COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

INTERIM NEEDS ASSESSMENT & ALTERNATIVES ANALYSIS REPORT

Wellfleet, MA - June 2012

Environmental Partners GROUP

A partnership for engineering solutions.

Environmental Partners GROUP

A partnership for engineering solutions.

Woburn:
18 Commerce Way, Suite 2000
Woburn, Massachusetts 01801

Phone: 781.281.2542
Fax: 781.281.2543

Headquarters:
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169

Phone: 617.657.0200
Fax: 617.657.0201

www.envpartners.com

Hyannis:
297 North Street, Suite 311
Hyannis, Massachusetts 02601

Phone: 508.568.5103
Fax: 508.568.5125

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

NEEDS ASSESSMENT & ALTERNATIVES ANALYSIS REPORT

TABLE OF CONTENTS

1. INTRODUCTION **1-1**

1.1 Background & Objective **1-1**

2. DATA REVIEW **2-1**

2.1 Introduction **2-1**

2.2 Technical Reports and Data **2-1**

2.2.1 Board of Health Files 2-1

2.2.2 Reports 2-1

2.2.3 GIS Data 2-2

3. REGULATORY ISSUES **3-1**

3.1 Introduction **3-1**

3.2 Federal and State Regulatory Issues **3-1**

3.2.1 Acts and Executive Orders 3-1

3.2.2 Regulations 3-4

3.3 Regional Regulatory Issues **3-10**

3.3.1 The DRI Review Process 3-10

3.3.2 Cape Cod Commission Regional Policy Plan 3-11

3.4 Town of Wellfleet Regulations and Bylaws **3-11**

3.4.1 Town of Wellfleet Local Comprehensive Plan 3-11

3.4.2 Wellfleet Board of Health Regulations: Local Amendments to Title V 3-12

4. EXISTING CONDITIONS IN WELLFLEET 4-1

4.1 Introduction 4-1

4.2 Study Areas 4-1

4.2.1 Marine Estuary Watersheds 4-1

4.2.2 Freshwater Recharge Areas 4-2

4.3 Natural Resources, Physical Characteristics 4-2

4.3.1 Coastal Resource Areas 4-2

4.3.2 Existing Wastewater Flows 4-3

4.3.3 Aquaculture 4-6

4.3.4 Existing Water Supply 4-6

4.3.5 Groundwater 4-7

4.3.6 Fresh Surface Water Resources 4-7

4.3.6.1 Ponds 4-7

4.3.6.2 Wetlands 4-7

4.3.6.3 Vernal Pools 4-8

4.3.7 Open Space, and Critical Wildlife and Plant Habitat 4-8

4.3.8 Geology/Soils 4-8

4.3.9 Floodplains and Velocity Zones 4-8

4.4 Harbor Water Quality Data 4-9

4.4.1 YSI Monitoring 4-9

4.4.2 Wellfleet Harbor Nitrogen Sampling 4-10

5. PRELIMINARY NEEDS ASSESSMENT 5-1

5.1 Scoring Matrix 5-1

6. IDENTIFICATION AND SCREENING OF ALTERNATIVE SOLUTIONS AND TECHNOLOGIES 6-1

6.1 Natural Remediation and Mitigation Solutions 6-1

6.1.1 Wellfleet Harbor Sustainable Oyster Propagation Project 6-2

6.1.2 Estuarine and Salt Marsh Restoration/Flushing 6-4

6.2 On-Site I/A Wastewater Treatment 6-5

6.3 Cluster I/A Systems 6-5

6.4 Centralized Wastewater Collection and Treatment 6-6

6.4.1 Effluent Disposal 6-6

6.5 Water System Expansion 6-6

6.5.1 Future Expansion of the Water System 6-7

6.6 Stormwater Management Measures 6-8

6.7 Marina Area, Mayo Beach and Baker Field Area 6-8

7. CONCLUSIONS 7-1

LIST OF TABLES

TABLE 4-1: WASTEWATER DESIGN FLOWS BY ESTUARY 4-3

TABLE 4-2: TITLE 5 VARIANCES (SYSTEM WITHIN 100' OF WELL) AND I/A SYSTEMS BY ESTUARY 4-4

TABLE 4-3: DISTRIBUTION OF I/A TECHNOLOGY 4-5

TABLE 5-1: WASTEWATER NEEDS PARAMETERS 5-1

TABLE 5-2: WASTEWATER NEEDS MATRIX 5-2

LIST OF FIGURES

FIGURE 4.1 WATERSHED AREAS

FIGURE 4.2 ON-SITE WASTEWATER SYSTEMS

FIGURE 4.3 SHELLFISHING AREAS

FIGURE 4.4 PUBLIC WATER SUPPLY

FIGURE 4.5 DRINKING WELL NITRATE LEVELS

FIGURE 4.6 SENSITIVE HABITAT AREAS

FIGURE 4.7 FLOOD ZONE AREAS

FIGURE 4.8 WATER QUALITY SAMPLING LOCATIONS

FIGURE 4.9 MEP SAMPLING LOCATIONS

FIGURE 5.1 WATERSHED AREAS RECOMMENDED FOR FURTHER STUDY

FIGURE 6.1 WELLFLEET HARBOR OYSTER SPAWNING STUDY AREA

FIGURE 6.2 STUDY AREA AFTER CULTCH PLACEMENT

FIGURE 6.3 OYSTER SPAT GROWING ON CULTCH IN STUDY AREA

FIGURE 6.4 HERRING RIVER AND MAYO CREEK ESTUARIES

FIGURE 6.5 POSSIBLE WATER SYSTEM EXPANSION AREAS

LIST OF APPENDICES

APPENDIX A Water Quality Data Review for Wellfleet Harbor, February 2012

APPENDIX B Harbor Sampling Water Quality Results

APPENDIX C Wellfleet Pond Management Plan

APPENDIX D Sustainable Oyster Propagation Project in Wellfleet Harbor - Draft Report

APPENDIX E Mayo Beach/Baker Field Bathhouse Facilities

1. INTRODUCTION

1.1 BACKGROUND & OBJECTIVE

The Town of Wellfleet is located on the outer arm of Cape Cod, has a classic seaside character, and is surrounded with abundant natural resources. Bounded on the east by the Atlantic Ocean and on the west by Cape Cod Bay, 61% of the land area of Wellfleet is within the Cape Cod National Seashore. Wellfleet has a total upland area of approximately 13,100 acres (20.47 square miles). Of this total, about 8,000 acres (12.5 square miles) are within the Seashore boundaries, leaving 5,100 acres (8 square miles) outside. During the summer, the population increases from approximately 3,200 year-round residents to an estimated 17,000 people.

At the present time, Title V septic systems serve as the sole means of wastewater management in Wellfleet, and there is only a limited municipal water supply system. Sampling and nitrate analysis of private drinking water supply wells obtained from the Board of Health indicate that the number of private wells with elevated nitrate levels has increased over the years. This data indicates that groundwater quality is declining, and on-site septic systems are believed to be the principal nitrate source.

The Massachusetts Department of Environmental Protection (MassDEP) is concerned about possible eutrophication in coastal estuaries, and has undertaken the Massachusetts Estuaries Project (MEP) in Southeastern Massachusetts. This project develops nitrogen limits for the coastal estuaries located within their study area, including Wellfleet Harbor. These nitrogen limits will then become the regulatory limits that will be enforced by the State. The proposed Total Maximum Daily Load (TMDL) Report for Wellfleet Harbor is expected in 2013.

The objectives for this Comprehensive Wastewater Management Plan (CWMP) include the following:

- Protect and enhance the harbor ecosystem and aquaculture base. The harbor is the life-blood of Wellfleet's shell fishing industry, and its protection and enhancement are paramount.
- Understand the nature of anthropogenic and natural sources of contamination/pollution from within the harbor and upstream (land side) including streams, storm water runoff, and groundwater impacted by septic systems.

- Collect sufficient information from the harbor and land/upstream sources to characterize the water quality and develop a reliable database of knowledge (using Geographic Information Systems (GIS)).

- Gain a meaningful understanding of the relationship between nitrogen concentrations and the overall health of shellfish populations.

- Based on solid science, promote aquaculture-based water quality management solutions as a practical and cost-effective approach, thus enhancing harbor water quality and the aquaculture industry.

- Evaluate the water quality in the Town's inland kettle ponds to determine their overall health and identify potential threats from anthropogenic and natural nutrient sources.

- Conduct the town-wide comprehensive wastewater management planning process in a measured and step-by-step fashion to present a clear understanding of wastewater management needs of the Town.

- Identify low cost and sustainable remedies (better storm water management, seasonal summer home education program) as warranted.

- Develop least-cost approaches to address identified sources, expedite water quality improvements, and establish a road map for future water quality enhancements initiatives.

- As a final resort only, engage in structured solutions (i.e. pipes, pumps, treatment systems).

2. DATA REVIEW

2.1 INTRODUCTION

This chapter provides an overview of information used in preparing the Needs Assessment and Alternative Analysis Report.

2.2 TECHNICAL REPORTS AND DATA

The following technical reports and data were reviewed for the needs assessment.

2.2.1 Board of Health Files

Over 3,000 files pertaining to on-site septic systems and private wells located at the Board of Health were reviewed. Specific data was extracted and used to build a town-wide GIS database that was used for various queries and data interpretation during the needs assessment. The data included physical information related to onsite septic systems and water quality of private wells where available. The information gathered for this database is discussed in later sections.

2.2.2 Reports

- "Water Quality Data Review for Wellfleet Harbor," February 17, 2012, Normandeau Associates (Appendix A).
- Final Report: "Sustainable Oyster Propagation Project in Wellfleet Harbor", Anamarija Frankic, January 2012 (Appendix D).
- "Wellfleet Harbor Management Plan", Natural Resources Advisory Board, Town of Wellfleet, January 2006.
- "Ponds Management Plan", Wellfleet, Massachusetts, February 2011
- "Local Comprehensive Plan Update", Wellfleet, Massachusetts, February 2008.

2.2.3 GIS Data

- Interim Wellhead Protection Areas (IWPAs) for public drinking water wells.
- Riparian area data.
- Parcel data.
- Orthophotography.
- Natural resources and rare species.
- FEMA flood maps.
- Cape Cod Commission Watershed/Recharge Area Delineations.

The data collected and entered in the GIS database was copied and transferred to the computer at the Board of Health and Conservation in January 2012.

3. REGULATORY ISSUES

3.1 INTRODUCTION

This chapter identifies and discusses the environmental regulations effecting wastewater facilities in the Town of Wellfleet at the time this report was prepared. Federal, state, regional, and Town of Wellfleet departments and governmental agencies have enacted environmental regulations, which relate to the collection and treatment of wastewater and the recharge of the treated effluent.

- The federal regulations are contained in the Code of Federal Regulations (CFR) and are enforced by the United States Environmental Protection Agency (USEPA).
- The Massachusetts regulations are contained in the Code of Massachusetts Regulations (CMR) and are enforced by MassDEP.
- The Cape Cod Commission has adopted a Regional Policy Plan, which provides guidance and goals for development and environmental protection on Cape Cod.
- The Town of Wellfleet has adopted Board of Health regulations and Town bylaws to protect the citizens of Wellfleet, and a Local Comprehensive Plan to provide growth management and environmental protection for the future.

These regulations, plans, bylaws, and guidance documents are intended to protect public health and the natural environment, and are briefly reviewed in this chapter.

Following is a brief summary of some of the regulations that are most applicable for this project. This is not intended to be a comprehensive list of all laws involved in the various regulations. For details on any of the requirements, refer to the actual law or regulation.

3.2 FEDERAL AND STATE REGULATORY ISSUES

3.2.1 Acts and Executive Orders

The USEPA and MassDEP have been working most recently in two areas applicable to this Project. The first of these efforts is regarding the establishment of Total Maximum Daily Loads (TMDLs) for non-point sources to coastal embayments, and the second is the National Pollutant Discharge Elimination System (NPDES) permitting program for stormwater. The following is a brief description of each of these regulatory requirements and other state and federal regulatory issues.

TMDLs. The Federal Clean Water Act (CWA) requires states to develop a list of impaired waters, which are waters that are unable to meet state-established water quality standards for their intended use (i.e., drinking water supply, fishing, recreational swimming and boating, or healthy ecosystems for plants and animals). States are then required to develop TMDLs for the impaired waters that are affected by pollutants. A TMDL is a determination of the maximum amount of pollutants that a body of water can withstand.

In 1998, the USEPA required all states to submit strategies for completing TMDLs within 8 to 13 years. Massachusetts submitted a strategy consisting of two stages. The first stage would make use of existing studies and information by working to implement corrective actions where feasible; develop a pilot program to define data collection needs and procedures to be used for TMDL development; and develop and standardize TMDL determination methods for pollutants that did not have well-established protocols. The second stage would focus on developing the TMDLs, beginning with those for pollutants with well-established determination methods.

Once TMDLs are determined, MassDEP develops a draft TMDL report, followed by a public review and comment period. After addressing public comments, MassDEP submits the TMDL report to USEPA for formal approval. The TMDL development process requires that communities develop plans to restore the health of water bodies and then make progress toward implementation of the plans. MassDEP monitors the progress of communities in achieving TMDLs. Restoration of water bodies is an extended process, so MassDEP looks for reasonable progress; if no reasonable progress is being made, enforcement actions may be taken.

The CWA requires states to monitor the quality of their water resources to determine if the water meets the standards for intended uses. This information is reported to the USEPA in the Integrated List of Waters. Category 5 of the Integrated List itemizes water bodies that are "impaired or threatened for one or more uses and requiring a TMDL." Therefore, this list becomes the basis for determining the water bodies for which TMDLs will be established. At the time of this report, the Herring River is the only water body within Wellfleet that is listed in the Integrated List as Category 5, Waters Requiring a TMDL.

Stormwater and Wastewater Discharges. Discharges to surface waters are regulated by the USEPA through the NPDES permit program, authorized by the Act. The NPDES program is intended to control water pollution by requiring discharge permits for any point source (i.e., stormwater systems, wastewater system(s)) that discharges pollutants to waters of the United States. In Massachusetts, application is made to both the USEPA and the MassDEP. USEPA issues the permit after the MassDEP certifies that the discharge meets water quality standards.

NEPA. The National Environmental Policy Act of 1970 (NEPA) provides the basis for protection of the environment, and is normally applied only to projects on federal lands. This Act ensures that environmental information is provided to the public for use in the decision making process for projects that might affect the environment. According to regulations, the "NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences; and take actions that protect, restore, and enhance the environment." This policy has been established to eliminate redundancy and combine NEPA requirements with other concerned agencies' requirements. The NEPA process is the forerunner of similar environmental review processes adopted by state and regional agencies; it allows for the assessment and identification of alternatives for projects concerning the environment, but is typically applied only to federal agency projects.

It is unlikely that the Town of Wellfleet will need to enter into the NEPA process. The Comprehensive Wastewater Management Plan (CWMP) project is regulated by the Massachusetts Environmental Policy Act (MEPA) and the Cape Cod Commission's Development of Regional Impact (DRI) review process, as described in subsequent sections of this report. The NEPA regulations could become an important factor for this project if wastewater facilities are proposed for federal lands, such as on or adjacent to the Cape Cod National Seashore.

Wastewater Treatment Plant Effluent Discharge at an Ocean Outfall. The Massachusetts Ocean Sanctuaries Act (Massachusetts General Law (M.G.L.) Section 13, c132A) regulations establish state environmental policy to be enforced in the five Massachusetts Ocean Sanctuary areas, consisting of the Cape Cod Ocean Sanctuary, the Cape Cod Bay Ocean Sanctuary, the Cape and Islands Ocean Sanctuary, the North Shore Ocean Sanctuary, and the South Essex Ocean Sanctuary. These areas are special resources and the goal of the Act is to protect them from any "exploitation, development, or activity that would seriously alter or otherwise endanger their ecology or appearance."

The Town of Wellfleet is located within the Ocean Management Planning Areas of the Cape Cod Bay Ocean Sanctuary (OS) and the Cape Cod OS. Municipal wastewater direct discharges into ocean sanctuaries are specifically precluded under these regulations, unless the discharge was approved and licensed prior to December 1971. A variance from these policies would require state approval and possible legislation stating that a special variance was needed to protect public health due to a limited number of feasible groundwater recharge alternatives.

The Massachusetts Oceans Act of 2008 is legislation that requires Massachusetts to develop a comprehensive plan to manage development in its state waters, balancing natural resource preservation with traditional and new uses, including renewable energy.

Governor King's Executive Order No. 181 on Barrier Beach Areas. This Executive Order defines barrier beach areas and sets several state policies to restrict and discourage development in these areas. One policy states that no state funds and federal grants for construction projects shall be used to encourage growth and development in hazard-prone barrier beach areas. This policy has been used by the state to restrict government-funded projects in hazard-prone areas, such as Velocity Zones.

It is likely that the state will discourage development in a Velocity Zone, and would withhold state funding for projects in these areas. This development would include the construction of a treatment facility or collection system in a Velocity Zone. This policy could affect any proposed planning area in the vicinity of a barrier beach.

3.2.2 Regulations

MEPA Environmental Review. CWMP projects on Cape Cod include an environmental review process that is governed by the Massachusetts Environmental Policy Act (MEPA) and Cape Cod Commission's DRI review process (see Section 3.3). In general, the MEPA process, as described in **301 CMR 11.00**, establishes thresholds, procedures, and timetables for a multi-level review process. If a project exceeds review thresholds or if state funding is requested for a project, the project proponent begins the review process by preparing and filing an Environmental Notification Form (ENF) with the Secretary of Environmental Affairs. A 30-day review period follows, during which the Secretary of Environmental Affairs receives agency and public comments and holds a site visit and consultation session. At the close of the ENF review period, the Secretary of Environmental Affairs determines whether a more detailed Environmental Impact Report (EIR) is necessary, and issues a MEPA certificate. If an EIR is required, it is prepared by the proponent and submitted to the Secretary of Environmental Affairs. The EIR is reviewed at both draft and final stages by agencies and the public. After completion of the Secretary's review, state agencies may act on the project. The Town will be expected to enter the MEPA process as part of a full CWMP.

Wetlands Protection. The Wetlands Protection Act (M.G.L. c.131, s.40) and parallel state regulations (**310 CMR 10.00**) were enacted to safeguard wetlands, associated resource areas, and floodplains from overdevelopment. The Wetlands Protection Act covers any wet area where the groundwater level is at or near the surface of the ground for a sufficient period during the year to support a community of wetland-type vegetation. Wet areas include any salt or fresh-water marsh, pond, meadow, swamp, or bog.

Areas subject to protection under the Wetlands Protection Act are referred to as resource areas. Resource areas are protected by a surrounding 100-foot buffer zone in which landscape alterations are regulated. The Wetlands Protection Act also covers construction on land subject to flooding or coastal storms. Generally, the regulations apply to two types of floodplain: those lands bordering directly on bodies of water, and those lands subject to flooding (called "Isolated Land Subject to Flooding") which do not border bodies of water.

The state regulates activities that involve filling, dredging, or excavating in or near a wetland or water body. The regulations govern additional construction activities, including site preparation, the removal of trees or bushes, vista pruning, and the changing of land contours.

A "Notice of Intent" must be filed for work in any resource area. The Notice of Intent requires a detailed description of the planned activity, and the applicant must show that if the resource area will be altered, the benefits will outweigh the damage. For work outside the resource areas but within a 100-foot buffer zone around a bordering vegetated wetland, bank, dune, or beach, the owner has the option of filing a "Request for Determination" to show that the work will not alter a resource area. If the Conservation Commission agrees, it will issue a "Negative Determination," permitting the work as presented. If the Conservation Commission decides that the work will alter a resource area, it will issue a "Positive Determination" and require a full hearing and the filing of a Notice of Intent.

Massachusetts Rivers Protection Act. This law is an amendment to the Wetlands Protection Act and establishes a Riverfront Area, which is included in the resource areas protected by the Wetlands Protection Act. The law authorizes conservation commissioners to regulate activities that occur within the Riverfront Area and establishes protection of the natural integrity of rivers as a state priority.

Permits for work in Riverfront Areas will be denied if a significant adverse impact would result or if there is a "practicable and substantially equivalent economic alternative" that will have less impact on the resource area. Certain activities are exempt from the Rivers Protection Act, including renovation of abandoned cranberry bogs and activities associated with wastewater treatment plants and their related structures, conveyance systems, and facilities.

On-Site Wastewater Management. Title V of the Massachusetts State Environmental Code provides minimum standards for the "protection of public health, safety, welfare and the environment by requiring the proper location, construction, upgrade, and maintenance of on-site sewage disposal systems and appropriate means for the transport and disposal of septage." The regulations contained in **310 CMR 15.00** come under the jurisdiction of the MassDEP and are enforced in conjunction with local health departments through permits, inspections, and financial penalties.

As defined by the regulations, an individual sewage disposal system is "a system or series of systems for the treatment and disposal of sanitary sewage below the ground surface." Systems typically consist of a septic tank, a distribution box, and a soil absorption system. These systems may also include tight tanks, shared systems, or alternative systems if allowed by local and state regulations. The design considerations for Title V systems include minimum setbacks, minimum separation from groundwater, sizing guidance, and soil requirements.

Title V regulations are generally enforced by local health departments. The local Board of Health, due to specific problems or concerns, can and may impose more stringent requirements. Individuals and/or communities can receive a variance from the regulations; however, it must be in accordance with 310 CMR 15.00.

Water Resources, Treatment and Supply of Potable Water. The Safe Drinking Water Act of 1974 is federal legislation that governs the regulation of public water supply in the United States. This legislation is incorporated into the regulations of 40 CFR 141, 142, and 143, which are enforced by the EPA.

Massachusetts is a primacy state for the regulation of potable water, which means that MassDEP is the primary agency for maintaining and enforcing the drinking water regulations. Massachusetts' regulations contained in **310 CMR 22.00** closely parallel the federal regulations and establish the maximum contaminant level (MCL) of the regulated contaminants in public drinking water supplies.

The Safe Drinking Water Act provides guidelines on the establishment of wellhead protection programs, which Massachusetts has established in 310 CMR 22.21. The program delineates three zones around each public water supply well. The Zone I delineation is the area immediately around the well or well field which must be owned by, or in the control of, the water purveyor. The Zone I for a well producing 100,000 gpd or greater must have a minimum radius of 400 feet. The Zone II is typically irregular in shape and is the area of an aquifer that contributes water to a well under the "most severe pumping and recharge conditions that can be realistically anticipated." The regulations define these conditions as 180 days of pumping at safe yield with no recharge from precipitation. Zone II areas are typically determined

by a hydrogeologic study involving particle-transport computer modeling. The Zone II is bounded by the groundwater divide and by the contact of the aquifer with less permeable material. The Zone III delineation is the area beyond the Zone II from which surface water and groundwater drain into the Zone II.

Interim Wellhead Protection Areas (IWPA's) are protective areas around public wells that are designated by MassDEP in the absence of an established Zone II area. They are usually applied to smaller, non-community wells that serve limited users such as restaurants or condominium associations, and typically have a radius of either 500 or 750 feet.

The allowed land use within each zone is regulated by the wellhead protection program. Land use activities within Zone I areas must be related to the water supply or have no significant adverse impact on water quality. The following land uses are prohibited from being sited in a Zone II area:

- Landfills or open dumps.
- Landfilling of sludge or septage.
- Automobile graveyards and junkyards.
- Stockpiling of contaminated snow or ice.
- Petroleum, fuel oil, and heating oil bulk stations and terminals.
- Treatment or disposal works for wastewater other than sanitary sewage.
- Facilities that generate, treat, store, or dispose of hazardous materials.
- Floor drainage systems in hazardous waste and hazardous material processing or storage facilities.

There are exceptions to the prohibition of wastewater treatment plants listed as the sixth bullet above. These exceptions are reviewed by MassDEP on a case-by-case basis.

Regulations for the Land Application of Sludge and Septage. The land application of sludge and septage, as well as the distribution of compost material made from WWTF sludge, are regulated by MassDEP in **310 CMR 32.00** and the federal standards contained in 40 CFR Part 503.

Under the MassDEP regulations, sludge, septage, and compost (collectively called "material") are classified as Type I, II, or III, depending upon chemical, pathogen, organic content, and sludge stabilization processes used. The sludge classification determines how the material is ultimately used or disposed of. Type I material can be used on any site and requires no further MassDEP regulations, while Type II and III materials require additional regulation on the ultimate use, the application site, and

allowable application rates. Compost must be classified as Type I to be sold or otherwise distributed to the public.

Clean Water State Revolving Fund (SRF) Program. This program gives the Commonwealth, acting through the Water Pollution Abatement Trust, the authority and responsibilities to select, approve and regulate water pollution abatement projects receiving financial assistance under the State Revolving Fund Program. In 2006, modifications to the regulations were proposed and then promulgated in 2007, integrating smart growth principles into the regulations. Eligible projects include comprehensive wastewater management planning or the design and construction costs associated with implementing planning recommendations for water pollution abatement.

Surface Water Discharge Permits. The Massachusetts Surface Water Discharge Permit Program described in **314 CMR 3.00** regulates all discharges of pollutants to surface waters located in Massachusetts. These include point sources for public and privately owned treatment works and stormwater discharges. Discharge of treated wastewater to surface waters in Wellfleet (except ponds with no surface outlets, which fall under the Wetlands Protection Act described below) would not be allowed due to the Massachusetts Oceans Act described previously.

Surface Water Quality Standards. In addition to the limitations imposed by the Massachusetts Oceans Act of 2008, the Massachusetts Surface Water Quality Standards define the activities that are prohibited in various class-designated surface water bodies. The water in Wellfleet Harbor is designated SA for "Shellfishing, Outstanding Resource Water" (**314 CMR 4.06**). This is the top salt-water ranking and means that the water is suitable for all types of water recreation. Any actions that would prevent swimming, fishing, or other recreational activities in these waters are strictly prohibited. An additional summary of water quality is provided in the Integrated List of Waters, also known as the 303(d) list.

Groundwater Discharge Permits. The March 2009 revisions to the Ground Water Discharge Permitting Program Regulations (the "Ground Water Regulations"), **314 CMR 5.00**, made a number of changes to streamline the existing permitting process and reduce the time it takes for an applicant to obtain a groundwater discharge permit. The revisions also incorporated another set of regulations into 314 CMR 5.00. These regulations were formerly published under 314 CMR 6.00, which has since been rescinded, and were aimed at protecting ground water quality and more specifically they defined the Ground Water Quality Standards. The Ground Water Regulations currently contain a list of specific effluent limits. These limits are water quality based in accordance with the maximum contaminant limits set forth in the Drinking Water Regulations as well as the Surface Water Quality Standards to ensure that

groundwater and surface water quality is not impaired. The regulation also defines additional Technology Based Effluent Limits and more stringent effluent limits for discharges within a Zone II or IWPA. These water supply protection effluent limits define limits for total suspended solids, turbidity, biological oxygen demand (BOD), total organic carbon (TOC), total nitrogen, and nitrate.

The regulations also provide that the MassDEP may issue an individual groundwater discharge permit that authorizes the reuse of effluent from permitted sewage treatment facilities in accordance with the Wastewater Reuse Regulations, **314 CMR 20.00,** that were published in March 2009. This regulation eliminates the need for the Wastewater Reuse Policy and allows the Department to issue one permit that authorizes a groundwater discharge of effluent resulting from the treatment of sewage at a facility and the reuse of this effluent as reclaimed water. The Wastewater Reuse Regulations are discussed further below.

Sewer System Extension and Connection Permit Program, 314 CMR 7.00 establishes the program whereby sewer system extensions and connections are regulated and permitted by the MassDEP, and was adopted to insure proper operation of wastewater treatment facilities and sewer systems within the Commonwealth.

Toxic/Incompatible Discharges to Wastewater Collection Systems. In the early 1980s, the USEPA established nationwide industrial pretreatment standards contained in 40 CFR 403, General Pretreatment Regulations for Existing and New Sources of Pollution, to regulate the discharge of industrial pollutants to Publicly Owned Treatment Works (POTWs). The general goals of this program are to limit those toxic/incompatible discharges, which could: (1) pass through a plant inadequately treated; (2) harm a plant's treatment processes, thereby preventing the plant from complying with its permit; or (3) reduce opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

When these regulations were established, all communities with POTW flows greater than 5 mgd were required to establish local industrial pretreatment programs. The programs are needed by larger plants that receive significant industrial and commercial wastewater flows.

Massachusetts's pretreatment regulations (**314 CMR 12.00**) parallel the federal regulations. Paragraph 12.09.2 of the Massachusetts regulation states that the Director of the MassDEP may require a POTW with a design flow of 5 mgd or less to establish a pretreatment program in order to meet the goals listed above.

Privately Owned Sewage Treatment Facilities and Publicly Owned Treatment Works. Privately owned sewage treatment facilities (PSTFs) are the private version of the publicly owned treatment works.

POTWs are defined in **314 CMR 12.02** as "any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial waste of a liquid nature which is owned by a public entity. A POTW includes any sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment." In Massachusetts, there are detailed requirements at the State level, which apply stringent requirements on the location and operation of PSTFs.

Current MassDEP regulations require the use of a PSTF or POTW for any residential or commercial discharge greater than 10,000 gpd. MassDEP reviews the performance of these facilities under its Groundwater Discharge Permit (GWDP) Program (314 CMR 5.00).

Reclaimed Water Use. The Reclaimed Water Permit Program and Standards Regulations (the "Reclaimed Water Regulations"), **314 CMR 20.00**, are a set of regulations governing the beneficial re-use of reclaimed water in Massachusetts. Reclaimed water is defined as domestic wastewater that is treated to a level such that it is suitable for beneficial reuse. Beneficial reuse is permitted through the elimination or reduction in the concentrations of microbial and chemical constituents of concern through the treatment and/or limitation of public or worker exposure to the water via design or operational controls thereby making reclaimed water suitable and safe. The applicant shall submit a Reuse Management Plan that provides a description of the proposed reclaimed water volume, the proposed class of the reclaimed water, a description of the reclaimed water distribution system, and the location of each reuse site. The regulation includes various public notification requirements for identification of the reuse sites as well as the reuse system infrastructure.

The regulations establish a system of classification, standards, and effluent limits specific to the proposed use. The highest standards apply to those proposed uses with greatest potential for exposure to the public. These regulations do not include standards for indirect aquifer discharge. Those standards are included in the Groundwater Discharge Permitting Program Regulations in 314 CMR 5.00.

3.3 REGIONAL REGULATORY ISSUES

3.3.1 The DRI Review Process

In accordance with the Cape Cod Commission Act, Chapter 716, the Cape Cod Commission has the authority to review and regulate Developments of Regional Impact (DRIs). This review is carried out by the Commissioners and the Cape Cod Commission staff in accordance with Administrative and Enabling regulations.

The Town will be expected to enter the MEPA and DRI process as part of a full CWMP. The review process will be a joint review.

3.3.2 Cape Cod Commission Regional Policy Plan

The Cape Cod Commission Act calls for an update to the Regional Policy Plan every five years (previous editions were released in 1991, 1996, and 2002). The current Regional Policy Plan went into effect October 30, 2008.

The minimum performance standards and other development review policies of the Regional Policy Plan are intended to be used by both the Cape Cod Commission and local regulatory authorities once they have adopted a Local Comprehensive Plan and it has been certified by the Cape Cod Commission. The goal of the water resources minimum performance standards is to preserve the high quality of the groundwater (the source of Cape Cod's drinking water) as well as the marine and fresh surface waters, which are connected to and dependent on the groundwater for ecological health and sustenance. The water resources classification system includes the following: drinking water, coastal embayments, ponds, sewage treatment facility standards, stormwater management standards, and natural resources standards. The reader is directed to the most current Regional Policy Plan for further information specifically relating to the minimum performance standards developed for each goal. Overall, the water resources minimum performance standards state a maximum nitrogen load of 5 parts per million unless there will be no adverse impacts on resources.

3.4 TOWN OF WELLFLEET REGULATIONS AND BYLAWS

The Town of Wellfleet has adopted the following regulations and bylaws that pertain to treatment of sanitary wastewater and effluent recharge.

3.4.1 Town of Wellfleet Local Comprehensive Plan

The Town of Wellfleet's most current version of the Local Comprehensive Plan (LCP) is the February 2008 update. The community vision is as follows, "We value protection of our natural environment and precious natural resources. We wish to preserve and improve access to open spaces. We want to preserve our Central Village and historic homes. We favor review of future development both as to pollution and aesthetic impact. We wish to maintain the population mix among ages, backgrounds and social backgrounds."

Wellfleet's overall goals and related needs include the following with respect to water quality and the protection of natural resources. Some of the goals of the LCP are summarized as follows:

- Protect and preserve water resources, both in terms of potability and treatment of wastewater.
- Maintain the quality and quantity of Wellfleet's ground water in order to ensure a sustainable supply of high quality untreated drinking water and to preserve and improve the ecological integrity of the Town's marine and fresh surface waters.

3.4.2 Wellfleet Board of Health Regulations: Local Amendments to Title V

In accordance with Massachusetts General Laws, Chapter III, Section 31, the Wellfleet Board of Health has adopted the following regulation to supplement the provisions of 310 CMR 15.00: State Environmental Code - Title V: Minimum Requirements for the Subsurface Disposal of Sanitary Sewage. The Board of Health regulations identify several provisions that are stricter than the revised Title V (March 31, 1995).

Sewage Disposal Works Construction Permits will be issued when the proposed system fully meets the physical (i.e. hardware and spatial) requirements of the State Sanitary Code (Title V), and the following specific requirements of the Wellfleet Board of Health:

- The leaching field must be at least 100 feet, and the septic tank at least 50 feet, from any water-course.
- The septic tank and the leaching facility must be at least 1 foot below the existing natural grade when in the 100 year floodplain.
- A minimum 1,500 gallon septic tank is required for single family dwelling units.
- The use of a nitrogen reducing system is required when there is a variance to the required 100 feet separation between a drinking water supply well and a soil absorption system, or when a soil absorption system is located less than 100 feet from a salt marsh or any marine surface water.

4. EXISTING CONDITIONS IN WELLFLEET

4.1 INTRODUCTION

This chapter provides a description of the Town of Wellfleet, and a summary of its natural resources, physical characteristics, and wastewater flows.

4.2 STUDY AREAS

There are sixteen watershed areas in Wellfleet, as illustrated in Figure 4.1. The watershed area boundaries are defined as groundwater recharge areas and surface-water watersheds. Fifteen areas are considered marine estuaries and one area is a freshwater recharge area. These watersheds were delineated by the Cape Cod Commission in their "Cape Cod Water Resources Classification Map II," which is part of the Commission's Regional Policy Plan. The watersheds were developed using a combination of surface topography and groundwater data.

4.2.1 Marine Estuary Watersheds

A recharge area contributes water to a coastal water body either through direct ground-water discharge or through discharge to a stream that flows into the coastal water body. In groundwater dominated systems such as Cape Cod, surface drainages, as defined by topography, cannot be used to delineate areas at the land surface that contributes water to a surface-water body. Instead the groundwater recharge area is the watershed to the surface-water body.

Wellfleet's Marine Estuary Watersheds include:

- Blackfish Creek
- Bound Brook
- Chipmans Cove
- Drummer Cove
- Duck Creek
- Duck Harbor
- Herring River
- Lieutenant Island
- Loagy Bay
- The Run
- Trout Brook
- Wellfleet Atlantic Ocean

- Wellfleet Cape Cod Bay
- Wellfleet Harbor A (north)
- Wellfleet Harbor B (east)
- Wellfleet Harbor C (west)

4.2.2 Freshwater Recharge Areas

Water from precipitation recharges the aquifer and then flows through the aquifer to a receiving surface-water body – a pond, stream, or to a pumped well. The area of the water table through which water recharges and ultimately discharges to the surface-water body is the recharge area to that surface-water body. There is one area in Wellfleet considered as a Freshwater Recharge Area. This area is mostly located in the National Seashore property in the northeast part of the Town as delineated on Figure 4.1.

4.3 NATURAL RESOURCES, PHYSICAL CHARACTERISTICS

The community profile characterizes the natural environment and demographic conditions of the Town. This helps to facilitate the identification of "problem areas" or "areas of concern", and provide the information necessary to establish treatment and disposal needs for these areas. Once treatment needs are established, appropriate alternatives can be developed and evaluated to find the most cost/effective, environmentally sensitive solution(s).

4.3.1 Coastal Resource Areas

Wellfleet Harbor is a semi-enclosed harbor and estuary system that encompasses nearly 6,100 acres at mean high tide. GIS maps indicate that approximately 2,500 acres have been utilized historically for wild shellfish harvesting. Approximately 200 acres have been leased for aquaculture. The local oyster population has been reported to be in decline, with recent estimates of approximately one million oysters harvested per year. Current populations are estimated to be less than ten percent of the populations cited from the 1800's.

As part of this study an evaluation of the existing water quality in Wellfleet Harbor was completed. This study focused on water quality parameters that might suggest impairment, including dissolved oxygen and chlorophyll *a*, as well as nutrients themselves, if available. A detailed study of water quality in the harbor is discussed in Section 4.4.

4.3.2 Existing Wastewater Flows

The Town of Wellfleet relies exclusively on the use of Title V septic systems for wastewater treatment and disposal. The locations of the Title V systems are shown in Figure 4.2. Under ideal circumstances, on-site systems can be very effective. Those circumstances include favorable soils, adequate depth to groundwater, protected water supplies, and absence of sensitive downgradient receiving waters. Individual on-site septic systems located on the same lots as private drinking wells are believed to be the primary nitrate source detected in historic well sampling results. This also raises a concern that other septic contaminants not being tested for may be contaminating groundwater sources. Potential contaminants include phosphorus, volatile organic compounds, personal care products, and pharmaceutical compounds. There is also concern that these nutrients and contaminants may be reaching the coastal estuaries in Wellfleet, where they could contribute to water quality degradation.

There are over 3,000 on-site septic systems in Wellfleet, with a total Title V design flow of approximately 1.4 million gallons per day (mgd). Actual average flows are likely to be approximately one-half of the Title V design flows, which represent peak flow conditions. However, considering the extreme population influx during summer months, seasonal flow variations are extreme. These flows are distributed across the Town's marine watersheds as presented in Table 4-1. The Wellfleet Harbor A and B watersheds, and Duck Creek, are the most densely developed of all the watersheds in Town, as represented in flow per acre.

TABLE 4-1: WASTEWATER DESIGN FLOWS BY ESTUARY

Marine Estuary	Title V Design flow, gpd	Flow/acre
Wellfleet Harbor A	50,939	432
Duck Creek*	211,446	374
Wellfleet Harbor B	25,960	330
Drummer Cove	63,263	269
Lieutenant Island	35,860	252
Chipmans Cove	148,422	248
Loagy Bay	41,030	169
Blackfish Creek	224,262	164

Trout Brook	134,821	125
Herring River	358,405	114
The Run	6,270	37
Wellfleet Atlantic Ocean	59,019	18
Wellfleet Cape Cod Bay	2,860	8
Duck Harbor	2,860	5
Bound Brook	1,210	4
Wellfleet Harbor C	0	0
Total	**1,366,627**	

*Subtracted 305 acres of CCNS from watershed

Approximately 500 of Wellfleet's on-site septic systems (16%) required variances from Title V, and 312 of these systems are documented to be within 100-feet of a drinking water supply. The spatial distribution of this variance category is depicted in Table 4-2. Over one-third of these systems are within the Duck Creek watershed. Other variances not reflected in Table 4-2 may have been due to setbacks to wetlands, setback to property lines, setback to structures, no reserve area, depth to groundwater, and depth of cover over system. Innovative Alternative (I/A) systems are required by the town regulations for septic systems located in sensitive areas. The 106 I/A technology systems in place at this time are summarized in Table 4-3.

TABLE 4-2: TITLE 5 VARIANCES (SYSTEM WITHIN 100' OF WELL) AND I/A SYSTEMS BY ESTUARY

Marine Estuary	Systems within 100' of drinking water well	Percentage	I/A Systems
Duck Creek	115	37%	31
Herring River	42	13%	13
Wellfleet Atlantic Ocean	29	9%	5
Chipmans Cove	27	9%	14
Wellfleet Harbor A	23	7%	5

Blackfish Creek	22	7%	11
Wellfleet Harbor B	19	6%	5
Lieutenant Island	12	4%	4
Trout Brook	8	3%	9
Loagy Bay	6	2%	3
Drummer Cove	4	1%	6
The Run	4	1%	0
Bound Brook	1	0%	0
Wellfleet Cape Cod Bay	0	0%	0
Duck Harbor	0	0%	0
Wellfleet Harbor C	0	0%	0
Total	**312**	**100%**	**106**

TABLE 4-3: DISTRIBUTION OF I/A TECHNOLOGY

Type of I/A Technology	Number
Bioclere	15
Septitech	11
FAST	41
Clivus	4
Advantex	12
Amphidrome	4
Orenco Trickling Filter	4
Aerobic (Singulair Bio-Kinetic)	3
Waterloo Biofilter	3
Aerobic (Singulair)	3
RSF	6
Total	**106**

4.3.3 Aquaculture

Shellfishing is an essential element of Wellfleet Harbor. Wellfleet's shellfish products, principally oysters and clams, are world renown. Shellfish are harvested for market either by hand-picking or hand-raking. In addition to the manual harvesting of shellfish, draggers are also used in deeper water. Wellfleet Harbor tidal and intertidal lands are divided into areas open to shellfishing with commercial and non-commercial shellfish permits as illustrated on Figure 4.3.

Shellfish aquaculture, conducted on grants made by the Town, represents a significant contribution to the local economy. Individuals are granted licenses for the exclusive right to grow shellfish on the public tidelands. These areas are seeded with juvenile oysters and quahogs. In two to three years these have grown to market size and are harvested. The Board of Selectmen may lease shellfish aquaculture sites in any of the tidal or intertidal lands in the Harbor currently designated for such license and identified as shellfish grants in Figure 4.3.

Cultivating or farming oysters and other shellfish is an environmentally sustainable operation. Shellfish aquaculture does not involve any feeding, fertilizing or additives, so there are no chemical additions to the bay. The oysters under cultivation simply consume phytoplankton in the water column. As they feed, oysters actually clean the water, with each adult filtering as much as 50 gallons of water per day, converting much of the nitrogen they remove from the water into protein, and discharging the balance to the substrate in pseudofeces, where much of it is captured in the benthic nitrogen cycle and converted to inert nitrogen gas.

4.3.4 Existing Water Supply

Figure 4.4 depicts the extent of the Town's public water system. At the time of this report there were 179 customers connected to the Town's system. There are approximately 2,200 private wells and 85 public well supplies on record. The Zone I's and IWPA's are also shown on Figure 4.4.

When private wells are installed for potable purposes, the Board of Health requires that an analysis of water quality be submitted prior to occupancy. There is no requirement for homeowner's to continue to document water quality after initial occupancy, so the water quality data is sporadic. However, it does show an increasing percentage of samples with nitrates above 1.0 mg/l. In the 1980s 21% of samples tested were above 1.0 mg/l. In the 1990s 31% of samples tested were above 1.0 mg/l. In samples tested after 2000, 39% tested above 1.0 mg/l for nitrates. This increasing trend over thirty years is consistent

with an extensive Cape Cod Commission database of nitrates in drinking water wells over time. Wellfleet nitrate sampling results on record are depicted on Figure 4.5.

4.3.5 Groundwater

The groundwater in Wellfleet provides drinking water supplies and recharges the ponds, wetlands, and coastal estuaries. The groundwater resources on Cape Cod are classified as a sole-source aquifer by USEPA.

4.3.6 Fresh Surface Water Resources

4.3.6.1 Ponds

There are approximately twenty (20) freshwater ponds in Wellfleet. These waters are used by residents and visitors for swimming, canoeing, walking, skating, and fishing. Currently most of the water filling the ponds comes from groundwater, and none of the ponds are stream-fed. The 2011 Ponds Management Plan report focuses on the seven great ponds: Gull, Great, Long, Duck, Dyer, Higgins, and Herring. Great ponds are defined as those with surface areas greater than 10 acres. All of Wellfleet's great ponds lie within the boundaries of the Cape Cod National Seashore. Various sections of the shorelines are owned by CCNS, Town of Wellfleet, or private-owners.

The pond recharge areas are shown on Figure 4.1. In general, the recharge areas are narrow and only a limited number of land-based sources could be contributing contaminants to the ponds. The concerns identified in the report are shoreline erosion, mainly due to the steep shorelines and access ways at some of the ponds.

Only two ponds were identified as showing signs of with water quality problems and eutrophication. They are Crowell Pond and Squires Pond. The causes of the eutrophication are thought to be natural.

Five of the great ponds are actively used for swimming. Water quality at these ponds has been regularly tested for coliform bacteria by the Town and there is no record of these beaches being closed due to contamination.

4.3.6.2 Wetlands

Wetlands in Wellfleet include both freshwater wetland and salt marsh vegetation. These resource areas are shown on Figure 4.6.

4.3.6.3 Vernal Pools

Vernal pools are temporary bodies of freshwater that provide critical habitat for a number of wildlife species. Approximately 12 vernal pools have been identified by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) in the Town of Wellfleet. It is possible that additional vernal pools have been mapped by the Seashore staff, but are not in the state database. The NHESP vernal pools located within the Town are shown on Figure 4.6. The locations are dispersed throughout Town and are not concentrated in any one recharge area.

4.3.7 Open Space, and Critical Wildlife and Plant Habitat

As shown on Figure 4.6, most of the Town is located within an Area of Critical Environmental Concern (ACEC) or area of estimated endangered species.

4.3.8 Geology/Soils

According to the Geologic Map of Barnstable County, the Town of Wellfleet is primarily comprised of "outwash plain and ice contact deposits", in addition to areas identified as "marsh deposits".

According to the Barnstable County Soil Survey, the predominant soil type within the Town of Wellfleet is carver coarse sand. This soil readily absorbs, but may not adequately filter, the effluent in septic tank absorption fields. The poor filtering capacity may result in the deterioration of ground water. The hazard of pollution increases with the density of housing. Precautionary measures may be necessary in some areas.

4.3.9 Floodplains and Velocity Zones

Floodplains serve to buffer land areas from excessive storm events because they act to dissipate the wind and wave action generated during these storms. V-Zones (velocity zones) are designated by FEMA, and are defined as areas susceptible to 100-year coastal flooding with high velocity wave action.

Also designated by FEMA, A-Zones are areas where flooding is predicted to occur once every 100 years. This flooding occurs with minimal associated wave action, and these areas are typically located landward of V-Zones, in salt marshes and low elevation areas of Wellfleet. The surface elevations in these areas typically lie less than 10 feet above mean sea level. The flood zones are illustrated in Figure 4.7.

4.4 HARBOR WATER QUALITY DATA

4.4.1 YSI Monitoring

In September 2011, a YSI data sonde was installed on the pier in Wellfleet Harbor to collect baseline water quality data at the mouth of Duck Creek, as shown on Figure 4.8. Water quality data that were logged included water temperature, specific conductance, dissolved oxygen, total dissolved solids (TDS), turbidity, oxidation reduction potential (ORP), chlorophyll *a*, and blue green algae. Data was collected from September 1 through December 9, 2011. The findings were then compared with data from other sources, including:

- The Massachusetts Estuary Project (MEP) data from twelve stations within Wellfleet Harbor as shown in Figure 4.9;
- The Cape Cod Cooperative Extension (CCCE) data at the Egg Island Station and at the L-Pier located within the harbor
- Data collected from the Provincetown Center for Coastal Studies in Wellfleet Harbor and other inshore/near shore stations in Cape Cod Bay from 2006 – 2010 was also reviewed.

A summary report on this overall database was prepared by Normandeau Associates as part of this project, and a copy of this report is included in Appendix A.

According to the Massachusetts Department of Environmental Protection, Wellfleet Harbor is considered a Class SA coastal marine habitat. The criteria for Class SA waters are as follows:

- Dissolved Oxygen > 6.0 mg/L
- Water temperature <29.4 ◦C
- pH between 6.5 and 8.5
- blue-green algae <70,000 cells per ml
- chlorophyll *a* < 10 ug/l

As described in the Normandeau report, the September water quality data recorded in Wellfleet Harbor near the mouth of Duck Creek indicate that eutrophication is occurring at that location. Relatively low dissolved oxygen, coupled with some high chlorophyll *a* readings, suggests that nutrient enrichment is degrading water quality. The MEP data indicated that dissolved oxygen decreased as sampling stations

progressed northward and inshore. The total nitrogen data and chlorophyll *a* showed a spatial trend consistent with the dissolved oxygen data in that lower levels were measured at the more offshore stations and higher levels were measured at the inshore stations. These data suggest a decline in inner harbor water quality environment over the past five years.

4.4.2 Wellfleet Harbor Nitrogen Sampling

The water sampling program evolved as the pilot oyster propagation project, described in Section 6, was initiated in the summer of 2011. Initially nitrogen samples were collected from three locations north of the marina (see Figure 4.8), as follows:

- at the outfall where Mayo Creek discharges to the harbor (designated OF),
- at the edge of the oyster propagation ground (designated 1C) and
- adjacent to the YSI water quality meter (designated YSI).

Samples from these three locations were collected and analyzed for nitrates, nitrate/nitrite, total Kjeldahl nitrogen (TKN), and total nitrogen (TKN + nitrate/nitrite) on July 17, August 7, and August 24, 2011. These three sampling events occurred near low tide during the warmest time of the year, and during peak tourist season in Wellfleet.

On September 19, 2011, two monitoring wells were installed on the shoreline to the north-northwest of the oyster propagation ground (see location on Figure 4.8) in order to monitor groundwater quality in the immediate vicinity of the study area, as it discharges to Wellfleet Harbor. Subsurface geology at the monitoring well location consisted of fine to coarse sand from 0 to 12 feet below ground surface (bgs) underlain by gray clay with little sand and trace silt from 12 to 35 feet bgs, and then underlain by more fine to coarse sand from 35 to 40 feet bgs. The total depth of the boring was 40 feet. The water table was encountered at a depth of 7 feet bgs.

The site stratigraphy indicated that groundwater from two discrete zones (shallow and deep) may be discharging into Wellfleet Harbor. Therefore, two observation wells were installed. One well was installed across the water table and was screened from 4 to 14 feet bgs (designated MW-1S), and a deep well was installed with a well screen from 35 to 40 feet bgs (designated MW-1D). The wells were developed by surging and over-pumping. Prior to collecting water samples from the monitoring wells, a minimum of three well volumes were purged in order to ensure that the samples are representative of the formation water.

Subsequent sampling rounds were conducted on October 2-3, 2011 and November 5, 2011. The results and laboratory analytical reports are included in Appendix B.

The highest nitrogen levels in surface water, including nitrate, nitrite, and TKN were consistently detected at the Mayo Creek outfall location, with the highest concentrations at 0.38 mg/l nitrate, 1.7 mg/l total nitrogen and 1.5 mg/l TKN. The lowest concentrations of nitrogen in surface water were at the 1C and YSI locations, which are located furthest from the Mayo Creek outfall, with more open water circulation. The concentrations of nitrate at 1C and YSI ranged from below method detection limits (BDL) to 0.11 mg/l. Total nitrogen ranged from BDL to 0.61 mg/l, and TKN ranged from BDL to 0.61 mg/l. The concentrations of total nitrogen at locations 1A and 1B, located between the outfall and 1C ranged from 1.0 to 1.3 mg/l, which is lower than the levels at the outfall, but higher than the levels at 1C and the YSI location.

At the monitoring wells, the concentrations of nitrate and total nitrogen were generally higher in the shallow well (MW-1S), than in the deeper well (MW-1D). Total nitrogen levels ranged from 0.69 to 1.7 mg/l in the shallow well and 0.31 to 0.61 in the deep well.

In summary, the groundwater and the discharge from Mayo Creek appear to be sources of nitrogen to Wellfleet Harbor. These data provide a baseline for assessing the overall water quality benefits from development of the oyster propagation project.

5. PRELIMINARY NEEDS ASSESSMENT

In the absence of the MEP Report for Wellfleet Harbor, which is expected to be released in mid-2013, we have prepared a preliminary needs assessment that is based on available information sources. To identify areas in Wellfleet that may need an alternative solution to on-site septic systems, Environmental Partners developed a scoring matrix for each study area using specific parameters discussed in Chapter 4. These parameters include: density of wastewater loads, well-water nitrate levels, septic system location relative to drinking water supply, water table depth, and the number of I/A systems within a study area. Individually and collectively, these parameters may reveal ongoing and detrimental impacts on public health and environmental quality.

5.1 SCORING MATRIX

Five parameters were assessed to compare the wastewater conditions in each watershed. The following table defines the scoring used for each parameter.

TABLE 5-1: WASTEWATER NEEDS PARAMETERS

Score	Wastewater Loads	Well Samples Tested >2 mg/L for Nitrates	Septic Systems within 100' of drinking water supply well	Septic System located where Water Table <10' deep	I/A System
1	>200 gpd/acre	>25%	>10%	>20%	>4%
0	100-200 gpd/acre	<25%	<10%	<20%	<4%

Wastewater loads are based on the Title V design flows, and the other parameters are based on the data collected from the Board of Health records. This broader approach provides a multi-parameter method to assess the relative health of each watershed in town, and generate comparative metrics. This approach offers a broader perspective than simply relying on surface water nitrogen concentrations in impacted water bodies.

The results are presented in the following table.

TABLE 5-2: WASTEWATER NEEDS MATRIX

	Wastewater Loads (> 200 gpd/acre)	Nitrates (>2 mg/l)	Septic System w/in 100 ft. of Well	Septic System located where Water Table Water Table is < than 10 ft.	% of Systems that are I/A Systems	Total Score
Duck Creek	1	1	1	0	1	4
Wellfleet Harbor B	1	1	0	1	1	4
Chipmans Cove	1	1	0	0	1	3
Wellfleet Harbor A	1	1	0	0	1	3
Drummer Cove	1	1	0	0	0	2
Lieutenant Island	1	0	0	0	1	2
Blackfish Creek	0	1	0	0	0	1
Duck Harbor	0	0	0	1	0	1
Herring River	0	0	1	0	0	1
Loagy Bay	1	0	0	0	0	1
The Run	0	1	0	0	0	1
Wellfleet Atlantic Ocean	0	0	0	0	1	1
Bound Brook	0	0	0	0	0	0
Trout Brook	0	0	0	0	0	0
Wellfleet Cape Cod Bay	0	0	0	0	0	0
Wellfleet Harbor C	0	0	0	0	0	0

This analysis reveals that four areas in Town warrant further study and may require an alternative to on-site septic systems for wastewater treatment. These watersheds are: Duck Creek, Wellfleet Harbor B, Chipmans Cove, and Wellfleet Harbor A, as shown in Figure 5.1.

Chapter 6 discusses alternative solutions that should be further examined.

6. IDENTIFICATION AND SCREENING OF ALTERNATIVE SOLUTIONS AND TECHNOLOGIES

The solutions available to address wastewater needs range from upgrades for individual on-site systems to centralized collection and treatment systems. Traditional Cape Cod wastewater programs historically focused on centralized treatment with groundwater discharge of treated effluent. Collection systems can use gravity, pressure, or vacuum piping systems to collect and transport wastewater to the treatment plant.

Satellite wastewater management systems should also be considered to serve subareas of a community as a means to reduce collection system costs, return treated wastewater closer to its origin, and reduce or eliminate the cost of a large central facility. The treatment technology at either a central treatment facility or smaller satellite facilities must provide sufficient treatment to produce effluent that meets the standards for groundwater discharge in that location.

The Wellfleet Comprehensive Wastewater Planning Committee has maintained a determination to thoroughly explore the feasibility of enhanced natural systems such as oyster reef propagation and salt marsh restoration and enhancement before structured solutions are considered. This approach is reasonable in areas where the water quality has been marginally impacted, and where excess nutrients are the principal water quality concern. In this context, the issue is one of an over-abundance of food and a shortage of consumers. If a more natural balance between food quantities and consumer organisms can be restored and maintained, the water quality concerns can be minimized or eliminated.

6.1 NATURAL REMEDIATION AND MITIGATION SOLUTIONS

The Comprehensive Wastewater Planning Committee and EPG have placed a high priority on pursuing natural remediation and mitigation solutions for wastewater management challenges that may exist. In fact, other Cape Cod communities are now considering study elements that include components such as increasing tidal flushing, use of salt marsh for nitrogen capture, and creating or expanding shellfish beds to capture nitrogen and improve estuarine water quality.

The concept of large scale oyster reef restoration for improving estuarine water quality is not a new one. In fact substantial projects have been underway in Chesapeake Bay for years, with substantial support from the U.S. Army Corps of Engineers and the USEPA. Approximately 2.600 acres of reef have been re-established in Chesapeake Bay under these programs in the past five years, where many experts agree that the over-harvesting of oysters for decades is the single largest factor in water quality decline.

Additional research and pilot projects are underway in New York Harbor and Great Bay, New Hampshire.

The current wastewater regulatory environment in Massachusetts has been focused for decades on traditional hard-piped sewer collection and centralized treatment systems. These traditional systems will collect and treat wastewater, and remove approximately 50% of the nitrogen content. However, these systems are very expensive and have not been embraced by the residents of many Cape Cod communities due to the projected construction costs, which have been unaffordable to most Cape Cod communities.

With this backdrop, Wellfleet has chosen to adopt a careful and measured approach that explores natural systems solutions. The first step in this approach was the Town's commitment to a unique oyster reef restoration/demonstration project located at the mouth of Duck Creek in the inner reaches of Wellfleet Harbor.

6.1.1 Wellfleet Harbor Sustainable Oyster Propagation Project

Under ideal conditions, oyster reef restoration relies on spawning brood stocks of native oysters to obtain millions of pelagic larvae, and an appropriate substrate upon which the larvae will settle, adhere to, and grow. In this region sea-clam shells, or cultch, has been found to provide the most ideal natural material for initiating a reef restoration project. Healthy oyster reefs provide the following ecological services:

- buffer erosion and sedimentation forces created by waves, currents and boat wakes;
- serve as habitat and substrate for dozens of forms of marine life;
- serve as a source of food for birds, marine organisms and humans;
- filter suspended solids, phytoplankton, and nutrients, which improves water quality and enhances conditions for other organisms such as eel grass.

The removal of nitrogen, principally in the form of phytoplankton by the filter feeding oysters, would be particularly valuable in supporting the Town's need to meet state-wide nutrient loading goals. It has been well documented that an adult oyster can filter between 25 and 50 gallons of seawater per day. The nitrogen absorbed into the flesh and shell of adult oysters has been measured in a number of studies, and is widely accepted to be approximately 0.5 grams per oyster per year.

The goals of this project were as follows:

- to establish a reef and sustainable oyster population over a roughly 2-acre area;
- realize a new oyster population of up to 2 million within the project area, with water filtration rates as high as 100 million gallons per day;
- reduce nitrogen content in the local waters by as much as 2,200 pounds per year;
- provide a model for expansion of the reef complex to other areas of the harbor; and
- demonstrate that reconstructed and sustainable oyster reefs can play a meaningful, and potentially significant role in meeting the Town's future nutrient loading goals.

In selecting the project site, careful consideration was given to identifying a location that was not currently productive for shellfishing, was accessible and observable, was protected from potential storm damage, and could contribute to improving local water quality over time. A two-acre mud flat at the mouth of Duck Creek, shown on Figure 6.1, met all three criteria. Project planning and execution were carried out in cooperation with Dr. Anamarija Frankic from the University of Massachusetts in Boston, and its affiliated Green Boston Harbor project, as well as the Wellfleet Shellfish Department, the Department of Public Works, and the Harbormaster.

In June of 2011, the Wellfleet Shellfish Warden placed approximately 10,000 pounds of cultch across the study area by barge, as shown in Figure 6.2. Transects were established at the outset, and the study area was monitored regularly by the Green Boston Harbor staff. Within four months, it was evident that multiple sets had occurred from native spawning cycles, and approximately 2-3 million oyster spat were growing on the cultch within the study area, as shown in Figure 6.3. A draft report on the initial year of work is included in Appendix D.

In support of the project's goals, a multi-parameter water quality monitoring plan was initiated in the harbor water surrounding the study site. In September 2011, a YSI Model 6600V2-4 unit was installed at the end of the marina pier as shown in Figure 6.1. The YSI unit was equipped with probes for the following parameters:

- temperature
- chlorophyll a
- blue-green algae

- dissolved oxygen
- pH
- conductivity
- redox
- salinity
- total dissolved solids
- turbidity

In addition to the YSI probe, surface water and monitoring well samples were collected for nitrogen analysis as transect monitoring was carried out. Based on the YSI and nitrogen data, we hope to gain insight on daily and seasonal water quality changes in the study area as the project continues.

The efficacy of the use of oysters for removal of nitrogen is encouraging. It will require two to three years of monitoring and data collection and analyses to develop a sufficient baseline of data upon which solid scientific conclusions can be drawn. Coupled with upstream and land-side strategies, oyster propagation and reef restoration can be viewed as another critical element in a CWMP. Compared to structured solutions, natural systems approaches can be a far more cost-effective solution for watersheds with marginal water quality degradation, such as Wellfleet. As this pilot study has already shown, with healthy native populations of oyster, the startup costs are minimal, and the system requires very little, if any, maintenance. Lifecycle cost savings and socio-economic benefits associated with such natural systems are potentially enormous compared to traditional wastewater management systems. For this reason alone, the pilot project needs to continue and expand in scope.

6.1.2 Estuarine and Salt Marsh Restoration/Flushing

The critical role of salt marshes in maintaining and improving water quality in coastal embayments has been studied for decades. A 2007 study for MassDEP entitled: ***"Natural Attenuation of Nitrogen in Wetlands and Waterbodies"*** by the Woods Hole Group Inc. and Teal Partners concluded that: "…denitrification in wetlands was the most effective nitrogen removal mechanism from surface and ground water, followed in effectiveness by small ponds, large ponds and stream." Nitrogen attenuation percentages for salt marshes are reported to be between 40-50%, depending on site-specific conditions.

For coastal salt marshes, the authors emphasized that the marshes be freely connected to tidal exchange so that they maintain pH and anoxic sediments that promote denitrification. Salt marshes isolated by culverts or bridges are often subject to conditions that can make them highly acidic, thus killing vegetation and valuable organisms, and reducing their treatment value significantly. Given these findings, the potential role of Wellfleet saltmarsh resources in improving harbor water quality should be carefully reviewed.

Two significant wetland areas in Wellfleet Harbor have been flow-restricted for decades, severely diminishing their potential effectiveness in the Wellfleet Harbor nutrient budget equation. They are the 1,100 acre Herring River estuary, and the 20 acre Mayo Creek estuary. Both areas are shown on Figure 6.4. The Herring River has been the subject of an extensive Town and National Park Service study, with the goal of substantially opening the mouth of the river to restore its large and diverse estuarine habitats. The Mayo Creek estuary has also been the subject of recent study, with the goal of restoring some tidal flushing to reverse the deterioration of that salt marsh that is now stagnant and choked with invasive species. Studies have demonstrated that water quality in outgoing stream flows is poor.

As shown in Table 4.1, the Herring River and Duck Creek estuaries, within which these wetlands lie, receive approximately 42% of the Title V flows for the entire Town. Wetland/salt marsh restoration projects in these estuaries could significantly reduce nitrogen loads to the harbor and dramatically improve water quality there. Implementation of these two restoration projects should be pursued vigorously and considered in the overall water quality management program for Wellfleet Harbor.

6.2 ON-SITE I/A WASTEWATER TREATMENT

Based on our review of the BOH data and the GIS database created, there are a total of 106 I/A systems and eleven (11) different treatment technologies in operation in Wellfleet.

6.3 CLUSTER I/A SYSTEMS

Cluster systems are typically small to mid-sized systems serving a neighborhood or group of homes or businesses in a community where development is decentralized. There can be multiple cluster systems in a community, as opposed to one central facility. One of the advantages of cluster systems is an economy of scale effect that comes from building one centralized system for a local area rather than multiple individual systems. In sparsely developed areas such as rural and coastal communities, cluster I/A systems are an alternative worthy of evaluation, as they reduce or eliminate the need for extensive collection and transmission components of centralized facilities.

6.4 CENTRALIZED WASTEWATER COLLECTION AND TREATMENT

A centralized system is a system that conveys wastewater from its sources to one central location for treatment and disposal. Centralized collection and treatment is a traditional solution in urban areas or where development is denser and more continuous, and is typically more cost-effective than building multiple satellite or cluster facilities.

One disadvantage of a centralized treatment facility may be that wastewater must be collected and conveyed by gravity or by pumping over long distances, requiring an extensive piping system, and effluent disposal and groundwater recharge is distant from the origin of the wastewater. There may be loss of groundwater from watersheds due to the transfer of wastewater flow from one watershed to the next.

6.4.1 Effluent Disposal

Treated effluent from a plant is discharged to a surface water body (stream or ocean) or to the ground through an infiltration system similar in concept to a leaching field used at an individual dwelling. Plants located adjacent to the ocean may discharge treated effluent to the ocean via an ocean outfall pipe which is located sufficiently far from shore to provide mixing and dilution.

Effluent disposal to the ground is regulated by the MADEP for discharges over 10,000 gpd through a Groundwater Discharge permit. Surface water discharges are regulated by the EPA through the NPDES program.

In accordance with the Ocean Sanctuaries Act, MassDEP does not permit surface water discharges for new facilities on Cape Cod.

Disposal factors that must be considered include volume of flow, available land, soil type (clay, silt, sand, or gravel, etc.), porosity, and depth to ground water. The effluent must be disposed of in a manner so that it does not cause adverse effects to the surrounding soils and environment. This requires knowledge of soil properties and the groundwater regime, and may require computer modeling of the impact of treated effluent on local aquifers.

6.5 WATER SYSTEM EXPANSION

The expansion of the water system in 2004 and in 2010 throughout the Central District and to the Marina has been a benefit to these areas. The water system has capacity for approximately 400 connections. As

of March 2012, there are over 120 active connections and an additional 60 connections that have been approved by the Water Commissioners. Therefore, by late 2012, it is reasonable to expect that there will approximately 180 active connections.

The small lots in the Central District and between the Central District and the Marina were faced with complex on-site wastewater treatment and disposal challenges in the past due to inadequate separation between private wells and septic system leaching fields. This limited separation forced property owners to upgrade their wastewater disposal systems to include advanced treatment.

The town, through the Water Commissioners and Board of Health, should continue to encourage abutters to connect to the water system. The discount offered by the Water Commissioners is currently 40% and will decrease by 10% each year. In 2012, the connection fee is $6,000 which will increase by $1,000 annually over the next four (4) years. Even at $10,000, this is less than the cost for an I/A wastewater treatment and disposal system.

6.5.1 Future Expansion of the Water System

Future expansion of the water system is expected to include the following areas:

- Installation of mains on Railroad Avenue, Baker Avenue, Masonic Lane and Whites Lane.
- Loop from the current dead-end at Kendrick Avenue and Hiller Avenue through Hiller Avenue to Chequesset Neck Road.
- Loop from the intersection of Main Street and Briar Lane via Briar Lane to Route 6, continuing along Route 6 to Money Hill Road, and connecting to Coles Neck Road.
- Replacement of the old 4-inch pipe along Coles Neck Road from the Well site to the intersection of Pole Dike Road (approximately 2 miles). The existing main is incapable of serving abutters and provide inadequate fire protection.

Figure 6.5 shows the likely future expansion of the water system, as envisioned by the Board of Water Commissioners. The expansion of the water system will depend on several factors including available funding, the financial stability of the Water Enterprise Fund, and the pace at which the current customer base expands.

The extensions of the system from its current terminus at Route 6 and Cahoon Hollow Road toward South Wellfleet would be beneficial to serve commercial and residential properties along the Route 6 corridor and adjacent areas such as Drummer Cove, and properties in the Lt. Island Road area.

In summary, the future expansion of the water system will protect public health by replacing private drinking wells with marginal water quality, provide more land area on small lots for on-site wastewater disposal, and potentially reduce the complexity and cost of I/A systems in environmentally sensitive areas.

6.6 STORMWATER MANAGEMENT MEASURES

Stormwater runoff from streets, lawns, and agricultural lands can carry significant contaminant loads to surface waters in both suspended and dissolved forms. The Town has already taken significant steps to abate direct runoff into Duck Creek from the Central District. In 2011/2012, stormwater collection and infiltration structures were installed along Commercial Street, between Bank Street and Howland Avenue. These structures now intercept and infiltrate substantial volumes of stormwater runoff that previously drained directly into Duck Creek from a busy commercial district.

6.7 MARINA AREA, MAYO BEACH AND BAKER FIELD AREA

At the request of the Town, an accelerated study of this area was initiated in the latter part of 2011 and completed in February 2012. The concept was to construct a local cluster system to serve the Marina, Beach Sticker Shack, Shellfish Building, Mayo Beach and Baker Field. Sewage would be collected and pumped to a localized treatment facility.

Flow estimates for system planning were established based on use projections provided by the Recreation Department and the Board of Health. The treatment system was sized to treat approximately 9,500 gpd, and both sequencing batch reactor (SBR) and membrane technologies were considered. Both processes produce a high quality effluent, with nitrogen typically in the 2-5 mg/l range. A limit of 5 mg/l was considered to be the treatment goal given the sensitive location (oceanfront) of the disposal systems.

Five alternative approaches were developed, and conceptual layouts and cost estimates were generated for each, as shown in Appendix E. Since conceptual level cost estimates for each alternative were in excess of $1M, a composting toilet alternative was considered, which would eliminate the need for collection and transmission pipes and pumping components. Composting toilets would also produce no leachate, thus eliminating the need for leach fields. Grey water from sinks would be leached locally.

As part of the composting toilet concept, the Committee decided to leave the existing Marina/Pier restroom, Sticker Shack, and Shellfish Building as they are for the present time and focus on the Mayo Beach and Baker Field needs. The committee concluded that a higher priority needed to be placed on providing bathhouses that could serve the Baker field activities, and the summer beach users at Mayo Beach, whiles still providing wastewater treatment in a more efficient and compact footprint through the use of composing toilets (which provide 100% nitrogen removal) in this critical waterfront area.

A similar composting toilet system is in place at the Wellfleet Audubon facility and reportedly is in good working condition. The composting toilets would be enclosed inside an architecturally appropriate building for this waterfront location. Two male and female bathrooms were proposed for the Mayo Beach building and three male and female bathrooms at Baker field. An outside rinse station was also included at the Mayo Beach building. A grey water treatment system was also included for sink wash water.

The estimated capital cost for the preferred plan (Alternative 5B) was approximately $820,000, including permitting, engineering design and construction administration costs, and contingency. The proposed facility includes a bathhouse and changing room at Mayo Beach, and a separate building near Baker Field with more bathrooms but no changing rooms. Each facility was sized to be approximately 500 square feet, with a basement for the composting collector bin.

These facilities can be active in peak and shoulder seasons, or for special events, and closed during the winter or other low use periods of the year. The Baker Field facility will see greater use due to the field activities (baseball, summer concerts, summer camps, proximity to tennis courts, skate board park, etc.) and could remain open year-round.

If constructed, these new facilities will reduce the hydraulic overloading at the existing marina complex bathroom and I/A system beneath the marina parking lot. That facility was designed for 700 gallons per day, but actual usage is reported to be in excess of 3,000 gallons per day during the summer season, comprising a significant source of nitrogen directly into the areas of most concern for water quality impairment.

7. CONCLUSIONS

Based on data entered into the GIS database and subsequent data base querying, watersheds within the town were evaluated using five (5) parameters. Based on these parameters, four watersheds have been identified with potential concerns. These watersheds are Duck Creek, Wellfleet Harbor A and B, and Chipmans Cove.

Solutions for these watersheds will be developed as part of the next phase of the project under Task 5 Evaluation of Alternatives.

Within the next few months, it is expected that the MEP will issue its findings for Wellfleet. At that time, the MEP findings will be compared to the findings contained in this interim report.

FIGURES

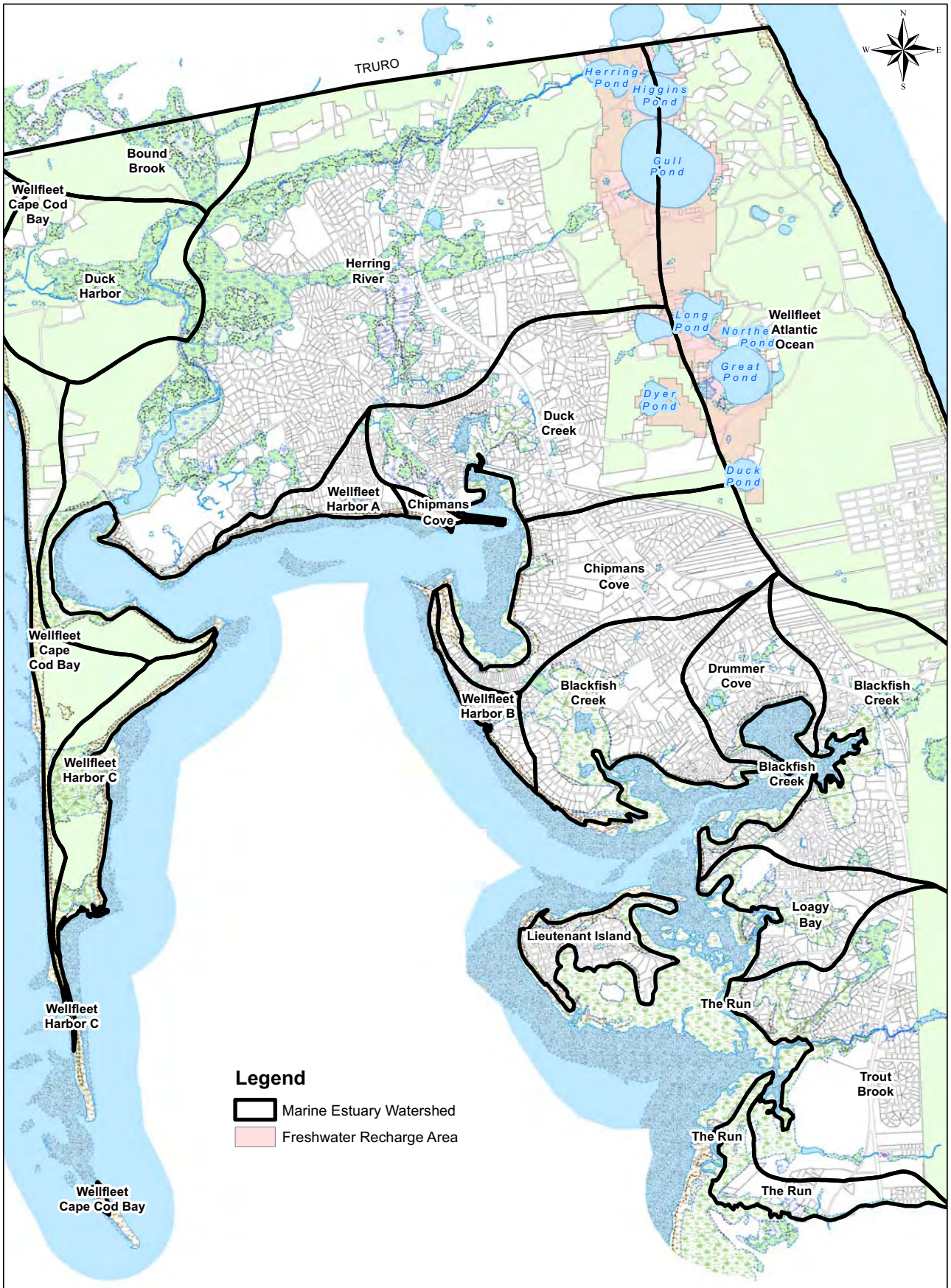


Figure 4.1
Watershed Areas
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

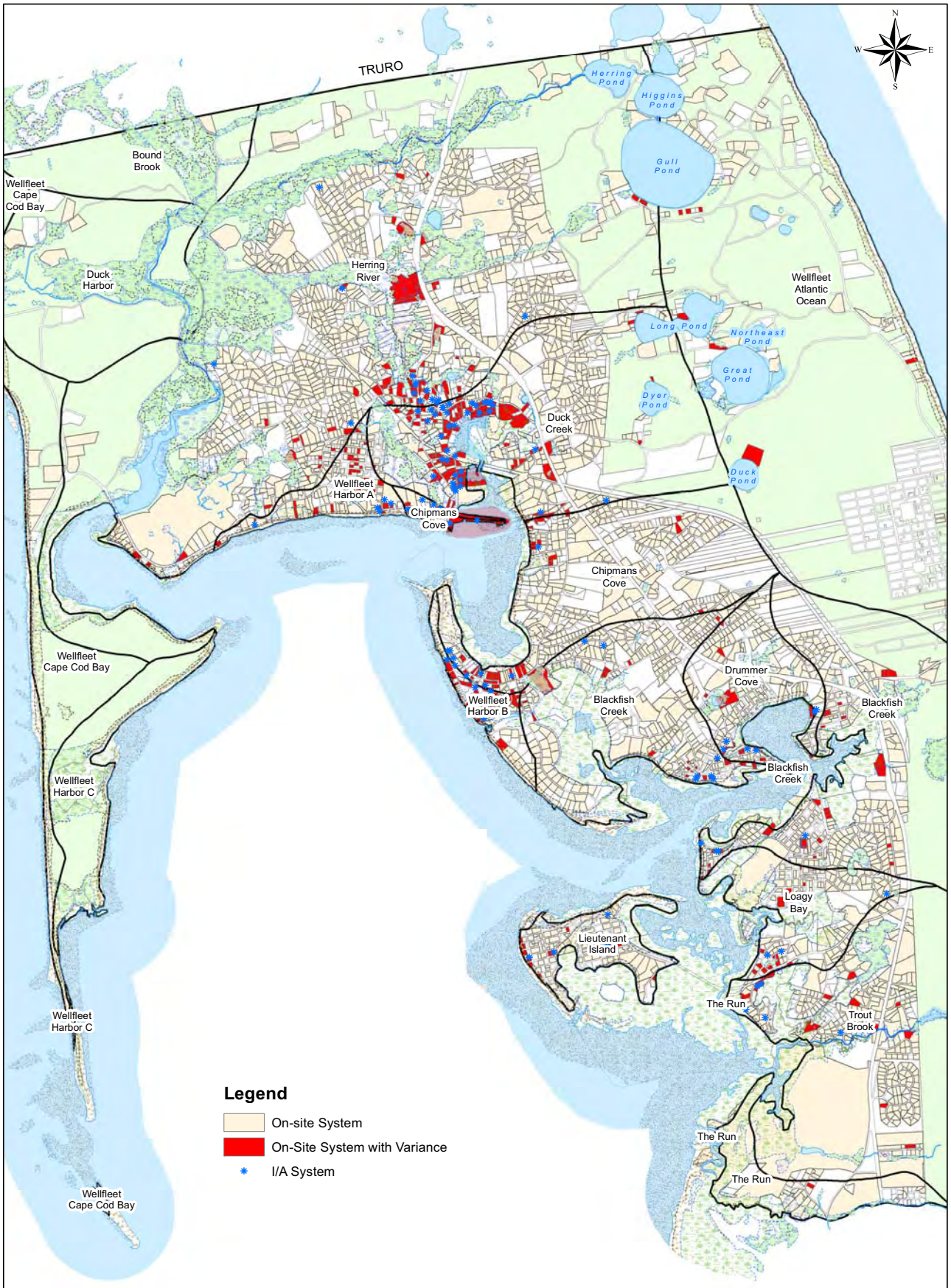


Figure 4.2
On-Site Wastewater Systems
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

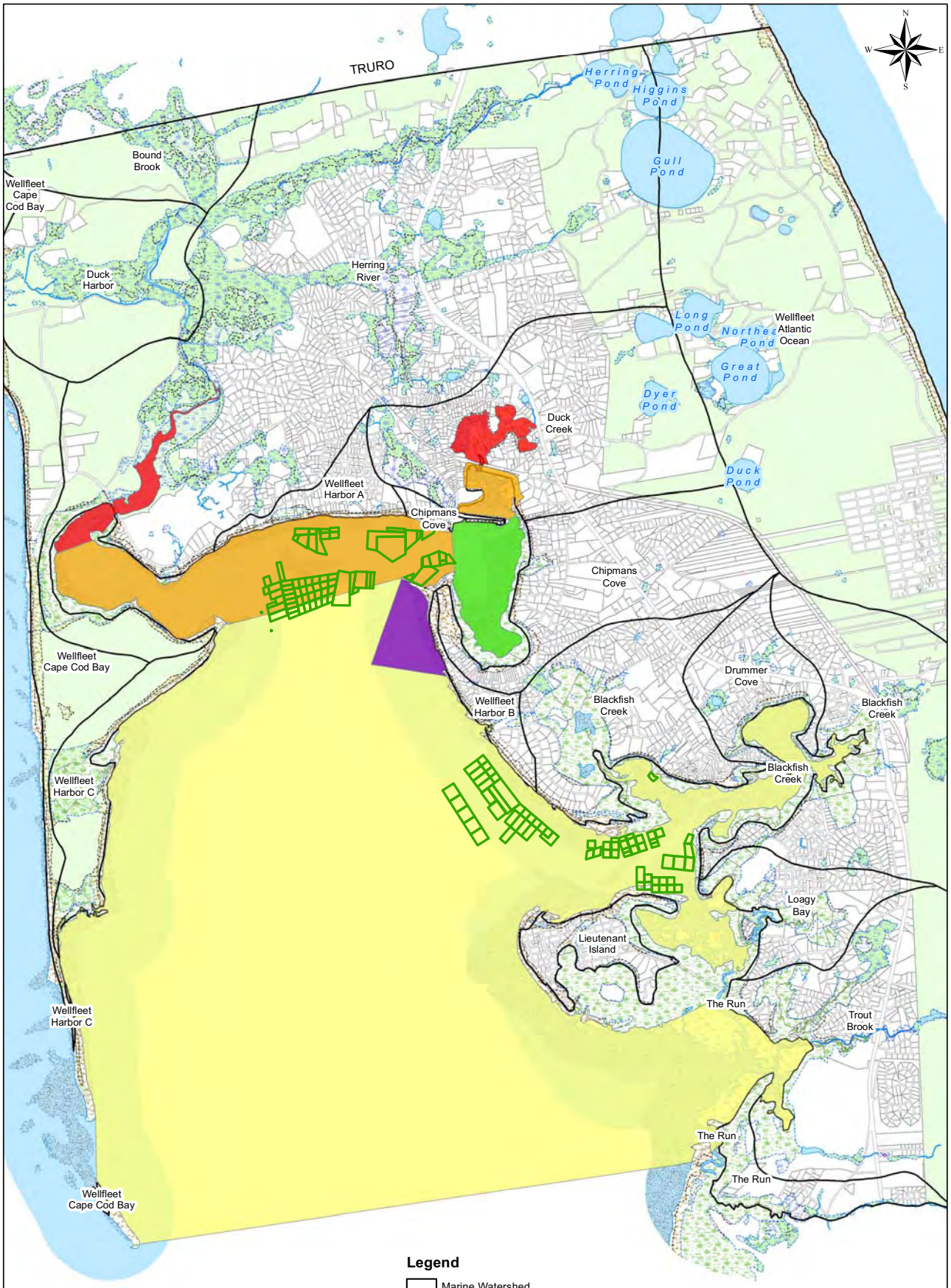


Figure 4.3
Shellfishing Areas
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

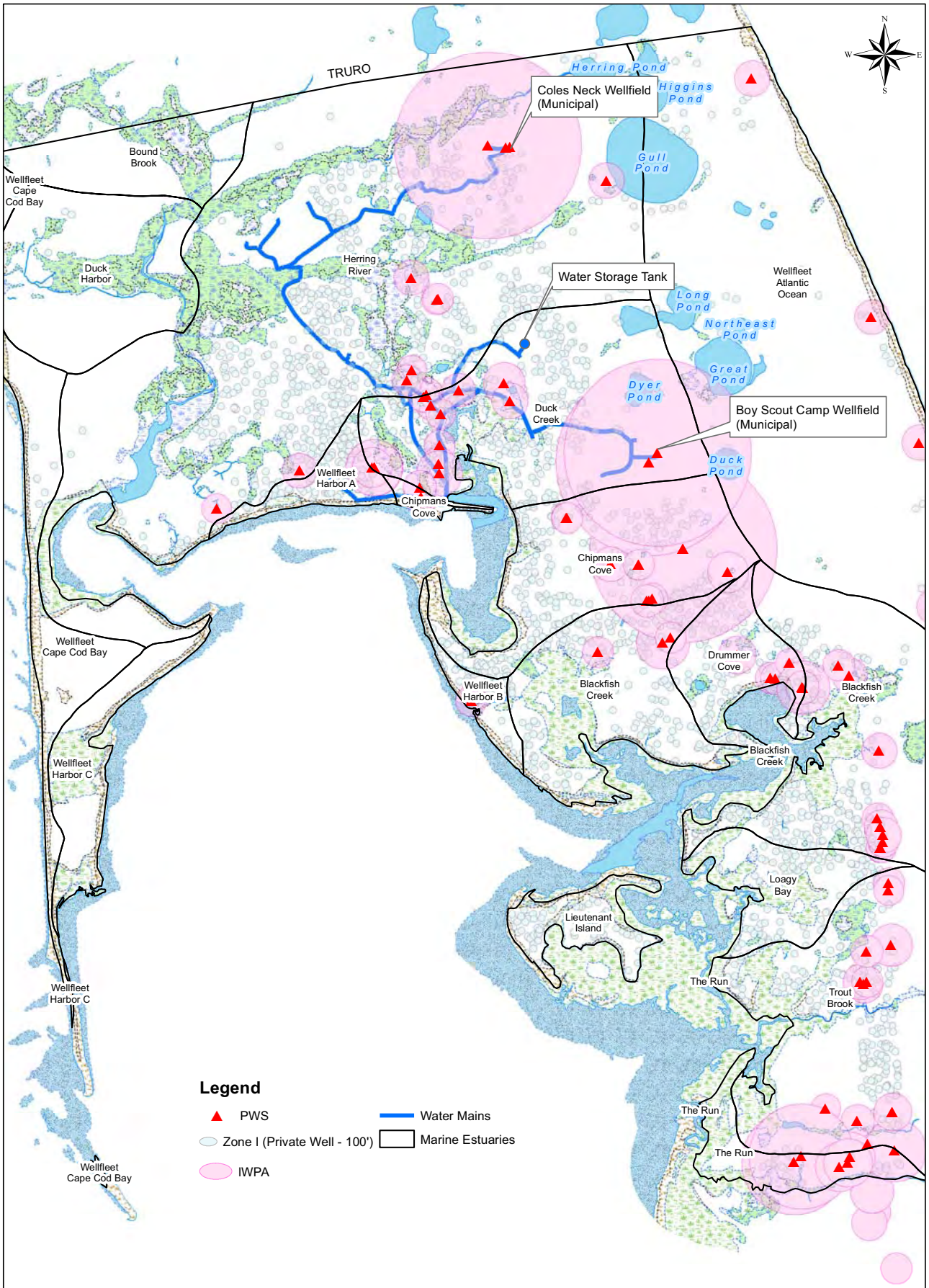


Figure 4.4
Public Water Supply
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

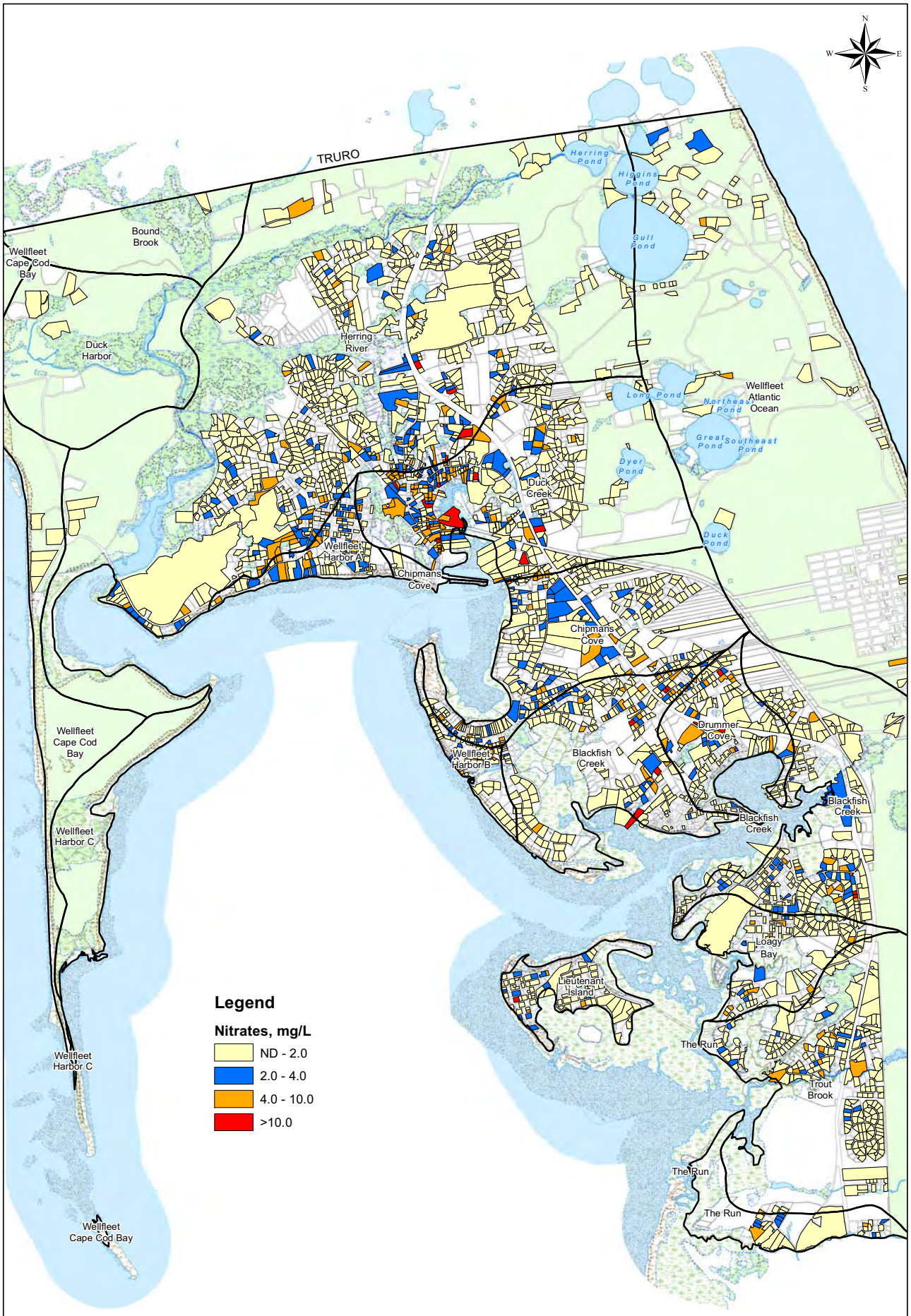


Figure 4.5
Drinking Well Nitrate Levels
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

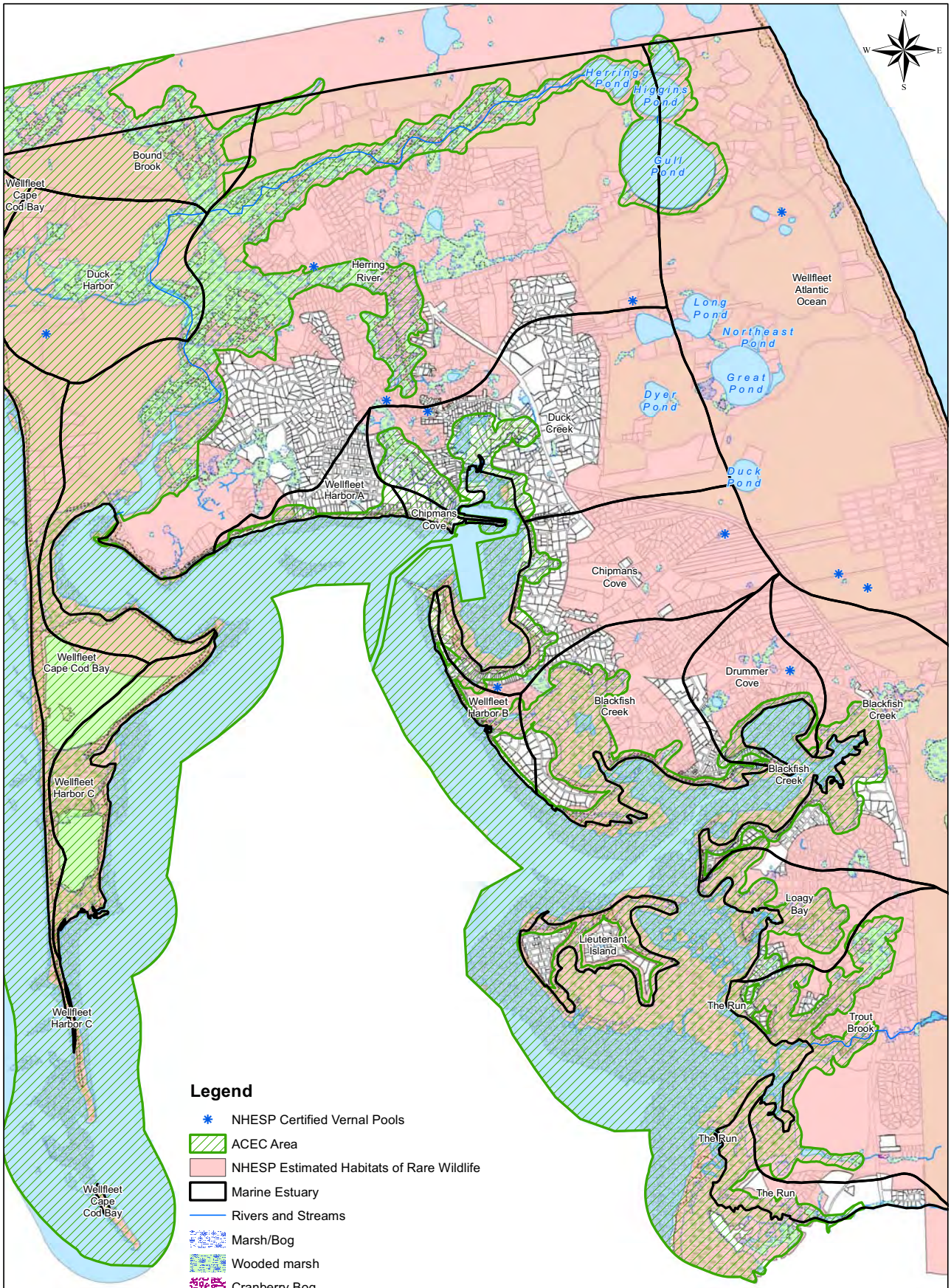


Figure 4.6
Sensitive Habitat Areas
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

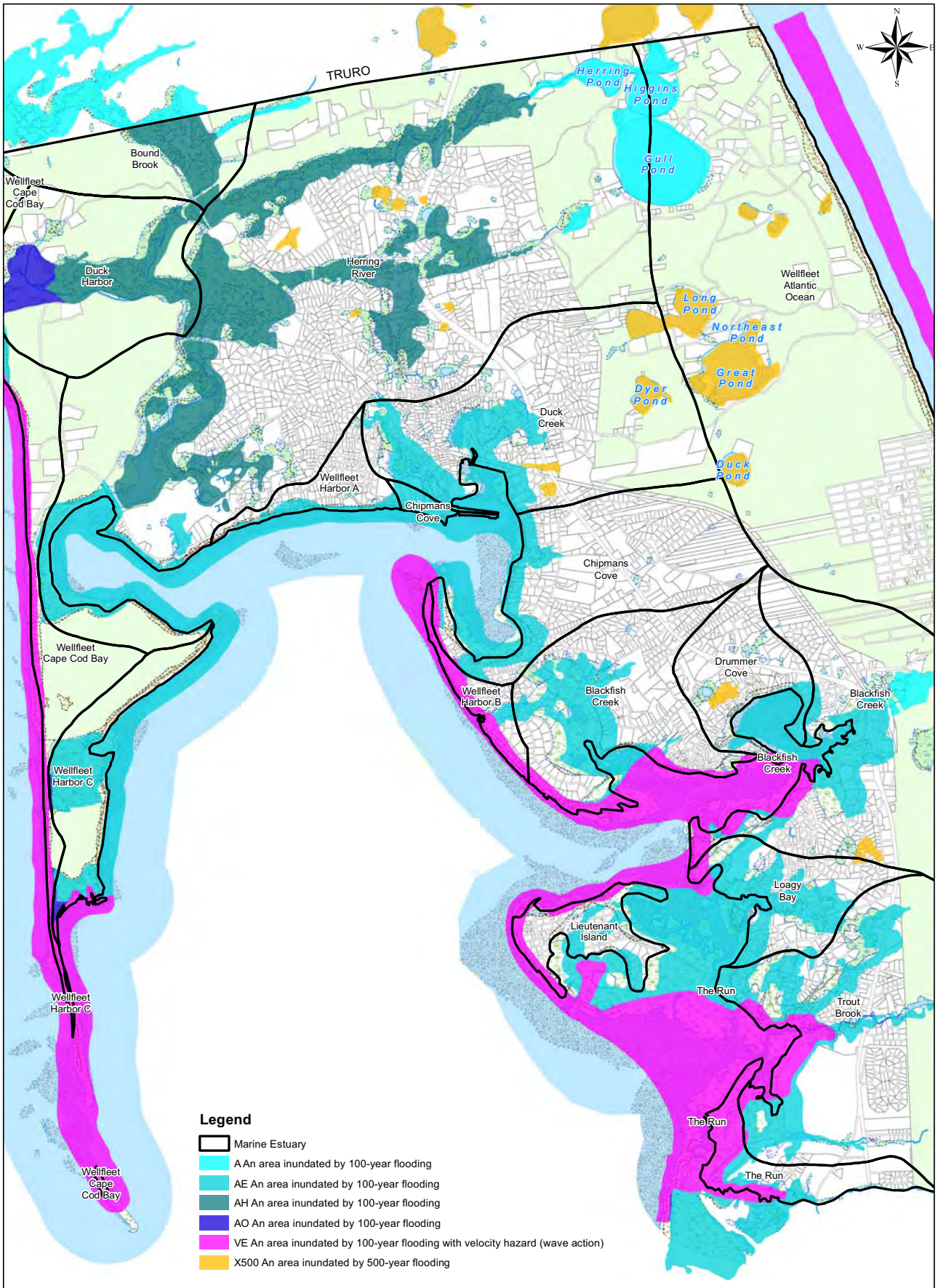


Figure 4.7
Flood Zone Areas
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

Environmental Partners GROUP

Figure 4.8
Water Quality Sampling Locations
Wellfleet Harbor, Massachusetts
June 2012

Figure 4.9
MEP Sampling Locations
Wellfleet Harbor, Massachusetts
June 2012

Environmental Partners GROUP

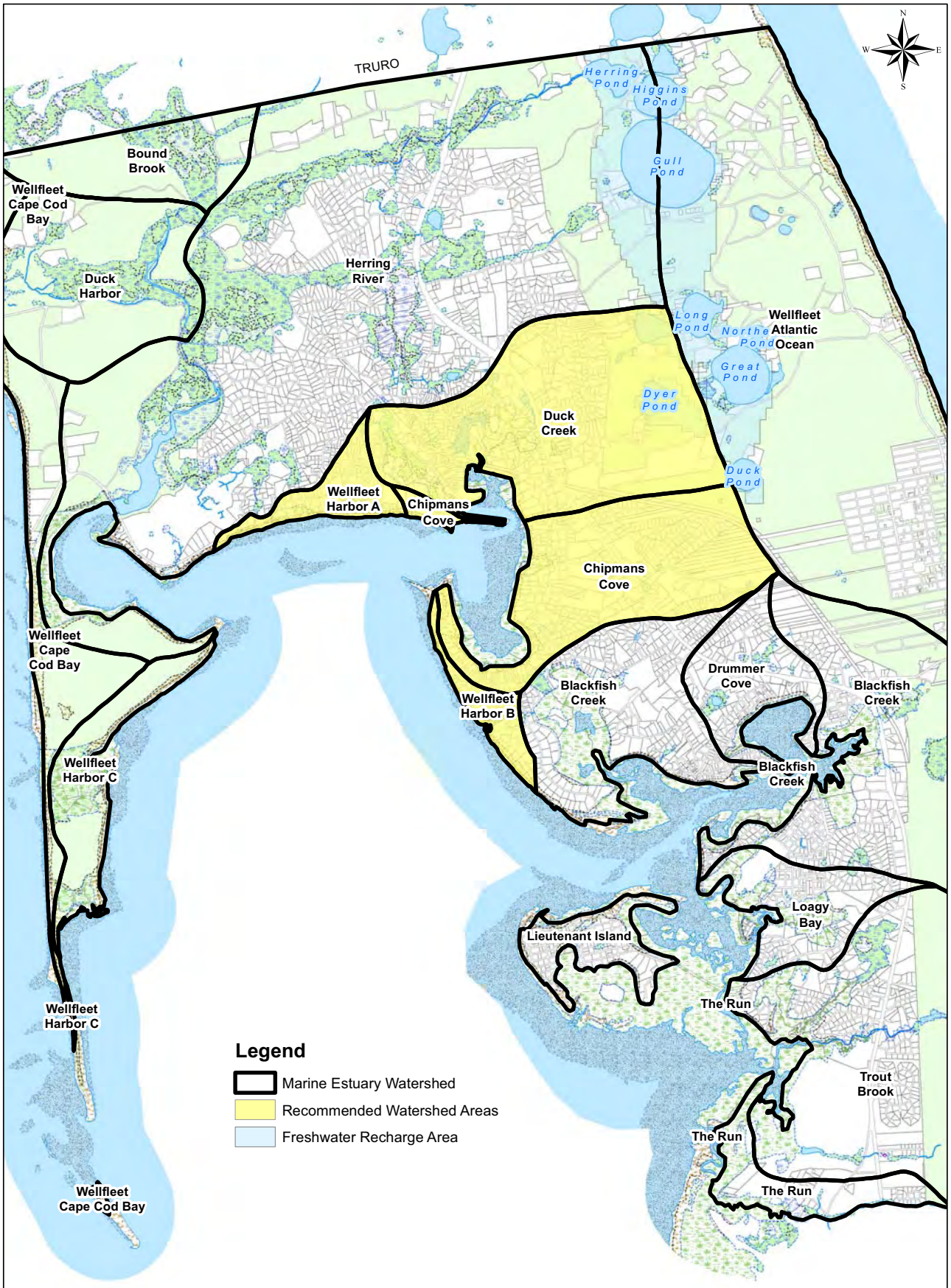


Figure 5.1
Watershed Areas Recommended for Further Study
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP

Figure 6.1
Wellfleet Harbor Oyster Spawning Study Area
Wellfleet, Massachusetts
June 2012

July 16, 2011

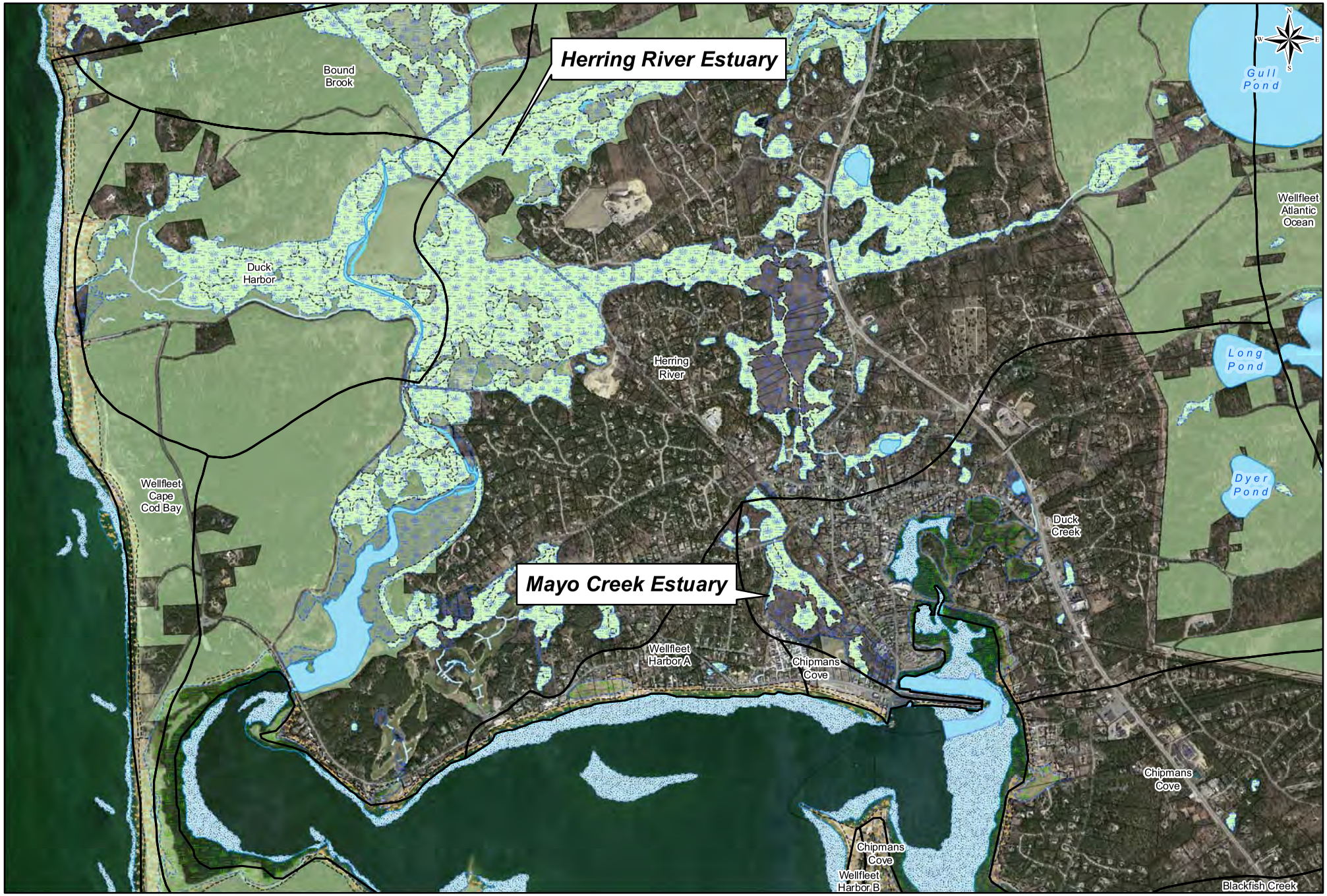
Figure 6.2
Study Area After
Cultch Placement
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP
A partnership for engineering solutions.

August 7, 2011

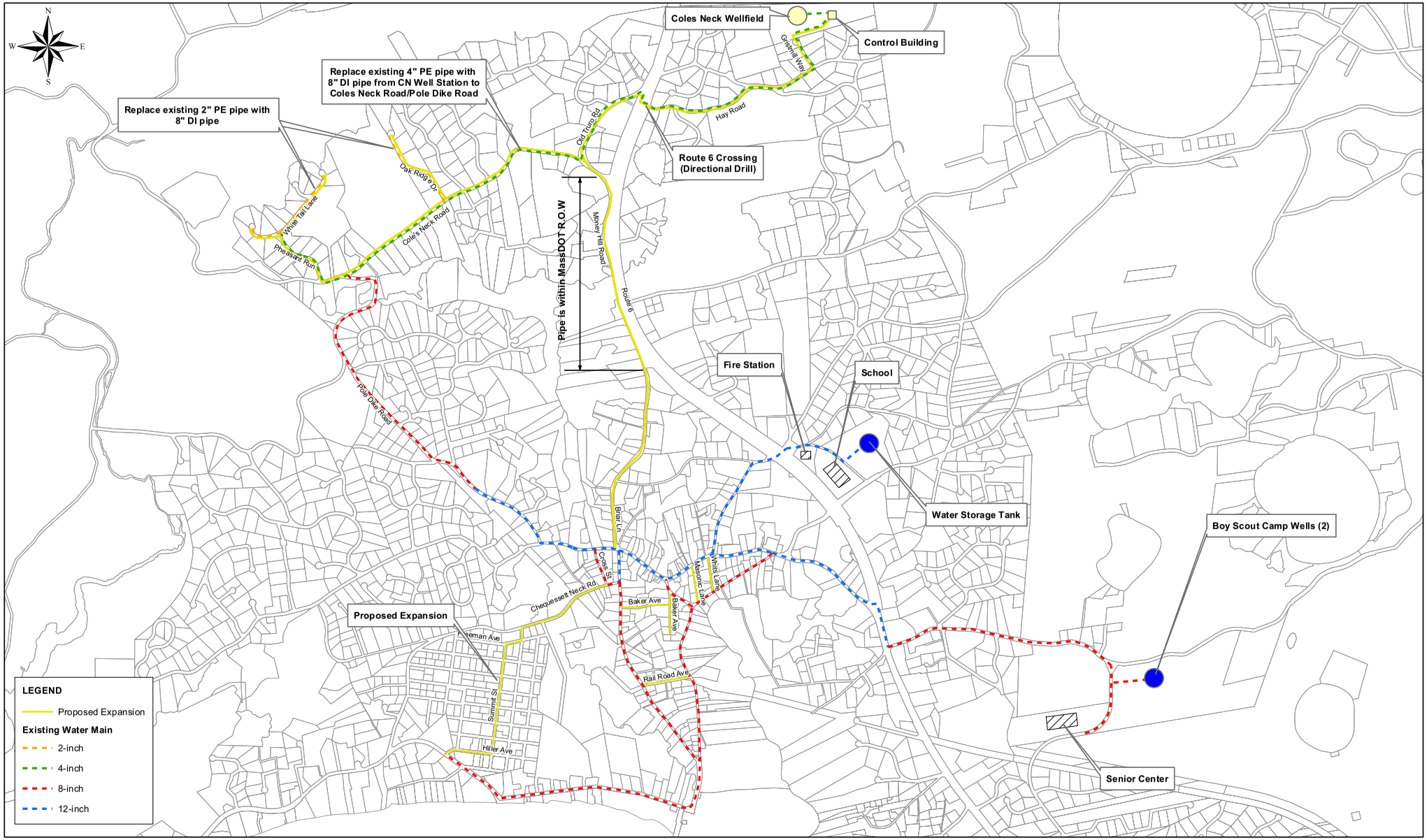
Figure 6.3
Oyster Spat Growing
on Cultch in Study Area
Wellfleet, Massachusetts
June 2012

Environmental Partners GROUP
A partnership for engineering solutions.



Environmental Partners GROUP

Figure 6.4
Herring River and Mayo Creek Estuaries
Wellfleet, Massachusetts
June 2012



Environmental Partners GROUP
A partnership for engineering solutions.

Figure 6.5
Water System Expansion, Wellfleet, Massachusetts
June 2012

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX E

Woburn:
18 Commerce Way, Suite 2000
Woburn, Massachusetts 01801

Phone: 781.281.2542
Fax: 781.281.2543

Headquarters:
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169

Phone: 617.657.0200
Fax: 617.657.0201

www.envpartners.com

Hyannis:
297 North Street, Suite 311
Hyannis, Massachusetts 02601

Phone: 508.568.5103
Fax: 508.568.5125