Chapter 5

Existing Environmental Resources and Demographics

CHAPTER 5

EXISTING ENVIRONMENTAL RESOURCES AND DEMOGRAPHICS

5.1 INTRODUCTION

This chapter provides a summary of the existing conditions in the project planning area (PPA), environmental resources, land use, zoning, demographics, and existing wastewater treatment facilities. The environmental resources are defined by the topography, geology and soils, groundwater, surface waters, salt waters, flood plains, forests, and protected natural areas. Each of these existing conditions has been identified through review of existing documents and records, interviews, and site evaluations made by the project team.

5.2 NATURAL RESOURCES

A. **Topography.** The town of Mashpee (which makes up the majority of the PPA) is located 66 miles southeast of Boston, in Barnstable County on Cape Cod, Massachusetts. The Town is bordered by Sandwich on the north, Barnstable on the east, Nantucket Sound on the south, and Falmouth on the west. All of the neighboring towns have portions within the PPA. Mashpee is approximately 28.86 square miles, or 18,470 acres (Comprehensive Plan – Land Use & Growth Mgt). Barnstable and Falmouth each have approximately 1,000 acres in the PPA; Sandwich has nearly 5,000 acres in the PPA. Elevations in the PPA range from high areas of over 150 feet above mean sea level in portions of Sandwich to sea level along Nantucket Sound.

B. **Geology/Soils.** The PPA, like most towns on Cape Cod, is comprised mostly of glacial deposits. Most of the PPA is dominated by Mashpee Pitted-Plain deposits, with the Great Neck area (New Seabury and Popponesset) dominated by kame deposits (W&S Facility Plan).

According to the Barnstable County Soil Survey (United States Department of Agriculture – Natural Resource Conservation Service, USDA NRCS, 1993), the most predominant soil types in the PPA include Carver course sand and Carver loamy coarse sand. In addition, there are significant areas of Merrimac sandy loam and Enfield silt loam. The shoreline along the southern coast is considered Hooksan-Beaches-Dune land.

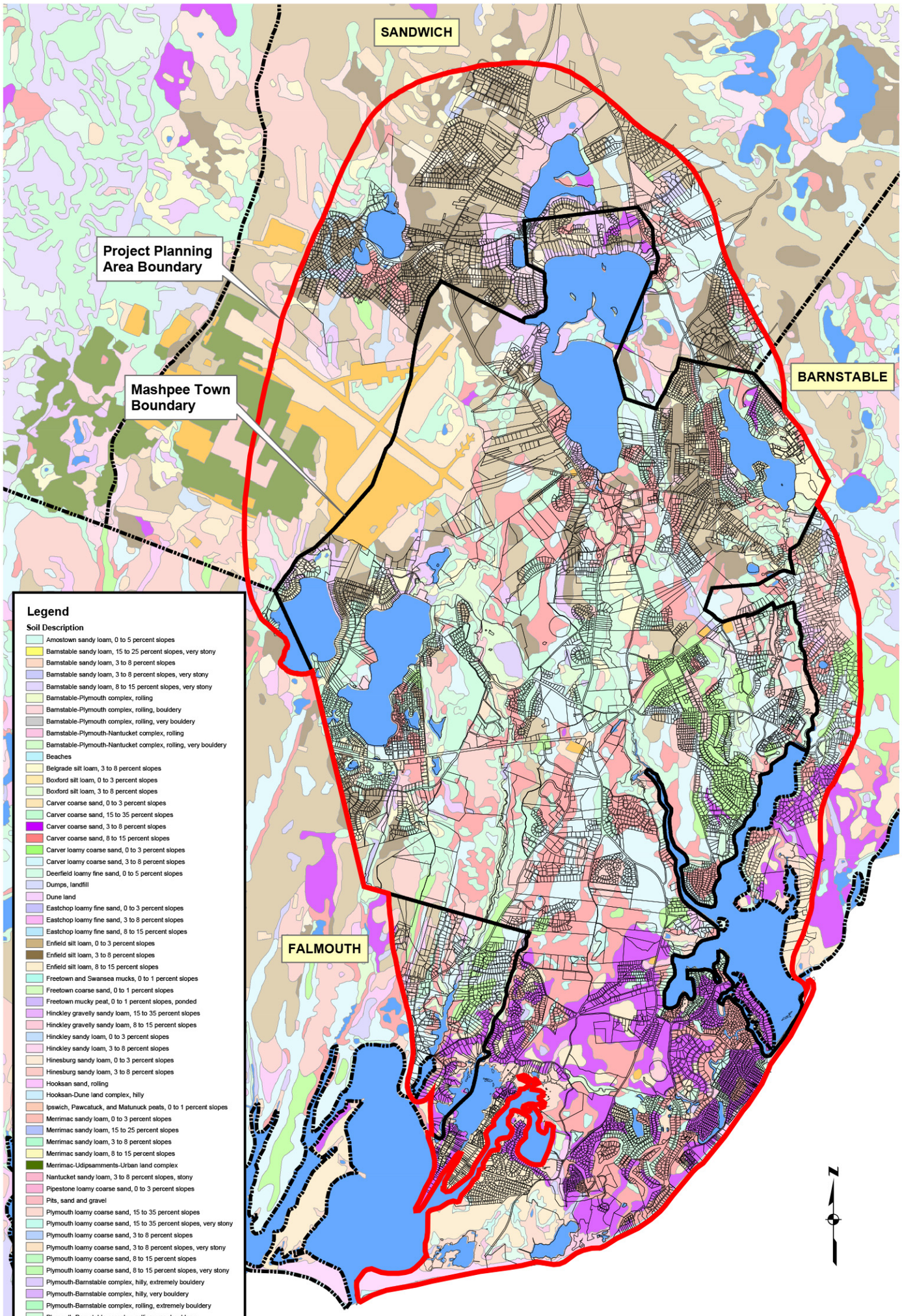
Figure 5-1 depicts the soils of the PPA as developed by the USDA NRCS. In general, the soils have a high permeability, and these high permeability soils are amenable to disposal of wastewater by rapid infiltration.

C. Groundwater.

1. **Flow Direction and Elevation.** The Ground Water Model prepared by Earth Tech in 1997 provides an overview of the groundwater contours in the Town of Mashpee. Generally, the groundwater system (Sagamore Lens) is at its highest elevation in the Town of Sandwich. Groundwater flows in a southeasterly direction, and most of the groundwater drains into Nantucket Sound.

2. **Public Water Supplies.** Residents in the PPA receive drinking water from the Sagamore Lens. The towns have multiple public and private water supply wells that draw water from this aquifer. There are currently six public water supply wells in Mashpee: High Wood #2 and #3, Quaker Run, Turner Road, Mashpee Village, and Belcher. High Wood #1, previously used as a summer backup supply, was recently abandoned. There are a limited number of public water supply wells in the other towns in the PPA – Barnstable has one and Sandwich has two.

3. **Protected Areas.** High Wood wells #2 and #3, and Quaker Run (Well T-4) all have 400-ft "Zone I" protective radii within which there can be no development. In addition, each of these wells has an upgradient monitoring well in place to detect contaminants that may be approaching the well. The recharge area of the Quaker Run well (also known as T-4) was modeled by Earth Tech and shown to overlap a contamination plume from the Augat Plant, indicating



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Watershed Nitrogen Management Plan

SOIL MAP

FIGURE 5-1

possible chlorinated Volatile Organic Compound (VOC) contamination of the groundwater (LCP, Water Resources, 1998). Based on statements from the Mashpee Health Agent, it appears that the portion of the plume overlapping the Quaker Run Zone II has been cleaned up as of early 2007.

The groundwater protection districts included in the in the Town of Mashpee zoning bylaw were first delineated in January 1988 to protect aquifers and recharge areas of public and private water supplies. These districts have been updated on a number of occasions to reflect new public wells and new Zone II information. Within these areas and within the Zone II recharge areas of any existing or proposed public water supply well, any land use which could cause possible contamination to groundwater is prohibited. Wastewater treatment facility construction is prohibited in mapped Zone II areas. The other towns in the PPA have similar groundwater protection districts, although they may vary slightly by Town. These groundwater protection districts and Zone II's are presented in Figure 5-2.

D. **Surface Waters.** The surface waters in the PPA consist of both freshwater bodies and salt water bodies. A brief discussion of the major waters in the PPA follows.

1. **Freshwater Bodies**

(a) **Lakes and Ponds.** The Town of Mashpee is characterized by four large inland freshwater ponds – Ashumet, Johns, Mashpee-Wakeby, and Santuit – and a variety of smaller ponds, totaling over 1600 acres of area. The four largest ponds, in addition to the smaller Great Flat Pond (which is brackish) and Moody Pond, are considered lacustrine wetlands by the U.S. Fish and Wildlife Service Classifications (Comprehensive Plan - Water Resources, 1998).

In addition to the ponds in Mashpee, there are several ponds in Sandwich, primarily Snake Pond, Pimlico Pond, and Peters Pond. The major ponds in the PPA are summarized in Table 5-1.

TABLE 5-1

FRESHWATER LAKES AND PONDS IN THE PROJECT PLANNING AREA (1)

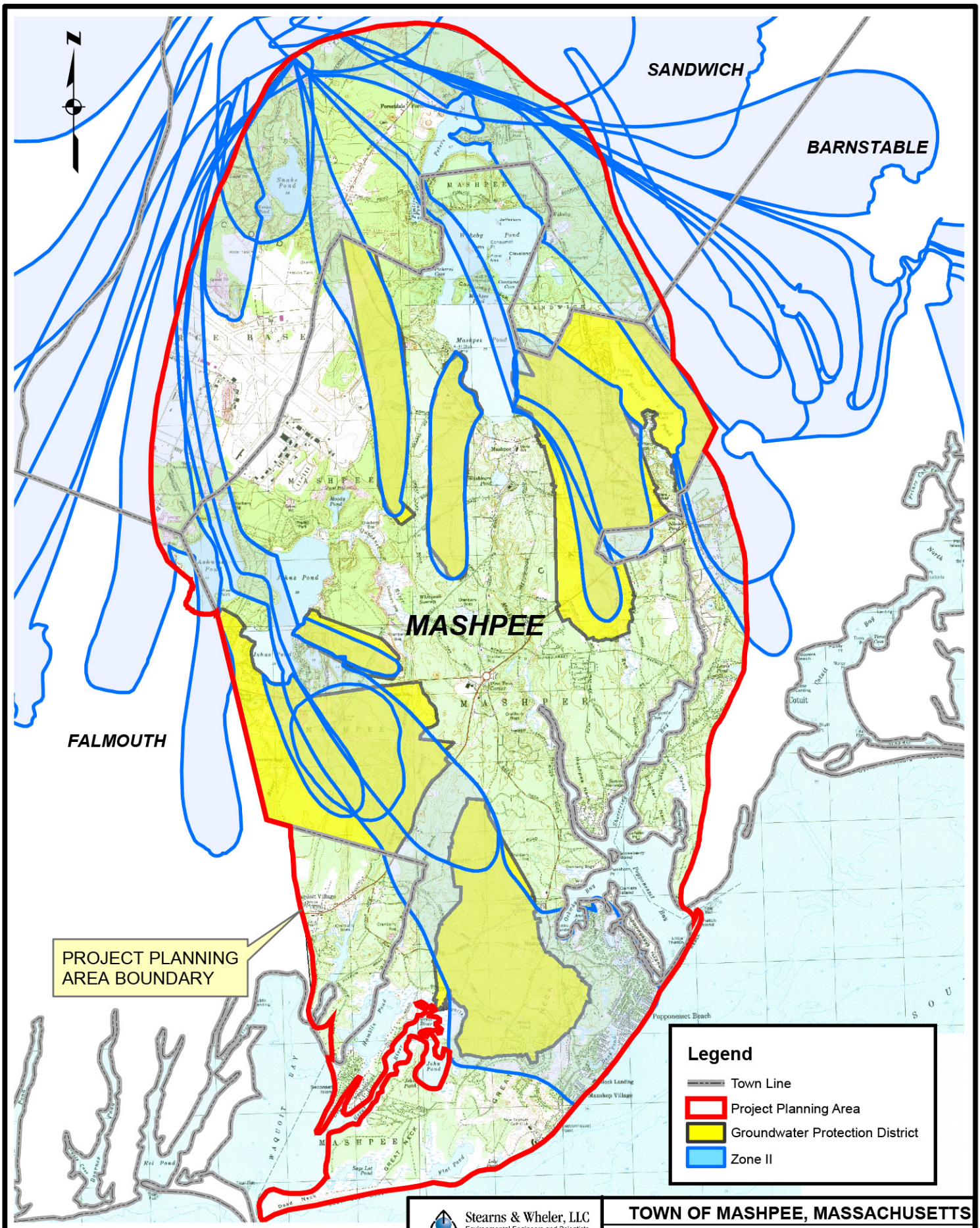
Pond Name	Surface Area (acres)	Max Depth (ft)
Mashpee & Wakeby Ponds	729	87
Ashumet Pond	203	65
Johns Pond	317	62
Santuit Pond	172	9
Great Flat Pond	37	na (2)
Moody Pond	18	14
Peters Pond	127	57
Pimlico Pond	14	25
Snake Pond	83	33

(1) Data provided by Town of Mashpee Local Comprehensive Plan: Water Resources, 1998 and Town of Sandwich Local Comprehensive Plan, 1996.

(2) No data available.

According to the Cape Cod Commission's 2001 Cape Cod Pond and Lake Atlas, all of the 18 Mashpee ponds sampled for the atlas are impacted by either chlorophyll-a, total nitrogen, or total phosphorus. Santuit Pond, in particular, is described as a "slightly nutrient enriched pond with some water quality concerns." Additionally, the Atlas says that "the ecosystem in Santuit Pond would rapidly respond to any additions of phosphorus." The Atlas recommended that a land use assessment be performed to determine future development (and resultant phosphorus additions) in the area. Ongoing pond monitoring has continued to show degradation in the water quality of Santuit Pond. Algal blooms and high bacteria levels, both likely related to nutrient loading and effluent runoff, have been documented on a regular basis.

In order to meet the requirements of the federal Clean Water Act, MADEP identifies waterbodies that will require TMDLs in order to meet water quality standards. The resultant list is known as the 303(d) List. Santuit Pond was listed under "impaired waters" on the Proposed 2006 303(d) List (for nutrients and organic enrichment/low DO). None of the Sandwich ponds were listed as requiring a TMDL.



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Watershed Nitrogen Management Plan

Zone II's and Groundwater Protection Districts

FIGURE 5-2

(b) **Rivers.** There are five long, narrow river valleys running from north to south through the PPA – the Childs, Quashnet, Mashpee, Quaker Run, and Santuit (W&S Facility Plan, 1988), in addition to the smaller streams of Abigail's Brook, Dutchman's Creek, and Red Brook. The following rivers were listed on the Proposed 2006 303(d) List:

- Mashpee River (Nutrients, Pathogens)
- Quashnet River (Nutrients, Organic enrichment/Low DO, Pathogens)

(c) **Wetlands.** Wetlands result from both salt and freshwater and are valuable for flood protection, nutrient uptake and release, wild life habitat and propagation, groundwater recharge, and open space for recreation and scenic beauty. The Wetlands Protection Act (WPA) is administered and enforced by MADEP's Wetlands Program. The WPA imposes restrictions on the removal, filling, dredging, or alteration of any designated wetland. The wetland delineations within the PPA are shown in Figure 5-3.

(d) **Vernal Pools.** Vernal pools are temporary bodies of freshwater that provide critical habitat for a number of vertebrate and invertebrate wildlife species. More than thirty vernal pools have been identified by the Natural Heritage & Endangered Species Program in the Town of Mashpee and along its borders with neighboring towns (Massachusetts Heritage Atlas, 2006). The vernal pools are located in three general areas: southeast of Johns Pond, in the corridor between Hamblin Pond and Popponesset Bay, and in the northeast portion of the PPA surrounding Santuit Pond. Figure 5-3 shows all of the locations.

2. Salt Water Bodies

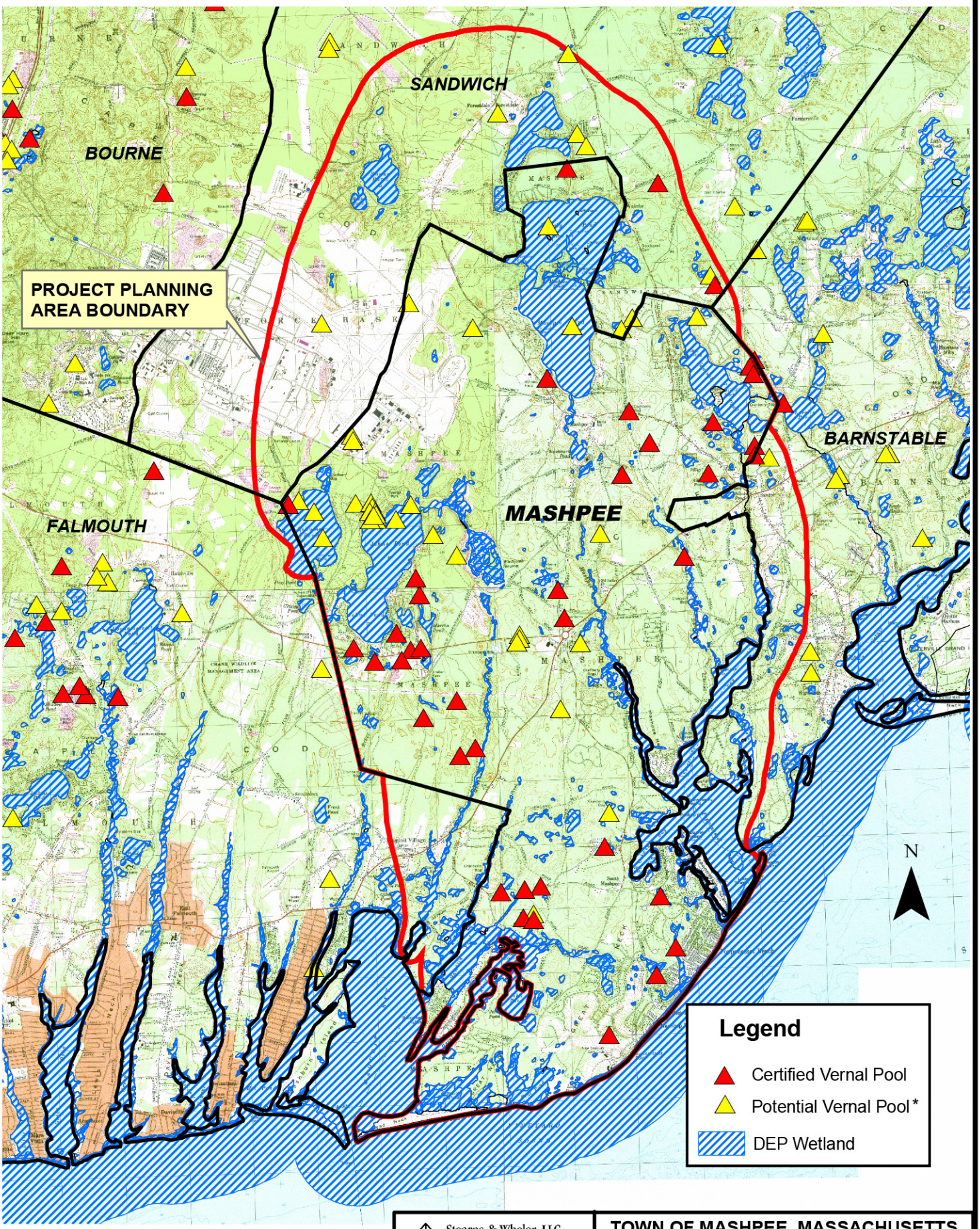
(a) **Coastal Embayments.** The rivers described above feed into the two large estuarine systems in the PPA – Waquoit Bay and Popponesset Bay – which are of particular concern for nitrogen loading sensitivity. Waquoit Bay includes the subembayments of Hamblin Pond, Jehu Pond, Sedge Lot Pond, Little River, Great River, and the brackish waters of

Great Flat Pond. Hamblin Pond was listed as an impaired water on the proposed 2006 303(d) list, requiring nutrient and pathogen TMDLs; Jehu Pond was listed as impaired, requiring a nutrient TMDL; Little River was listed as impaired, requiring nutrient and pathogen TMDLs. The Popponesset Bay estuary subembayments include Shoestring Bay, the lower Mashpee River, Ockway Bay, Popponesset Creek, Spoondrift Cove, Pinquickset Cove, and Spinnaker Cove. Popponesset Creek was listed as impaired water on the Proposed 2006 303(d) list, requiring a pathogen TMDL.

- **Nitrogen Sensitivity.** Coastal embayments are sensitive to nitrogen inputs because nitrogen is typically the limiting nutrient in these surface water systems. This means that coastal waters have more than enough phosphorus and other nutrients to fertilize marine plants, and the growth of these marine plants is limited by the nitrogen content in the water. Therefore, as more nitrogen is added to the system, more plant material is produced. Water quality can be impacted by the additional plant material that is produced.

Nitrogen enters a coastal embayment through its recharge area (watershed). The nitrogen originates from on-site septic systems; discharges from wastewater treatment plants; fertilization of lawns and agricultural lands; waterfowl; wetlands; atmospheric deposition; benthic flux (the nitrogen release from the degradation of organic material from the sediment in the estuaries); and stormwater runoff from impervious surfaces. Wastewater treatment plants are currently designed to remove nitrogen to less than 10 milligrams per liter (mg/L). Therefore, the discharge of treated wastewater from wastewater treatment plants has lower nitrogen concentration than discharge from individual septic systems. Typical Title 5 approved septic systems provide minimal nitrogen removal and are usually the largest source of nitrogen to coastal embayments. Typical Title 5 approved systems can be upgraded to remove nitrogen, and these systems are often called "Innovative and Alternative (I/A) Systems." These I/A systems typically have effluent nitrogen concentrations of 19 mg/L.

The assimilative capacity of a coastal embayment is a function of its depth and tidal



* "NHESP Potential Vernal Pools: NOT equivalent to Certified Vernal Pools"

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Vernal Pools/DEP Wetlands
FIGURE 5-3

flushing characteristics and is unique to each embayment. Often, coastal embayments are impacted by average embayment nitrogen concentrations as low as 0.35 mg/L. This is considerably lower than the State drinking water standard of 10 mg/L. The assimilative capacities for the Waquoit Bay and Popponesset Bay have been determined through a nitrogen loading assessment by the MEP. The MEP evaluated and identified the critical nitrogen loading limits for each estuary.

- **Shellfish and Finfish Resources.** The PPA's coastal and estuarine water bodies have significant finfish and shellfish resources. Waquoit Bay and Popponesset Bay are both desirable habitat for a variety of shellfish. Commercial and recreational harvesting of quahogs, bay scallops, and soft shell clams occurs in both bays. Ribbed mussels, whelks, razor clams, and crabs are also present in the bays.

Shoestring Bay and the lower Mashpee River have seen shellfish bed closures since the 1980s due to high concentrations of fecal coliform bacteria. The remaining shellfish resources are classified as either approved or conditionally approved. See Figure 5-4 (A, B, and C).

With the goal of addressing the nitrogen loading and eutrophication problems, the Town of Mashpee's Shellfish Department is currently investigating the possibility of using oysters to mitigate existing impacts in the waters of the Mashpee River – one of the most impacted embayments in Mashpee. The ultimate goal is to remove 500 kilograms of nitrogen from the Mashpee River with oyster fisheries. The oysters harvest the algae and nitrogen, thereby improving the quality of the water. Once the oysters are harvested, that nitrogen is removed from the system. More than 100,000 oysters have been harvested each year for the last two years, which is equivalent to an estimated 50 kilograms of nitrogen removed per year. In Fiscal Year 2008, SMAST will be doing a study on the nitrogen removal capabilities of cultured oysters.

(b) **Floodplains and Velocity Zones.** Floodplains are nature's way of buffering land from

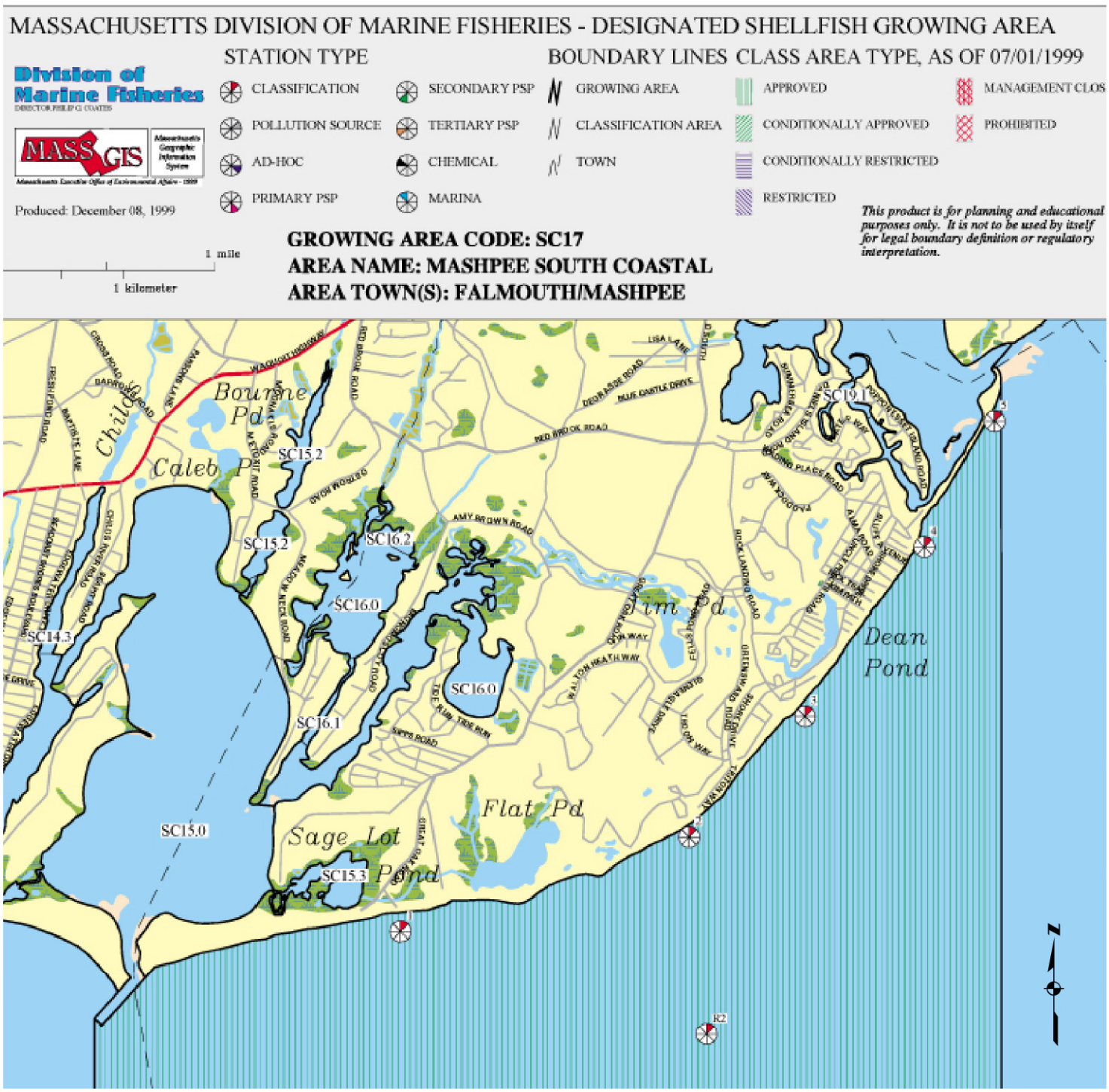
excessive storm events because they act to dissipate the wind and wave action generated during these storms. The majority of the floodplains within the PPA are along Mashpee's coasts. Article XI: Floodplain Zone Provisions of the Town of Mashpee Zoning bylaws prohibits new development within areas designated as V (Velocity) Zones on the Flood Insurance Administration Flood Rate Maps and are defined as areas susceptible to 100-year coastal flooding with high velocity wave action. The V-Zones are illustrated in Figure 5-5.

A-Zones are also designated by FEMA and are areas where flooding is predicted to occur once every 100 years. This flooding occurs with minimal associated wave action, and these areas are located landward of the V-Zones, typically in salt marshes and low elevation areas of Mashpee. The surface elevations in these areas typically lie below ten feet mean sea level (MSL). The A-Zones are also illustrated in Figure 5-5.

(c) **Salt Marshes.** Salt marshes cover approximately 250 acres of waterfront in the Town of Mashpee (Comprehensive Plan, Water & Water Resources), and provide critical habitats and nurseries for marine and terrestrial species. The salt marshes in Mashpee are included in the Wetlands Map (Figure 5-3).

E. Forests

A combination of frequent forest fires and soil depletion resulting from agricultural activities and wind action in exposed areas has resulted in a loss of much of Cape Cod's original forest area. The forests that remain in the PPA are classified primarily as pine-oak climax forests. Various species of oak trees, including scrub oak, white oak, red oak, and pin oak, as well as pitch pines dominate these forests. In addition, there are some white cedar swamplands in the southern portion of the PPA.



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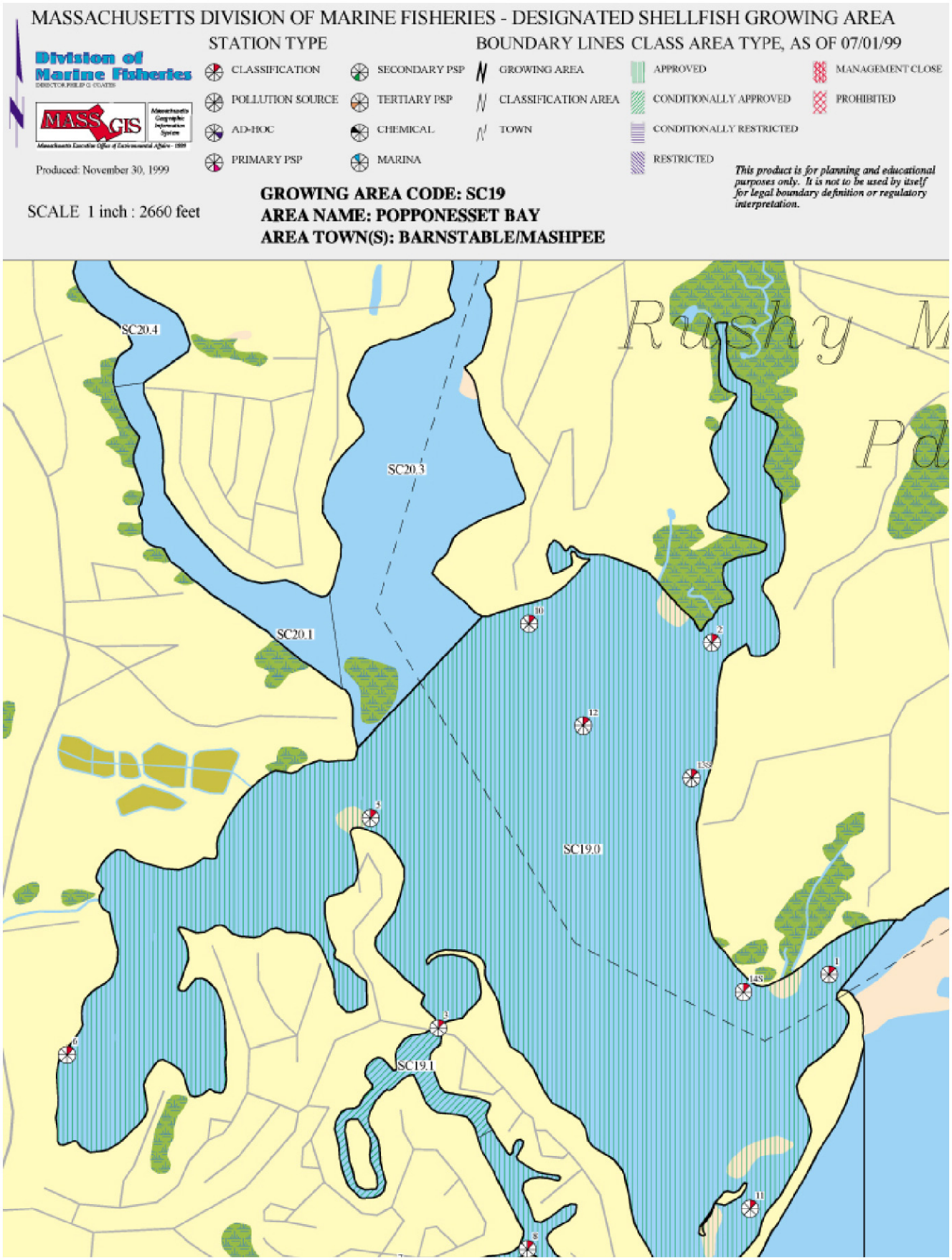
TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Shellfish Growing Map
Area SC17

FIGURE 5-4A



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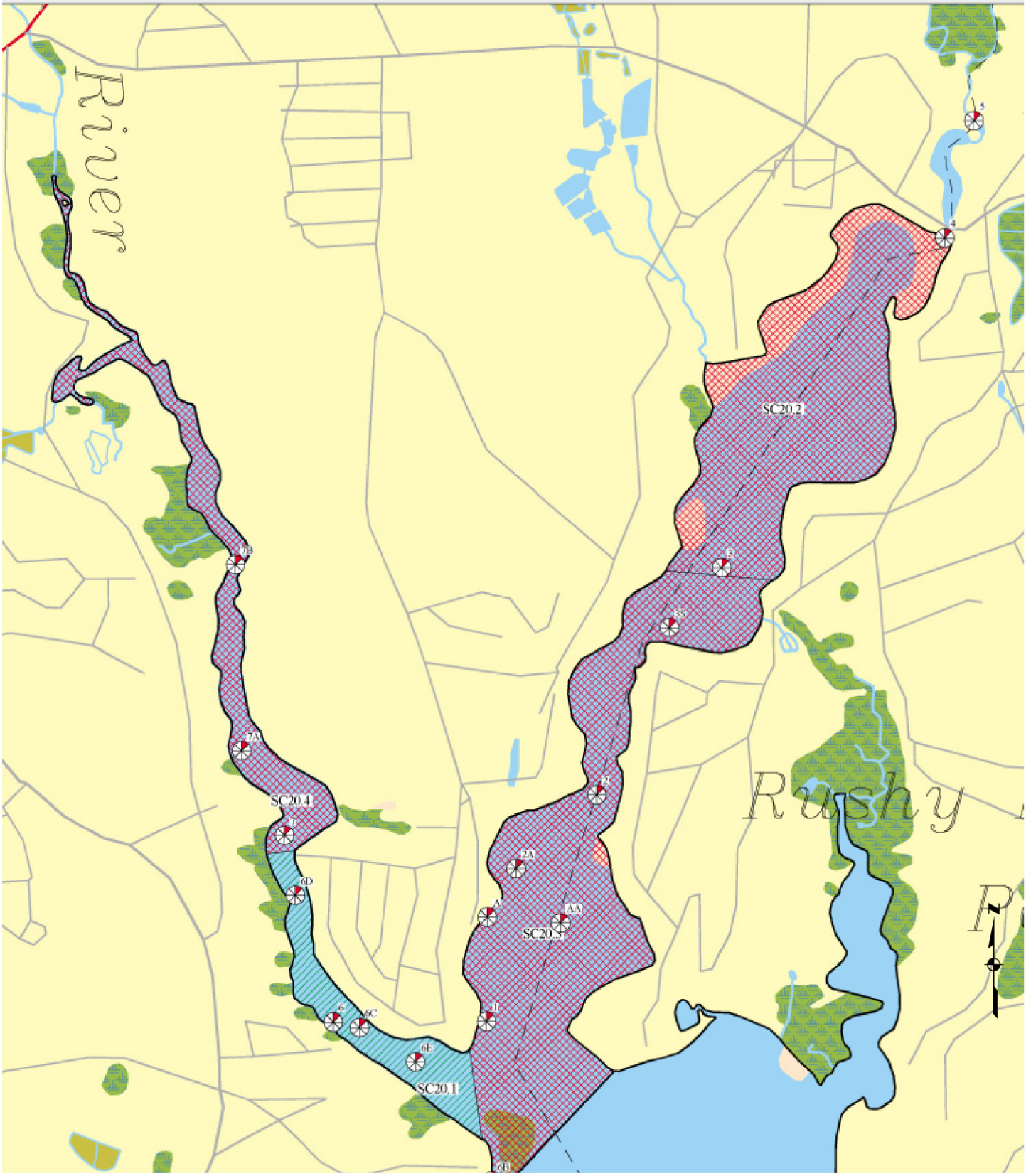
Shellfish Growing Map
Area SC19

FIGURE 5-4B

SCALE 1 inch : 3045 feet

GROWING AREA CODE: SC20
AREA NAME: MASHPEE RIVER & SHOESTRING BAY
AREA TOWN(S): BARNSTABLE/MASHPEE

for legal boundary definition or regulatory interpretation.



*Note: See Figure 54-B for Legend

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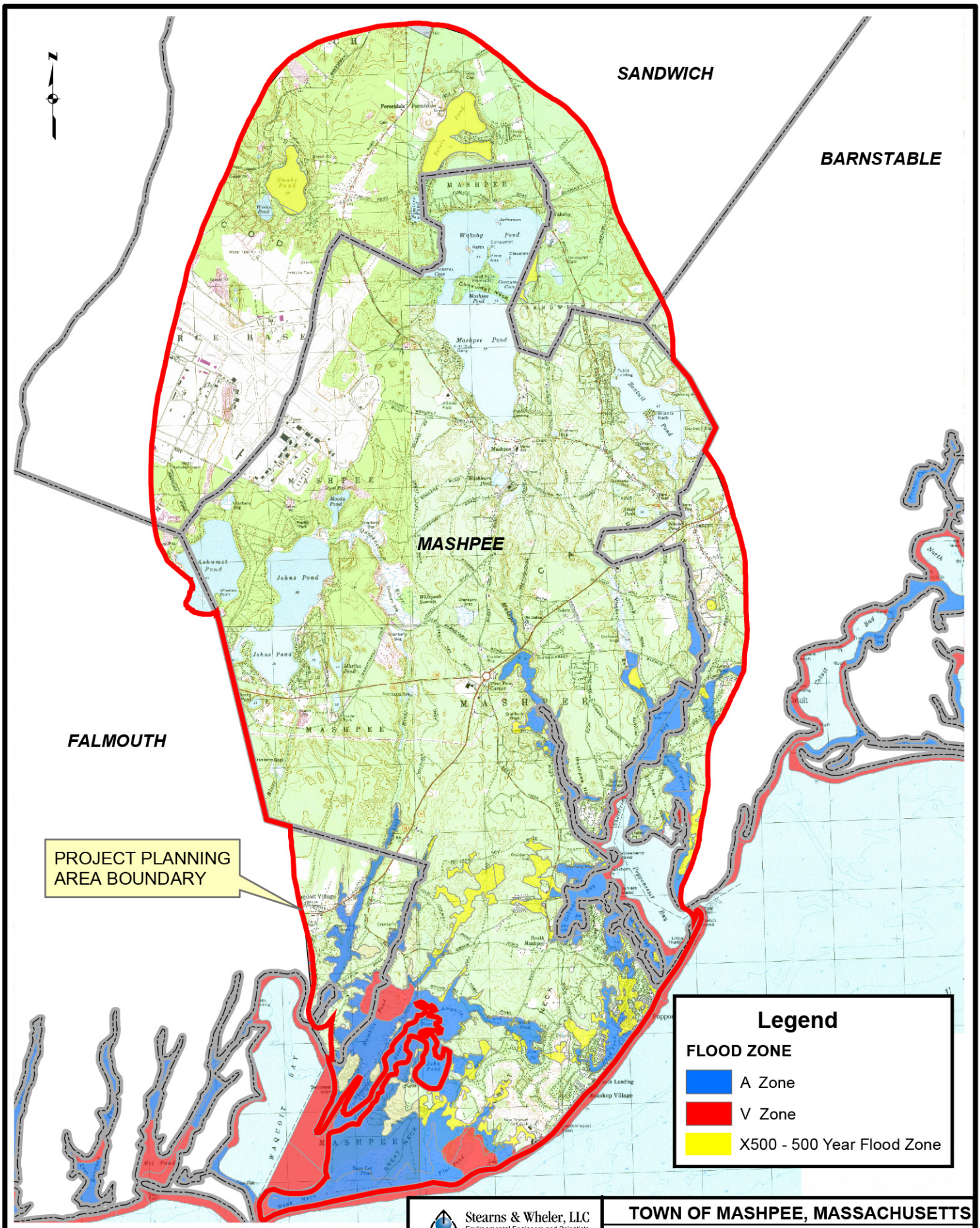
Shellfish Growing Map
Area SC20

FIGURE 5-4C



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TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

FLOOD ZONES

FIGURE 5-5

F. Critical Wildlife and Plant Habitat

There are several regions in the PPA that have been identified as estimated habitats of rare species and wildlife by the Massachusetts Division of Fisheries & Wildlife (October 2006). These areas are shown in Figure 5-6.

Of particular interest in the Waquoit Bay National Estuarine Research Reserve (WBNERR) is the decline in eelgrass population over the past 50 years, and the subsequent replacement of microalgal mats in its place. Eelgrass provides a habitat for a number of estuarine invertebrates (The Ecology of Waquoit Bay).

G. Protected Areas

1. **Areas of Critical Environmental Concern (ACEC's).** The Massachusetts Executive Office of Environmental Affairs (EOEA) designated the Waquoit Bay Area of Critical Environmental Concern in November, 1979. This ACEC is centered around the Waquoit Bay Area and includes Waquoit Bay, Childs River, Moonakis River, Bourne Pond, and Quashnet River in the towns of Mashpee and Falmouth. Within this area and a buffer zone extending 25 feet landward from the edge of the ACEC, specific regulations regarding construction and land alteration are enforced in Mashpee (Zoning Bylaws, Town of Mashpee, 2000). The ACEC is included in Figure 5-6.

2. **Protective Districts.** Mashpee River and Quashnet River Protective Districts have been designated in the Town of Mashpee Zoning Bylaws. No new structures may be built within 100 horizontal feet from the natural banks of the Mashpee River (excepting the Pirate's Cove subdivision on the east side and those properties south of the southern boundary of the Stemberg property on the west side) or of the Quashnet River south of the southern side line of Route 151. These protective districts are delineated in Figure 5-7.

3. **Primary and Secondary Conservation Areas / Open Spaces.** The Town of Mashpee Open Space Incentive Development (OSID) Zoning Bylaw (174-46 OSID) requires that a minimum of 50 percent of the parcels included within the OSID be dedicated as open space. This open space must be located within the primary and secondary conservation areas designated on the Mashpee Open Space Incentive Plan (See Figure 5-8).

4. **Historic Districts.** The Mashpee Facility Plan (W&S, 1988) identified four (4) sites of prehistoric archaeological importance, listed on the State Register of Historic Places by the Massachusetts Historical Commission (MHC). These sites are in the vicinity of the Willowbend Development, although the exact locations are kept confidential by the MHC.

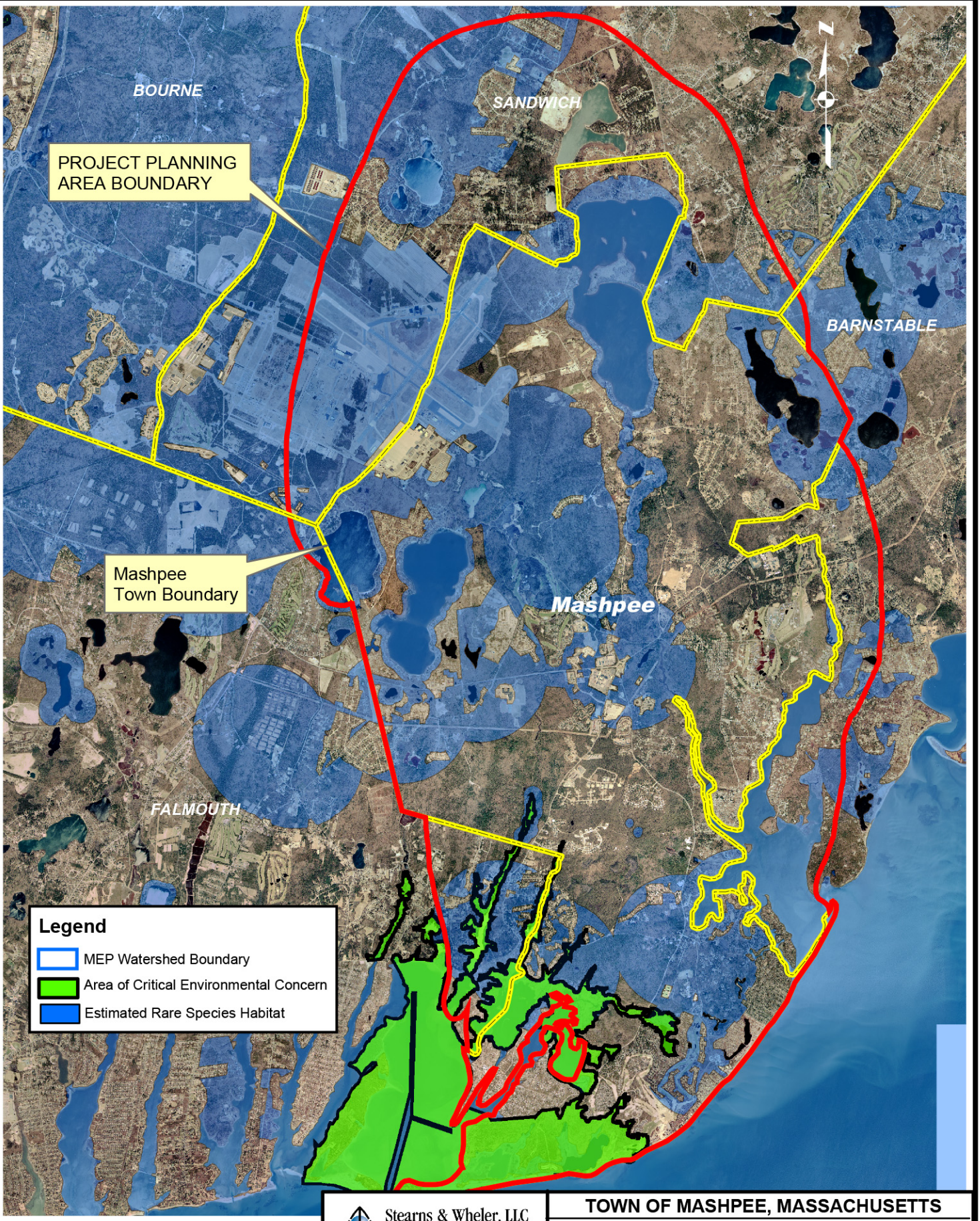
The Mashpee Historical Commission has identified or is researching various sites within the Town. The sites are important as archaeological sites, historic buildings, or burial grounds. There is an historic district currently proposed in the vicinity of the Mashpee Town Hall/Route 130. Approval of this district will be sought at the time of the October 2007 Town Meeting.

5.3 LAND USE AND ZONING

Town Planning Departments use State Classification Codes for identifying general uses of all of the properties in PPA. The uses can then be grouped as either residential, commercial, industrial, or institutional (which includes Town, State, and Federally owned properties). This information is useful because it provides a general overview of a Town's development and is a tool used in developing build-out estimates. Figure 5-9 illustrates the land uses in Mashpee.

A. Town Planning Zones

The Town of Mashpee is broken into 161 "Planning Zones," based on traffic flow and neighborhoods. The analysis done in this study will be based on the 161 planning zones, which are presented in Figure 5-10. The areas of the PPA that are outside of Mashpee lines have been given "planning zone" identifications for the purposes of this WNMP. These are not Town-designated



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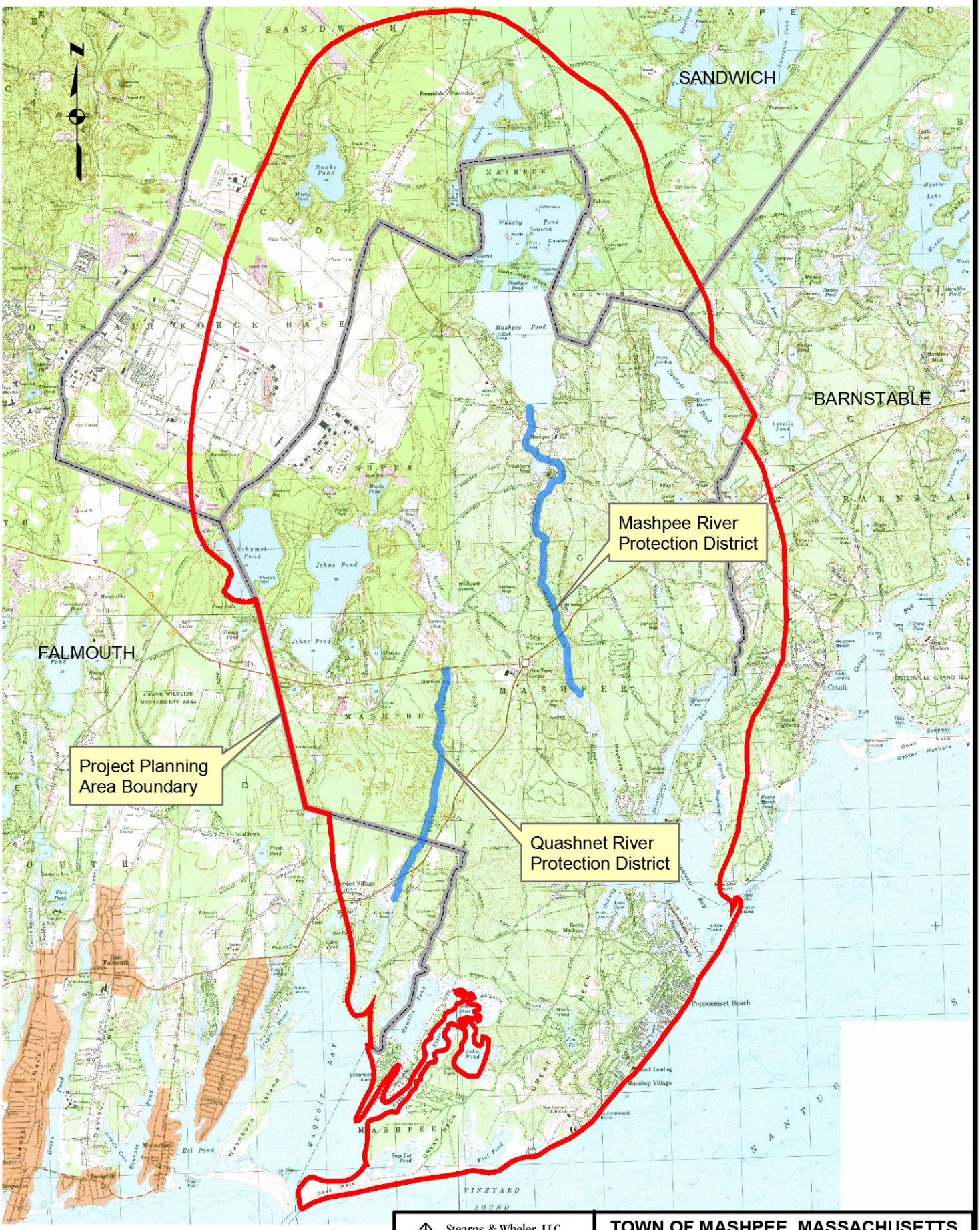
Watershed Nitrogen Management Plan

Natural Heritage Estimated Rare Species/ Areas of Critical Environmental Concern

FIGURE 5-6



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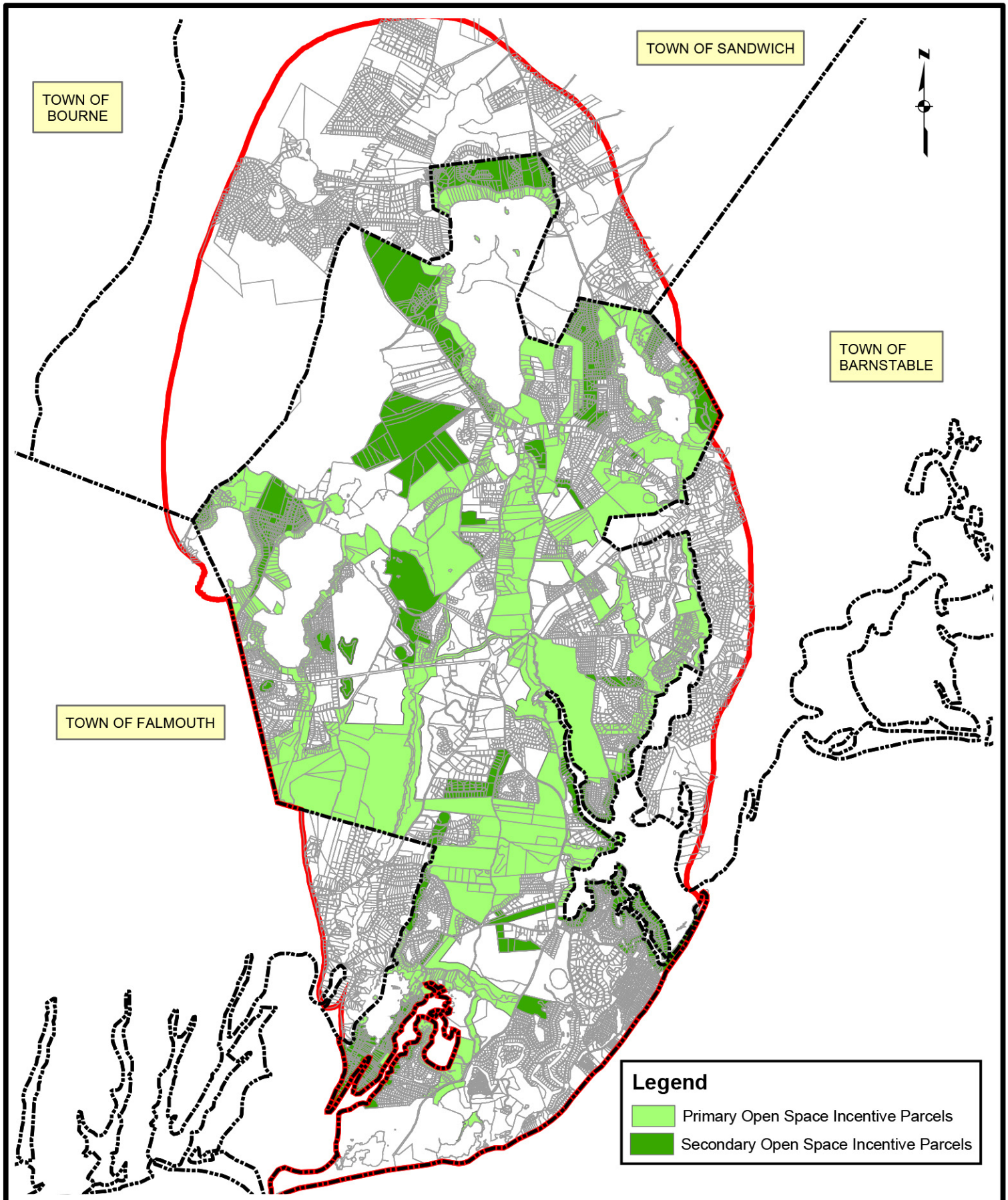
Watershed Nitrogen Management Plan

Mashpee & Quashnet River Protection District

FIGURE 5-7



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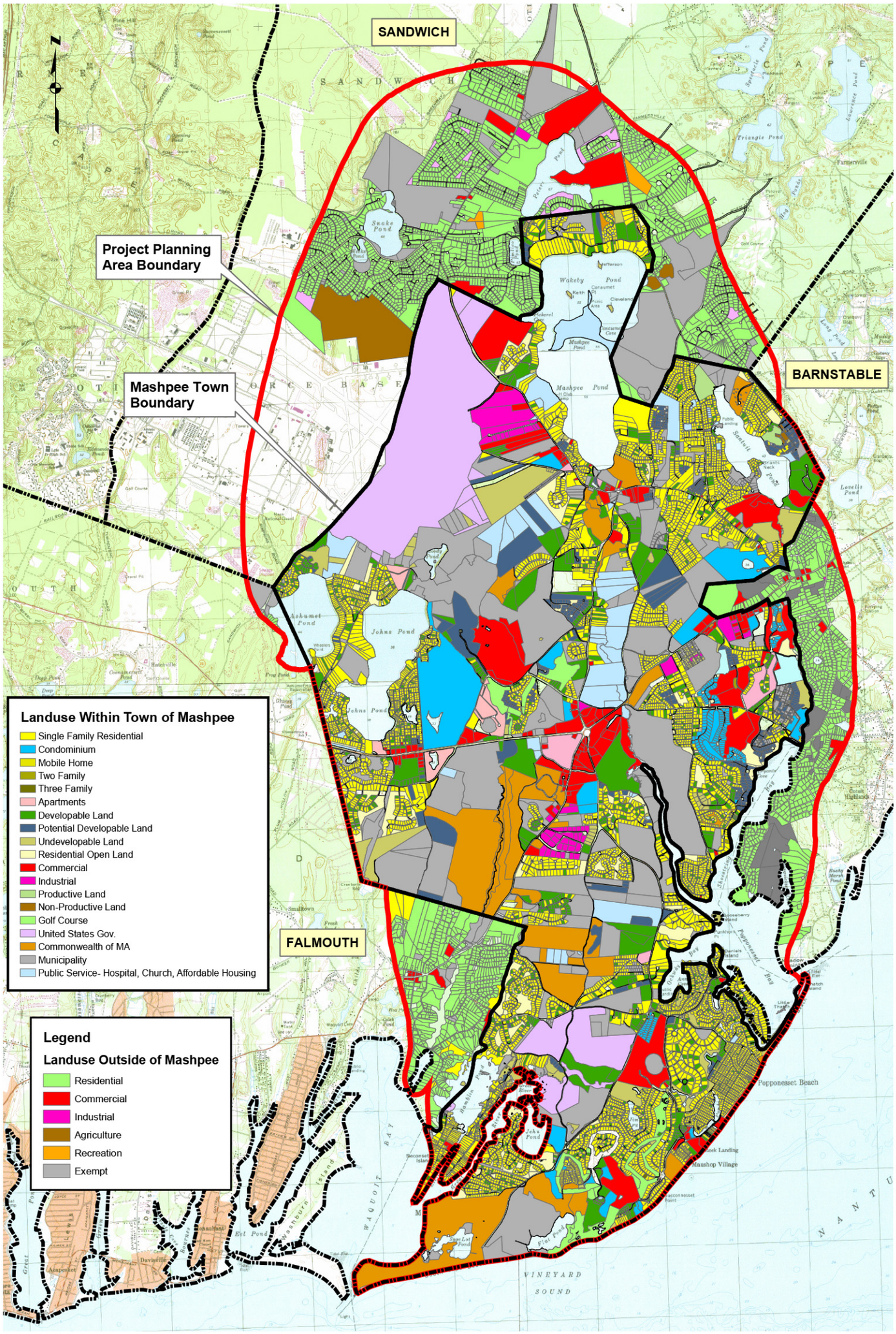
TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Mashpee Open Space Incentive Plan

FIGURE 5-8



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Landuse Map

FIGURE 5-9

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planning zones.

B. **Town Zoning**

As of 2007, the Town of Mashpee was divided into the following zoning districts: Residential (R-3, R-5), Commercial (C-1, C-2, C-3), and Industrial (I-1). These districts are presented in Figure 5-11, along with the zoning designations (designated by the respective towns) for the portions of the neighboring towns.

5.4 TOWN DEMOGRAPHICS

A. **Current Population.** U.S. census data indicates that Mashpee's year round population was 12,946 in 2000. CCC also reports Cape Cod population estimates (from the U.S. Census Bureau) in its newsletter *Cape Cod Commission REPORTER.* The August 5, 2004 edition reported population estimates for Mashpee as follows:

TABLE 5-2

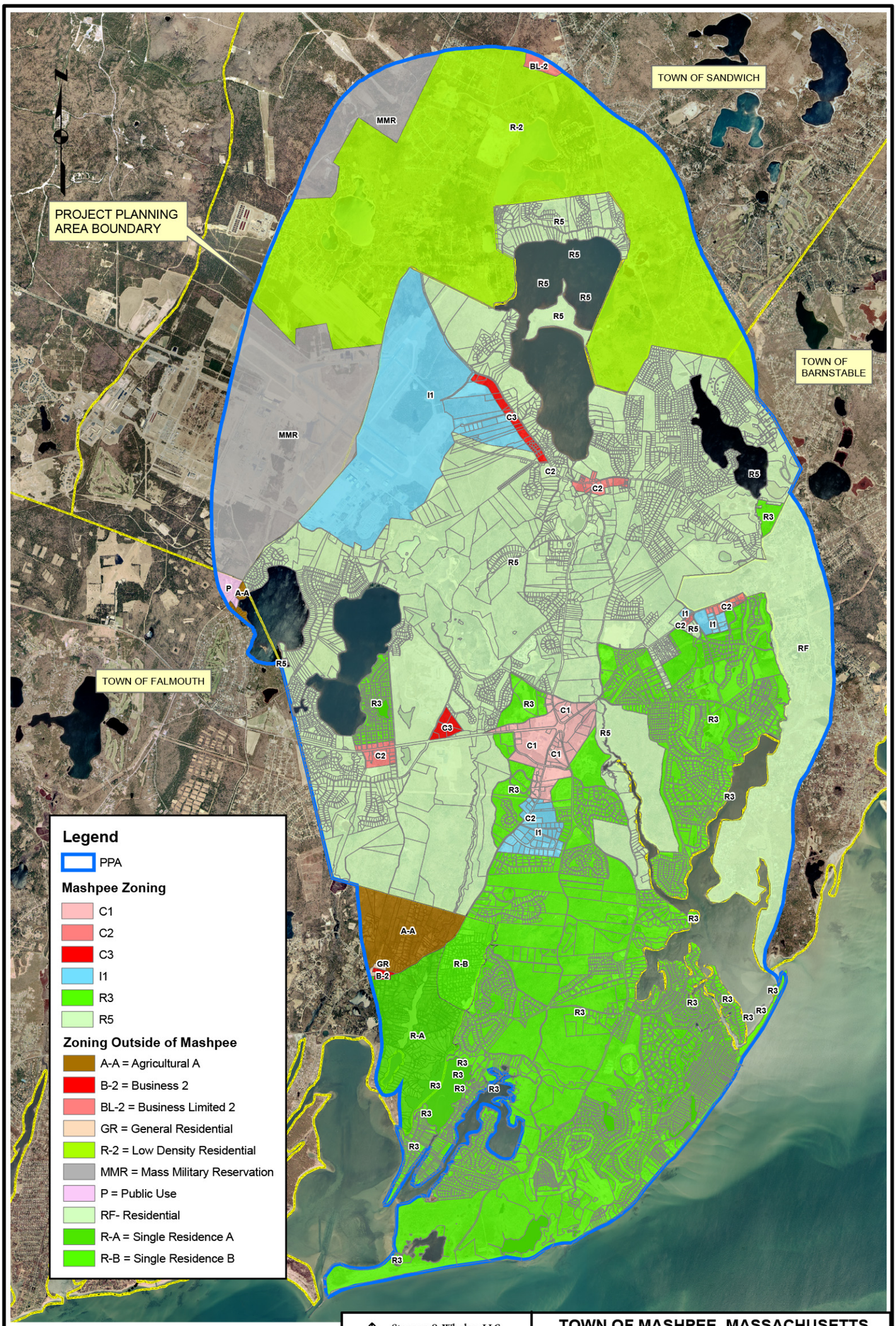
POPULATION ESTIMATES FOR TOWN OF MASHPEE

Year	Population
2001	13,500
2002	13,939
2003	14,200

In addition, the U.S. Census Bureau issued 2004 population estimates on June 30, 2005. Mashpee's estimated population was 14,301. This represents a 10.5% population increase since 2000, making Mashpee the fastest-growing town on Cape Cod. Population statistics are only reported for Mashpee because it is the only town of the four towns in the PPA that is entirely within the PPA.

B. **Seasonal Population.** The 2000 U.S. census indicated that 33% of the housing units in Mashpee are designated as seasonal, recreational, or occasional use. This results in summer

populations that are significantly higher than the year-round population. Estimates generated for the Town's Local Comprehensive Plan indicated seasonal populations ranging from 27,000 to 31,000.



Data Source: Mass GIS, Town of Barnstable Zoning Map dated 4/14/2005 (Town GIS Dept.), Town of Sandwich Zoning Map by CCC dated 9/19/2005

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TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

ZONING MAP

FIGURE 5-11