a flood event with a recurrence interval between 100 and 500 years. The Piscassic River rose to a level that exceeded its normal drainage basin, entered Moonlight Brook, and was impounded behind the PanAm Railways culvert at the intersection of Gerry Avenue and Exeter Street. The earthen embankment at the railroad arch culvert

[14] Federal Emergency Management Agency, Flood Insurance Study, Town of Newmarket, New Hampshire, Rockingham County, 1991.

subsequently failed and storm flows flooded Route 108, in the "Exeter Street Bowl." During this flood event, floodwaters in Exeter Street were approximately four feet deep, vehicles were submerged, oil tanks and dumpsters displaced and silt from eroded roadways and foundations was discharged into the Lamprey River. As a result of the flood damage, a presidential disaster declaration was made on May 25, 2006 for seven New Hampshire counties, including Rockingham County.

Patriot's Day 2007 Flood Event

On April 15 and 16, 2007 nearly seven inches of rain fell in Newmarket. The U.S. Geologic Survey Lamprey River gauging station located near the Packers Falls Road Bridge measured a peak flow of approximately 8,450 cubic feet per second on April 18, 2007, the second highest flow. This flood level was estimated to have a recurrence interval of just below 100 years. Normal flows for this date would be 654 cubic feet per second. While there was flooding in the "Exeter Street Bowl" again, the damage was not as severe as occurred with the 2006 flood. Flooding in the New Road area extending to Exeter Street was significant necessitating temporary road closures.

Major flooding on Exeter Street "the Bowl" during flooding event
Photo Credit: Town of Newmarket

Both floods resulted in significant damage to public and personal property in Newmarket. Roads were impassable for days and severely damaged, and residential areas were evacuated due to high water levels and inundation of homes by floodwaters.

Other Localized Events of Significance

Data gathered from the 2018 Hazard Mitigation Plan Update identified three additional flooding events of consequence, including the spring of 1996, February 2010, and October 2016. The February storm impacted parts of Route 152. The October storm impacted parts of Route 108 and Gerry Ave; however, the issues at Gerry Ave were attributed to beaver damage in a local manhole that backed up water from Moonlight Brook and has not happened since. The Committee could not recall the specifics of this storm other than it caused damage in the "bowl" area on Exeter Street. According to the Flood Insurance Study for Rockingham County (2014), this event had a recurrence interval of approximately 100 years and recorded a peak discharge of 3,060 cubic feet per second (cfs) on parts of the Exeter River in Brentwood.

Compliance with the National Flood Insurance Program

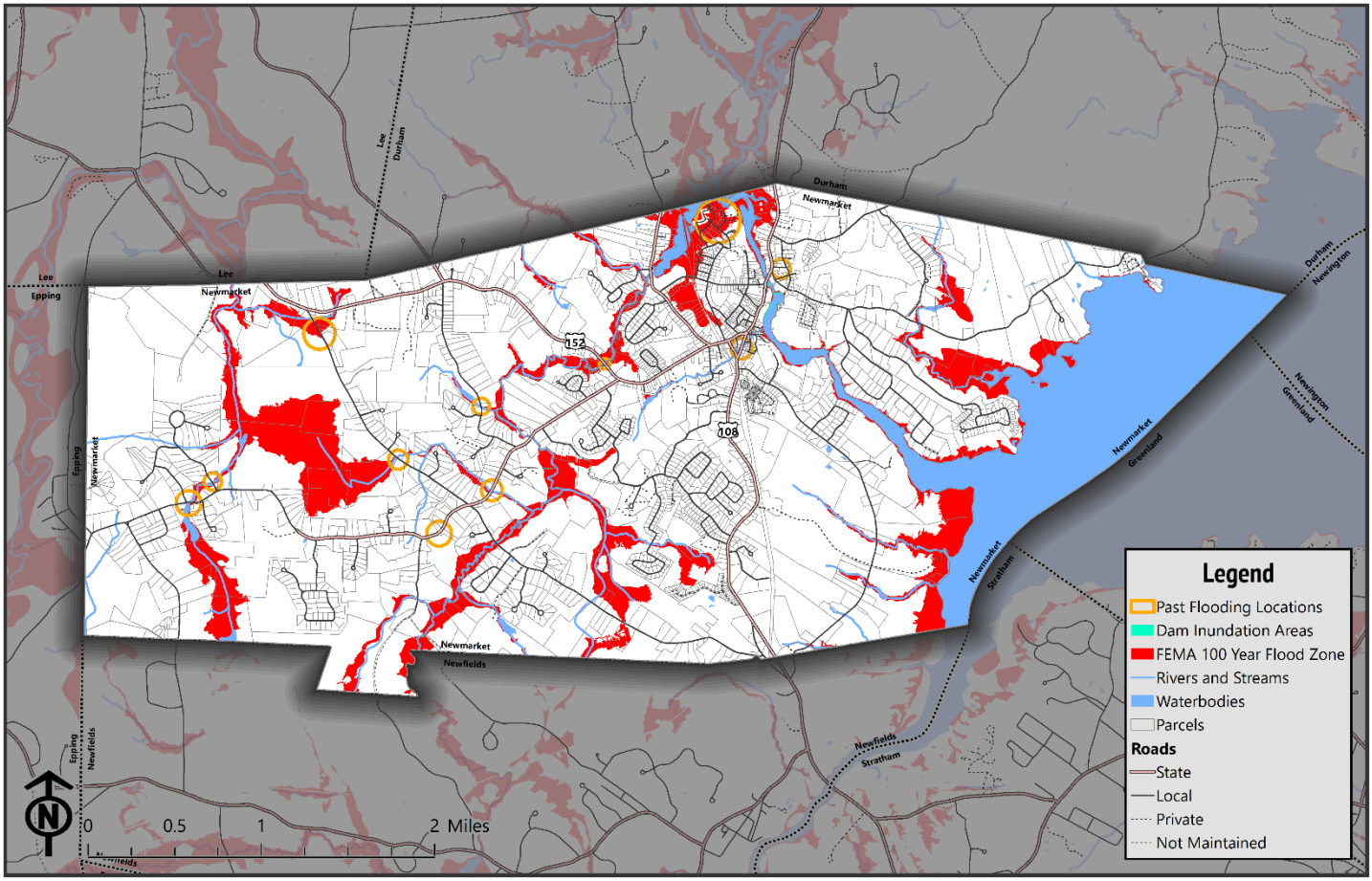
According to FEMA's Community Status Book Report, Newmarket has been a member of the National Flood Insurance Program (NFIP) since May 2, 1991. In order to remain in NFIP compliance, Newmarket has implemented several floodplain management actions, including: providing education materials to homeowners, participating in a FEMA Community Assistance Visit, updating Master Plan Chapters with a focus on climate adaptation and resilience, replacing an undersized culvert over Lubberland Creek, completing a climate study in the Moonlight Brook watershed, and improving drainage at the Middle/High School.

On July 29, 2020, FEMA issued a Letter of Final Determination (LFD) finalizing the preliminary coastal Rockingham County Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) report that were originally issued in

2014. The LFD establishes the effective date of the new FIRMs and FIS report and provides communities six months to adopt them prior to the effective date. The FIRM effective date is January 29, 2021.[15]

The new floodplain maps were developed as part of the Coastal NH Floodplain Mapping Project. This effort was conducted to update FEMA flood hazard data for the Atlantic Coast and Great Bay watersheds that dates to the 1970s and 1980s. Drainage patterns have changed due factors such as to land use, surface erosion, and other natural forces. As a result, the likelihood of flooding in some areas has increased significantly. By using sophisticated mapping technology and improved topographic information, the updated maps more accurately represent the risk of flooding; therefore, representing an important tool for Coastal NH communities to use in the effort to reduce risk and create a more resilient community.

According to the new maps, in Newmarket, the total overall amount of floodplain has decreased roughly 8% (184 acres). The 2005 maps show 2,183 acres of floodplain, while the updated 2014 maps (see below) show 1,999 acres. Areas that appear to have experienced the most significant decreases are Tuttle Swamp, along the portions of the unnamed Lamprey River tributary, and a small wetland area north of Bay Road. Areas that experienced an increase in the floodplain include shoreland areas where the two tributaries that cross New Road and flow into Great Bay are loacted and the residential neighborhoods east of the Piscassic River along Piscassic Street, Cedar Street, and Elm Street south of the Riverside Cemetery.



Map 8. Newmarket's Proposed Floodplains [Source: FEMA DFIRM 2014]

[15] These maps are available at https://www.fema.gov/flood-maps/tools-resources/risk-map/products.

Additional Studies, Plans, and Initiatives

New Hampshire Coastal Flood Risk Summary Part 1: Science
The New Hampshire Coastal Flood Risk Summary – Part 1: Science provides a synthesis of the state of the science relevant to coastal flood risks in New Hampshire. Specifically, this document provides updated projections of sea-level rise, coastal storms, groundwater rise, precipitation, and freshwater flooding for coastal New Hampshire. This information is intended to serve as the scientific foundation for the companion New Hampshire Coastal Flood Risk Summary - Part II: Guidance for Using Scientific Projections and is intended to inform coastal land use planning and decision-making

New Hampshire Coastal Flood Risk Summary Part II: Guidance for Using Scientific Projections
The primary purpose of the 2019 New Hampshire Coastal Flood Risk Summary, Part II: Guidance for Using Scientific Projections (NHCFR Guidance) is to help decision-makers assess and incorporate best available projections for relative sea-level rise (RSLR), coastal storms, RSLR-induced groundwater rise, and extreme precipitation into state and local land use planning and decision-making.

Gomez & Sullivan and GZA GeoEnvironmental, Inc.: Macallen Dam Findings
Gomez and Sullivan Engineers (GSE) were originally contracted by the Town to conduct a dam removal feasibility study. However, as the study progressed the Town broadened the focus of the project to identify other potential alternatives, other than dam removal, to address NHDES requirements to pass the 100-year flood with one foot of freeboard based on past studies and the information gained from the study. Subsequent to that, final design and engineering services related to the rehabilitation of the Macallen Dam were prepared by GZA GeoEnvironmental to provide the Town with conceptual alternatives to choose from in meeting the NHDES letter of deficiency relative to the Macallen Dam. Construction, involving renovations to the dam, is moving forward at the time of this chapter revision, with a completion date of December 2020.

Climate Adaptation Plan for the Moonlight Brook Watershed
In 2016, Newmarket, in partnership with the Horsley Witten Group, participated in a resiliency to flooding and climate change project in the Moonlight Brook watershed. This project was a two part effort to: 1) study flood risk associated with climate change as well as how future development and build out of the community affect these risks, and 2) design robust green infrastructure practices within the Moonlight Brook watershed to help reduce risk of flooding while reducing pollutant load into the Brook and further downstream into the Lamprey River and ultimately Great Bay. Current erosion at Schanda Park, as witnessed by members of the Conservation Commission, indicates increased tidal flooding, as well as impacts from severe rain events at this location.

Coastal Risk in the Seacoast: Vulnerability Assessment
The Climate Risk in the Seacoast (C-RiSe) vulnerability assessment project produced maps and statistical data about the potential impacts to New Hampshire's ten inland coastal municipalities from sea-level rise and storm surge to infrastructure, critical facilities transportation systems, and natural resources. The project also assessed both aquatic organism passage capacity and hydraulic flow capacity of twelve road crossings in each of the ten inland coastal municipalities.


King Tide Flooding at the fishing weir at Schanda Park
Photo Credit: Kyle Pimental

New Hampshire Flood Hazard Handbook: A Guide for Municipal Officials
The Flood Hazards Handbook was developed and released in 2019 by the New Hampshire Silver Jackets, a unified team of individuals from federal and state agencies. The Silver Jackets work collaboratively on the state's flood risk management priorities and provide technical expertise to help reduce flood risk in New Hampshire communities.

A Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction
The purpose of this guide is to provide a process that communities can use to assess the costs and benefits of green infrastructure to reduce flooding. The guide takes a step-by-step, watershed-based approach to documenting the costs of flooding; projecting increased flooding and associated costs under future land use and climate conditions; and calculating benefits and costs of reducing flooding with green infrastructure over the long term.

Federal/State Protection Measures

National Flood Insurance Program
The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), is designed to manage floodplains, and restrict development in floodplains to reduce flood hazards and structural damage. Under this program, flood hazard areas are mapped and studied in participating communities.

Existing Local Protection Measures

Floodplain Overlay District
Section 32-158 of the Town's Zoning Ordinance (as revised June 21, 2017) outlines the Town's floodplain development regulations (last updated August 4, 2010). The purposes of the floodplain protection overlay district are to: protect floodplains from development and construction activities which would aggravate flooding; prevent development in locations which would place occupants at risk or which would likely require rescue of occupants by emergency services personnel during floods; protect the floodplains for use as habitat and for the aesthetic qualities; and ensure town compliance with the National Flood Insurance Program. The regulations shall apply to all lands designated as areas of special flood hazard by FEMA in its "Flood Insurance Study for the County of Rockingham, N.H." dated May 17, 2005. The Town has recently received word from FEMA that new modified and flood hazard information and revised map panels will become effective as of January 29, 2021.

Recommendations

1. Review the updated floodplain model ordinance from NH Office of Strategic Initiatives and update the Town's floodplain ordinance, once FEMA maps are approved and adopted. An outreach campaign targeting existing property owners shall accompany this update.
2. Explore options to develop a creative outreach campaign to educate the public on future coastal flood risk (i.e. high-water mark initiative, participation in the king tide photo contest, etc.) at public spaces such as Schanda Park and Heron Point.
3. Use the New Hampshire Living Shoreline Site Suitability Assessment[16] to identify sites in Newmarket that may be suitable for specific living shoreline approaches to address erosion issues along the tidal shoreline.
4. Incorporate impacts to municipal infrastructure identified in the C-RiSe project into current and future capital infrastructure projects, including water access at Schanda Park, the pump station on Creighton

[16] Download report here: https://www.des.nh.gov/organization/commissioner/pip/publications/documents/r-wd-19-19.pdf

Street, and flooding on critical roads such as Treatment Plant Road. This also includes evaluating the extent of sea-level rise and storm surge flooding on individual facilities such as sewer pipes located at the end of Water Street, Creighton Street, and Lamprey Street and the intersection of Bay Road.

5. Revisit the Climate Resiliency in Moonlight Brook report to accomplish the two remaining ICLEI Climate Resilient Communities milestones identified in the plan. Site specific projects include: alleviate flooding in re-occurring areas by redirecting stormwater flows away from downtown in the "bowl " area on Route 108; installing a new drainage system with a gravel wetlands to provide water quality treatment on New Road and a stormwater outfall on Young Lane; and assess impacts upstream in the watershed at the new drainage system at the Elementary School.
6. Identify and implement green infrastructure and nature-based approaches to improve flood resilience and stormwater management throughout the Town referenced in the New Hampshire Flood Hazard Handbook.
7. Review Appendix C in the Town's 2018 Multi-Hazard Mitigation Plan to identify riverine flooding mitigation approaches, including prevention, property protection, natural resource protection, emergency services, structural projects, and public education.
8. Update the Town's Open Space Plan to strategically identify high value land for future land conservation. Incorporate climate resilience benefits, such as future flood storage salt marsh migration, etc., into scoring criteria to ensure the Town considers climate adaptation benefits when evaluating land for conservation purposes.
9. Integrate climate adaptation measures into all future master plan updates.

Potential Threats to Water Resources

Potential Threats to Water Resources Policy Statement

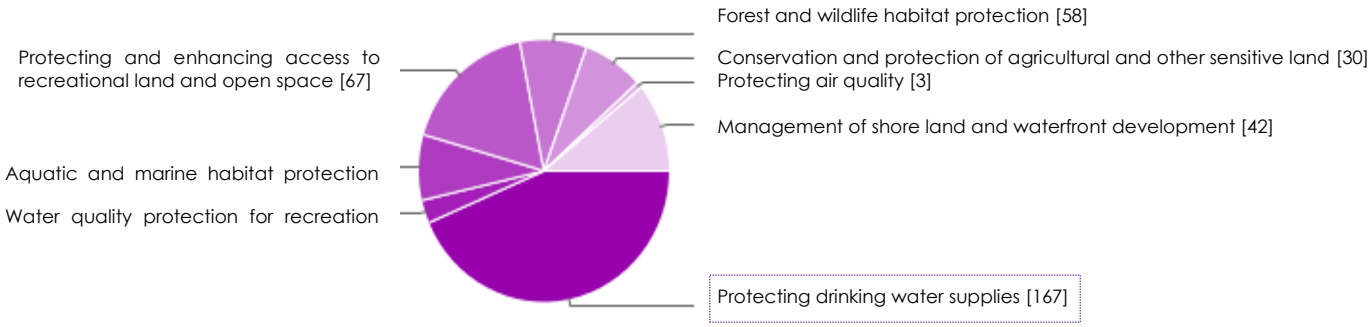
Protect water quality for drinking water sources and wildlife habitat from current and potential threats to preserve critical functions, benefits, and the ecological integrity of these resources.

Overview

In previous iterations of the Water Resources Chapter, Newmarket has approached potential threats to water resources through a point and non-point source threats lens. Based on available data, this worked; however, Newmarket's revised Vision Chapter of the Master Plan (2015) encourages vigorous protection of **ALL** water resources. This chapter update includes a summary of local upgrades and efforts, as well as potential threats based on new information about contaminants, degradation, and climate change impacts.

Figure 3. Results from Visioning Showing the Public's Prioritization of Protecting Drinking Water Supplies

Which of the following would you place the highest priority on in Newmarket over the next 10 years?



Source: 2015 Master Plan Visioning Public Input

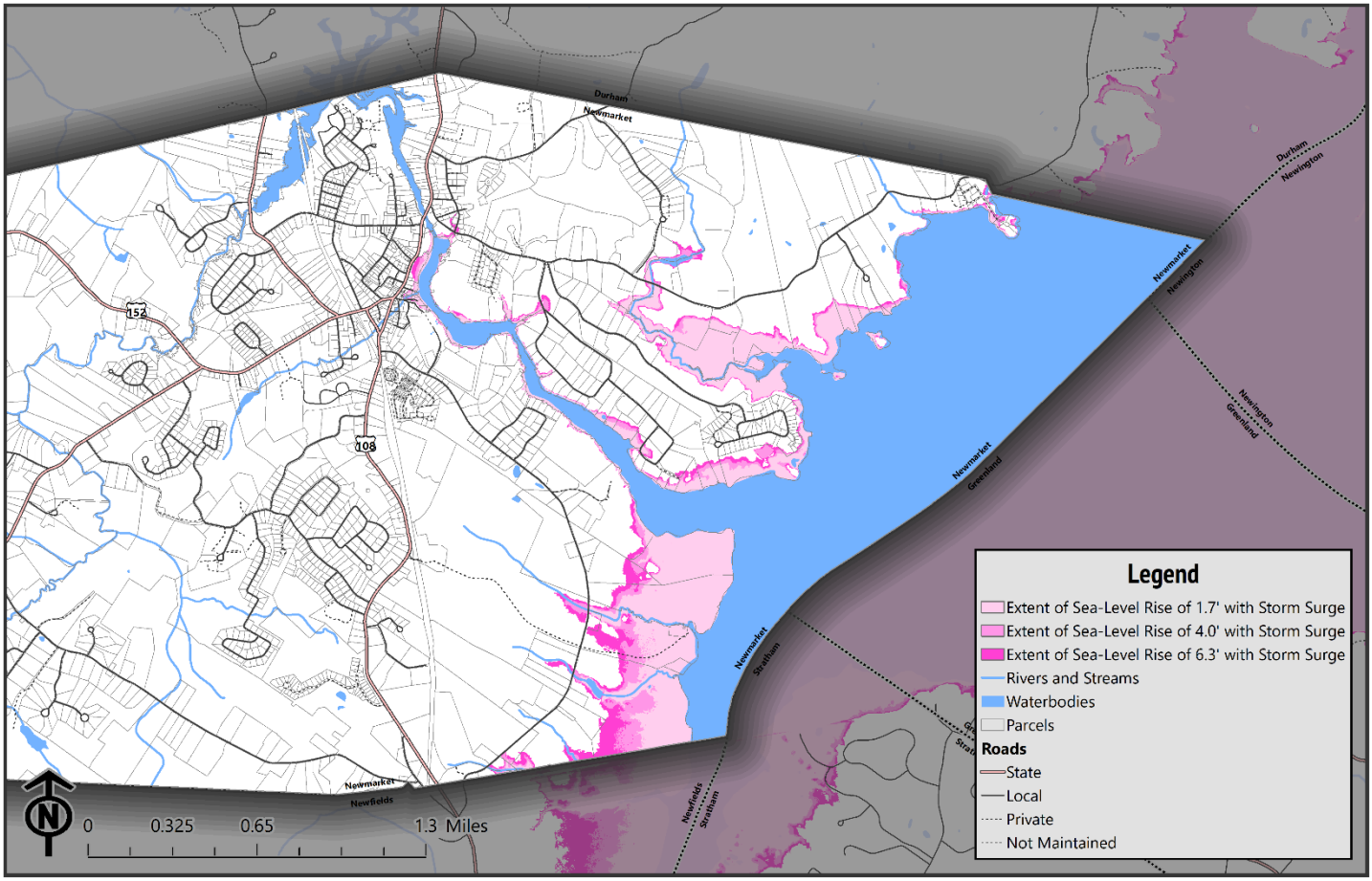
Local Upgrades and Efforts

Historically, much of Newmarket's attention on threats to water resources has been focused on addressing challenges with the Town's wastewater system and exploring ways to improve it to minimize pollution. The Town's most recent National Pollution Discharge Elimination System (NPDES) Permit, which was originally authorized in 2000 and extended in 2011 to 2016, allows the Town to discharge from their Young Lane Wastewater Treatment Plant to the Lamprey River below the Macallen Dam. The most current upgrade to the facility was completed in 2017 and included a 4-Stage Bardenpho process for nitrification and denitrification. This upgrade was given national recognition when the Town was awarded the 2019 PISCES Exceptional Project for Region 1, a first in New Hampshire, and will help the Town meet nitrogen effluent limits and improve the water quality of the Lamprey River and Great Bay Estuary.

Newmarket has also honed in on stormwater runoff, pollution, erosion, and sedimentation. The Town has been proactive in making substantial efforts to reduce the total nitrogen load to the Lamprey River. Strategies include infrastructure maintenance, organic waste and leaf litter collection, enhanced street and pavement cleaning, and stormwater structural BMPs. Lastly, during the development of this chapter, the Town was actively working to develop and implement a water quality program to monitor the effectiveness and in-stream quality response of implementing the 2018 Nitrogen Control Plan as part of the EPA's Administrative Order of Consent.

Groundwater Threats

While New Hampshire is a relatively water rich state, NHDES recommends that surface waters are not used as a source for drinking water for private homes because of their risk to contamination. Instead, they suggest groundwater through bedrock wells or wells installed in sand and gravel. The Town withdraws water primarily from the Sewall Well and the Bennett Well (the MacIntosh Well facility was constructed and put into operation in 2016 and the Tucker well is permitted but has yet to be developed).



Map 9. Sea-Level Rise Scenarios in Newmarket [Source: NH GRANIT]

Impacts from Sea Level Rise (Groundwater Rise and Saltwater Intrusion)

In 2017, Strafford Regional Planning Commission (SRPC), in partnership with the University of New Hampshire (UNH) implemented a groundwater modeling study to "identify existing and potential future locations where public water systems may be vulnerable to sea-level rise impact on groundwater" in Newmarket. The analysis identified one contamination hazard site, one local potential contamination site, one sewer pump station, as well as 30 private drinking water suppliers that have a potential to be impacted by groundwater rise. In addition, the study found that the Moody Point development is projected to experience saltwater intrusion.

Did you know?

In March 2019, Newmarket voters approved up to $12.2 million in municipal bonds for seven water system upgrade and extension projects, including construction plans to extend a public watermain to the Moody Point development in response to the groundwater rise threat. The project ranked #10 (out of 72) in the 2019 NHDES drinking water SRF project priority list and is scheduled for construction in the summer of 2021.

As a coastal community, Newmarket will have to explore opportunities to combat salinity concentrations with new water treatment technology, replacement of underground pipes that corrode faster under salt water, and possibly the extension of municipal water infrastructure to locations with high salt concentrations. Homeowners may need to site new private drinking wells and relocate septic systems.

Public Water Supply Susceptibility
Drinking water can be contaminated through natural or man-made causes. Man-made contamination can happen because of failing septic systems, animal waste, plumbing fixture leaching, leaking storage facilities, or improper waste disposal. Public health standards are in place to protect water sources, and New Hampshire currently tracks four man-made contaminants: atrazine, Di (2-ehylhexyl) Phthalate (DEHP), Tetrachloroethylene (PCE), and Trichloroethylene (TCE) to protect community water systems.

In 2007, NHDES assessed the vulnerability of every source of public water in Newmarket. Each source is ranked according to several criteria. According to the report, of greatest concern in Newmarket are confirmed detections of certain contaminants, the presence of numbered state highways or active railroads, the presence or density of septic systems and sewer lines.

Aquifers
As mentioned in the Surface and Groundwater Section, there are four identified stratified-drift aquifers deposits in Newmarket encompassing a total of 657.5 acres. While these are extremely important from a biological standpoint, they are at risk due to the combination of inland droughts and floods, increased surface water components and diversions, increased groundwater withdrawals, sea level rise, and increased storm surges. The Sewall Well and the Bennett Well produce high quality drinking water that requires minimal treatment. However, recent studies indicated that the rate of withdrawal from this source and several years of drought conditions resulted in the lowering of the groundwater levels in the aquifer. Recovery of the aquifer after the drought years of the early 2000's has continued, reaching nearly expected capacity with careful management of water withdrawals. Since the drought, the Town has initiated a water management program, allowing better control of water use during times of drought or other periods of high demand on the water system.

Land Use Discharges into Groundwater
In Newmarket, groundwater usually flows from areas of high groundwater altitude toward natural discharge areas in the Lamprey River and Great Bay. While groundwater is naturally cleaned of particulate matter, both natural and human-induced chemicals can still be found in it. Industrial discharges, groundwater intrusion, urban activities, agriculture, groundwater pumping, and disposal of waste can all affect the groundwater quality. Any commercial activity using regulated substances or contaminants that discharges into the ground, or any activity that releases a chemical having a groundwater standard without approval from NHDES is a violation of state law (See NH Code of Administrative Rules Part Env-Ws 421 and Newmarket Code of Ordinances CH. 32 Art. V Sect. 32-153 "Aquifer Protection Overlay District).

Arsenic, Radon, and other Natural Contaminants Levels
According to survey data from the Spring 2018 Granite State Poll, NH resident's top concerns about their drinking water include bacteria, PFC, lead, arsenic, radon, taste, and odor.

Arsenic occurs naturally in groundwater across New Hampshire. When present above the drinking level standard, it is important to reduce the concentration as it has negative long-term consequences on human health. In October 2019, the State of NH lowered the Maximum Contaminant Level for arsenic in drinking water from 10

parts per billion (ppb) to 5 ppb.[17] Currently, the Town water system levels are at 6 ppb. To become compliant by July 1, 2021, Newmarket is designing a new facility to treat water from the Macintosh and Tucker Wells to lower arsenic levels to 2 ppb.

Radioactive elements (radon, radium 226, radium 228, uranium, and gross alpha emitting particles) are naturally present in New Hampshire rock, soil, and water. When dissolved in water, radionuclides are colorless, tasteless, odorless, and cannot be detected by our senses, but are a health concern regarding such as cancer, kidney damage, and tumors with long-term exposure.[18] All drinking water radionuclides can be treated at the kitchen sink or point-of-use as they are not volatile and cannot be absorbed through the skin. Newmarket's water system is in compliance with the Safe Drinking Water Act requirements.

Most radon exposure is through the air because it is a gas. A smaller amount of exposure happens through water because water use (shower and water use) exposes the radon. Radon concentrations in both air and water are measured in picocuries per liter (pCi/L) and NHDES recommends a general rule of thumb that for every 10,000 pCi/L of radon in a home's water supply, the radon concentration in indoor air is increased by 1 pCi/L.

Higher sodium and chloride levels imply contamination of groundwater sources by human activities, including the use and storage of road salt, discharges from water softeners, human or animal waste disposal, leachate from landfills, and other activities.[19] Chloride, in the form of salt, is imported to local watersheds from several major sources: roadway deicing, snow removal, food waste, water softeners, atmospheric deposition, and roadway salt pile runoff. Chloride is most transported within a watershed through stormwater runoff and groundwater flow to surface waters. Year to year variations in chloride contributions are primarily due to differences in the severity of any given winter. Currently, the Town is not required to have a Chloride TMDL[20], as it is not on the 3030D List for Newmarket, but the Town might need to address it as part of NH-MS4 in the future.

According to the Groundwater Modeling study, high levels of sodium and chloride can result in increased treatment costs for water providers and may render groundwater wells unusable. This may require the development of new well locations or alternative sources of freshwater. Sodium and chloride levels in the seacoast area typically reach up to 75 mg/L sodium and 150 mg/L chloride. While the EPA does not identify a maximum contamination level, advisory drinking water standards for these two contaminates are 250 mg/L (a concentration level at which drinking water can taste salty). Higher levels of sodium and chloride can also indicate that surface water is reaching wells and is potentially bringing in other contaminants with it. While public water sources are regulated, private wells are not and could be more prone to contamination. Newmarket's water system is in compliance with the Safe Drinking Water Act requirements.

PFAS

PFAS stands for "Per- and Polyfluoroalkyl Substances." These are synthetic chemicals that have historically been used in a variety of household and commercial products from non-stick cookware and microwave popcorn bags, to shampoo and dental floss. Outside of the home, they have been used in firefighting foams and other industrial processes. While studies do not clearly show whether PFAS causes cancer and further study is needed, several studies suggest that PFAS may have various harmful impacts on human health.

[17] https://www.newmarketnh.gov/water-wastewater/pages/arsenic-levels-october-2019
[18] NHDES Radionuclides in Drinking Water Fact Sheet
[19] NHDES Sodium and Chloride in Drinking Water Fact Sheet
[20] Total Maximum Daily Load refers to pollutant reduction a water body needs to meet NH's water quality standards.

In July 2016, New Hampshire Department of Environmental Services emailed and/or mailed a letter requesting that all community and non-transient, non-community water systems voluntarily sample for PFOA, PFOS, and four other per fluorinated chemicals (PFCs) totaling nine samples. Results from this effort led to NHDES deciding that Newmarket did not need to continue monitoring on a regular basis.

In July 2018, the Water Department made the decision to resample for PFOA and PFOS because technology made it possible to detect a greater number of per fluorinated chemicals. Again, Newmarket came back well under accepted levels according to New Hampshire Department of Environmental Services. The Town of Newmarket Water Department plans to continue to sample for PFOA/PFOS as science and technology improves making it possible to detect different variations of per fluorinated chemicals to try and stay ahead of this emerging contaminant. In July 2020, a NH law set new standards were set and require local water systems, landfills, and wastewater plants to routinely test and treat for four PFAS chemicals. These include PFOA, PFOS, PFHxS, and PFNA. These will take effect in October 2020.[21]

Offline Wells

Bennett and Sewall Well pump stations are essential to the overall supply capacity for Newmarket's drinking water system, and yet have undergone only minor upgrades since their installation. If one of these wells were to go offline line, Macintosh's well supply would need to be reduced because this water currently needs to be blended with the Sewall and Bennett wells. Improvements, according to recommendations by Underwood Engineers[22], include replacing the chemical feed, electric, heating, ventilation, and some structural improvements.

Surface Water Threats

Newmarket currently does not use any surface waters as a source for public drinking water and there are no plans to charge aquifers with surface water from the Lamprey River; however, there are several important surface water resources that play a vital ecological role in the community. As mentioned in surface and groundwater section, the Lamprey River, Great Bay, Piscassic River, Moonlight Brook are all identified waterbodies that are impaired or threatened. This means they are not expected to meet water quality standards within a reasonable time even after the application of best available technology standards or best management practices; or they require a comprehensive water quality study (total maximum daily load) in order to meet water quality standards.

Lamprey River Winding Through the Downtown Mills
Photo Credit: Bill Doucet

Stormwater Runoff

Studies conducted in the northeast have documented that by converting as little as ten (10) percent of a watershed to impervious surfaces, stream water quality, stream channel structure, and species habitat begins to deteriorate. As of 2015, Newmarket's land based (excluding open water) impervious coverage[23] was estimated to be 8% and will likely rise as Newmarket continues to grow.

[21] More information is available here.
[22] Macintosh and Tucker Wells Treatment Evaluation
[23] An updated GIS impervious coverage dataset for 2020 will likely be available sometime in 2021.

According to data collected during the development of the 2015 Vision Chapter, residents expressed their concerned with this population growth and the impacts it could have on water quality. Development associated with rapid population growth changes the natural water balance on a site by increasing impervious area and reducing the amount of ground area capable of infiltration, converting naturally vegetated areas to impervious or manicured areas, and compacting natural soils.

On July 1, 2018, Newmarket officially became subject to the United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) program. This is a national program aimed at improving New Hampshire's water quality, with improved stormwater management as well as an array of training and implementation tools to assist communities with implementation, commonly referred to the MS4 program.

Increased Flooding Impacts

In New Hampshire, there are many types of flooding: riverine, flash flooding, coastal flooding, and shallow flooding. Riverine flooding is produced by a river or stream and has potential to last for longer periods of time. Flash flooding can occur when large amount of rain falls in a short amount of time, and usually rise and recedes quickly. This allows little or no warning time to evacuate and can be destructive and hazardous. Coastal flooding occurs in low-lying areas in NH's coast due to major storms in combination of full moon tides causing storm surge and wave effects. Shallow flooding occurs in flat areas where water is prevented from draining easily due to inadequate channels. One type of shallow flooding, urban drainage, occurs when man-made drainage structures, meant to handle 10 year-storm water levels, are overloaded by larger storms and result in backed-up sewers and overloads ditches.

Roadway Damage from Flooding
Photo Credit: Town of Newmarket

Although the flood mitigation capacity of floodplains is relatively well protected by federal and local regulations, other factors can contribute to increased flooding. These factors include: increases in impervious surface coverage, filling of wetlands, stormwater management practices that increase peak flow rates, inadequate infrastructure to accommodate current storm flow volumes, beaver dams and less natural dissipation of flood flows through infiltration and interception by trees and vegetation.

Other identified flood risks include the inability of culvert stream crossings to withstand storm flows (see C-RiSe report for hydraulic ratings and assessments), loss of tidal wetlands and salt marsh habitat from sea level rise.[24] Current threats to salt marshes include reduced tidal flow due to undersized culverts under roadways and train beds, loss of the upland buffer due to coastal development, saltwater intrusion, and colonization by invasive species such as australis (autrian pine)and Lythrum salicaria (purple loosestrife).

Erosion and Sedimentation

The erosion and sedimentation development processes typically involve the removal of vegetation, the alteration of topography, and the covering of some previously vegetated surfaces with impervious cover such as roads, driveways, and buildings. These changes to the landscape may result in the erosion of soil and the sedimentation of water bodies as soil travels to streams, rivers, and lakes in water runoff during storms at an increased velocity due to the lack of vegetative cover. The removal of vegetative cover and its roots system

[24] NH Wildlife Action Plan Appendix B Habitats

compromise the ability of vegetation to stabilize soil, reduce the velocity of runoff, shield the soil surface from rain, and maintain the soil's ability to absorb water.

Increased Extreme Temperatures and Drought

Over the past two decades, Newmarket has experienced several significant periods of drought (2001-2002; 2015-2016; and most recently 2020). According to the NH Drought Management Program, the drought that impacted the state in the early 2000's was the third worst on record. Locally, during the dry summer months, the capacity of Newmarket Plains Aquifer, which was the Town's primary source of drinking water, was significantly reduced to critical levels; however, with careful management the aquifer recovered within a few years. To accomplish this, the Town started implementing a Water Management Program in 2002 (see Figure 4.) that requires all users to adhere to restrictions during these critical dry periods.

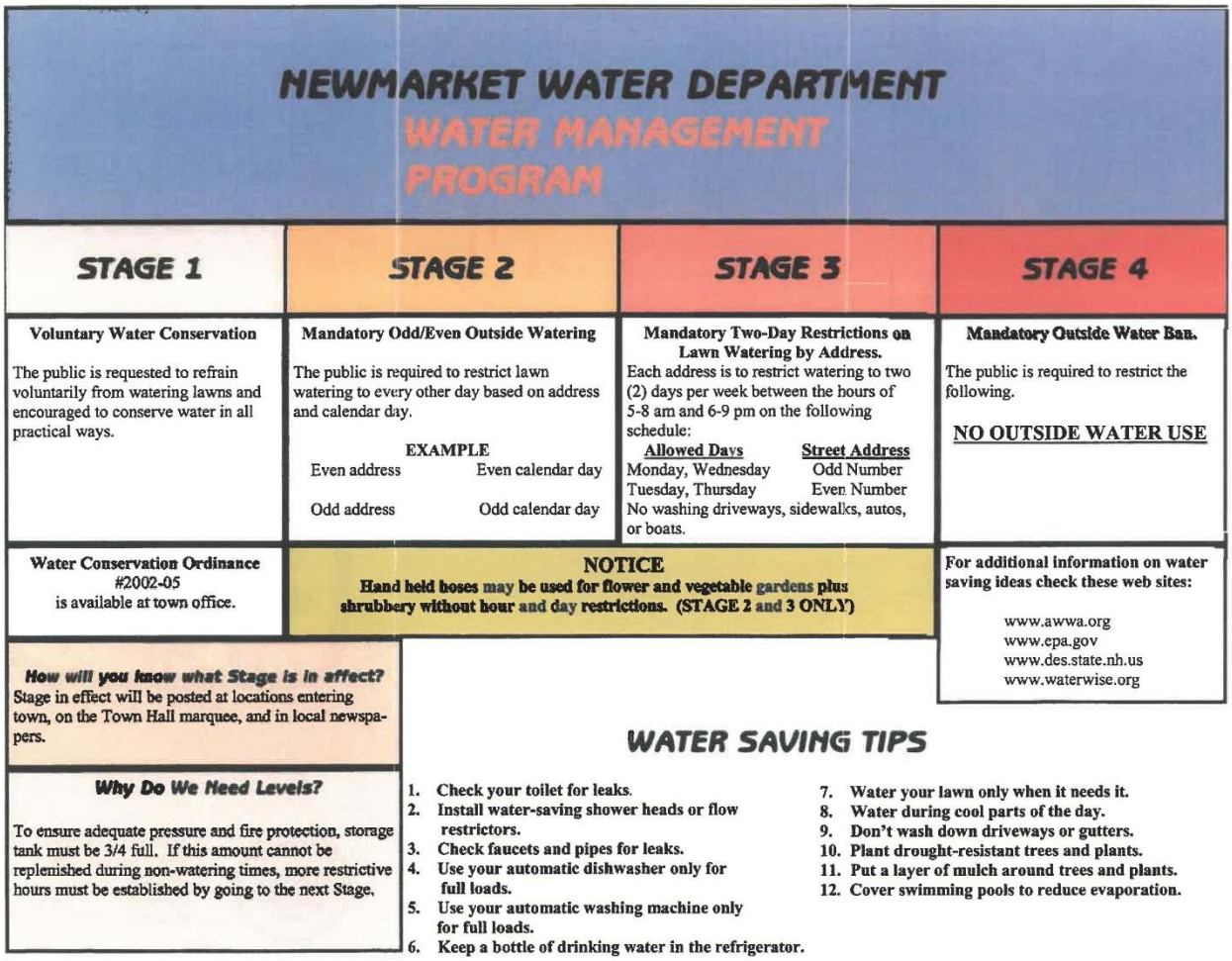
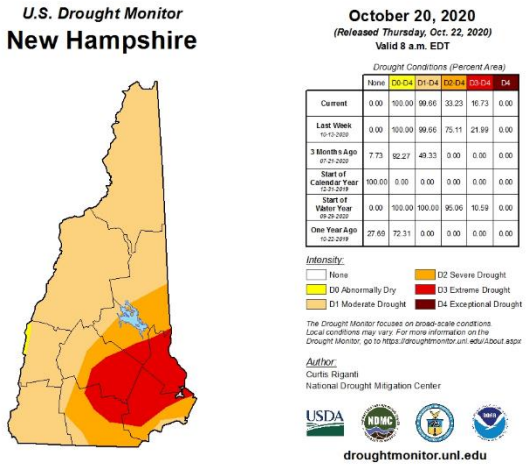


Figure 4. Newmarket's Water Management Program

For many years, the Town has operated at a Stage 2 level. More recently in September 2020, that warning was upgraded to a Stage 3 level. The upgraded warning was a result of severe drought conditions along with the decision to remove the MacIntosh well off-line temporary to install treatment for arsenic. Capacity at both the Bennett and Sewall wells appear to be in good condition. This is largely because when the MacIntosh well came online in 2016, it allowed the Town to operate the Bennett and Sewall wells at lower pumping rates for 4 years.

As the 2020 drought continues, 100% of New Hampshire's population is experiencing abnormally dry conditions. According to the United States Drought Monitor, it is estimated that 16.7% of the State is facing extreme drought conditions, categorized by major crop or pasture losses and widespread water restrictions and shortage. Figure 5 depicts the most up-to-date drought conditions in New Hampshire (at the time this plan was developed) and indicates that Newmarket is in an area experiencing the most severe conditions in the State.

Figure 5. US Drought Monitor: New Hampshire (10/20/20)



The NHDES Drought Management Program has stated that the drought was due to a combination of a below average snowpack in the spring, little precipitation to recharge the groundwater, and the inability of watersheds to store large volumes of water due to their geology.

More extreme heat in New Hampshire, because of climate change, not only causes a rise in electricity demand and urban heat effects, but also increases the demand for water. Additionally, as air temperatures rise, so do ocean, lake, and river temperatures. This can lower water quality and affect fish populations (such as causing them to migrate and loose suitable habitat) and the deaths of other aquatic organisms. The 2014 National Climate Assessment states that increasing air and water temperatures, paired with increases precipitation and runoff, and intensifying droughts can decrease water quality in several ways. These potential threats include increases in sediment, nitrogen, and other pollutant loads and other climate change triggers such as declining water levels, greater flood risk, and altered precipitation patterns.[25]

Often paired with increases in extreme heat are increase in drought across the U.S. Droughts are natural events that are part of the cyclical fluctuations of the climate; they can last anywhere from several months to years but there is not reliable method to accurately predict a drought.[26] Even in New England, where water is comparably abundant to the rest of the U.S., recent droughts—paired with NH's limited long-term water storage—have serious consequences on human demand for freshwater resources.[27] Compounding on these issues are increased demand for drinking water, saltwater intrusion, and rapidly development in watersheds, more extreme temperatures because of climate change.

Regulatory and Conservation Challenges

Regulatory

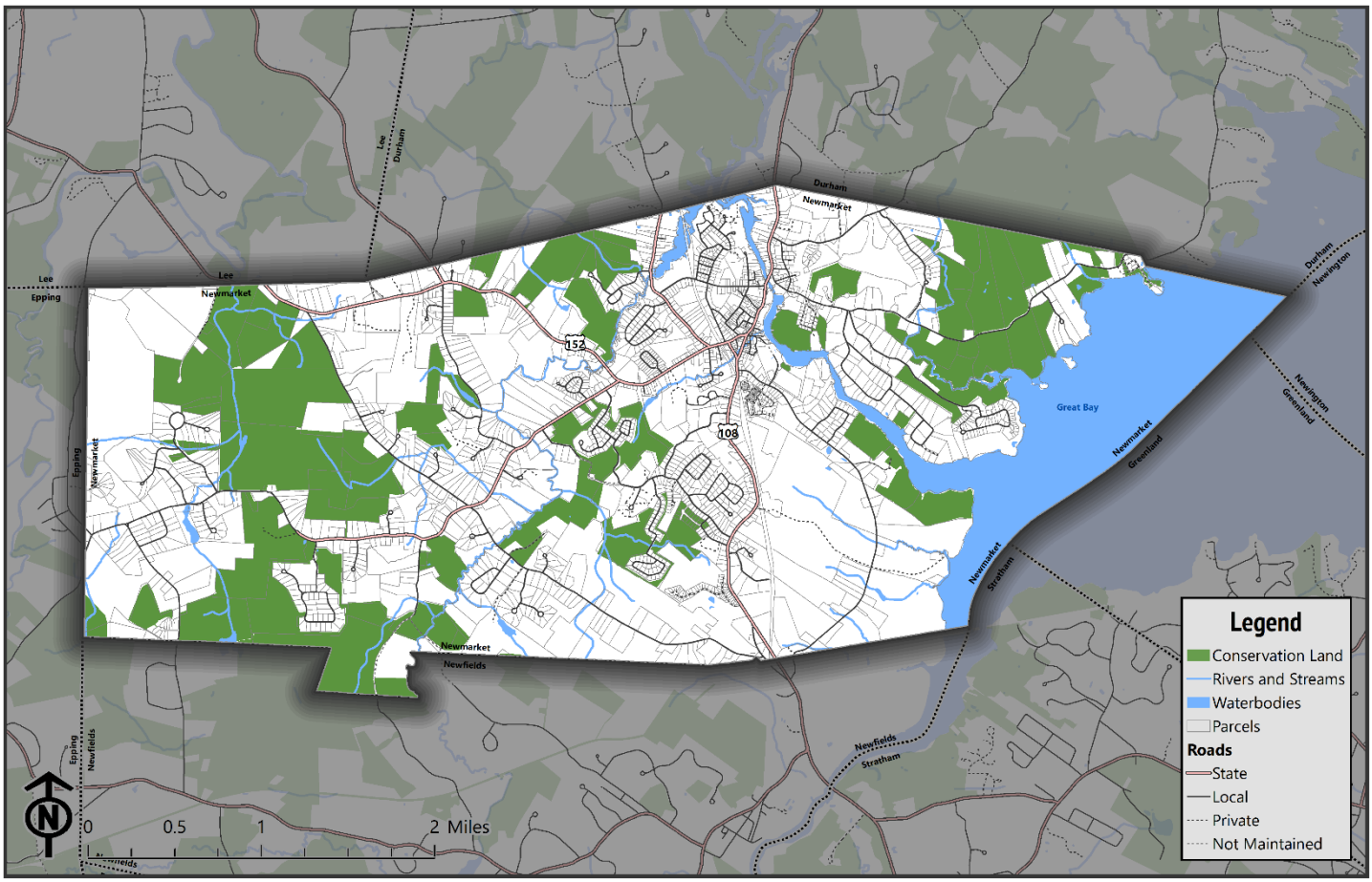
Current water regulations, which are based around preservation and restoration, assume that natural systems "fluctuate within an unchanging envelope of variability (stationarity)". [28] Climate change is projected to impact water supplies in wide-ranging and pervasive ways and may reveal weaknesses in current water regulations.

[25] More information can be found on the Conservation in a Changing Climate website.
[26] NHDES Water Resources Primer
[27] Analysis of Drought Conditions in New Hampshire. J.M. Davis and M. Stampone. University of New Hampshire. December 2014. Available here.
[28] Ibid

Therefore, assumptions about stationarity are unhelpful when writing and using water regulations. Agencies may need to seek flexibility in regulations and laws to achieve the best use of limited water resources and capacity.

Conservation Challenges

New Hampshire watersheds rank among the most highly threatened watersheds in the nation because of the high potential for conversion of private forests to residential development. In fact, three of the four most threatened watersheds in the US (which could experience the largest change in water quality because of increased residential development in private forests) occur at least partially in New Hampshire.[29] The long-term impacts of this rapid population growth and the associated changes in land use on New Hampshire's surface waters are uncertain. Of concern are the impacts of pollution such as septic systems, urban runoff, stormwater, application of road salt and fertilizers, deforestation, and wetland conversion.



Map 10. Conservation Lands in Newmarket [Source: NH GRANIT]

Newmarket's Vision for the Future emphasizes the importance of numerous environmental protection measures, including conservation of land and preservation of open spaces for the town's ongoing drinking water goals to be met. The 2015 Master Plan Visioning Public Input Session revealed that the public values the Town's emphasis on conservation and want to see it continue to be a priority.

[29] Stein et al. Private Forests, Public Benefits: Increased Housing Density and Other Pressures on Private Forest Contributions. USDA. 2009. Available here.

The Newmarket Open Space Plan reports identifies areas with key natural resources and a high priority for protection through land conservation efforts, including the Town's drinking water sources (Newmarket Plains Aquifer and surrounding wellhead protection areas); floodplains of the Lamprey and Piscassic Rivers; prime wetlands; the Great Bay Estuary; highest quality wildlife habitat (NH Fish and Game, Wildlife Action Plan); ecologically significant areas (NH Coastal Program, The Nature Conservancy, and partners); and large unfragmented blocks of forests and farmland.

Federal/State Protection Measures

Refer to Surface and Groundwater Resources section.

Existing Local Protection Measures

Refer to Surface and Groundwater Resources section.

Recommendations

1. Ensure that the sanitary protective radius around the four (4) existing wells (Tucker, MacIntosh, Bennett, and Sewall) are all protected and controlled by the Town through ownership or easements.
2. Continue to explore grant opportunities to secure funding for existing and future drinking water protection efforts.
3. Finalize DRAFT stormwater regulations and adopt at the Planning Board.
4. Ensure that land use regulations protect environmentally sensitive resources including drinking water aquifers, tidal wetlands, and salt marsh that are subject to potential saltwater intrusion or other negative impacts associated with groundwater rise.
5. Collaborate with NHDES to update 2007 assessment of public water supply sources for susceptibility criteria including well proximity to septic, highways, and agriculture. Use this assessment to identify threats and target protection management (such as education for landowners, an inspection program, or emergency response planning) techniques.
6. Encourage better management of activities that add salt into or onto the ground (i.e. using newer technologies, equipment upgrades, good housekeeping measures, and inspection of storage sites on commercial areas such as Bennett Way).
7. Consider requiring advanced treatment for septic systems to reduce pollution often associated with traditional systems.
8. Increase awareness of radon levels and protection practices for Newmarket residents by posting NHDES information on the Building Department's webpage.
9. Work with state, federal regulators, and the Seacoast PFAS Commission to minimize PFAS contamination in the Town. This may including exploring water and land uses that could mitigate PFAS use and release; obtaining the latest inventory of (Tier II) data collection for facilities that have the potential to discharge PFAS using guidance from NHDES (SWP Grant 301).
10. Increase coordination with other watershed towns, higher-level collaboration with water-related organizations and stakeholders, and encourage a greater involvement of Newmarket's Conservation Commission in leading public education programs on water resources management and efforts to ensure compliance with stormwater requirements.
11. Prioritize buffer and floodplain protection based on Buffer Options for the Bay's regulatory options and suggestions.
12. Review appropriate zoning for activities that use chemicals or processes that could affect drinking water to proactively protect these resources.

13. Research effective education and outreach efforts to strengthen Newmarket's community values around water resources. Create community dialog around water resource stewardship for future generations.
14. Ensure that Planning and Zoning Board members are aware and have access to relevant land use trainings (e.g. OSI conferences, NHMA lectures, regional planning workshops) so that participants fully understand local ordinances, regulations, and state laws when making important decisions.
15. Continue to appropriate adequate funding to enable the Town to implement recommendations set forth in Newmarket's "Twenty-Year Water and Wastewater System Build-Out Study."
16. Continue efforts in implementing the Water Management Plan and educating the public of what they can do to complement these local actions.

Implementation Key

Action Type:
There are three action types, including:

- Regulatory
- Operations, Policies, and Procedures
- Outreach, Engagement, and Partnerships

Action Item:
Various recommendations for the Town to consider implementing to protect water resources over the lifespan of the chapter.

Chapter Topic:
There are five water resource topics:

- SW: Surface Water
- GW: Groundwater
- WET: Wetlands
- FLD: Floodplains
- THR: Potential Threats

Protection Type:

- RP: Resource Protection
- DWP: Drinking Water Protection
- WQP: Water Quality Protection

Priority:
There are four priority rankings, including:

- Ongoing: Actions which are continuous or already being carried out
- High: Actions which should be undertaken in 1–2 years
- Moderate: Actions which should be undertaken in 3–5 years
- Low: Actions which will take more than 5 years to initiate and complete

Responsible Party:
The identified party or municipal department that is the acting or responsible body to implement that action item.

Implementation Matrix

Action Items		Chapter Topics	Protection Type	Priority	Timeframe	Responsible Party
Regulatory						
1.	Review the current Aquifer Protection Overlay District with the state's updated model ordinance to recommend any necessary revisions.	GW	DWP	High	1–2 years	Planning Board & Conservation Commission
2.	Review all permitted uses within the base zoning districts to ensure that high intensity uses are consistent and in sync with the goals and objectives outlined in the Master Plan.	SW/GW	RP/DWP	High	1–2 years	Planning Board & Conservation Commission
3.	Evaluate the current regulations and ordinances with regards to septic system setbacks to ensure all waterbodies are adequately protected.	SW	RP	High	1–2 years	Planning Board & Conservation Commission
4.	Compare the existing Wetland Protection Overlay District with new state rules and make necessary revisions to be consistent with jurisdictional areas and other state-level changes.	WET	RP	High	1–2 years	Planning Board & Conservation Commission
5.	Review the updated floodplain model ordinance from NH Office of Strategic Initiatives and update the Town's floodplain ordinance once FEMA maps are approved and adopted. An outreach campaign targeting existing property owners shall accompany this update.	FLD	RP	High	1–2 years	Planning Board, Conservation Commission, Building Official
6.	Ensure that the sanitary protective radius around the four (4) existing wells (Tucker, MacIntosh, Bennett, and Sewall) are all protected and controlled by the Town through ownership or easements.	THR	WQP	High	1–2 years	Town Council, Conservation Commission, Water Department
7.	Finalize DRAFT stormwater regulations and adopt at the Planning Board.	THR	WQP	High	1–2 years	Planning Board
8.	Review appropriate zoning for activities that use chemicals or processes that could affect drinking water to proactively protect these resources.	THR	WQP	Moderate	3-5 years	Fire Department & Town Council
9.	Consider adopting stricter buffer requirements for setbacks to wetlands that include consideration of climate change in order to protect land that allows coastal habitats and populations to adapt to changing conditions and also provides ecosystem services that protect people, structures, and facilities.	WET	RP	Low	5+ years	Planning Board & Conservation Commission
10.	Ensure that land use regulations protect environmentally sensitive resources including drinking water aquifers, tidal wetlands, and salt marsh that are subject to potential saltwater intrusion or other negative impacts associated with groundwater rise.	THR	WQP	Low	5+ years	Regional Planning Commissions (Strafford/Rockingham)
11.	Consider requiring advanced treatment for septic systems to reduce pollution often associated with traditional systems.	THR	WQP	Low	5+ years	Building Official
12.	Prioritize buffer and floodplain protection based on Buffer Options for the Bay's regulatory options and suggestions.	THR	WQP	Low	5+ years	Planning Board & Conservation Commission

Action Items		Chapter Topics	Protection Type	Priority	Timeframe	Responsible Party
Operations, Policies, and Procedures						
13.	Incorporate impacts to municipal infrastructure identified in the C-RiSe project into current and future capital infrastructure projects, including water access at Schanda Park, the pump station on Creighton Street, and flooding on critical roads such as Treatment Plant Road. This also includes evaluating the extent of sea-level rise and storm surge flooding on individual facilities such as sewer pipes located at the end of Water Street, Creighton Street, and Lamprey Street and the intersection of Bay Road.	FLD	RP	Ongoing	-	Town Department of Environmental Services
14.	Encourage better management of activities that add salt into or onto the ground (i.e. using newer technologies, equipment upgrades, good housekeeping measures, and inspection of storage sites on commercial areas such as Bennett Way).	THR	WQP	Ongoing	-	MS4 Coordinator, Town Planner, Town Engineer, and Public Works
15.	Continue to appropriate adequate funding to enable the Town to implement recommendations set forth in Newmarket's "Twenty-Year Water and Wastewater System Build-Out Study."	THR	WQP	Ongoing	-	Town Engineer & Town Department of Environmental Services
16.	Continue efforts in implementing the Water Management Plan and educating the public of what they can do to complement these local actions.	THR	WQP	Ongoing	-	
17.	Revisit the Climate Resiliency in Moonlight Brook report to accomplish remaining ICLEI Climate Resilient Communities milestones identified in the plan. Site specific projects include:	FLD/THR	RP/WQP	Ongoing/ High	1–2 years	MS4 Coordinator, Public Works, Town Department of Environmental Services
	Alleviate flooding in re-occurring areas by redirecting stormwater flows away from downtown in the "bowl " area on Route 108; installing a new drainage system with a gravel wetlands to provide water quality treatment on New Road and a stormwater outfall on Young Lane; and assess impacts upstream in the watershed at the new drainage system at the Elementary School.		RP/WQP RP/WQP			
18.	Update the Town's Prime Wetland Maps and associated GIS layers that were completed in 2006 using new available GIS and Lidar data.	WET	RP	High	1–2 years	Conservation Commission & Planning Department
19.	Update the Town's Open Space Plan to strategically identify high value land for future land conservation. Incorporate climate resilience benefits, such as future flood storage salt marsh migration, etc., into scoring criteria to ensure the Town considers climate adaptation benefits when evaluating land for conservation purposes.	FLD	RP	High	1–2 years	Conservation Commission

Action Items		Chapter Topics	Protection Type	Priority	Timeframe	Responsible Party
20.	Identify and implement green infrastructure and nature-based approaches to improve flood resilience and stormwater management throughout the Town referenced in the New Hampshire Flood Hazard Handbook.	FLD	RP	High	1–2 years	Planning Department, MS4 Coordinator, Planning Board
21.	Use resources, such as the NH Statewide Asset Data Exchange System (SADES) crossing database, Resilient Tidal Crossing Assessment, and the C-RiSe climate ready culvert analysis, to identify infrastructure projects for inclusion in the Capital Improvements Plan that would assist with long-term planning decisions regarding the placement, design, and size of new culverts or when upgrades and repairs are being made to existing culverts. Site specific projects include:	SW/WET/ FLD	RP	High	1–2 years	Conservation Commission & Public Works
	*Replacement of the Grant Road and Ash Swamp Road crossings over the Piscassic River to help restore surface waters to natural, free flowing systems.		RP			
	*Replacement of the Route 108 crossing over the northernmost unnamed perennial stream behind the Newmarket Storage that flows easterly beneath New Road into Great Bay to improve wetland function.		RP			
*Projects should include hydraulic analyses and survey data on channel dimensions to determine appropriate bridge sizing as part of a larger Town-wide infrastructure capacity assessment.						
22.	Integrate climate adaptation measures into all future master plan updates.	FLD	RP	Moderate	3-5 years	Planning Board & SRPC
Data, Studies, and Research Needs						
23.	Explore funding opportunities to conduct a town-wide vernal pool inventory to locate, document, and map vernal pools in Newmarket.	WET	RP	Ongoing	-	Conservation Commission
24.	Review Appendix C in the Town's 2018 Multi-Hazard Mitigation Plan to identify riverine flooding mitigation approaches, including prevention, property protection, natural resource protection, emergency services, structural projects, and public education.	FLD	RP	Ongoing	-	Emergency Management Director, Public Works, Town Engineer
25.	Continue to explore grant opportunities to secure funding for existing and future drinking water protection efforts.	THR	WQP	Ongoing	-	Town Department of Environmental Services
26.	Collaborate with NHDES to update 2007 assessment of public water supply sources for susceptibility criteria including well proximity to septic, highways, and agriculture. Use this assessment to identify threats and target protection management (such as education for landowners, an inspection program, or emergency response planning) techniques.	THR	WQP	Ongoing	-	Town Department of Environmental Services
27.	Use the New Hampshire Living Shoreline Site Suitability Assessment to identify sites in Newmarket that may be suitable for specific living shoreline approaches to address erosion issues along the tidal shoreline.	FLD	RP	Low	1–2 years	Conservation Commission, Riverfront Committee, Lamprey River Advisory Committee, SRPC

Action Items		Chapter Topics	Protection Type	Priority	Timeframe	Responsible Party
28.	Work with state, federal regulators, and the Seacoast PFAS Commission to minimize PFAS contamination in the Town. This may including exploring water and land uses that could mitigate PFAS use and release; obtaining the latest inventory of (Tier II) data collection for facilities that have the potential to discharge PFAS using guidance from NHDES (SWP Grant 301).	THR	WQP	Low	1–2 years	Water Department & Town Department of Environmental Services
29.	Investigate funding opportunities to help pay for the development of watershed-based plans to recommend methods to address specific impairments identified in the 303(d) list.	SW	RP	Moderate	3-5 years	MS4 Coordinator, Town Engineer, Town Department of Environmental Services, and Conservation Commission
Outreach, Engagement, and Partnerships						
30.	Continue to support local watershed groups and organizations.	SW/GW	RP/DWP	Ongoing	-	All Town Boards, Commissions, and Departments
31.	Collaborate with local, regional, and statewide partners to identify other wetland mitigation projects or restoration opportunities.	WET	RP	Ongoing	-	Conservation Commission
32.	Explore options to develop a creative outreach campaign to educate the public on future coastal flood risk (i.e. high-water mark initiative, participation in the king tide photo contest, etc.) at public spaces such as Schanda Park and Heron Point.	FLD	RP	Ongoing	-	Conservation Commission & Historical Society
33.	Increase coordination with other watershed towns, higher-level collaboration with water-related organizations and stakeholders, and encourage a greater involvement of Newmarket's Conservation Commission in leading public education programs on water resources management and efforts to ensure compliance with stormwater requirements.	THR	WQP	Ongoing	-	Conservation Commission
34.	Research effective education and outreach efforts to strengthen Newmarket's community values around water resources. Create community dialog around water resource stewardship for future generations.	THR	WQP	Ongoing	-	MS4 Coordinator
35.	Ensure that Planning and Zoning Board members are aware and have access to relevant land use trainings (e.g. OSI conferences, NHMA lectures, regional planning workshops) so that participants fully understand local ordinances, regulations, and state laws when making important decisions.	THR	WQP	Ongoing	-	Planning & Zoning Boards
36.	Increase awareness of radon levels and protection practices for Newmarket residents by posting NHDES information on the Building Department's webpage.	THR	WQP	Low	1-2 years	Building Department