Section 4: Environmental Inventory and Analysis

This section explores the biological and physical components of some of the town's ecosystems. These components include soils, surface and ground water, vegetation, fisheries and wildlife. *Topography, Geology, and Soils* provides a general understanding of the ways different soil characteristics can impact land use values. *Landscape Character* provides an overall scenic context. *Water Resources* derscribes all of the water bodies in town, above and below ground, including their recreational value, public access, and any current or potential quality or quantity issues. In the subsection *Vegetation*, Gill's forest, farmland, and wetlands are documented and in *Fisheries and Wildlife*, wildlife, habitat, special corridors, and rare, threatened, and endangered species are discussed. Gill's *Scenic Resources and Unique Environments* are identified. Finally, *Environmental Problems* addresses current and potential problems that may influence open space or recreation planning.

The natural resources and scenic landscapes of the Town of Gill have been cherished by residents for generations. This Open Space and Recreation Plan is intended to help residents protect the town's scenic value and natural resources in the face of potential increasing development and changes in land use, while recognizing that people need places to live, learn, work and play. These needs – when sited in areas previously unsettled rather than as infill in existing developed areas – can require infrastructure such as homes, roads, power, water, and wastewater systems. These collective needs, in turn, depend upon and impact critical natural systems. One way to understand the impact of development on natural resources is to understand the ecosystem of the town and the region.

Ecosystems and Mapping

Ecosytems

An ecosystem is a geographically specified system of organisms, including humans, their environment, and the processes that control their dynamics. Ecosystems involve complex connections between organisms and their environment, and the processes that drive the system and can occur at different scales.[1] A large forest and a decayed tree trunk are both examples of ecosystems. The health and function of ecosystems depend on the relationship between living beings and their environment.

Ecosystems provide a variety of "services" that are very important to human communities. Wetlands, for example, filter rainwater, store floodwaters, recharge water to groundwater aquifers, and provide habitat for many aquatic plant and animal species. All ecosystems are vulnerable to any changes to the environment, whether naturally occurring or human made. Understanding the complexity of the systems in which we live can help Gill residents to consider the impact of actions and land uses on the environment and on their quality of life.

[1] http://ecosystems.noaa.gov/what_eco.htm

DRAFT

Documenting and Mapping Ecosystems: BioMap2

Just as the Town of Gill contains multiple and varied ecosystems, the state of Massachusetts, while relatively small, has many diverse ecosystems and habitats. Documentation and mapping of such ecosystems and habitats – and their associated flora and fauna – can be a first step toward protecting and preserving these resources.

To that end, in 2010 The Massachusetts Department of Fish and Game and The Nature Conservancy launched *BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World.*[2] This project, produced by the Natural Heritage and Endangered Species Program (NHESP), is a comprehensive biodiversity conservation plan for Massachusetts. Last updated in 2001, this new plan endeavors to protect the state's biodiversity in the context of projected effects of climate change.

BioMap2 combines NHESP's 30 years of rare species and natural community documentation with the Division of Fish and Wildlife's[3] 2005 State Wildlife Action Plan (SWAP). It also integrates The Nature Conservancy's assessment of ecosystem and habitat connections across the State and incorporates ecosystem resilience in the face of anticipated impacts from climate change. Note: *BioMap2* data replaced former BioMap and Living Waters data.

Figures 4-1 and 4-2 and Table 4-1 show the core findings summed up in *BioMap2's* Executive Summary.

Figure 4-1: Core Habitat Statewide Summary

Figure 4-1: Critical Natural Landscape Statewide Summary

[2] http://www.mass.gov/dfwele/dfw/nhesp/land_protection/biomap/biomap_home.htm
[3] http://www.mass.gov/dfwele/dfw/

Table 4-1: BioMap2 Statewide Summary Total Acres and Acres Protected

	Total Acres	Percent of State	BioMap2 Acres Protected
Core Habitat	1,242,000	24%	559,000
Critical Natural Landscape	1,783,000	34%	778,000
BioMap2 Total *(with overlap)*	2,092,000	40%	861,000

Documenting and Mapping Ecosystems: NHESP Priority Habitats

Priority and Estimated Habitats is a program administered by NHESP. Identification and mapping of Priority and Estimated Habitats is based on the known geographical extent of habitat for all state-listed rare species, both plants and animals, and is codified under Massachusetts Endangered Species Act (MESA). Habitat alteration within Priority Habitats is subject to regulatory review by the Natural Heritage & Endangered Species Program. Priority Habitat maps are used for determining whether or not a proposed project must be reviewed by the NHESP for MESA compliance.[4]

Benefits of BioMap2 and NHESP Priority Habitats

On the statewide level, mapping Core Habitat and Critical Natural Landscapes helps to guide strategic conservation to protect those areas that are most critical to the long-term survival and persistence of rare and other native species and their related habitats and ecosystems. On the local level, Gill can use this information to better understand where the Town's ecosystems and habitats fit into the bigger picture. For example, a seemingly insignificant parcel of land could be a key link to two larger, intact ecosystems. BioMap2 can help the Town of Gill look beyond its municipal boundary to plan for open space and recreation needs.

On an individual landowner level, BioMap2 – as well as NHESP Priority and Supporting Habitats – is an important tool that can be used to apply for grants to help improve, manage and monitor certain lands. An example is the Mass Wildlife Landowner Incentive Program, which helps fund efforts to maintain grasslands and create areas of young tree and shrub growth (early woodlands) to enhance wildlife habitat, with preference given to land that is classified as or nearby NHESP areas.

Information and mapping from BioMap2 and NHESP Priority Habitats will be referenced throughout this section on Environmental Inventory and Analysis. Related maps – Maps 4-1 and 4-2 – are located at the end of this section.

Geology, Soils and Topography

Decisions relating to open space and recreation planning should take into consideration the inherent suitability of a site for different uses. The condition of geology, soils, and topography is essential in determining potential sites for future development, for farming and forestry, and for new parks, hiking trails, and open space. Maps relevant to geology, soils, and topography are

[4] http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/priority_habitat_home.htm

DRAFT

Maps 4-3 and 4-4, found at the end of this section. Please note there are no digitalized soil data for Franklin County.

Geology

The Town of Gill as we know it today is the result of millions of years of geologic history such as great upheavals of the earth's crust and the sculpting power of moving water, ice and wind. This distinctive physical base has determined the distribution of the town's water bodies, its soils and vegetation and its settlement patterns, both prior to and since colonial times. Gill's current landscape can be better understood through its geologic history.

The Connecticut Valley was formed as a result of continental drift, almost 200 million years ago. Streams flowing into the river from higher areas brought alluvium, including gravels, sand and silt. At the time, the area that is now the Town of Gill was located south of the equator. The Dinosaur era had begun, and the footprints of these giant reptiles are still visible in the rock formed from sediments deposited on the valley floor millions of years ago. By the close of the Dinosaur age, the entire eastern United States, including Gill, was part of a large featureless plain, known as the peneplain, leveled through erosion, with the exception of a few higher, resistant areas. Today, these granite mountaintops, called monadnocks, are still the high points in this region. Local examples include Mt. Wachusett, Mt. Greylock, and Mt. Monadnock in New Hampshire.

The view up through the forest understory reveals jutting cliffs near Barton Cove's plunge pools.

As the peneplain eroded, the less resistant rock eroded to form low-lying areas, while bands of schist remained to form upland ridges. By this time, the Connecticut Valley had been filled with

sediment, while streams that would become the Deerfield, Westfield, and Farmington Rivers continued to meander eastward. The westward-flowing streams would become more significant later on. Approximately 8 million years ago, as the Rocky Mountains were forming in the west, the eastern peneplain shifted upward a thousand feet. As a result of this steeper topography, stream flow accelerated, carving deep valleys into the plain. Today, the visible remnants of the peneplain are the area's schist-bearing hilltops, all at about the same 1,000-foot elevation.

Approximately 2 million years ago, accumulated snow and ice in glaciers to the far north began advancing under their own weight. A series of ice ages followed, eroding mountains and displacing huge amounts of rock and sediment. This last glacier scoured and polished the land into its final form, leaving layers of debris and landforms that are still distinguishable. During the end of the last ice age, Lake Hitchcock, a 150 mile long inland lake formed in the Connecticut River Valley.

Four forms of bedrock can be found in the Town of Gill: Turners Falls Sandstone, Mount Toby Conglomerate, Sugarloaf Arkose and Deerfield Basalt.

Soils

Soil is the layer of minerals and organic material that covers the rock of the earth's crust. All soils have characteristics that make them more or less appropriate for different land uses. Scientists classify soils by these characteristics, including topography; physical properties including soil structure, particle size, stoniness and depth of bedrock; drainage or permeability to water, depth to the water table and susceptibility to flooding; behavior or engineering properties, and biological characteristics such as presence of organic matter and fertility Soils are classified and grouped into associations that are commonly found together.

What is Prime Farmland?

According to Natural Resources Conservation Service (NRCS), Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if managed with acceptable farming methods.

In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding.

The majority of Gill's soils fall into two major soil groups: Hollis-Charlton (about 45 percent) and Hinckley-Windsor-Merrimac (about 40 percent). The Hollis-Charlton group is typically well drained, varies in soil depth and can be characterized by both rolling and steep wooded hills. Ledges and rock outcroppings are also common to this group. The Hinckley-Windsor-Merrimac

DRAFT

group also has prime farmland capabilities. It is characterized by deep well-drained soils consisting of glaciofluvial deposits of sand, gravel and cobbles.

Within these soil types, soils can be classified as "hydric," or having certain qualities from occurring in or near a wetland. Hydric soils are good indicators for wetland delineation. The identification of hydric soils can aid in the preservation and remediation of freshwater wetlands as mandated by the Wetlands Protection Act.

Many of the soil types in Gill have prime farmland capabilities. Those areas with a prime farm land classification are good candidates for land conservation and use restrictions. In order for land to qualify for an Agricultural Preservation Restriction, it must meet several criteria including soil type. Included in any application for an APR must be a United States Department of Agriculture (USDA) Natural Resources Conservation Services (NRCS) Soils Map showing a breakdown of the Project's various soil types and acreage possessing soil capability Class I through VIII as well as prime farmland, soils of state or local significance, and unique soils.[5] Note: These soil maps have not yet been digitized for Franklin County.

An inactive fault line runs along the French King Gorge, separating the towns of Gill and Erving.

[5] http://www.mass.gov/agr/legal/regs/330_CMR_22.00.pdf

Topography

The Town of Gill's topography is a result of glacial deposition and river erosion. Gill's terrain varies greatly in slope from level floodplains to steep river valley terraces. Elevations in Gill range from 150 feet at the junction of the Fall and Connecticut Rivers to 816 feet at the top of Pisgah Mountain. Unsorted glacial deposits of soil and rocks, or drumlins, are present throughout Gill's landscape. A fault line, inactive for more than 140 million years, is located along the French King Gorge at the border of Gill and Erving. Other significant geologic features include the plunge pools at Barton Cove, the falls at the Turners Falls Dam, and glacial eskers at the Town Forest.

Landscape Character

As discussed in Section 3, Gill's landscape character is one of rolling hills, river terraces, farmlands, and upland forests. Distinguishing Gill from other towns in the area are its woodland brooks and streams, the Connecticut and Fall Rivers that form its eastern, southern, and western borders, and Barton Cove in the southwestern corner of town. In addition, the majority of Gill is still either forest or rolling pasture, and it boasts a number of distinctive archaeological and geologic sites of interest.

Gill also has a number of wooded wetland areas, which contribute greatly to the overall scenic quality of the town and to wildlife habitat. Gill's rural character stems from its long history as both a farming community and a mill town.

Potential Changes in Development

The overall scenic character of Gill could be affected by a number of potential changes. Potential impacts of climate change could begin to push populations further west in the State and more of Gill's land could be used for residential development. Diminishing supplies of fossil fuels – and their potential rising costs – continue to cause people to turn to alternate sources of locally produced energy sources, such as wood, which could impact Gill's woodlands. Related to the rising costs of fossil fuels, costs of shipping foods long distances could cause an even greater demand for locally grown and processed food, potentially causing more land to be farmed in Gill. Land that is currently forested and that contains prime farmlands could be converted to farmland. With thoughtful planning, though, Gill's landscape character, and the Town overall, could remain largely intact and could even return to a more lively and productive farming community.

Water Resources

The water resources discussed in this section are shown on Map 4-5 at the end of this section.

Watersheds

The Town of Gill contains one major watershed, the Connecticut River Watershed. Fall River Watershed is a sub-watershed of the Connecticut. The Connecticut River is nationally significant in that in 1991, Congress established the Silvio O. Conte National Fish and Wildlife Refuge, the only refuge in the country to encompass an entire watershed – the Connecticut River watershed

DRAFT

in New Hampshire, Vermont, Massachusetts and Connecticut. Seven years later, in 1998, the Connecticut River became one of only fourteen rivers in the country to earn Presidential designation as an American Heritage River.

Watershed Protection

Local watershed associations include the Connecticut River Watershed Council[6] (CRWC) which advocates for the entire, four-state Connecticut River watershed. The CRWC works to protect water—the river, its tributaries, lakes, fish; and the land, plants, and creatures connected to that water.

The CRWC has been conducting the following activities that include Gill:

- Bacteria Monitoring at Barton Cove: The CRWC has been conducting weekly monitoring of the state boat ramp at Barton Cove in the summer of 2011. In the last couple of years prior to 2011, they have done additional bacteria monitoring around the Cove, on the Gill and Montague sides, in order to better understand sources of occasional high readings at the state ramp. See http://www.umass.edu/tei/mwwp/ctrivermonitoring.html.
- CRWC continues to participate in advocacy related to the operation of Northfield Mountain pumped storage facility and the Turners Falls dam, with issues related to erosion, fish passage, and recreation. The CRWC are a member of the Connecticut River Streambank Erosion Committee. From 2009-2013, there are five ongoing streambank restoration projects along the riverfront in Gill.
- CRWC owns one piece of conservation land in Gill and has a conservation restriction on a riverfront property in Gill.
- In 2011, the CRWC facilitated a rain barrel workshop with the Gill Energy Committee as part of an effort to mitigate the impact of stormwater runoff on water resources.
- In 2008 and 2009, the CRWC received grants from several town cultural commissions (including Gill) to do a river song writing contest.

At the local level in Gill, the main mechanism in place to protect watersheds and surface waters are private and non-profit land trusts. The Conservation Commission also has the ability to impact watershed protection.

Source Water Assessment Program (SWAP)

Massachusetts has over 1,700 public water systems that provide drinking water to homes, schools, businesses, and industries. Over 90 percent of the state's population depends on public water supply sources, which are often vulnerable to contamination. More than 70 communities have shut down at least one source because it was contaminated. The Massachusetts Department of Environmental Protection (MassDEP) has had a strong water supply protection program since 1980. As a result, local water suppliers and municipal officials received more hydrogeological and planning assistance from MassDEP for improved protection of local drinking water sources.

MassDEP's SWAP process included the following:

- Delineated protection areas for all public ground and surface water sources;
- Inventoried land uses in these areas that may present potential threats to water quality;

[6] http://www.ctriver.org/about_us/index.html

DRAFT

- Determined the susceptibility of water supplies to contamination from these sources; and
- Publicized the results.

Source Water Assessment reports help local and state officials target inspections and focus technical assistance where they are needed the most, encourage cooperative emergency response, and contribute to comprehensive protection of all public water sources.

The results of the Assessment show the top five potential threats to public water sources are:

1. Residential lawn care/gardening;
2. Residential septic systems and cesspools;
3. Residential fuel oil storage;
4. Stormwater discharge; and
5. State-regulated underground storage tanks.

MassDEP is using this information to target technical assistance and outreach work. What does the Assessment tell the residents of Gill? The Assessment will tell the following:

- Whether your drinking water is from a surface or a groundwater source,
- The locations of the wells or the intakes,
- The water supply protection area,
- Potential Sources of Contamination (PSC) within the protection areas,
- What recommended steps you should take to maintain or improve protection. [7]

Four drinking water well or intake locations were identified in Gill including

1. Northfield Mount Hermon
2. Gill Elementary School
3. Alan's Bar B Que
4. Oak Ridge Golf Club

Each location has an overall ranking of susceptibility to contamination for the wells as "high." The Assessments are available to the public and can be accessed via the Massachusetts Department of Environmental Protection's website.[8]

Surface Water Resources[9]

The following inventory describes Gill's rivers, streams, brooks, and ponds and focuses on water quality issues and the public access and recreational value of these waters.

DRAFT

[7] http://www.mass.gov/dep/water/drinking/swapover.htm
[8] http://www.mass.gov/dep/water/drinking/weroreps.htm#g
[9] The 2010 Massachusetts Integrated List of Waters prepared by the Department of Environmental Protection (DEP) is used as a source document for the Connecticut River and all listed surface waters within the Town of Gill.The State is required by the United States Environmental Protection Agency to identify water bodies that are not expected to meet surface water quality standards after the implementation of technology-based controls. In each case, the most severe pollutant is identified. Although the affected water bodies may contain other pollutants, the Integrated List of Waters only includes the results of evaluations upon which DEP has performed some measure of quality control.

Connecticut River

The Connecticut River has a "Class B" water quality designation from the New Hampshire-Vermont border to Holyoke and is classified as a warm water fishery. Class B waters should provide suitable habitat for fish and other wildlife, and should support primary recreational activities such as fishing and swimming. Class B water should also be suitable for irrigation and other agricultural uses. Land along the Connecticut River – and the River itself – contains NHESP/TNC BioMap2 and NHESP Priority Habitats of Rare Species.

Connecticut River Water Quality Assessment

The "Connecticut River Basin 2003 Water Quality Assessment Report" published in 2008[10] by the Massachusetts Department of Environmental Protection presents a summary of water quality data/information in the Connecticut River Watershed by segment. The segment relevant to Gill runs from the Route 10 bridge in Northfield to the Turners Falls Dam in Gill. The complete text from this segment is available in the Appendix F of this plan.

Report Summary Status

This segment of the Connecticut River is assessed "Support" – or supporting of – all designated uses with the exception of fish consumption, which was assessed as "Impaired". See Table 4-1.

Aquatic Life Status

Although aquatic life status is "support", based upon the good survival of test organisms in toxicity tests and good water quality conditions. There is an alert status however, due to the regulated flow regime, severe bank erosion issues, the presence of non-native plant species and the risk that fish tissue contaminants pose to fish-eating wildlife.

Table 4-1: Connecticut River Use Summary Table

Connecticut River (Segment MA34-02) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		Recreation Primary Contact
Secondary Contact		Recreation Secondary Contact
Aesthetics		SUPPORT*

* Alert Status, see details in use assessment

Source: Connecticut River Basin 2003 Water Quality Assessment Report (2008)

Fish Consumption Status

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, fish consumption status is assessed as "impaired". Note: As this report is a

[10] Note: The Connecticut River Basin 2003 Water Quality Assessment Report is the most current data report. River samples are taken every five years. Samples taken in 2008 will be published in 2013.

number of years old, the impaired fish consumption was reviewed to determine whether the status was still valid. In September 2011, the Massachusetts Health and Human Services Department had in place a Public Health Fish Consumption Advisory[11] as follows in Table 4-2.

Table 4-2: Public Health Fish Consumption Advisory

Water Body	Hazard	Advisory	Fish Type
Connecticut River	PCBs (polychlorinated biphenyls)	P1 Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this water body.	All fish
		P2 The general public should not consume Channel Catfish, White Catfish, American Eel or Yellow Perch from this water body.	American Eel Channel Catfish White Catfish Yellow

Source: 2011 Massachusetts Public Health Fish Consumption Advisory

Primary and Secondary Contact Recreation and Aesthetics Status

These uses are assessed as "support" based upon the low bacteria counts and the lack of objectionable deposits, odors or oils. However, these uses did receive an "alert" status given the turbid conditions, regulated flow regime and severe erosion issues identified upstream.

Report Recommendations

Report recommendations include the following:

1. Due to the presence of an invasive algae found in the river, boaters should follow a check-clean-dry protocol when exiting waters
2. Continue river-bank stabilization projects
3. Continue water quality testing
4. Continue monitoring for the presence of invasive non-native aquatic vegetation

According to the Connecticut River Five Year Action Plan 2002-2007 developed by the Massachusetts Executive Office of Environmental Affairs, the Town of Gill lies in the most rural portion (the Northern Reach) of the Connecticut River Watershed in Massachusetts. Important characteristics of this part of the watershed include agricultural lands, large tracts of forestland, and the presence of two hydroelectric facilities. The Plan lists the following objectives for the Northern Reach:

- Increase awareness of the importance of riparian buffers along the mainstem of the Connecticut River and its tributaries;
- Reduce human-influenced erosion along the mainstem and its tributaries;
- Restore vegetative riparian buffers where appropriate;
- Protect water quality through the implementation of growth management strategies;
- Obtain additional water quality data;
- Reduce non-point source pollution with a particular focus on the mainstem and four priority tributaries;
- Assist communities with the protection of drinking water resources;
- Improve fish passage;
- Encourage the protection of important wildlife habitat;

[11] http://webapps.ehs.state.ma.us/dph_fishadvisory/SearchTown.aspx?Town=Gill

DRAFT

- Complete an updated inventory of existing boat access points;
- Implement an education program for boaters; and
- Assist with the development of a public access point on the Fall River in Bernardston.

Barton Cove

A part of the Connecticut River Greenway State Park, the Barton Cove Access Ramp is located on Route 2, 1.5 miles east of the Gill-Montague Bridge. Barton Cove and buffering lands contain areas of NHESP/TNC BioMap2 and NHESP Priority Habitats of Rare Species. Of special significance is the Bald Eagle, which uses the shoreline as nesting, feeding and perching habitat.

Barton Cove Boat Access and Campground

A part of the Connecticut River Greenway State Park, the Barton Cove Access Ramp is located 1.5 miles east of Turners Falls on Rte. 2. The boat ramp can accommodate recreational motorboats, canoes, and fishing boats. The Barton Cove state boat ramp is one of three state-managed public access points on the Connecticut River in Franklin County. The two others are Pauchaug Access in Northfield and the Sunderland Access.

Barton Cove Campground

Located on a rocky peninsula jutting into the Connecticut River, Barton Cove is a recreational area owned and managed by FirstLight Power Resources. People can use the site for day trips and picnicking or for a week-long camping trip. Barton Cove has bathroom and tent camping facilities and minimal automobile access. The area boasts a nature trail along a scenic rocky ridge overlooking the river, an abandoned dinosaur footprint quarry, unusual rock formations, a multitude of ferns and wildflowers, plunge pools of ancient waterfalls, and views of sunsets and bald eagles over the Connecticut River. Canoes and kayaks can be rented on an hourly or daily basis in season. Rock formations hanging out over small coves are best viewed in a canoe or kayak.

Otter Run

Otter Run flows into the Connecticut River approximately opposite the midpoint of Kidd Island's western shore.

Fall River

Fall River is located along the town's western border with Greenfield. This river empties into the Connecticut just below the Turners Falls dam and is a scenic and historic asset to the town. There are former mill sites along the Fall River, and its course meanders between cascades, small waterfalls and pools. The mills once used it for hydropower, but it is now primarily a place for fishing, swimming and is an important habitat corridor for wildlife. The middle third of section of Fall River that borders Gill is within the NHESP/TNC BioMap2. The southernmost quarter mile of the river is within the NHESP Priority Habitat of Rare Species.

Dry Brook

Dry Brook originates in the Town of Bernardston and flows into the Connecticut River near Grist Mill Road. At one time, Dry Brook was used to power five mills along its banks. Two of

DRAFT

the mills were known as Janes' Grist Mill and were located approximately 1,500 feet from the brook's confluence with the Connecticut River.

The entire length of Dry Brook is within the NHESP/TNC BioMap2 and is also designated as an NHESP Priority Habitat of Rare Species. Dry Brook supports a dense population of Eastern Pearlshell, a species of freshwater mussel known from only twenty-two water bodies in Massachusetts. This species inhabits streams and rivers that are cool and clean enough to support trout, its fish host.

Remnant of one of several grist mills in Gill tumbles into this stream.

Otter Brook

Otter Brook is located in the northern portion of Gill, is a tributary of Dry Brook and is fed by Otter Pond. There is also a sixty-acre marsh on Otter Brook off Ben Hale Road.

Beaver Brook

Beaver Brook is a tributary of Dry Brook. It originates in a wetland off Mountain Road and flows through Gill Center. It contains habitats for rare and endangered species.

Ashuela Brook

Ashuela Brook originates at Shadow Lake and flows into the Connecticut River approximately opposite the downstream end of Kidd Island. Parts of Ashuela Brook are within the NHESP/TNC BioMap2 and are also designated as NHESP Priority Habitat of Rare Species.

Lily Pond

Lily Pond is located off Barton Cove and is a plunge pool created by a glacial dam. It is considered part of the same NHESP area as Barton Cove.

DRAFT

Shadow Lake
Shadow Lake is a five and one-half acre lake located on the Mount Hermon Campus in the northeastern portion of Gill.

Cascade Brook
Cascade Brook, located in western Gill, flows into the Fall River near South Cross Road. The brook has a set of falls known as the Cascades located off South Cross Road. A wheelwright shop was once located at the falls.

Otter Pond
Otter Pond is a shallow six-acre pond located in the northwestern corner of Gill between Hoe Shop Road and Dole Road.

There are a number of other un-named streams, ponds and wetlands in Gill that are located in the Connecticut River Watershed.

Aquifer Recharge Areas

Aquifers are composed of water-bearing soil and minerals, which may be either unconsolidated (soil-like) deposits or consolidated rock. Consolidated rock, also known as bedrock, consists of rock and mineral particles that have been welded together by heat and pressure or chemical reaction. Water flows through fractures, pores and other openings. Unconsolidated deposits consist of material from the disintegrated consolidated rock like gravel and sand. Water flows through openings between particles.

As water travels through the cracks and openings in rock and soil, it passes through a region called the "unsaturated zone," which is characterized by the presence of both air and water in the spaces between soil particles. Water in this zone cannot be pumped. Below this layer, water fills all spaces in the "saturated zone". The water in this layer is referred to as "groundwater". The upper surface of the groundwater is called the "water table" (Masters, Gilbert. *Introduction to Environmental Engineering and Science, Second Edition*, 1998).

The route groundwater takes and the rate at which it moves through an aquifer is determined by the properties of the aquifer materials and the aquifer's width and depth. This information helps determine how best to extract the water for use, as well as determining how contaminants, which originate on the surface, will flow in the aquifer.

Aquifers are generally classified as either unconfined or confined (EPA and Purdue U.; 1998). The top of an unconfined aquifer is identified by the water table. Above the water table, in the unsaturated zone, interconnected pore spaces are open to the atmosphere. Precipitation recharges the groundwater by soaking into the ground and percolating down to the water table. Confined aquifers are sandwiched between two impermeable layers (Masters; 1998). Almost all the public wells in Massachusetts, including those in Gill, and many private wells tap unconfined aquifers (Mass. Audubon Society; 1985). Wells that rely on confined aquifers are referred to as "artesian wells."

DRAFT

Gill's surficial geology has characteristics that would support medium yield aquifers. A medium-yield aquifer provides a yield of between 25 and 1000 gallons per minute. According to MassGIS[12] and the United States Geological Survey (USGS), the following areas support medium-yield aquifers:

- An area approximately three-fourths of a mile to the north of Munn's Ferry Road and approximately one mile to the south of Munn's Ferry Road, along the Connecticut River;
- An area approximately one half mile to the north of Pisgah Mountain Road and approximately one half mile to the south of Pisgah Mountain Road, along the Connecticut River; and
- An area bordered by the town's border with Bernardston, Boyle Road, the intersection of Main Road and Cross Road and Dry Brook

Flood Hazard Areas

Flooding along rivers is a natural occurrence. Floods happen when the flow in the river exceeds the carrying capacity of the channel. Some areas along rivers flood every year during the spring, while other areas flood during years when spring runoff is especially high, or following severe storm events. The term "floodplain" refers to the land affected by flooding from a storm predicted to occur at a particular interval. For example, the "one hundred-year floodplain," is the area predicted to flood as the result of a very severe storm that has a one percent chance of occurring in any given year. Similarly, the 500-year floodplain is the area predicted to flood in a catastrophic storm with a 1 in 500 chance of occurring in any year.

According to the Town of Gill Multi-Hazard Mitigation Plan, there are approximately 583 acres within the 100 year floodplain in Gill. The plan identifies the Riverside section of Gill as a flood prone area in Town. Other areas within floodplain include the area along the Connecticut River in the farmland area northeast of Stacey Mountain, and in the area of Barton Cove, along the Fall River, Dry Brook and Otter Brook.

Wetlands

Wetlands are transitional areas where land-based and water-based ecosystems overlap. Inland wetlands are commonly referred to as swamps, marshes and bogs. Technically, wetlands are places where the water table is at or near the surface or the land is covered by shallow water. Sometimes, the term wetland is used to refer to surface water as well.

Historically, wetlands have been viewed as unproductive wastelands, to be drained, filled and "improved" for more productive uses. Over the past several decades, scientists have recognized that wetlands perform a variety of extremely important ecological functions. They absorb runoff and prevent flooding. Wetland vegetation stabilizes stream banks, preventing erosion, and trap sediments that are transported by runoff. Wetland plants absorb nutrients, such as nitrogen and phosphorus, which would be harmful if they entered lakes, ponds, rivers and streams. They also absorb heavy metals and other pollution. Finally, wetlands are extremely productive, providing food and habitat for fish and wildlife. Many plants, invertebrates, amphibians, reptiles and fish depend on wetlands to survive. Wetlands have economic significance related to their ecological

[12] MassGIS 2007 Aquifer Data Layer information: http://www.mass.gov/mgis/aq.htm

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functions: it is far more cost-effective to maintain wetlands than build treatment facilities to manage stormwater and purify drinking water, and wetlands are essential to supporting lucrative outdoor recreation industries including hunting, fishing and bird-watching.


This woodland wetland provides important habitat for wildlife in Gill.

In recognition of the ecological and economic importance of wetlands, the Massachusetts Wetlands Protection Act is designed to protect eight "interests" related to their function: public and private water supply, ground water supply, flood control, storm damage prevention, prevention of pollution, land containing shellfish, fisheries, and wildlife habitat. To this end, the law defines and protects "wetland resource areas," including banks of rivers, lakes, ponds and streams, wetlands bordering the banks, land under rivers, lakes and ponds, land subject to flooding, and "riverfront areas" within two hundred feet of any stream that runs all year. Local Conservation Commissions are responsible for administering the Wetlands Protection Act; some towns also have their own, local wetlands regulations.

Many of Gill's wetlands can be found in its uplands in isolated forested areas. Some of these wetlands are mapped by the National Wetlands Inventory (NWI).[13] Nearly all the wetlands mapped by NWI in Gill are classified as "freshwater forested/shrub", defined as a forested swamp or wetland shrub bog or wetland.[14] Most upland wetlands are associated with the headwaters of the major stream systems in town.

Vernal Pools[15]

Vernal pools are unique wildlife habitats best known for the amphibians and invertebrate animals that use them to breed. Vernal pools, also known as ephemeral pools, autumnal pools, and temporary woodland ponds, typically fill with water in the autumn or winter due to rising ground

[13] http://www.fws.gov/wetlands/Data/Mapper.html
[14] http://www.mass.gov/mgis/nwi.htm
[15] http://www.mass.gov/dfwele/dfw/nhesp/vernal_pools/vernal_pools.htm

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water and rainfall and remain ponded through the spring and into summer. Vernal pools may be very shallow, holding only 5 or 6 inches of water, or they may be quite deep. They range in size from fewer than 100 square feet to several acres. Vernal pools are found across the landscape, anywhere that small woodland depressions, swales or kettle holes collect spring runoff or intercept seasonal high groundwater, and along rivers in the floodplain. Many species of amphibians and vertebrates are completely dependent on vernal pools to reproduce. Loss of vernal pools can endanger entire populations of these species.

NHESP has a program to certify the existence of vernal pools when evidence is submitted to document their location and the presence of breeding amphibians that depend on vernal pools to survive. Certified vernal pools are protected by the Massachusetts Wetlands Protection Act and by additional state and federal regulations. Landowners are not required to report the existence of vernal pools on their property and landowner permission must be obtained prior to any person attempting to certify a vernal pool on private property. According to MassGIS data, there are 46 potential vernal pools in Gill and 3 certified vernal pools.[16]

Potential Sources of Public and Private Drinking Water Supply Contamination

Potential sources of contamination of public and private wells include septic systems, sub-surface fuel tanks, manure piles, improper use, storage and disposal of hazardous materials, herbicide runoff from farmland, utility rights-of-way, and state highway vegetation control, and road runoff.

More information on drinking water supply contamination and mitigation can be found at http://www.mass.gov/dep/water/drinking/sourcewa.htm.

Vegetation

The vegetated landscape of Gill includes mixed hardwood forests, farmlands and riparian lands. Farmland is made up of crop fields and rolling fields for grazing. Land that borders the Connecticut River is not the broad, flat plains characteristic of much of the Connecticut River Valley but instead is often quite steep wooded embankments. Examples of this can be seen at Barton Cove and at the French King Gorge.

Forests

Forests constitute one of the most important natural resources in the Town of Gill and in the region. While much of the town's lands are forested, privately owned forest is much more common than publicly owned. The extent of forest cover in Gill is shown in Map 4-3 at the end of this section. The values of large blocks of contiguous forestland are many. Some primary values include:[17]

- Ecosystem Services. Woodlands have significant ecosystems values, including water supply, nutrient retention, carbon sequestration, and climate stabilization. Large blocks of

[16] According to January 2010 MassGIS Data, http://www.mass.gov/mgis/ftpstate.htm, there are 3 certified vernal pools in Gill. The NHESP website data, also from 2010, there are 4.
[17] Wildlands and Woodlands: A Vision for the New England Landscape, Harvard Forest, Harvard University, 2010.

contiguous forests support groundwater recharge and provide ample clean water for humans. Another significant woodland service is mitigation of climate change through carbon dioxide uptake and storage.

- Habitat Connectivity. Large blocks of contiguous forest help support biodiversity and the successful migration of plant and animal species impacted by fragmentation such as that caused by new development. Forestland provides habitat for wildlife species that require a certain amount of deep forest cover and separation for humans.
- Recreation and Tourism. Forestland also provides a natural infrastructure for tourism and recreation economy. Fall foliage season is a vital part of the Western Massachusetts economy, drawing visitors to the area for leaf peeping, contributing to the hospitality industry and other sectors of the economy. Forestland also provides places for hiking, skiing, bird watching, hunting, paddling, and other outdoor activities.

A mixed hardwood forest rises up alongside Barton Cove.

Fragmentation of large blocks of contiguous forestland can be caused by a variety of impacts including:[18]

- Deforestation and development including subdivisions, commercial complexes, roads and infrastructure.
- Perforation of contiguous forestland including individual houses – and their associated driveways, lawns and human activities – on large parcels of land.
- Climate change – including wide fluctuations in temperature, precipitation, and length of growing season – causing impacts such as outbreaks of certain diseases and pests and changes in the range of certain plants and animals. These changes could have real impacts to the local economy such as a decline in maple sugaring.\
- Adverse forest practices such as clear cutting with erosion that often follows.

[18] Ibid.

- Parcelization including increased number of owners – often absentee – and decreased parcel size.
- Invasive organisms including insects, plant species and pathogens.

The woodlands in Gill are used for hiking and nature study and are important habitat for wildlife. They also add to the scenic and rural character of the town. Gill's forests include species associations common to the Hemlock-Northern Hardwoods Forest to the north and the Appalachian-Oak Forest to the south.

Forested lands in Gill are at varied stages of growth due to the changes in landscape, elevation and exposure to elements. Table 4-2 gives a general inventory of the typical species in Gill.

Table 4-2: General Inventory of Forest Types in the Town of Gill

Forest Type	Common Trees, Shrubs and Herbaceous Vegetation
Hemlock-Northern Hardwoods Forest	Eastern hemlock, sugar maple, red maple, American beech, yellow birch, paper birch, white ash, white pine, willow, speckled alder, sedges
Appalachian-Oak Forest	
Higher elevations	White oak, red oak, shagbark hickory, bitternut hickory, black cherry, white ash, American basswood, Eastern cottonwood
Lower elevations	American sycamore, silver maple, box elder, staghorn sumac, smooth sumac

Source: USDA; 1992

Public Shade Trees

Public shade trees are located in Gill Town Center, most notably, a majestic sycamore adjacent to the Town Hall. Public shade trees are also located in Town right of ways, at the Slate Library and in Town cemeteries. In a Town as heavily forested as Gill, preserving public shade trees may seem unnecessary; however, loss of trees in public spaces can significantly change the character of that place. Some methods towns use to protect shade trees include adopting a scenic roads bylaw, limiting the amount of salt used on roads, and requiring replacement of any trees that are lost.

Agricultural Land

In 2005, according to MassGIS data, of the total 9,478 acres of land in Gill, there were approximately 1,600 acres or 17% of agricultural land (includes cropland and pastureland). This number is down slightly from the estimated 20% in 1999. However, during this time, methodology for classifying land has changed. This change may account for the decline from 1999 to 2005.

In 2011, the Gill Agricultural Commission's ***Gill Farms: A Guide to Buying Gill Products and Supporting Agriculture in Our Community*** indicated the number of small family farms are on the rise.[19] Active farmland with prime farmland soils (shown in Map 4-3) in Gill is primarily

19 Steve Damon, Chairperson, 2011 Gill Agricultural Commission

located along the Connecticut River, the upper Fall River, Cascade Brook, Otter Brook, Dry Brook, Ashuela Brook, and along Main Road. Other active farmland can be found along West Gill Road, River Road, North Cross Road, Mount Hermon Road, Boyle Road, Route 2 and Franklin Road.

Vegetation in agricultural lands can include crops and fields for grazing. Along with grasses, farm fields contain many perennial herbaceous plant as well as some invasive plants, such as multiflora rose, buckthorn, and bittersweet. Farm field edges are often in an early successional forest stage, containing shrubs and small trees. These edges serve as important areas for forage, cover and escape for wildlife.

Wetland Vegetation

As discussed on previously in the Wetlands subsection, wetlands provide important ecological functions and offer important wildlife habitat. Typical wetlands in Gill are forested deciduous swamps. Vegetation found in these wetlands can vary, depending upon shade and other conditions. Some typical plants found in and near Gill wetlands are red maple (Acer rubrum), eastern hemlock (Tsuga Canadensis), winterberry (Ilex verticillata), sedges (Carex spp.), ferns, and skunk cabbage (Symphlocarpus).

Rare, Threatened, and Endangered Plant Species

The Natural Heritage and Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries and Wildlife has designated several "Priority Habitat" areas in the Town of Gill (see Map 4-2). A Priority Habitat is an area where plant and animal populations protected by the Massachusetts Endangered Species Act Regulations (321 CMR 10.00) may occur. These areas include:

- Along the banks of the Connecticut River;
- An area in the northeastern corner of Gill along Mount Hermon Road and the intersection of Mount Hermon Road and Main Road;
- An area along the eastern end of North Cross Road;
- Along Ashuela Brook from its confluence with the Connecticut River to approximately three-fourths of a mile upstream;
- An area along Main Road in the central portion of Gill, just northeast of Wyart Road;
- Along Pisgah Mountain Road; and
- An area to the west of Barney Hale Road (see Water Resources and Wildlife Habitat Maps).

Statewide, NHESP has identified 259 native plant species as rare, threatened or endangered. Twelve rare plant species have been documented in the Town of Gill (see Table 4-3).[20] These plants occur in some of the Priority Habitats identified above.

Table 4-3: NHESP Rare Plant Species in the Town of Gill

[20] These data were extracted from the database of the Natural Heritage and Endangered Species Program in September 2009: http://www.mass.gov/dfwele/dfw/nhesp/species_info/town_lists/town_g.htm#gill

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Scientific Name	Common Name	MESA* Status	Most Recent Observation
Aplectrum hyemale	Putty-root	Endangered	2007
Boechera missouriensis	Green Rock-cress	Threatened	2008
Carex grayi	Gray's Sedge	Threatened	2008
Cerastium nutans	Nodding Chickweed	Endangered	2004
Deschampsia cespitosa ssp. glauca	Tufted Hairgrass	Endangered	1991
Malaxis monophyllos var. brachypoda	White Adder's-mouth	Endangered	2005
Minuartia michauxii	Michaux's Sandwort	Threatened	2005
Morus rubra	Red Mulberry	Endangered	1987
Prunus pumila var. depressa	Sandbar Cherry	Threatened	1984
Symphyotrichum tradescantii	Tradescant's Aster	Threatened	2008
Tillaea aquatica	Pygmyweed	Threatened	1980
Viola adunca	Sand Violet	Special Concern	2005

*Massachusetts Endangered Species Act. Source: NHESP 2010

NHESP has produced fact sheets for some species. Those available for rare plant and animal species are located in Appendix E. The fact sheets include the species status, description, aids for identifying and habitat as well as drawings or photos, such as those shown below of Morus rubra or Red Mulberry. Plants (and animals) listed as *endangered* are at risk of extinction (total disappearance) or extirpation (disappearance of a distinct interbreeding population in a particular area). *Threatened* species are likely to become endangered in the foreseeable future. Species of special concern have been documented to have suffered a decline that could result in its becoming threatened, or occur in very small numbers and/or have very specialized habitat, the loss of which could result in their becoming threatened (NHESP and The Nature Conservancy, *Our Irreplaceable Heritage: Protecting Biodiversity in Massachusetts*; 1998).

Natural Heritage and Endangered Species identifies Morus rubra (Red Mullberry) as endangered. See the NHESP fact sheets in the Appendices of this report for complete information. Photos from NHESP Morus Rubra fact sheet and by Charles S. Eiseman

Unique Natural Resources

Gill's unique natural resources are discussed and inventoried in Section 4-G and are mapped at the end of Section 4. Dinosaur footprint quarries, a record of Gill's history, are located in several areas in Gill. Other unique natural resources include the French King Gorge (pictured on page __) and Barton Cove (pictured on page __).

Vegetation Mapping Projects

As part of annual Biodiversity Days, efforts have been started to map vegetation in the Town Forest. A goal for future mapping projects are including in the Seven-Year Action Plan.

Fisheries and Wildlife

Gill's forests, rivers, wetlands and open farmland provide habitat for a variety of common and rare wildlife species. This section discusses wildlife species and their habitats from the perspective of natural communities, individual species, and patterns of wildlife distribution and movement across the landscape.

Natural Heritage Endangered Species Program and the Natural Conservancy BioMap2 show Core Habitats critical for the long-term persistence of rare species and Critical Natural Landscape, including buffers along Core Habitats. (BioMap2 is discussed in more detail at the beginning of Section 4.) These areas mapped in Gill are shown in Map 4-1 at the end of this section. The most notable pattern of Core Habitat is the significant area that buffers the entire length of the Connecticut River in Gill. There is also a large area of Core Habitat in the south central part of Gill, between Barney Hale Road and Mountain Road. These areas provide habitat for rare species in Gill.

In addition to BioMap2, Natural Heritage Endangered Species Program maintains a list of all Massachusetts Endangered Species Act (MESA)-listed species observed and documented in each Massachusetts town. These lists are updated once a year or when there are approved MESA list changes and are shown in the following pages.

Wildlife Corridors

Wildlife and fisheries populations move along corridors such as rivers, riparian areas, ridgelines, farm fields, and forested slopes. Wildlife seek natural cover for shelter and food and forage where human uses, such as horticultural and ornamental plantings, provide browse or food. Remote large blocks of forestland, riparian areas, farm fields, and the parcels of land connecting them together, are important areas to preserve and protect in Gill.

General Description and Inventory of Wildlife and Wildlife Habitats

Amphibians and Reptiles

Diverse amphibian and reptile species inhabit Gill. Large tracts of forested uplands and forested riparian corridors provide excellent habitat that supports amphibians and reptiles.Vernal pools and wetlands are essential habitat for two-thirds of the Commonwealth's amphibious species. Table 4-4 shows the rare amphibian and reptile species identified in Gill. The Jefferson salamander is a species of concern that inhabits upland forest areas near ponds or vernal pools.

DRAFT

Also found in Gill are the marbled salamander, a threatened species and the wood turtle, a species of special concern. Identifying and protecting the habitats are the best means to ensure that these species remain a part of the New England biota.

Table 4-4: NHESP Rare Amphibian and Reptile Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA* Status	Most Recent Observation
Amphibian	Ambystoma jeffersonianum	Jefferson Salamander	Special Concern	1997
Amphibian	Ambystoma opacum	Marbled Salamander	Threatened	1997
Reptile	Glyptemys insculpta	Wood Turtle	Special Concern	2003

Source: NHESP MESA Massachusetts List of Endangered, Threatened and Special Concern Species, updated 2008

The forests, wetlands and other surface waters in Gill are home to nine snake species, five turtle species, nine frog and toad species and seven species of salamanders, such as the spotted salamander and the eastern newt. See Appendix E for complete fact sheets on these species.

Fish and Mussels

Migratory fish species such as shad and salmon once inhabited the Connecticut River in great numbers. When the Turners Falls dam was built in 1798 and subsequent dams were built further downstream, the salmon stopped running in the Connecticut River. FirstLight Power Resources is maintaining a fish ladder at Turners Falls in order to aid the comeback of this once abundant species.

As shown in Table 4-5, three fish species and one mussel species make NHESP's list of rare species. The shortnose sturgeon is listed as endangered on both the state and federal level. Shortnose sturgeon spawn in fast flowing rocky areas and Longnose suckers are found primarily in cool upper sections of streams and rivers. See Appendix E for complete fact sheets on these species.

Table 4-5: NHESP Rare Fish and Mussel Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Federal Status	Most Recent Observation
Fish	Acipenser brevirostrum	Shortnose Sturgeon	Endangered	Endangered	1993
Fish	Catostomus catostomus	Longnose Sucker	Special Concern		2005
Fish	Lota lota	Burbot	Special Concern		2000
Mussel	Alasmidonta varicosa	Brook Floater (Swollen Wedgemussel)	Endangered		Historic

Source: NHESP MESA Massachusetts List of Endangered, Threatened and Special Concern Species, updated 2008

Other migratory species found in Gill are shad, blueback herring and alewife. Non-migratory species present in the Connecticut River are walleyed pike, carp and bass. Shadow Lake has a native population of blue-gill, crappie, perch and pickerel.

Fall River is stocked with trout for recreational fishing and native brook trout are found throughout the town's waterways.

Birds

The Connecticut River Valley is a part of a major migratory flyway from North to South and vice versa. Game birds include ruffed grouse, woodcock, black duck, and mallard. Many shorebirds visit the Connecticut riverbanks in the summer months. Some examples of Gill shorebirds are killdeer, yellow legs, green heron, great blue heron, and spotted sandpiper.

Cistothorus platensis – or Sedge Wren – is one of two bird species listed as endangered in Gill.

Other bird species in Gill include the common loon, osprey, snow geese, wild turkey, Canada goose, hawks, falcons, nighthawks and swallows. A nesting pair of American Bald Eagles has resided on Barton Island for about a decade. In addition, the river valley is important habitat for songbirds and other migratory birds.

As shown in Table 4-6, the American bald eagle and the sedge wren are the two bird species in Gill currently identified as endangered by NHESP. See Appendix E for species fact sheets.

Table 4-6: NHESP Rare Bird Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation
Bird	Cistothorus platensis	Sedge Wren	Endangered	1996
Bird	Haliaeetus leucocephalus	Bald Eagle	Endangered	2009

Source: NHESP MESA Massachusetts List of Endangered, Threatened and Special Concern Species, updated 2008

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Dragonflies and Damselflies

As shown in Table 4-7, there are nine species in the dragonfly/damselfly taxonomic group on NHESP's list of rare species for Gill. See Appendix E for complete fact sheets on these species.

Table 4-7: NHESP Rare Dragonfly/Damselfly Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation
Dragonfly/Damselfly	Enallagma carunculatum	Tule Bluet	Special Concern	1997
Dragonfly/Damselfly	Gomphus abbreviatus	Spine-crowned Clubtail	Endangered	2008
Dragonfly/Damselfly	Gomphus fraternus	Midland Clubtail	Endangered	2002
Dragonfly/Damselfly	Gomphus vastus	Cobra Clubtail	Special Concern	2008
Dragonfly/Damselfly	Gomphus ventricosus	Skillet Clubtail	Special Concern	2008
Dragonfly/Damselfly	Neurocordulia yamaskanensis	Stygian Shadowdragon	Special Concern	2008
Dragonfly/Damselfly	Ophiogomphus aspersus	Brook Snaketail	Special Concern	2007
Dragonfly/Damselfly	Stylurus amnicola	Riverine Clubtail	Endangered	2008
Dragonfly/Damselfly	Stylurus spiniceps	Arrow Clubtail	Threatened	2008

Source: NHESP MESA Massachusetts List of Endangered, Threatened and Special Concern Species, updated 2008

Mammals

Though many larger mammals were driven out or killed off by colonists in the nineteenth century, some are slowly returning to the area as forests have grown back across the landscape. Black bear, white-tailed deer and beaver are making a comeback in some parts of the region. Mammal species common to Gill and surrounding towns are: Eastern coyote, opossum, gray fox, red fox, eastern cottontail, New England cottontail, flying squirrel, gray squirrel, red squirrel, varying hare, mink, otter, porcupine, skunk, raccoon, fisher cat, bobcat and weasel.

The NHESP list of rare species cites no mammals for Gill. There is, however, a list of mammals for Massachusetts. This list is included in Appendix E after the fact sheets.

Conserving Gill's Biodiversity

Island Biogeography and landscape ecology are concepts which can be used to help explain Gill's options for pursuing the conservation of the town's biodiversity. The theory of island biogeography is based on observations that biodiversity is greater on large islands than on small ones, and greater on islands that are close to the mainland. The concept of islands surrounded by water has been applied to the idea of "islands" of protected open land surrounded by developed areas. Based on this theory, ecologists predict that increasing the size of a protected land area increases its biodiversity (MacArthur and Wilson; 1967). Therefore, connecting two protected areas via a protected corridor to create one large area should also increase natural biodiversity (Wilson and Willis; 1975).

Another model for wildlife habitat protection aggregates similar land uses while allowing other uses in discrete areas (Forman; 1997). This model is reflected in Gill in areas where agriculture is concentrated along river or stream corridors. This model allows large blocks of forest to

remain intact. Individual animals move within a landscape and seek cover for shelter and food. Some species willingly forage where human uses, such as farm fields, gardens and trash cans provide browse or food. As the land within Gill continues to be fragmented by development, it is reasonable to expect that remaining large blocks of undeveloped forest and the parcels of land connecting them will become more important to area wildlife.

Many species of wildlife in Gill have home ranges greater than fifty acres in size. Even those species with smaller home ranges move across the landscape between sources of shelter, water, food and mating areas. Some animals, including white-tailed deer and black bear, seek both interior forest habitat and wetland edges where food sources may be more abundant. Permanently protected wildlife corridors are particularly critical in a landscape which is experiencing development pressures, to ensure that animals have the ability to travel across vegetated areas between large blocks of habitat.

Connections between bodies of water and sub-watersheds are also important for wildlife and fisheries species. Some of the more common animals that use river and stream corridors are beaver, muskrat, raccoon, green heron, kingfish, snapping turtle, and many species of ducks, amphibians, and fish. Since many species rely on a variety of habitats during different periods of their life cycle, species diversity is greatest in areas where several habitat types occur in proximity to each other. With this in mind, the protection of all habitat types is vital for maintaining and enhancing biodiversity in Gill.

How will the Town of Gill determine the most appropriate conservation strategies for wildlife habitat? There are some general paths to follow in conserving the health of wildlife populations. One is to protect the habitat of specific species that are rare, threatened, or endangered. It is thought that other species will also benefit from this strategy. A second path is to conserve landscape-level resources such as contiguous forest or riparian areas. This helps to protect the habitats of a large number of species, but it might not meet the needs of all rare and endangered species. The third method is a combination of the first two. Maintaining the biodiversity of Gill over the long term will likely require the protection of both unique habitats for specific species and networks of habitat across the landscape.

Conservation strategies for the town to consider include monitoring of species locations, numbers, and movements; the protection of core habitat areas as identified by the NHESP BioMap2; the continued protection and linkage of large blocks of contiguous forestland; the retention of early successional habitats like fields and grasslands; and the protection of vernal pools, wetlands, and riparian corridors that sustain the greatest diversity of life in Gill.

Scenic Resources and Unique Environments

The characteristics that allow a stranger to distinguish Gill from other towns in the region may be different than the unique qualities and special places that only residents can really know. This section – along with the natural and historic resources discussed in Section 3 – identifies the scenic resources and unique environments that most town residents would agree represent the essence of Gill's character. In many ways the history of Gill – how people came to settle the land, use its resources, and enjoy its forests, streams, and bodies of water – can be seen in the

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landscapes that have retained a sense of the past. The unique environments in Gill play a very important role in providing residents with a sense of place. Brooks, mountains, wetlands, and village centers provide markers on the landscape within which we navigate our lives.

Scenic landscapes often derive their importance from their location relative to other landscape features. The purpose of inventorying scenic resources and unique natural environments in Gill is to provide a basis for setting resource protection. Note: For the purposes of capturing all significant resources in one table, Table 4-4 includes historic resources cited in Section 3. The locations of the resources shown in Table 4-4 are shown in Map 4-6 at the end of this Chapter.

Table 4-4: Significant Gill Resources and Scenic Landscapes/Environments

Map #	Historic Resources
H1	Riverside Archaeological District
H2	Bascomb Hollow
H3	French King Bridge
H4	Water power mill sites (three)
H5	Old bridge crossing
H6	Cemeteries (four)
H7	Factory Hollow
H8	Capt. Turner Monument
H9	Old Red Bridge Anchor
H10	Sunset Rock
H11	Munn's Ferry
H12	Stacy's Ferry
H13	Miller's Ferry
Map #	Recreation Resources
R1	Oak Ridge Golf Course
R2	Riverside School Recreation Area
R3	Barton Cove Recreation Area (FirstLight Power Resources)
R4	State Boat Ramp
R5	Gill Elementary School
R6	Town Forest
Map #	Natural Resources
N1	Shadow Lake
N2	Otter Pond
N3	Otter Brook
N4	Dry Brook (formerly known as Unadilla Brook)
N5	Ashuela Brook
N6	Otter Run
N7	Fall River
N8	Fall River Tributary "Cascades"
N9	Beaver Brook
N10	Dry Brook "Cascades"
N11	Connecticut River
N12	Great Falls & Great Island

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N13	Route 2 Geologic Corridor
N14	Submerged dinosaur footprint quarry
N15	Armored mudballs
N16	Dinosaur footprint quarry
N17	Dinosaur footprint quarry
N18	Barton Island
N19	Dinosaur footprint quarry
N20	French King Gorge
N21	French King Rock
N22	Lily Pond
N23	Horse Race
N24	King Phillip's Abyss
Map #	Scenic Resources
S1	Mt. Hermon Campus & Scenic Vista
S2	Bascom Hollow/Bascom Road
S3	West Gill Road
S4	Historic & Scenic Farm Area (Main Road north)
S5	Munn's Ferry Road
S6	Pisgah Mountain
S7	Historic & Scenic Farm Area (Main Road south)
S8	Grist Mill Road
S9	Pisgah Mountain Road
S10	Stacey Mountain & Scenic Vista
S11	River Road
S12	Riverview Drive
S13	Great Falls Overlook
S14	Mohawk Trail
S15	French King Bridge & Scenic Vista

Source: 2011 Open Space and Recreation Plan Committee

Environmental Challenges

There are two main environmental challenges in Gill:

- Fragmentation of farm and forestland, and
- Connecticut River bank erosion.

Farm and Forestland Fragmentation

Although there may not be agreement as to its severity or solution, the demand for single-family detached housing in Gill and in the region appears to be growing at a faster rate than in the state overall. Gill is far from immune to these regional trends. Taking other constraints into consideration including wetlands and buffer areas to surface waters, 7,606 acres of land could still be developed in town. This is equal to 80 percent of the town. While the scenario is unlikely, there is enough land in town to fit approximately 3,800 more building lots (based on 2-acre zoning). This means that 9,500 residents could potentially live in Gill at some point in the future.

Many of the largest undeveloped parcels in town are also the most suitable for development and include farm and forestland with slopes under 25 percent, which are also not protected from development. These open and forested lands contribute most to the town's rural character and are owned by a handful of families. Their agricultural businesses maintain the landscapes as they are: pastoral, historic, and overall, simply breathtaking. Were these farm businesses to fail, the future of the farms and their families, the farm and forestlands, as well as the rural character of the town itself, would be in jeopardy.

Unplanned residential development across town would also increase non-point source pollution like road runoff and reduce the value of remaining wildlife habitat. Increases in runoff would diminish the biodiversity in the stream network all over town. One solution to the problem could be a combination of zoning techniques applied to encourage development in suitable areas and land conservation to minimize development in those areas with the cultural, historic, scenic, natural, archeological, and natural resources values, which are also most threatened from development.

Planning for development – where and how to develop – is perhaps just as important as planning for conservation. Conserving any and all land without considering its value as a potential residential, commercial or industrial site might ultimately force further fragmentation. As such, an Action Item to continue to assess areas of potential development is included in the Action Plan.

Erosion and Sedimentation on the Connecticut River

Northfield Mountain Pumped Storage Project

The following text was developed by the Natural Resources Program of the Franklin Regional Council of Governments Planning Department, for the Final Project Report for the Connecticut River Watershed Restoration Phase II.

The Northfield Mountain Pumped Storage Project, completed in 1970, is located about five miles upstream of the Turners Falls dam. The concept behind the Pumped Storage Project is simple. This facility only provides power when it is needed; for example, during periods of peak demand. Water is pumped from the lower reservoir (the Connecticut River) to the upper reservoir (elevation 1,000 feet) that is located atop Northfield Mountain. The 300-acre upper reservoir holds 5.5 billion gallons of water. During periods of peak demand, water is released to the lower reservoir via the turbines to generate electricity. The power generating/pumping facility is located completely underground and consists of four 250 thousand kilowatt reversible pump turbines. Each of these turbines can pump a maximum of 22,500 gallons per second of river water up to the upper reservoir. To generate electricity, each turbine can discharge water from the upper reservoir back to the river at a maximum rate of 33,700 gallons per second.

During the construction of the Pumped Storage Project, the dam at Turners Falls was raised to accommodate a power generating facility to elevation 185.5 feet. A 2,500-acre lower reservoir, known as the Turners Falls Power Pool, was created behind the dam. The Turners Falls Power

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Pool is a 22-mile long reach of the Connecticut River between the Turners Falls Dam and the Vernon Dam in Vernon, Vermont. The Turners Falls Power Pool, an impoundment of the Connecticut River, is referred to as the "lower reservoir," although it was never designed to act as such in support of the Northfield Mountain Pump Storage Facility.

The hydrodynamics of the Turners Falls Power Pool are primarily controlled by the three hydroelectric generating facilities: Turners Falls, Vernon, and the Northfield Mountain Pumped Storage Project. The joint operations of the Turners Falls facility and the Northfield Mountain Pumped Storage Project have resulted in larger and faster pool fluctuations, which have significantly changed the daily regime of this reach of the Connecticut River. Typical pool fluctuations average 3.5 feet per day. Much higher pool fluctuations, on the order of 9-10.5 feet, may occur over the course of the weekly pump/release cycle.

The banks of non-cohesive, alluvial sand and silt, which dominate the Turners Falls Power Pool section of the Connecticut River, typically exceed twenty (20) feet in height. Erosive forces have destabilized many sections of bank resulting in slumping and mass wasting of large sections of bank and the loss of trees and other riparian vegetation on the top of the banks.

Over the years, several studies have been undertaken to inventory and assess erosion sites, identify the possible causes of the erosion, and propose various bank stabilization techniques for the Turners Falls Power Pool. In 1979, the Army Corps of Engineers (ACOE) issued a "Report on: Connecticut River Streambank Erosion Study, Massachusetts, New Hampshire and Vermont." This document presented the results of a detailed study of the numerous variables that contribute to bank erosion in the 141-mile reach of the river from Turners Falls Dam to the headwaters of the Wilder Hydro Pool in Haverhill, New Hampshire and Wells River, Vermont. One of the six index sites evaluated by the ACOE was located in the Turners Falls Power Pool approximately eight miles upstream of the Turners Falls Dam.

The ACOE's analysis in 1979 found that the natural shear stress exerted on a bank by flowing water can be increased by as much as 60 percent by such factors as flood stage variations, pool fluctuations, boat and wind waves, gravitational forces, etc. Further, they reported that causes of bank erosion in the 141-mile reach of the Connecticut River stretching north from Massachusetts into New Hampshire and Vermont, in descending order of importance were: shear stress (velocity), pool fluctuations, boat waves, gravitational forces, seepage forces, natural stage variations, wind waves, ice, flood variations, and freeze-thaw cycles. In July 1991, the ACOE released the results of a follow-up study on the erosion in the Turners Falls Power Pool. This study concluded that bank erosion in the Power Pool had increased almost threefold since the 1979 study and approximately one-third of the bank in the Power Pool was actively eroding.

In the spring of 1994, the Franklin County Commission (now the Franklin Regional Council of Governments) convened the stakeholders to encourage a cooperative approach to assessing and mitigating the erosion in the Turners Falls Power Pool. The Connecticut River Streambank Erosion Committee (CRSEC) was formed and its membership is comprised of local officials, state and federal agencies, non-profit environmental groups, landowners, and utility representatives. This time, the stakeholders reached consensus and the utility prepared a Draft Environmental Impact Report, which described a bank project that would stabilize several

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thousand feet of eroding riverbank using bioengineering techniques. The necessary environmental permits were secured and the utility committed $1.2 million over six years toward what would be called Phase I of the bank stabilization work.

The Franklin Regional Council of Governments (FRCOG) was awarded $142,000 from the Massachusetts Department of Environmental Protection's s.319 Non-point Source Competitive Grant Program in order to monitor, document and report on three of the sites to be restored under Phase I, to staff the CRSEC, and to provide partial funding for construction of one of the sites. The purpose of Phase I was to demonstrate the feasibility and effectiveness of using various bioengineering techniques, an innovative, "soft" alternative to rip-rap, gabions, and other traditional "hard" engineering solutions.

Bioengineering techniques incorporate woody and/or herbaceous plants and plant materials to construct a living system of bank protection. Using bioengineering to stabilize eroding banks has many advantages when compared to traditional armored bank treatments, including: the restoration and enhancement of wildlife habitat, the restoration of aesthetic resource values and the compatibility of the treatment with on-site environmental resources. The use of vegetation to stabilize banks also provides a buffer that can reduce the pollutant and sediment loading associated with overland runoff and flood flows. The June 1999 report prepared by the Franklin Regional Council of Governments for the s.319 grant describes the work completed at three Phase I sites. A total of 2,250 linear feet of eroding riverbank were stabilized.

Following the completion of work at the three sites monitored under the s.319 grant, the CRSEC and NU continued their bank stabilization work. Two additional sites, approximately 3,180 linear feet in total length, were stabilized between 1998 and 2000 using bioengineering techniques. In April 2000, the FRCOG was awarded a second s.319 grant for Phase II of the Connecticut River bioengineering restoration work.

A 2007 Fluvial Geomorphology Study of a reach of the river in the Gill area recommended the use of large woody debris (LWD) to protect eroding river bank. The LWD would preserve existing beaches and promote the development of new beaches by trapping fine sediment. The beaches help to dissipate the erosive forces of water level fluctuations caused by the operation of the Northfield Mountain Project and boat wakes. The LWD bank stabilization site is located in Gill, MA and is approximately 1,200 feet long (see Figure 4-1).

Figure 4-1: Large Woody Debris Bank Stabilization Site in Gill, MA

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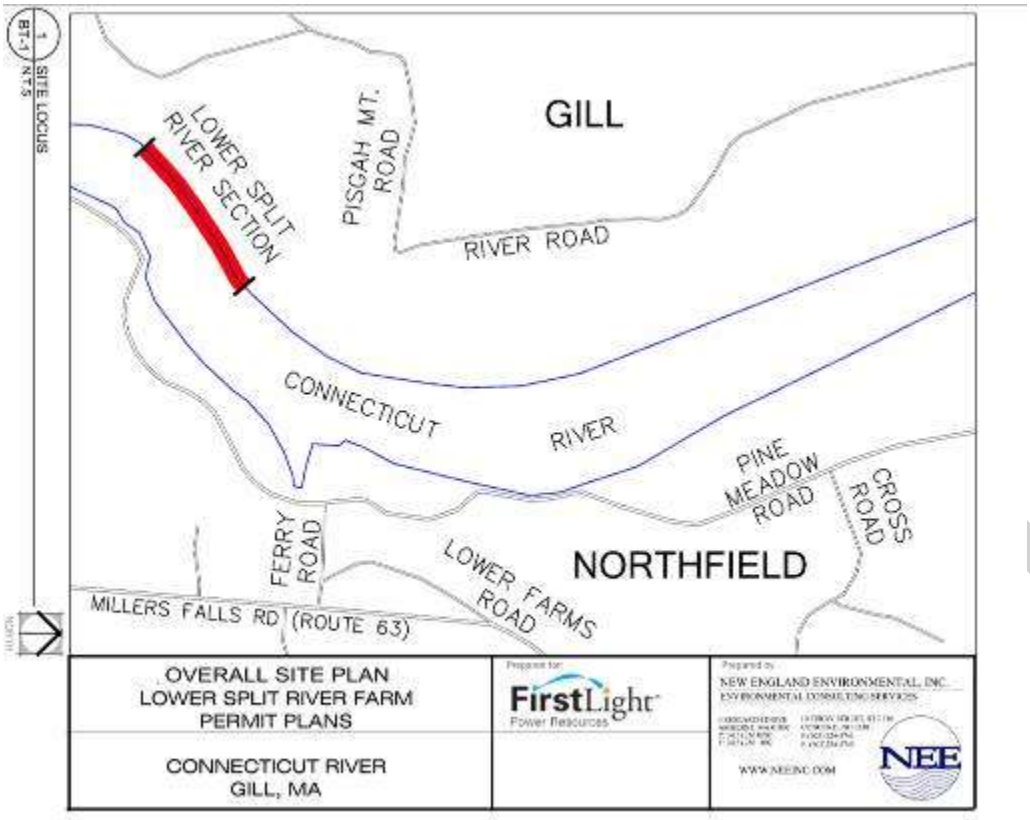

At time of writing, the initial bank stabilization project has been installed and will continue to be monitored in 2011. A Tri-State Connecticut River Targeted Watershed Initiative virtual tour of the site can be found at the at http://www.cesd.umass.edu/twi/TWI_Projects.

Construction of the large woody debris structure

Testing the stability of the large woody debris structure

The remaining issue regarding erosion along the banks of the Turners Falls Power Pool is that erosion is occurring at a faster rate than the completion of the riverbank bioengineering restoration work. The full restorative work, paid for by FirstLight Power, takes time to do correctly. There have been some discussions as to the best strategies for stemming the erosion by faster, less expensive means in advance of the full bioengineering method.

Other Environmental Challenges

Recreational Boating Waves

Boat waves continue to be a significant problem on the Connecticut River in Gill. As is mentioned in the ACOE's 1979 study, stream bank erosion and other problems are caused by boat waves. The Commonwealth of Massachusetts General Laws include a prohibition of open water speeds in excess of 45 mph. However, there are no restrictions on motor craft speed near the banks of a river or on the number of craft that can be in operation at any one time. Other problems that are associated with the amount and speed of motor craft on the Connecticut River in Gill include water pollution from silt and mud churned-up by motorboats, noise pollution, and the impacts of large numbers of big motor craft on other forms of recreational boating (e.g. canoeing and kayaking).

Chronic Flooding Areas

The Town of Gill Multi-Hazard Mitigation Plan identifies the Riverside section of Gill as a flood-prone area in Town. No other areas subject to significant chronic flooding have been identified.

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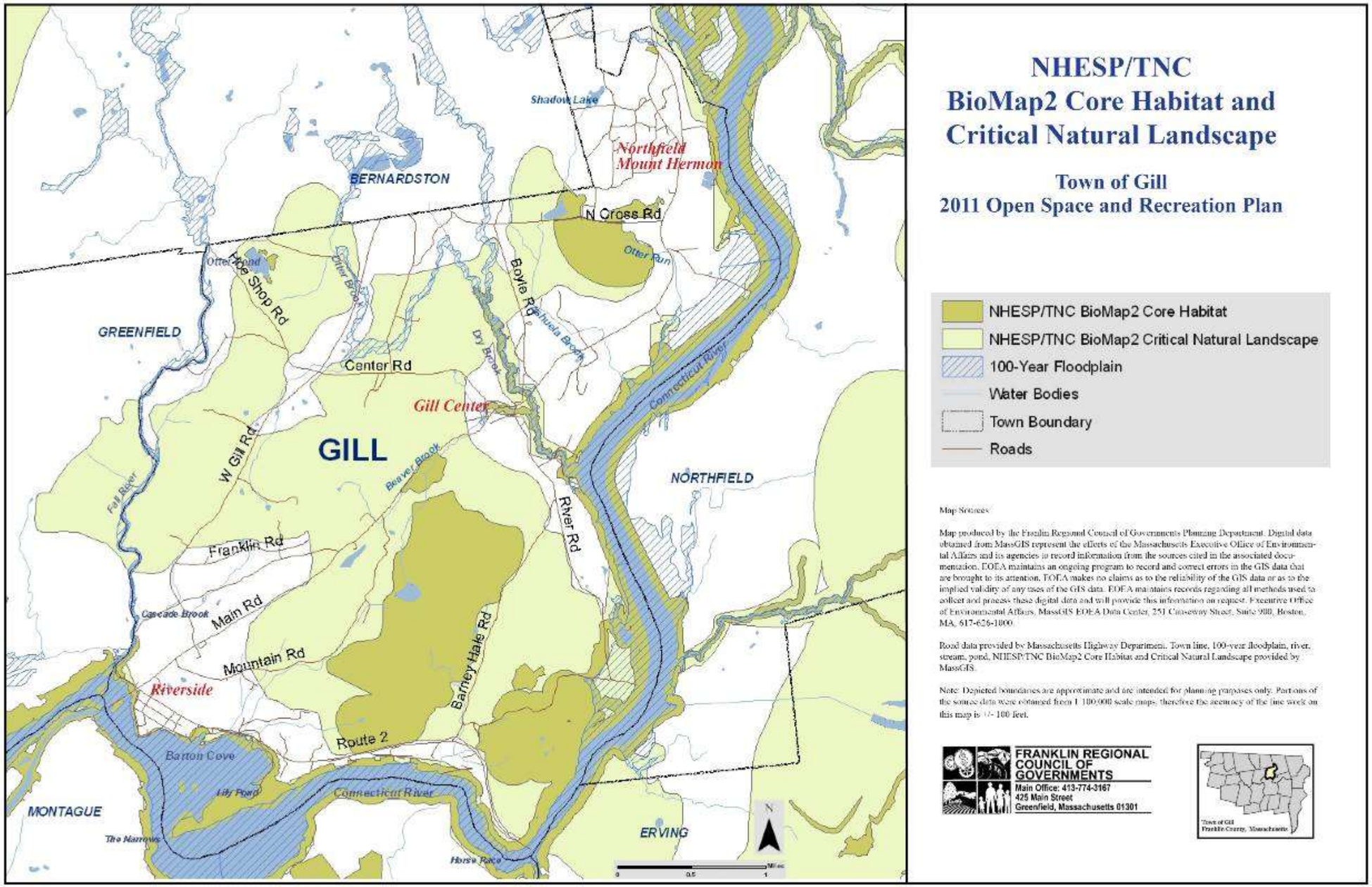
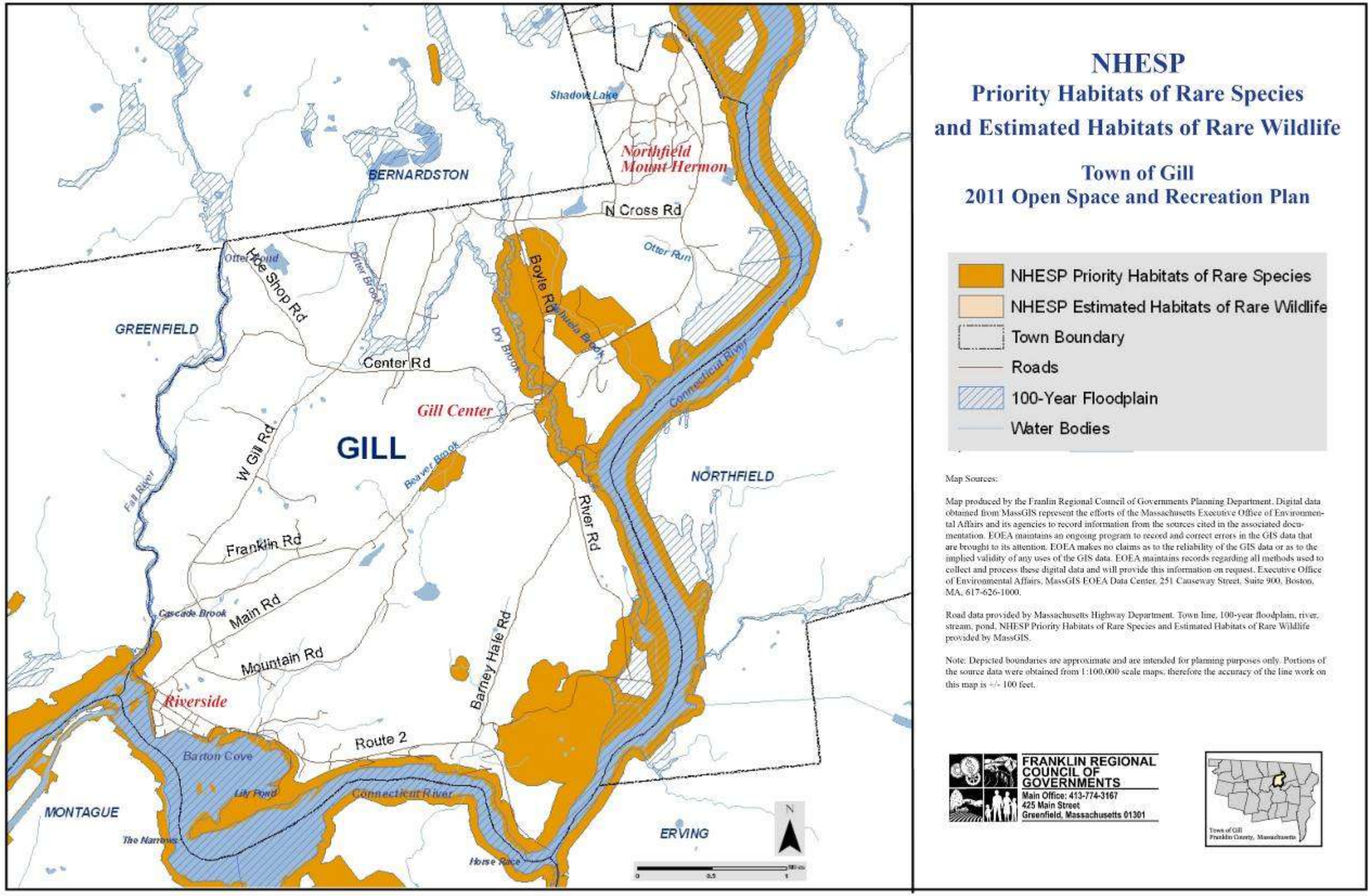
Map 4-1: NHESP/TNC BioMap2 Core Habitat and Critical Natural Landscape



Map 4-2: NHESP Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife



NHESP
Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife

Town of Gill
2011 Open Space and Recreation Plan

- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife
- Town Boundary
- Roads
- 100-Year Floodplain
- Water Bodies

Map Sources:

Map produced by the Franlin Regional Council of Governments Planning Department. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Road data provided by Massachusetts Highway Department. Town line, 100-year floodplain, river, stream, pond, NHESP Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/- 100 feet.

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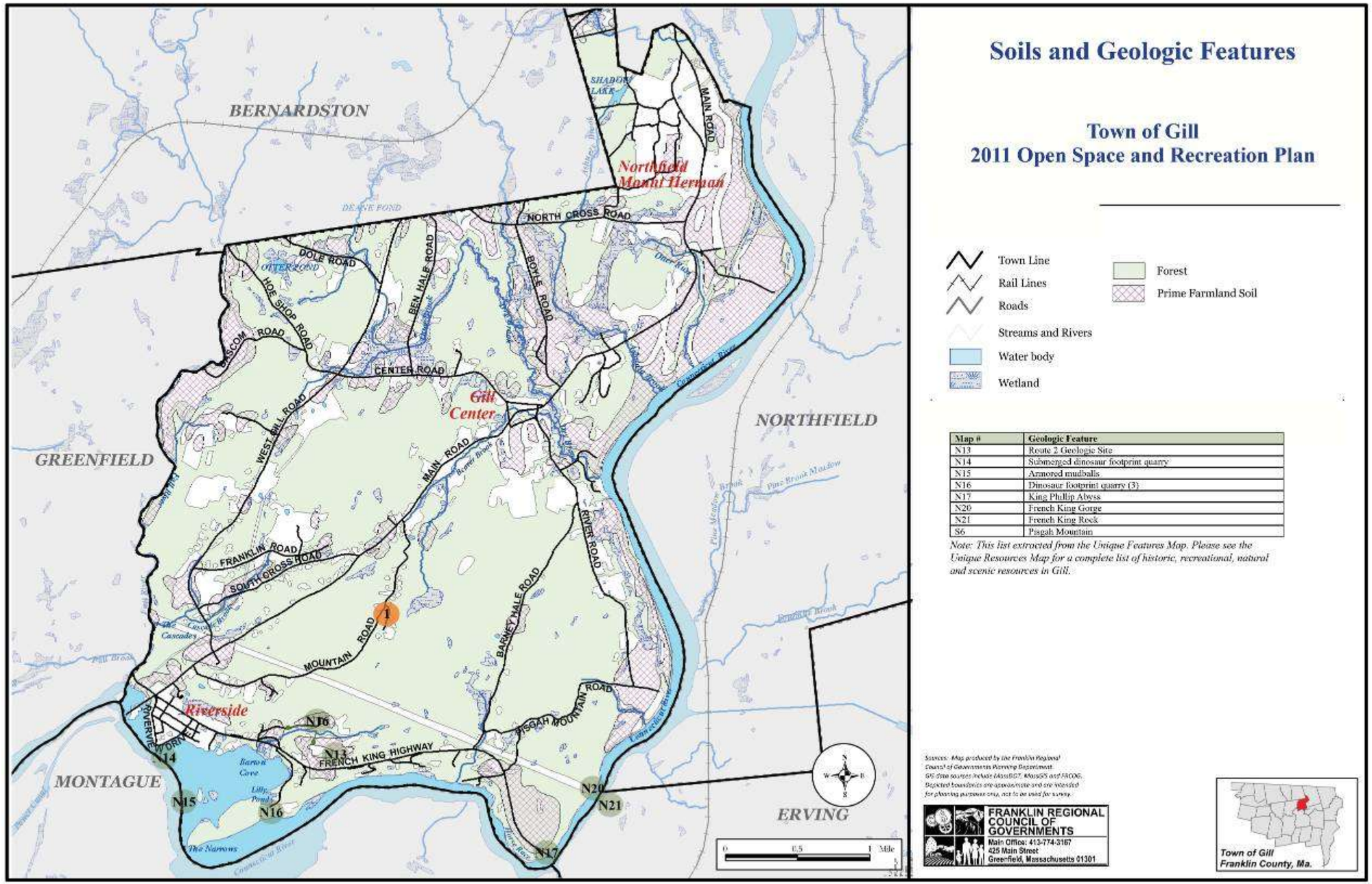
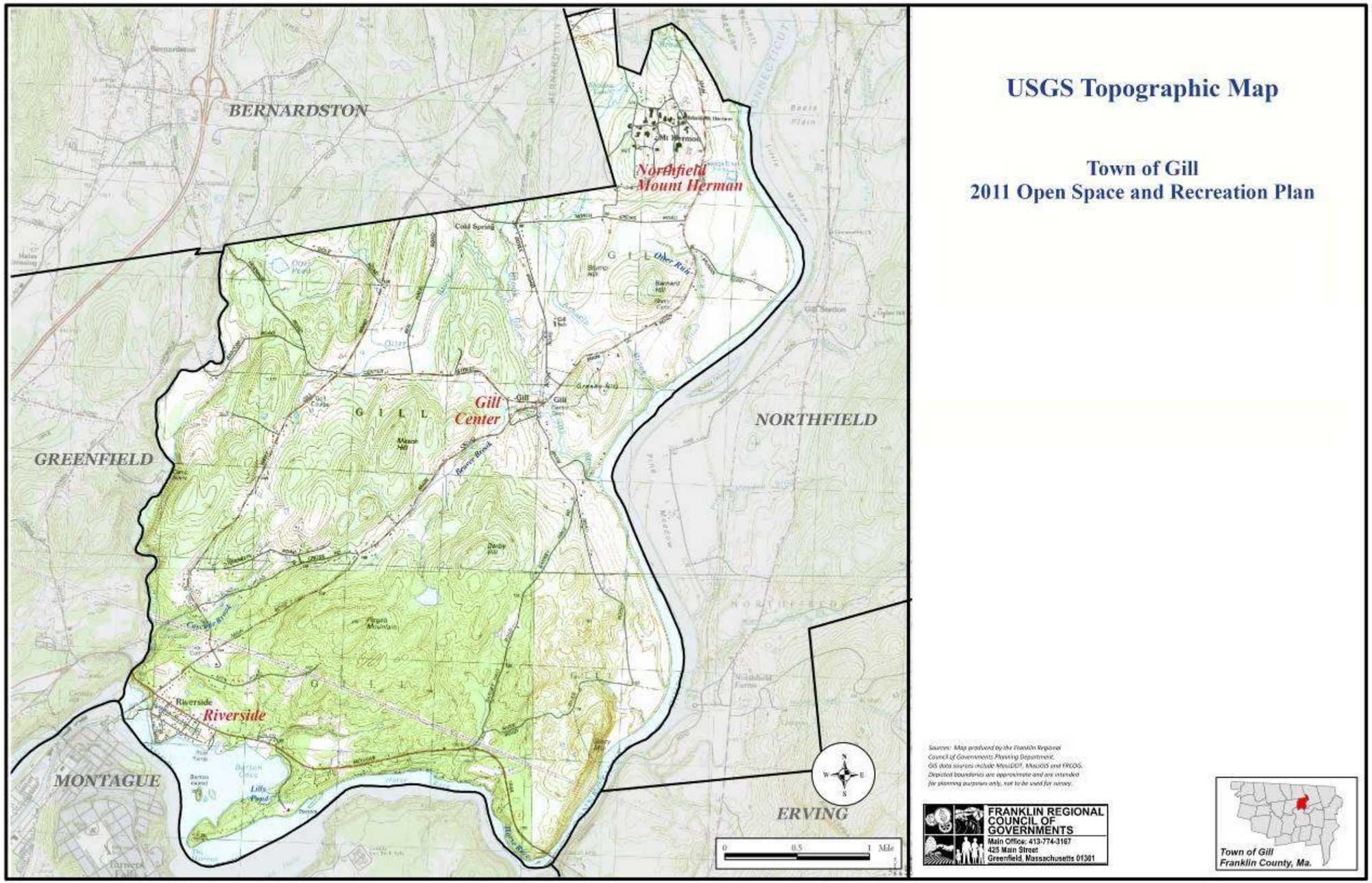
Franklin County, Massachusetts

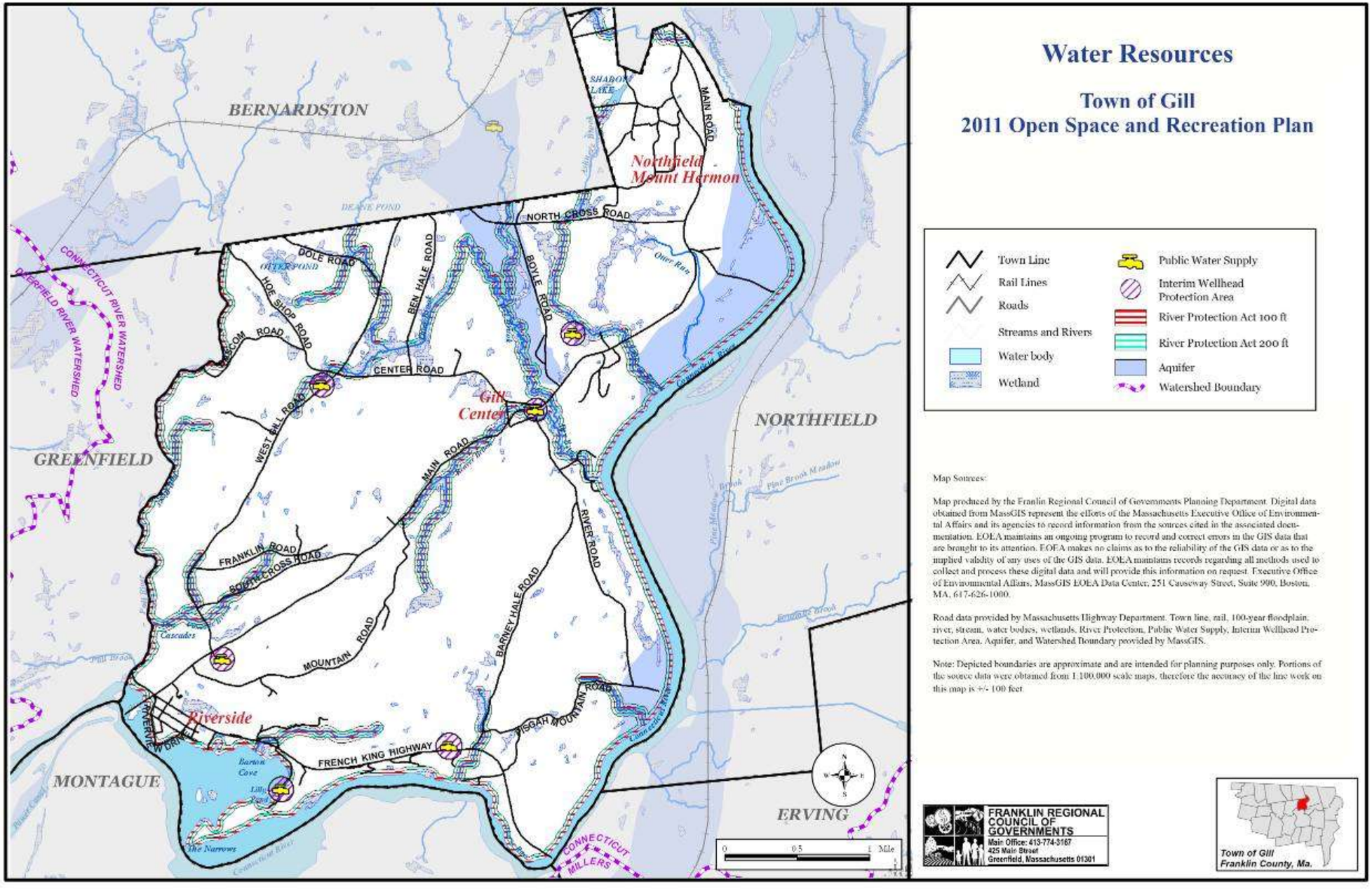
Map 4-3: Soils and Geologic Features



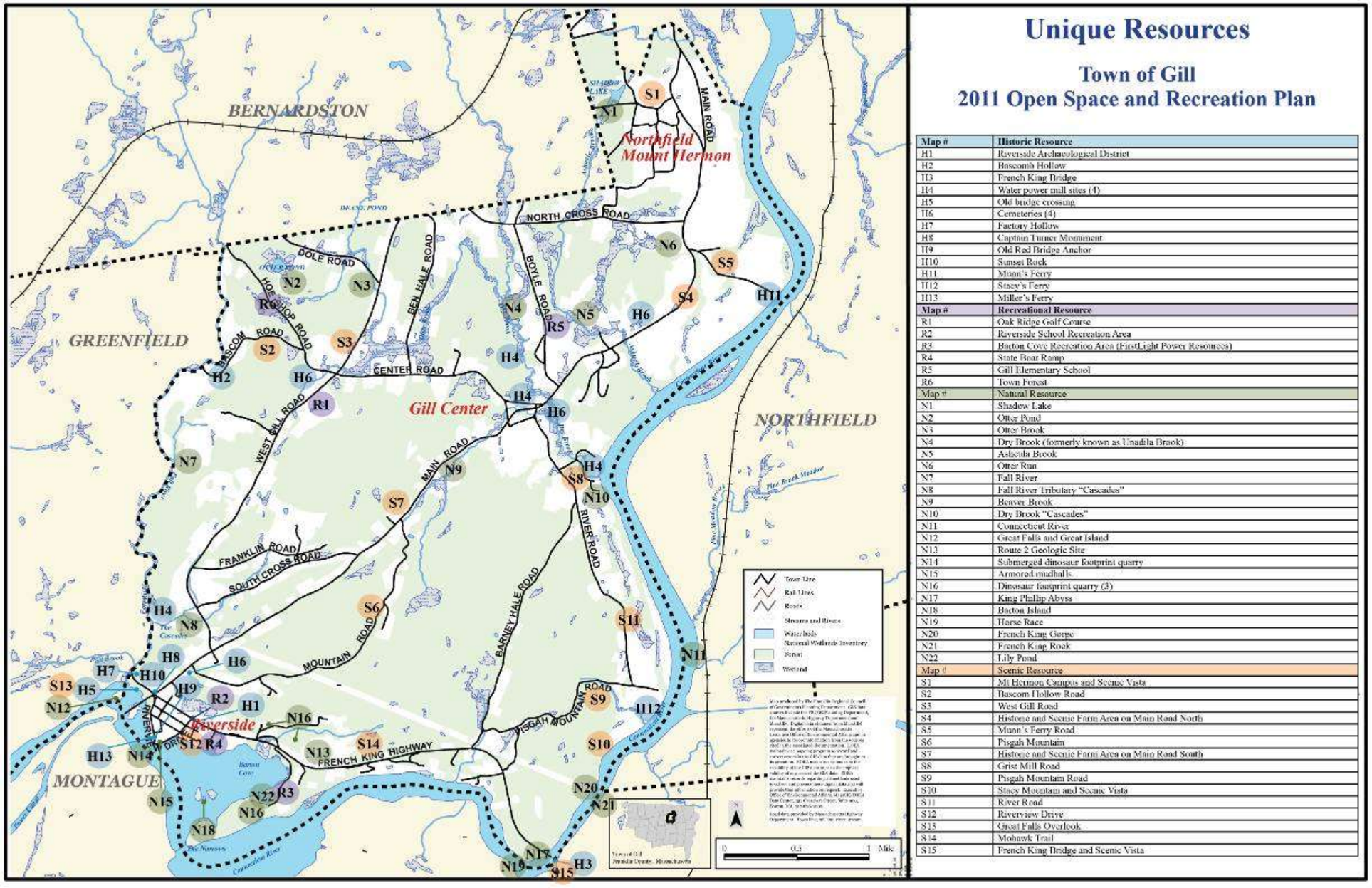
Map 4-4: USGS Topographic Map



Map 4-5: Water Resources Map



Map 4-6: Unique Resources Map



Unique Resources

Town of Gill
2011 Open Space and Recreation Plan

Map #	Historic Resource
H1	Riverside Archaeological District
H2	Bascomb Hollow
H3	French King Bridge
H4	Water power mill sites (4)
H5	Old bridge crossing
H6	Cemeteries (4)
H7	Factory Hollow
H8	Captain Turner Monument
H9	Old Red Bridge Anchor
H10	Sunset Rock
H11	Munn's Ferry
H12	Stacy's Ferry
H13	Miller's Ferry
Map #	**Recreational Resource**
R1	Oak Ridge Golf Course
R2	Riverside School Recreation Area
R3	Barton Cove Recreation Area (FirstLight Power Resources)
R4	State Boat Ramp
R5	Gill Elementary School
R6	Town Forest
Map #	Natural Resource
N1	Shadow Lake
N2	Otter Pond
N3	Otter Brook
N4	Dry Brook (formerly known as Unadilla Brook)
N5	Ashuela Brook
N6	Otter Run
N7	Fall River
N8	Fall River Tributary "Cascades"
N9	Beaver Brook
N10	Dry Brook "Cascades"
N11	Connecticut River
N12	Great Falls and Great Island
N13	Route 2 Geologic Site
N14	Submerged dinosaur footprint quarry
N15	Armored mudballs
N16	Dinosaur footprint quarry (3)
N17	King Phallip Abyss
N18	Bacton Island
N19	Horse Race
N20	French King Gorge
N21	French King Rock
N22	Lily Pond
Map #	Scenic Resource
S1	Mt Hermon Campus and Scenic Vista
S2	Bascom Hollow Road
S3	West Gill Road
S4	Historic and Scenic Farm Area on Main Road North
S5	Munn's Ferry Road
S6	Pisgah Mountain
S7	Historic and Scenic Farm Area on Main Road South
S8	Grist Mill Road
S9	Pisgah Mountain Road
S10	Stacy Mountain and Scenic Vista
S11	River Road
S12	Riverview Drive
S13	Great Falls Overlook
S14	Mohawk Trail
S15	French King Bridge and Scenic Vista