EXECUTIVE SUMMARY

Holland Massachusetts is located in south-central Massachusetts on the Connecticut border. It has a year round population of approximately 2,500 and a summer population of nearly 6,000. The primary development and existence of Holland is centered around the Hamilton Reservoir. This is a large body of water oriented along a north/south axis of the town.

Holland is located in the "Last Green Valley," the last swath of undeveloped land along the New England coast between the Washington-Boston megalopolis. This valley is known as the Quinebaug – Shetuket Rivers Valley Corridor, and Holland is the location of the headwater for the Quinebaug River.

The project provides an inventory and history of the natural and cultural resources of Holland by providing geologic history of the region, assessment of hydrologic processes, and biodiversity of the town. The geology is the template for all other processes, from vegetative growth to potential businesses. The hydrologic cycle integrates the cultural and natural process by providing sensitive habitat areas, and areas around which the town has developed, i.e. the Hamilton Reservoir. The cultural processes of the town must be understood to educate about the future, from the Native American influence prior to any European intervention, to today with a potential casino being developed just east of Holland. Other cultural history explains the creation the Reservoir and remnants of dams and sluiceways thought the town. These all provide the basis for exciting tourism opportunities and potential economic development in Holland.

This study will also provide analysis of the Massachusetts Executive Office of Environmental Affairs' maximum buildout projection for Holland. This projection is a theoretical maximum and not indicative of the definite development future for Holland.

Therefore, in response to the buildout projection this study will take into consideration the priorities of the townspeople of Holland, and on that basis propose strategies for future planning. These strategies include proposals for linking open space in Holland to promote biodiversity and maintain the quality of life. Secondarily, balanced residential development to promote careful and ecologically minded housing. Thirdly, tributary protection by raising awareness in the community and school children of the importance of the hydrologic process and the careful balance that should be protected to preserve the bodies of water in Holland. Finally, tourism and recreation development to promote the cultural and natural history of Holland, and by promoting low impact economic development with galleries or cafes and restoring the historic canoe trail.

The Quinebaug – Shetuket Rivers Valley Corridor was recently named a National Heritage site and therefore Holland sits in a strategic place for receiving funding for growth and development that promotes ecologically minded changes.

Goal, Objectives, & Methods

Goal:

To prepare landscape planning concepts for the town of Holland, by providing future scenarios and recommendations for ecologically minded growth, and motivate informed discussion about future opportunities and threats to the town's future development.

Objectives:

1) To take inventory of the abiotic, biotic and cultural resources of the town.

2) To make assessments of the resources by examining the potential changes, existing functions and strategies for protecting and managing them.

3) To present future scenario's and recommendations to the town which address:

a) The Hamilton Reservoir tributary zone.

b) Analysis and interpretation of the "build-out" plan as prepared by the Executive Office of Environmental Affairs, 2000.

c) Recommendations regarding future planning decisions that incorporate strategies for open space, residential development, tributary protection and increasing tourism opportunities

Methods:

GIS mapping, personal interviews with town official and residents, fish and wildlife specialists, naturalists, historical map analysis, build-out analysis, literature reviews, and workshops with town officials and citizen

INTRODUCTION

The town of Holland is located in south-central Massachusetts, and is one of 13 Massachusetts towns that are included in the French-Quinebaug watershed. Incorporated in 1836, the town was named after Lord Holland, also known as Charles James Fox, who "*won America's love as an eloquent defender of her rights, but who subsequently became an ardent royalist and for that reason was elevated to the peerage and given the title of Lord Holland"* (Lovering, 1915). In 1865 a reservoir was created to provide power to the mills in the area. Today, Hamilton Reservoir (**Figure 1-1**) has be described as the defining characteristic, the "heart and soul" of Holland, providing aesthetic, economic and recreational benefits. Overall, the rural, small town character found here attracts many people who want to get away from the "city life."

Figure 1-1: The Hamilton Reservoir is heavily populated, especially during the summer months.

Holland covers approximately 13 square miles or 8,060 acres. Auto accessibility is provided by Interstate 84, which cuts through the southeastern corner of the town, as well as Route 90 (the Massachusetts Turnpike) and Route 20, both to the North. Zooming out to a more regional scale, Holland lies approximately 35 minutes from each Springfield, Worchester and Hartford, CT (**Figure 1-2**). This central location makes Holland a prime location for commuters to live while working in these and other area cities. Another way to look at the regional significance of a town is to examine it from a watershed perspective. The French-Quinebaug Watershed, along with the Quinebaug-Shetucket Rivers Valley, is part of the larger Thames River Watershed, which includes towns from both Massachusetts and Connecticut.

Figure 1-2: Holland is located approximately 35 minutes from Worcester, Springfield, and Hartford, CT. *Scource: www.mapquest.com*

The French-Quinebaug Watershed is considered to be an important part of the "Last Green Valley," an area of land that appears as the only dark spot on a satellite night photo of the Boston to Washington, DC corridor (**Figure 1-3**). The Last Green Valley is composed of both the Quinebaug and Shetucket Rivers Valley, which has recently been granted National Heritage Corridor status by the National Park Service. Covering 1,085 square miles, the Last Green Valley is surprisingly rural in character, despite the presence of the heavily traveled Massachusetts Turnpike and other highways, as well as the growth of population from the movement of those in the city to this picturesque setting. As described by the Quinebaug-Shetucket Corridor's planning publication *Vision 2010*, "The relatively undeveloped character of this green and rural island in the midst of the most urbanized region in the nation makes it a resource of local, regional, and national importance" (2000). This landscape plan recognizes and respects the beauty of this place, and attempts to provide future scenarios that will protect it for generations to come.

Figure 1-3: Satellite image of the Last Green Valley. *Source:* www.lastgreenvalley.org

GEOLOGY

Geology serves as a basic template that controls and influences all other elements in the landscape: from topography, soils, hydrology, and human activities. Therefore, to better understand and reveal important landscape issues in Holland, one should begin with the geology. The geology will be examined in three sections.

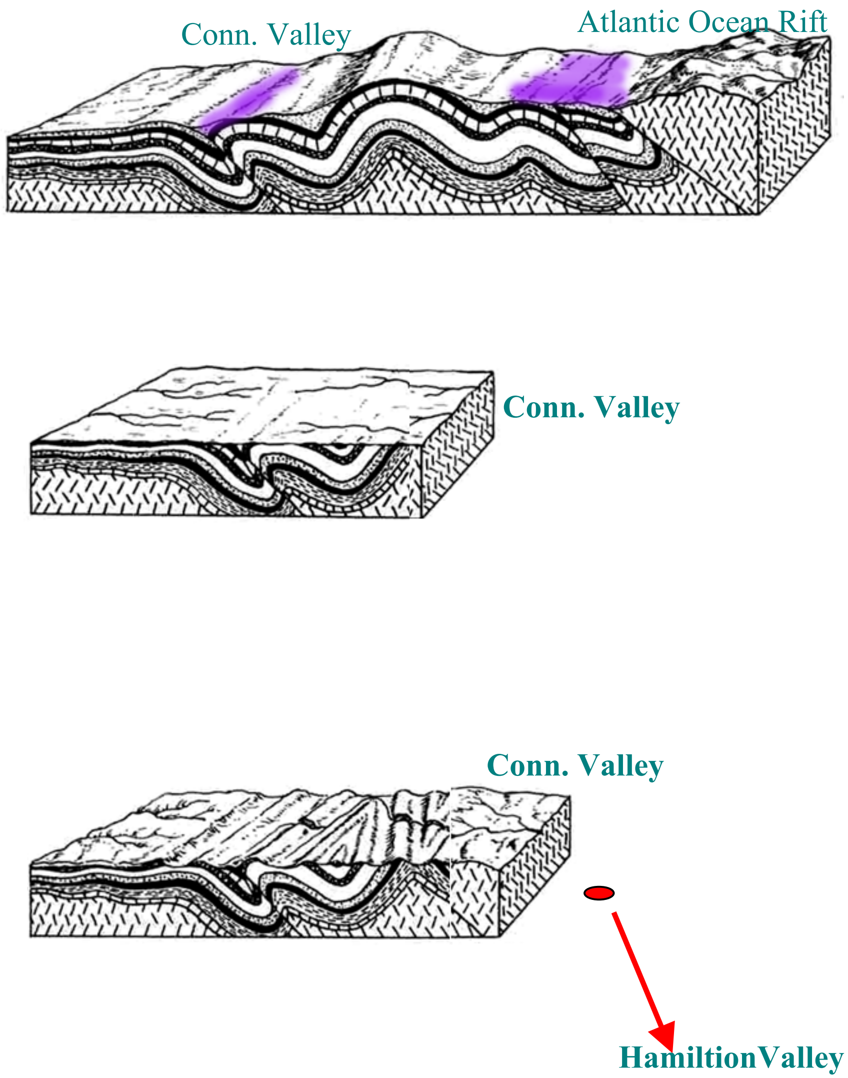
GEOLOGIC HISTORY

The 'Big Bang' to the formation of North American Continent.

The story of the New England region began millions of years ago and continues today. Approximately 600 million years ago the mass of land we now known as North America was south of the equator and submerged by the Lapetus Ocean. Some 170 million years later, the Taconic Orogeny resulted from a collision with the Gondwana continent. This collision resulted in the uplifting of North America above the water surface.

The Age of Great Folding and Collision—formation of Appalachian Mountain.

After millions of years of erosion and changing sea levels, around 350 million years ago, the famous Appalachian Orogeny compressed the strata of the geosyncline in New England into a series of parallel folds, oriented southwest-northeast. Today's topography still reflects this structure and orientation. The once-marine sedimentary rock of New England was metamorphosed from the collision stress. This resulted in the formation of folded gneisses, schists, and slate. Melting of selected metamorphic rocks resulted in granite igneous formations throughout New England today (Univ. Mass. French/Quinebaug, 1999). (**Figure 2-1**)



A. 350 mil. years ago, Appalachian Revolution compressed the strata of the geosyncline in New England into a series of parallel folds, oriented southwest-northeast.

B. Approximately 65 million years ago, long time of erosion resulted in a flat peneplain at Connecticut Valley of today

C. Subsequent continuing uplift and further erosion have produced the present condition revealed in the long, narrow, sharply crested parallel mountain ridges and valleys. Hamilton Valley in Holland might be one of them.

Fig. 2-1: Geological Formation of Hamilton Valley, Holland.
Source: Zen, White, Hadley&Thompson edits. Studies of Appalachian Geology: Northern and Maritime. Interscience Publishers, 1968)

The Age of Erosion and Uplift—formation of Connecticut River Valley.

Tensile stresses within the continent caused rifting, or splitting of the continent. Several rifts were formed; Among them, the Eastern Border Fault space (this rift stretched from what is now New Haven, CT to Keene, NH) later resulted in what is now the Connecticut River Valley (Zen et al., 1968). Holland lies just to the east edge of the valley.

Millions of years of subsequent erosion of this landscape resulted in a flat peneplain approximately 65 million years ago. Subsequent continuing uplift and further erosion have produced the present condition revealed in the long, narrow, sharply crested parallel mountain ridges and valleys. **(Figure 2-2)**

The Age of Glaciation—formation of Hamiltion Valley.

Nearly 20,000 years ago, huge continental ice sheets covered the whole New England Area today. This glaciation rounded and smoothed mountains and ridges of the French-Quinebaug Valley. As the glacier melted and retreated, the former terrain was deeply reformed. Current landscape in Holland reflects this most recent geological event. As receding of the melted glacier, vast amounts of sand and gravel deposits are commonly found in the Hamilton Valley today. Hills were buried in till consisting of silt, fine sands, cobbles and boulders. Rounded hills of till known as drumlins were formed. Meanwhile, the widespread wetlands were formed in the Hamilton Reservoir Valley as melting glacial water was trapped in the valley by the glacier's margin - leaving ice-contact deposits while disrupted previous drainage patterns. Streams of melted ice carried sand, gravel, silt and clays and forming flat, sloping stretches of land that are called outwash plains. Most areas of the Hamilton Reservoir and Holland Pond Valley are such plains. Sometimes, depressions in the ground known as kettles formed as stranded ice blocks melted and the debris covering them subsided. If that kettle fills with water, it becomes a kettle lake, which is usually steep-sided, basin- or bowl-shaped. The Lost Lake in Holland is such a lake. In Holland, many huge boulders, or glacial erratics are easily found, these are rocks carried from a distance in or on the ice; As the ice melted, they remain where they were deposited by ice because they are too large to be carried by melt water streams. **(Figure 2-2)**

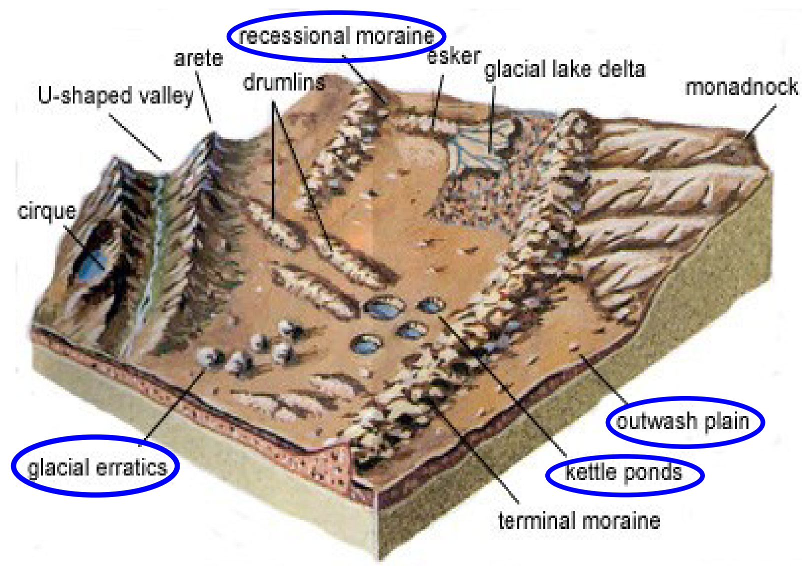


Fig. 2-2: Glacial processes and resultant landforms among them, glacial erratics, recessional moraine, outwash plain and kettle ponds are found in Holland.
Source:

BEDROCK AND STRUCTURAL GEOLOGY

Geologically, the whole French-Quinebaug Watershed is a subregion of the central upland of Massachusetts known as the Worcester County Plateau. The watershed contains highly folded and metamorphosed rock of both sedimentary and igneous origin (Univ. Mass. French/Quinebaug, 1999). Holland is dominated by one structural region—the Oakham Anticline, which is an intensely folded region found in the Upper Quinebaug. Two fault lines exist in Holland that run in a northeast-southwest orientation through Holland and have been noted as Pond Fault and Rock Meadows Fault. They run through the northern part of Hamilton Reservoir and the eastern edge of Holland Pond (Univ. Mass. Holland Master Plan, 1995). **(Figure 2-3)**

The intensely folding bedrock geology as well as the two NE-SW faults through Holland potentially affected the terrain we see today in Holland: the faults further lead to the formation of Hamilton Valley, while the folding areas strengthen the NE-SW orientation of ridges and valleys.

Generally speaking, the bedrock and structural geology of Holland has a minimal impact on land uses, as glacial deposits and soils cover much of the bedrock. Faults within the bedrock are inactive and pose no threat to public safety. The most common limitation posed by the bedrock units in areas of shallow bedrock and bedrock outcroppings where construction and farming are complicated by shallow soils and hard bedrock.

SURFICIAL GEOLOGY

The current surficial geology of Holland is a result of glaciation 14,000-20,000 years ago and continuous fluvial processes since that time. There are three main components of surficial geology found in Holland: Glacial till is a heterogeneous mixture of clays, silts, sands, gravel, cobbles, and boulders moved or deposited by glacial ice; Sand and gravel deposits are primarily glacial outwash deposits; Floodplain alluvium are the most recent deposits in the town, which consists of gravel, sand, silt and clay that has been reworked and deposited by rivers and streams (Ward & O'Brien, 1981).

Glacial tills are found throughout the town beyond the Hamilton Reservoir and Upper-Quinebaug Watershed. Sand and Gravel deposits are found along the floodplains and valleys within the Hamilton Reservoir, Holland Pond and Upper Quinebaug Watersheds. Floodplain alluvium is mainly found in the floodplains of Upper Quinebaug Watershed at the north end of Holland. **(Figure 2-4)**

Sand and gravel deposits represent a resource, which functions as valuable sources of groundwater and construction materials. Floodplain alluvium has a constraint, since these fine-grained deposits are generally unsuitable for septic systems and have limited suitability for development.

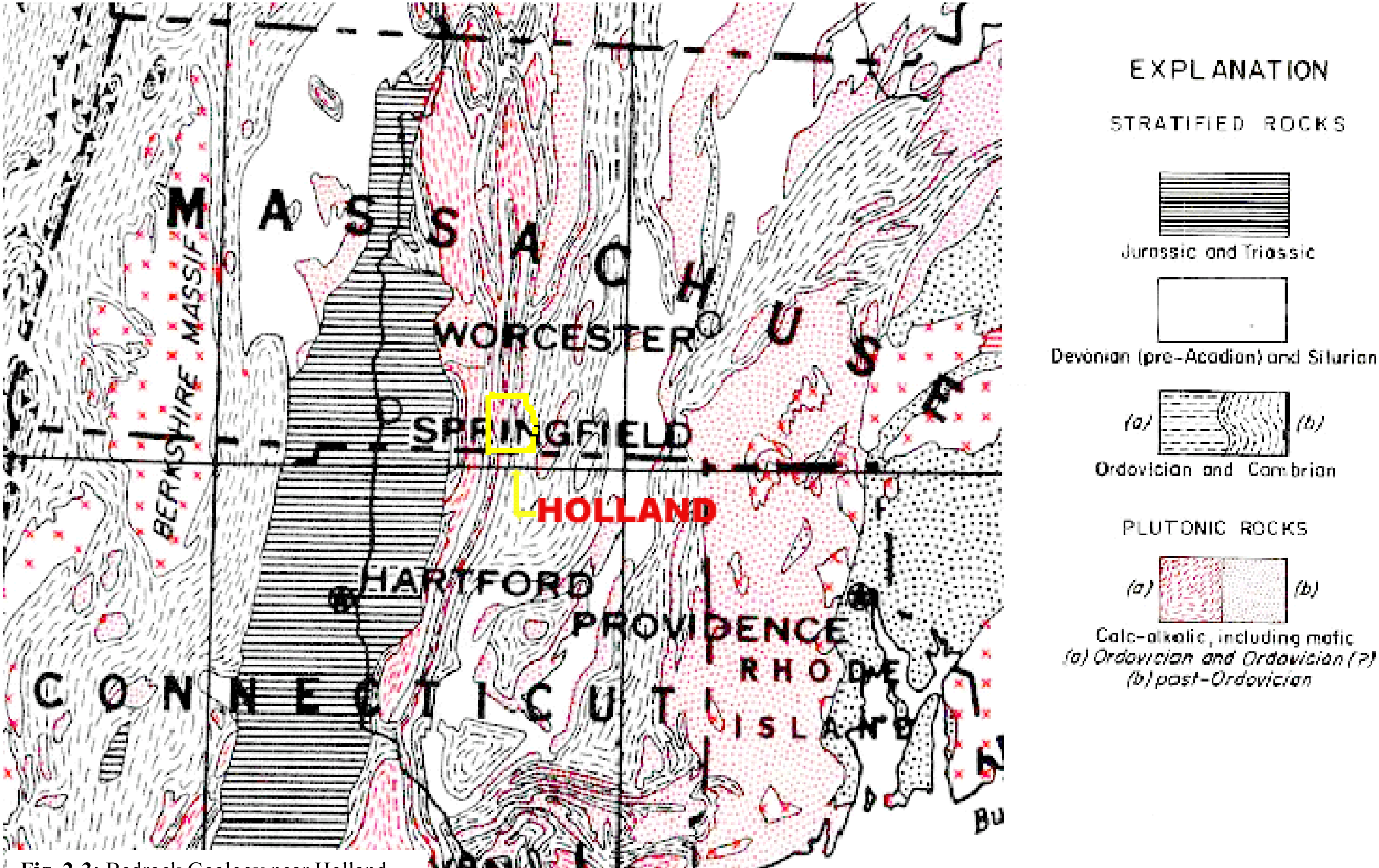
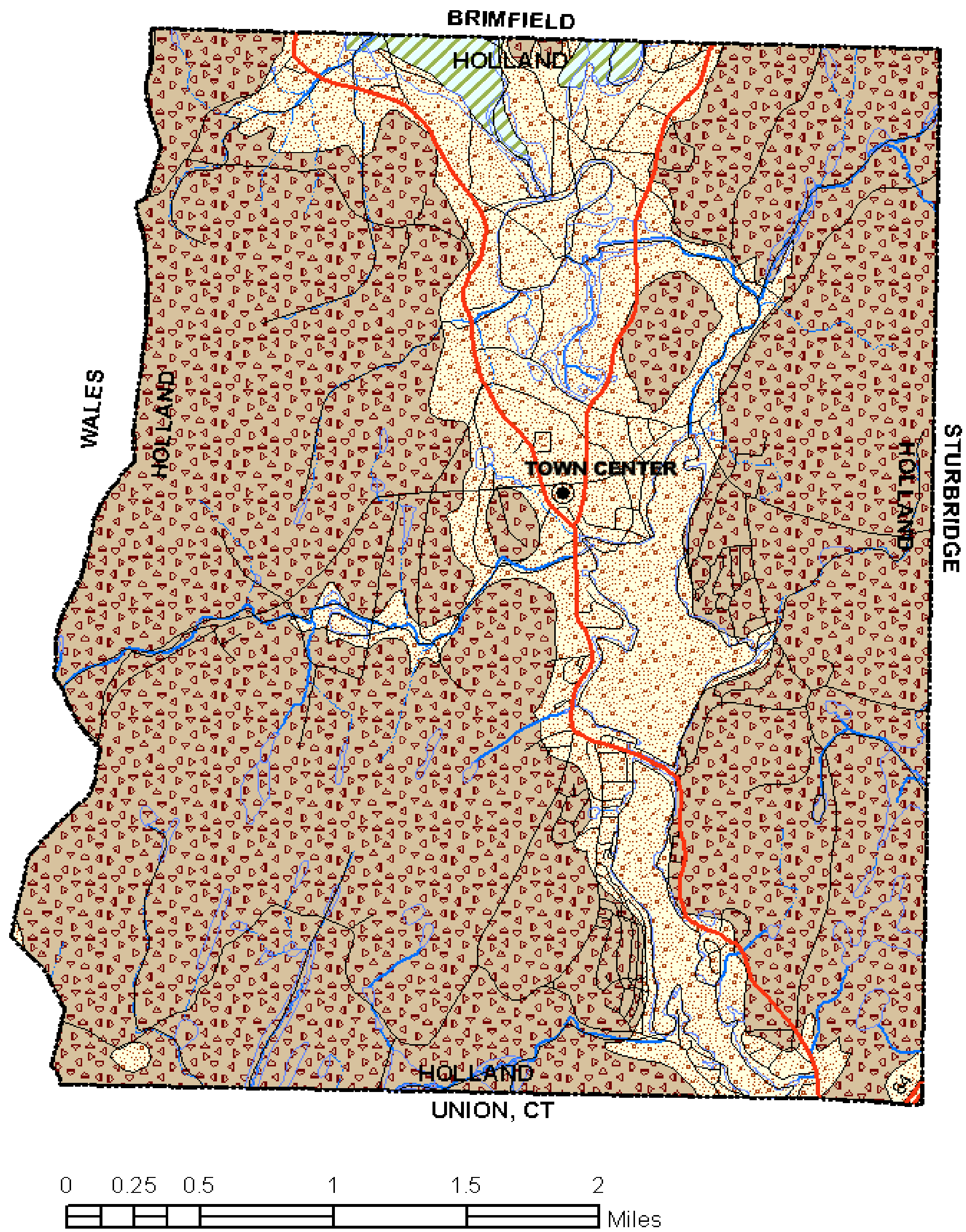


Fig. 2-3: Bedrock Geology near Holland
Source: Zen, White, Hadley&Thompson edits. Studies of Appalachian Geology: Northern and Maritime. Interscience Publishers, 1968

SURFICIAL GEOLOGY



Legend

CODE

- Sand and Gravel Deposits
- Tills or Bedrock
- Floodplain Alluvium

N

Fig. 2-4
Source: Mass GIS

A general understanding of hydrology is necessary to better understand the conditions that have occurred to shape the landscape of Holland. In addition, the state of the hydrology determines the relative physical, ecological and economic health of the community, which is focused around the Hamilton Reservoir. A watershed is a geographic area of land in which all surface and ground water flows downhill to a common point, such as a river, stream, pond, lake, wetland, or estuary. (www.state.ma.us/envir/mwi/watersheds.htm) **(Figure 3-1)** Water from falling rain and melting snow generally drains into ditches, streams, wetlands, lakes, and coastal waters, or seeps into the ground. As water moves over the land it picks up sediment and dissolved materials and transports it to lakes, rivers, ponds, streams and coastal bays. Vegetation, leaf litter, fallen logs, and the naturally uneven terrain of forests and other natural areas slow down and filter runoff. Water flowing over parking lots and other developed areas speeds up and can pick up a variety of pollutants *en route* to water bodies. (www.state.ma.us/envir/mwi/watersheds.htm).

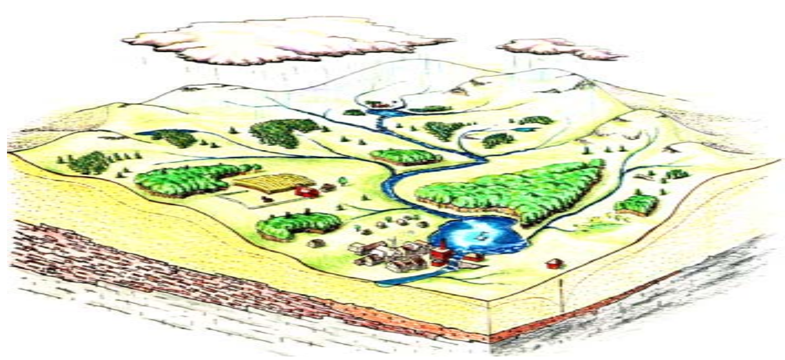


Fig. 3-1: The landscape of a watershed.
Source: www.state.ma.us/envir/mwi/watersheds.htm

WATERSHED PLANNING

It is important to consider Holland in the larger context of watershed planning. The view of the watershed offers a good spatial unit for planning because it is an area interconnected by its hydrological processes over time. The watershed boundary will not change but the conditions within it will. Increasing urbanization has an impact on water quality throughout the watershed. The watershed acts as a report card for the surrounding landscape. Watershed planning is important because it ensures that environmental objectives are well integrated with those for economic and other social and cultural goals (www.epa.gov/owow/watershed/framework.html)

THE FRENCH AND QUINEBAUG RIVER WATERSHEDS

The town of Holland is part of the French & Quinebaug River Watersheds. This watershed combines with the Quinebaug-Shetucket River Valley to form the Thames River Watershed, which comprises the "Last Green Valley." The relatively undeveloped character of this green and rural island in the midst of the most urbanized region in the nation makes it a resource of local, regional and national importance. (www.thelastgreenvalley.org)

This region of the country was formed by glaciers, which shaped the earth thousands of years ago leaving behind geologic and hydrologic patterns that have come to characterize the rural landscape of the French & Quinebaug Watersheds. The Watersheds encompass approximately 1,474 square miles (251 square miles of which occur in Massachusetts) of land area. The French River, the smaller of the two, extends approximately 21 miles (with 14 miles in Massachusetts), while the Quinebaug River spans approximately 65 miles (with 19 in Massachusetts). (www.state.ma.us/envir/mwi/watersheds.htm,)

QUINEBAUG RIVER WATERSHED

The Quinebaug River Basin covers 744 square miles in south central Massachusetts, eastern Connecticut, and northwestern Rhode Island. The Quinebaug River flows 76 miles from its source in Mashpaug Pond in Union Connecticut to its confluence with the Shetucket River in Norwich, Connecticut, forming the Thames River. The headwaters of the Quinebaug River start in Holland at the northern tip of the Hamilton Reservoir. **(Figure 3-2)** Leaving the reservoir, the river flows north to Sturbridge. The U.S. Army Corps of Engineers, following extensive flooding in 1955, constructed three major flood control dams on the Quinebaug River. (The Quinebaug River, 1980 Water Quality Data) The towns within the Quinebaug watershed have an opportunity to capitalize on the "Last Green Valley" designation and work with each other to bring needed economic stimulus (in the form of recreation-based tourism) to the region. Cooperative efforts could include interconnecting hiking and canoeing trails throughout the watershed.

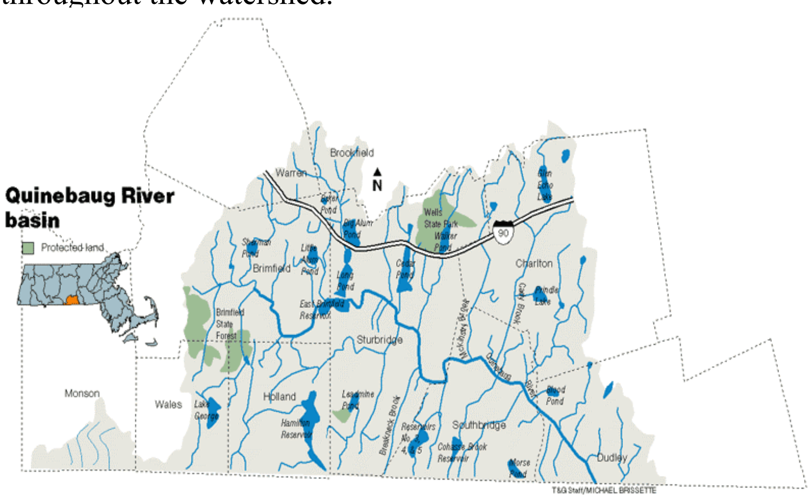


Fig: 3-2, The Quinebaug River Watershed
Source: Mass GIS

SIGNIFICANT WATER BODIES OF HOLLAND

Hamilton Reservoir

The Hamilton Reservoir was created in 1865 when the Hamilton Woolen Company dammed the Quinebaug River. The present dam was constructed in 1956, after a flood caused the original dam to rupture and flood large areas of town. The reservoir provides year-round flood protection, beautiful vistas, and is the source for a considerable amount of the economic activity in the town, mostly from recreation activities. The reservoir is located in the headwater region of the Quinebaug River Watershed and has two distinct basins, the north basin and the south basin separated by a culverted causeway. (Hamilton Reservoir Watershed Study) **(Figure 3-3)**

The mean depth is 6 feet and the maximum depth is 21 feet. The reservoir encompasses 249 acres with 9 miles of shoreline. The shoreline of Hamilton Reservoir is very heavily populated (Residential development – 80%), has steep slopes and exhibits scant vegetation. (McCann, James and Daly, Leo. 1972) Problems in erosion arise due to the combination of dense population, scant vegetation and steep slopes. In addition, there are a number of unpaved roads around the perimeter of the reservoir. These conditions have aggravated sediment loading into the reservoir, which has a direct effect on the reservoir's capacity to handle recreation activities. In addition, residential development along the shores of Hamilton Reservoir has exhibited failing or substandard septic systems. A combination of dense population, small lots and poor soils could be leading to raw sewage leeching into the reservoir. Currently, there is no water quality assessment for primary and secondary contact (swimming and boating) that would determine if fecal coliform bacteria are present)

HYDROLOGY

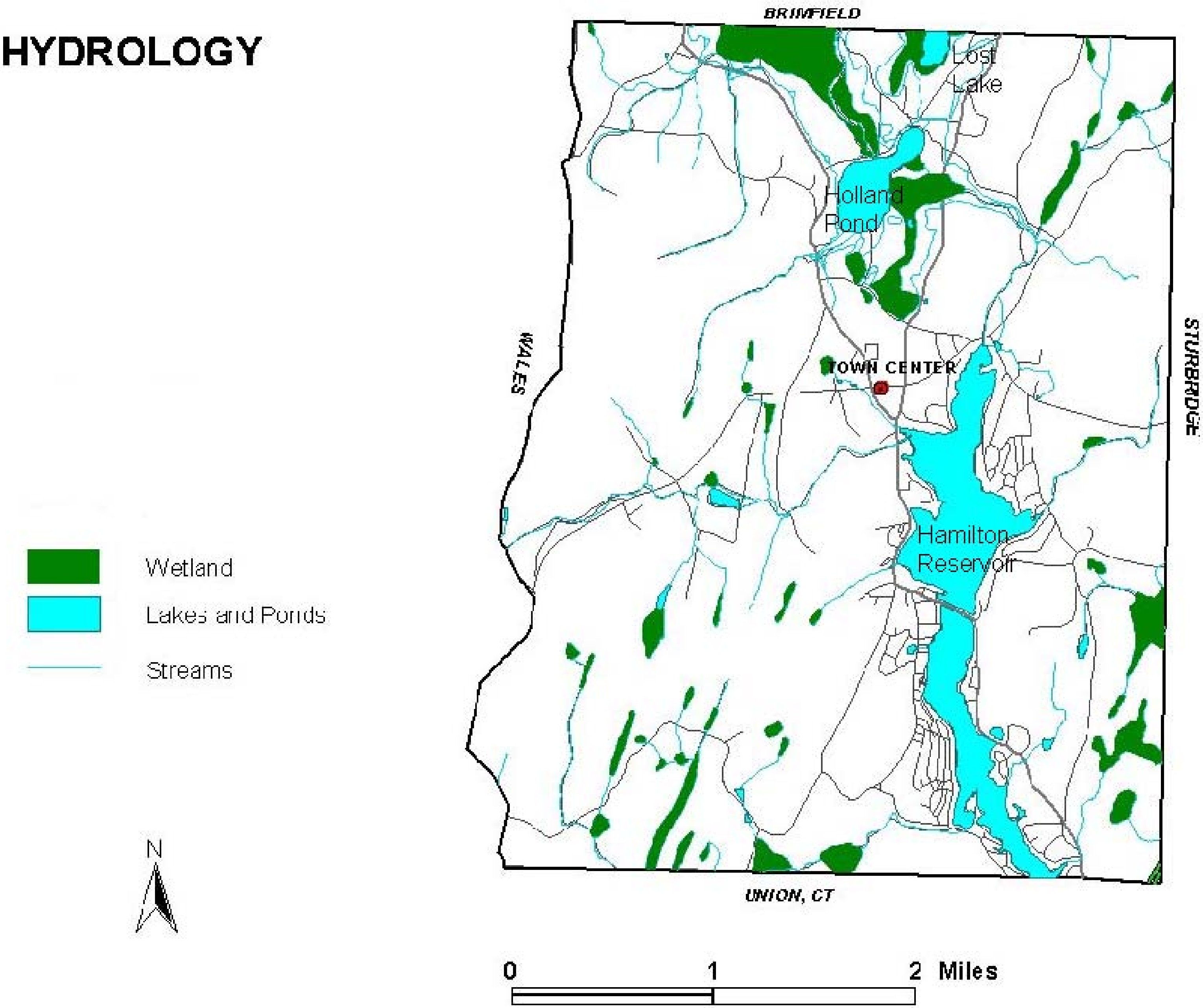


Figure 3 - 3
Source: Mass GIS

Holland Pond, also known as Lake Siog, is an important resource for the town. A high quality, medium flow aquifer is located in the general area of Lake Siog and the surrounding wetlands. It does not currently provide public water for the town as all water in town is supplied by private wells. However, it may supply water for private wells in Holland as well as in Brimfield. The recharge area spans both Brimfield and Holland. The aquifer is overlaid by impermeable layers of gneiss and schist, thus making contamination unlikely from land use located directly above

Lake Siog is located 1 mile north of town. It has a mean depth of 11 feet and a maximum depth of 21 feet. The pond encompasses 65 acres with 1.5 miles of shoreline. Lake Siog Park was opened in 1994, on land leased by the Army Corps of Engineers, providing opportunities for recreation. Lake Siog has not been assessed for primary and secondary contact. However, there is a mercury advisory for fish consumption by children and pregnant or nursing women. The cause is assumed to be atmospheric. (French & Quinebaug Water Quality Summary, 2001)

Lost Lake also known as Gould Pond is a "kettlehole" which is a water body having no surface inlet or outlet. It is approximately 1.8 miles north of town. It has a mean depth of 6 feet and a maximum depth of 15 feet. It encompasses 15 acres with .5 miles of shoreline. (McCann, James and Daly, Leo. 1972)

BROOKS

Hamilton Reservoir has five named brooks flowing into it **(Figure 3-4)**. The largest brook is Leadmine Brook, on the east side of the Reservoir, which flows southward into Connecticut and enters the reservoir via Mashapaug Pond. Brown Brook flows into the south basin while Stevens Brook discharges into the northern basin. Both are on the east side of the reservoir. Amber Hill Brook is a small, steep brook located on the southwest end of the north basin. (Hamilton Reservoir Watershed Study, 2000) May Brook also enters the reservoir at the southwest region. The uplands are the next area of Holland that will undergo changes due to increasing residential development. Erosion is one of the main problems that will accompany the landscape changes. Protection of the five named brooks as well as tributaries should be a priority for the community.

TRIBUTARIES

The tributaries of the watershed are the next part of the hydrological cycle that will be affected by increasing residential development into the uplands. Two unnamed brooks one on either side of the reservoir have been determined to exhibit the steepest naturally occurring slopes in the watershed. These brooks should be considered a priority to the town as a large amount of sediment loading is occurring from these two sources. (Hamilton Reservoir Watershed Study, Conway School of Design, 2000) This report focuses on the unnamed tributary on the northwest corner of the reservoir. This tributary is sensitive to pressure from Stafford Road that runs parallel for a stretch and expanding residential development on its east side. **(Figure 3-5)** The increase in impermeable surfaces and the loss of tree canopy that results from residential development has caused more erosion problems in this steeply sloped tributary. Erosion from this tributary is contributing a significant amount of sediment loading into Hamilton Reservoir according to resident and Selectman Jim Wettlaufer.

TRIBUTARIES IN HOLLAND

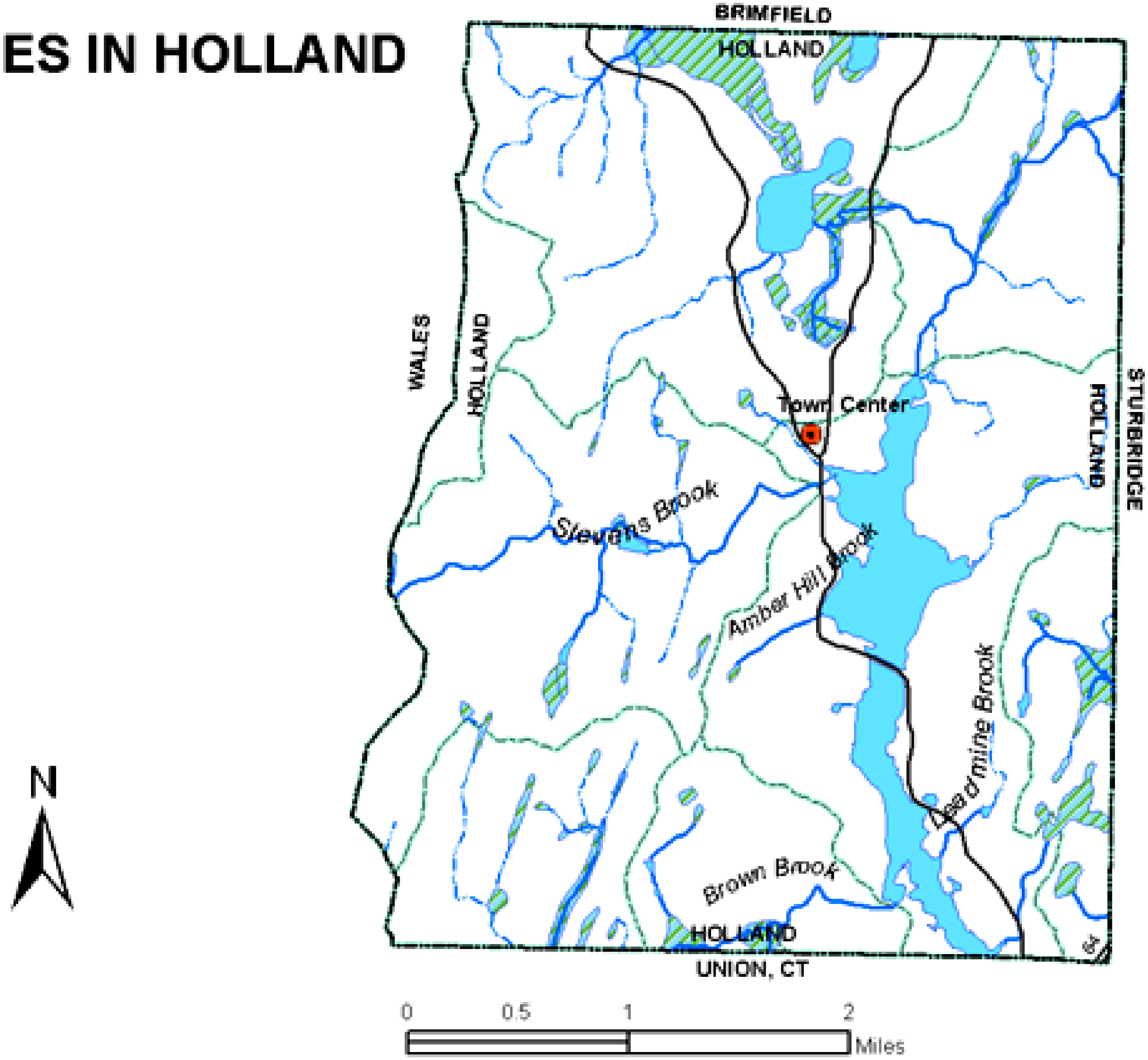


Figure 3-4
Source: Mass GIS

HYDROLOGY AND RESIDENTIAL DEVELOPMENT

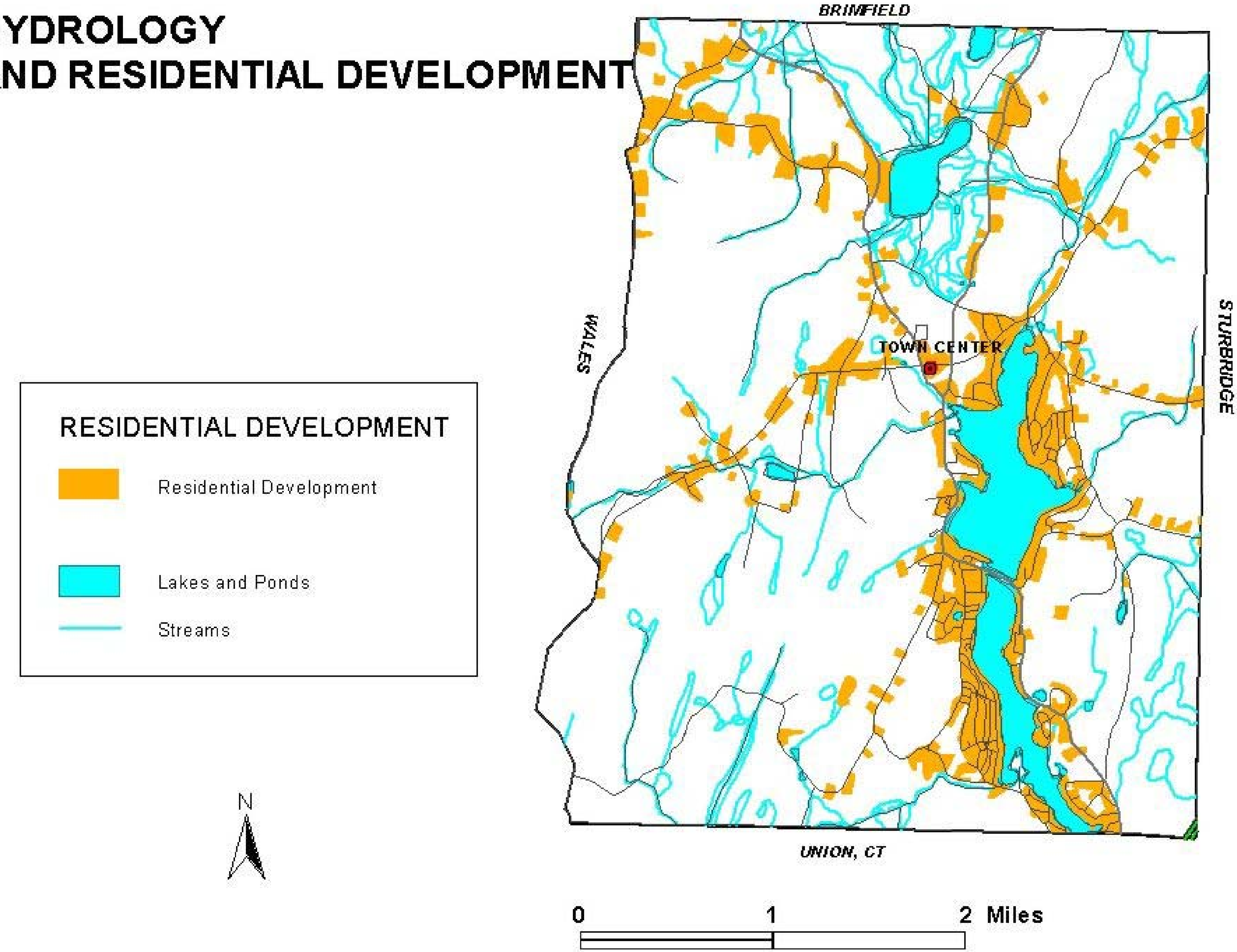


Figure 3-5
Source: Mass GIS

There is an opportunity for the town to protect the land to the west of the tributary from residential development and the subsequent loss of tree canopy. The canopy is needed to slow down and mediate the amount of water reaching the ground. Any additional loss of canopy could result in: higher velocity runoff, less infiltration, higher pollutant loads, loss of wildlife habitat, and warmer waters. (Federal Interagency Stream Restoration Working Group, 1998) Protection of the land west of this unnamed tributary will provide the town with increased protection from erosion and sediment loading into the reservoir. Recommendations for community involvement in addressing this issue include adopt-a-stream program, integration into classroom curriculum through the Benchmarks of Environmental Literacy Grades 5-8 established by the Massachusetts Executive Office of Environmental Affairs (see Strategy 3).

WETLANDS

Wetlands are another major part of the hydrological system in Holland. Wetlands are those areas of land where water is so abundant that it is the major factor that dictates the nature of the plant growth on the site. Wetlands provide many functions that contribute to maintaining the quality of the environment, such as flood control, pollution filtration, and recreational and scenic amenities. Wetlands are also vital in maintaining the biological diversity in Holland. In Holland the major types of wetland types include flood plain forests, cattail marshes, red maple swamps, and vernal pools. In general, Massachusetts' wetlands are mostly confined to basins formerly occupied by ponds and lakes, to shallow basins or flat areas, or to the floodplains of streams. (Motts, Ward, O'Brien, Arnold L., 1981) Holland has a wealth of wetlands, covering approximately 11% of the town's land area. **(Figure 3-6)** Wetlands are a valuable source of groundwater. Ground water is that which penetrates the earth's surface from precipitation and from infiltration by streams, ponds, and lakes.

Wetlands in Massachusetts are protected by the **Wetlands Protection Act** which is charged with the protection of private and public water supply, protection of groundwater, flood control, prevention of storm damage, prevention of pollution, protection of land containing shellfish, protection of wildlife habitat and protection of fisheries. In 1996, the **Rivers Protection Act** was passed as a state act for protecting the natural integrity of the Commonwealth's rivers and to establish open space along rivers (http://www.state.ma.us/dep/brp/ww/files/riverqa.htm). Wetlands are already protected but the surrounding land can be incorporated into a broader network of protected land.

SOILS

The major factors of soil formation are parent material, climate, topography, time and living organisms. In Holland, parent material and topography are the primary factors. The parent material in Holland consists of glacial till and glacial outwash derived from crystalline rocks and geologically recent alluvial deposits, which are materials deposited on floodplains by a stream. Glacial till consists of unstratified, unsorted clay, silt, sand and boulders that were moved and deposited by a glacier. The glacial outwash consists of sorted, stratified gravel, sand, and silt that were deposited by glacial meltwaters. The recent materials deposited by stream overflow are on flood plains and consist of gravel, sand, silt, or clay. In wet areas, thick deposits of decomposed organic matter can be found. Most of the soils in this survey area are of the same age, except for the soils formed by alluvial deposits and the thick organic deposits. (Soil Survey, 1984)

The three most common soils found in Holland are Paxton, Brookfield, and Woodbridge. **(Figure 3-7)** In general, these types are very deep, gently sloping to steep, well-drained and moderately well drained soils formed in loamy glacial till; on uplands. The area where these types of soils are found consists of low hills and ridges. Most areas have stones on the surface that are 5 to 20 feet apart. Slopes range from 3 to 35%. Holland consists of about 27% Paxton soils, 12% Brookfield soils, 10% Woodbridge soils and 51% soils of minor extent. (Soil Survey, 1984)

Most of Holland is covered in woodland. The stones on the surface make this area poorly suited to cultivated crops, hay or pasture. The Paxton-Woodbridge-Brookfield soils have moderate to high potential for woodland productivity. The upland areas are generally well suited to building site development; however, wetness is a limitation in low-lying areas and in depressions. **(Figure 3-8)** Most soils have restricted permeability and do not readily absorb effluent from septic systems. (Soil Survey, 1984) This is a potentially serious problem since all of the lakeside residents utilize septic systems. Also due to the very small size of the average lakeside lot, and the high density of population there are potentially a large number of septic systems that could be leeching raw sewage into the reservoir.

CLIMATE

Holland experiences typical New England weather with cold winters and moderately warm summers (and occasional hot spells). In winter the average temperature is 26' F. The summers average temperatures of 69' F with an average daily maximum of 81'F. The uplands of Holland are exposed to winds and the valley area of the reservoir is susceptible to frost and fog. The annual precipitation is 42". Of this, about 22 inches usually falls in April through September. The average seasonal snowfall is 47". (Soil Survey, 1984)

WETLAND TYPES

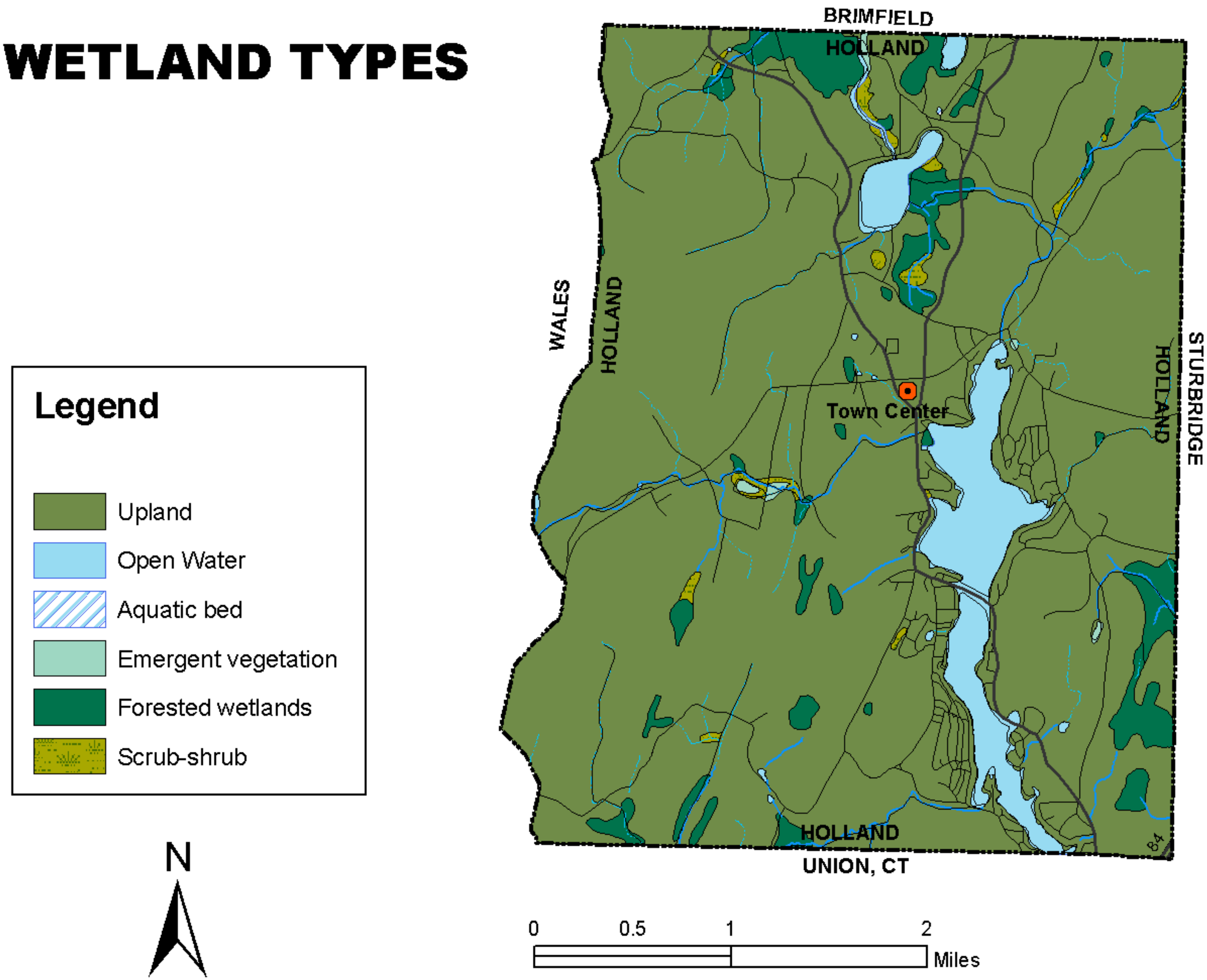
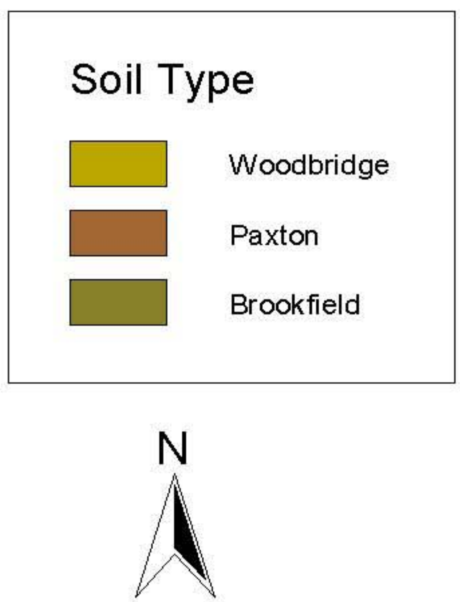


Figure 3-6
Source: Mass GIS

SOIL TYPE



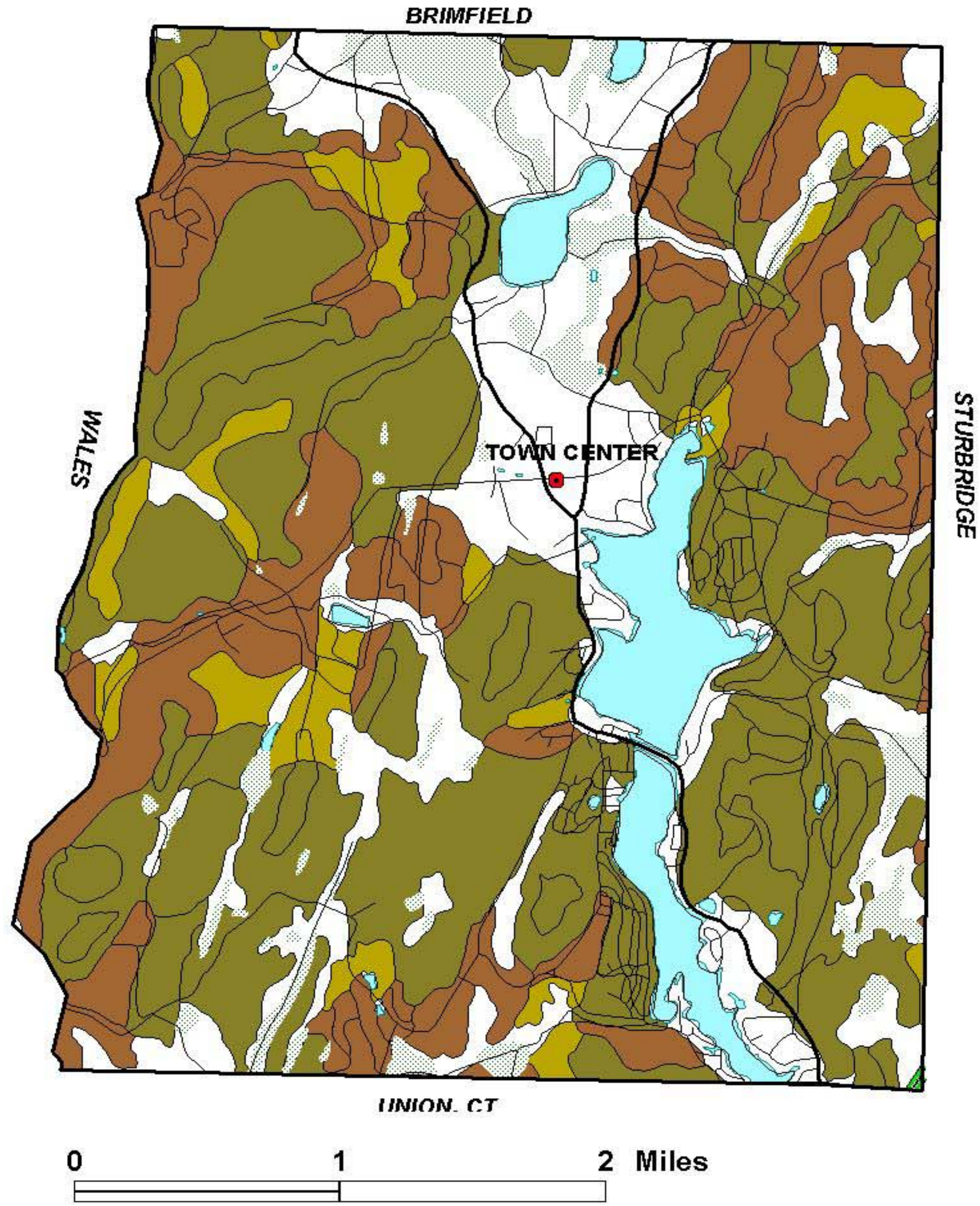
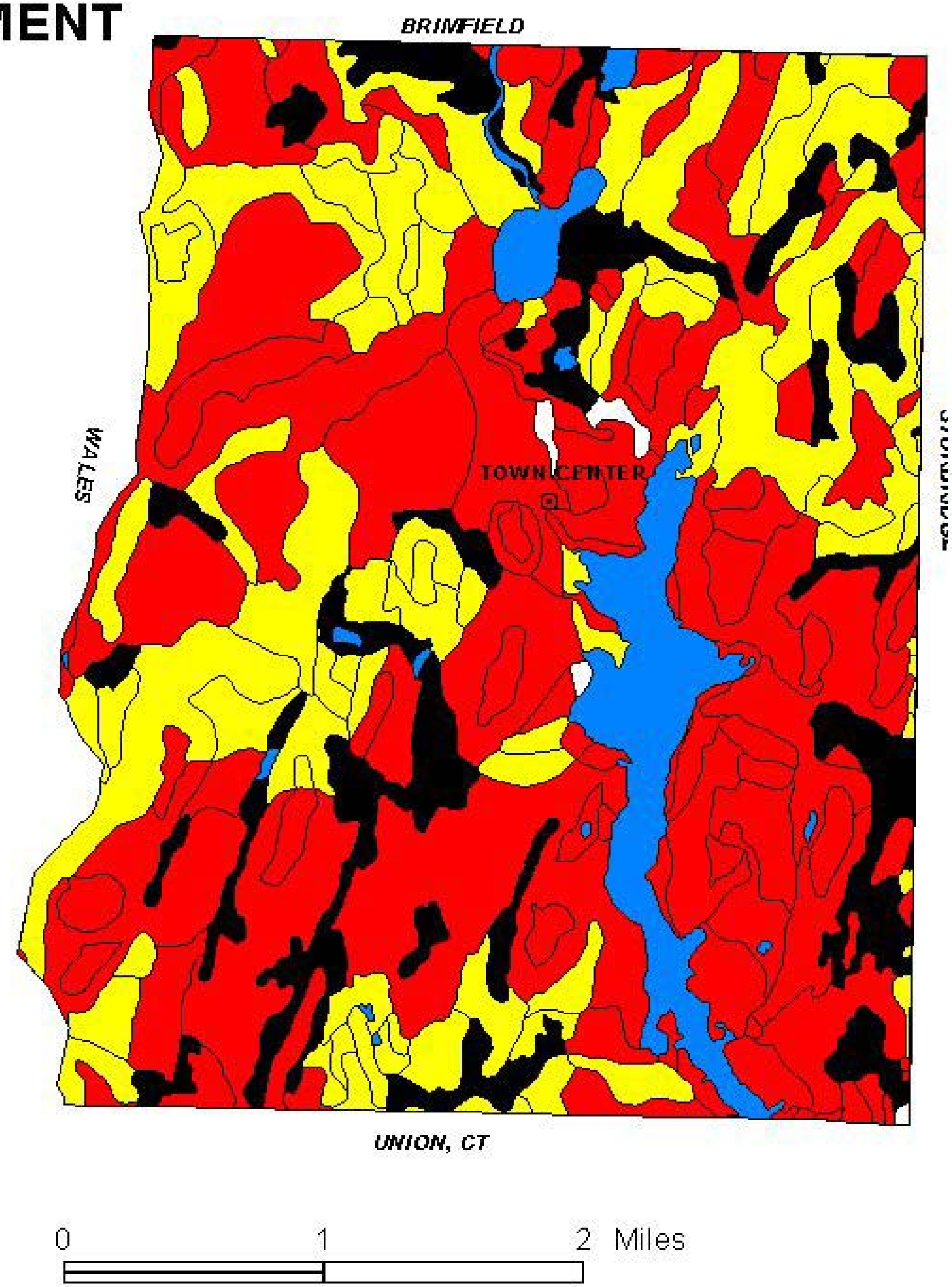


Figure 3-7
Source: Mass GIS

SOIL SUITABILITY
FOR RESIDENTIAL DEVELOPMENT



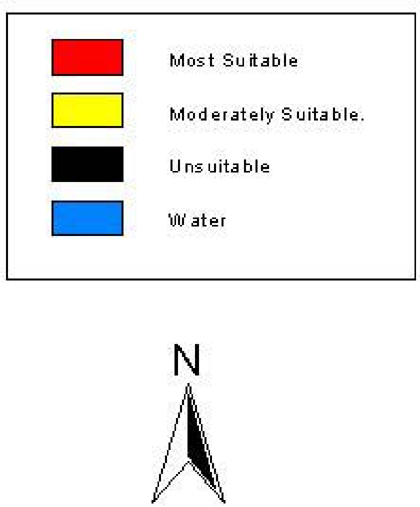


Figure 3-8
Source: Mass GIS

BIODIVERSITY

WHAT IS BIODIVERSITY AND WHY IS IT IMPORTANT?

Biodiversity is the variety of life forms, especially the number of species, but including number of ecosystem types and genetic variation within species. In general, those communities with the most biodiversity (variety of plants and animals) are the healthiest. Those communities with invasive and exotic species have less biodiversity, and are therefore, less healthy. Planning for biodiversity simultaneously aids in preserving and enhancing other important attributes of the landscape for people: outdoor recreation, education, water quality, and a strong economy (Mill River, 1998, Krey, 2002).

Richard Forman, in his book <u>Land Mosaics</u> (1995), outlines four indispensable patterns which are key to healthy landscape functioning and including biodiversity in the landscape: large patches, riparian corridors, high connectivity between elements, and other "little bits of nature." *Patches* are relatively homogeneous nonlinear areas that differ from their surroundings. A large or deep patch will promote a wider variety of species especially those that prefer interior habitat conditions. Patch shape determines many of the functions or processes supported in a patch. Regular shaped patches create the best habitats for species **(Figure 4-1).** An *Edge* is the perimeter of a patch or ecosystem, which is a habitat for particular species. The more edge space a patch has relative to its size is a crucial factor in determining patch habitat value. *Riparian (River) Corridors* are strips of a particular type that differ from the adjacent land on both sides. They serve as habitats and barriers along rivers. Because water and vegetation that grows along wet areas provide particular habitat and food for wildlife, it is important to protect the spaces along rivers and connect them with larger patches. The *Matrix* is the background ecosystem or land-use type in a mosaic and in which the patterns of patches, edges, and corridors are seen. It has extensive vegetative cover, is highly connected and directs the dynamics of the landscape (Mill River, 1998).

Fragmentation results when landscapes change and native vegetation (i.e. forest) is reduced from a continuous cover to a pattern of small patches separated by other land uses. Fragmentation eliminates habitat for those species which require large unbroken blocks of habitat (e.g., bobcats and upland sandpipers). Additionally, the small habitat patches resulting from fragmentation often do not provide the food and cover resources for many species that attempt to use them (e.g., New England cottontail, which requires large patches of shrub land). This can result in an increased risk of death by predation, if the animal has to venture beyond the cover of the patch to find new food resources.

Biodiversity and protection of wildlife is important to preserve the landscape and number of species that exist today. Patches, edges and corridors are important landscape elements to consider when choosing open space or development locations.

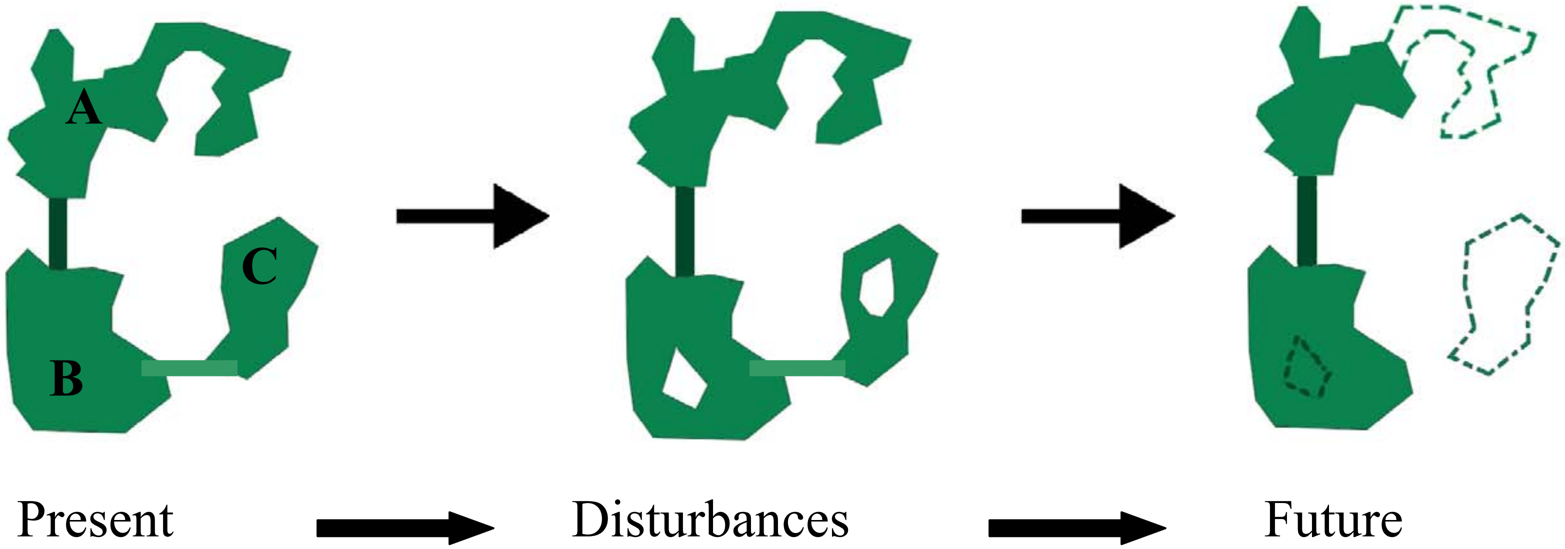


Fig. 4-1: The Size, shape, and connectivity affect the functions supported by the patch.
Source: Forman, 1995

Ecoregions

The U.S. Environmental Protection Agency has established 13 regions within Massachusetts that have distinctly similar regions known as ecoregions (EOEA, 2001). *Ecoregions* are landscape units within which environmental conditions are similar. The topography, geology, soils, plant and animal habitats are relatively homogeneous throughout each region (EOEA, 2001). Holland is within the Lower Worcester Plateau Ecoregion. *Ecosystems* are living communities of plants, animals, and microorganisms, plus their non-living environment of soil, rock, air, and water resources. Watersheds are ecosystems. They contain smaller ecosystems, called natural communities, and are nested within larger ecosystems, called ecoregions.

In 2001 the Commonwealth of Massachusetts through the Natural Heritage and Endangered Species Program published an evaluation of records of rare plants and animals and natural communities (EOEA, 2001). From this study a "Biomap" resulted indicating areas throughout the state that are most important to protect. Within the Biomap are two categories: core habitat and supporting natural landscape. *Core Habitat* is the sum total of viable rare plant habitat, viable animal habitat, and viable exemplary natural communities (EOEA, 2001). *Supporting Natural Landscape* is the combination of Core Habitat buffers, large vegetation patches, large road less areas, and undeveloped watersheds that together help maintain ecological integrity and enhance the Core Habitat (EOEA, 2001). Both are important regions to consider when choosing open space areas within a town. The EOEA has made the information available for conservation planning, because protecting these sensitive landscapes will encourage the state's biological diversity (EOEA, 2001).

The Hierarchical Theory of Landscape

The landscape can be conceived in terms of "Hierarchical Theory" This means each landscape can be perceived as part of a much greater whole, from the smallest area of similarity to portions of continents. From aerial photos, it is clear that Holland is one of the remaining green spots within the Last Green Valley in New England; this suggests the idea of the important role of the town on many different scales.

By applying the 'Hierarchical Theory of Landscape' to Holland's Biodiversity, three levels can be clearly found pertaining to ecological consideration and then political borders:

1) Level of concern: the biodiversity within borders of Holland.
2) Upper level of hierarchy: the biodiversity of Holland within broader scale of context, i.e. at the scale of the ecoregion (ecological concerns), the relationship of Holland with large Biomap of Massachusetts.
3) Lower level of hierarchy: different species and habitats in Holland, and their specifications.

At the upper level, the BioMap of Massachusetts **(Figure 4-2)**, and the BioMap of Lower Worcester Plateau **(Figure 4-3)** show that the role of Holland can be described as a Supporting Natural Landscape. This information could be integrated with information from the Natural Heritage and Endangered Species report in 1998. This report classified Holland as one of 27 towns within Massachusetts that does not have any endangered or rare species. Therefore the role of the town within its larger context is to provide large patches of landscape as an undisturbed/undeveloped areas, to support the transformation and possible expansion of the adjacent Core Habitat zones to the west of Holland **(Figure 4-3)**.

At the scale of concern, three maps are developed: Holland Town BioMap **(Figure 4-4)** shows the locations the Supporting Natural Landscape zones in the town, and its relationship with the local streams and water bodies, which can be explained as a "Patches and Corridors" relationship. **Figure 4-4** shows the locations of the Riparian Corridors, as an important element in terms of connectivity, at both scales, the local scale and the landscape context.

From the discussion of the two scales described above, it is clear that the integration between the development direction and growth as well as the hydrologic concerns, and the biodiversity strategies should result in terms of: preventing fragmentation of the large patches, producing an acceptable ecological shape of patches, as well as providing and conserving the required connectivity across the landscape.

VEGETATION OF HOLLAND

Holland is located in The Eastern Broadleaf Province type. The province in characterized by a winter deciduous forest (sometimes called temperate deciduous forest) dominated by tall broadleaf trees that provide a dense, continuous canopy in summer and sheds its leaves completely in winter. Lower layers of small trees and shrubs develop beneath the forest canopy. In spring, a luxuriant ground cover of herbs quickly develop, but are greatly reduced after trees reach full foliage and shade the ground. Forest vegetation is divided into three major associations: Mixed Mesophytic, Appalachian oak, and Pine-Oak (www.fs.fed.us/colormap/ecoreg1_provinces).

Mixed Mesophytic vegetation, the deciduous forest with the greatest diversity, occupies moist, well-drained sites in the Appalachian Plateaus. This includes *Tsuga canadensis, Pinus strobus, Quercus alba, and Betula lenta.* Chestnut (*Castanea)* formerly was abundant, but a blight destroyed most of this species. Holland is unique in that there are some remaining chestnut trees producing fruit (Ohop, 2002).

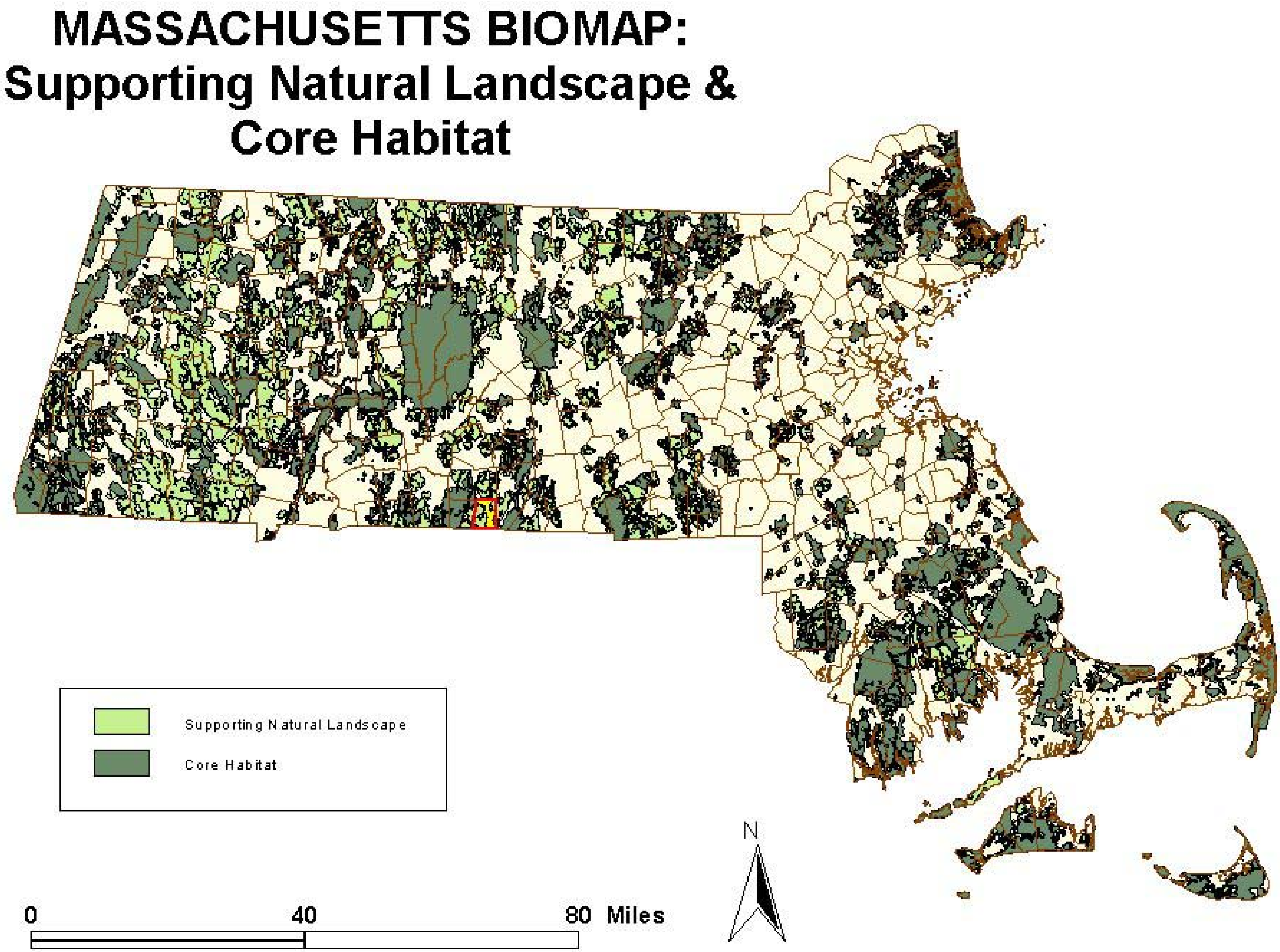


Figure 4-2
Source: Mass GIS

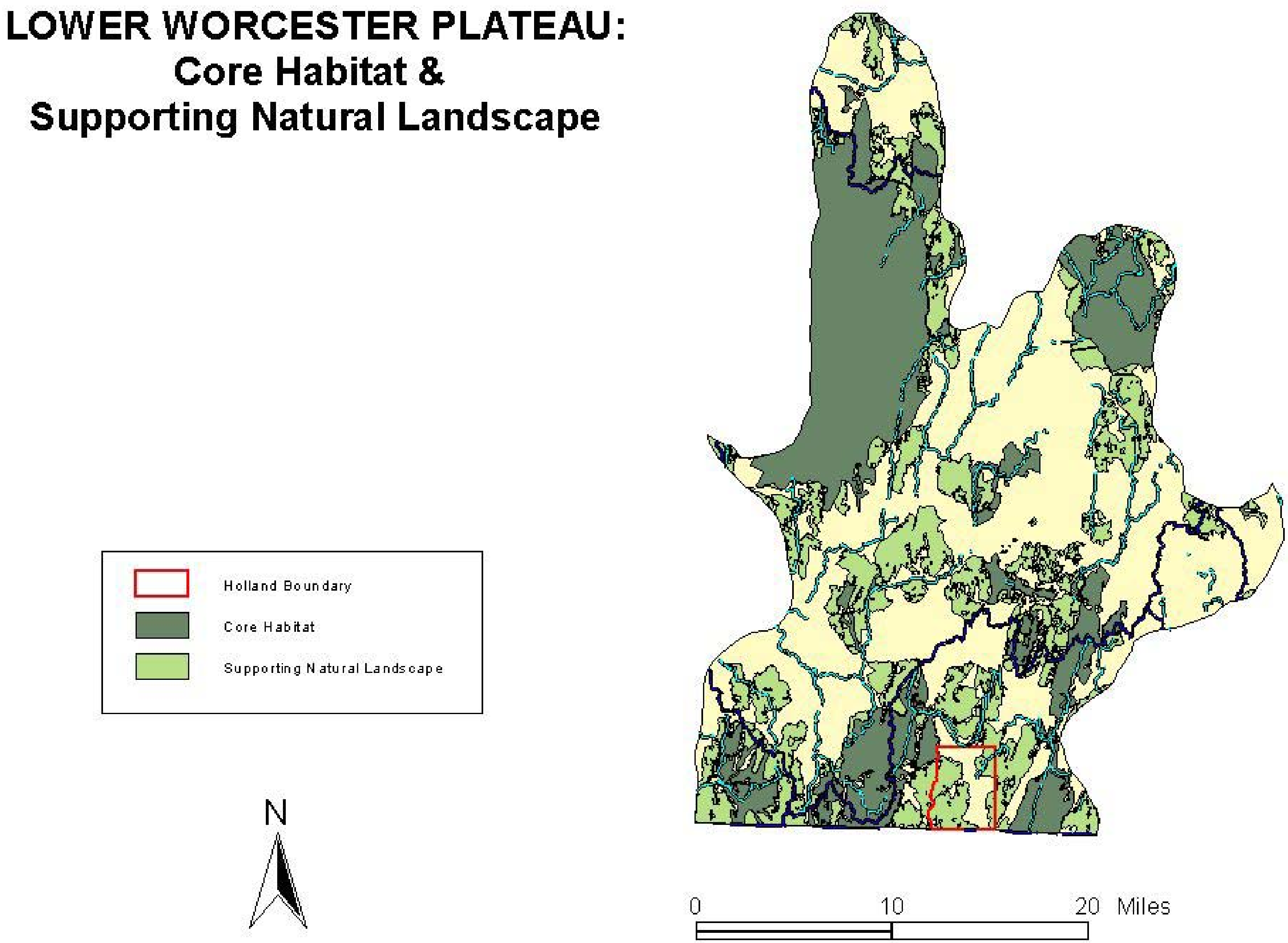


Figure 4-3
Source: Mass GIS

BIO-MAP

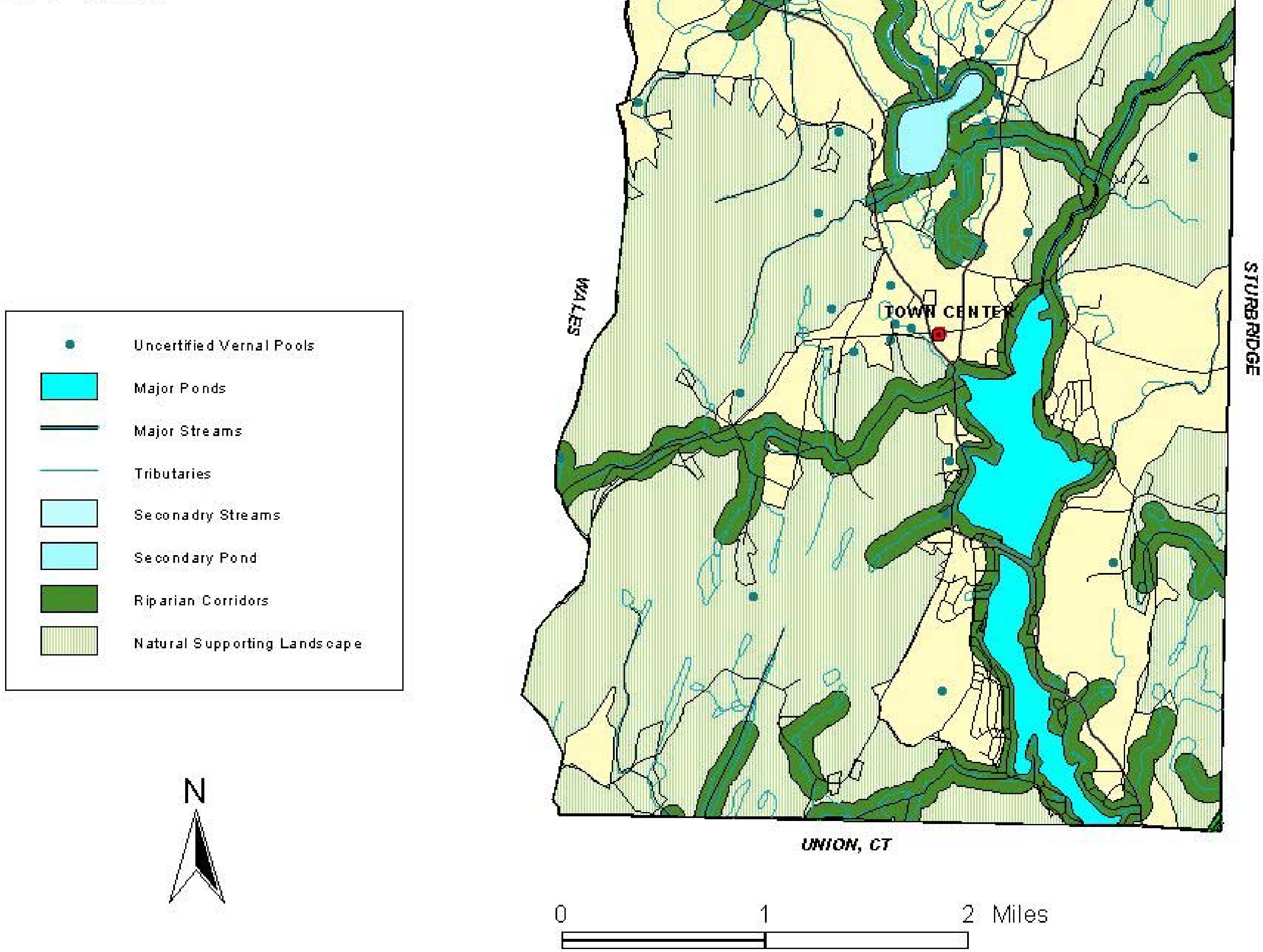


Figure 4-4
Source: Mass GIS

HISTORICAL AND CULTURAL RESOURCES

Cultural elements often influence the "natural" elements that exist within a town, and vice versa, so it is important to recognize their role in the landscape, whether positive or negative, and to plan in such a way that balances both human and natural needs. There are 4 main cultural and historical themes that are of particular interest to the creation of a landscape plan for the town of Holland. These are: 1) the Native American influence, 2) the Hamilton Reservoir, 3) past and current land use, and 4) demographics and community. These themes can be linked together to provide opportunities within Holland to promote tourism or other economic activity, as well as recreation and education.

THE NATIVE AMERICAN INFLUENCE

Several tribes have lived in the general area of the Last Green Valley for thousands of years, up to the present day, including the Nipmuc, Narragansett, Mohegan and Pequot. Extensive trade with these tribes brought Europeans to the Quinebaug and Shetucket Rivers Valley corridor, and this trade was an important part of the economy until the 18th century (www.lastgreenvalley.org). A Native American presence was recorded in a report dated July 16, 1675, and many arrowheads, earthenware objects and hatchets have been found, especially around Lake Siog (today called Holland Lake). Residents still find such artifacts in their backyards. It is known that there was a Native American village in what is now known as Holland, as Lake Siog was good for fishing, and the soil was good for crops. In fact, the word "siog" means pickerel, of which there were plenty. The word "Quinebaug" is a clan name in the Nipmuc language in Massachusetts, and a place name in both Massachusetts and Connecticut (Goodhall, 1976). Currently, the Tantaigue Reservation lies to the east of Holland, in Sturbridge, and the Native Americans there are looking to receive tribal recognition. Should this happen, it is possible that a casino could be built mere miles from Holland, and the increases in tourism and traffic could very well have the largest impact on this area since the Industrial Revolution in the early 1900s.

HAMILTON RESERVOIR

The Hamilton Woolen Manufacturing Company was largely responsible for the dam that was built to create Hamilton Reservoir. In 1865, factory owners decided that they needed a reservoir to produce more power during dry periods. So, due to an old flowage law that allowed for the company to build the dam, which was "intended to encourage the building of saw and grist mills to accommodate the farmers," the South Meadow was flooded. This low area had previously been used to produce enough hay to allow farmers to keep large herds of cattle in the uplands, and severely reduced their ability to produce. The law was later repealed and compensation was provided to the farmers, but it was not enough to replace what they had lost (Goodall, 1976 and Lovering 1915).

Hamilton Reservoir was most valued for its ability to produce power in its earlier days. Today, however, it is valued for its recreation and real estate value. Approximately 650 cottages are built within a 1,000 setback of the Reservoir, and most of these cottages were built in the 1930s and 1940s (Phippen & Reynells, 2000). While until fairly recently non-residents from out of town used the cottages only during the summer, it is becoming more and more common for owners to make their cottages year-round residences. Taxation on these properties, some of which are only 40 feet x 80 feet, are approximately 10 times higher than non-lakefront properties. Much boating, swimming and water-skiing takes place on the Reservoir. The Reservoir has been described as the economic and cultural heart of Holland, but increased sedimentation and septic system problems due to the increase of year-round residents are beginning to reduce its health. It will become more and more important in the near future to protect this vital resource.

PAST AND CURRENT LAND USE

Historically, much of Holland was forested, and most development consisted of homesteads, farms, and mills or factories along the waterways. Before the Hamilton Reservoir was created, South Meadow was a fertile floodplain used extensively for agriculture. During the mid- to late 19th century, many mills existed in Holland, and at least 5 dams were built between the Hamilton Reservoir and Lake Siog, one of which is shown in **(Figure 5-1)** (Lovering 1915). Products manufactured in Holland include lumber and shingles, cotton batting and candle wicking, cloth, and bricks. Lovering also reported that in 1915 there was evidence of a tan yard, powder mill, grist mills and blacksmith shops.

Figure 5-1: An image of one of the dams that existed between Hamilton Reservoir and Lake Siog. It has since been demolished.
Source: Lovering, 1915

While Holland remains heavily forested to this day, there is little farming or commercial development in the town, and most residential development has occurred along the shore of the Hamilton Reservoir. Some homes have been built on non-lakefront property, but this development is fairly sparse and has only occurred along existing roadways, many of which are still unpaved **(Figure 5-2)**. Current zoning requires a minimum of 1-2 acre lots in the agricultural-residence zone (away from the lakefront), and provides only a small zone for businesses near the current town center **(Figure 5-3)**. For this and other reasons, few businesses are run in Holland, and these include a pizza place, bar, storage company, liquor store, gas station, gravel business and a welding business. While no manufacturing industry remains in the town, ruins of old dams and mills can still be seen along the Quinebaug River. An example of an old foundation is shown in **Figure 5-4.** This may provide an opportunity for education and tourism should the town re-establish the Quinebaug River Canoe Trail.

Much of the land in Holland has remained as open space, as it has been purchased by a number of government and private organizations. The Norcross Wildlife Foundation, established in 1939, owns approximately 4000 acres in and around Holland. Norcross is headquartered in

Figure 5-4: Ruins of an old building, possibly an old mill, along the Quinebaug River.

Current Land Use

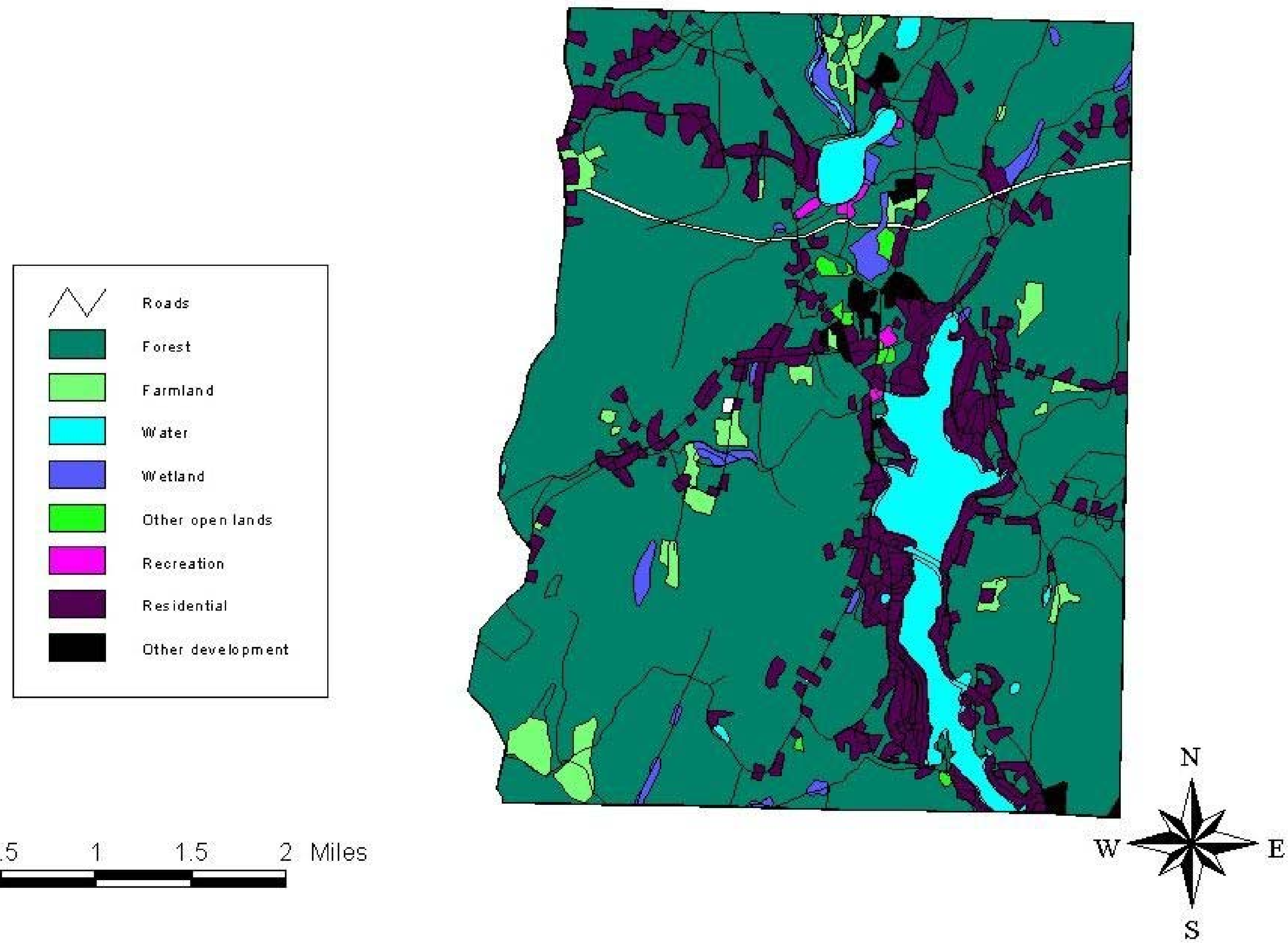


Figure 5-2
Source: Mass GIS

CURRENT ZONING

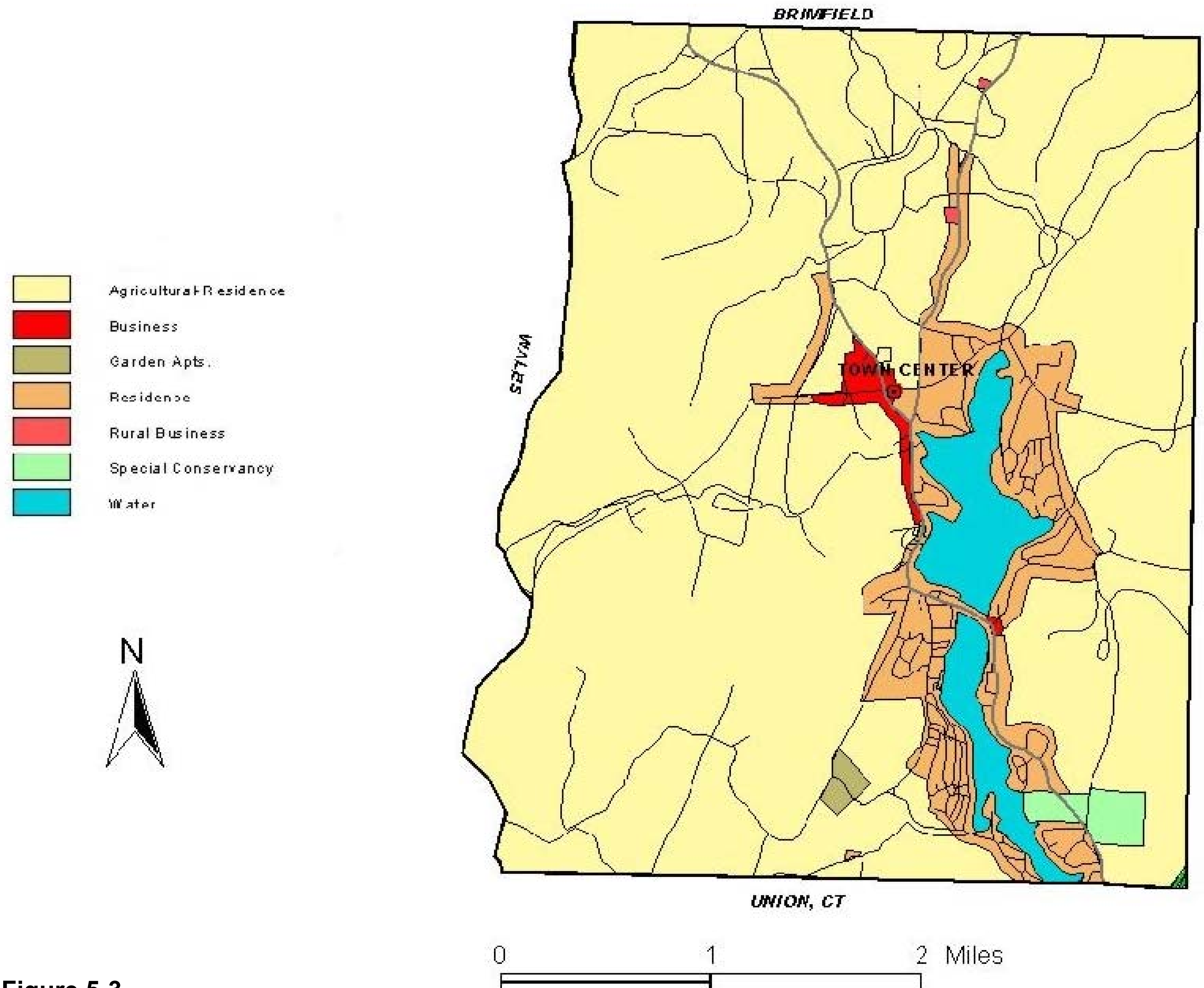


Figure 5-3
Source: Mass GIS

OPEN SPACE: Levels of Protection

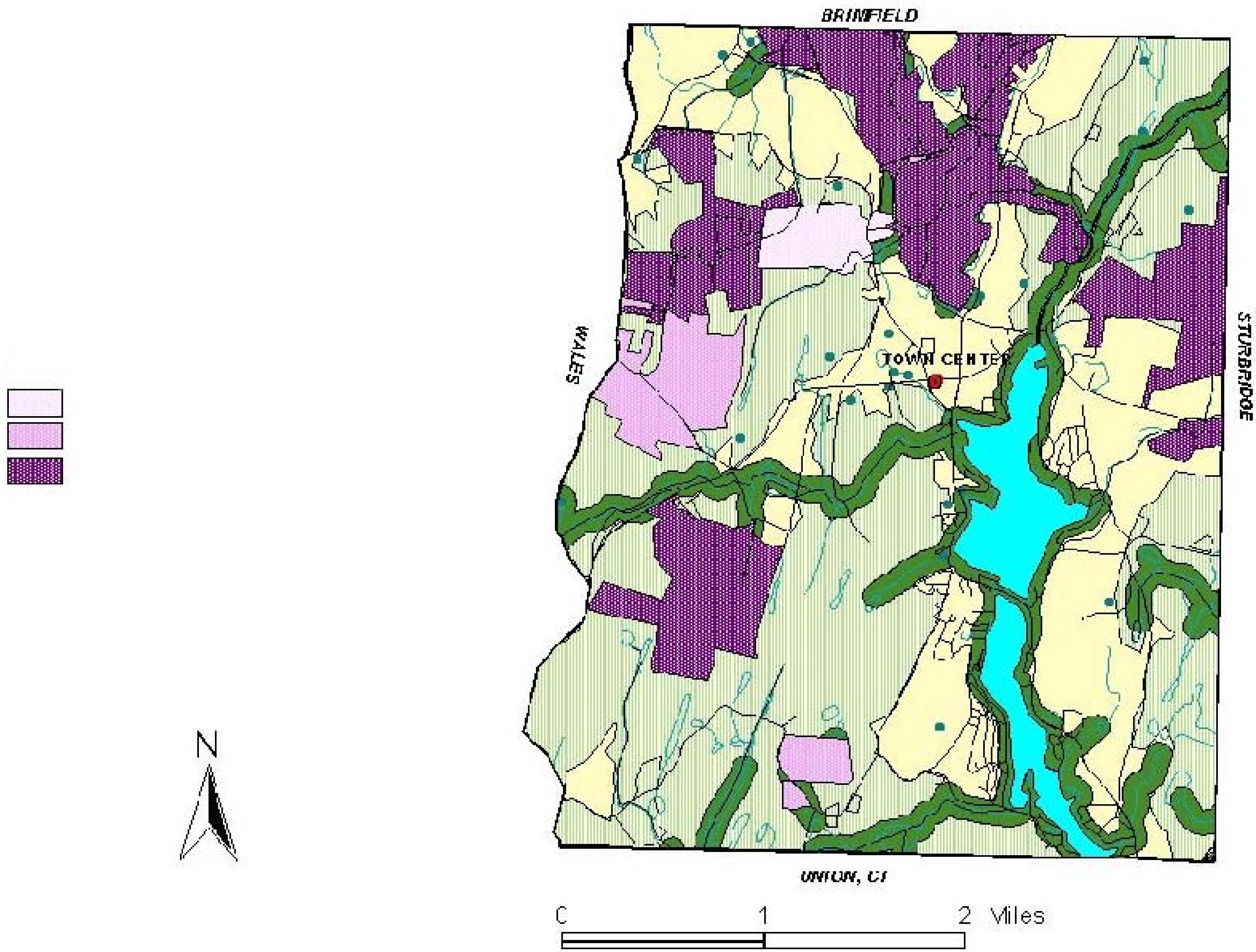


Figure 5-5
Source: Mass GIS

nearby Wales, and purchases land for permanent protection. The land owned by Norcross in Holland has 3 miles of recreation trails and these areas are open to the public, but most of their land is not accessible. While Norcross does not pay taxes to the town, they have in the past provided some money in lieu of taxes, as well as grant opportunities for their host community. Other open lands are owned by Massachusetts Division of Fish and Game, the Opacum Land Trust, and the town itself. **Figure 5-5** shows the open space parcels currently owned in Holland, as well as their level of protection. Open space has become somewhat of an issue in the town because once land has been bought for the purpose of protection, there is little or no possibility of expanding development. Much of the land area in Holland is protected as open space, and some of that which remains is unsuitable due to poor soils or steep slopes, so development has essentially been limited to current locations around the center of town . Due to the stress this has places on the Reservoir, it is becoming more necessary for the town to turn its attention to the upland areas, where careful planning will be particularly important to protect the water, forest canopy and other resources.

DEMOGRAPHICS AND COMMUNITY

According to the 2000 US Census, the year-round population in Holland is 2,407. However, town records show that the summer population more than doubles to approximately 6,000 people. The population of Holland from 1790 to 2000 is shown in **Figure 5-6**; population growth has continued steadily since 1930. Recent growth is likely caused by the conversion of lake front summer cottages into year-round residences, as well as the discovery of Holland by those people willing to commute to area cities. The median age within the town is 37 years old, and selectmen have described the town as containing many young families today whose children are still in the school system. **Figure 5-7** shows how Holland compares to Hampden County, Massachusetts, and the United States in terms of population growth, percentage of married couples, and percentage of households with children under 18 years old. Since 1980, there has been a 40% increase in the number of children aged 1-13 years old. Holland has its own elementary school, but sends middle and high school students to the Tantasqua regional school system in Sturbridge,

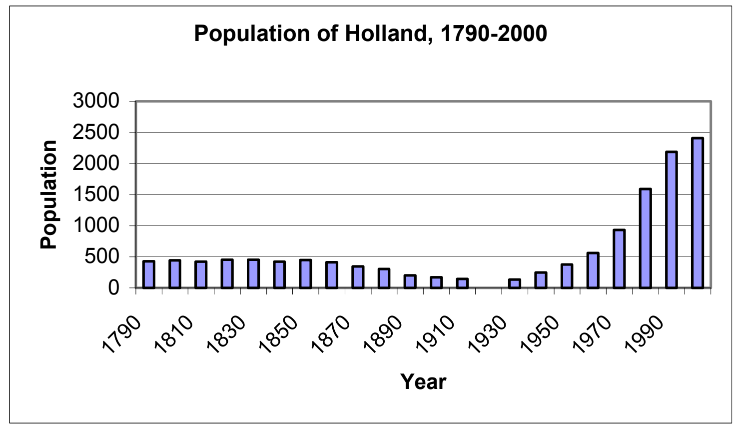


Figure 5-6: The population of Holland has increased rapidly since 1930; the greatest increase was from 1970-1980, when the population experienced a 71% increase.

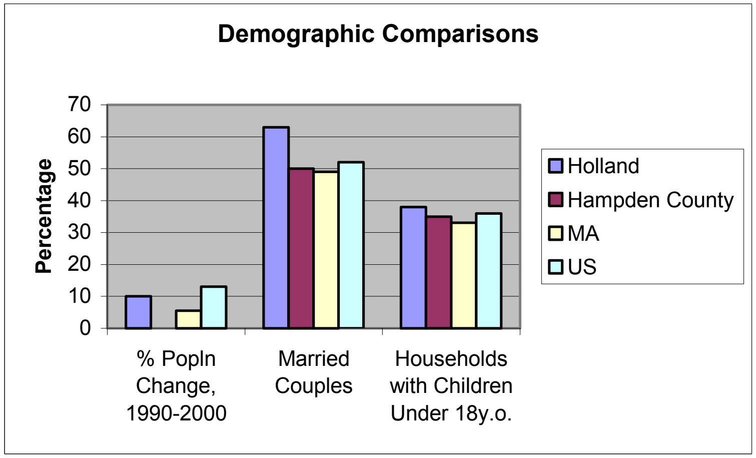


Figure 5-7: Holland as it compares to the county, State, and country in categories that indicate an increasing need for services.

MA. Additionally, there has been a recent increase of 31.3% in people of retirement age (Fahl & Gaudette 1998). Both of these populations generally have a great need for town-provided services.

Median family income in 1989 was $36, 941, slightly higher than the median income in Hamden County, and most people commute to work. The cities of Hartford, CT and Worcester and Springfield, MA are each about a 35-minute drive from Holland, and receive many commutes from the area. Others commute to nearby towns such as Sturbridge or Southbridge. As mentioned above, there are very few businesses within the town itself, and those that do exist are rather small, providing few opportunities for employment within the town.

While those residents we spoke to reported that there is a strong sense of community within the town, much of which centers around youth sports, there is some desire among residents to create a gathering place where community activities could take place, such as a community center or recreation hall. The park at Lake Siog has provided for some of this need, but its use is generally dependent on weather and season (Fahl & Gaudette 1998).

Figure 5-8: The the Fisherman's Landing Dock on Hamilton Reservoir provides recreation opportunities for residents. Tourists are attracted to the water-based activities so prevalent in Holland.

Most of the recreational activity within the town is centered on Hamilton Reservoir and Lake Siog **(Figure 5-8)**. Additional recreational opportunities are provided by trails such as those in the Quinebaug Woods.

Future Scenario's For Holland

The EOEA Buildout

In 2000 and 2001, the Executive Office of Environmental Affairs (EOEA) developed a "Buildout Analysis" for each town in Massachusetts as a part of Executive Order 418, which was a measure passed to encourage communities to plan for future development, open space preservation and infrastructure improvements. The buildout consists of a series of GIS maps that show the constraints on development within a town, along with the amount of land that is available for future development. The purpose of the buildout is to act as "a tool for towns to explore growth and development planning" (The Commonwealth of Massachusetts 2000). The maps are based on current zoning and other regulations, and show what the theoretical maximum amount of development could be. These are not *predictions* about the future, rather, they simply show how much a town could be developed if current zoning regulations are kept and current trends continue. The buildout provides an opportunity for towns to determine whether or not their current zoning regulations really reflect their planning objectives, and also whether or not the town is protecting its most valuable assets (The Commonwealth of MA 2000).

The process used by the EOEA to develop the buildouts is shown in **Figure 6-1** below.

Step 1

Gather source maps and materials from the town:
- Zoning maps and bylaws
- Board of Health Regulations
- Conservation Bylaws

Step 2

All land

minus

Absolute constraints:
- Developed Lands
- Protected open space
- 100 ft river buffer

minus

Partial constraints:
- **100 yr floodplain**
- **100-200 ft river buffer**
- **Steep slopes (>15%)**
- **Wetlands**

Result:

Maximum buildout

Fig. 6-1 The process of the EOEA buildout.

Absolute restraints refer to those areas that are already developed, or regulated in some way—such as permanently protected land. Partial constraints are areas that may require some sort of mitigation in order to build on that land, such as steep slopes or 100-year floodplains. With this process, it was determined that 71% of Holland is still available for development. (Note that this includes areas with partial constraints upon them, as well as land that has since been permanently protected by Norcross Wildlife Foundation.) **Figure 6-2** shows the composite buildout map provided by EOEA, which illustrates absolute constraints, partial constraints, and developable land, and the table below provides data for housing and service maximums expected at buildout.

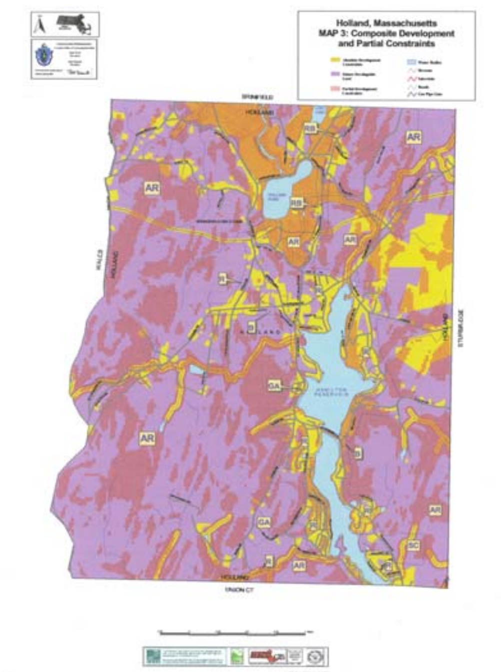


Figure 6-2: The Composite Buildout map, which shows developable land in Holland in purple. *Source: EOEA, 2000.*

THE ALTERNATIVE SCENARIO

As a product of the inventory . Holland we have developed an alternative scenario for development. By using a N.U.L.A. process, Net Useable Land Available (Ahern, 2002) to establish the percentage of land developable in the town we found 50% of the land in Holland to be available and suitable **(Figure 7-1)**.

All land

minus

Developed land

minus

Absolute Contraints:
•100 yr floodplain
•Unsuitable soils
•Steep slopes (>25%)
•Permanently protected land
•100 ft river/wetland buffer

Result:

N.U.L.A. = Net Unused Land Available

Fig. 7-1 Process for Alternative Scenario

This process involved subtracting the following land: protected open space, the 100 year flood plain, unsuitable soils, areas developed as of 1999, slopes over 25 percent grade, and the 100 foot rivers buffer. This process is more stringent than the EOEA buildout scenario because the EOEA scenario did not consider all of these constraints as absolute constraints for building. Also, since the buildout projection, more land has been purchased for open space in Holland **(Appendix B, Fig. 7-2)**.

SUITABILITY ASSESSMENT

In order to determine the sites that qualified as suitable for building, four physical factors –slope, soil, water and wetlands and floodplain—were used as initial inputs to the assessment process. Their selection was based on their validity as indicators of suitability. These four factors were synthesized to get the composite suitability assessment for Holland.

SLOPE

Slope is a useful indicator of buildability because it shows areas that are difficult or impractical for building. Slope values that are critical in development costs depend on a number of factors in addition to slope alone, such as the nature of the surface material and required infrastructure. As a result, the usual practice is to use 15% and 25% as general thresholds. Places with a 15% slope generally require large lots and expensive construction techniques. Those with 25% slope require extraordinary construction measures (Buildout Study 1998).

For this study, areas with slopes over 25% were used as the threshold for Absolutely Unsuitable Lands; Areas with slopes under 15% were used as the threshold for Most Suitable Lands; and areas with slopes between 15% and 25% were categorized as Moderately Suitable Lands **(Apd. B, Figs. 7-4)**.

Table 1: Suitability: Slope

	Acres	**Percent of town**
Most Suitable Lands	6481	77%
Moderately Suitable Lands	1569	19%
Absolutely Unsuitable Lands	324	4%

WATER AND WETLANDS

Holland contains a significant number of ponds, lakes and steams as well as many Federally designated wetlands (Massachusetts regulations preserve wetlands of an acre or less in size). Due to such reasons as biodiversity protection and relating soils and drainage, lands adjacent to water and wetlands have great constraints for developments **(Apd. B, Fig. 7-5)**

To deal with issues of the suitability of areas adjacent to water and wetlands, perennial streams and rivers were given a buffer of 100 feet. The Rivers Protection Act (Chapter 258 of the Acts of 1996) took effect August 7, 1996 as an amendment to the Massachusetts Wetlands Protection Act and established a new resource area (Riverfront Area) with requirements for specific performance standards. A two hundred foot buffer was required for any perennial river or stream (However, it does not apply to lakes or ponds).

For this study, a 100-foot buffer was chosen to represent strictly protected riverfront area rather than a 200-foot buffer because certain proposed developments and projects in existence before August 7, 1996 are grand-fathered under this act and new lots and developments can occur within the riverfront area provided specific performance standards are met. Actually, The Rivers Protection Act recognizes two riparian zones within the 200-foot Riverfront Area: the inner riparian zone (0-100 feet) and the outer riparian zone (100-200 feet), with the inner zone having higher performance standards than the outer. In short, excluding buffers only up to the inner zone is more likely to represent the actual suitable area.

For the purposes of this assessment study, lakes, ponds and wetlands were not buffered; Perennial streams and rivers were buffered at two levels: 100 feet and 200 feet; Intermittent streams were buffered 100 feet. Areas within water bodies and 100 feet of perennial streams are assessed as Absolutely Unsuitable Lands; Areas within 100 feet of intermittent streams and between 100 feet and 200 feet of perennial streams are assessed as Moderately Suitable Lands; the remaining areas are assessed as Most Suitable Lands.

Table 2: Suitability: Water and Wetlands

	Acres	Percent of town
Most Suitable Lands	6548	78%
Moderately Suitable Lands	571	7%
Absolutely Unsuitable Lands	1257	15%

Soil suitability for development, especially residential developmental, was determined by examining the depth to water table and hydrologic group of each soil found in Holland accordinf to the USGS Soil Survey. These characteristics were chosen because they directly affect suitability for septic sytems, which is important because currently, Holland does not have sewer service.

The deeper the soil is before reaching the water table, the better its drainage capacity. The depth to water table was ranked in three groups: greater than 6 feet to the water table, 1.5-3 feet, and less than 1.5 feet. Hydrologic groups (A,B,C, and D) refer to the runoff-producing characteristics of the soils, and are determined by the rate of infiltration. Group A has the highest infiltration rate, and the least runoff potential, and is most suitable for development. Group D presents the other extreme. The matrix below shows the interaction between these two soil characteristics, depth to water table and hydrologic group, and how this determines suitability for residential development. Additionally, the map in **Figure 3-8** provides a graphic display of this information.

Table 3: Suitability: Soil

	Acres	Percent of town
Most Suitable Lands	4471	53%
Moderately Suitable Lands	2398	29%
Absolutely Unsuitable Lands	1504	18%

FLOOD AREAS

Floodplains are the lands bordering a stream, river, or lake that can be flooded. They play a significant role in the flow, storage and recycling of water as well as for maintaining water quality. Obviously, development in the floodplain will lead to the damage to property and sometimes loss of human life as a result of flooding.

For the purpose of this study, floodplains, which will be inundated with water during a 100-year storm will be strictly protected and any development will be prohibited. Hence, areas within 100-year floodplains are assessed as Absolutely Unsuitable Lands, while the outer areas are assessed as Suitable Land **(Apd. B, Fig. 7-7)**

Table 4: Suitability: Floodplain

	Acres	**Percent of town**
Suitable Lands	7230	86%
Absolutely Unsuitable Lands	1138	14%

COMPOSITE

To get a composite suitability assessment for development, we should consider different combinations of all above four physical features—slope, soil, water and wetlands and floodplain.

In this study, areas available for development should first be selected. Hence areas already developed and areas designated as protected lands (such as those that are publicly owned for environmental recreation or conservation or private land under an Agricultural Preservation Restriction) were excluded from the total land area in Holland. Then, based on above four main physical factors, the available lands (for development) were determined and evaluated by using the following criteria **(Table 5, Apd. B, Fig. 7-8).**

Table 5: Criteria of Composite Suitability

Composite Suitability	**Criteria**			
Suitable	Slope = 2 Wetland = 2 Soil = 2 Floodplain = 2	Slope = 2 Wetlands=2 Soil=1 Floodplain = 2	Slope = 2 Wetland = 1 Soil = 2 Floodplain = 2	Slope = 1 Wetland = 2 Soil = 2 Floodplain = 2
Moderately Suitable	Slope = 1 Wetland = 1 Soil = 1 Floodplain = 2	Slope = 1 Wetland = 1 Soil = 2 Floodplain = 2	Slope = 1 Wetland = 2 Soil = 1 Floodplain = 2	Slope = 2 Wetland = 1 Soil = 1 Floodplain = 2
Absolutely Unsuitable	Slope = 0 OR Wetland = 0 OR Soil = 0 OR Floodplain = 0			

Table 6: Composite Land Suitability for Development

	Acres	**Percent of town**
Permanent Protected Open Space	1793	21%
Developed Lands As of 1999	1126	13%
Most Suitable Lands	3887	46%
Moderately Suitable Lands	440	6%
Absolutely Unsuitable Lands	1130	14%

Strategies for Development

For this remaining 50 percent of the land in Holland we developed four strategies for considering development. These include, open space preservation, balanced residential development, tributary protection and increasing tourism and recreation.

One: Protecting Open Space

The first strategy is a proposed increase the protected open space in Holland in order to promote biodiversity and preserve the quality of life in Holland. There are five areas that are crucial to linking habitats and current open space throughout the town and to neighboring towns **(Figure 8-1)**. Except for the un-named tributary, all the proposed lands are part of Holland's supporting natural landscape. The Stafford Road location along the western boarder is key to linking between two existing open space properties and protecting a threatened riparian corridor. The Steven's Brook, running parallel to Stafford Road at this point, is currently threatened by residential development, and the remaining parts that are not developed along should have increased protection. The linkage of the open space will further protect habitats for wildlife.

The South Wales Road proposal is in the southwestern portion of the town and would link two patches of existing open space, and protect sensitive wetland areas in that region. The Un-named Tributary proposal is just southwest of the town center. This portion is a last small green space in a developed area. Protecting this area from further development is crucial to correcting the sediment loading of the streams into the Hamilton Reservoir. The Quinebuag Headwater proposal for open space links and expands protected space between the Reservoir and Holland Pond. This is a cultural and landscape sensitive area, and will be important to developing tourism opportunities for the town. Finally, the Sturbridge Road proposal would further protect a riparian corridor and link open space from Holland to Sturbridge. This could also provide a potential tourism opportunity.

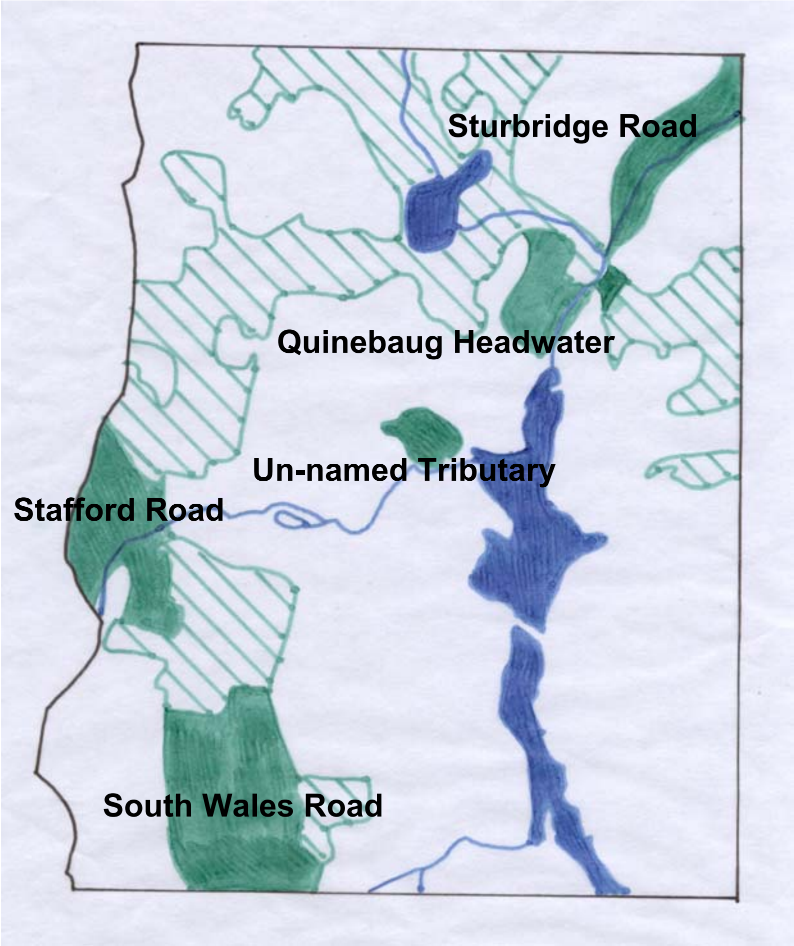


Figure 8-1

TWO: BALANCED RESIDENTIAL DEVELOPMENT

The second strategy of concern is for residential development. This strategy explains "Balanced Development," and its benefits, in comparison with the conventional design developments.

It is clear that the linear produced pattern of growth **(Figure 5-2)** following the conventional development in Holland has created many physical problems. The dense arrangement of streets from development along the banks of Hamilton Reservoir and tributaries, are costly to maintain, and increase the rate of the water runoff sediments deposited into the lake. The street pattern and landform mean inevitable high costs for any sewage proposal.

Land use aggregation is an indispensable rule of ecological landscape planning (Forman, 1995), and the grouped (clustered) pattern produced by following the "Balanced Development" will avoids the problems that are caused by sprawl, by creating less street area. The grouped pattern of " Balanced Development" should not be mistaken for increasing the density of population in Holland. It will produce the same number of dwellings for a subdivided large parcel of land, as it considers a rate of 2-acre lots in the agricultural-residence zone as a density constraint, however each residential lot will be one acre and the one acre difference will be used as an open public space.

We define the "Balanced Development Strategy" as: *a residential development that responds to the landscape and creates a network of interconnected open public spaces*. This strategy considers the landscape elements within Holland. The resulting the spatial configuration integrates other strategies in this study including trail connectivity, open space and tributary protection.

The "Balanced Development Strategy" has more economical, ecological and social benefits than the conventional residential development. **Figure 8-2** shows a comparison between developments for the same site under the two different strategies. The economic benefits for the strategy are largely the result of less infrastructure, and the possibility to have a sewage system at lower costs than conventional design, because of a shorter distance between the dwellings and avoiding the steep slopes in choosing the house location. This strategy protects the natural resources of the landscape and considers connectivity between the landscape elements, which is essential to guarantee a healthy landscape. In addition to recreational advantages, the open space that is created either by preserving wooded areas or creating an open public space for games and gathering, both reduce the demand for new public park land to be protected within the town. At the same time the opportunities of neighbors to gather in a public land, which has a great social effect on the community, is preserved (Alexander, 1977).

In order to give an example of how the "Balanced Development" could be applied we picked a large parcel of land in Holland **(Appendix C, Fig. 8-3)** and demonstrate the design process. The following steps are outlined by Randall Arendt (1997). The design progress consists of four design phases:

1. Identifying all potential conservation areas.
2. Locating the house sites.
3. Designing street alignments and trails
4. Drawing in the lots lines.

In the first phase of design, the layers of site assessments are integrated **(Apd. C, Fig. 8-4)**. To create the

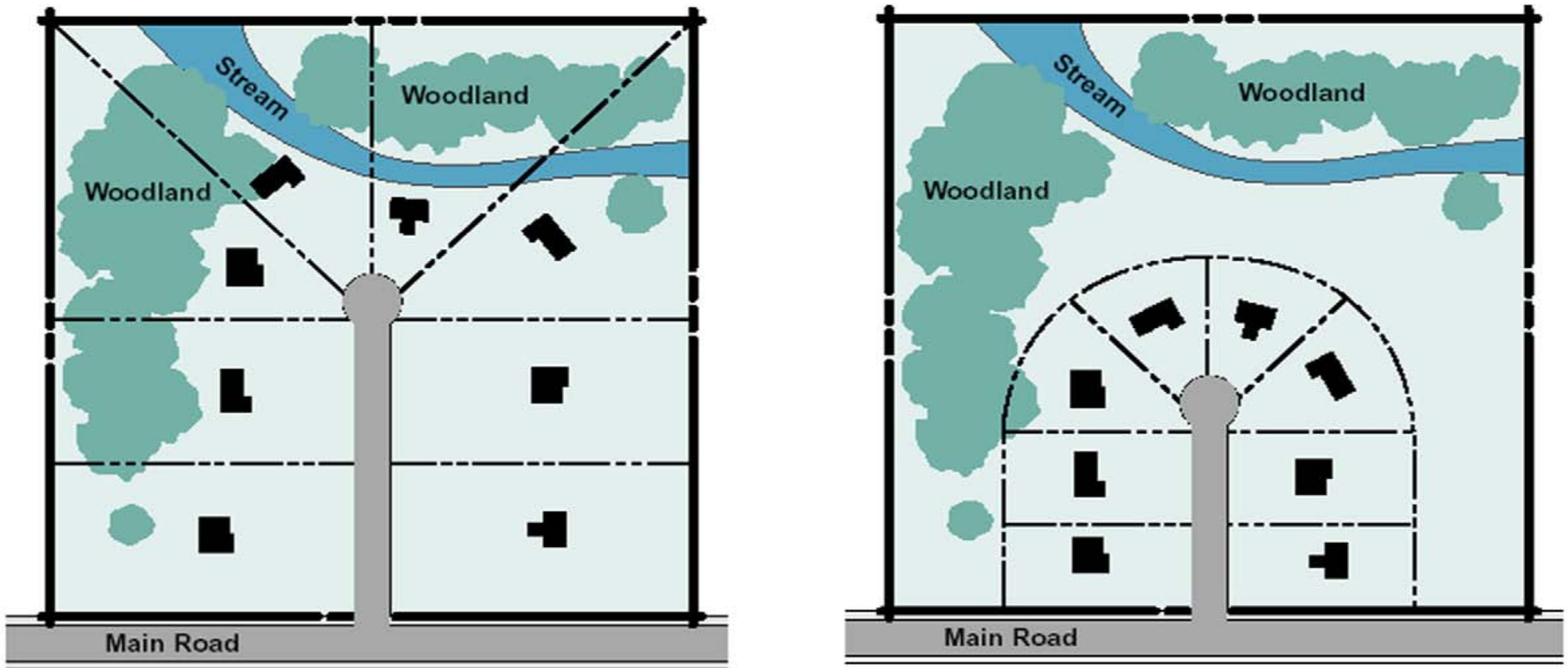


Figure 8-2: A comparison between developments for the same site under the conventional design strategy to the left and Balanced Development Strategy to the right.
Source: Foth & Van Dyke Consultants websiste.

primary and the secondary areas of conservation, twelve criteria are considered in need to determine the area of conservation: soils, wetlands, floodplains, slopes, significant wildlife habitat, woodlands, farmland, cultural features, views, and aquifers.

The soil suitability is the same within this parcel, and no wetland exists within its border. The factors determining the primary conservation area **(Apd. C, Fig. 8-5)** were slopes and the stream to the south. The slopes were analyzed in two categories: greater than 25% and greater than 15%. Although both are considered as a non-buildable area within the site, it is useful to consider the zones of more than 15% slopes, as a margin for design requirements at some point. The area preserved by these slopes is 66 acres, and from the stream buffer is 4 acres.

The secondary area of preservation **(Apd. C, Fig. 8-6)** is determined from the BioMap information **(Figure 4-5)**. Fourteen acres of the parcel are included in supporting natural landscape. Seven acres are within the previous calculated steep slopes. At this point views toward the Hamilton Reservoir were taken into consideration, as well as views to the farmland in the center of the parcel. Ideally, this parcel should be protected to avoid potential negative visual effect as in the case of it being subdivided.

In the second phase, locating the house lots, first the number of available houses is calculated, by getting the buildable area as following:

Buildable Area = Total – 50% (Area with Slopes>15%) – 90% (Stream Buffer + Significant Wildlife habitat area) = 97 acres

Total area for house lots = Buildable Area – 10% (Buildable Area) for the streets = 88 acres

Conventional design would allow for 44 houses on two-acre lots. In the "Balanced Development Strategy" 50% of the buildable area is to be used as open space, so each lot must be equal to one acre.

The second step in this phase is to determine the potential area of development **(Apd. C, Fig. 8-7)**, by identifying the locations for the 44 houses **(Apd. C, Fig. 8-8)**. Views off the site or to open space, integration with the topography, and potential connectivity between the houses are all factored into the design.

The third phase in the design process, is to design the street alignment and trails **(Apd. C, Fig. 8-9).** These must guarantee connectivity whether between the lots within the site or between the site and the existing street network of the town. The trail and street design also takes into consideration the open space connectivity by minimizing the surface of the streets.

The final phase of the design is to draw the lots lines **(Apd. C. Fig. 8-10)**, where each lot is one acre, with two exceptions (1.25 acre) due to accessibility considerations.

This example could be applied to any large parcel within the developable land in Holland, using the same steps of design. These goals completely integrate with the other three strategies that we consider in this scenario, whether on a local scale (the residential development itself) or on the scale of the town, in terms of protecting the natural resources (water bodies and significant wildlife habitat) and ensuring their connectivity as a significant factors for the healthy landscape, it also avoids the disadvantages that coherently appeared in the conventional way of growth by din terms of producing less street surface which means less sediments go to the lake and having the possibility to create an economical sewage system .

THREE: TRIBUTARY PROTECTION

The third strategy is for tributary protection. The tributaries are a valuable part of the hydrologic system in Holland. Our proposal for this strategy includes protecting the vulnerable tributaries in the uplands and monitoring water quality. Holland needs to establish and monitor the water quality in the streams, ponds and reservoir. Septic regulations should be enforced and monitored in order to promote healthy waterways. Also, the vegetative buffers along the streams and water bodies should be protected and where re-established where possible.

One of the key elements to all of these goals for tributary protection is to promote public awareness. For example, the town could hold a contest to name the unnamed tributaries. The fact that they are not named is indicative of the fact that they are going unnoticed and not properly protected. Creating awareness can create action for protection and correction of the problems of sediment loading into the Hamilton Reservoir.

Integrating issues affecting the unnamed tributary into the classroom curriculum (see sample benchmark below) and applying for grants from the Quinebuag-Shetuckett Rivers Valley Corridor are other ways to promote protection.

The Massachusetts Executive Office of Environmental Affairs has provided benchmarks of environmental Literacy for grades 5-8:

1. Learners can describe an environmental change (i.e. soil erosion, air quality degradation, species extinction) and give a consequence of that change.

2. Content/Context. Change is the most constant thing in the universe; changes are always underway at varying rates. Some changes occur very rapidly (i.e. explosions); others take place very slowly over vast periods of time (i.e. development of rock layers or cooling of stars). There is some consequence for every change. Decaying leaves are broken down into their simplest components which can be reused to create new leaves; eroded topsoil is deposited somewhere else but what remains behind is less productive of living things; as species become extinct the ecosystems of which they were a member become less stable, and so forth. Not all consequences are negative. The consequences of some changes are quite positive for some factors but may well be negative for others.

3. Process skills:

- Inferring
- Predicting
- Compare & contrast
- Critical thinking
- Communicating
- Estimating
- Categorizing
- Analyzing
- Synthesizing

4. Habits of the mind:

- Reliance on data, facts & observations
- Looks for connections
- Projects likely consequences of actions
- Investigates historical development of issue

5. Environmental ethics

- Environmental awareness
- Environmental understanding

6. Disciplinary focus

- Science
- Interdisciplinary

(www.state.ma.us/envir/)

FOUR: TOURISM AND RECREATION DEVELOPMENT

The final strategy is to sustain the natural and cultural history of Holland by promoting tourism and recreation. There are three potential opportunities for trails in the northeastern quadrant of the town. One possibility is to link trails to Brimfield State Park, secondly, through the protected land along the eastern border of Holland and owned by the Massachusetts Department of Fisheries and Wildlife in Holland and Sturbridge, and another is contingent on obtaining open space along the riparian corridor to Sturbridge. If the open space is created then trials could provide links of tourists from Sturbridge to Holland.

Along these trials kiosks could highlight the Native American history and manufacturing history of the town at specific historic sites, particularly at the remains of dams and sluiceways throughout the woods.

Finally, the town could establish low impact development in the town center by encouraging efforts for art galleries, or cafes, and accentuating the few historic buildings of the town.

EOEA BUILDOUT VS. ALTERNATIVE SCENARIO

In comparison of the two concepts the EOEA buildout scenario proposes a theoretical maximum for potential development in Holland **(Figure 8-11)**. It does not take into consideration the towns existing open space or the towns priorities cultural or natural resources. While the EOEA buildout projects a maximum development of 71 percent of the land in Holland, the Alternative Scenario takes into consideration the priorities and concerns of the townspeople and more reasonably proposes developing 50 percent of the land in Holland. The alternative plan allows for strategic, balanced and planned residential development, high connectivity of the open space and protection of cultural and natural resources.

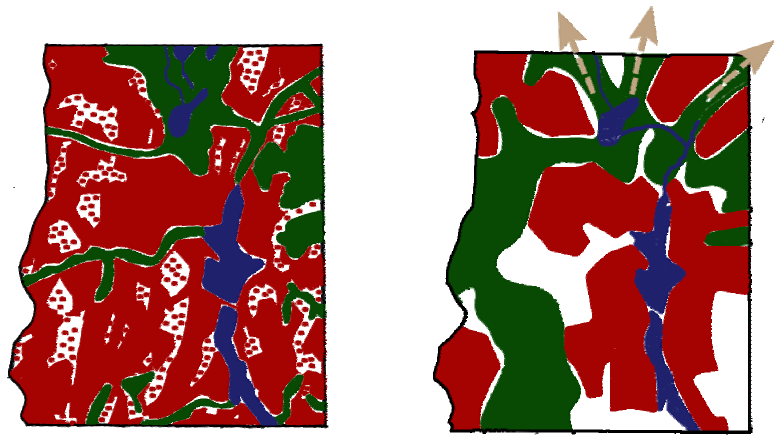


Fig. 8-11: The EOEA Buildout projects maximum development and low connectivity, while the Alternative Scenario promotes planned development, high connectivity and protecting rescources.
Source: EOEA

CONCLUSION

Holland is a strategic town to the Last Green Valley, it is a green town and its residents love it that way. Planning should accentuate that characteristic. Holland is also a strategic town to its neighbors. As the location of the Quinebaug Headwater Holland has regional responsibilities to promote healthy lakes and streams, preserve land and protect habitats. Holland can lead the watershed in ecologically minded development.

Water is the essence of Holland. All recent growth in the town has taken place around the Hamilton Reservoir. The next wave of development is starting in the uplands, and has potential of dramatic effect on the valley. Therefore, tributary protection is a new challenge of utmost importance. Protecting the vegetative cover along the tributaries, stopping development near the riparian corridors, and applying for grants with the National Heritage Quinebaug – Shetuket Rivers Valley Corridor are all crucial steps to protecting the balance of the tributaries. Furthermore, water quality must become a mandatory practice for the town. This basic information is important for directing future intervention and planning.

Holland is positioned for key developmental decisions to be made. Thoughtful, careful planning is imperative.

APPENDIX A

Species found in Holland

Local Tree and Plant Species:

White Pine, Hemlock, Black Maple, Red Maple, Red Oak, White Oak, Chestnut, American Beech, Tuliptree, Ash, Sugar Maple, Paper Birch, Black Birch, Pitch Pine, Aspen, Huckleberry, Blueberry, Shadbush, Mountain Laurel, Hornbeam, Poison Ivy, Common Horsetail, Water Horsetail, Cinnamon Fern, Phragmites, Lichen, Mosses, Clover, Violet, Dandy Lion, Buttercup

Animal Species:

Moose, Bear, Deer, Beaver, Fox, Squirrel, Porcupine, Rabbit, Skunk, Raccoon, Coyote, Frogs, Snakes, Salamander, Newt, Toad, Spring Peeper, unconfirmed rare species: Spotted Turtle

Bird Species:

Turkey, Owl, Hawk, Red-winged Black Bird, American Crow, Brown-headed Crowbird, Tree Swallow, Warbler, American Robin, Mourning Dove, Sparrow

Insects

Phantom Crane Fly, Deer Fly, Mosquitoes, Black Fly, Water Striders, Jumping Spiders, Whirligig Beetles, Bumble Bees, Dragon Fly

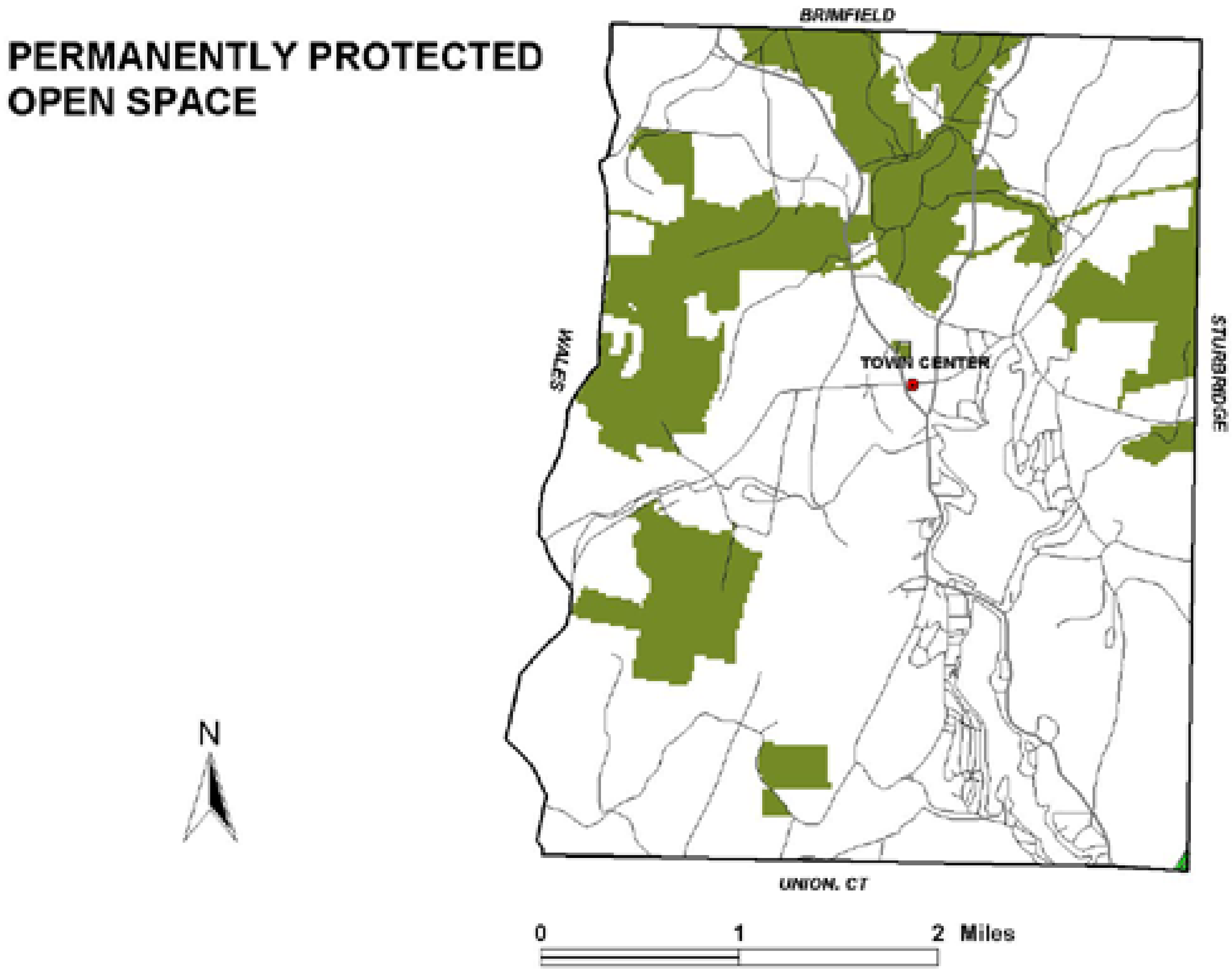


Figure: 7-2
Source: Mass GIS

DEVELOPED LAND AS OF 1999

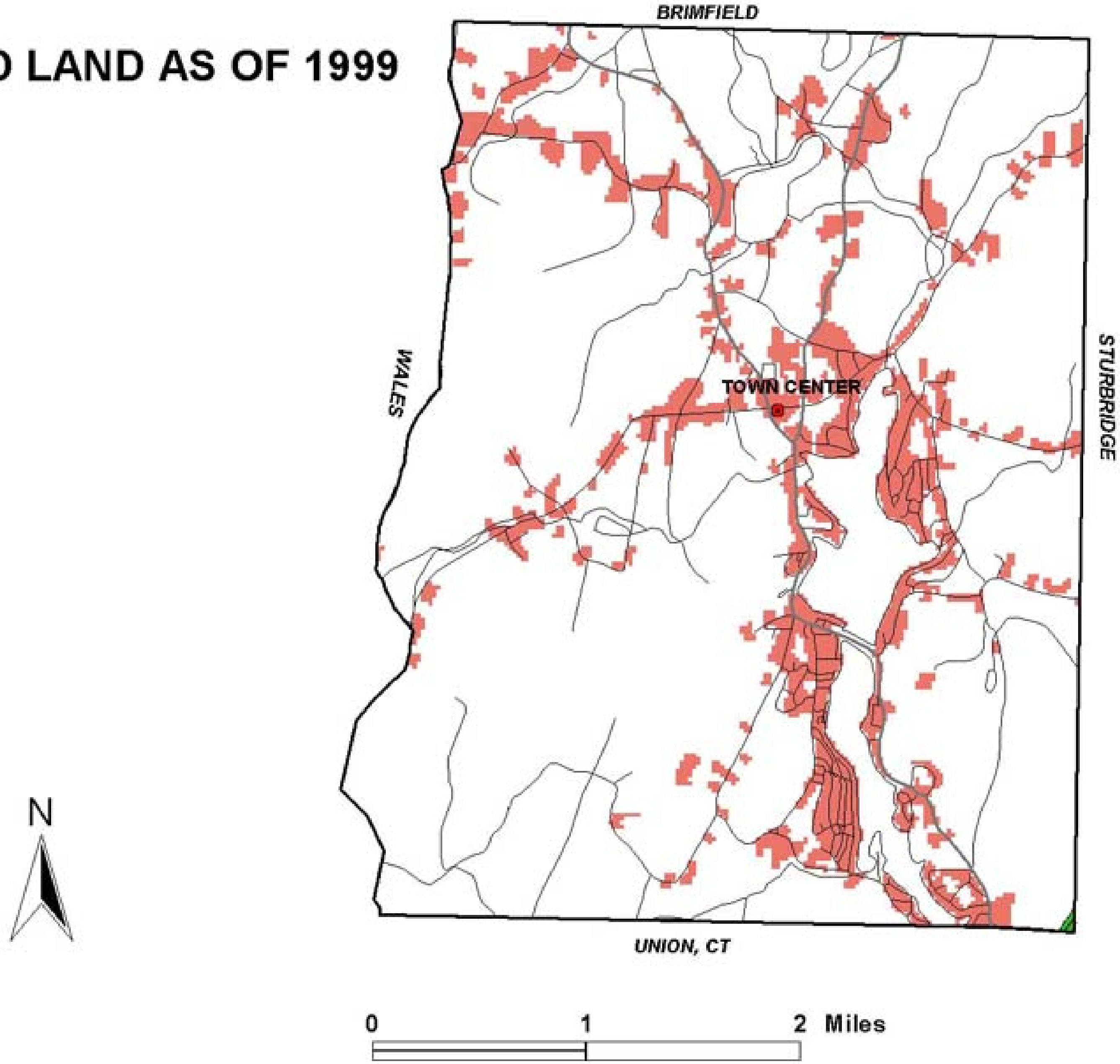


Fig. 7-3
Source: Mass GIS

Suitability Assessment - Slope

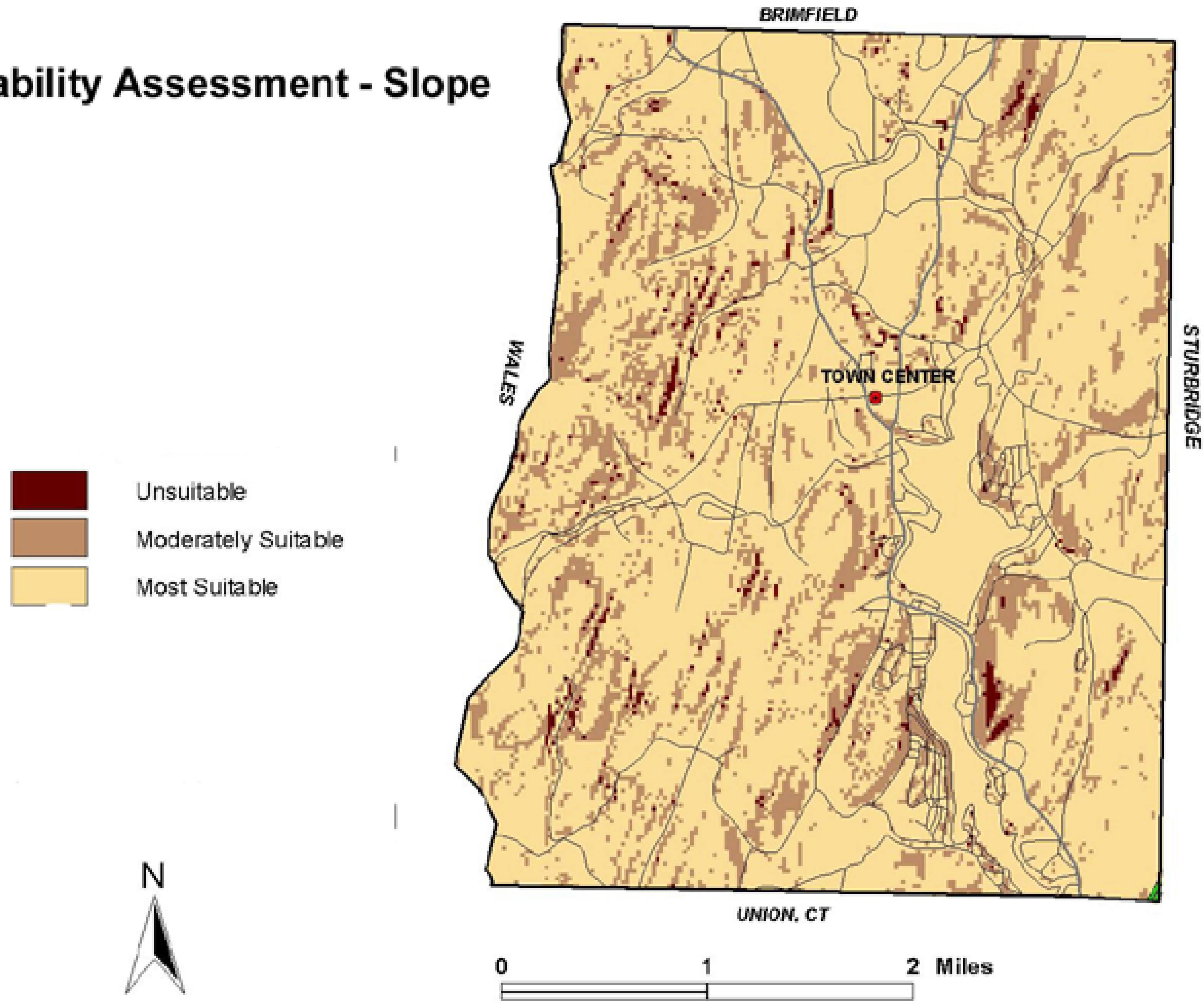


Figure 7- 4
Source: Mass GIS

Suitability Assessment
- Water and Wetlands

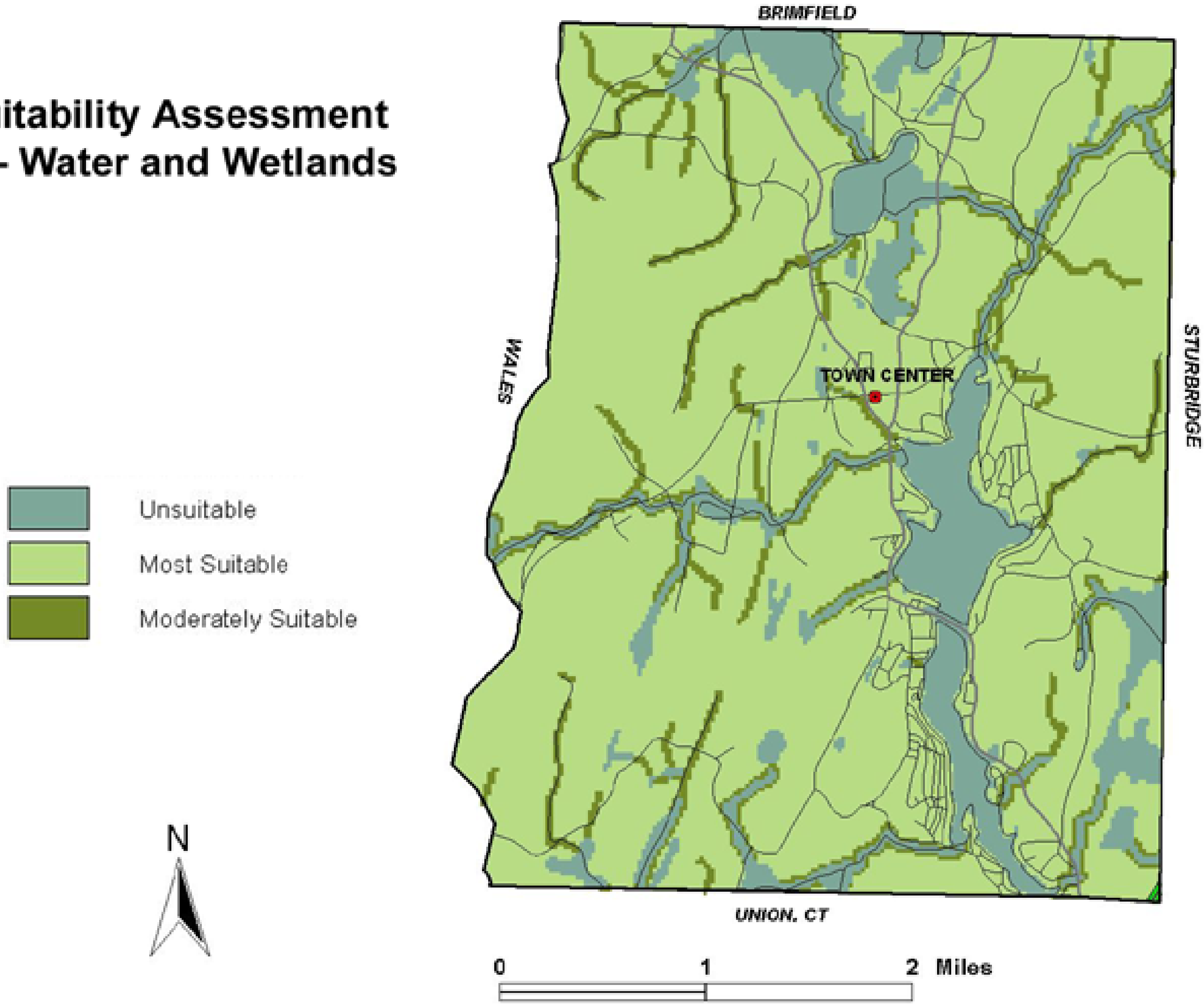


Figure 7- 5
Source: Mass GIS

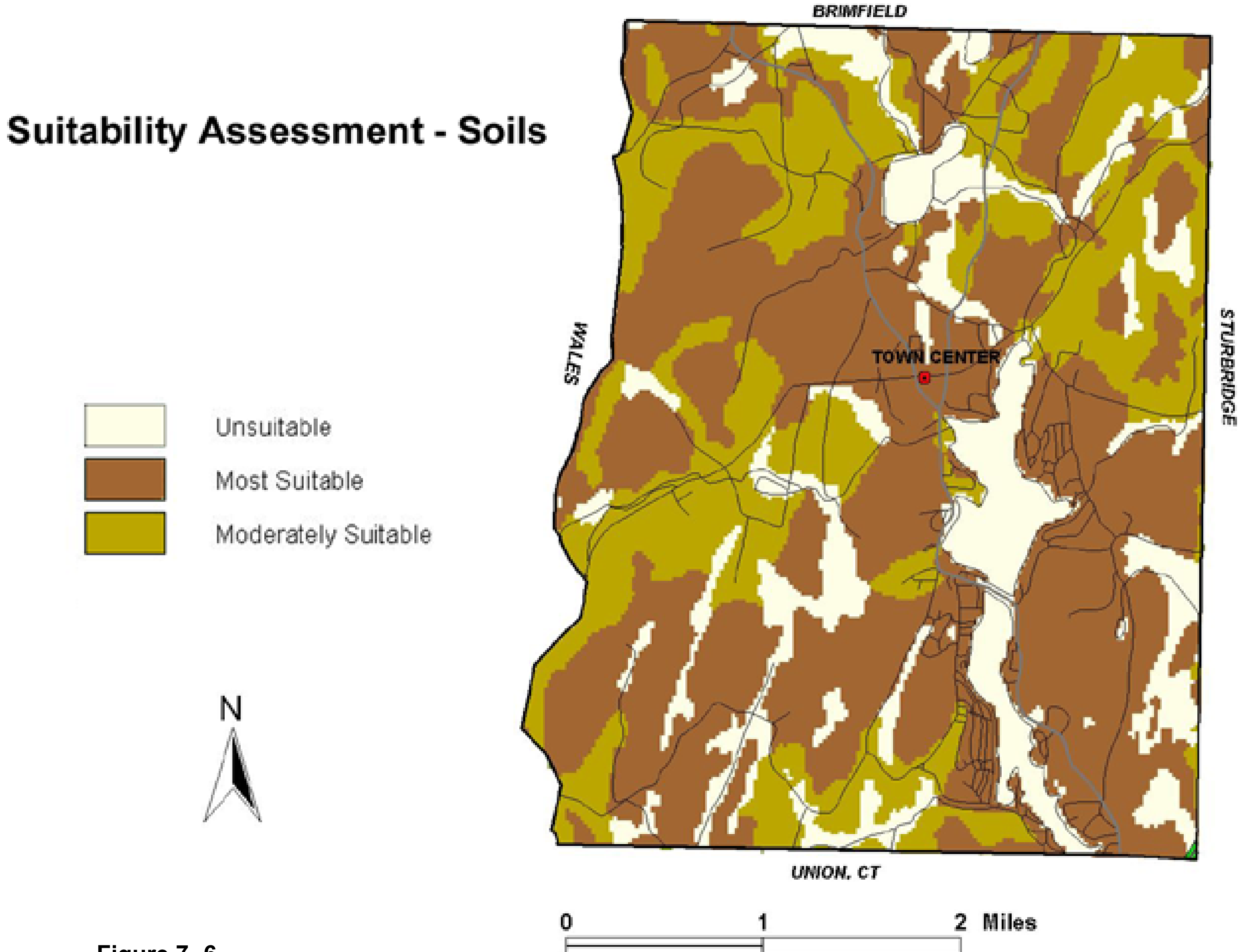


Figure 7- 6
Source: Mass GIS

Suitability Assessment - Floodplain

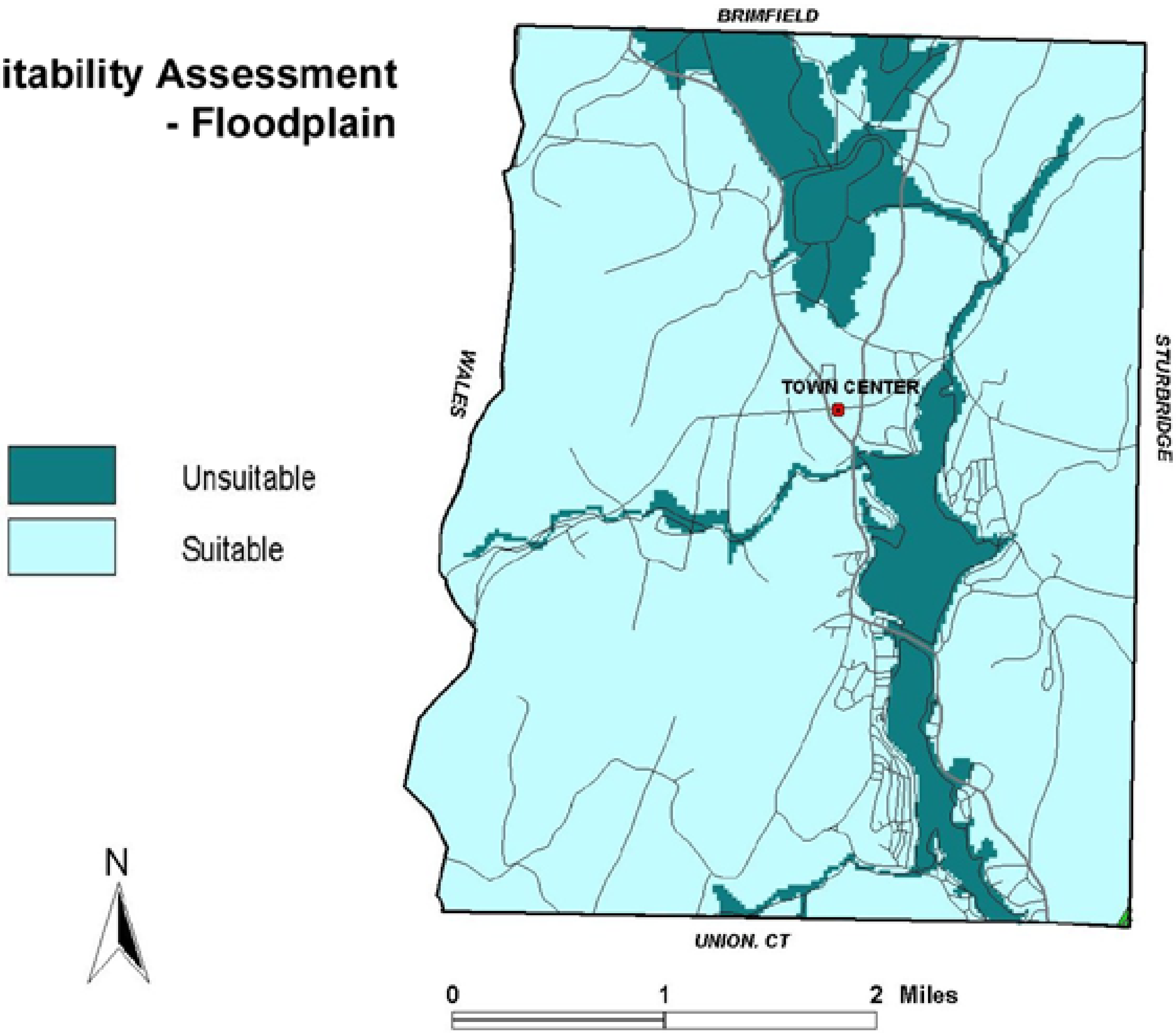


Figure 7- 7
Source: Mass GIS

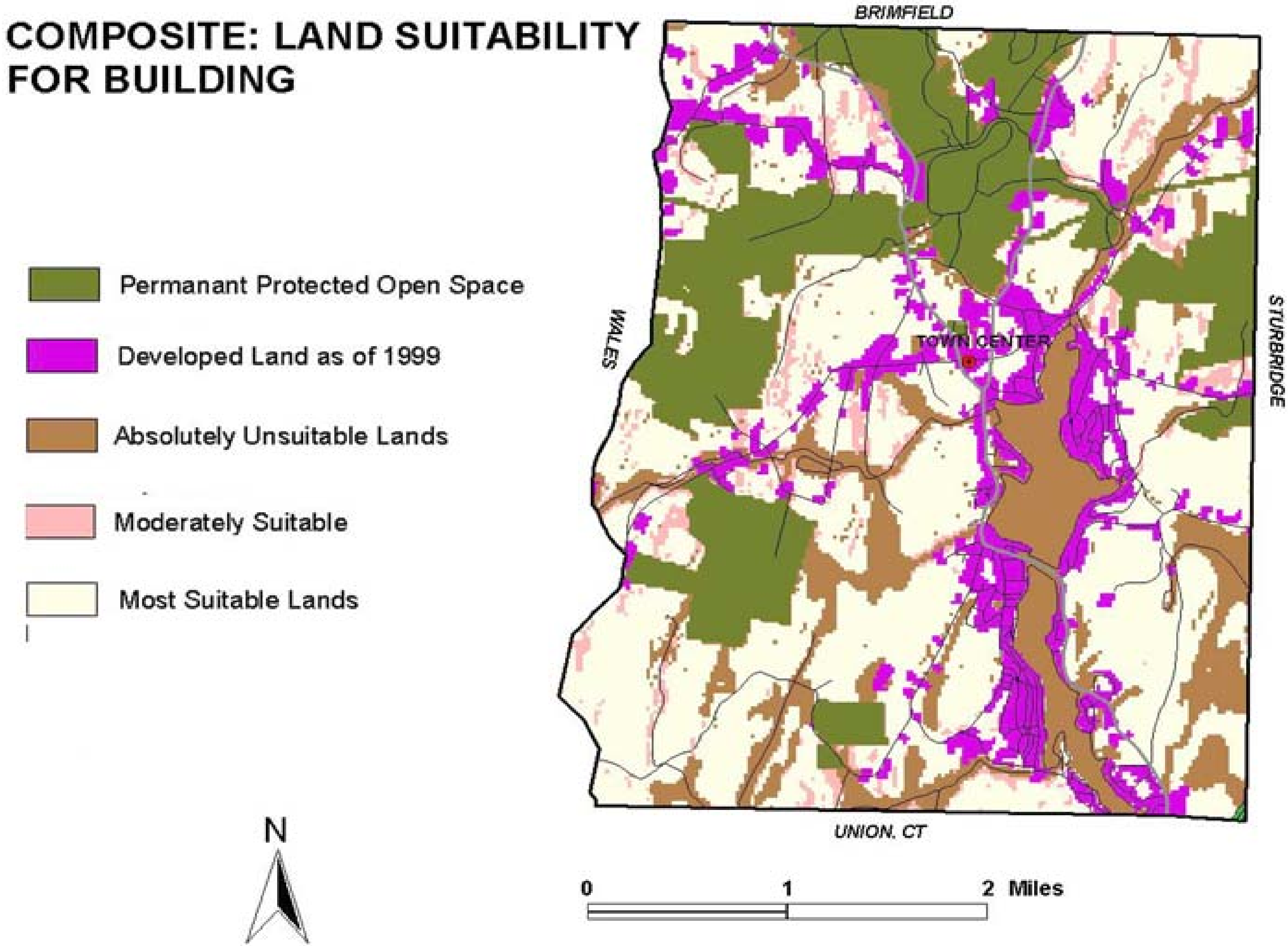


Figure 7- 8
Source: Mass GIS

APPENDIX C

Figure 8-3: 145 acre parcel of land within the developable area in Holland as a case study for the Balanced Development.

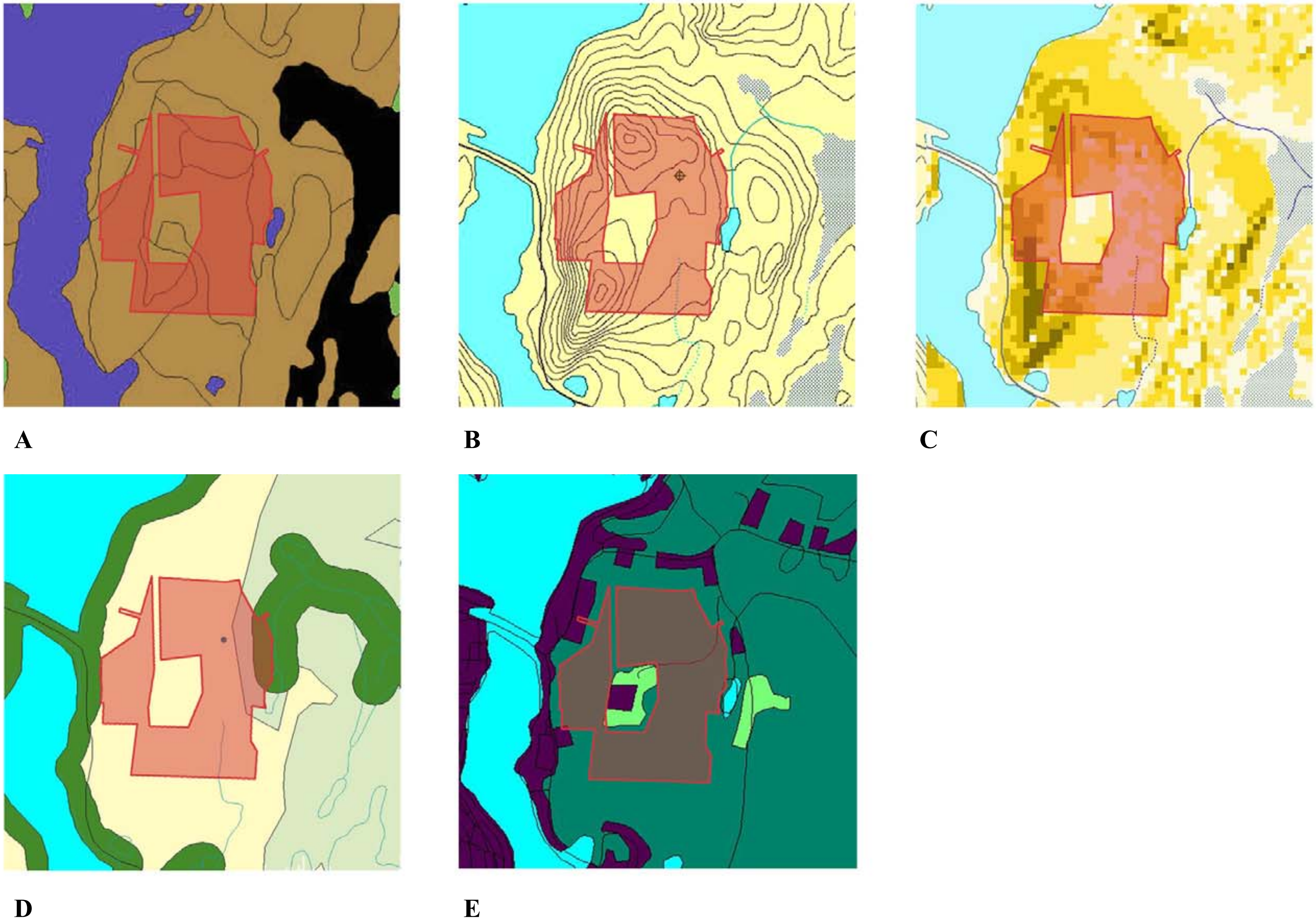


Figure 8-4: Integration layers of information for the parcel ,
A) Soil Suitability, B) Hydrology Elements, C) Slopes,
D) BioMap, E) Land Cover.

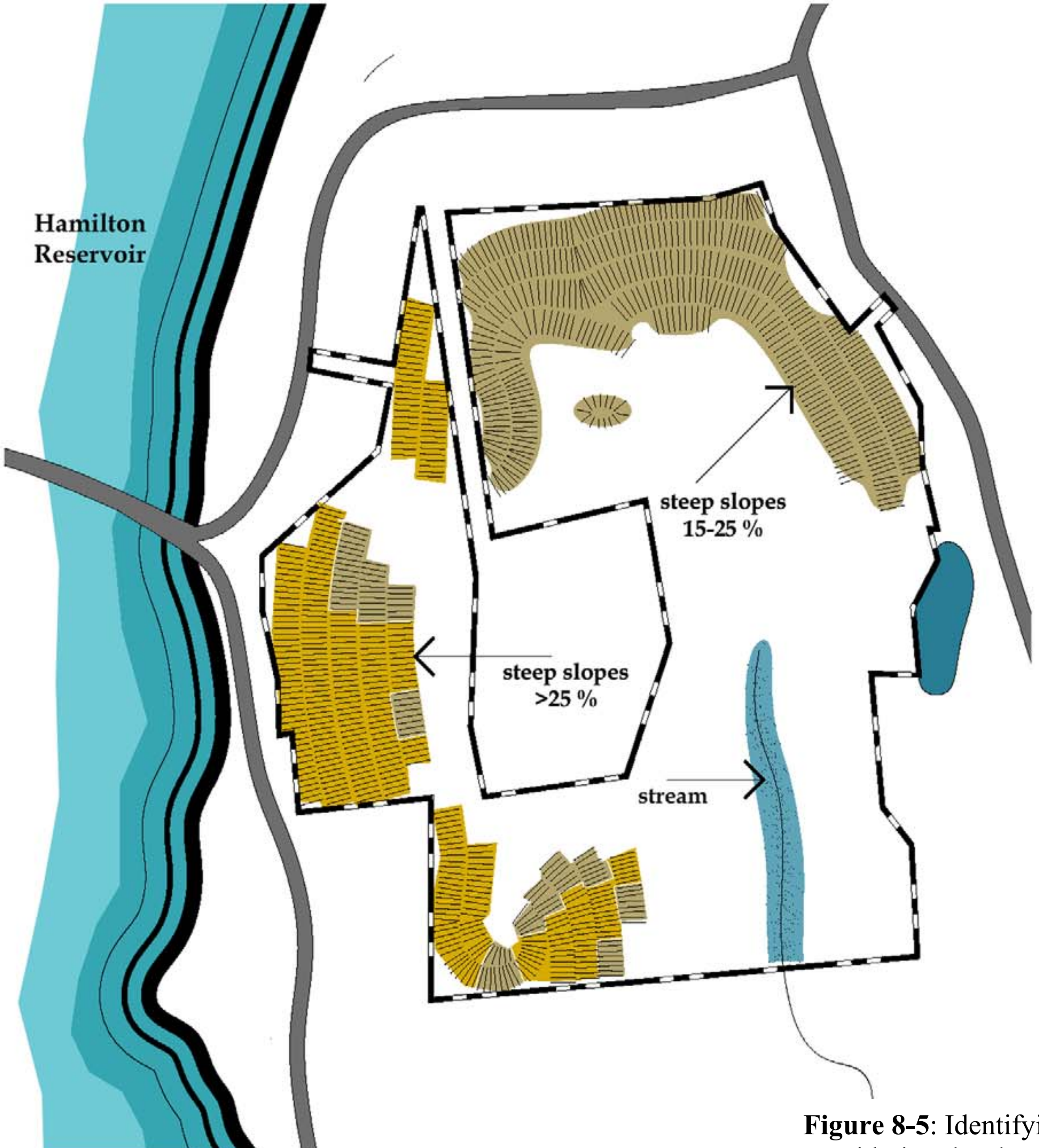


Figure 8-5: Identifying the primary conservation area, considering the slopes over 25% and 15 %, and streams within the site

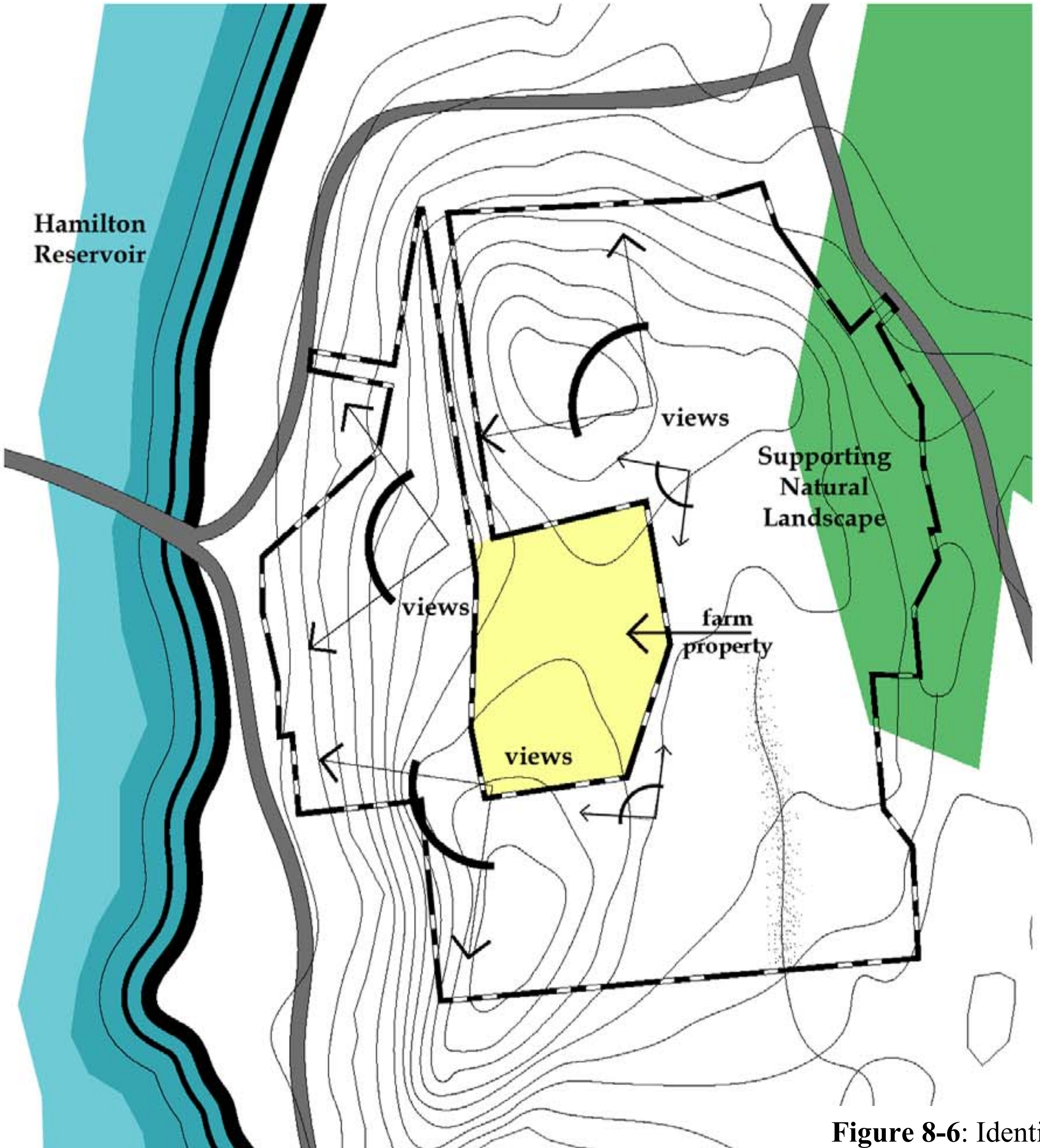


Figure 8-6: Identifying the secondary conservation area, considering the wildlife habitat constrains and views in & out of the site.

Figure 8-7: Identifying the potential area of development, as result from identifying the conservation areas

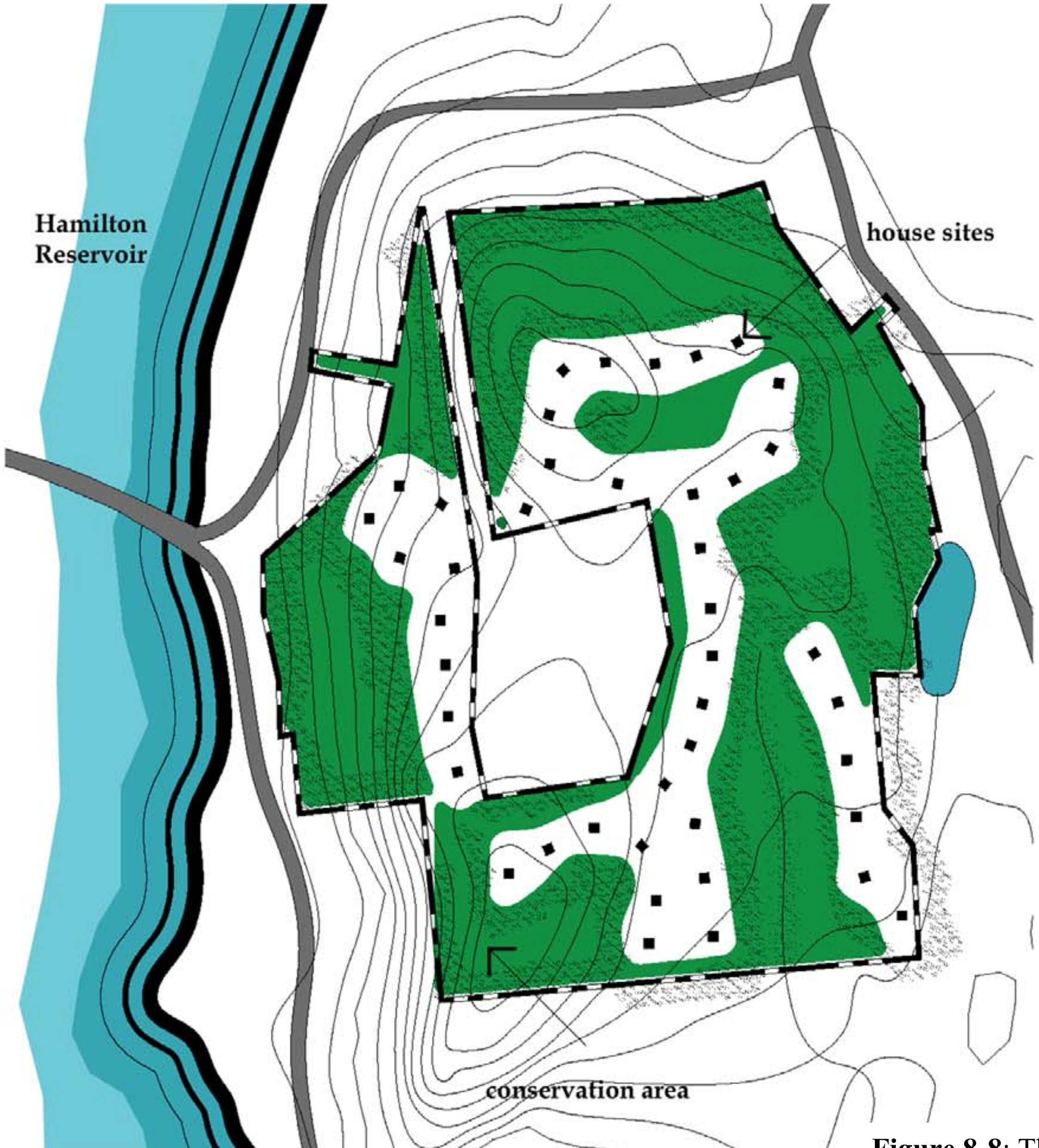


Figure 8-8: The potential locations for the 44 house lots, considering the views and integration with the topography.

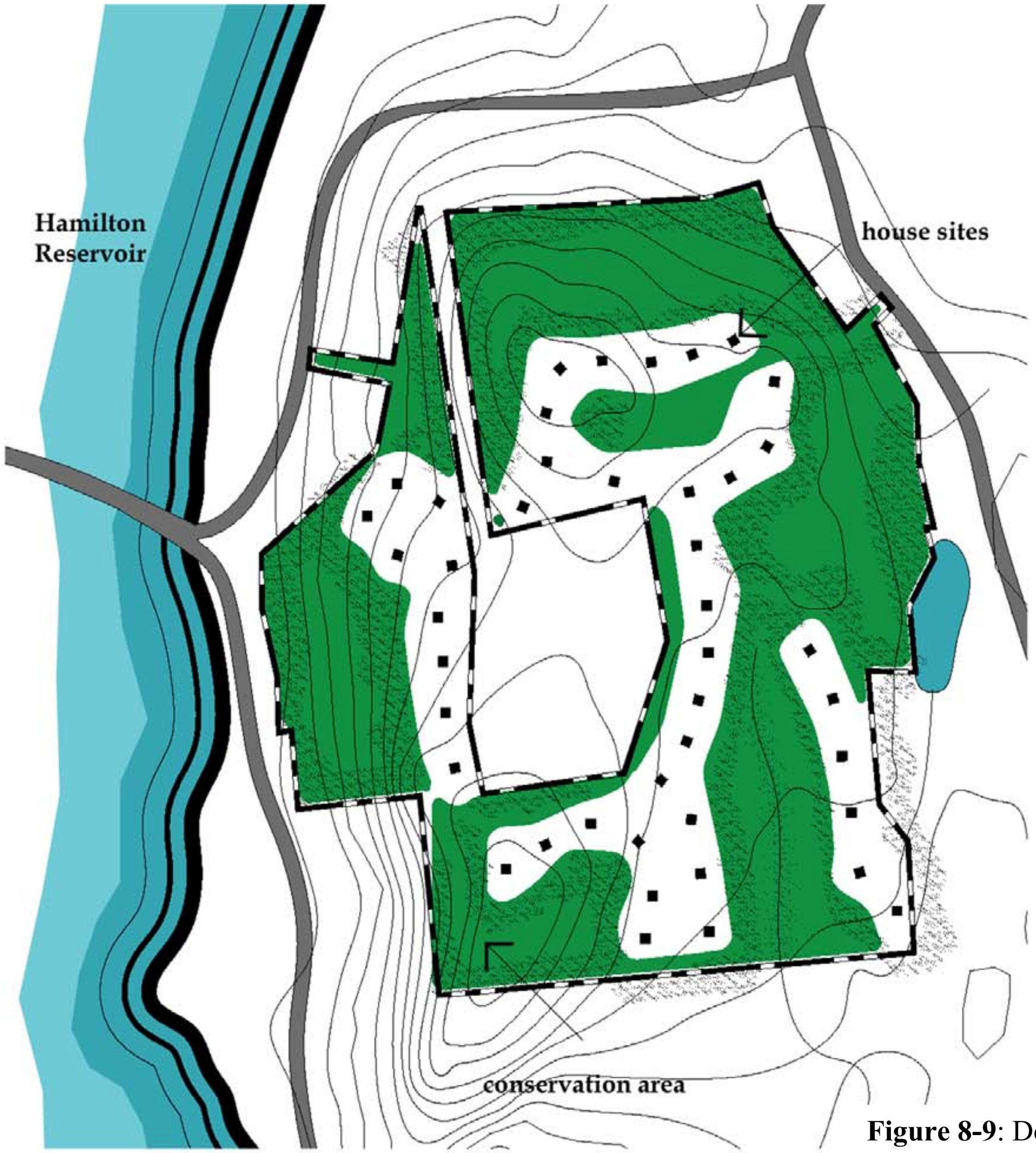


Figure 8-9: Design the street alignment and trails, to ensure the connectivity between the site and its context.

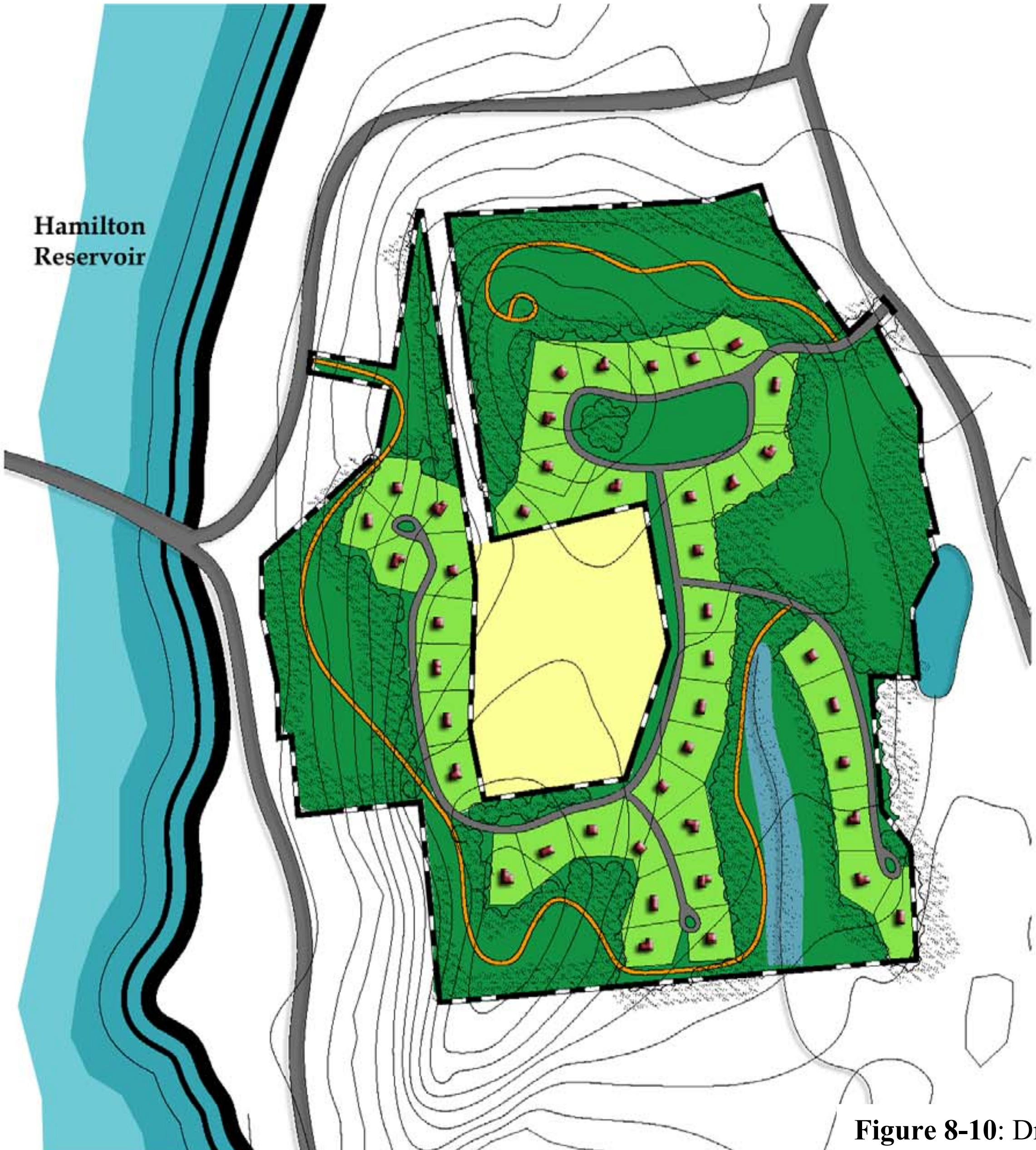


Figure 8-10: Drawing the line lots to create 44 lots, 1 acre a lot that is the same expected density for the same large parcel in case of having 2 acres size lots

References

Ahern, Jack F. Greenways as Strategic Landscape Planning: Theory and Application. Wageningen, Netherlands, 2002

Alexander, Christopher. A Pattern Language. New York. Oxford University Press, 1977.

Arendt, Randall. Conservation Desgin for Subdivisions. Washington D.C. Island Press, 1996.

Conway School of Landscape Design. HamiltonReservoir Watershed Study. June 2000.

Department of Environmental Quality Engineering, Division of Water Pollution Control. The Quinebaug River, 1980 Water Quality Data for Massachusetts.

Dramstad, W.E., D.D. Rudis. "New England Wildlife: Habitat, Natural History, and Distribution." U.S. Department of Agriculture Forest Service. Broomall, PA General Technical Report NE – 108. 491 pp. 1986.

Executive Office of Environmental Affairs, Commonwealth of Massachusetts. BioMap: Guiding Land Conservation for Biodiversity in Massachusetts. Natural heritage and Endangered Species Program Massachusetts Division of Fisheries and Wildlife. 2001.

Federal Interagency Stream Restoration Working Group (FISRWG) "Stream Corridor Restoration: Principles, Processes, and Practices, 10/98. Patch/matrix, hydrological cycle, and canopy/vegetation images

Forman, Richard T. T. Land Mosaics: The Ecology of Landscape and Regions. Cambridge University Press. U.K. 1995.

Goodhall, C. 1976. "Early History to 1783." In *Holland Massachusetts Commemorates America's Bicentennial*." Batchley's Printers. Monson, MA.

Kennedy, Laurie E., Stella Kiras & Richard McVoy, Ph.D. French and Quinebaug River Watersheds 2001 Water Quality Assessment Report. Department of Environmental Protection, Division of Watershed Management.

Krey, Lindsay. Assistant Planner, U.S. Fish and Wildlife Service, Hadley, Massachusetts. Interview 5 April 2002.

Larson, Joseph. A Guide To Important Characteristics and Values of Freshwater Wetlands in the Northeast, Water Resources Research Center, University of Massachusetts at Amherst, 1973

Lovering, Rev. Martin. 1915. *History of the Town of Holland Massachusetts*. Tuttle Company. Rutland, VT.

McCann, James and Daly, Leo. An Inventory of the Ponds, Lakes and Reservoirs of Massachusetts, Hampden and Hampshire Counties, Water Research Center, University of Massachusetts, 1972

Motts, Ward, O'Brien, Arnold L. Geology and Hydrology or Wetlands in Massachusetts. Water Resources Research Center, University of Massachusetts at Amherst, 1981.

O'Brien, C.D. "History of the Schools of Holland." In *Holland Massachusetts Commemorates America's Bicentennial*." Batchley's Printers. Monson, MA.

Ohop, Jennifer. Naturalist, Norcross Conservancy, Holland, Massachusetts. Interview 5 April 2002.

United States Department of Agriculture, Soil Conservation Service. Soil Survey of Hampden and Hampshire Counties, Massachusetts, Eastern Part. 1984.

University of Massachusetts at Amherst. A Build-Out Study of the Mid-Connecticut Valley of Massachusetts, 1998.

University of Massachusetts at Amherst LARP Studio VI. Reflections of the Future: The Holland Master Planning Study. Spring 1995

University of Massachusetts at Amherst LARP Studio IV. The Mill River Watershed Study. Spring 1998.

University of Massachusetts at Amherst. The French-Quinebaug Watershed Plan, 1999.

Ward S. Motts, Arnold L. O'Brien, *Geology and Hydrology of Wetlands in Massachusetts*. Water Resources Research Center, University of Massachusetts at Amherst, 1981. P17

www.state.ma.us/envir/mwi/watersheds.htm Watershed image

www.epa.gov/owow/wetlands/types/ Wetland intro image

www.state.ma.us/dep/brp/ww/files/riverqa.htm Information about the Rivers Protection Act

www.state.ma.us/envir/mwi/watersheds.htm Information about the Massachusetts Watersheds Initiative

www.epa.gov/owow/watershed/framework.html Information about the framework for the watershed approach to planning

www.state.ma.us/dfwele/dfw/bdi/Bdihome.htm Information about the Massachusetts Biodiversity Initiative

www.state.ma.us/envir/ The Massachusetts Executive Office of Environmental Affairs.

www.thelastgreenvalley.org This website provides information about the Quinebaug Shetucket Rivers Valley National Heritage Corridor such as general facts, brochures press releases, and newsletters.

www.fourmilab.ch/earthview/vplanet.html By John Walker, this site provides images of the earth and moon.

www.state.ma.us/cc/holland A site for the Commonwealth of Massachusetts. It provides information and education and links to town websites.

www.fs.fed.us/colormap/ecoreg1_provinces descriptions of the ecoregions of Massachusetts.

Zen, White, Hadley&Thompson edits. *Studies of Appalachian Geology: Northern and Maritime*. Interscience Publishers. 1968