Final Alternatives Screening Analysis Report

Town of Mashpee Sewer Commission



August 2013

Executive Summary

ES.1 Background

The purpose of the Alternative Screening Analysis Report (ASAR) is to expand upon the Draft Alternative Screening Evaluation and Site Evaluation Report issued in 2008, present the findings of the Massachusetts Estuaries Project (MEP) modeling work, and provide a description of the eight scenarios/options run to meet the nitrogen Total Maximum Daily Loads (TMDLs). These findings are used to develop the framework and direction of the project so the Town of Mashpee can develop its Draft Recommended Plan/Draft Environmental Impact Report for TMDL compliance within the Project Planning Area (PPA) watersheds of Popponesset Bay and Waquoit Bay East. The PPA is shown in Figure ES-1.

Several reports have been issued to date including the 2007 Needs Assessment Report (NAR) and 2007 Technology Screening Analysis Report. Since the start of this project two notices of project change have been issued through MEPA. The certificates and response to comments are included in Appendix ES-1.

ES.2 Needs Assessment Report (April 2007) Summary

The NAR discussed the environmental resources, existing and future development conditions, and nitrogen removal needs. In addition, various factors were identified to aid in determining priority areas for nitrogen removal and development of a management plan. The factors that were used in identification of needs assessment priority areas included:

- MEP calculations of necessary nitrogen removal for estuary health.
- Wastewater nitrogen loading per acre.
- Seasonality (seasonality was identified for towns outside of Mashpee for comparison only—the other towns may not consider this a priority when developing their town-wide management plans).
- Other Town considerations (phosphorus, previous studies, etc.).

The document then summarized the estimated wastewater flows and loads based on existing water data used as part of the MEP modeling efforts. In addition a parcel by parcel analysis of nitrogen per acre was developed to help identify concentrated areas of nitrogen loading relative to the watersheds.

ES.3 Technology Screening Report (November 2007) Summary

Following the issuance of the Needs Assessment Report, the Technology Screening Report was issued. This report identified a group of alternative wastewater management technologies and management options to be considered to meet the Project Planning Area's nitrogen reduction requirements, with a primary focus on wastewater treatment and disposal technologies.

The Technology Screening Report identified specific technologies associated with:

- Decentralized technologies including:
  - Individual Innovative and Alternative (I/A) septic systems.
  - Cluster systems:
    - Those serving flows less than 10,000 gallons per day (gpd).
    - Those requiring a groundwater discharge permit (small wastewater treatment plants).

- Centralized facilities:
    - Those facilities serving large areas of Town. These facilities are often municipally run and typically treat wastewater flows greater than 150,000 gpd.

Some additional components that are associated with cluster systems and centralized facilities were evaluated in this report. Those components included:

- Collection systems.
- Disinfection technologies.
- Effluent disposal (treated water recharge).
- Water reuse technologies.

In addition other nitrogen mitigation measures were identified and reviewed.

ES.3.1 Technology Findings (Wastewater)

A multitude of small individual onsite I/A technologies were evaluated in this report. Approved technologies are identified by MassDEP. However, at the time the 2007 report was prepared the following technologies were identified as favorable for nitrogen removal applications within the Project Planning Area:

- Amphidrome®
- Bioclere®
- FAST®
- Nitrex™/Omni RSF
- Norweco Singulair
- Recirculating Sand Filters (RSF)
- RUCK

To the extent they are currently being discussed on Cape Cod, Eco-Toilets were not carried forward as part of the Technology Screening Report; however there is growing interest in these types of systems. Mashpee will need to establish how Eco-Toilets may be used as part of the Recommended Plan. The Town of Falmouth is actively leading this work in demonstration projects, and the Town of Mashpee currently has regulations allowing the use of certain types of Eco-Toilets, but a robust plan of how these can be used as part of achieving TMDL compliance will likely be part of the adaptive management approach of the Recommended Plan.

Cluster/Package and centralized facilities have a large array of technologies as well. However, the focus was identifying those capable of meeting groundwater discharge permit levels of less than 10 mg/L total nitrogen (TN) and those less than 3 mg/L TN. The findings recommended that technologies such as those listed below be considered when treatment performance of less than 6 to 10 mg/L TN is required.

- Activated Sludge/Extended Aeration(AS/EA)
- Sequencing Batch Reactor (SBR)
- Membrane Biological Reactor (MBR)

- Rotating Biological Contactor (RBC)—for existing facilities only

To achieve less than 3 mg/L these technologies are typically coupled with a denitrification filter. The use of denitrification filters to achieve levels less than 3 mg/L will be considered for those facilities that would recharge within one of the watersheds (Popponesset or Waquoit Bay); however, since it is possible to add properly planned and designed denitrification processes to the end of the treatment process, these types of advanced treatment facilities may be phased in over time.

There are several different types of denitrification processes. They will be specified based on the treatment system that precedes them and client preference regarding operations, among other considerations. These can include traditional upflow and downflow filters in addition to Nitrex™ or other media based systems.

Use of RBCs will only be considered for use as they currently exist within the Town at existing wastewater treatment facilities. Any facility that has to achieve 3 mg/L in the future will need to be upgraded to one of the three previously identified technologies (AS/EA, SBR, MBR) due to the difficulty of RBC systems to consistently achieve full nitrification of their effluent. This too will be a phased approach as existing facilities reach their design capacity or design life.

Ancillary facilities for these larger systems would include:

- UV disinfection will be the only disinfection technology considered as stated in Chapter 2 and the Technology Screening Report.
- Odor Control and sludge management systems/technologies will be considered on a site-by-site and process-by-process consideration as part of the Recommended Plan development and will be evaluated in the next report phase.
- Collection systems (vacuum, gravity, STEP, STEG, and low pressure sewers) all remain in consideration and should be evaluated at the time of design when site conditions, survey, utility constraints, and design requirements are known. At this time the Town/District/Sewer Commission does not have any formal sewer guidelines or regulations that may dictate the components of the system and therefore impact the cost or feasibility of installation.
- Use of open sand beds, traditional subsurface leaching facilities, and drip irrigation are being carried forward as treated water recharge technologies. Spray irrigation is limited by its use, its infrastructure requirements, time of year use restrictions, and strict DEP regulations that regulate its use and its effluent quality and therefore is not being carried forward.

ES.3.2 Technology Findings (Stormwater)

Best Management Practices (BMP's) need to be implemented on a case-by-case basis, with nutrient removal capabilities considered in most sensitive watersheds. The Town should continue the implementation of these features and focus on the use of the following technologies within the more sensitive watersheds:

- Dry extended detention basins.
- Wet retention ponds.
- Infiltration basins.

- Stormwater wetlands.
- Submerged gravel wetlands.
- Bioretention (rain gardens).
- Water quality swales.
- Infiltration trenches.

ES 3.3 Technology Findings (Other Nitrogen Reduction Approaches)

The report also reviewed items such as oyster propagation, groundwater treatment, fertilizer management, landscape design practices, animal waste management, open space acquisition, and public education—all of which are potential components of what the Town will craft into an adaptable management approach. All of these non-wastewater related methods have the potential to provide a means of reducing nitrogen (to varying degrees). However, due to their variability in performance and variability in the nitrogen concentrations they would address, their performance on a watershed basis is currently difficult to quantify for consistent, widespread performance to achieve a TMDL. Demonstration projects in neighboring Falmouth, the County 208 Planning efforts, and MassDEP guidance will be critical in identifying how nitrogen reduction would be credited. It is important to state that a number of these nitrogen reduction measures will vary in their nitrogen removal performance because of their reliance on natural systems and highly variable loadings. Many are not currently credited with nitrogen removal by regulatory agencies. Additional public education, management structure, and enforcement would be required in order for them to be considered a reliable, long-term means of nitrogen removal. However, they are all considered potential parts of any adaptive management plan.

ES.4 Draft Alternatives Scenarios Analysis and Site Evaluations

ES.4.1 Alternatives Development

As part of the identification of scenarios/options that have been evaluated to date, the report summarizes the various potential effluent (treated water) recharge sites that would be used in conjunction with these alternative scenarios/options and evaluates their suitability. Chapter 3 identifies a number of sites located within the Project Planning Area that were considered as possible recharge sites throughout the duration of the project.

ES.4.1.1 Sites

The process of identifying sites began in 2003 and was revisited in 2007, 2010, and again in 2012.

Figure ES-2 shows the sites being considered for the development of the Recommended Plan.

Based on these evaluations, the following Table ES-1 summarizes the results:

Table ES-1 Sites Under Consideration

Site Name	Treatment Site	Recharge Site
Site 2—Ashumet Road	X	
Site 4—Transfer Station	X	X
Site 6—Keeter Property	X	X
Back Road Sites	X	X
New Seabury/Site 7		X
Willowbend Golf Course		X

Note: Site 2—although being kept as a viable location—will likely be combined with a facility at Site 4. Similarly, the Back Road Site may be considered as a cluster facility, but if combined would likely be served from a new facility potentially located at the High School.

Upgrade and expansion of the following facilities/locations is to be considered in the Recommended Plan:

- New Seabury
- Willowbend
- Mashpee High School
- Mashpee Commons

Upgrade and expansion may include physical plant improvements, upgrades to systems handling the currently permitted design flows, upgrades required to handle additional wastewater flows, or complete replacement of the existing facility with a new facility (due to age of system, year of implementation, level of treatment).

The remaining existing WWTFs will remain in use although some may ultimately be converted to pumping stations to transfer the flow to one of the larger proposed/existing facilities.

ES.4.1.2 Massachusetts Military Reservation (MMR) Site

The potential use of the MMR site will remain in consideration as part of the Recommended Plan; however, because a local or regional plan has yet to be developed or agreed upon with the MMR, the details of its use may need to be addressed as part of the adaptive management approach the Town takes into consideration with its neighbors Falmouth and Sandwich. The Town's Board of Selectmen has written a letter dated March 27, 2013 stating the Town's interest in the use of facilities at this site.

ES.4.1.3 Rock Landing

Rock Landing was removed from further consideration for several reasons:

- Difficulty and cost associated with the relocation of the existing wells.
- The site is a very high-quality drinking water supply site that supplies nearly 50 percent of the Town's water supply.

- Recharge from the location (if wells were relocated and site was used for treated water recharge) would still end up back in several of the Towns' sensitive embayment's and not directly out to Nantucket Sound (for example Site 7).

ES.4.1.4 Potential Cluster System Sites

Cluster development potential was screened based on proximity to these areas. Based on the summary shown in Table 6-1, the following areas will be carried forward in the Recommended Plan development for further evaluation:

- Briarwood/Otis Trailer Village
- Pickerel Cove
- Pirates Cove
- Tri-Town Circle
- Santuit Pond

Areas within identified natural habitats will need to be addresses on a site-by-site basis. Mitigation and land swap will be considered if these areas remain as part of any Recommended Plan. These efforts will need to be coordinated with Natural Heritage and Endangered Species Program (NHESP) and will likely require additional study that is currently beyond the scope of this project.

ES.4.2 Alternative Scenarios

Following the release of the Needs Assessment Report, the Mashpee Sewer Commission identified five different management scenarios for evaluation and analysis. This chapter identifies the general characteristics of each scenario and discusses the basic methodology for evaluating each scenario.

The five scenarios are:

- Scenario 1—No expansion of existing wastewater treatment facilities.
- Scenario 2—Upgrade and expansion of existing facilities to a practical extent.
- Scenario 3/3R—Cluster Scenario (prepared by LAI).
- Scenario 4—Fair Share.
- Scenario 5—Centralized approach.

Each of these scenarios were run through the MEP model for both Popponesset Bay and Waquoit Bay East. The following table summarizes the findings as presented in Tables 3 and 4 from the MEP technical memorandum.

Table ES-2 Summary of Threshold Comparison Results[1] by Scenario

Watershed/Embayment Section	TMDL/MEP Threshold	Scenario					
		1	2	3	3R[(2)]	4	5
		mg/L					
Popponesset Bay—Head	0.38	**0.394**	**0.386**	0.372		0.378	**0.389**
Mashpee River—Mid to Low	0.4-0.5	**0.601**	**0.570**	0.472		**0.529**	**0.596**
Shoestring Bay—Upper to Lower	0.4-0.5	0.472	0.462	0.461		0.449	0.461
Ockway Bay—Upper	0.4-0.5	0.457	0.449	0.421		0.438	0.453
Jehu Pond	0.446	0.429	0.435	**0.472**	0.429	0.437	0.434
Hamblin Pond	0.380	0.252	0.253	**0.400**	0.251	0.260	0.252
Quashnet River	0.520	**0.536**	**0.547**	**0.585**	0.460	**0.523**	**0.559**

Notes:

(1) Data from Tables 5 and 6 from December 15, 2009 MEP Technical Memorandum, except for data regarding Scenario 3R (see Note 2).

(2) Revised Scenario 3 (3R) as identified in Table 3 of the February 2010 MEP technical memorandum. This scenario did not include rerunning the model for Popponesset Bay. In summary, flow was moved from Waquoit Bay East watershed to the area identified as "Rock Landing/outside" watershed. Flow changes were also made within the following areas/subwatersheds: Moody Pond, Outside watershed, Ashumet Pond, Mashpee-Wakeby Pond, Quashnet River, Peter's Pond, Santuit River, and Red Brook watersheds, per the report.

(3) Blue shading represents those that do not meet the Threshold.

ES.5 2012 Development of Options 1A, 1B, and 1C

As the Town moved forward in development of a Recommended Plan for nitrogen management within the PPA, three "options" were developed in 2012. These options were developed to meet the TMDL goals. Each option was modeled by the MEP to demonstrate feasibility to meet the TMDLs and was structured based on the previous efforts in 2008. The following tables (ES-3, ES-4, and ES-5) summarize these options:

Table ES-3 Option 1A—Summary of Recharges

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	South Cape Village; Site 4 (Transfer Station); Willowbend; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village	280,000
WWTF recharge within Waquoit Bay East Watershed	Back Road	370,000
Septic / I/A recharge in planning area	Various	500,000
Recharge outside watershed	Rock Landing; New Seabury; Sandwich: Barnstable; Falmouth	1,550,000
Totals (rounded)		**2,700,000**

Table ES-4 Option 1B—Summary of Recharges

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	Site 6 (Keeter); South Cape Village; Site 4 (Transfer Station); Willowbend and golf course; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village; Pirates Cove; Santuit Pond Cluster, Sandwich	1,520,000
WWTF recharge within Waquoit Bay East Watershed	Back Road; Site 6 (Keeter)	480,000
Septic / I/A recharge in planning area	Various	340,000
Recharge outside watershed	Site 6 (Keeter); New Seabury; Barnstable; Falmouth	350,000
Totals (rounded)		**2,700,000**

Table ES-5 Option 1C—Summary of Recharges

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	Site 6 (Keeter); South Cape Village; Site 4 (Transfer Station); Willowbend and golf course; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village; Pirates Cove; Santuit Pond Cluster,	1,030,000
WWTF recharge within Waquoit Bay East Watershed	Back Road; Site 6 (Keeter)	480,000
Septic / I/A recharge in planning area	Various	500,000
Recharge outside watershed	Site 6 (Keeter); New Seabury; Barnstable; Sandwich; Falmouth	690,000
Totals (rounded)		**2,700,000**

ES.5.1 MEP Model Results

In November 2012, the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST) issued the model results for the three Options (1A, 1B, and 1C). The results indicated that "all three options meet the threshold values/TMDLs at the sentinel station for restoration of eelgrass in Popponesset Bay." The results also indicated that "all three options do not meet the threshold values at the sentinel station for restoration of eelgrass in Jehu Pond or Hamblin Pond. All three options do meet the water column TN concentration that would be restorative of infaunal habitat in the Quashnet River". Their model result tables also indicate that all three options meet the TMDL/MEP threshold for Great/Little River and Upper Waquoit Bay.

Based on their model analysis in this watershed, Options 1A and 1B removed more nitrogen than necessary indicating that these options could potentially be adjusted to reduce the amount of sewering or accept additional flows from the Waquoit Bay watershed to help address the nitrogen load in Jehu Pond and/or Hamblin Pond.

The following table summarizes the findings as presented in Tables 3 and 4 from the MEP technical memorandum.

Table ES-6 Summary of Threshold Comparison Results by Option

Watershed/Embayment Section	TMDL/MEP Threshold	Option 1A	Option 1B	Option 1C
	mg/L	mg/L	mg/L	mg/L
Popponesset Bay—Head	0.38	0.359	0.366	**0.381**
Mashpee River—Mid to lower	0.4-0.5	0.447	0.474	0.492
Shoestring Bay—Upper to lower	0.4-0.5	0.433	0.440	0.481
Ockway Bay—Upper	0.4-0.5	0.413	0.436	0.451
Jehu Pond—WB1	0.446	**0.471**	**0.481**	**0.481**
Great/Little River—WB3	0.38	0.355	0.359	0.359
Hamblin Pond—WB4	0.38	**0.39**	**0.398**	**0.398**
Quashnet River—WB7, WB8	0.52	0.502	0.503	0.503
Upper Waquoit Bay—WB12	0.38	0.358	0.359	0.359

Blue shading represents those that do not meet the Threshold.

Discussions with MEP indicate that although Jehu and Hamblin Ponds do not meet the TMDL thresholds, this is a reflection of the new model including all of Waquoit Bay, not just the portions evaluated previously. This also reflects no nitrogen removal in other parts of Waquoit Bay. If additional nitrogen removal occurs in Falmouth within the Waquoit Bay watershed west of the PPA, it is very likely that these two subwatersheds will meet the TMDLs.

ES.6 Cost Evaluation, and Operations and Maintenance Considerations

ES.6.1 Introduction

Cost evaluations as part of this project—and ultimately its implementation—are being performed in multiple steps. The initial step, started in 2008, was used to compare the various alternatives being considered on a macro scale across the entire watershed areas including adjacent communities. The purpose of developing costs at this scale was to consider alternatives on a side-by-side analysis and attempt to provide the large (whole) picture perspective.

As part of this report, costs were then developed for Options 1A, 1B, and 1C to establish a baseline to work from as the plan is refined. These costs will ultimately be included in the development of the Recommended Plan and reported in the Draft Recommended Plan/Draft Environmental Impact Report (DEIR) document as stated previously as a baseline comparison as alternative measures are considered (i.e. regionalization/MMR facility use, shellfish aquaculture, etc.). The estimated project costs for the Recommended Plan will be established as part of the cost-effectiveness analysis. This analysis in the subsequent report will identify and compare cost-effective alternatives (shellfish aquaculture, PRBs, cluster systems, regional solutions, and ownership/operational issues etc.) to more traditional methods in certain areas for the Town to consider as part of implementation. These costs would then be further refined as part of the Final Recommended Plan/Final EIR, and ultimately as part of any design phase and implementation.

Because each alternative is dependent on achieving the TMDL, the key factor is how much nitrogen can be recharged within a watershed at a particular location. Each of the alternatives presented to date include

some component of reuse of existing septic systems, reuse of existing WWTFs, upgrade of existing WWTF, construction of new WWTFs, and regional solutions, all of which are based on a future build-out condition.

Phasing will be defined in the Draft and Final Recommended Plan Reports.

It is important to identify that costs for implementation of any Recommended Plan will be incurred over an extended time period based on the magnitude of the problem and the economic impacts associated with such a solution. Project phasing and actual future growth will also impact costs. Therefore, the use of adaptive management to monitor cost and performance will be discussed in more depth as part of the Recommended Plan. The monitoring of the embayment systems, implementation of growth controls through land use and zoning, and implementation of best management practices for control of run-off and other non-wastewater nitrogen contributions will all aid in the management of wastewater and may provide for a reduction in sewering. As towns are forced to achieve higher levels of treatment to achieve nitrogen removal, phosphorus removal, or other wastewater constituents, the costs will likely increase to provide these higher levels of treatment.

ES.6.2 Operation, Maintenance, and Monitoring of Plan Components

Operation, maintenance, ownership, and monitoring of the components of any plan will also have a significant impact on the system costs. Whether a Town or District owns/operates/maintains each of their system components (pumps, stations, treatment facilities, etc.) or relies on contract operations, private ownership, etc., these all have an impact on costs. The following section discusses some of the options the Town/District will have to consider regarding the management and operation of these systems.

ES.6.3 Options for Ownership and Management of Facilities

There are several options that can be considered in ownership and management of any facilities integrated into the Recommended Plan. Several documents have been developed on the regional, state, and federal level discussing management options that Mashpee will need to consider as Mashpee develops its approach to own and operate these facilities.

ES.6.3.1 Federal Guidance

USEPA published the “Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems” in March 2003. This document presents five different management models that could be employed by a town or regional management entity. These could relate to several issues including:

- Grinder/STEP pumping systems.
- Package/Cluster treatment facilities
- Onsite septic/denitrifying (I/A)/eco-toilet type systems.

ES.6.3.2 State Guidance

MassDEP also prepared a guidance document as part of the Massachusetts Estuaries Project. This document entitled “Embayment Restoration and Guidance for Implementation Strategies” was published in 2003, and discusses several approaches to nitrogen reduction including the formation of management districts. Mashpee has already started this process related to the formation of a Water and Sewer District;

however until the legislation regarding that District is completed it is unclear how individual systems and existing systems will fit into this new structure. Their inclusion in this new District is currently being considered.

This state guidance document summarizes the advantages of a "District Approach" in dealing with nitrogen reduction, including the flexibility and funding advantages this type of approach to management could provide.

ES.6.3.3 Regional Guidance

The Cape Cod Commission (CCC) also developed a "Cape Cod Comprehensive Regional Wastewater Management Strategy Development Project" report published in June 2003. This document also discussed Wastewater Management Districts.

The formation of a district or town department to manage these types of systems will need to be considered as part of any alternative plan.

ES.7 Framework

ES.7.1 Introduction

The Project team worked through a worksheet prepared by the Sewer Commission to consider which items/plan components should be carried forward, and based on that list Options 1A, 1B, and 1C were examined to see how these components could be integrated into those nitrogen management options. Major components were identified so that a cost evaluation of various alternatives could be compared as part of the Recommended Plan Report.

Based on the various components to be considered, each was grouped into one of the following three categories (each as defined below):

- Source Removal
- Direct Environmental Mitigation
- Land Management Strategies

ES.7.2 Source Removal

Source removal is the removal of nitrogen (or some portion of it) before it reaches the local groundwater, and can be further divided into the following subcategories:

- Wastewater Management
- Stormwater Management
- Fertilizer Management

Each of these allows the towns within the planning area to mitigate nitrogen before it enters the groundwater and eventually makes it to the ponds and estuary systems.

Several approaches were identified:

- Cluster Systems at the following locations:
  - Santuit Pond area

- Pirates Cove
- Monomoscoy / Seconsett / Popponesset Island
- Other areas

- Use of Existing WWTPs (in the planning area)
  - Use of all; however ownership, upgrade, and expansion will be site-dependent and discussed later in the cost section
- New WWTPs
  - Transfer Station and High School
  - Possibly at Keeter, Old Highwood Well
  - Unlikely at Rock Landing or Back Road sites
- Eco-Toilets
  - Mashpee needs to establish what its plan will be to address these, may follow Falmouth's lead
- MMR
  - Unknown at this time whether the site will be available for any use. Ideal for regional facility, especially if expanded recharge is allowable at the existing sand infiltration beds.
- Stormwater
  - BMPs need to be implemented on a case-by-case basis, with nutrient removal capabilities considered in most sensitive watersheds

ES.7.3 Direct Environmental Mitigation

Direct environmental mitigation is essentially removal of nitrogen (or some portion of it) at or in close proximity to the area of impact. This can be further divided into the following subcategories:

- Dredging/Inlet Widening
  - No clear areas identified in either MEP reports for dredging or widening to significantly improve water quality. For Popponesset Bay the MEP report stated "it is unlikely that dredging will improve water quality with the three main subembayments", however the report stated that the main channel should continue to be dredged to avoid further degradation of estuaries health. Same as for removal of "muck" removal from the bottom any of the Town's estuaries (outside of regular maintenance for navigation).
- Shellfish Aquaculture
  - Oysters—Mashpee River, Popponesset Bay
  - Quahogs—Jehu, Hamblin, Great River, Little River, Ockway Bay, and Popponesset Bay
- Permeable Reactive Barriers (PRBs)
  - Pirates Cove
  - No other definitive areas identified at this time

- Enhanced Natural Systems
  - Abandoned Cranberry Bog naturalization/conversion
    - Discussion on bogs south of Santuit Pond and those east of the Quashnet River
    - Potential conversion of shallow ponds/water hazards to deeper ponds for additional natural attenuation

ES.7.4 Land Management Strategies

Land management strategies are essentially growth and development management strategies to reduce the potential of the PPA reaching a build-out condition which increases the cost and difficulty of achieving TMDL compliance.

Much of the discussion as part of this project to date has focused on the Source Removal approach, and recently there has been a greater push for the Direct Environmental Mitigation to be used in one of two ways—reduce or eliminate the need for Source Removal in certain areas, or be implemented prior to Source Removal—to either allow longer phasing of any Source Removal strategy or ultimately the reduction of the need for full-scale traditional wastewater management.

As was clearly shown in all eight previous scenarios, a massive amount of Source Removal is required to achieve the TMDLs under the build-out condition if Direct Environmental Mitigation is not considered or feasible.

- Growth Neutral/Flow Neutral
  - Town will need to develop a policy that meets the criteria of the State SRF program to make themselves eligible for zero-percent SRF loans
- Purchase of Open Space/Build-out Development Properties
  - Town will need to identify which properties could be purchased to reduce build-out potential, therefore reducing potential future flow and reducing the projected nitrogen loading to the embayments
- Potential Well and/or Treatment and Disposal Sites
  - Town can work towards securing additional public drinking water supply well locations and potential treated water recharge sites to foster flexibility in addressing their wastewater needs and protecting their drinking water supplies
- Seasonal and year-round property phasing impacts
  - Phasing and implementation can target year-round developments or apply near-term solutions to areas that are more seasonal in nature to achieve a quicker rate of result while minimizing infrastructure investment in the near-term

ES.8 Draft Recommended Plan and Draft Environmental Impact Report Outline

The following outline was developed for the Draft Recommended Plan Draft Environmental Impact Report. It is detailed in Chapter 7.

Chapter 1 Introduction

Chapter 2	Summary of Previous Documents Prepared as Part of Mashpee's Watershed Nitrogen Management Plan (WNMP)
Chapter 3	Public Participation and Outreach
Chapter 4	Recommended Plan Framework (from ASAR)
Chapter 5	Evaluation of Recommended Plan Variables
Chapter 6	Environmental Impact Report
Chapter 7	Recommended Plan
Chapter 8	Draft Section 61 Findings
Chapter 9	Phasing and Implementation
Chapter 10	Adaptive Management Plan Framework
Chapter 11	Next Steps

ES.9 Summary

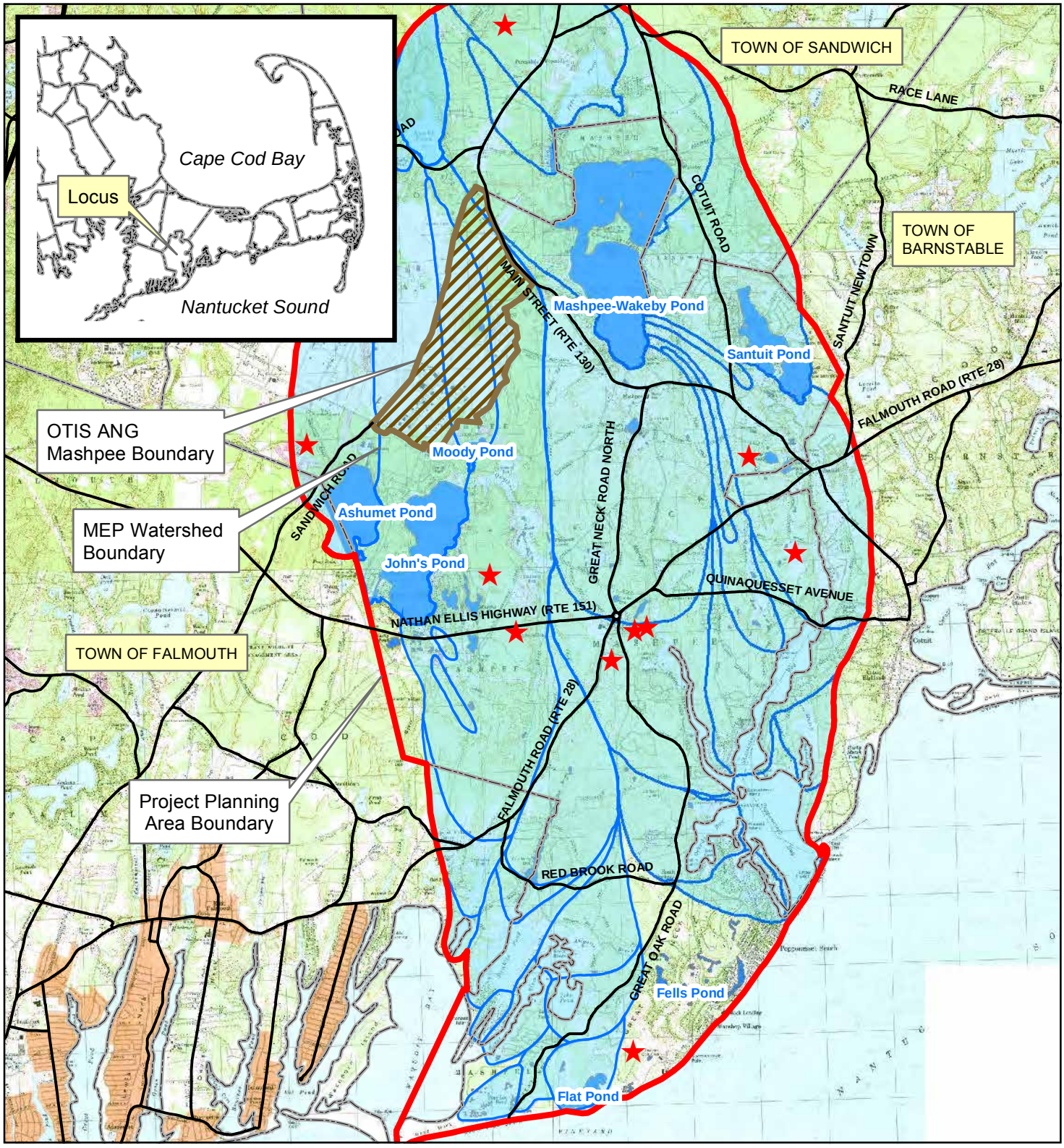
The Alternative Screening Analysis report sets the framework for the Recommended Plan; and in the draft Recommended Plan report additional evaluation of alternative methods, costing, and phasing will be established in addition to the framework for the adaptive management plan.

There remain several important factors that still need to be addressed either as part of the plan or identified as additional efforts as part of that plan to be completed as the Town looks to phase in their mitigation measures to work toward achieving the TMDLs with their neighboring communities of Barnstable, Falmouth, and Sandwich. Some of those items are outlined below:

Key components and next steps in developing the Recommended Plan:

- Cape Cod Commission and MassDEP direction on the enforcement and permitting issues associated with the TMDLs, such that each Town within the PPA will have a clear understanding of their regulatory obligation, and therefore will be able to create the necessary structure to monitor, manage, and enforce TMDL compliance, whether that be through a Board of Health, Sewer Commission, Department of Public Works, Sewer Department, Sewer District, or other structure.
- Development of an Adaptive Management Plan and Long-term TMDL Monitoring (fresh and salt water). The groundwater travel patterns and times, and estuary flushing conditions are influenced by a number of factors; an appropriate plan will need to be developed by the towns and regulatory agencies to monitor the effectiveness of the plan in meeting the TMDLs.
- Development of a flexible management approach that allows change based on the permitting and monitoring requirements identified above. As part of the WNMP, it is anticipated that a cost-effective approach to water quality improvement in the estuaries will be established, setting the framework of fiscally achievable goals with a long-term plan (likely greater than 20 years) to work towards TMDL compliance.

- Need to discuss ownership of collection systems, management options, development versus build-out impact on costs, including private facilities acquisition/ownership/operations/maintenance
- The plan's funding mechanism including cost of phasing and bonding in increments
- Additional effluent disposal site evaluations (including those outside of the watersheds) and securing of facility, cluster, and PRB sites, and pumping station locations
- Development of sewer regulations and sewer rate structure
- Phosphorus removal considerations (upgradient of fresh water systems)
- Consideration of Town regulation on fertilizer use/application



LEGEND

★ WWTF Location

***The Project Area is the combination of the Town of Mashpee area and the watersheds of Popponesset Bay and Waquoit Bay-East as delineated by the Massachusetts Estuaries Project (MEP)**

Paper Size ANSI A

0 0.375 0.75 1.5 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

GHD

Town of Mashpee Sewer Commisiion
Watershed Nitrogen Management Plan

LOCUS MAP

Job Number 86-12001
Revision A
Date 07 Aug 2013

Figure ES-1

1545 Iyannough Road, Hyannis Massachusetts 02601 USA T 1 508 362 5680 F 1 508 362 5684 E hyamail@ghd.com W www.ghd.com

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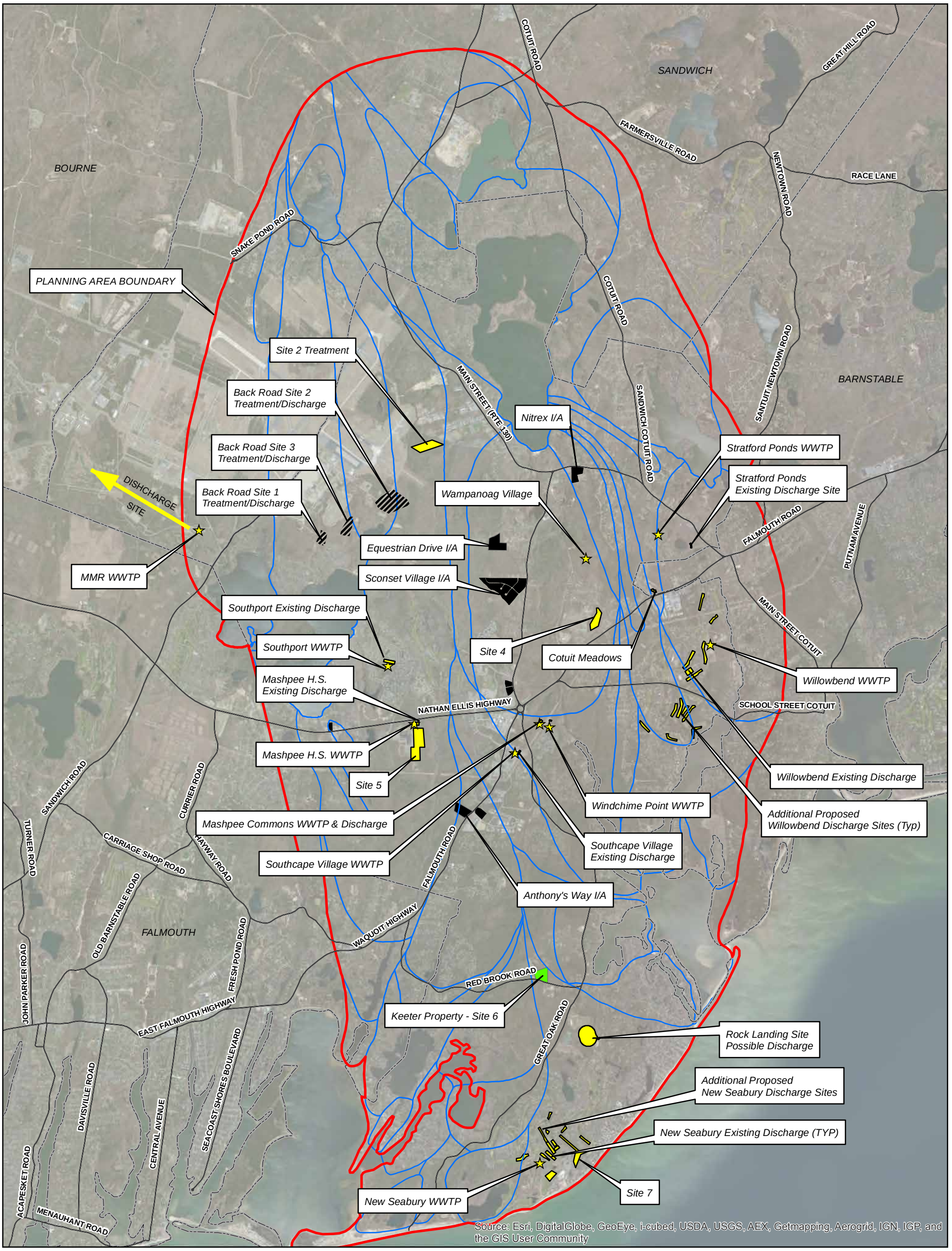

LEGEND

- MMR_Site
- Planning Area Boundary
- Town Boundaries
- Proposed Treatment/Discharge Site
- Existing Discharge Site
- Existing Private WWTP
- I/A Systems (cluster only)

Paper Size ANSI B

0 0.375 0.75 1.5 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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GHD

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Wastewater Removal Areas

Job Number 86-12001
Revision A
Date 07 Aug 2013

Figure ES-2

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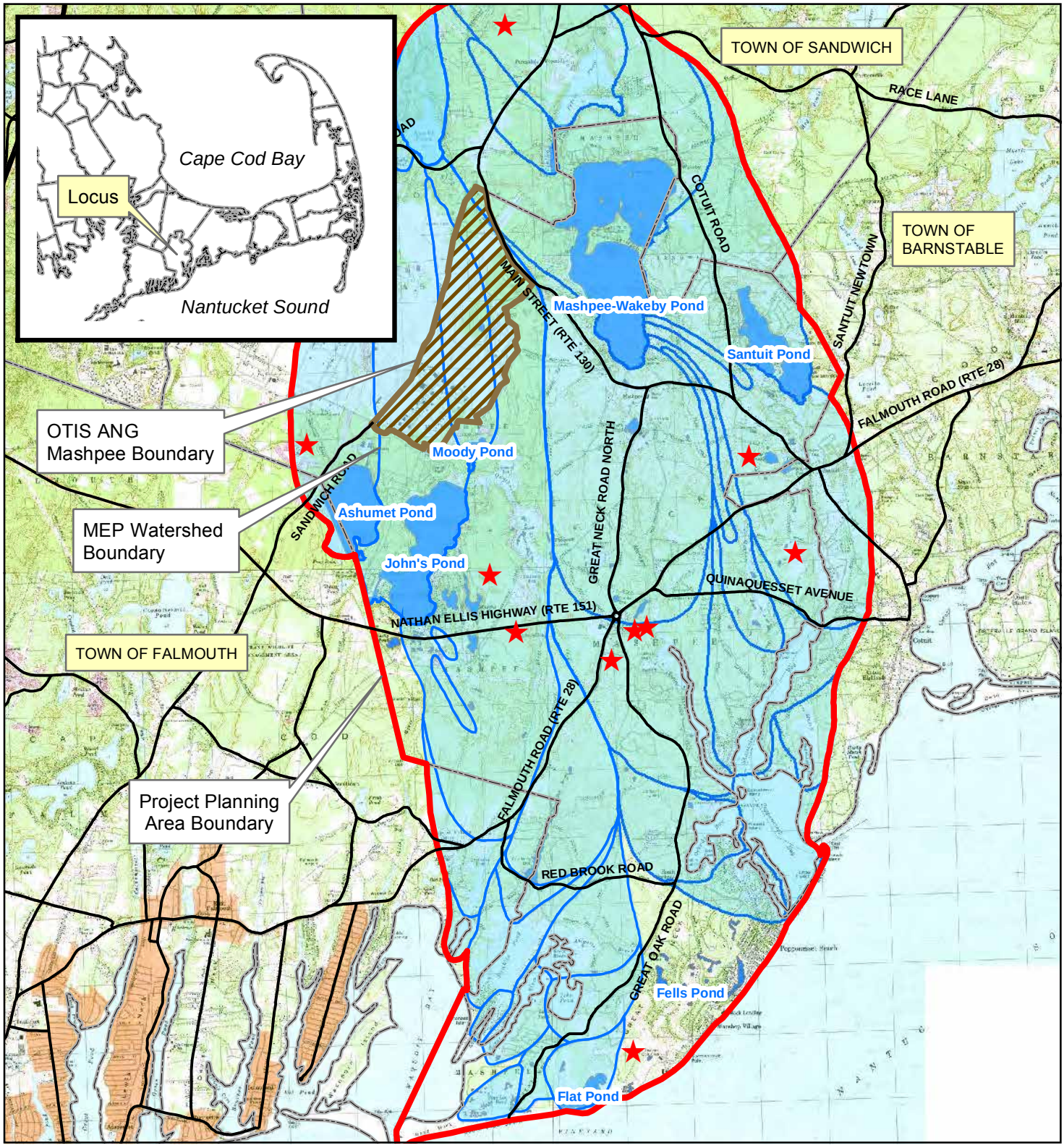

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Town of Mashpee Sewer Commisiion
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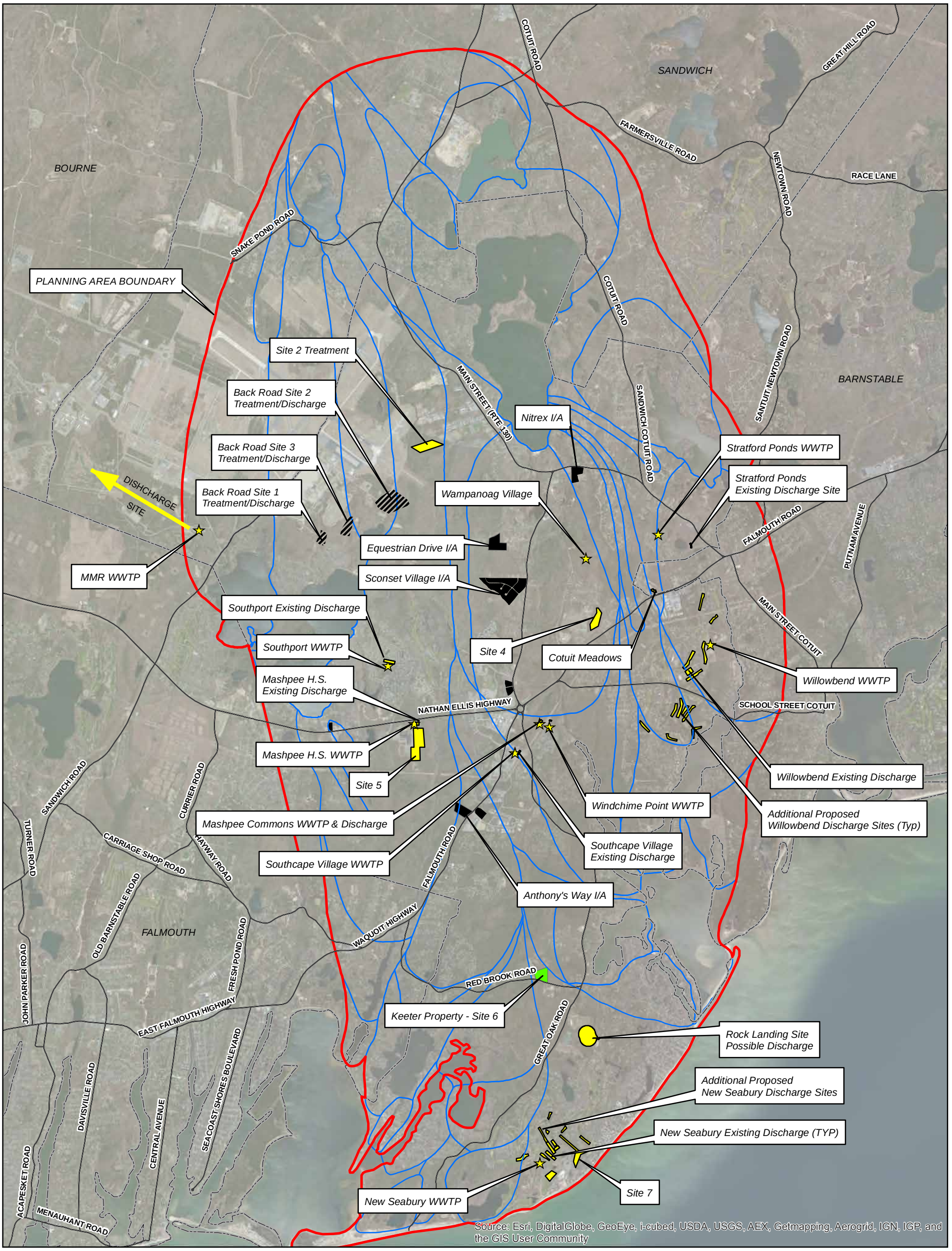

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GHD

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Appendix I Town of Mashpee Selectmen Letter to MMR Dated March 27, 2013

Appendix J Complete 2007 Technical Screening Report

Appendix K Complete Draft 2008 Alternative Scenarios and Site Evaluation Report

Glossary of Common Acronyms

ACEC	Area of Critical Environmental Concern
ASAR	Alternatives Screening Analysis Report
AS/EA	Activated Sludge/Extended Aeration
BMP	Best Management Practices
BNR	Biological Nitrogen Removal
BOD	Biochemical Oxygen Demand
CAC	Citizens Advisory Committee
CCC	Cape Cod Commission
CD	Compact Disc
DEIR	Draft Environmental Impact Report
DEP	Department of Environmental Protection
FAST	Fixed Activated Sludge Treatment
FEIR	Final Environmental Impact Report
GIS	Geographic Information System
gpd	gallons per day
GWDP	Groundwater Discharge Permit
I/A	Innovative and Alternative
kg/yr	kilograms per year
LAI	Lombardo Associates, Inc.
LID	Low Impact Development
MassDEP	Massachusetts Department of Environmental Protection
MBR	Membrane Bio-Reactor
MEP	Massachusetts Estuaries Project
MEPA	Massachusetts Environmental Policy Act
mgd	million gallons per day
mg/L	milligrams per liter
ml	milliliters
MMR	Massachusetts Military Reservation

MOU	Memorandum of Understanding
NAR	Needs Assessment Report
NHESP	Natural Heritage and Endangered Species Program
NTU	Nephelometric Turbidity Units
O&M	Operations & Maintenance
PPA	Project Planning Area
PRB	Permeable Reactive Barrier
RBC	Rotating Biological Contactor
RME	Responsible Management Entity
RSF	Recirculating Sand Filter
SBR	Sequencing Batch Reactor
SMAST	School of Marine Science and Technology
SRF	State Revolving Fund
STEG	Septic Tank Effluent Gravity
STEP	Septic Tank Effluent Pump
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	Ultraviolet
WNMP	Watershed Nitrogen Management Plan
WWTF	Wastewater Treatment Facility

1 Introduction

1.1 Project Identification and Purpose

The Town of Mashpee initiated a Watershed Nitrogen Management Plan (WNMP) in 1999 in order to address the need for reducing nitrogen impacts to coastal embayments and to evaluate options for restoring those embayments. Because the contributing areas to the estuaries (watersheds) are shared by multiple towns, Mashpee's WNMP Project Planning Area includes the Town of Mashpee and the portions of neighboring towns (Barnstable, Falmouth, and Sandwich) that fall within the Popponesset Bay and Waquoit Bay East watersheds. The Project Planning Area is illustrated in Figure 1-1. The WNMP is intended to provide an environmentally and economically sound plan for nitrogen reduction, wastewater treatment, and treated water recharge in the Project Planning Area.

The purpose of the Alternatives Screening Analysis Report is to supplement the Draft Alternative Scenarios Evaluation and Site Evaluation Report issued in March 2008 and to expand on those results by evaluating three additional scenarios/options in order to make recommendations as the Town of Mashpee moves towards development of a Recommended Plan.

The first major deliverable for the WNMP was the Needs Assessment Report (NAR), issued in April 2007. The Needs Assessment Report was designed to develop the understanding of existing and future conditions in the Project Planning Area. The Needs Assessment Report summarized information on existing wastewater facilities (septic systems and small treatment plants), physical/environmental features, land use patterns, and regulatory issues affecting wastewater facilities. The Needs Assessment Report identified future conditions for the Project Planning Area relating to population, growth, and the potential effects of that growth on any proposed wastewater collection, treatment, and disposal facilities.

The second major deliverable was the Technology Screening Report—issued in November 2007—which outlined various centralized and decentralized wastewater collection, treatment, and disposal technologies, and the advantages and disadvantages of each. It provided recommendations of technologies to be considered for use in the development of the scenarios, and ultimately the Recommended Plan for addressing nitrogen. The Technology Screening Report, and the Alternative Scenarios Analysis and Site Evaluation Report findings and updates have been combined with additional items outlined in the scope to create this Alternatives Screening Analysis Report for Massachusetts Environmental Policy Act (MEPA) submittal and review.

The third major deliverable was the Draft Alternative Scenarios Analysis and Site Evaluation Report, issued in March 2008, which was the preliminary evaluation of potential recharge sites and development of alternative scenarios to meet the nitrogen removal needs of the Project Planning Area.

Since the start of this project two notices of project change have also been issued and their certificates and response to comments are included in Appendix ES-1.

The Town has also contracted with other consultants and received additional reports that will be used by the Town in developing their Recommended Plan in addition to information freely solicited from equipment suppliers and vendors. These reports and documents are outside of those identified in the MEPA plan of study and scope of services.

1.2 Massachusetts Estuaries Project (MEP) Findings

The MEP program was developed to evaluate the health of Massachusetts' estuaries and to establish nitrogen loading thresholds that can be used as management goals for a watershed. The MEP approach and results are discussed in detail in Chapter 4 of the Needs Assessment Report. In addition, the following reports and documents relevant to the Project Planning Area have been produced as part of MassDEP, University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST), and MEP work:

- "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Popponesset Bay, Mashpee and Barnstable, Massachusetts" Final Report – September 2004.
- "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Quashnet River, Hamblin Pond, and Jehu Pond, in the Waquoit Bay System of the Towns of Mashpee and Falmouth, MA" Final Report – January 2005.
- "FINAL DRAFT: Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen" October 14, 2005.
- "FINAL: Popponesset Bay Total Maximum Daily Loads for Total Nitrogen" December 5, 2006.
- MEP Technical Memo "Popponesset Bay: Results Pilot Modeling Scenarios – Final" June 15, 2006.
- MassDEP "Inter-municipal Watershed Planning and TMDL Implementation to Restore Embayment Water Quality on Cape Cod: Three Case Studies of Towns Sharing Coastal Watersheds" November 2008.
- MEP Technical Memo "Report on Unified Database and Requested MEP Scenarios", November 13, 2009.
- MEP Technical Memo "Report on Revised MEP Scenario 3 for Eastern Basins of Waquoit Bay System", February 9, 2010.
- "Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Waquoit Bay and Eel Pond Embayment System – Towns of Falmouth and Mashpee, Massachusetts" Revised Draft Report – May 2012.
- MEP Technical Memo " Scenarios Results for Popponesset Bay and Waquiot Bay based on MEP Linked Models", November 15, 2012 (revised).

Results obtained through the MEP monitoring and modeling are used to provide one possible scenario (as presented by MEP) to achieve the nitrogen limits for a given estuary. Table 1-1 summarizes the suggested nitrogen removal rates from septic systems in the subwatersheds of Popponesset Bay and Waquoit Bay East under "existing" (2001) conditions as presented as part of the original reports and as updated based on the 2012 Revised Draft MEP Report for Waquoit Bay.

Table 1-1 Percent Nitrogen Removals from Septic Systems

Embayment System	Embayment	Percent Removal to Meet Threshold [3]	Updated Percent Removal to Meet Threshold [3]
Popponesset Bay System[1]	Popponesset Bay	0%	0%
	Popponesset Creek	100%	100%
	Pinquickset Cove	0%	0%
	Ockway Bay	100%	100%
	Mashpee River	100%	100%
	Shoestring Bay	100%	100%
	Mashpee River [4]	49%	49%
	Santuit River [4]	35%	35%
	Quaker Run River [4]	0%	0%
Waquoit Bay System[2] [6]	Hamblin Pond	75%	100%
	Upper Hamblin Pond	75%	100%
	Little River	75%	100%
	Lower Great River	100%	100%
	Upper Great River	100%	100%
	Jehu Pond	100%	100%
	Upper Quashnet River	67%	67%
	Lower Quashnet River	67%	67%
	Red Brook [4]	75%	90%
	Quashnet River [4, 5]	67%	67%

Notes:

1. Source: Table B-1 of *Final Popponesset Bay Total Maximum Daily Loads for Total Nitrogen*, April 10, 2006, no change in the "updated column".
2. Source: Table B-1 of *Final Draft Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen*, October 14, 2005.
3. Based on one MEP developed scenario, that is considered one of many potential scenarios to achieve the target concentration.
4. Indicates a surface water source.
5. MEP report lists this as Moonakis River. However, based on information provided by the Mashpee Town Planner, Moonakis River is only the lower, brackish portion of this river (Moonakis referring to the name given to the river in the Town of Falmouth).
6. Source: Updated Column Table VIII-2 of *Revised Draft Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Waquoit Bay and Eel Pond Embayment System Towns of Falmouth and Mashpee, Massachusetts,* May 2012.

Figure 1-2 shows the various subwatersheds and the updated removal percentages identified in Table 1-1. These percent removals form the initial basis for the alternative scenarios and options developed to date, and evaluated in detail in this report. However, the scenarios and options were also based on the findings of the Needs Assessment Report and therefore were a combination of the information presented in Table 1-1 and the findings summarized in the following section.

1.3 Needs Assessment Report Findings

The Needs Assessment Report (April 2007) discussed the environmental resources, existing and future development conditions, and nitrogen removal needs. In addition, various factors were identified to aid in determining priority areas for nitrogen removal and development of a management plan. The factors that were used in identification of priority areas included:

- MEP calculations of necessary nitrogen removal for estuary health.
- Wastewater nitrogen loading per acre.
- Seasonality (seasonality was identified for towns outside of Mashpee for comparison only—the other towns may not consider this a priority when developing their town-wide management plans).
- Other Town considerations (phosphorus, previous studies, etc.).

Planning zones were grouped into primary, secondary, and tertiary priority areas based on the criteria listed above. Figure 1-3 summarized the initial 2007 Needs Assessment classification of the priority areas throughout the Project Planning Area. It should be noted that the identification of these priority areas was performed as a planning tool to identify areas with high nitrogen removal needs. Table 1-2 (Table 9-1 of the Needs Assessment Report) outlines the various priority areas and the criteria used in the identification of these areas.

Table 1-2 Priority Area Criteria Summary

Priority Area Name	MEP Removal Rate	Nitrogen Loading Rates	Year-Round	Other Town Considerations	Zone II
Primary Priority Areas					
M-1 – Johns Pond	√	√	√		
M-2 – Mashpee Central	√	√	√		
M-3 – Shoestring Bay	√	√	√		√
Secondary Priority Areas					
M-4 – Santuit Pond		√	√	√	√
M-5 – Mashpee River			√	√	√
M-6 – Jehu Pond	√	√			
M-7 – Popponesset Creek	√	√			
S-4 – Sandwich Quashnet		√	√		√
F-1 – Red Brook	√	√			
Tertiary Priority Areas					
M-8 – Mashpee-Wakeby Pond			√		
M-9 – MMR			√		
M-10 – Mashpee East			√		√

Priority Area Name	MEP Removal Rate	Nitrogen Loading Rates	Year-Round	Other Town Considerations	Zone II
M-11 – Quashnet River			√		√
M-12 – Mashpee South			√		√
M-13 – New Seabury		√			√
B-1 – Barnstable Fresh Water			√		√
B-2 – Shoestring Bay (Barnstable)	√		√		√
B-3 – Pinquickset Cove					
B-4 – Popponesset Bay	√				
S-1 – Sandwich West			√		√
S-2 – J Well			√		√
S-3 – Snake Pond			√		√
S-5 – Sandwich Popponesset			√		√
F-2 – Falmouth Quashnet	√				
F-3 – Falmouth North			√		√

Note: Prioritization is based on build-out conditions.

1.3.1 Needs Assessment Report Revisions

The Needs Assessment Report included two tables summarizing nitrogen loads: Table 7-9 summarized load by town; and Table 8-2 summarized load by planning area (both included in Appendix A) as broken down by Town and watershed. These tables outline how the nitrogen loads are attributed to the various priority areas. The tables identify the average annual nitrogen load (in kg/yr) as generated by wastewater sources (septic systems, small wastewater treatment plants) and non-wastewater sources (fertilizer, run-off, natural deposition). These tables were developed based on 35 mg/L total nitrogen from septic systems and did not account for attenuation. The loads were adjusted for nitrogen reduction through the leaching facilities to an estimated concentration of 26.25 mg/L according to MassDEP and MEP. Upon further analysis of the data, it was noted that there was a difference in how nitrogen loads to golf courses were determined. The nitrogen loads were recalculated using methodology consistent with MEP calculations for golf courses. The tables were reissued as an addendum to the original report.

This information was initially intended to form the basis for developing scenarios to address nitrogen within the watersheds.

These adjusted nitrogen loads at the 26.25 mg/L concentration are later entered into the MEP “rainbow” spreadsheets (Table IV-5 from the MEP technical reports for each estuary). Once entered into the “rainbow” tables, the same attenuation factors applied as part of the MEP work were able to be applied to the new estimates of wastewater nitrogen load (including septic and wastewater treatment recharge) to estimate the load each estuary may see.

In addition to the changes to the tables discussed above, there was further input from the Town of Barnstable regarding priority areas. Three areas within Area B-2 “Shoestring Bay (Barnstable)” were identified during the Town of Barnstable’s facilities planning process as “Areas of Concern” (designated in that report as C3, C4, and C5). Therefore, additional consideration should be made as part of the scenarios development to incorporate solutions for these areas.

In the six-plus years since the NAR was originally produced and reviewed, the Town and Sewer Commission have requested adjustments to the approach and additional data has come from MEP and other sources. The scenarios discussed later in this report reflect these changes.

1.4 Technology Screening Report Summary

1.4.1 Introduction

The Technology Screening Report (November 2007) identified a group of alternative wastewater management options to meet the Project Planning Area’s wastewater treatment and disposal needs. This section summarizes the findings presented as part of the 2007 Technology Screening Report. This complete report is included on compact disc (CD) as Appendix J.

The Technology Screening Report identified specific technologies associated with:

- Decentralized technologies including:
  - Individual Innovative and Alternative (I/A) septic systems.
  - Cluster systems:
    - Those serving flows less than 10,000 gallons per day (gpd).
    - Those requiring a groundwater discharge permit (small wastewater treatment plants).
- Centralized facilities:
  - Those facilities serving large areas of Town. These facilities are often municipally run and typically treat wastewater flows greater than 150,000 gpd.

Some additional components that are associated with cluster systems and centralized facilities were evaluated in this report. Those components included:

- Collection systems.
- Disinfection technologies.
- Effluent disposal (treated water recharge).
- Water reuse technologies.

In addition, the report examined other methods of reducing nitrogen through stormwater control, fertilizer management, oyster/shellfish propagation, and groundwater treatment. All of these non-wastewater related methods can provide a positive means of reducing nitrogen (to varying degrees), but they would be difficult to rely on or quantify for consistent, widespread performance to achieve a Total Maximum Daily Load (TMDL). It is important to state that a number of these nitrogen reduction measures will vary in their nitrogen removal performance because of their reliance on natural systems and highly variable loadings. Many are not currently credited with nitrogen removal by regulatory agencies; and therefore additional public education, management structure, and enforcement would be required in order for them to be

considered a reliable, long-term means of nitrogen removal, however they are all considered potential parts of any adaptive management plan.

1.4.2 Findings

The findings and recommendations from the Technology Screening Report are summarized in the following sections.

1.4.2.1 Decentralized Treatment Alternatives

All of the technologies identified by MassDEP as I/A technologies and that are approved for use (whether Pilot, Provisional, or General Use) are considered feasible for use in the Project Planning Area. Although none of these technologies are ruled out completely, some of these technologies have shown better performance (based on the Barnstable County Report) on Cape Cod. The following technologies are considered the most favorable for nitrogen removal applications within the Project Planning Area:

- Fixed Activated Sludge Treatment (FAST)
- Recirculating Sand Filters (RSF)
- Bioclere™
- Nitrex™ combined with Omni RSF (or other nitrifying process)
- RUCK®
- Amphidrome®
- Waterloo Biofilter®
- Norweco Singulair®

Other technologies either have very limited performance data or other considerations that make them less favorable.

1.4.2.2 Small Wastewater Treatment Facilities and Cluster Systems

Small wastewater treatment facilities and cluster systems, similar to a number of facilities found in Mashpee, utilize biological nitrogen removal (BNR) processes that are compact in size and are generally more mechanized than the individual and multiple-home, on-site type systems (not requiring a groundwater discharge permit) discussed in the Technology Screening Report. These wastewater treatment facilities can produce a treated effluent that meets the permitted standards of 30 mg/L Biochemical Oxygen Demand (BOD_5), 30 mg/L Total Suspended Solids (TSS), and 10 mg/L nitrate-N. Rotating biological contactors (RBCs), sequencing batch reactors (SBRs), Amphidrome®, and MBR systems were recommended for further consideration due to the flexibility in relation to providing treatment for relatively small wastewater flows and their current (or proposed) use throughout Mashpee. SBRs are often more expensive for smaller flows but become more cost-effective as the flows increase due to the change from precast structures to cast-in-place concrete; they also remain fairly compact and have other process advantages over some of the more package type systems like Bioclere™, Amphidrome®, and FAST systems. Those package type systems are often more cost-effective at lower flows but are less flexible when it comes to any potential expansion.

Bioclere™ and FAST systems would not be recommended for use (as small wastewater treatment facilities) in the Project Planning Area as they would be introducing another technology into a planning

area that already has a variety of systems. If the Town of Mashpee (or an existing or future district) were to take over management of the existing facilities, the best option would be to minimize the number of different systems and maximize common components, spare parts, and operational requirements to simplify the operations and maintenance activities for multiple wastewater treatment facilities.

1.4.2.3 Centralized Treatment Facilities

Centralized facilities capable of treating larger wastewater flows (considered greater than 150,000 gpd for the purpose of this report) were discussed separately from the small/cluster package plants discussed in the Technology Screening Report. The following list summarizes those that were recommended for further consideration as the WNMP process continues:

- Activated Sludge/Extended Aeration (AS/EA)
- Sequencing Batch Reactor
- Membrane Biological Reactor (MBR)
- Denitrification Filters (in combination with other centralized technologies)

RBCs, although very common in Mashpee, may become cost-prohibitive for a large-scale wastewater treatment facility (as flows exceed 0.5 mgd) because of the large structure required to house such a facility and to shelter components in winter conditions. On the other hand, the recommended technologies can have large open tanks or—in the case of MBRs—a smaller footprint, reducing the cost of structures. Therefore, RBCs would not be considered for a centralized facility, unless site conditions or other conditions are identified during final design.

1.4.2.4 Disinfection Alternatives

It is very likely that any treatment facilities constructed in the Project Planning Area will be required to provide disinfection. The disinfection technologies considered in the Technology Screening Report were:

- Chlorination
- Ozonation
- Ultraviolet (UV) radiation

Based on the higher costs and safety concerns associated with chlorination and ozonation, UV disinfection was the only technology that is recommended.

1.4.2.5 Collection System Technologies

Prior to reaching a treatment facility, wastewater flows through a collection system. The following collection system technologies were discussed in the Technology Screening Report:

- Gravity sewers and lift stations
- Pressure sewers and grinder pumps
- Septic tank effluent sewers (pump and gravity systems)
- Vacuum sewers
- Combination of technologies

Many collection systems involve a combination of the various technologies. One possible combination that will be practical for use in the Project Planning Area involves gravity and low pressure systems, as

discussed in the Sewer Modeling and Preliminary Design Evaluations Guidance Document and Case Study Report prepared for Barnstable County. Since the development of this report, the Town also received "complementary" evaluations from various manufacturers (AIRVAC, E-One, and Orenco representing STEP/STEG systems).

When a project area consists of rolling terrain and large numbers of properties located in low areas along ponds, wetland, rivers, and estuaries, a combination of technologies is typically most cost-effective. The most common technology combination is gravity and pressure sewers, although other technologies can be considered.

Although other options like vacuum sewers and septic tank effluent pump (STEP)/septic tank effluent gravity (STEG) systems can also be used; for the purpose of developing order of magnitude costs for this report, gravity and pressure were used. The Mashpee Sewer Commission has requested that all collection system technologies remain under consideration as the scenarios are refined and a Recommended Plan is developed.

1.4.2.6 Treated Water Recharge (Effluent Discharge) Technologies

All wastewater treatment facilities require a means of discharging and/or reusing treated effluent. The technology selected for treated water recharge needs to be specific to the discharge site to minimize the impacts of treated water on nearby surface waters and groundwater, while utilizing the unique features of any potential site. Land availability, nearby land use, discharge technology, and distance from the treatment plant also play a role in determining suitable effluent discharge sites.

The alternatives that were recommended for further consideration include:

- Wetland restoration
- Sand beds
- Subsurface infiltration
- Drip irrigation

The Mashpee Sewer Commission has also expressed interest in further consideration of wick-well technology. It was identified that one of the reasons it was screened out had to do with the limited number of facilities, limited performance data, and the potential for redundant systems to be installed as a backup for treated water recharge. Therefore, this technology will remain under consideration, and a determination will be made as part of the Recommended Plan as to its use for the Project Planning Area.

1.4.2.7 Stormwater Treatment Technologies

Stormwater runoff is typically a significant nitrogen source, although this depends on the amount of impervious area (roofs, driveways, roads, parking lots, etc.) in a planning zone. Reduction of impervious areas can reduce the resulting pollutant loads. Town bylaws can be used to encourage Low Impact Development (LID), to regulate amounts of impervious areas, and to reduce the amount of runoff that flows to Town paved roads from individual properties. However, runoff from paved roads is also a significant contributor to nitrogen loads.

The Technology Screening Report included a discussion on various nitrogen removal alternatives that do not involve wastewater management, including stormwater technologies. The stormwater management alternatives that were evaluated and screened include:

- Dry extended detention basins
- Wet retention ponds
- Infiltration basins
- Stormwater wetlands
- Submerged gravel wetlands
- Bioretention (rain gardens)
- Water quality swales
- Porous pavement
- Infiltration trenches

As presented earlier, the use of other non-wastewater related methods of reducing nitrogen through stormwater control, fertilizer management, oyster/shellfish propagation, and groundwater treatment has its limitations when trying to achieve a regulated limit. Best management practices for stormwater control, fertilizer management, and other innovative non-wastewater approaches can provide a positive means of reducing nitrogen but are difficult to rely on for consistent performance. It is important to identify that a number of these nitrogen control measures will vary in their nitrogen removal performance because of their reliance on natural systems and highly variable loadings. Many are not currently credited with nitrogen removal by regulatory agencies and would therefore require additional public education, management structure, and enforcement to be considered a reliable/long-term means of nitrogen removal.

1.4.3 Summary

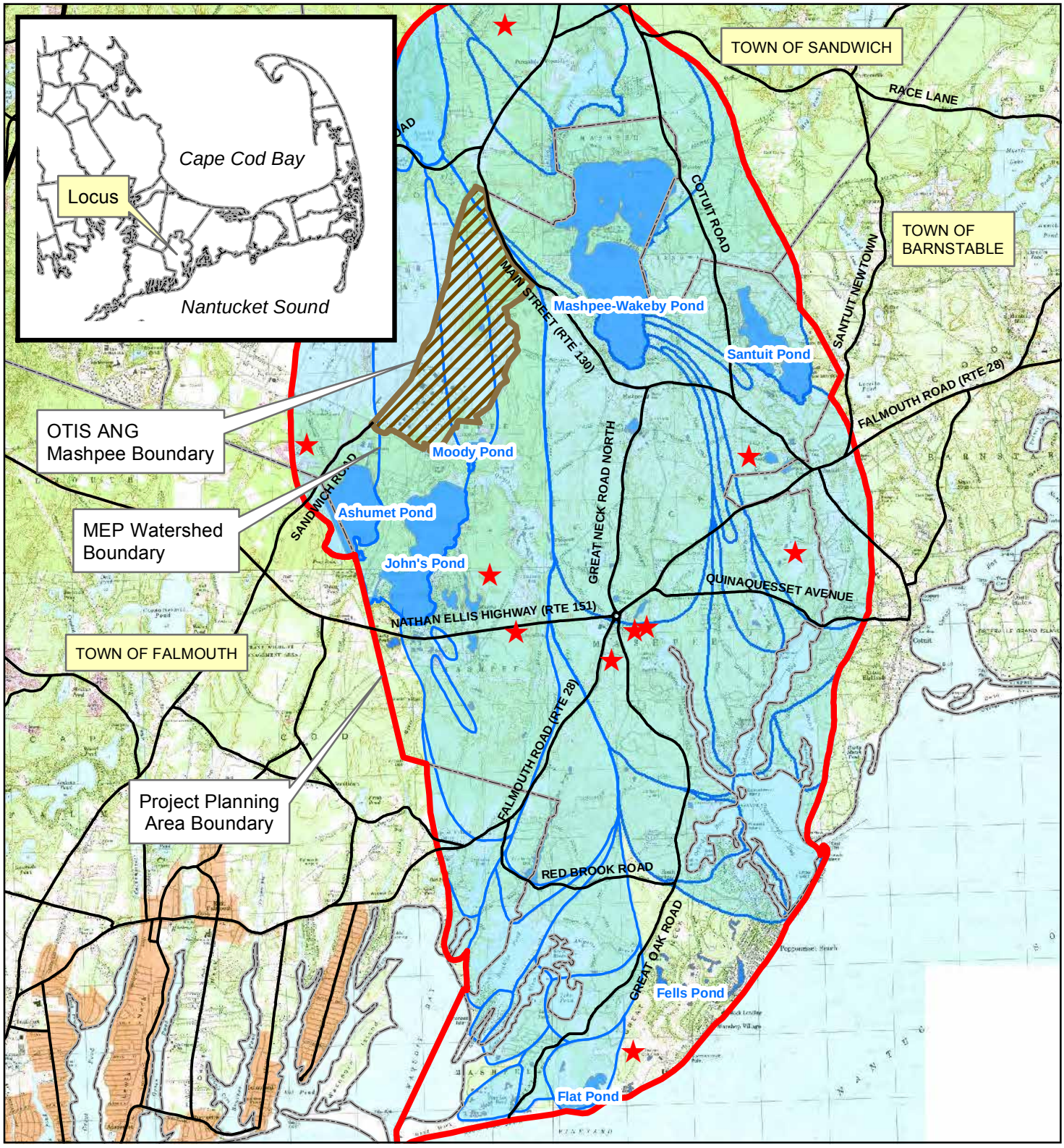
Appendix B includes the technology summary tables from the original report:

- Table 4-2 Summary of Decentralized Treatment Technologies
- Table 5-1 Small Wastewater Treatment Facilities (Package Plants)
- Table 5-3 Summary of Secondary/Advanced Treatment Technologies
- Table 5-4 Summary of Disinfection Technologies
- Table 6-1 Summary of Sewer System Technologies
- Table 6-2 Summary of Effluent Discharge Technologies
- Table 7-1 Summary of Stormwater Treatment Technologies

Since the six-plus years following the submittal of the final Technology Screening Analysis Report, the Town and Sewer Commission have identified the desire to keep as many technologies open for consideration with increased interest in some of the newer—or in some cases less traditional—options including:

- MBRs
- Nitrex™ denitrifying filters
- Permeable Reactive Barriers (PRBs)
- Vacuum Sewers
- STEP Sewers
- Shellfish propagation

However, they understand that other more traditional technologies will need to be used and the Town will need to work to take advantage of as much existing infrastructure as they can.



LEGEND

★ WWTF Location

***The Project Area is the combination of the Town of Mashpee area and the watersheds of Popponesset Bay and Waquoit Bay-East as delineated by the Massachusetts Estuaries Project (MEP)**

Paper Size ANSI A

0 0.375 0.75 1.5 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

GHD

Town of Mashpee Sewer Commisiion
Watershed Nitrogen Management Plan

LOCUS MAP

Job Number	86-12001
Revision	A
Date	07 Aug 2013

Figure 1-1

1545 Iyannough Road, Hyannis Massachusetts 02601 USA T 1 508 362 5680 F 1 508 362 5684 E hyamail@ghd.com W www.ghd.com

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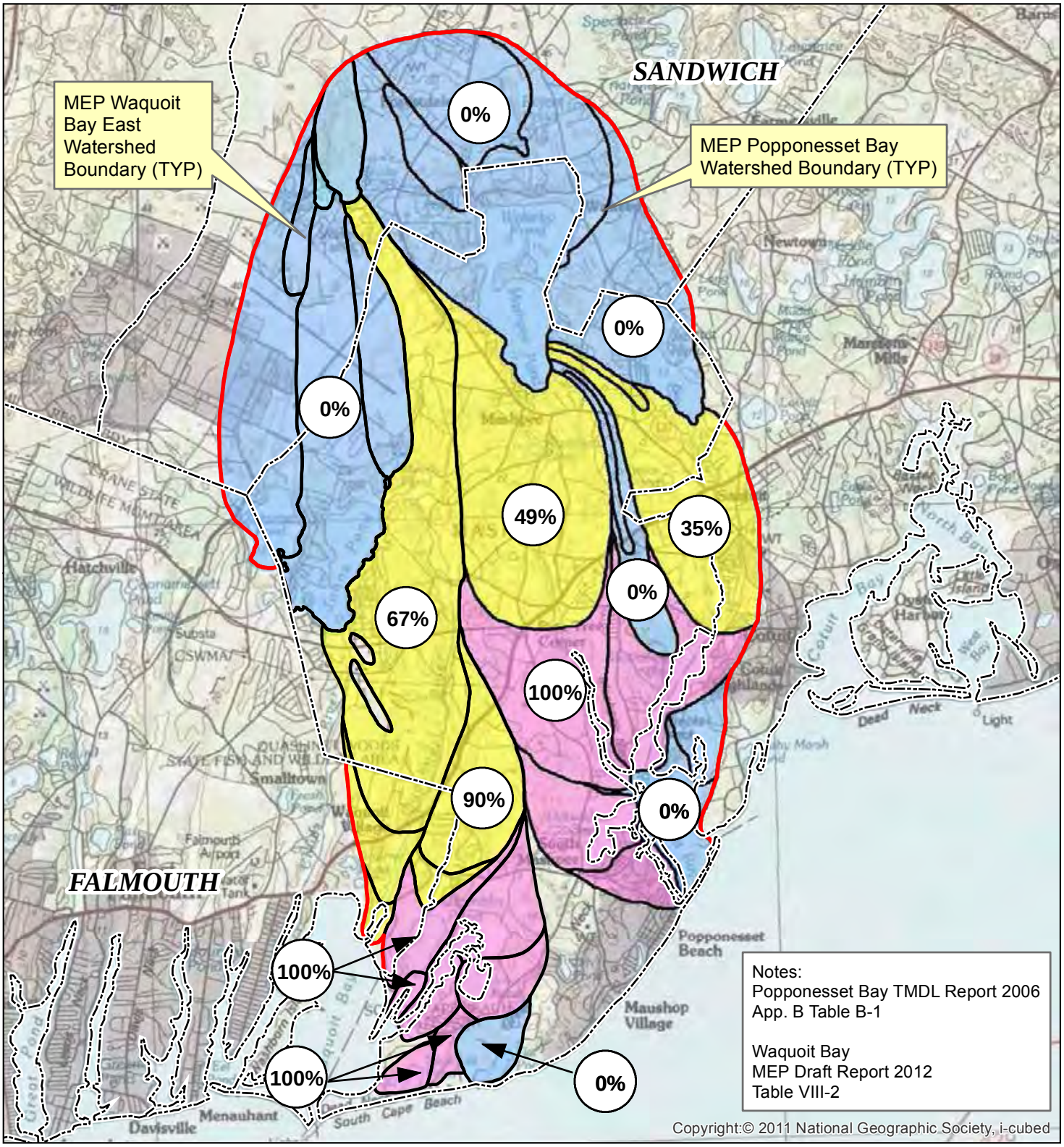

LEGEND

100% Percentage of Wastewater Nitrogen Removal Suggested by MEP (Septic Only)

0% Removal | 1-99% Removal | 100% Removal

The "Project Area" is the combination of the Town of Mashpee and the watersheds of Popponesset Bay and Waquoit Bay East as delineated by the Massachusetts Estuaries Project (MEP). Updated for draft MEP report May 2012

Paper Size ANSI A

0 0.5 1 2 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

MEP Percent Septic (only) Removals

Job Number 86-12001
Revision A
Date 17 Apr 2013

Figure 1-2

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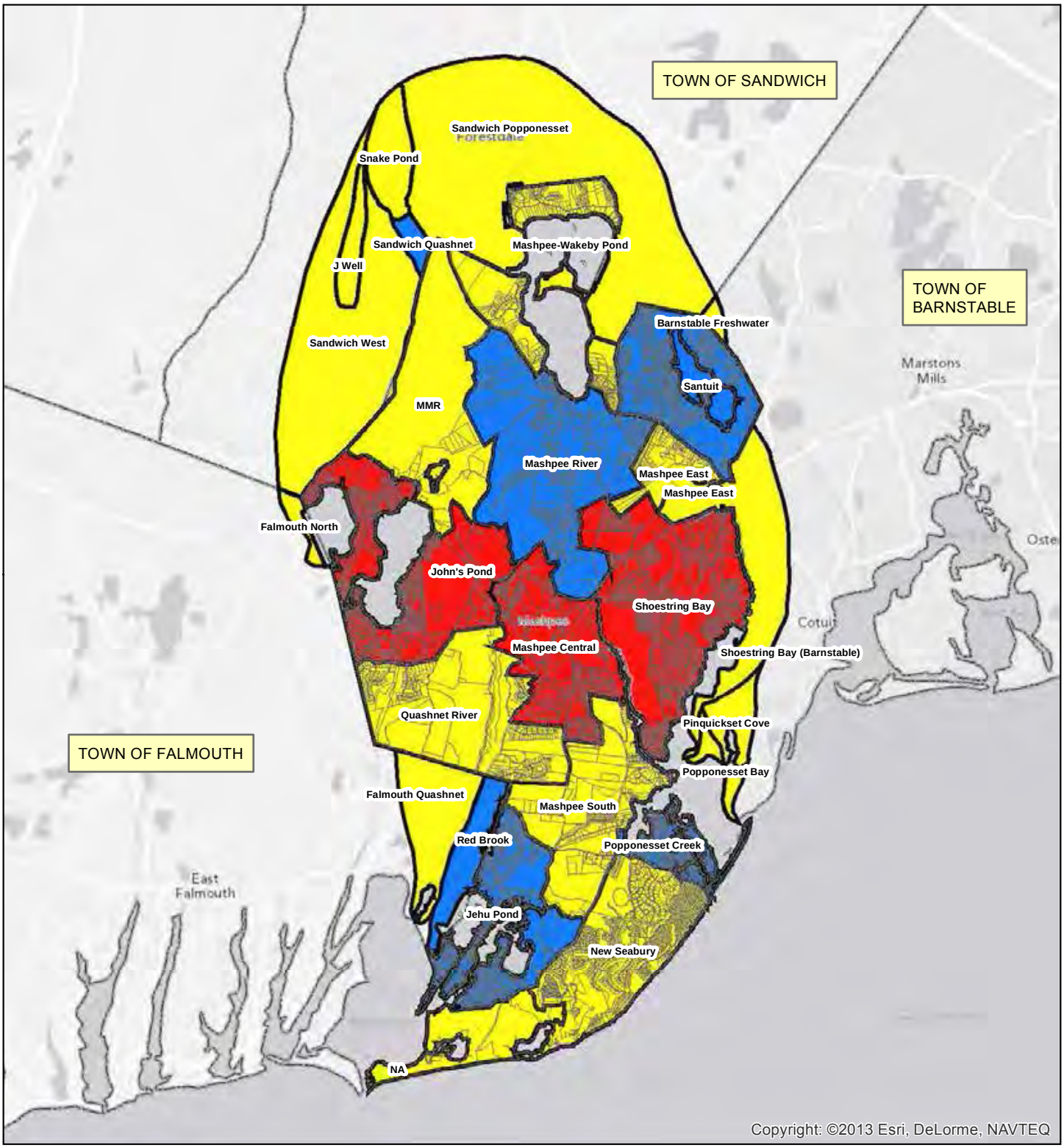

Legend

Priority Area

Primary Secondary Tertiary

Paper Size ANSI A

0 0.5 1 2 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Priority Areas

Job Number 86-12001
Revision A
Date 17 Apr 2013

Figure 1-3

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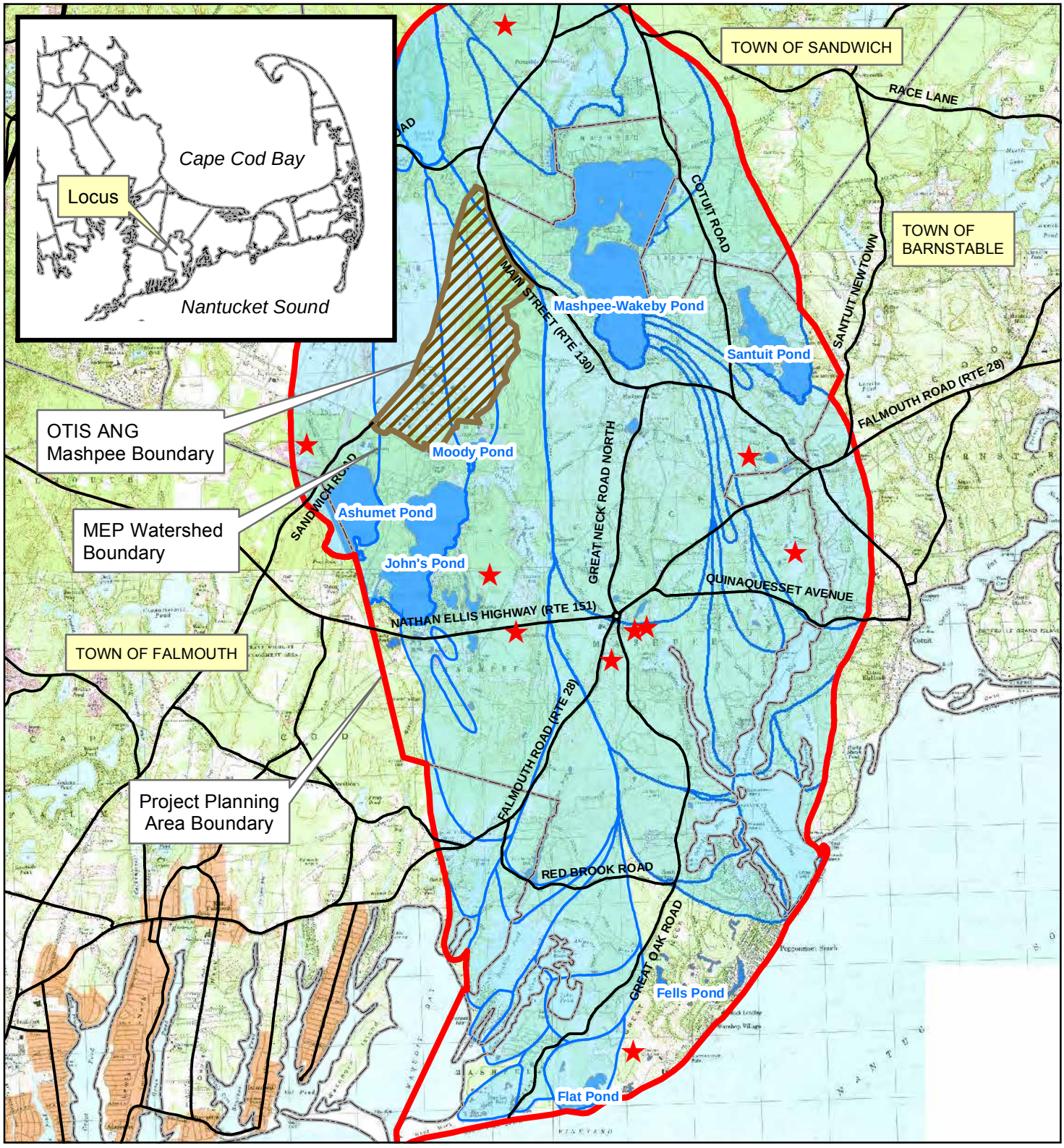

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0 0.375 0.75 1.5 Miles

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Horizontal Datum: North American 1983
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N

GHD

Town of Mashpee Sewer Commisiion
Watershed Nitrogen Management Plan

LOCUS MAP

Job Number	86-12001
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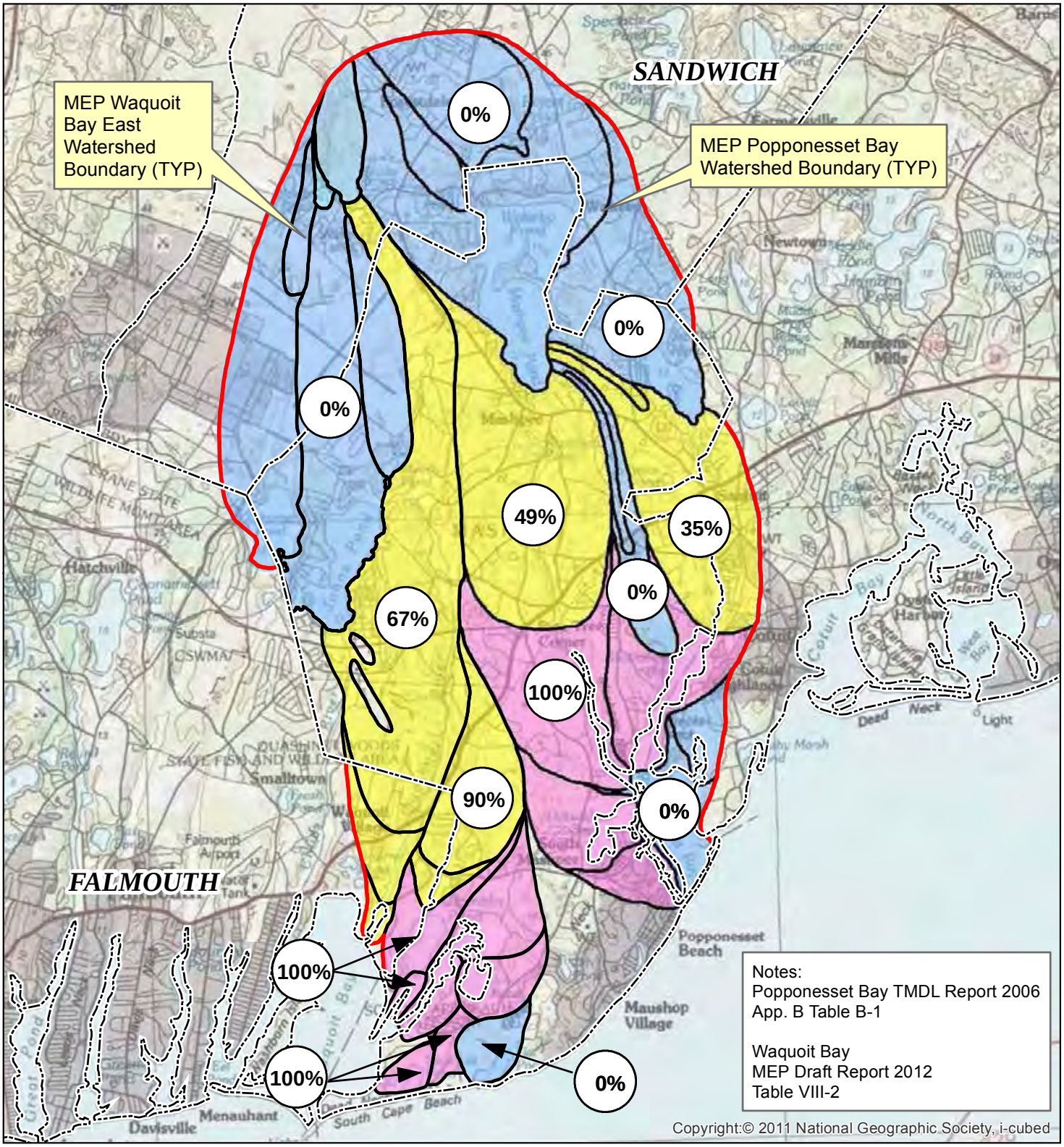

LEGEND

100% Percentage of Wastewater Nitrogen Removal Suggested by MEP (Septic Only)

0% Removal | 1-99% Removal | 100% Removal

The "Project Area" is the combination of the Town of Mashpee and the watersheds of Popponesset Bay and Waquoit Bay East as delineated by the Massachusetts Estuaries Project (MEP). Updated for draft MEP report May 2012

Paper Size ANSI A

0 0.5 1 2 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

MEP Percent Septic (only) Removals

Job Number 86-12001
Revision A
Date 17 Apr 2013

Figure 1-2

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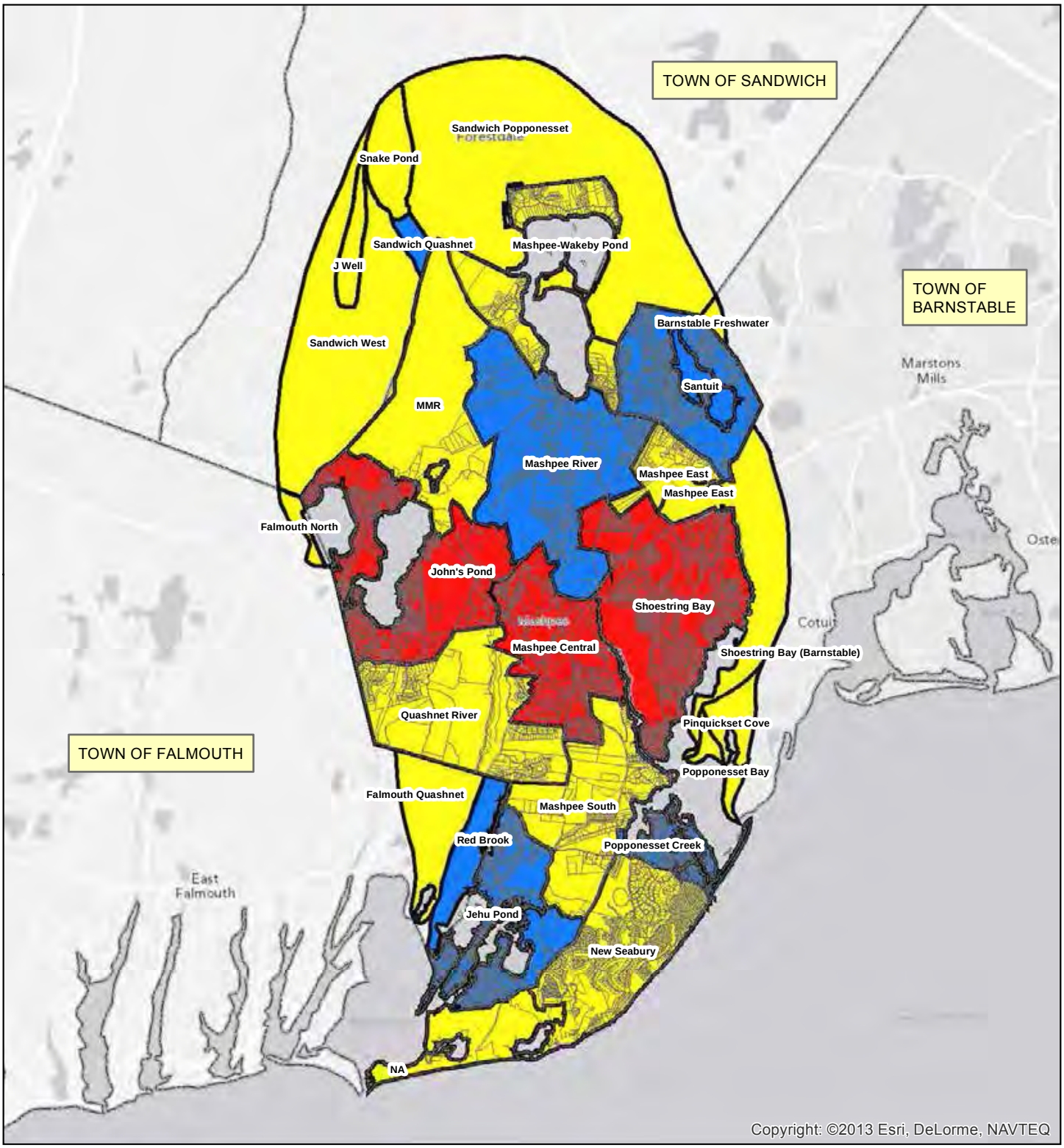

Legend

Priority Area

Primary Secondary Tertiary

Paper Size ANSI A

0 0.5 1 2 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

N

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Priority Areas

Job Number 86-12001
Revision A
Date 17 Apr 2013

Figure 1-3

1545 Iyannough Road, Hyannis Massachusetts 02601 USA T 1 508 362 5680 F 1 508 362 5684 E hyamail@ghd.com W www.ghd.com

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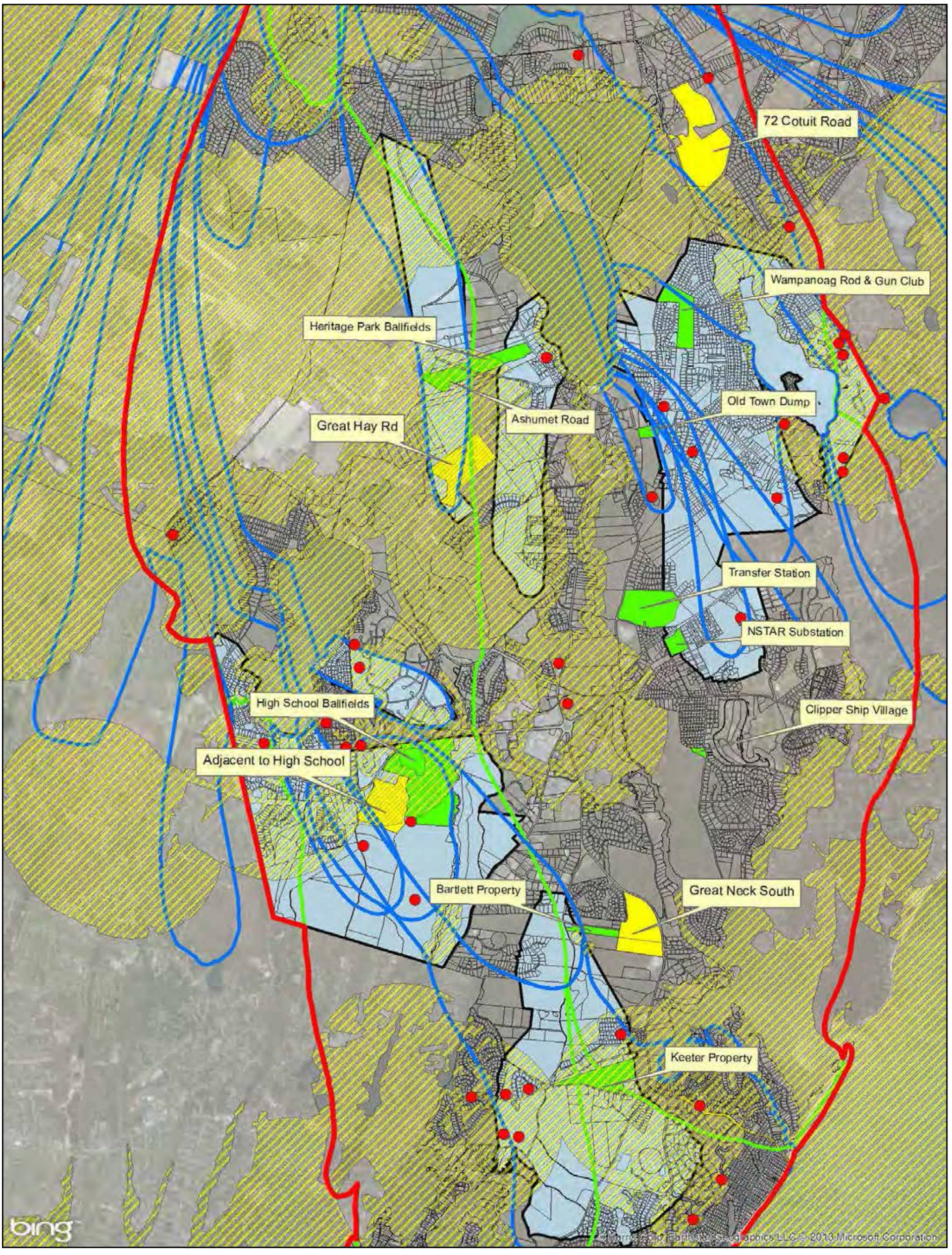

LEGEND

- Certified Vernal Pool
- Estimated /Priority Rare Species Habitat
- Zone II
- Watershed Boundary
- 2007 Site Identification
- Preliminary Site Identification
- Groundwater Protection District

Paper Size ANSI B

0 0.375 0.75 1.5 Miles

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

N

GHD

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Potential Effluent Recharge Sites

Job Number 86-12001
Revision A
Date 17 Apr 2013

Figure 2-1

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2 Preliminary Site Evaluation and Design

2.1 Introduction

As part of the identification of scenarios/options that have been evaluated to date, it is necessary to evaluate potential effluent (treated water) recharge sites that would be used in conjunction with these alternative scenarios/options. This Chapter identifies a number of sites located within the Project Planning Area that were considered as possible treatment and recharge sites throughout the duration of the project.

The process of identifying sites began in 2003 when several sites were identified and those considered most favorable were modeled through the efforts of United States Geological Survey (USGS) and services provided through the Cape Cod Commission to various Towns on the Cape. Since that time, additional sites were identified or reconsidered and are identified in this Chapter.

The findings and the results of the evaluations identify those sites requiring additional site-specific analysis. It is anticipated that the Town will need to perform more detailed evaluations in subsequent phases of work as the recommendations are finalized as part of the Final Recommended Plan/Final Environmental Impact Report.

2.2 Treated Water Recharge Technologies

The second report issued as part of the WNMP was the Technology Screening Report (November 2007). This report identified the various alternatives available for treated water recharge as discussed in Chapter 1. The technologies evaluated included sand infiltration beds, subsurface infiltration, spray irrigation, drip irrigation, deep well injection, wick wells, ocean outfall, and wetland restoration. The Technology Screening Report recommended the following technologies for further consideration:

- Sand infiltration beds
- Subsurface leaching
- Spray irrigation (in conjunction with other technologies for winter discharge)
- Drip irrigation
- Wetland restoration (if appropriate sites are available)

For detailed descriptions of the technologies, and discussions of the advantages and disadvantages of each technology, please refer to the Technology Screening Report included in Appendix J. The site evaluation process performed as part of the Scenario Evaluation took into consideration which of these technologies would be most appropriate for each particular site. Estimates were determined for the recharge capacity of each site with the appropriate technology, which is discussed in detail later in this chapter.

2.3 Preliminary Site Evaluations

2.3.1 Introduction

As discussed in Chapter 2 of the 2008 Draft Alternatives Scenarios and Site Evaluation Report, the Town went through several iterations of site identification and investigation. Early in the project the following eleven (11) sites below were identified as potential locations:

- Heritage Park Ball Fields (Site 1)

- Ashumet Road Property (Site 2)
- Wampanoag Rod and Gun Club
- Old Town Dump (Site 3)
- Transfer Station (Site 4)
- NSTAR Substation
- High School Ball Fields (Site 5)
- Clipper Ship Village
- Wading Place Road
- Keeter Property (Site 6)
- Bartlett Property
- New Seabury Country Club (Site 7)

Preliminary estimates of the application area of each of these sites was determined by assuming a 100-foot buffer from the property line on undeveloped parcels, and a 50-foot buffer from the property line on developed parcels (ball fields, golf course, etc.). Once this initial area was determined, the area available for recharge was reduced by 10-percent to account for berms, access roads, pumps, and any other required infrastructure. The available area was used to estimate potential recharge capacity of each of the sites based on use of subsurface infiltration or sand beds.

Each site's potential recharge capacity (as described in the previous report) was estimated, and several were considered for USGS Modeling.

2.4 USGS Modeling Efforts

In 2004 the Town of Mashpee began working with the USGS to perform groundwater modeling of various recharge sites in Mashpee as described above. The modeling was also used to evaluate the effects of various treated water recharge scenarios on the groundwater.

The USGS model reflects groundwater contours as a function of pumping from production wells and the recharge from various small wastewater treatment plants located within Mashpee, including: Stratford Ponds condominiums, Willowbend Development, Windchime Point condominiums, Southport condominiums, Mashpee Commons shopping center, South Cape Village shopping center, Mashpee High School, and New Seabury. The USGS model also accounts for natural recharge and discharge, and recharge from septic systems.

The existing USGS model provides a tool to evaluate the effects of treated water recharge from a centralized facility at various candidate sites. The USGS model can also generate information on mounding, flow direction, travel time, and discharges to surface waters.

As part of this program, in 2005 ten model runs were performed at seven of the sites (listed previously as Sites 1 through 7):

These seven sites became the basis for the recharge scenarios submitted to USGS for modeling. The following is a summary of the USGS modeling scenarios requested by the Mashpee Sewer Commission.

1. Model Run 1—Existing Conditions. Included modeling water supply well pumping rates, existing effluent recharge sites for small wastewater treatment facilities, on-site septic system recharges, and particle tracks to sensitive receptors.
2. Model Run 2—Future Well Conditions. Included the addition of two water supply wells.
3. Model Run 3—Future Well Conditions with 0.5 mgd discharge at Site 7 (New Seabury). This scenario assumed no effluent recharge at Mashpee Commons, Windchime Point, and South Cape Village discharge locations.
4. Model Run 4—Future Well Conditions with new discharge alternative "A".
    a. 0.5 mgd discharge at Site 7 (New Seabury) and 1.0 mgd discharge at Site 2 (Ashumet Road).
    b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.
5. Model Run 5—Future Well Conditions with new discharge alternative "B".
    a. 1.0 mgd discharge at Site 7 (New Seabury) and 1.0 mgd discharge at Site 5 (High School Ball Fields).
    b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.
6. Model Run 6—Future Well Conditions with new discharge alternative "C".
    a. 0.5 mgd discharge at Site 7 (New Seabury) and 1.0 mgd discharge at Site 1 (Heritage Park Ball Fields).
    b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.
7. Model Run 7—Future Well Conditions with new discharge alternative "D".
    a. 0.5 mgd discharge at Site 7 (New Seabury), 0.3 mgd discharge at Site 3 (Old Town Dump), and 0.8 mgd discharge at Site 4 (Transfer Station).
    b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.
8. Model Run 8—Future Well Conditions with new discharge alternative "E".
    a. 0.5 mgd discharge at Site 7 (New Seabury) and 1.0 mgd at Site 6 (Keeter Property).

b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.

9. Model Run 9—Future Well Conditions with new discharge alternative "F".

   a. 0.8 mgd at Site 4 (Transfer Station) and 1.0 mgd at Site 6 (Keeter Property).

   b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.

10. Model Run 10—Future Well Conditions with new discharge alternative "G".

    a. 0.3 mgd discharge at Site 7 (New Seabury), 0.5 mgd at Site 2 (Heritage Park), 0.3 mgd at Site 4 (Transfer Station), 0.3 mgd at Site 5 (High School Ball Fields), and 0.2 mgd discharge at Site 6 (Keeter Property).

    b. Any remaining Mashpee flow is returned through residential septic systems outside the "100-percent sewer subwatersheds" and Mashpee River subwatersheds. No discharge from Mashpee Commons, Windchime Point, and South Cape Village discharge locations.

USGS ran these scenarios and the draft particle tracking results are presented in Appendix C as Figures 2-2 through 2-11. It is noted that the results presented are the Draft results that were provided in February 2005. Final results were not issued.

The results of the modeling will be used as part of the WNMP to develop alternative solutions and a Recommended Plan for the Town.

2.5 2007 Site Evaluations

As discussed in previous reports, the WNMP process began in earnest in 2005, after the MEP reports for Popponesset Bay and Waquoit Bay East were released. During the Scenario Evaluation, the potential recharge sites were re-evaluated and a search was made for any additional properties that could possibly be used. Using Geographic Information Systems (GIS) mapping, assessor's information, site visits, and discussions with Town officials, 13 sites were identified in the Project Planning Area (PPA). Eleven of the 13 sites are located within Mashpee and two within Sandwich. No properties were identified within Barnstable or Falmouth.

The seven properties identified in conjunction with USGS modeling were included in the updated list of 13 potential sites. In addition, the Mashpee Sewer Commission requested two additional sites be added to the list—the Bartlett property (which had been eliminated prior to the USGS modeling) and the property adjacent to the Mashpee High School. Each of these sites is identified in Appendix D Table 2-3, and shown on Figure 2-1. Table 2-3 summarizes some of the major physical features and site specific criteria that were used to evaluate each site.

The sites that were identified are shown on Figure 2-1 and included:

- Site 1—Heritage Park Ball Fields
- Site 2—Ashumet Road
- Site 3—Old Town Dump
- Site 4—Transfer Station
- Site 5—High School Ball Fields
- Site 6—Keeter Property
- Site 7—New Seabury Country Club
- Site 8—Great Neck South
- Site 9—Great Hay Road
- Site 10—72 Cotuit Rd, Sandwich
- Site 11—168 Route 130, Sandwich
- Site 12—Bartlett Property
- Site 13—Adjacent High School Parcel

The sites were then ranked based on this initial analysis to determine the top candidate sites for further evaluation. The summary of this evaluation is presented in Appendix D Table 2-4. The results of this analysis were reviewed with the Mashpee Sewer Commission and nine sites were identified for further evaluation. Sites 8 and 9 were identified as conservation lands and were thus eliminated from further evaluation. Initial discussions with the Town of Sandwich indicated that Site 11 was a feasible possibility for further consideration. The nine sites (seven owned by a municipality, one privately owned, and one held in conservation according to available GIS data) retained for further evaluations include:

- Site 1—Heritage Park Ball Fields
- Site 2—Ashumet Road
- Site 4—Transfer Station
- Site 5—High School Ball Fields
- Site 6—Keeter Property
- Site 7—New Seabury Country Club
- Site 11—Route 130, Sandwich
- Site 12—Bartlett Property
- Site 13—Adjacent High School Parcel

Sites are highlighted on Figure 2-1.

All of the recommended recharge technologies were considered for each site. Selection of the most appropriate technology for each site was then based on considerations of location, capacity, feasibility, and general acceptance. The following technologies were evaluated for each site:

- Heritage Park Ball Fields—drip irrigation and subsurface infiltration
- Ashumet Road—open sand beds

- Transfer Station—open sand beds and subsurface infiltration
- High School Ball Fields—drip irrigation and subsurface infiltration
- Keeter Property—open sand beds
- New Seabury Country Club—drip irrigation and subsurface infiltration
- 168 Route 130 (Sandwich)—open sand beds
- Bartlett Property—open sand beds
- Adjacent High School Parcel—open sand beds and subsurface infiltration

Open sand beds were considered as much as possible because they provide significantly greater recharge capacity. Subsurface infiltration was considered on parcels where there may be aesthetic impacts on surrounding properties but where irrigation is not currently used. Subsurface leaching and drip irrigation were considered for the properties that are currently used for recreational activities.

Appendix D includes Figures 2-12, 2-13, and 2-14 which illustrate the general layout of each technology that was used as a basis for determining recharge capacity at the various sites. Figure 2-12 shows the area that was assumed for berms and access roads between sand beds.

Detail of this evaluation is included in Chapter 2 of the 2008 Draft report included in Appendix K.

2.6 2010 Site Evaluations

Several additional sites were identified as potential effluent recharge sites in early 2010. This section summarizes the evaluations of these sites. Four of the sites are located between Ashumet, Johns, and Moody Ponds, and the Massachusetts Military Reservation (MMR) boundary. These four sites will be discussed individually. A number of areas on both the Willowbend and New Seabury golf courses were identified. All of the areas within the Willowbend development will be considered as one potential site, and all of the areas in the New Seabury development will be considered as another potential site. Further, the Sewer Commission requested that the Wading Place Road site be reconsidered for effluent recharge. Sites with their estimated average are as follows:

A. Back Road Site 1. 5.2 acres
B. Back Road Site 2. 24.77 acres
C. Back Road Site 3. 8.2 acres
D. Back Road Briarwood West Site. 6.73 acres
E. New Seabury Golf Course. 18.63 acres
F. Willowbend Golf Course. 9.51 acres plus four portions of fairways (within the Santuit River Watershed)
G. Wading Place Road Site. 6.4 acres

Following the identification of these “new” locations, the Town also wanted to look at contingency plans if the New Seabury Golf Course site(s) were unavailable. Therefore the Sewer Commission identified the remote possibility of relocation of existing water supply wells in the “Rock Landing” area as an option. Although this would be a difficult effort, this site or possibly the adjacent driving range (which would also

require well relocation for use) were identified as locations outside of the Popponesset Bay and Waquoit Bay watersheds that could be used as an alternative to New Seabury.

As discussed later in this report, nitrogen loads and recharge volumes were applied to several of these sites to establish the best locations for recharge while trying to achieve TMDLs. However, while considering this, several other issues regarding the sites needed to be considered, and these are identified in the following section.

2.7 Treated Water Recharge Considerations

If the towns within the Project Planning Area consider developing new treated water recharge sites (within their boundaries), potential future recharge limitations must be considered.

1. Treated water that is recharged into subsurface leaching facilities must have low suspended solids to avoid plugging the soil infiltration system, which can require costly repairs. Effluent filtration would reduce this potential for plugging.

2. Treated water recharges upgradient of freshwater ponds and lakes would need to consider phosphorus removal to avoid the creation of a phosphorus plume that could migrate to the freshwater body and cause eutrophication. The Otis Air Force Base wastewater treatment facility discharge and the eutrophication of Ashumet Pond in Falmouth and Mashpee is a recent example of this issue on Cape Cod. This case study is described in the 2003 report by the USGS entitled *"Reactive-Transport Simulation of Phosphorus in the Sewage Plume at the Massachusetts Military Reservation, Cape Cod, Massachusetts."*

3. Treated water recharge into Zone II areas (drinking water supply areas) will need to meet the MassDEP *314 CMR 5.00: Ground Water Discharge Permit Program* and *314 CMR 20:00: Reclaimed Water Permit Program and Standards.* Effluent limits for this type of recharge would need to meet the following treatment and design standards (for recharge within the Zone II but beyond a two-year time of travel to the nearest well):

   Standard Limits:

   - pH: 6 to 9
   - BOD concentration: <30 mg/L
   - Total Nitrogen (TN) concentration: <10 mg/L

   Additional requirements within Zone II

   - Turbidity: <5 Nephelometric turbidity units (NTU)
   - Fecal coliform content: <200 colonies/100 ml
   - TSS concentration: <10 mg/L
   - Total Organic Carbon (TOC) concentration: <3 mg/L

   These standards are typically met by the addition of advanced treatment, filtration facilities, and disinfection.

   Treated water recharge in a Zone II area with less than a two-year travel time to a public water supply would need to meet the following more stringent treatment and design standards:

- pH: 6 to 9
- TSS concentration: <5 mg/L
- Turbidity: <2 NTU
- BOD concentration: <10 mg/L
- TOC concentration: < 1 mg/L
- TN concentration: <5 mg/L
- Fecal coliform content: median of no detectable colonies/100 ml and no single sample to exceed 14 colonies/100 ml

These more stringent standards for recharge within a two-year time of travel, as currently issued, are typically met by microfiltration and disinfection. Additionally, recharge through sand infiltration beds and groundwater travel through the aquifer will remove any bacterial pathogens through the natural filtration abilities of the soil. This has been well documented by George Heufelder of the Barnstable County Health and Environment Department in septic system evaluations. Viruses become inactivated after six months to one year of travel time in the groundwater.

2.7.1 Spray Irrigation Reuse

There has been much interest by some Cape towns on the possible reuse of treated water for spray irrigation of public lands and private properties. This alternative has potential cost-saving implications by making productive use of what could be considered a waste product. Also, several applications of this technology in Florida and in the western United States have been raised as examples of how the technology could be used on Cape Cod.

This alternative would require the following components beyond the typical Wastewater Treatment Facility (WWTF) processes or upgrades to existing facilities:

- Meeting Class A (or possibly Class B depending on location) reuse per MassDEP *314 CMR 20:00: Reclaimed Water Permit Program and Standard:*
  - Class A:
    - pH: 6.5 to 8.5
    - BOD concentration: ≤10 mg/L
    - TSS concentration: ≤5 mg/L
    - Turbidity: ≤ 2 NTU
    - TN concentration: ≤10 mg/L
    - Fecal coliform content: median of no detectable colonies/100 ml and no single sample to exceed 14 colonies/100 ml
  - Class B
    - pH: 6.5 to 8.5
    - BOD concentration: <30 mg/L
    - TSS concentration: <10 mg/L
    - TN concentration: <10 mg/L

- Fecal coliform content: median of no detectable colonies/100 ml and no single sample to exceed 14 colonies/100 ml

- UV disinfection to the highest performance level would be required for further disinfection of the water.
- Microfiltration may be required and would be provided by advanced membrane materials. This process is similar to a reverse osmosis process that can desalinate sea water and produce a pure water product, except that it has a lower membrane pore size and lower capital and Operation & Maintenance (O&M) costs. It is effective at removing various pathogen cysts that may not otherwise be removed by a WWTF. This process would be required by MassDEP if the spray irrigation was to occur in a public place without restrictive site controls. The process would be installed and operated in a building at the proposed WWTF generating the water to be recharged.
- Storage facilities would be needed to store the treated water that is produced at the plant so that it could be available for peak irrigation demand times. This type of storage is typically provided in an elevated storage tank similar to those used by water departments to store and provide pressurized drinking water within parts of Barnstable, Falmouth, Mashpee, and Sandwich.
- Dedicated treated water transmission pipes would be required to convey the water to the spray irrigation sites.
- Booster pump station(s) would be needed if the storage facilities were not elevated. These pumps could be located at each irrigation site to ensure sufficient pressure for the site or at the non-elevated storage tank to pressurize the whole system.
- Site controls at the irrigation sites would be as required by MassDEP permits. These permits would also require sampling and groundwater monitoring at the site.

Spray irrigation facilities would likely be used in conjunction with other recharge technologies as required to manage average treated water recharge requirements. The spray irrigation type technologies could be used to provide additional capacity during the peak demand expected during summer months.

There is precedent for this type of irrigation at golf courses in Massachusetts when the treatment plant is located at (or very near to) the golf course. The closest example is the seven-hole portion of the Bayberry Hills Golf Course that is constructed on the capped Yarmouth landfill. The treatment facility already had a large elevated storage facility when the landfill cap and golf course was planned and designed. This site also uses Town drinking water for irrigation.

There is no precedent on Cape Cod for the irrigation on other Town or private properties that are accessible by the public.

2.8 Wetland Restoration at the Santuit Bogs

As discussed previously, no effluent recharge sites were identified within the part of Barnstable that is within the Project Planning Area. However, discussions were held with various representatives from Barnstable. The Towns of Barnstable and Mashpee purchased a large area of land within the boundaries of Mashpee with Land Bank funds. The property consists of abandoned cranberry bogs to the south of Santuit Pond. As part of the Popponesset Bay Pilot Project, these bogs were evaluated for potential modification to perform additional nitrogen attenuation. Barnstable representatives indicated that the use of these bogs would be highly acceptable for consideration as a site for treated water recharge to restore

groundwater flow in the drainage basin. Before this option is considered further, it will need to be determined if Land Bank restrictions or Zone II issues will affect the feasibility of this option. Similar discussions have been raised about the potential of wetland restoration along bogs located in the Quashnet River Watershed as well.

Further consideration of this as an option will require additional study and groundwater modeling to evaluate potential impacts on the ecosystem and surrounding properties. Therefore it is not currently included in the scenarios development; however, it could become a part of the Recommended Plan or an adaptive management plan as the additional studies are completed and appropriate approvals are received for these types of wetland restoration projects.

2.9 Treated Water Recharge Sites for MEP Model Runs

As will be discussed in Chapters 3 and 4 of this report, based on these site evaluations and decisions made with the Sewer Commission, the following sites (not including sites already associated with existing wastewater treatment facilities within the planning area) were used as part of the scenarios and options run through the MEP model.

A. Initial Alternative Scenario Sites (2008)
    1. Treatment
        a. Site 2—Ashumet Road
        b. Site 4—Transfer Station
        c. Site 6—Keeter Property
        d. Site 11—368 Route 130, Sandwich
    2. Recharge
        a. Site 1—Heritage Park Ball Fields
        b. Site 2—Ashumet Road
        c. Site 4—Transfer Station
        d. Site 7—New Seabury
        e. Site 11— Route 130, Sandwich

B. 2012 – Options 1A, 1B, and 1C
    1. Treatment
        a. Site 2—Ashumet Road
        b. Site 4—Transfer Station
        c. Site 6—Keeter Property
        d. Back Road Sites
    2. Recharge
        a. Rock Landing/New Seabury/Site 7

b. Back Road Sites

c. Site 4—Transfer Station

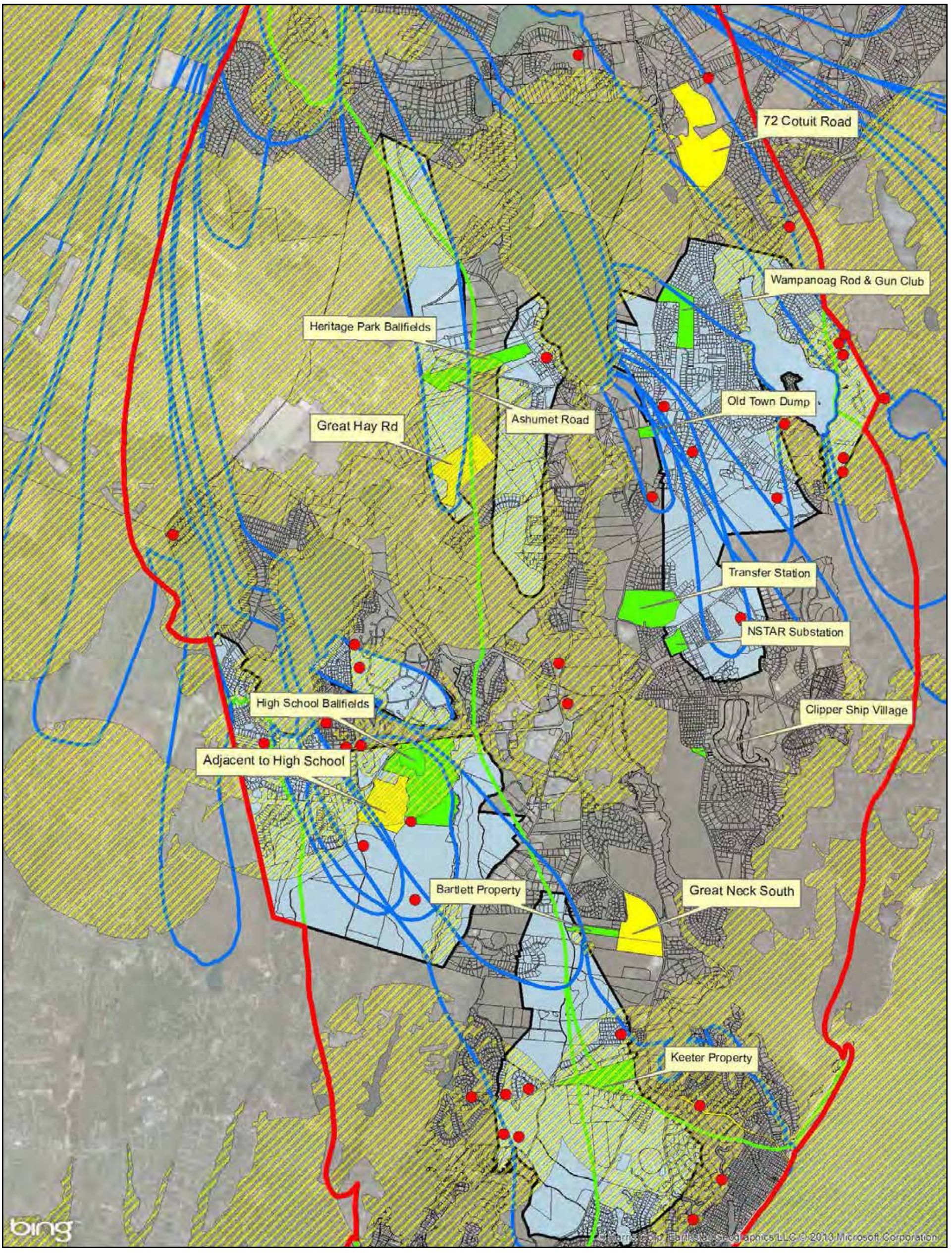
d. Site 6—Keeter Property

e. Willowbend Golf Course

Figure 2-2 shows all sites that were being considered as part of the latest model runs.

2.10 Findings

Following review with the Mashpee Sewer Commission, the difficulties of the relocation of the Rock Landing wells, and the associated time and cost impacts of such an effort eliminated that site from further consideration. Initially, the Sewer Commission expressed reservations regarding the use of the Back Road Site adjacent to the Briarwood/Otis Trailer Village neighborhoods for treatment facilities, but continued to identify the area as a location for potential recharge only. However, in later discussions, the Sewer Commission did identify this location as a possible cluster treatment site. This site—in addition to the potential expansion of the existing Mashpee High School Site—may be considered when addressing the Johns Pond/Ashumet Pond areas of Mashpee.



LEGEND

- Certified Vernal Pool
- Estimated /Priority Rare Species Habitat
- Zone II
- Watershed Boundary
- 2007 Site Identification
- Preliminary Site Identification
- Groundwater Protection District

Paper Size ANSI B

0 0.375 0.75 1.5 Miles

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

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GHD

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Potential Effluent Recharge Sites

Job Number 86-12001
Revision A
Date 17 Apr 2013

Figure 2-1

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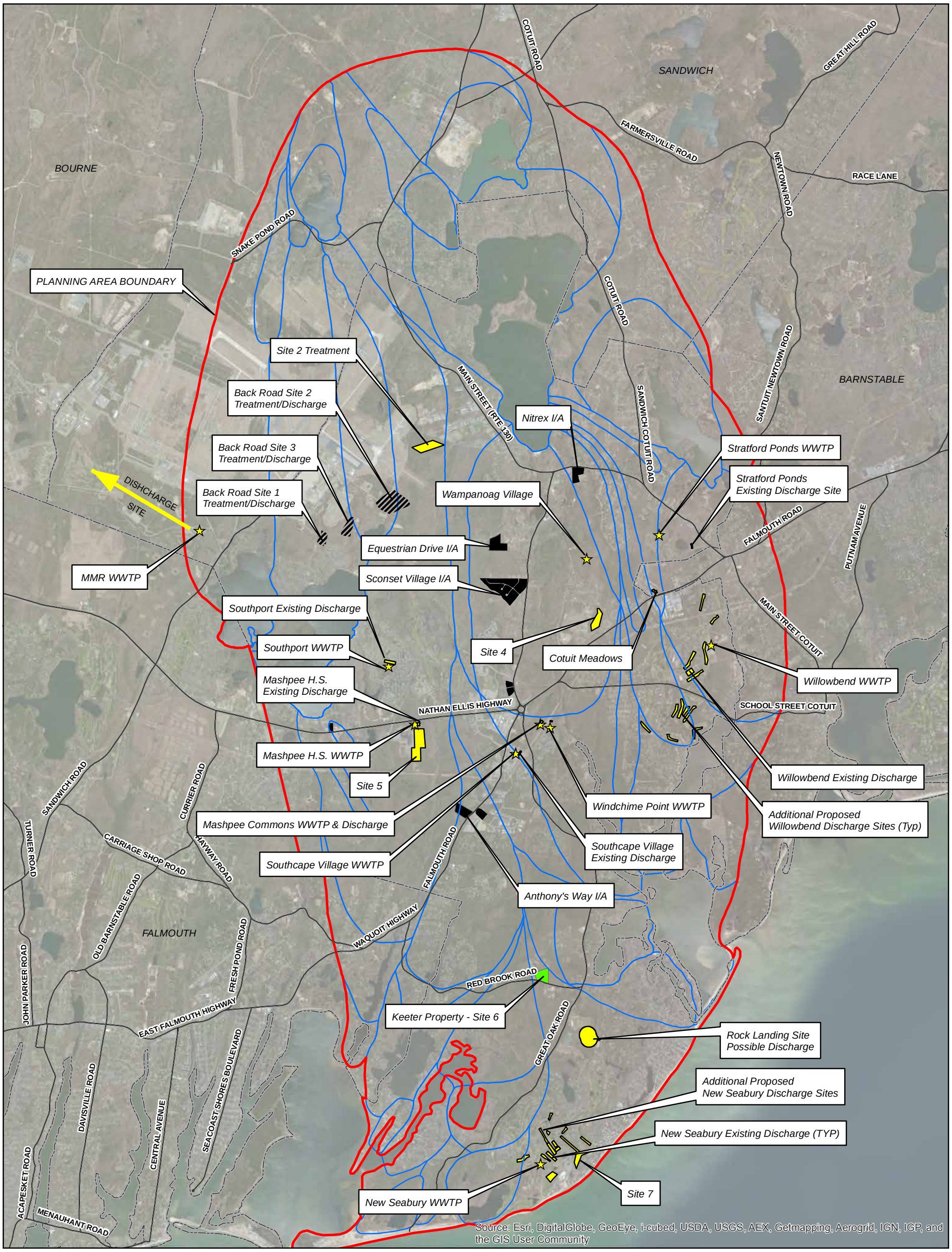

LEGEND

- MMR_Site
- Planning Area Boundary
- Town Boundaries
- Proposed Treatment/Discharge Site
- Existing Discharge Site
- Existing Private WWTP
- I/A Systems (cluster only)

Paper Size ANSI B

0 0.375 0.75 1.5 Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

GHD

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Wastewater Removal Areas

Job Number 86-12001
Revision A
Date 07 Aug 2013

Figure 2-2

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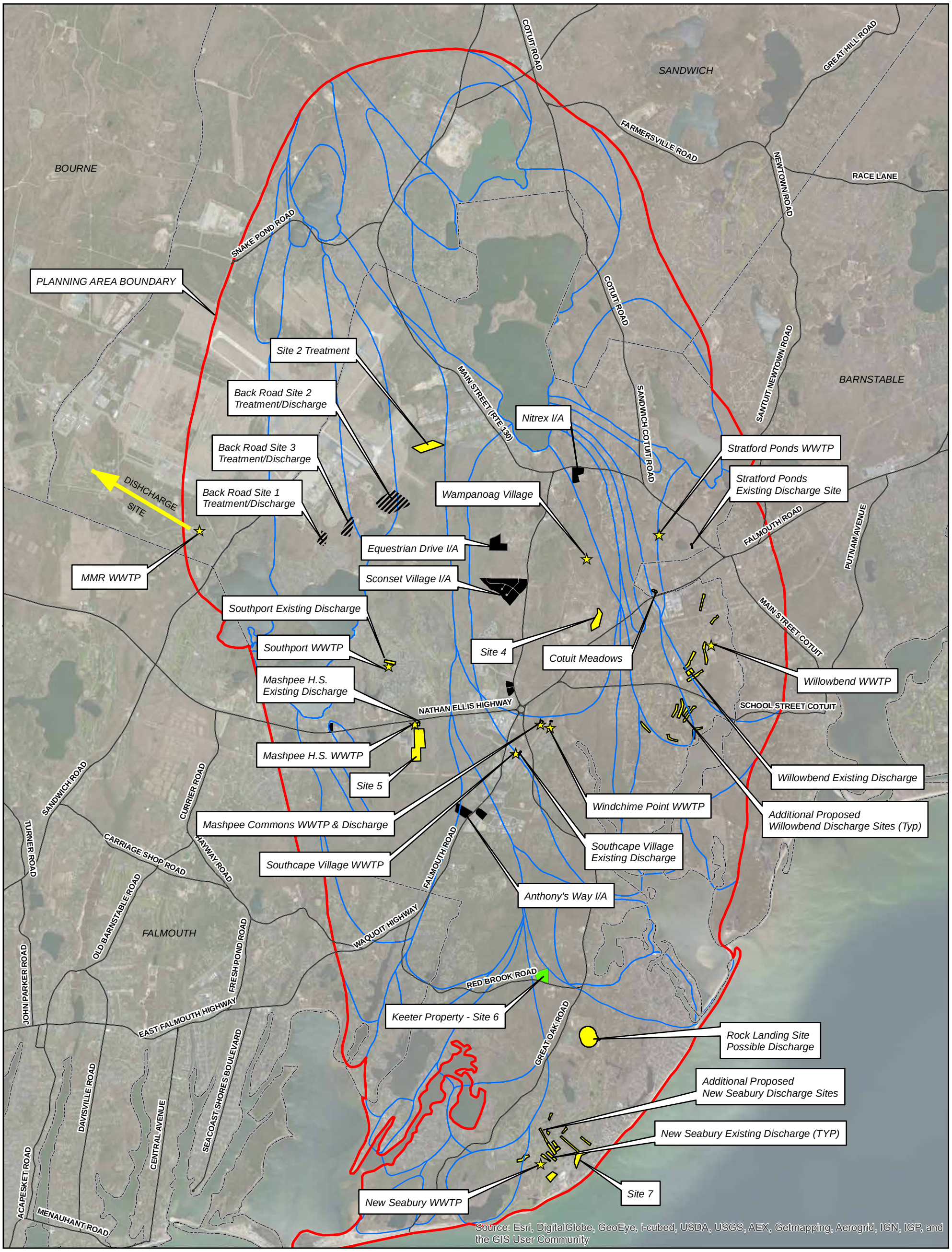

LEGEND

- MMR_Site
- Planning Area Boundary
- Town Boundaries
- Proposed Treatment/Discharge Site
- Existing Discharge Site
- Existing Private WWTP
- I/A Systems (cluster only)

Paper Size ANSI B

0 0.375 0.75 1.5 Miles

Map Projection: Lambert Conformal Conic
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GHD

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Wastewater Removal Areas

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Figure 2-2

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3 2008 Initial Alternative Scenarios and Model Results

3.1 Introduction

Following the release of the Needs Assessment Report, the Mashpee Sewer Commission identified five different management scenarios for evaluation and analysis. This chapter identifies the general characteristics of each scenario and discusses the basic methodology for evaluating each scenario.

The five scenarios are:

- Scenario 1—No expansion of existing wastewater treatment facilities
- Scenario 2—Upgrade and expansion of existing facilities to a practical extent
- Scenario 3/3R—Cluster—prepared by Lombardo Associates, Inc. (LAI)
- Scenario 4—Fair Share Reduction
- Scenario 5—Centralized approach

The term "Scenarios" in this report will refer to those evaluated by GHD—Scenarios 1, 2, 4, and 5. Scenario 3R has been developed by others, and presented to the Sewer Commission under separate cover is included on CD as Appendix F. However the findings of Scenario 3R regarding the MEP Model results are included in this Chapter.

Scenarios 1, 2, 4, and 5 all incorporate some degree of sewer construction and the use of an "effluent pipeline" that carries treated effluent outside of the watershed for discharge. The pipeline concept is based on the assumption that a portion of the New Seabury Golf Course (Site 7) is used for subsurface infiltration. This property is privately owned and located at the southern-most tip of the Town, and could therefore pose management issues further along in the process in transporting and recharging flows there. For this reason, each of the scenarios (1, 2, 4, and 5) was initially analyzed with and without consideration of the use of Site 7.

Preliminary scenarios developed as part of this effort were presented to the Sewer Commission for review and discussion. Issues associated with Site 7 including ownership and natural habitats were identified; however, due to its location outside of the watershed and the continued interest in the Site by the Sewer Commission, it remains under consideration. Following additional evaluation of scenarios, it was determined that the use of Site 7 will likely be necessary to achieve the Total Nitrogen TMDL goals. Therefore the remaining discussions on Scenarios 1, 2, 4, and 5 will be based on the consideration of using this site for treated water recharge and, as drafted, is currently a component of each of the four scenarios described in this Chapter.

Each scenario evaluated by GHD is described and includes information on proposed treatment facilities, estimated lengths of sewers, force mains, grinder pumps/vacuum valve pits, and number of pumping stations. Technologies are not being selected as part of this evaluation; however, technologies considered for costing purposes are based on the recommendations of the Technologies Screening Report.

Scenarios 1, 2, 4, and 5 were evaluated under build-out conditions. The associated costs that were developed for these four scenarios as part of the 2008 report and their associated flows were estimated based on achieving build-out conditions. If build-out conditions are never attained, it is possible that fewer

areas will need to be addressed to meet the total nitrogen TMDLs. Therefore, through an adaptive management approach, the extent of wastewater facilities can be modified.

Each of the five main scenarios (including Scenario 3—Cluster, by LAI) was developed so that it can be run through the MEP Model to identify its ability to meet the TMDL and sentinel station threshold concentration in both the Popponesset Bay and Waquoit Bay East estuaries. The findings of these model results are discussed later in this Chapter and were used to help form the basis for identifying the options discussed in Chapter 4.

Several workshops and presentations on the development of these scenarios were made to the Mashpee Sewer Commission in the fall and winter of 2007. Initially, the use of data by Planning Zones was the basis of all scenarios, as was done for the identification of areas of need in developing the Needs Assessment Report. Planning Zones, although useful for identifying demographics, are often not the most effective way to plan wastewater infrastructure. Topography must also be considered. Watersheds are also excellent for use in the evaluation of the nitrogen impacts; however they often do not coincide with efficient wastewater infrastructure planning. Both watershed boundaries and Planning Zones provide the basis for identifying where wastewater infrastructure is necessary, and therefore are still very important in the process of scenarios development.

After the preliminary analysis based on Planning Zones, “sewersheds” were laid out for the entire Project Planning Area. Sewersheds are developed to provide a reasonable estimation of the area that could effectively be served by a single pumping station. For example, all the properties that could flow by gravity to one pumping station (where wastewater is collected and pumped to a WWTF) would be grouped together in a sewershed. However, not all sewersheds consist of properties served entirely by gravity sewer; some sewersheds will require a combination of technologies. The sewersheds are used as the basis for the calculations performed in developing the various scenarios.

Sewersheds, like Planning Zones, do not necessarily conform to watershed lines. The sewersheds were used to refine the preliminary analyses and determine more realistic sewer scenarios. Because sewersheds are based on potential infrastructure layout and not watershed boundaries, use of nitrogen loadings generated by a “sewershed” could overestimate the effective nitrogen that reaches the estuary. Therefore the sewersheds were used as a guide and a means to estimate infrastructure; however, in each of the scenarios, nitrogen loading was refined using parcel-by-parcel data to determine in which sewershed and subwatershed each parcel lays. The final scenarios were developed based on this analysis. Since attenuation is best determined through the MEP analysis methods, it complicates the ability to assign an “attenuated” nitrogen load to each parcel. Depending on the analysis approach, if a general “attenuation” factor is applied, it will differ from the results of attenuation when the MEP “rainbow” spreadsheets are used. As a result, general attenuation factors were used to provide a reasonable approximation of the nitrogen loading; each scenario’s load was estimated based on parcels within MEP subwatersheds and, for the MEP modeling, input into the “rainbow” spreadsheets to achieve the goal.

This chapter summarizes the characteristics of each scenario as well as some potential variations on the scenarios, summarizes the infrastructure components of each scenario, and discusses the advantages and disadvantages of each alternative. Order of magnitude costs of the various scenarios were presented in Chapter 4 of the Draft Alternative Scenarios Analysis and Site Evaluation Report in March 2008. Cost

development of scenario evaluations will be compiled in the Draft Recommended Plan; this is discussed further in Chapter 5.

Table 3-1 summarizes the wastewater flows and loads for all portions of the Project Planning Area. In addition, the number of wastewater-generating parcels is presented. The table is divided by both town and watershed.

Table 3-1 Summary of Project Planning Area Estimated Flows(1)

Location	Wastewater Generating Parcel	Build-out Wastewater Flow (mgd)
Popponesset Bay		
Mashpee	4,200	1.2
Barnstable	790	0.18
Sandwich	1,600	0.28
Falmouth	No Contribution (no parcels in watershed)	
Total	**6,600**	**1.7**
Waquoit Bay East		
Mashpee	2,200	0.65
Barnstable	No Contribution (no parcels in watershed)	
Sandwich	530	0.11
Falmouth	530	0.12
Total	**3,300**	**0.88**
Outside Popponesset or Waquoit Bay Watersheds		
Mashpee	1,500	0.31
Barnstable	No Contribution (no parcels in Planning Area)	
Sandwich		
Falmouth		
Total	**1,500**	**0.31**
Project Planning Area Total		
Mashpee	7,900	2.2
Barnstable	790	0.18
Sandwich	2,100	0.39
Falmouth	530	0.12
Total	**11,000**	**2.9**

Notes:

1. Values rounded to two significant figures.

Information developed as part of this chapter and the final results of the MEP modeling analysis were used to formulate recommendations for the options discussed in Chapter 4.

Although nitrogen comes from many sources, wastewater is the primary source and is also the most controllable. As a result, it was decided early on in the development of the scenarios that the entire

nitrogen load to be removed would be achieved by addressing wastewater nitrogen. The Technology Screening Report discussed a variety of options to reduce the other sources of nitrogen. However, because of the variability in the concentration of nitrogen from non-wastewater sources and the difficulty in controlling the other sources, any reduction achieved by other nitrogen management alternatives will not be considered as part of this analysis. It is understood that the value of these additional reductions and their contributions in achieving a lower nitrogen load to the watershed will be considered as part of the development of any recommended plan. These additional nitrogen mitigation efforts will be part of adaptive management. The effectiveness of any recommendation will be determined through a monitoring program developed to validate the recommended plan's performance in achieving the goals of the TMDLs.

In order to compare the different scenarios, it is necessary to estimate sewer coverage area and the size of any additional treatment facilities. This was initially done on a planning zone level but was then refined by creating sewersheds. The total nitrogen loads that need to be removed for each watershed are based on the MEP technical reports and total nitrogen TMDLs. As the scenarios were developed and sewersheds were identified for sewering, the wastewater nitrogen load from each selected sewershed was subtracted from the total nitrogen identified to be removed. Sewersheds were connected to treatment facilities until the necessary amount of nitrogen was removed. Recharge from these facilities was then introduced at specific recharge sites within and outside of each watershed as shown in Appendix E. The flow charts were originally presented in Chapter 3 of the draft report, and are now included in Appendix E of this report. Scenarios were then iteratively readjusted based on the impacts of recharge.

The following sections identify each Scenario and identify the estimated infrastructure required for its implementation within the Project Planning Area. Sewer layouts as presented only represent a preliminary layout and approach; only after detailed surveys and pumping/vacuum station site selection can a final layout be determined. All lengths are considered approximations and are provided for cost and scenario comparison purposes. All GHD scenarios assumed the same lengths of gravity and pressure sewer within a particular sewershed. Force main lengths varied from scenario to scenario based on the location of sewersheds selected, and on the WWTF and treated water recharge sites recommended.

The following Table 3-2 summarizes the number of sewersheds and properties that would be served by sewer or onsite/cluster I/A systems in the future. Table 3-3 from the 2008 report and included in Appendix E summarizes the estimated flows for each treatment facility and treated water recharge site under each scenario.

Table 3-2 Estimated Number of Properties Served Under Each Scenario (1, 2, 4, and 5)

Location	Total Wastewater Flow Addressed (mgd)[1, 2]	Number of Sewersheds Served	Number of Properties Served by Sewer[1]	Number of Properties Served by I/A Systems
Scenario 1				
Mashpee	1.9	45	5,700	347
Barnstable	0.11	4	570	
Sandwich	0.30	6	1,300	28
Falmouth	0.10	17	530	
Total	**2.4**	**72**	**8,100**	**375**
Scenario 2				
Mashpee	1.7	41	5,500	36
Barnstable	0.11	4	570	
Sandwich	0.22	5	1,100	16
Falmouth	0.10	17	530	
Total	**2.1**	**67**	**7,700**	**52**
Scenario 4				
Mashpee	1.7	41	5,500	130
Barnstable	0.09	3	300	
Sandwich	0.27	6	1,300	
Falmouth	0.09	15	480	
Total	**2.1**	**65**	**7,700**	**130**
Scenario 5				
Mashpee	1.5	37	5,300	111
Barnstable	0.11	4	570	
Sandwich	0.15	3	700	12
Falmouth	0.10	17	530	
Total	**1.9**	**61**	**7,100**	**123**

Notes:

1. Values rounded to two significant figures.
2. Includes build-out flows from existing WWTFs, which is approximately 0.5 mgd.

3.2 Scenario 1—No Expansion of Existing Treatment Plants

Scenario 1 involves the continued operation of existing private WWTFs and construction of additional treatment facilities as needed to achieve the nitrogen TMDLs. Existing WWTFs were identified and discussed in detail as part of the Needs Assessment Report, and are as follows:

- New Seabury
- Willowbend
- Southport

- Mashpee Commons
- Mashpee High School
- Windchime Point
- Stratford Ponds
- South Cape Village
- Forestdale School (Sandwich)

Under this scenario, these existing WWTFs are expanded only to include areas that were identified as future connections in each of the WWTFs facility plan and included in their existing Groundwater Discharge Permits (GWDP). New Seabury is the only exception to the no-expansion consideration. New Seabury is expected to have considerable capacity and is in close proximity to portions of Mashpee that are not near other WWTFs or the potential sites discussed in Chapter 2. Wastewater treatment requirements for the existing facilities are based on those limits stipulated in their GWDP at the time of this report. Therefore the effluent total nitrogen limits for these facilities are 10 mg/L or 5 mg/L, depending on their permit. The only exception is the Forestdale School WWTF, which does not have a nitrogen limit stipulated in their GWDP. Because proposed additional WWTFs have not been designed, an effluent nitrogen concentration of 3 mg/L (the current limit of technology) is used for future facilities due to the requirements of reducing total nitrogen within the Popponesset Bay and Waquoit Bay East watersheds.

For Falmouth, under this option, essentially any wastewater removed from the Project Planning Area and treated in Falmouth will stay outside of the Waquoit Bay East and Popponesset Bay watersheds, resulting in no nitrogen recycling from those areas.

This scenario was developed by first determining how much nitrogen reduction would be achieved by assuming all WWTFs are operating at build-out flows and treating to their respective GWDP nitrogen limit. The next step was to identify “clusters” within the Project Planning Area that would be suitable for small package WWTFs. The clusters were chosen by selecting sewersheds that could logically be connected together and that had relatively dense development. The clusters were generally selected based on the nearness to potential effluent recharge sites as discussed in Chapter 2.

The following are the basic characteristics of Scenario 1. New treatment facilities are identified *in italics*.

Scenario 1

- WWTF at Forestdale School
- WWTF at Southport
- WWTF at Mashpee High School
- WWTF at Mashpee Commons
- WWTF at South Cape Village
- WWTF at Windchime Point
- WWTF at Willowbend
- WWTF at Stratford Ponds
- WWTF at New Seabury (expanded)
- *WWTF at Site 11—168 Route 130 (Sandwich)*

- *WWTF at Site 2—Ashumet Road (recharge at Site 1 and at Site 2)*
- *WWTF at Site 4—Transfer Station*
- *WWTF at Site 6—Keeter Property (recharge at Site 7—New Seabury Country Club)*
- Sewersheds 11 and 23 on I/A systems (to 10 mg/L)
- All parcels in the Waquoit Bay East watershed that are outside sewersheds are on I/A systems (to 10 mg/L)
- Falmouth would remove and treat all Falmouth wastewater

Treated water would be recharged at each of the existing WWTF sites. The Falmouth recharge would occur outside of both the Waquoit Bay East and Popponesset Bay watersheds. Figures in Appendix E (Figures 3-1 and 3-2) provide a flow chart of the proposed facilities and illustrate this scenario with a layout of the Project Planning Area. Sewersheds that are treated at a common WWTF are coordinated by color. Parcels that are connected to the existing WWTFs are highlighted with a red outline.

A new WWTF is proposed for Site 2 under this scenario. However, due to the amount of wastewater nitrogen that needs to be removed from Waquoit Bay East, treated water recharge occurs on both Sites 1 and 2. Site 1 will receive approximately 60-percent of the recharge and Site 2 would receive the remaining 40-percent.

Because Site 6 is located upgradient of a drinking water supply well, no treated water is proposed to be recharged at this site under this scenario. For this reason, treated water is expected to be recharged at Site 7—New Seabury Country Club. If Site 7 does not continue as a feasible option, Site 6 may be reconsidered. The preference of the Sewer Commission is for any recharge at Site 6 to be located within the Popponesset Bay watershed boundary to promote groundwater flow toward Popponesset Bay rather than the wells that are south of the property.

Sewersheds 11 and 23, which are located in the southwestern and southeastern corners of Mashpee, are proposed to be treated with individual onsite I/A systems or cluster systems, with a goal of achieving an annual average concentration of 10 mg/L total nitrogen in their effluent. This approach was considered for these sewersheds because of their locations—Sewershed 11 is an island and Sewershed 23 is not contiguous with the other parts of Mashpee. In order to connect these sewersheds to collection systems in Mashpee, water bodies would have to be crossed. This type of construction would involve significant permitting and construction obstacles. In addition to Sewersheds 11 and 23, all parcels in the Waquoit Bay East watershed that are *not* included in sewersheds are proposed to be on I/A systems.

It should be noted that the number of properties served by sewers does not include properties that were originally planned to be connected or already have been connected to the existing private WWTFs.

Several of the sewersheds that are proposed to be connected to WWTFs within the Town of Mashpee are located partially or completely in either Barnstable or Sandwich. If this scenario proceeds, there would be the need for an inter-municipal agreement or regional sewer district to facilitate wastewater treatment outside of respective town boundaries.

Appendix E Table 4-1 summarizes the infrastructure components of this scenario.

Under this scenario, 62 sewersheds were identified for sewering. This equated to approximately 70 miles of gravity and 100 miles of low pressure collection sewers; an additional 40 miles of force mains are

required to connect potential pumping stations to the proposed WWTFs and to connect these WWTFs to treated water recharge sites. New WWTFs are identified at Sites 2, 4, 6, and 11 with new treated water recharge at Sites 1, 2, 4, 7, and 11. The Falmouth treatment and recharge is not included in these sites. The scenario also includes approximately 380 properties on new I/A systems.

3.3 Scenario 2—Expansion of Existing Treatment Facilities

Development of this scenario began in a method similar to that used in Scenario 1—Falmouth wastewater is considered to be treated and recharged outside of the Project Planning Area and existing WWTFs address those properties originally identified as being connected (now or in the future) to that WWTF.

This scenario varies from the first one in that the existing WWTFs are expanded to the extent feasible to address neighboring sewersheds, and the treatment process is improved to achieve an effluent nitrogen concentration of 3 mg/L under the future condition. Construction of new WWTFs is considered only after the expansion potential of each existing WWTF is considered. The WWTFs that were not considered for expansion included the Forestdale School, Stratford Ponds, Windchime Point, and South Cape Village. These facilities have either limited space for expansion, will approach the facility's capacity under build-out conditions, or use a technology that is not easily expandable or reliable to treat to 3 mg/L on a consistent basis.

WWTFs typically have a design life of 20 years; therefore, any improvements for the WWTFs will likely be phased. As the flows increase and each facility approaches its design life or GWDP expiration date, improvements will be proposed to achieve greater nitrogen reduction (3 mg/L nitrogen concentration is estimated under the build-out condition), including considerations for replacement with a new wastewater process.

Table 3-3 presents the estimated design-life (based on 20 years) and "current" GWDP renewal year for those facilities under consideration for expansion. This information is based on the permit information available at the time of this report. These dates will be taken into consideration when evaluating potential phasing scenarios in the future.

Table 3-3 Existing WWTF Design Life and Permit Expiration Years

WWTF	Estimated Design Life Year	Year GWDP Expires[(1)]
Southport	2017	2011
Mashpee Commons	2010[(2)]	2009
Willowbend	2013	2008
Mashpee High School	2015	2012
New Seabury	2020	2006

Notes:

1. Based on MassDEP information as updated in January 2008.
2. Mashpee Commons was planning an upgrade to the facility in 2008.

The following are the basic characteristics of Scenario 2. New treatment facilities are identified *in italics*.

Scenario 2

- WWTF at Forestdale School
- WWTF at Southport (expanded)
- WWTF at Mashpee High School (expanded)
- WWTF at Mashpee Commons (expanded)
- WWTF at South Cape Village
- WWTF at Windchime Point
- WWTF at Willowbend (expanded)
- WWTF at Stratford Ponds
- WWTF at New Seabury (expanded)
- *WWTF at Site 2—Ashumet Road (recharge at Site 1 and Site 2)*
- *WWTF at Site 4—Transfer Station*
- *WWTF at Site 6—Keeter Property (recharge at Site 7)*
- *WWTF at Site 11—168 Route 130*
- Falmouth would remove and treat all Falmouth wastewater
- All parcels in the lower portions of the Waquoit Bay East watershed (Hamblin Pond, Jehu Pond, and Quashnet River subwatersheds) that are not served by sewers are on I/A systems (to 10 mg/L)

As in Scenario 1, treated water from a new WWTF at Site 6 is recharged at Site 7 in order to remove the nitrogen from the watersheds and to eliminate recharge upgradient from drinking water supply wells. Also, recharge from a WWTF at Site 2 is recharged mostly at Site 1 (90-percent), with the remainder being recharged at Site 2.

Figure 3-3 (in Appendix E) provides a schematic of the sewersheds, WWTFs, and treated water recharge sites. Figure 3-4 (in Appendix E) illustrates the layout of this scenario. Sewersheds that are treated at a common WWTF are color coordinated. Figures can be found in Appendix E.

Table 4-2 (in Appendix E) summarizes the components of this scenario.

Under this scenario, 61 sewersheds were identified for sewering. This scenario requires approximately 70 miles of gravity and 90 miles of low pressure collection sewers; 40 miles of force mains would be required to connect potential pumping stations to proposed WWTFs and to connect these WWTFs to treated water recharge sites. New WWTFs are identified at Sites 2, 4, 6, and 11 with new treated water recharge at sites 2, 4, 7, and 11. The Falmouth treatment and recharge is not included in these sites. The scenario also includes approximately 50 properties on new I/A systems.

3.4 Scenario 3/3R—Cluster

Lombardo Associates, Inc. (LAI) prepared a “Cluster Scenario” for the Mashpee Sewer Commission for the Project Planning Area of the East Waquoit and Popponesset Watersheds to achieve the MassDEP

TMDL requirements. This was completed independently of the work performed by GHD. The following is a brief description of the Cluster Scenario.

By its memorandum of November 13, 2009, MEP determined that Scenario 3 for the Popponesset Bay watersheds and Scenario 3R, a refinement of Scenario 3 solely in the East Waquoit watershed, met the TMDL requirements for the seven subwatersheds for which TMDL requirements exist in Popponesset Bay and East Waquoit Bay.

The Cluster Scenario consisted of the following approaches using the Nitrex™ technology:

1. Cluster Systems
2. Individual Onsite Nitrex™ Treatment Systems for application as:
    a. Retrofit to properties
    b. New systems
3. Nitrex™ Groundwater Treatment System(s)
    a. Pump and Treat
    b. Permeable Reactive Barrier

Potential solution scenarios of individual onsite systems and the groundwater treatment systems were developed for cost comparison purposes only. Cluster Scenario 3/3R relies solely upon the use of cluster systems. Sole use of individual systems and groundwater treatment would not achieve TMDL requirements.

Use of individual and groundwater treatment technologies in a hybrid scenario were presented as cost-saving techniques.

The Cluster Systems Scenario is a sewer system using innovative but well proven techniques for collection and treatment. The following assumptions were made concerning parcels that will not initially be served by a cluster system:

1. Any non-sewered parcel that has a future expansion in flow, either by developing an undeveloped lot or by expanding an existing development, will either be connected to an existing cluster system or will be required to install an I/A system capable of removing 90-percent of the influent TN load.
2. Any non-sewered parcel that does not have an increase in future TN load will remain with its existing onsite system—no future upgrade is assumed for these properties.

The Cluster Scenario consists of:

1. Septic tanks on individual properties—either salvaging the existing tank or replacing it with a new septic tank.
2. Septic tank effluent collection system from the served properties to a cluster treatment facility.
3. Cluster treatment facility—a wastewater treatment facility that will treat the flows from the collection system relying upon the Nitrex™ technology.

4. Treated water recharge either at treatment site or other location, outside of watershed where necessary, to meet TMDL requirements.

LAI determined the total attenuated nitrogen removal required to meet the TMDL threshold and the natural attenuation occurring along the flow path to the sentinel station for each property in the PPA. Using this information, 16 cluster systems were delineated to capture the total amount of attenuated nitrogen required within each subwatershed in the PPA to achieve TMDL compliance. Appendix (xx) Figure 1 illustrates the locations of the 16 cluster systems and the proposed associated dispersal locations.

It is noted that Scenario 3/3R was developed with the guideline that connection to an existing WWTF was not available. Use of existing WWTF and strategic use of on-site systems and PRB would reduce the cost of the decentralized option and would be performed in the next planning step during which an optimized plan is to be developed. LAI determined areas that had the highest potential for PRB application, which are illustrated in Appendix F Figure 2.

A complete copy of this report is available online at http://www.mashpeewaters.com/documents.html, and in Appendix F.

3.5 Scenario 4—Fair Share Reduction

This scenario is based on evaluations initially considered as part of the MassDEP-funded Mashpee Pilot Project. The Pilot Project team determined that a 49.2-percent reduction of all existing (2001) nitrogen sources (not including benthic flux or atmospheric deposition directly onto the embayment) throughout the entire Popponesset Bay watershed would achieve the nitrogen reduction necessary to restore estuary health. Once this homogeneous reduction rate was decided upon, the scenario was evaluated by the MEP, and it was concluded that this reduction would achieve the MEP goals. A similar analysis that attempted to mimic the Popponesset Bay “fair share reduction” scenario was applied to the Waquoit Bay East watershed as well. The calculations for that watershed (under existing conditions) resulted in a fair share reduction of approximately 63-percent.

There are some differences between the approach taken by the Pilot Project and the approach taken as part of the WNMP that should be noted.

1. The Pilot Project analysis included a 49.2-percent reduction in nitrogen from all sources, with the exception of atmospheric deposition on the estuary surface. The WNMP analysis does not consider a reduction in nitrogen loading to natural surfaces (forests, fields, etc.) or atmospheric deposition to freshwater body surfaces to achieve the nitrogen limits. Instead, a nitrogen mass equivalent to the amount removed based on the MEP analysis is achieved through reduction of wastewater nitrogen *only*. This is the most controllable source of nitrogen, and is therefore the easiest to quantify and achieve.
2. The Pilot Project analyzed a 49.2-percent nitrogen reduction for only the Popponesset Bay watershed, which is the focus of that effort. The WNMPs goal is to determine management plans for the entire Project Planning Area. The Waquoit Bay East watershed is estimated to require a 63-percent nitrogen reduction.
3. Wastewater was assumed to be completely removed from the watershed for the Pilot Project analysis. A more likely situation will include effluent recharge somewhere within the watershed. This will result in some recycling of nitrogen, which is considered as part of the WNMP evaluation.

4. The original Pilot Project and MEP work was based on 2001 “existing” conditions; however the analysis used for this project is based on the future (build-out) nitrogen load being removed, and therefore the amount of nitrogen to be removed will be larger.

This scenario is intended to provide one means of achieving a consistent nitrogen reduction in the various towns that make up the Project Planning Area. Each town is considered separately when presenting methods of nitrogen reduction—i.e. 50 percent of the Barnstable nitrogen is removed by Barnstable, 50-percent of the Sandwich nitrogen (in the Popponesset Bay portion) is removed by Sandwich, etc. Each town will also be responsible for the facilities necessary to reduce the nitrogen loads. Therefore under this scenario, no inter-municipal agreements and no sharing of resources are considered.

Although Falmouth wastewater is still considered to be treated and recharged outside of the watersheds, this scenario involves removal of only the required “fair share” of the Falmouth wastewater generated within the Project Planning Area, unlike the other scenarios where 100-percent of this flow was considered removed. Because this scenario is based on the Fair Share concept, approximately 63-percent of the existing Falmouth wastewater plus build-out is proposed to be treated and recharged outside of the watersheds.

The following are the basic characteristics of Scenario 4. New treatment facilities are identified *in italics*.

Scenario 4

- WWTF at Stratford Ponds
- WWTF at Willowbend
- WWTF at South Cape Village
- WWTF at Windchime Point
- WWTF at Forestdale School
- WWTF at Southport (expanded)
- WWTF at Mashpee High School (expanded)
- WWTF at Mashpee Commons (expanded)
- WWTF at New Seabury (expanded)
- *WWTF at Site 4—Transfer Station*
- *WWTF at Site 6—Keeter Property (recharge at Site 7)*
- *WWTF in Barnstable*
- *WWTF in Sandwich—Site 11*
- Falmouth removes and treats Falmouth’s wastewater
- Sewershed 23 on I/A systems (to 10 mg/L)
- No inter-municipal agreements and no sharing of resources are considered

Under this scenario, wastewater from the various towns within the Project Planning Area are treated and recharged within each town’s boundaries.

Once again, Sewershed 23 is proposed to utilize I/A systems to treat to lower nitrogen levels than are achieved with Title 5 septic systems. This sewershed consists of 130 parcels.

The flow schematic for Scenario 4 is shown in Appendix E, Figures 3-5 and 3-6 which illustrate the layout of the scenario.

Appendix E Table 4-3 summarizes the components of this scenario.

Under this scenario, 58 sewersheds were identified for sewering. This equated to approximately 65 miles of gravity and 90 miles of low pressure collection sewers; an additional 35 miles of force mains would be required to connect potential pumping stations to proposed WWTFs, and to connect these WWTFs to treated water recharge sites. New WWTFs are identified at Sites 4, 6, and 11 with new treated water recharge at Sites 4, 7, and 11. The scenario also includes approximately 130 properties on new I/A systems. Wastewater originating in Barnstable or Falmouth is anticipated to be treated and recharged outside of the Project Planning Area.

3.6 Scenario 5—Centralized Wastewater Treatment

Scenario 5 involves wastewater treatment by means of centralized (municipal) wastewater treatment facilities. Although this scenario proposes that the flow from both watersheds be treated at a WWTF located on Site 4 (in the Popponesset Bay watershed), treated water recharge occurs at multiple sites within the two watersheds, with the intention of reducing the impact of significant changes to the volume of groundwater flow in either watershed.

This scenario includes the conversion of each of the existing private WWTFs (with the exception of New Seabury) within the Popponesset Bay and Waquoit Bay East to a pumping station. Wastewater treatment activities would cease at these facilities. New Seabury has significant capacity, is outside of the watersheds, and has the potential to service sewersheds that are at significant distances from proposed centralized facilities, therefore the continued use of this facility is recommended. The Forestdale School would serve as a pumping station to pump flow to a new WWTF located in Sandwich (Site 11).

The facilities required for this scenario are summarized as follows:

Scenario 5

- WWTF and recharge at Site 4—Transfer Station
- Recharge at Site 5—Mashpee High School
- Recharge at Site 1—Heritage Park Ball Fields
- Recharge at Site 7—New Seabury Country Club
- WWTF and recharge at Site 11—168 Route 130
- WWTF at New Seabury (expanded)
- Falmouth wastewater treated and recharged by Falmouth

This scenario involves one Mashpee sewershed being treated at a Falmouth WWTF and several Barnstable sewersheds being treated and recharged within the Mashpee Town boundaries. For this scenario to work successfully there would need to be agreements or sewer districts to deal with treating wastewater outside of its respective town boundaries.

Treated effluent recharge under this scenario is distributed over a number of properties. The proposed WWTF is located at Site 4, where 1,000,000 gpd can be recharged. Another 200,000 gpd can be recharged at Site 7, which removes the nitrogen recycle from the watershed. The remaining recharge is

split between Sites 1 and 5. Site 1 receives 75-percent of the effluent and Site 5 receives the remaining 25-percent. Although Site 5 has the capacity to handle additional flow, the amount of nitrogen removal required for Waquoit Bay East limits the recharge that can occur within that watershed.

A general schematic and a layout of Scenario 5 are shown in Appendix E Figures 3-7 and 3-8.

Table 4-4 (in Appendix E) summarizes the components of this scenario.

Under this scenario 61 sewersheds were identified for sewering. This equated to approximately 70 miles of gravity and 75 miles of low pressure collection sewers; 35 miles of force mains would be required to connect potential pumping stations to proposed WWTFs, and to connect these WWTFs to treated water recharge sites. New WWTFs are identified at Sites 4 and 11 with new treated water recharge at Sites 1, 4, 5, 7, and 11. The scenario also includes approximately 120 properties on new I/A systems. As discussed, an additional treatment and recharge facility outside of the Project Planning Area is used to treat Falmouth wastewater flows.

3.7 MEP Model Runs and Results

In November and December 2009, the University of Massachusetts Dartmouth SMAST issued two technical memoranda summarizing the model results for the five scenarios described above. The results indicated that “all of the scenarios yield water column TN concentrations restorative of infaunal habitat in Ockway and Shoestring Bays, but all but Scenario 3 (and possibly 4) leave excess TN levels in the Mashpee River.” The results also indicated that “Scenarios 1, 2, 4, and 5 meet the threshold values at the sentinel station for restoration of eelgrass in Hamblin and Jehu Ponds. Scenario 3 did not meet the threshold for either Hamblin or Jehu Pond. In addition, none of the scenarios (1 through 5) had sufficient nitrogen source reduction to meet the Quashnet River water column TN concentration threshold necessary to restore infaunal habitat, although Scenario 4 may be sufficiently close for planning purposes (0.523 mg/L versus 0.520 mg/L).”

Following the issuing of these findings, at the request of Lombardo Associates, Inc, a revised Scenario 3 was run and MEP issued a follow-up technical memo (dated February 2010) to address the failure of that scenario to meet the limits initially. These updated findings are shown in the summary table below.

The following Table 3-4 summarizes the findings as presented in Tables 3 and 4 from the MEP technical memorandum.

Table 3-4 Summary of Threshold Comparison Results[1]

Watershed/Embayment Section	TMDL/MEP Threshold	Scenario					
		1	2	3	3R[(2)]	4	5
		mg/L					
Popponesset Bay—Head	0.38	**0.394**	**0.386**	0.372		0.378	**0.389**
Mashpee River—Mid to Low	0.4-0.5	**0.601**	**0.570**	0.472		**0.529**	**0.596**
Shoestring Bay—Upper to Lower	0.4-0.5	0.472	0.462	0.461		0.449	0.461
Ockway Bay—Upper	0.4-0.5	0.457	0.449	0.421		0.438	0.453
Jehu Pond	0.446	0.429	0.435	**0.472**	0.429	0.437	0.434
Hamblin Pond	0.380	0.252	0.253	**0.400**	0.251	0.260	0.252
Quashnet River	0.520	**0.536**	**0.547**	**0.585**	0.460	**0.523**	**0.559**

Notes:

1. Data from Tables 5 and 6 from December 15, 2009 MEP Technical Memorandum, except for data regarding Scenario 3R (see Note 2).
2. Revised Scenario 3 (3R) as identified in Table 3 of the February 2010 MEP technical memorandum. This scenario did not include rerunning the model for Popponesset Bay. In summary, flow was moved from Waquoit Bay East watershed to the area identified as "Rock Landing/outside" watershed. Flow changes were also made within the following areas/subwatersheds: Moody Pond, Outside watershed, Ashumet Pond, Mashpee-Wakeby Pond, Quashnet River, Peter's Pond, Santuit River, and Red Brook watersheds, per the report.
3. Blue shading represents those that do not meet the Threshold.

3.8 Summary

As identified in the Draft report issued in 2008, each of the five scenarios described above was compared based on monetary and non-monetary considerations. As the Sewer Commission reviewed the findings of the Draft report, three new options were developed as presented in the next chapter.

4 2012 Development of Options 1A, 1B, and 1C

4.1 Introduction

As the Town moves forward in development of a Recommended Plan for nitrogen management within the Project Planning Area, one management approach is to collect wastewater, treat it to a very high level, and then recharge the treated effluent back to the ground. The purpose of this Chapter is to summarize the three most recent approaches developed on behalf of the Town for evaluation and modeling by the MEP. That modeling effort is to identify whether the approach presented will achieve the TMDLs under a future condition. This Chapter describes the development and outline of these new options that will form the basis of the Recommended Plan being developed as part of the WNMP.

4.2 Background

In the Spring of 2008, as part of the WNMP, a Draft Alternatives Scenario Analysis and Site Evaluation Report was issued; and a "Nitrex^{TM} Technology Scenario Plan" (Scenario 3—Cluster) was also prepared in order to evaluate five different scenarios for addressing future nitrogen loadings on the Project Planning Area.

These reports, with some updates made to the Scenario 3—Cluster approach, were then run through the MEP Modeling Approach as described in Chapter 3 to evaluate their ability to meet the TMDLs established for Popponesset Bay and Waquoit Bay East. The results were issued in two memorandums dated November 13, 2009 and February 9, 2010. The results were compared to embayment thresholds and those total nitrogen thresholds associated with eelgrass and infauna. These scenarios and findings are summarized in Chapter 3 of this Report.

Following the release of those findings, the Sewer Commission then met to discuss possible discharge locations including those identified previously, such as Site 4 (the Transfer Station) and Site 7 (part of the New Seabury Golf Course), and new locations such as several parcels north of John's Pond (identified for presentation purposes as the Back Road Parcels), expansion of use at Willowbend Golf Course, and possible expansion of use at the New Seabury Golf Course.

As a result of these initial MEP scenario findings, the Sewer Commission had asked GHD to move forward with the development of two new scenarios to be modeled at that time. The initial step of establishing these two new scenarios was based on a Sewer Commission map which re-divided the Project Planning Area into several sections identifying preliminary collection and treatment locations within the Project Planning Area. These groupings were similar to those established in the Draft Alternatives Scenario Analysis Report (called out as "sewersheds"); however, they were often larger and not necessarily based on potential collection system layouts but more often on neighborhood/development areas. This preliminary figure (Figure 1 dated 12-13-10 in Appendix G) shows each of these areas and their proposed discharge location. This preliminary layout plan included a portion of Barnstable and Falmouth within the planning area, but did not include the Town of Sandwich. However, it was understood that the Town of Sandwich would be included in any alternative to be evaluated in the project.

These layouts were then used to create two initial options (Nos. 1 and 2) that were presented to the Sewer Commission in the Spring of 2011. Based on these two options for addressing nitrogen within the Project

Planning Area, the Sewer Commission offered several suggestions. These were considered and the options were transformed into Option 1A and Option 1B, as described in subsequent sections.

The general comments from the Sewer Commission relative to these initial two options helped form Options 1A and 1B, and were as follows:

- Use of Rock Landing—Consider one option of relocating the wells from that location and a second alternative where Rock Landing site was not available.
- Maximize use of New Seabury Golf Course (under one scenario, the other scenario should focus on it not being available).
- Maximize use of Willowbend Golf Course.
- Sewer Popponesset Island under all options.
- Possible pilot project within the Pirates Cove neighborhood using Nitrex™ technology or PRB technologies.
- Look at options of Barnstable, Falmouth, and Sandwich dealing with their nitrogen loads outside of the watershed. In subsequent meetings, the Sewer Commission requested a second look at the portion of Falmouth east of the Quashnet/Moonakis River in Mashpee (as originally presented to the Committee). Based on this reconsideration, the eastern part of Falmouth was to be addressed within the watershed when developing the options.
- Consider sensitivity analysis of improved attenuation south of Santuit Pond and Quashnet Bogs; and possibly through Willowbend.
- Improve all small WWTFs to 3 mg/L. Initially, the approach by GHD was to only consider improvements to larger facilities as it would likely be more cost-effective in the short term relative to the amount of nitrogen load discharged by these smaller facilities.
- I/A systems for now will continue to be considered at 19 mg/L, with the understanding that it is possible to achieve higher performances if designed, installed, and operated properly (which was the basis for initially considering 10 mg/L TN effluent for some of these facilities). It is presumed that the average 19 mg/L (as shown in recent reports prepared by Barnstable County) is a reasonable assumption for average use and remains consistent with the MassDEP approval process for these systems.

Additional assumptions by GHD used in the analysis:

- Sites being considered (outside of existing WWTF discharge sites) include:
  - Site 2 (Ashumet) for treatment only
  - Site 4 (Transfer Station) for treatment and discharge
  - Site 6 (Keeter) for treatment and discharge
  - Back Road Site for treatment and discharge
  - Site 7 (New Seabury) for discharge
  - New Seabury Golf Course for discharge (expanded beyond the original one fairway)

- Willowbend Golf Course for discharge
- Site 11—Golden Triangle in Sandwich for possible treatment and/or discharge

- Expansion of existing facilities include:
  - Willowbend
  - New Seabury
- New Small WWTF considered with possible expansion:
  - Wampanoag Village
  - Cotuit Meadows
  - A possible cluster northeast of Santuit Pond
- All other existing WWTFs may see upgrade to 3 mg/L and may or may not relocate their discharge.

For the purpose of aggregating flows and loadings, each of the areas highlighted by the Sewer Commission in their December 2010 map were assigned a letter designation; and then those areas not covered, or outside of Mashpee, were assigned a separate designation in GIS, some using past "sewershed" numbers as established in the Draft Scenarios Report, and some new designations.

The following is a brief description of the approximate area (please see Figure 2 – Appendix G).

A. Seconsett Island
B. Areas to the east and west of the existing New Seabury facility
C. Monomoscoy Island
D. Areas surrounding and including the Keeter Property
E. Area around Holland Mills Estates, Great Hay Acres, and Southcape Resorts
F. Pirates Cove
G. Mashpee Village
H. Areas south of Johns Pond including the High School
I. Area around Willowbend
J. Southport
K. Cotuit Meadows and portion of Barnstable to the east
L. North of Johns Pond, Briarwood area
M. North of Ashumet Pond
N. Steeplechase
O. Stratford Ponds
P. Area around Mashpee Rotary north along Great Neck Road

Q. Future Wampanoag Village site north towards Town Hall

R. Northeast of Santuit Pond

S. West of Santuit Pond (south picking up neighborhoods west and south of Willowbend)

T. Area along Route 130 between Town Hall and Sandwich

Additional designations include:

- Sandwich Sewersheds 1 through 9 were used again (includes the northernmost part of Mashpee)
- Falmouth Sewersheds 1 through 17
- Barnstable Sewersheds 37, 38, 39, and 42
- Miscellaneous areas were also picked up including areas of Mashpee outside the watersheds, Popponesset Island, areas within the watersheds anticipated to remain on septic systems, and some clusters of I/A systems like Sconset Village and the Nitrex™ system located near Town Hall.

It's important to note that although these options present a way of identifying where flows and loads are collected, treated, and discharged, it is the nitrogen discharge and its location within the watershed(s) that is the critical piece for modeling through MEP. Within any alternative that is ultimately developed, there remains the possibility that flows could be "traded" for balancing purposes if it is determined to be more cost-effective. For example, around Johns Pond some properties may end up potentially being served at the Back Road Site, while other areas might end up outside of the watershed. Most likely there will be some balance between the loads generated from Southport and those generated from the areas south and west of the pond. Once the options are modeled through MEP, the more difficult tasks of cost estimating, refining, and phasing of any alternative plan can take place; however that is not the purpose of this part of the analysis.

Options 1A and 1B were presented in October 2011, and the Sewer Commission requested that a third option (Option 1C) be developed. This third option would reflect parts of Options 1A and 1B. Primarily, it focuses on the New Seabury/Rock Landing sites not being available, however Option 1C requires that the portions of Barnstable, Falmouth, and Sandwich that are proposed to be addressed are handled the same as in Option 1A. Therefore, properties within the Town boundaries of Mashpee are handled very similarly to Option 1B.

Following the October 2011 presentation on Options 1A and 1B, some additional minor changes were made to these scenarios to address questions raised regarding meetings TMDL's within subwatersheds and requests to examine some individual properties. These included the following:

- Barn-39 was included under each scenario (1A, 1B, and the new 1C) to address higher loads to Shoestring Bay. This flow was considered removed from the watershed under each scenario.
- Additional flow removed from Jehu Pond under each scenario (1A, 1B, and 1C) to reduce loads in this watershed (approx. 1,600 gpd treated at either Rock Landing or Keeter Property depending on the Option).
- Added Anthony's Way and Equestrian into the I/A group.

- Identified a double-accounting of build-out wastewater flow within the Mashpee River watershed. As part of the estimation of nitrogen impacts, GHD modified the MEP "Rainbow Spreadsheets" to estimate the nitrogen load and attenuation to the watersheds. MEP had estimated build-out load which included wastewater and non-wastewater sources. To evaluate the options, the MEP build-out load was modified to eliminate wastewater flows (as they are being accounted for as part of the GHD analysis); however, within the Mashpee River watershed, not all the wastewater nitrogen was removed during the initial GHD analysis from the MEP model. This has been corrected as part of this data analysis.
- T. Fudala of the Sewer Commission identified a change in a future 40B project, and flows for Parcel 19-10 were reduced to eliminate 120 apartments; however, the projected remaining build-out as previously identified by the Town is to remain.

4.3 Option Description

4.3.1 Option 1A Description

This option was a modification to the first of two presented in the Spring of 2011. The primary goal was to look at sending as much flow as possible to the existing Rock Landing Well Site or Site 7, under the assumption for Rock Landing to be considered that these wells would be relocated in the future to allow treated water recharge to occur at this site. The balance of flow would either be managed within the watersheds or remain as flow from septic systems.

Table 1 in Appendix G outlines where/how each part of the Project Planning Area is proposed to be served in the future and where the treated effluent from that area would be recharged in order to meet the TMDLs. In Option 1A the majority of the treated flow is proposed to be sent out of the watershed to the south in Mashpee; the majority of the smaller WWTF would remain although treated at a higher level; and portions of Barnstable, Falmouth, and Sandwich would be treated out of the watershed.

Figure 3 shows the location and discharge areas summarized on Table 1 (figures and tables can be found in Appendix G).

4.3.2 Option 1B Description

This option was developed after receiving comments from the Sewer Commission on Option 1A. The primary goal was to look at how wastewater might be managed if the Rock Landing and New Seabury discharge locations were not available. The balance of flow would either be managed within the watersheds or remain as flow from septic systems.

Table 2 in Appendix G outlines where/how each part of the Project Planning Area is proposed to be served in the future under this option, and where the treated effluent from that area would be recharged in order to meet the TMDLs. In Option 1B the future flows are more dispersed with eastern Mashpee (around Willowbend) receiving the largest portion of the flow, with other large recharges at Sites 4, 6, and the Back Road parcels. Again some of the smaller WWTFs would remain with a higher treatment level. This option also assumes that all of Sandwich's flow remains within the Project Planning Area, and Barnstable's flows are treated within the planning area as well. This option does consider that the portion of Falmouth west of the Moonakis/Quashnet River is removed from the Project Planning Area (similar to Option 1A).

Figure 4 shows the location and discharge areas summarized on Table 2 (figures and tables can be found in Appendix G).

4.3.3 Option 1C Description

This option was developed after receiving comments from the Sewer Commission following the submittal of the October 3, 2011 Draft Memorandum on Options 1A and 1B. This option is similar to 1B as it looks at how wastewater might be managed if the Rock Landing and New Seabury discharge locations were not available; however, there was concern that Options 1A and 1B managed flow from the neighboring towns differently, so Option 1C was established to replicate how flows in Barnstable, Falmouth, and Sandwich are managed similar to Option 1A. The balance of flow would either be managed within the watersheds or remain as flow from septic systems.

Table 3 in Appendix G outlines where/how each part of the Project Planning Area is proposed to be served in the future under this option, and where the treated effluent from that area would be recharged in order to meet the TMDLs. In Option 1C the future flows are more dispersed with eastern Mashpee (around Willowbend) receiving the largest portion of the flow, with other large recharges at Sites 4, 6, and the Back Road parcels. Again, some of the smaller WWTFs would remain with a higher treatment level. This option manages the neighboring towns in the same manner as done in Option 1A.

Figure 5 shows the location and discharge areas summarized on Table 3 (figures and tables can be found in Appendix G).

4.3.4 Preliminary Findings Leading to MEP Model Runs

The results of this analysis were then entered into previously developed MEP “Rainbow Spreadsheets” that were modified/updated to show the recharges based on the tables referenced above and compared against the MassDEP issued TMDLs for nitrogen in the various watersheds. The preliminary results are shown in Table 4 (Appendix F) which demonstrates that distribution of the nitrogen loads should be within the allowable thresholds.

Because this was not the official model run by the MEP, the impact on the various watersheds was considered approximate until run through the MEP model for verification. This analysis and the supporting data (GIS data set of the unified database) was submitted to MEP to run each of the three options in their model. MEP then issued another technical memorandum summarizing the results, similar to those issued November 13, 2009 and February 9, 2010.

The following caveats were issued as part of the Option development for MEP modeling:

- The focus of this step is to identify the discharge locations and volumes so they can be incorporated into a scenario including considerations for maximum month and peak day conditions required for facilities design.
- All these options are based on the assumption that private facilities will be owned and operated in the future by the Town or District. The Town/District should continue with negotiations with all of these facilities.
- All these options are based on the assumption that the recharge sites can accommodate the flows (at all conditions: average, maximum month, peak day); the Town/District will need to verify this as part of preliminary design, final design, or as an amendment to this project.

- Recharge to the Keeter Property assumes there is a distribution of treated recharge to several watersheds including directly to Nantucket Sound. More recent USGS modeling efforts may provide a clearer estimation of the distribution of this nitrogen load.
- This assumes that towns will manage their respective loads or be willing to enter into agreements regarding regional facilities.
- Nitrogen concentrations from septic systems at 26.25 mg/L are based on MEP/DEP findings.
- Nitrogen concentrations from I/A systems are assumed to be 19 mg/L based on current MassDEP permitting and the findings of the Barnstable County study; however it is understood that some of these facilities may be able to achieve much higher treatment performance, however a conservative approach was selected.
- Flows are based on those in the unified database and build-out information developed previously. It is also understood that MEP has been developing the full Waquoit Bay Watershed TMDL, and therefore adjustment may be required to address changes related to those findings as an amendment to this project.
- The development of the Recommended Plan is where the implementation and phasing approach of the project will be developed, which will focus on addressing current wastewater needs with the understanding that proposed facilities will need to be able to accommodate future growth.
- It is understood that the current economic climate and population trends across the Cape are flat; however any future plan will have to consider that over a 20-year period these conditions will change, and will need to be flexible in both a positive (growth) and negative (declining) direction. Per the 2010 Census, Barnstable County saw a 2.9-percent decrease in population while Mashpee experienced a growth of almost 9-percent over that same period.

4.4 MEP Data

The Unified Database was transmitted to MEP with additional columns provided to allow correlation to Tables 1 through 3. The following options as outlined in Tables 4-1 through 4-3 were referenced for model runs.

Table 4-1 Option 1A—Summary of Recharges (from Table 1)

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	South Cape Village; Site 4 (Transfer Station); Willowbend; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village	280,000
WWTF recharge within Waquoit Bay East Watershed	Back Road	370,000
Septic / I/A recharge in planning area	Various	500,000
Recharge outside watershed	Rock Landing; New Seabury; Sandwich: Barnstable; Falmouth	1,550,000
Totals (rounded)		**2,700,000**

Table 4-2 Option 1B—Summary of Recharges (from Table 2)

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	Site 6 (Keeter); South Cape Village; Site 4 (Transfer Station); Willowbend and golf course; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village; Pirates Cove; Santuit Pond Cluster, Sandwich	1,520,000
WWTF recharge within Waquoit Bay East Watershed	Back Road; Site 6 (Keeter)	480,000
Septic / I/A recharge in planning area	Various	340,000
Recharge outside watershed	Site 6 (Keeter); New Seabury; Barnstable; Falmouth	350,000
Totals (rounded)		**2,700,000**

Table 4-3 Option 1C—Summary of Recharges (from Table 3)

Planning Area	Locations	Est. Average Annual Future Flow (gpd, rounded)
WWTF recharge within Popponesset Bay Watershed	Site 6 (Keeter); South Cape Village; Site 4 (Transfer Station); Willowbend and golf course; Windchime Point; Stratford Ponds; Cotuit Meadows; Wampanoag Village; Pirates Cove; Santuit Pond Cluster,	1,030,000
WWTF recharge within Waquoit Bay East Watershed	Back Road; Site 6 (Keeter)	480,000
Septic / I/A recharge in planning area	Various	500,000
Recharge outside watershed	Site 6 (Keeter); New Seabury; Barnstable; Sandwich; Falmouth	690,000
Totals (rounded)		**2,700,000**

4.5 MEP Model Results

In November 2012, the University of Massachusetts Dartmouth SMAST issued the model results for the three options (1A, 1B, and 1C). The results indicated that "all three options meet the threshold values/TMDLs at the sentinel station for restoration of eelgrass in Popponesset Bay." The results also indicated that "all three options do not meet the threshold values at the sentinel station for restoration of eelgrass in Jehu Pond or Hamblin Pond. All three options do meet the water column TN concentration that would be restorative of infaunal habitat in the Quashnet River. Their model result tables also indicate that all three options meet the TMDL/MEP threshold for Great/Little River and Upper Waquoit Bay.

Based on their model analysis in this watershed, Options 1A and 1B removed more nitrogen than necessary indicating that these options could potentially be adjusted to reduce the amount of sewering or accept additional flows from the Waquoit Bay watershed to help address the nitrogen load in Jehu Pond and/or Hamblin Pond. In addition, discussions with MEP indicate that although Jehu and Hamblin Ponds do not meet the TMDL thresholds, this is a reflection of the New Model including all of Waquoit Bay, not just the portions evaluated previously. This also reflects no nitrogen removal in other parts of Waquoit Bay. If additional nitrogen removal occurs in Falmouth, it is very likely that these two watersheds will meet the TMDLs.

The following Table 4-5 summarizes the findings as presented in Tables 3 and 4 from the MEP technical memorandum.

Table 4-4 Summary of Threshold Comparison Results

Watershed/Embayment Section	TMDL/MEP Threshold	Option 1A	Option 1B	Option 1C
	mg/L	mg/L	mg/L	mg/L
Popponesset Bay—Head	0.38	0.359	0.366	**0.381**
Mashpee River—Mid to lower	0.4-0.5	0.447	0.474	0.492
Shoestring Bay—Upper to lower	0.4-0.5	0.433	0.440	0.481
Ockway Bay—Upper	0.4-0.5	0.413	0.436	0.451
Jehu Pond—WB1	0.446	**0.471**	**0.481**	**0.481**
Great/Little River—WB3	0.38	0.355	0.359	0.359
Hamblin Pond—WB4	0.38	**0.39**	**0.398**	**0.398**
Quashnet River—WB7, WB8	0.52	0.502	0.503	0.503
Upper Waquoit Bay—WB12	0.38	0.358	0.359	0.359

Blue shading represents those that do not meet the Threshold.

5 Cost Evaluation and Operations and Maintenance Considerations

5.1 Introduction

Cost evaluations as part of this project—and ultimately its implementation—are being performed in multiple steps. The initial step, started in 2008, was used to compare the various alternatives being considered on a macro scale across the entire watershed areas including adjacent communities. The purpose of developing costs at this scale is to consider alternatives on a side-by-side analysis and attempt to provide the large (whole) picture. The second step which will be included in the development of the Recommended Plan and reported in the Draft Recommended Plan/Draft Environmental Impact Report (DEIR) Document will be the further cost effectiveness analysis to refine the Recommended Plan to identify and compare cost-effective alternatives (shellfish aquaculture, PRBs, cluster systems, regional solutions, and ownership/operational issues etc.) for the Town of Mashpee to consider as part of implementation. These costs would then be further refined as part of the Final Recommended Plan/Final Environmental Impact Report (FEIR), and ultimately as part of any design phase and implementation. It is important to understand that costs developed in this Alternatives Screening Analysis Report (ASAR) are for comparing alternatives scenarios developed to date based on traditional implementation methods. It is also important to note that each of these alternatives/options is looking at the nitrogen removal first. Once that is established, these options are compared on this traditional path to set the baseline upon which all other cost refinements can be compared. Because some of these "refinements"—like shellfish, PRBs, etc.—have not been assigned a "nitrogen credit value", the baseline reflects the regulatory backup if performance is not proven out over long-term implementation.

As the project proceeds to the development of the Recommended Plan, the costs in the Recommended Plan would then be broken into implementation phases, refined to take advantage of phased implementation and financing mechanisms and alternative technologies to maximize the cost-effectiveness of implementation. It is also important to note that costs in the planning phase include a significant contingency (typically on the order of 25- to 30-percent), to deal with unknowns that aren't typically identified until final design. As the design progresses, these contingency values are typically reduced to 10- to 15-percent, and ultimately the actual cost will come down to the construction bidding climate at the time the project is to proceed. Projects receiving funding from the State Revolving Fund (SRF) will then carry approximately 5-percent contingency into construction to deal with changed conditions.

Because each alternative is dependent on achieving the TMDL, the key factor is how much nitrogen can be recharged within a watershed at a particular location. Each of the alternatives presented to date include some component of reuse of existing septic systems, reuse of existing WWTFs, upgrade of existing WWTF, construction of new WWTFs, and regional solutions, all of which are based on a future build-out condition.

Phasing—for the purpose of these reports—will be defined as how costs will be divided over a projected timeline in the project to achieve TMDL compliance, and the target areas and approaches that will come first versus those implemented in later stages (if necessary) to deal with growth and the findings of adaptive management. Those items will not be presented in this report, but will be addressed in the next report as outlined in Chapters 6 and 7. Density, proximity to sensitive receptors, seasonal/year-round

occupancy, proximity to existing infrastructure, and existing versus build-out projected use will all be considered in the subsequent report.

5.2 2008 Cost Analysis

A detailed cost evaluation was prepared as part of the development of the 2008 scenarios presented in the Draft Alternatives Report. These costs were then used as the basis of discussing the various options to be considered in formulation of the Recommended Plan as described in Chapter 3.

The approach was to look at comparing alternative solutions to an area and showing the relative cost difference between them; this is in contrast to the full development of a cost for every option as there are multiple “choices” that can be considered.

Appendix H includes Table 4-5 which presents a summary of the required infrastructure for each scenario. These infrastructure totals were used to develop costs in order to compare the four scenarios (1, 2, 4, and 5). Scenario 3/3R—Cluster by LAI was evaluated by others and is presented in detail in a document included in Appendix F. For the purpose of the cost evaluations the term “scenario” will refer to costs developed for scenarios 1, 2, 4, and 5. Costs for Scenario 3/3R—Cluster by LAI are included in Appendix F.

Because each scenario could conceivably use any number of technologies identified and recommended as part of the Technology Screening Report analysis, specific technologies were identified in this report so that preliminary (order of magnitude) costs could be developed. The intent of the cost comparison presented here is to be able to compare each of these initial scenarios that have been identified by the Sewer Commission for MEP analysis. This analysis is not intended to represent the final cost or selection of technologies; rather, it is to provide a common basis for evaluating Scenarios 1, 2, 4, and 5. The technologies used as the basis for this cost evaluation are as follows:

- Gravity and pressure (grinder pump) collection systems
- Sand infiltration and subsurface leaching facilities
- Sequencing Batch Reactors and denitrification filters for new facilities
- Allowance for process expansion and modification at existing facilities

The technologies identified above are applied to each scenario equally. Therefore, it is the intent of this analysis that if vacuum or STEP sewer systems were used in place of pressure and gravity sewers that these changes would be made in all scenarios and the relative change would not impact the findings of the cost evaluation, only the bottom line costs. The same methodology is true for the consideration of other wastewater technologies in place of SBRs. The ultimate goal of the development of these scenarios is to achieve the total nitrogen TMDLs. If each scenario achieves the TMDLs following MEP modeling, then the relative cost comparisons would be used as a guide for refining and selecting new scenarios to be evaluated further. As developed, the costs are intended to provide a means of side-by-side comparison.

Additional detailed analysis and cost evaluations will be developed as these scenarios are refined, and when recommended technologies are selected and approved by the Sewer Commission. The refined cost evaluations (as described in Section 5.1—Introduction) for future scenarios, and ultimately the Recommended Plan, will be based on those findings.

Estimated capital costs for each scenario (1, 2, 4, and 5) were developed for the following:

- Individual I/A system costs
- Upgrades to existing facilities
- Collection system costs
- New wastewater treatment facilities
- Treated water recharge facilities

Because a detailed design will not be prepared until after the completion and approval of a Recommended Plan, typical costs are applied. The preliminary collection system layouts created in 2008 allowed for a certain level of detail based on linear feet of pipe, number of pumping stations, etc. Data from the Barnstable County Health Department's report for Eastham, Massachusetts was used as a basis for individual system costs. Allowances were made for additional treatment required to achieve closer to 10 mg/L total nitrogen in the effluent; O&M costs were adjusted to account for additional sampling requirements expected to achieve TMDL compliance.

Wastewater treatment facility costs were based on similar projects and equipment cost quotes from equipment suppliers with allowances for site work, yard piping, electrical and instrumentation, general conditions, etc. Additional allowances were made for engineering, contingencies, and fiscal and legal issues. Costs for the four scenarios did not include allowances for acquisition of private facilities, land, or easements.

Estimates were also made on O&M costs that could be expected for each facility. O&M costs for existing facilities were only presented as "estimated additional" O&M costs that might be expected for a substantial upgrade to an existing system in order to generate a reasonable estimate of present worth. Gravity system O&M cost estimates are based on the gravity system only, and the O&M costs associated with the force mains and pumping stations is included in the force main O&M number. I/A system O&M cost estimates are based on allowances for electrical, maintenance, laboratory analyses, and sludge pumping.

O&M costs are converted into present worth cost in order to calculate an estimated total present worth of each scenario. Present worth analysis is based on February 2008, with a discount rate of 4.875-percent based on U.S. Department of Treasury rates effective for Water Resource Development Act. The rate was applied for a 20-year period using the equation for uniform series present worth.

Estimated total capital costs are presented for each scenario in Appendix H Table 4-7 from the draft 2008 report.

It is important to identify that costs for implementation of any Recommended Plan will be incurred over an extended time period based on the magnitude of the problem and the economic impacts associated with such a solution. Project phasing and actual future growth will also impact costs. Therefore, the use of adaptive management to monitor cost and performance will be discussed in greater depth as part of the Recommended Plan. The monitoring of the embayment systems, implementation of growth controls through land use and zoning, and implementation of best management practices for control of run-off and other non-wastewater nitrogen contributions will all aid in the management of wastewater and may provide for a reduction in sewering. As Towns are forced to achieve higher levels of treatment to achieve nitrogen removal, phosphorus removal, or other wastewater constituents, the costs will likely increase to provide these higher levels of treatment.

5.3 Updated Cost Evaluation

The unit costs used as part of the original 2008 work were then used as a basis to provide a Mashpee-focused cost basis. In 2008, costs included estimates for infrastructure within the other planning area Towns of Barnstable, Falmouth, and Sandwich. Because each of those communities is actively pursuing their own planning efforts in order to develop cost-effective means for each to address their own Town-wide water resource management issues, it was decided by the Sewer Commission to focus on Mashpee costs.

This updated 2013 cost basis was used for an estimated average cost per wastewater generating property served and was applied to the new "service areas" of Options 1A, 1B, and 1C as outlined in Chapter 4. The estimated costs for collection systems were updated based on recently bid projects on Cape Cod adjusted for an ENR index of 9483 for April 2013. An average of $22,500 per property connected was used for the collection system costs, which includes the sewer mains, pumping stations, and road construction. These costs do not include property-owner connection costs, treatment, recharge, force mains, or any of the design or contingencies as outlined in the following Table 5-1. In 2008, the number of estimated parcels served in Mashpee ranged from 5,300 to 5,700 depending on the scenario, and the new options are between 5,900 and 6,100 Mashpee parcels out of approximately 8,000.

Costs were then adjusted to provide a total capital cost estimate, including wastewater treatment and treated water recharge site.

These costs were developed based on traditional implementation methods as identified as part of the 2008 scenarios and in this report. However, a goal of this project as part of the Recommended Plan development (a process as outlined in Chapters 6 and 7 of this report) is to use these costs as the starting point (baseline) and then look at the cost-effectiveness of reducing sewer areas through the use of shellfish aquaculture, potential cost comparisons of using a regional MMR facility or cluster neighborhood systems, or other means.

As described previously, phasing and prioritization will be considered in the Recommended Plan report which will also look at cost-saving approaches.

The following Tables 5-1 through 5-4 present the Engineering Estimate of Project Capital Costs for order of magnitude comparison in millions of dollars for a traditional approach of addressing wastewater in Options 1A, 1B, and 1C. As you will recall, Options 1A, 1B, and 1C do not discuss treatment technologies, they only focus on the concentration of the recharge and the location of that recharge within the watersheds, and what would remain in I/A, septic system, or existing WWTFs throughout the Project Planning Area.

Table 5-1 Comparison of Estimated Scenarios/Options Collection System Costs [1, 2]

Estimated Collection System Costs	Option 1A	Option 1B	Option 1C
Collection System Construction Cost[3]	$130	$134	$130
Force Mains[3]	$21	$19	$21
Subtotal	$151	$153	$151
General Conditions	$23	$23	$23
Total Construction Cost	**$174**	**$176**	**$174**
Contingency	$43	$44	$43
Fiscal, Legal,	$17	$18	$17
Engineering (Design and Construction)	$33	$33	$33
Total Collection System Capital Cost	**$267**	**$271**	**$267**

Notes:

1. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.
2. Costs do not include the siting and construction of new wastewater collection/treatment/recharge facilities in Barnstable, Falmouth, or Sandwich.
3. Collection System Costs include pumping station. Costs do not include land acquisition. Force main costs are based on estimated lengths of force mains from pumping station to discharge point. Costs also include force main from WWTF to treated recharge site. Does not include costs associated with land acquisition.

Table 5-2 Comparison of Estimated Scenarios/Options WWTF Costs[1, 2]

Estimated WWTF Costs	Option 1A	Option 1B	Option 1C
Construction Cost for Modification to Existing WWTFs [3]	$14	$11	$14
Construction Cost for New WWTFs [5]	$28	$37	$28
Construction of Treated Water Recharge Facilities [4]	$8	$9	$9
Subtotal Wastewater Treatment Facility Construction Costs	$50	$57	$51
General Conditions	$8	$9	$8
Total Construction Cost	**$58**	**$66**	**$59**
Contingency	$15	$17	$15
Fiscal, Legal	$6	$7	$6
Engineering (Design and Construction)	$11	$13	$11
Total WWTF Capital Cost	**$90**	**$103**	**$91**

Notes:

1. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.
2. Collection system costs presented in Table 5-1.
3. Does not include costs associated with acquiring the facility.
4. Costs do not include the siting and construction of new wastewater collection/treatment/recharge facilities in Barnstable, Falmouth, or Sandwich.
5. Costs include facilities at new sites and estimated expansion on some existing sites. Does not include costs associated with land acquisition.

Table 5-3 Comparison of Estimated Scenarios/Options I/A Component Costs[1, 2, 3, 4]

Estimated Individual System Upgrade Costs	Option 1A	Option 1B	Option 1C
Individual I/A Systems Construction Costs	$ -	$ -	$ -
Total Construction Cost	$ -	$ -	$ -
Contingency	$ -	$ -	$ -
Engineering (Design)	$ -	$ -	$ -
Total Capital Cost	**$ -**	**$ -**	**$ -**

Notes:

1. Options 1A through 1C were estimated based on traditional collection, treatment, and recharge at a cluster system, new WWTF, or existing WWTF.
2. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.
3. Costs do not include the siting and construction of new wastewater collection/treatment/recharge facilities in Barnstable, Falmouth, or Sandwich.
4. Does not include costs associated with land acquisition.

Table 5-4 presents the summary of estimated capital costs for each Scenario/Option as presented in Tables 5-1 through 5-3 and includes collection, treatment, recharge and individual I/A facilities.

Table 5-4 Comparison of Estimated Scenarios/Options Total Capital Costs [(1)]

Estimated Individual System Upgrade Costs	Option 1A	Option 1B	Option 1C
2013 Total Capital Cost (from Tables 5-1 through 5-3)	$357	$374	$358

Notes:

1. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.

5.4 Operation, Maintenance, and Monitoring of Plan Components

Operation, maintenance, ownership, and monitoring of the components of any plan will also have a significant impact on the system costs. Whether a Town or District owns/operates/maintains each of their system components (pumps, stations, treatment facilities, etc.) or relies on contract operations, private ownership, etc., these all have an impact on costs. The following section discusses some of the options the Town/District will have to consider regarding the management and operation of these systems.

5.4.1 Decentralized Facilities

Although large-scale implementation of denitrifying on-site systems will not meet the total nitrogen TMDLs for the planning area as previously modeled by MEP, there will be areas that will likely remain on some type of “individual” system (i.e. septic system, denitrifying septic system, eco-toilet, etc.). Although these systems will be considered part of the Recommended Plan as individual systems, working to achieve TMDLs for regulatory requirement will require a higher level of operations, maintenance, and monitoring to verify that they are meeting the overall goal of the project. Unfortunately this approach of meeting a TMDL makes regulating the individual operation, maintenance, and monitoring of these systems more complex as the plan is relying on their performance as much as any other system.

Denitrifying systems—and possibly the retrofit of an existing residence or business to eco-toilets—are a larger investment that must be properly operated and monitored if they are expected to achieve (or show compliance with) the required nitrogen removal. They will require operation, maintenance, and monitoring knowledge and skill that was not required for Title 5 systems. Denitrifying systems require additional maintenance and monitoring beyond the typical Title 5 system, and require owners to have a better understanding of their system and its requirements for proper operation. Most town health departments do not have the resources to regulate large-scale implementation of these systems or to provide the continuous monitoring for compliance. Therefore, if left to the private homeowner, these systems (or components of these systems) would have to be operated/monitored by a third party (contract operator or Town/District/County Agency).

As the Town finalizes its legislation allowing the formation of a Water and Sewer District, the town(s) within the planning area may have to consider the possible formation of decentralized management districts to address concerns regarding maintenance, operations, and monitoring of these systems. A decentralized management district could be set up similar to a sewer or water district through special legislation in the Massachusetts Legislature. That legislation would define the limits, function, and responsibility of the district. The district would be staffed to provide the following possible functions:

- On-site system records storage
  - system pumping records
  - system design
  - monitoring and performance data
- System maintenance and repairs
- Regulatory enforcement
- Summary reporting on district (watershed) performance
- Monitoring on other district or watershed issues such as fertilizer usage or stormwater system operations

This type of district could report to the Board of Selectman, Board of Health, Water and Sewer District, or another similar entity.

5.4.2 Larger Private Facilities or Private System Components

Similar to individual home systems, grinder pumps, STEP/STEG pumps and or septic tanks, and some vacuum system components (i.e. valve pits/buffer tanks) could be owned and operated by individual users. Vacuum system manufacturers recommend against this; however some of their components may require installation on private property, or multiple property easements in order to be implemented. Similarly, pumping systems or those requiring access to septic tanks (like STEP/STEG) may also require these types of easements, creating operations and maintenance issues for the Town/District to maintain a fully operational system; therefore, these issues must be considered during the planning stages of the project.

The next section highlights some of the options available for Towns/Districts to deal with these issues. It is important that discussions regarding these issues begin so the phasing and implementation can take these into consideration.

5.5 Options for Ownership and Management of Facilities

Several documents have been developed on the regional, state, and federal level discussing management options that Mashpee will need to consider as they develop an approach to own and operate these facilities.

5.5.1 Federal Guidance

United States Environmental Protection Agency (USEPA) published the “Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems” in March 2003. This document presents five different management models that could be employed by a Town or Regional Management Entity. These could relate to several issues including:

- Grinder/STEP pumping systems
- Package/Cluster Treatment Facilities
- Onsite septic/denitrifying (I/A)/eco-toilet type systems

The five models identified are as follows:

1. **Model 1—Homeowner Awareness Model.** The homeowner/association is educated on their system, including operations and maintenance requirements.
2. **Model 2—Maintenance Contract Model.** The homeowner/association is required to contract with a maintenance company to maintain their system, usually for those onsite systems that would go beyond a standard Title 5 system in Massachusetts.
3. **Model 3—Operating Permit Model.** This would be applicable to those properties in the planning area that would be required to have an I/A system based on their location or the current Water Reuse Regulations. This would be similar to a groundwater discharge permit for each individual property falling into this category.
4. **Model 4—Responsible Management Entity (RME) Operation and Maintenance Model.** This would be similar to Model 3, except a management district/Town department would be responsible for permit compliance, however the system would still be owned by the homeowner/association.
5. **Model 5—RME Ownership Model.** This is taking Model 4 to the next level where the system ownership and maintenance requirements fall on the management district/Town department and the homeowner/association is no longer responsible for the system.

A more detailed summary of the Management Models presented in the above referenced document is included in Appendix H.

5.5.2 State Guidance

MassDEP also prepared a guidance document as part of the Massachusetts Estuaries Project. This document entitled “Embayment Restoration and Guidance for Implementation Strategies” was published in 2003, and discusses several approaches to nitrogen reduction including the formation of management districts. Mashpee has already started this process related to the formation of a Water and Sewer District; however until the legislation regarding that District is completed it is unclear how individual systems and existing systems will fit into this new structure. Their inclusion in this new District is currently being considered.

This state guidance document summarizes the advantages of a “District Approach” in dealing with nitrogen reduction, including the flexibility and funding advantages this type of approach to management could provide. The document also identifies the three legal options for creation of such districts:

1. **Massachusetts General Law**
   - Formation of “Water Pollution Abatement Districts”, as defined under the Massachusetts Clean Water Act
   - Creation of “Independent Water and Sewer Commissions and Inter-municipal Agreements”
   - Creation of “Regional Health Districts” for two or more municipalities
2. **Special Act of the Legislature.** Allows municipalities to file home-rule petitions requesting enactment of a special law. The best example of this on Cape Cod is Provincetown’s legislation on the “checkerboard” approach to sewering.

3. **Municipal Home Rule Authority, Bylaws, and Regulations.** Essentially, this provides the municipality the ability to use Zoning Bylaws, General Bylaws, and Local Boards of Health to regulate wastewater. This is currently being applied in Chatham with the Board of Health's Interim Nitrogen Loading Regulations.

5.5.3 Regional Guidance

The Cape Cod Commission (CCC) also developed a "Cape Cod Comprehensive Regional Wastewater Management Strategy Development Project" Report published in June 2003. This document also discussed Wastewater Management Districts.

The formation of a District or Town department to manage these types of systems will need to be considered as part of any alternative plan.

6 Framework

6.1 Introduction

Following the Mashpee Sewer Commission meeting held on January 17, 2013, the framework of the Recommended Plan development began to take form based on the findings of the three options run through the MEP model and summarized in Chapter 4 of this report.

The Project team worked through a worksheet prepared by the Sewer Commission to consider which items/plan components should be carried forward; and based on that list, Options 1A, 1B, and 1C were examined to see how these components could be integrated into those nitrogen management options. Major components were identified so that a cost evaluation of various alternatives could be compared as part of the Recommended Plan Report.

Based on the various components to be considered, each was grouped into one of the following three categories (each as defined below):

- Source Removal
- Direct Environmental Mitigation
- Land Management Strategies

Source Removal is the removal of nitrogen (or some portion of it) before it reaches the local groundwater and can be further divided into the following subcategories:

- Wastewater Management
- Stormwater Management
- Fertilizer Management

Each of these allows the Towns within the planning area to mitigate nitrogen before it enters the groundwater and eventually reaches the ponds and estuary systems.

Direct Environmental Mitigation is generally defined in this report as the removal of nitrogen (or some portion of it) at or in close proximity to the area of impact. This can be further divided into the following subcategories:

- Dredging/Inlet Widening
- Shellfish Aquaculture
- Permeable Reactive Barriers
- Enhanced Natural Systems

Land Management Strategies are generally defined in this report as the growth and development management strategies to reduce the potential of the Project Planning Area reaching a build-out condition which increases the cost and difficulty of achieving TMDL compliance.

Much of the discussion as part of this project to date has focused on the Source Removal approach, and recently there has been a greater push for the Direct Environmental Mitigation to be used in one of two ways—reduce or eliminate the need for Source Removal in certain areas, or be implemented prior to

Source Removal—to either allow longer phasing of any Source Removal strategy or ultimately the reduction of the need for full-scale traditional wastewater management.

As was clearly shown in all eight previous scenarios, a massive amount of Source Removal is required to achieve the TMDLs under the build-out condition if Direct Environmental Mitigation is not considered or feasible.

6.2 Source Removal

During the Sewer Commissions recent monthly working session, several approaches were identified:

- Potential Cluster Systems at the following locations:
  - Santuit Pond Area
  - Pirates Cove
  - Monomoscoy / Seconsett / Popponesset Island
  - Other Areas
- Use of Existing WWTPs (in the planning area)
  - Use of all, but ownership, upgrade, and expansion will be site-dependent and discussed later in the cost section
- Potential New WWTPs
  - Transfer Station and High School
  - Possibly at Keeter Property, Old Highwood Well
  - Unlikely at Rock Landing or Back Road Sites
- Eco-Toilets
  - Mashpee needs to establish what its plan will be to address these, may follow Falmouth's lead
- MMR
  - Unknown at this time whether the site will be available for any use. Ideal for regional facility, especially if expanded recharge is allowable at the existing sand infiltration beds
- Stormwater
  - BMP's need to be implemented on a case-by-case basis, with nutrient removal capabilities considered in most sensitive watersheds.

6.3 Direct Environmental Mitigation

- Dredging/Inlet Opening
  - No clear areas identified in either MEP reports for dredging or widening to significantly improve water quality. For Popponesset Bay the MEP report stated "it is unlikely that dredging will improve water quality with the three main subembayments", however the report stated that the main channel should continue to be dredged to avoid further degradation of estuaries health. Same as for removal of "muck" removal from the bottom any of the Town's estuaries (outside of regular maintenance for navigation).
- Shellfish Aquaculture
  - Oysters—Mashpee River, Popponesset Bay
  - Quahogs—Jehu, Hamblin, Great River, Little River, Ockway Bay, and Popponesset Bay

- PRBs
  - Pirates Cove
  - No other definitive areas identified at this time
- Enhanced Natural Systems
  - Abandoned Cranberry Bog naturalization/conversion
    - Discussion on bogs south of Santuit Pond and those east of the Quashnet River.
    - Potential conversion of shallow ponds/water hazards to deeper ponds for additional natural attenuation.

6.4 Land Management Strategies

- Growth Neutral/Flow Neutral
  - Town will need to develop a policy that meets the criteria of the State SRF program to make themselves eligible for zero-percent SRF loans
- Purchase of Open Space/Build-out Development Properties
  - Town will need to identify which properties could be purchased to reduce build-out potential, therefore reducing potential future flow, and reducing the projected nitrogen loading to the embayments.
- Potential Well and/or Treatment and Disposal Sites
  - Town can work towards securing additional public drinking water supply well locations and potential treated water recharge sites to foster flexibility in addressing their wastewater needs and protecting their drinking water supplies.
- Seasonal and year-round property phasing impacts
  - Phasing and implementation can target year-round developments or apply near-term solutions to areas that are more seasonal in nature to achieve a quicker rate of result while minimizing infrastructure investment in the near-term.

6.5 Recommended Plan Components

6.5.1 General

As developed as part of the initial scenarios/options, the following sections identify those decisions/recommendations made to date as they relate to Source Removal, Direct Environmental Mitigation, and Land Management Strategies.

6.5.2 Source Removal

The following sites and technologies were selected for further consideration for wastewater treatment and removal. This section will also briefly touch on stormwater removal technologies identified previously in this report.

6.5.2.1 Sites

As identified in Chapter 2, the following new treatment and recharge sites were identified and should be carried forward.

6.5.2.1.1 Potential Treatment Sites

1. Site 2—Ashumet Road
2. Site 4—Transfer Station
3. Site 6—Keeter Property
4. Back Road Sites

Site 2—although being kept as a viable location—will likely be combined with a wastewater treatment and recharge facility at Site 4. Similarly, the Back Road Site may be considered as a cluster facility, but if combined would likely be served from a new WWTF facility potentially located at the High School.

6.5.2.1.2 Recharge Sites

1. New Seabury/Site 7
2. Back Road Sites
3. Site 4—Transfer Station
4. Site 6—Keeter Property
5. Willowbend Golf Course

Rock Landing was removed from further consideration for several reasons:

- Difficulty and cost associated with the relocation of the existing wells.
- The site is a very high-quality drinking water supply site that supplies nearly 50-percent of the Town's water supply.
- Recharge from the location (if wells were relocated and site was used for treated water recharge) would still end up back in several of the Towns' sensitive embayments and not directly out to Nantucket Sound (for example Site 7).

6.5.2.1.3 Potential Cluster System Sites

In addition, the following potential cluster developments were identified by the Sewer Commission as shown on Figure 6-1:

- Briarwood/Otis Trailer Village
- Holland Mill Estates & South Cape Resorts
- Pickerel Cove
- Pirates Cove
- Popponesset Island
- Santuit Pond
- Monomoscoy Island
- Seconsett Island

- The Seabrooks
- Tri-Town Circle

Within these development areas the Sewer Commission identified possible vacant properties, private association lands, and Town landings as a first look at any potential space for locating a cluster system. Each of these developments was then examined to see where they were relative to Zone II's, flood zones, natural habitats, and Areas of Critical Environmental Concern (ACEC). Figures 6-2 through 6-10 show these features in relation to these developments. Cluster development potential was screened based on proximity to these areas. Based on the summary shown in Table 6-1, the following areas will be carried forward in the Recommended Plan development for further evaluation:

- Briarwood/Otis Trailer Village
- Pickerel Cove
- Pirates Cove
- Tri-Town Circle
- Santuit Pond

Areas within identified natural habitats will need to be addressed on a site-by-site basis. Mitigation and land swap will be considered if these areas remain as part of any Recommended Plan. These efforts will need to be coordinated with Natural Heritage and Endangered Species Program (NHESP) and will likely require additional study that is currently beyond the scope of this project.

Table 6-1 Potential Cluster System Site Review

Cluster Sites	In Zone II	In 100 Year Flood	In V Zone	In 500 Year Flood	In Natural Habitat
Briarwood/Otis Trailer Village					Yes
Holland Mill Estates & South Cape Resorts	Yes			Yes - Part	Yes
Pickerel Cove					Yes - Part
Pirates Cove		Yes	Yes	Yes	
Popponesset Island		Yes			
Santuit Pond	Yes - Part				Yes
Monomoscoy Island		Yes		Yes	
Seconsett Island		Yes		Yes	
The Seabrooks	Yes - Part	Yes	Yes	Yes	Yes - Part
Tri-Town Circle	Yes				

Developments within a Zone II or 100-year flood zone were screened from consideration based on the additional costs, siting limitations, and restrictive regulations regarding the location of treatment and

recharge facilities within these areas. The proximity of Pirates Cove to potentially available adjacent areas and the Willowbend Golf Course were taken into consideration in keeping this a viable option for a cluster system.

6.5.2.1.4 Existing WWTF Sites (in the Planning Area)

The Recommended Plan evaluations will consider the use of all existing facilities. However the ownership, upgrade, and expansion issues associated with each specific facility will be site-dependent and will need to be taken into consideration as part of the Recommended Plan regarding their integration into that plan.

Upgrade and expansion of the following facilities/locations is to be considered in the Recommended Plan:

- New Seabury
- Willowbend
- Mashpee High School
- Mashpee Commons

Upgrade and expansion may include physical plant improvements, upgrades to systems handling the currently permitted design flows, upgrades required to handle additional wastewater flows, or complete replacement of the existing facility with a new facility (due to age of system, year of implementation, level of treatment).

6.5.2.1.5 Massachusetts Military Reservation Site

The potential use of the MMR site will remain in consideration as part of the Recommended Plan; however, because a local or regional plan has yet to be developed or agreed upon with the MMR, the details of its use may need to be addressed as part of the adaptive management approach the Town takes into consideration with its neighbors Falmouth and Sandwich. The Towns' Board of Selectmen have written a letter stating the Town's interest in the use of facilities at this site dated March 27, 2013. A copy of the letter is included in Appendix I.

6.5.2.2 Wastewater Treatment Technologies to be Considered

Wastewater treatment facilities with performance to reach 6 to 10 mg/L total nitrogen being carried forward include:

- Activated Sludge/Extended Aeration
- Sequencing Batch Reactor
- Membrane Biological Reactor

The use of each of these technologies with denitrification filters to achieve levels less than 3 mg/L will be considered for those facilities that would recharge within one of the watersheds (Popponesset or Waquoit Bay); however, since this can be added to the end of the treatment process, these types of advanced treatment facilities may be phased in over time. There are several different types, and they will be specific based on the treatment system that precedes them and client preference regarding operations. These can include traditional upflow and downflow filters in addition to Nitrex™ or other media-based systems.

Use of RBCs will only be considered as they currently exist within the Town at existing wastewater treatment facilities. Any facility that has to achieve 3 mg/L in the future will be based on one of the three previously identified technologies (AS/EA, SBR, MBR) due to the difficulty of RBC systems to consistently achieve full nitrification of their effluent.

UV disinfection will be the only disinfection technology considered as stated in Chapter 2 and the Technology Screening Report.

Odor Control and sludge management systems/technologies will be considered on a site-by-site and process-by-process consideration as part of the Recommended Plan development and will be evaluated in the next report phase.

Collection systems (vacuum, gravity, STEP, STEG, and low pressure sewers) all remain in consideration and should be evaluated at the time of design when site conditions, survey, and utility constraints and design requirements are known. At this time the Town does not have any formal sewer guidelines or regulations that may dictate the components of the system and therefore impact the cost of installation.

6.5.2.3 Treated Water Recharge Technologies

As stated previously, use of open sand beds, traditional subsurface leaching facilities, and drip irrigation are being carried forward as treated water recharge technologies. Spray irrigation is limited by its use, its infrastructure requirements, and the DEP regulations that regulate it and its effluent quality. In addition, there are also time of year use restrictions and other considerations when dealing with spray irrigation that have screened it from consideration.

6.5.2.4 Eco-Toilets

Mashpee will need to establish how Eco-Toilets may be used as part of the Recommended Plan. The Town of Falmouth is actively leading this work in demonstration projects, and the Town of Mashpee currently has regulations allowing the use of certain types of Eco-Toilets; but a robust plan of how these can be used as part of achieving TMDL compliance must be established and will likely be part of the adaptive management approach of the Recommended Plan.

6.5.2.5 Stormwater

Best Management Practices (BMP's) need to be implemented on a case-by-case basis, with nutrient removal capabilities considered in most sensitive watersheds. The Town should continue the implementation of these features and focus on the use of the following technologies within the more sensitive watersheds:

- Dry extended detention basins
- Wet retention ponds
- Infiltration basins
- Stormwater wetlands
- Submerged gravel wetlands
- Bioretention (rain gardens)
- Water quality swales

- Infiltration trenches

6.5.3 Direct Environmental Mitigation

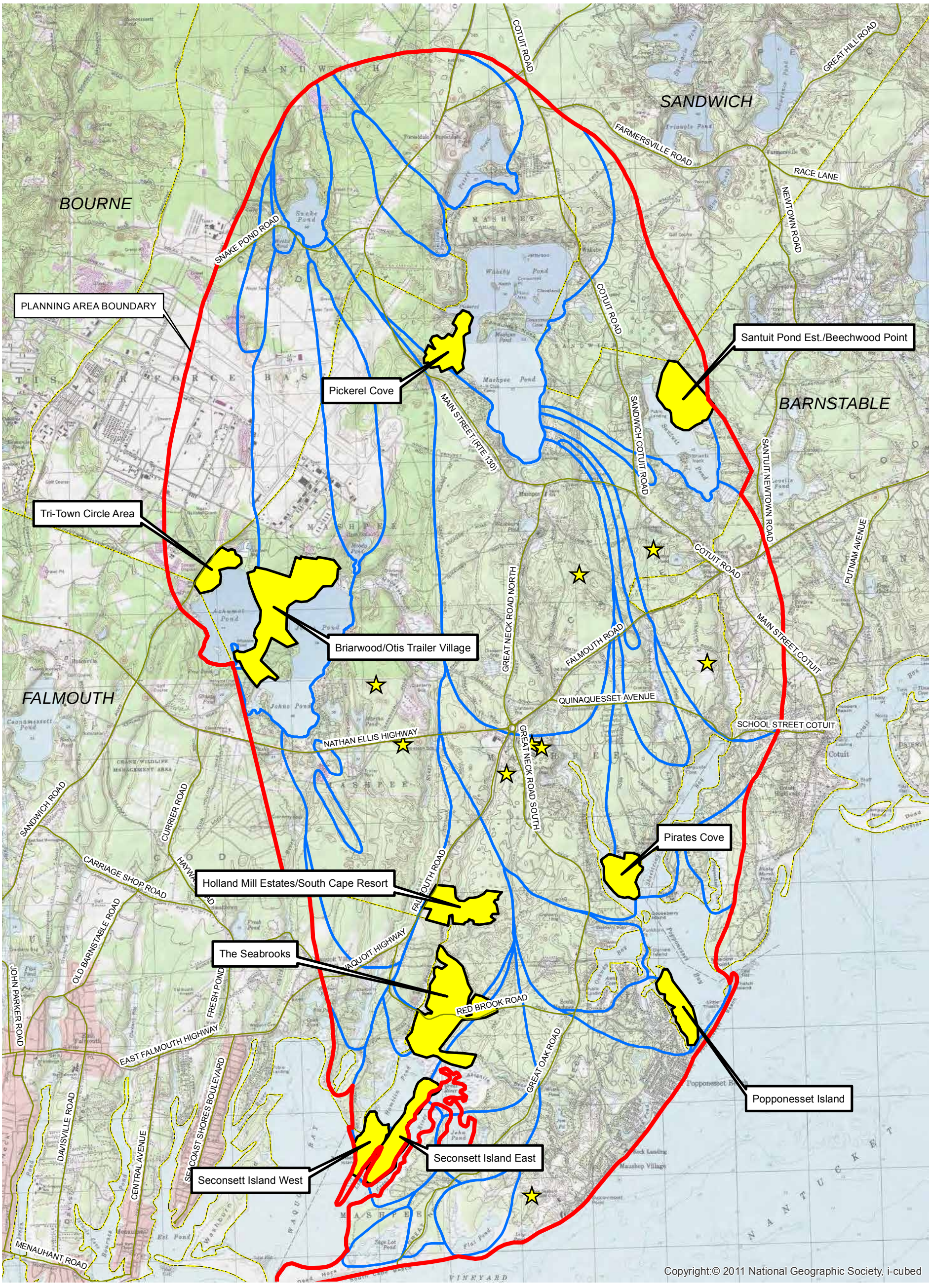
As discussed previously in this chapter, these measures will be considered as features of any Recommended Plan. Their implementation will depend on several factors, which will be a function of existing pilot projects, new pilot/demonstration projects, and adaptive management strategies developed with the Recommended Plan. These will include at a minimum:

- Dredging/Inlet Opening
- Shellfish Aquaculture
- PRBs
- Enhanced Natural Systems (wetlands/old cranberry bog restoration)

6.5.4 Land Management Strategies

In addition to the traditional Source Removal and Direct Environmental Mitigation measures, the Town/District should consider how to include other nitrogen mitigation measures through the following approaches identified previously:

- Growth Neutral/Flow Neutral
- Purchase of Open Space/Build-out Development Properties
- Potential Well and/or Treatment and Disposal Sites
- Seasonal and year-round property phasing impacts



Legend

Planning Area Boundary ☆ Existing Private WWTP Potential Cluster System

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Watershed Nitrogen Management Plan

CLUSTER SYSTEM LOCATIONS

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Figure 6-1

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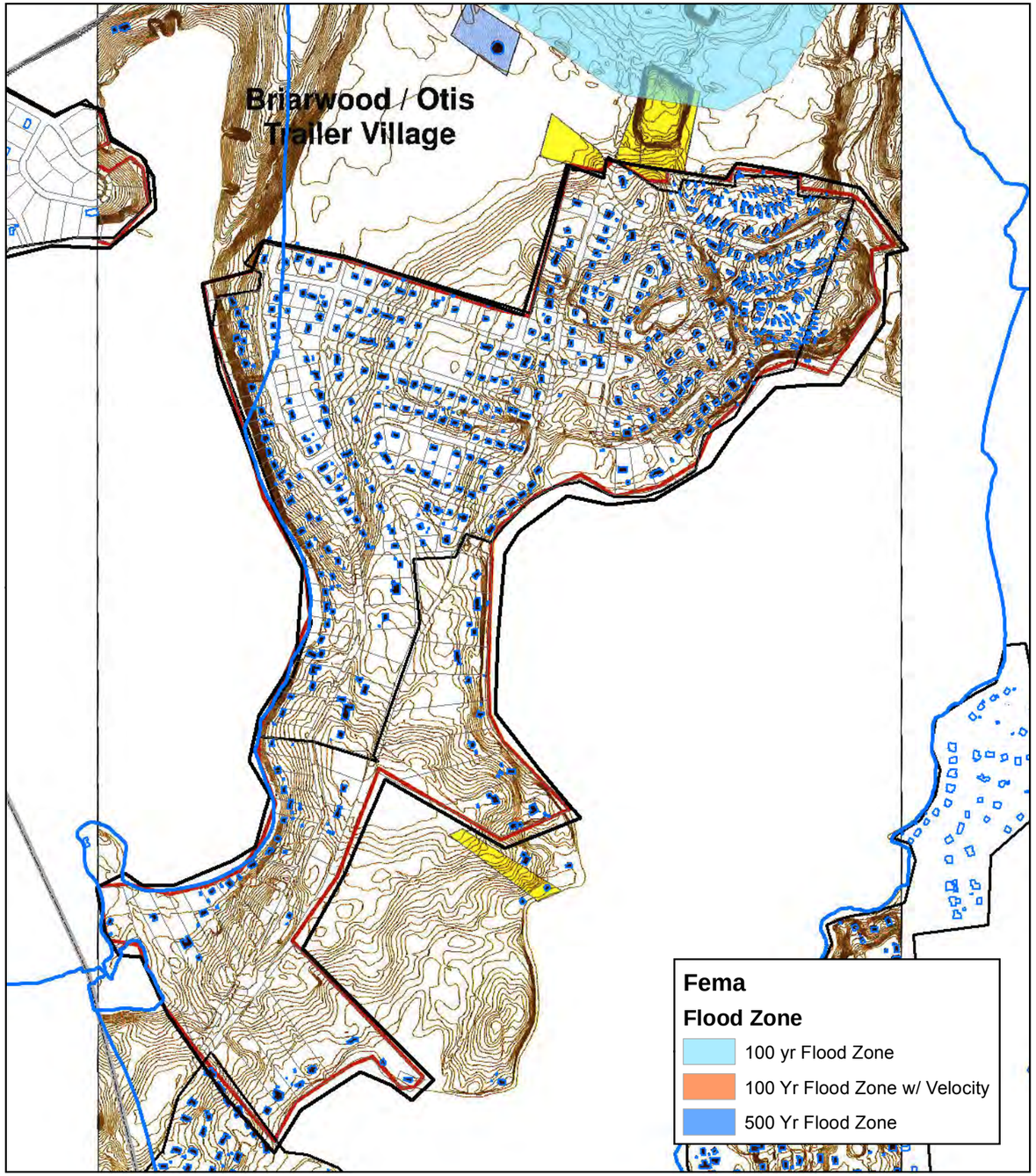

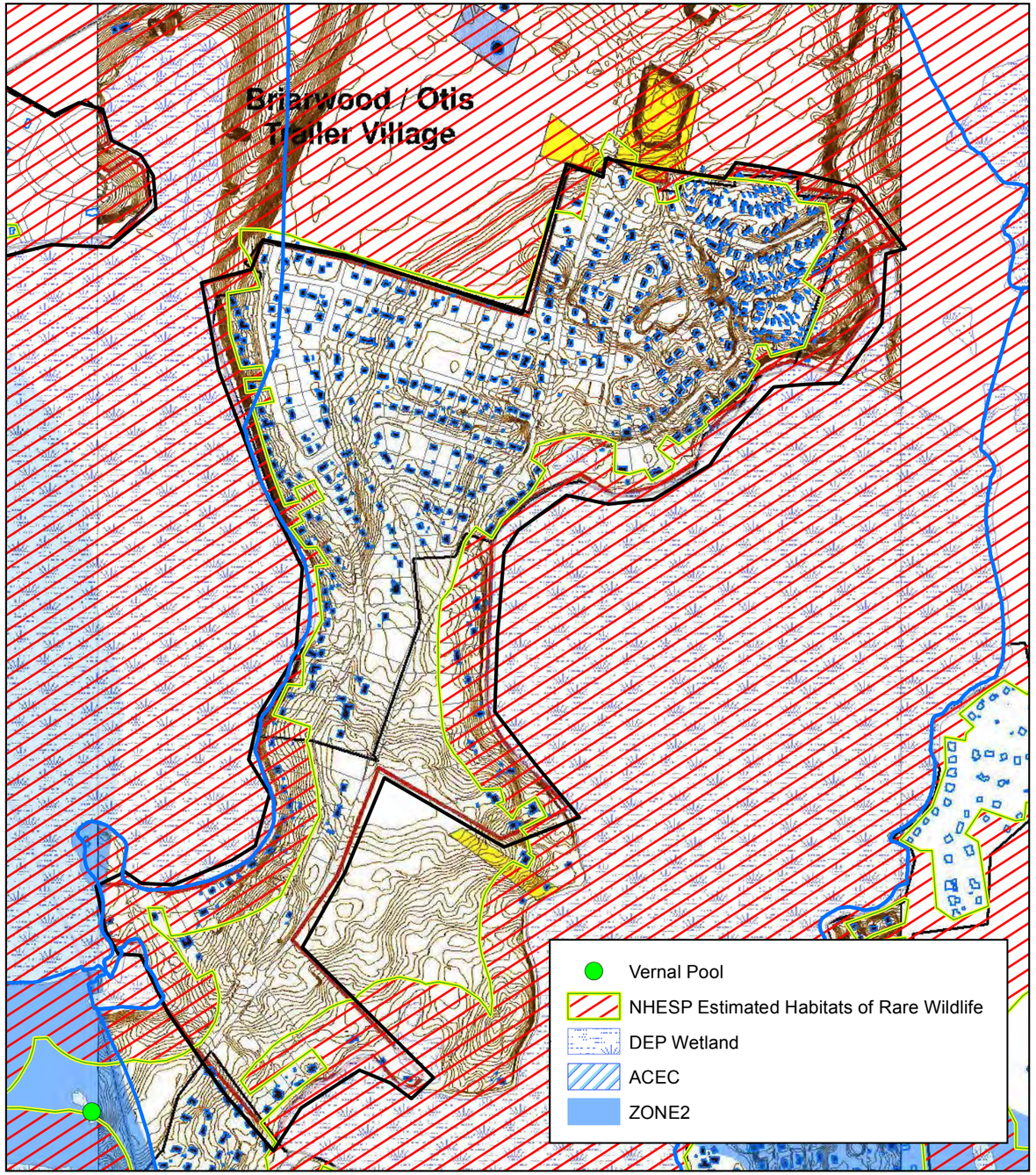

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Briarwood

Figure 6-2

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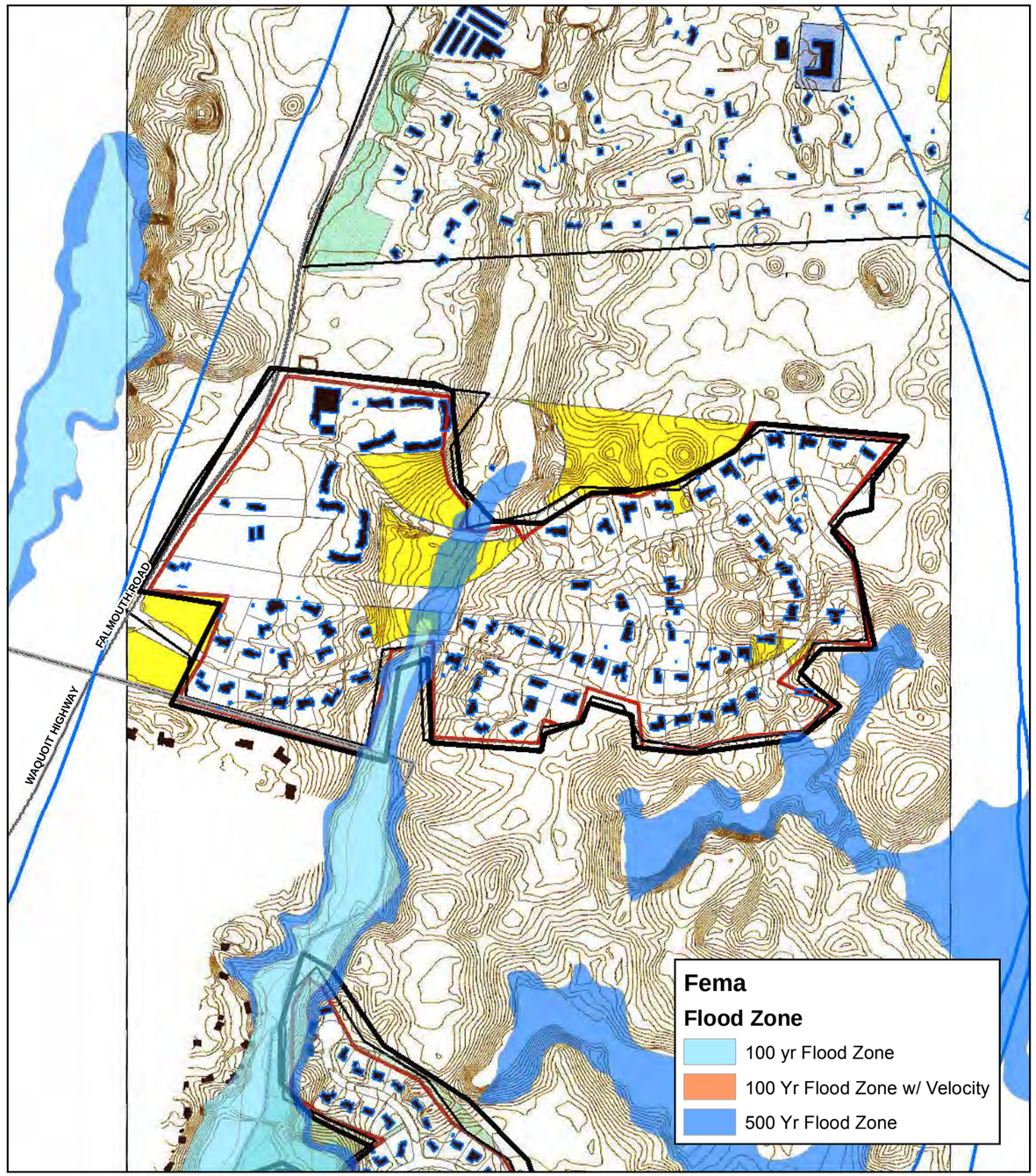

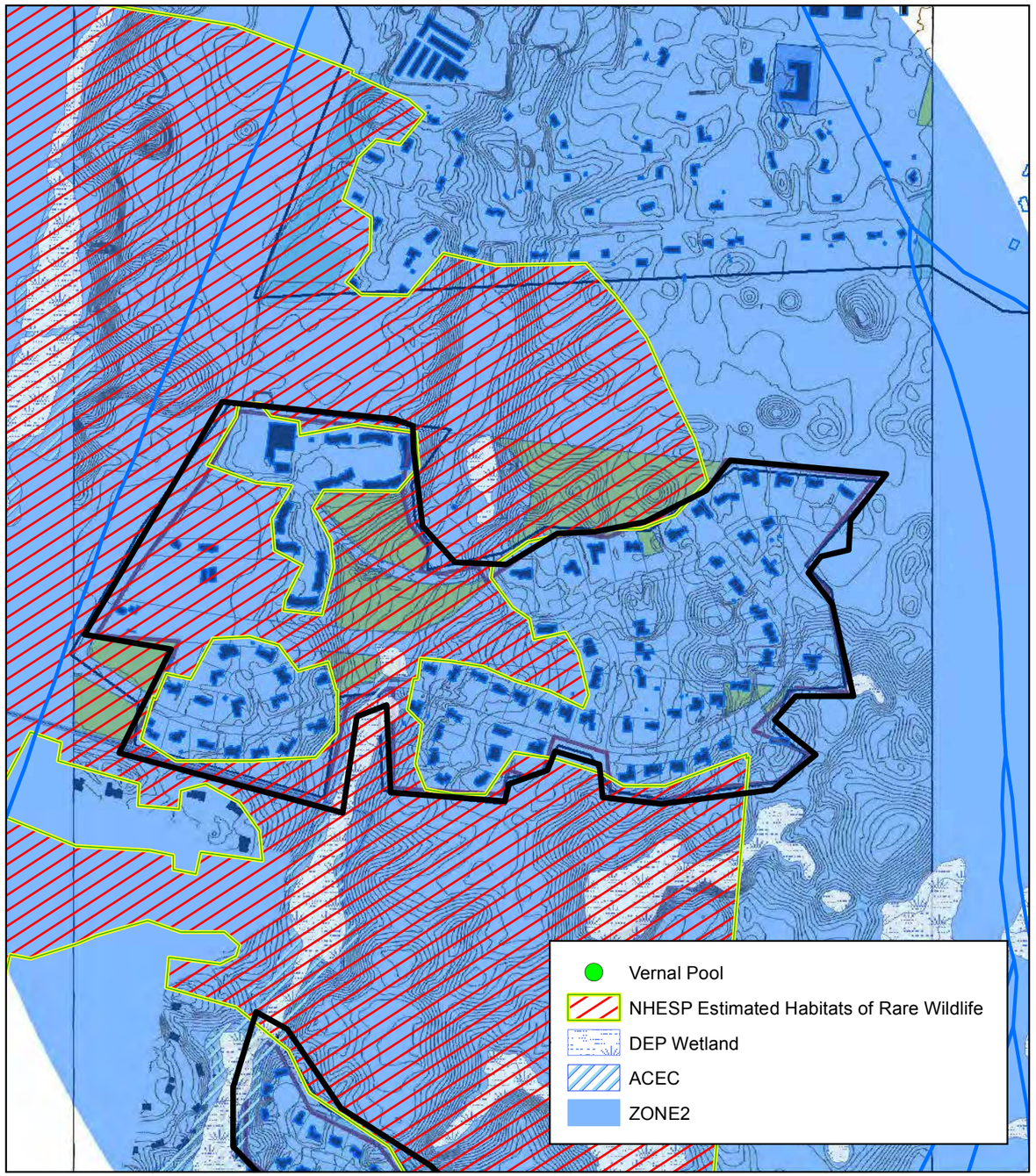

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Holland Mills

Figure 6-3

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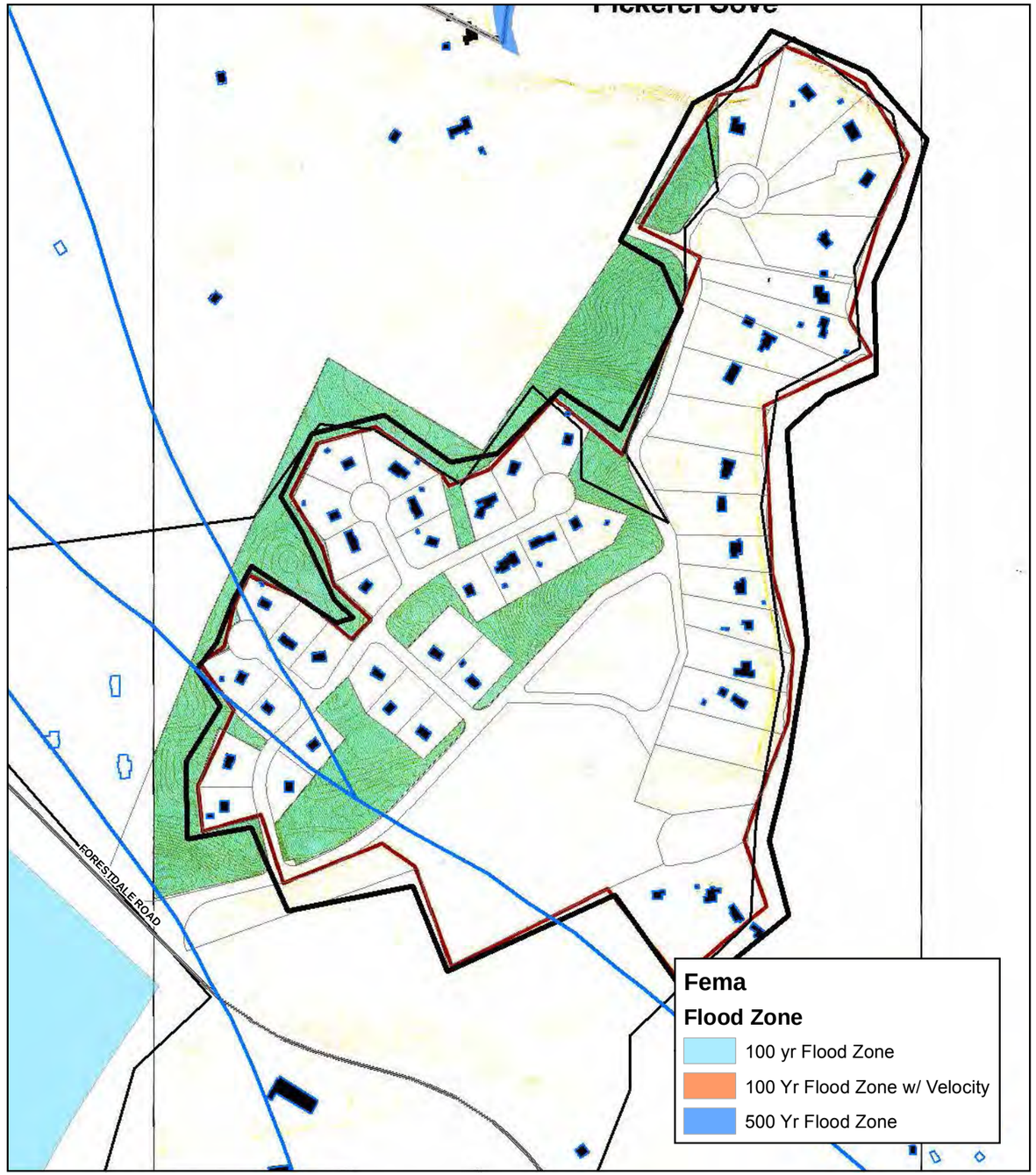

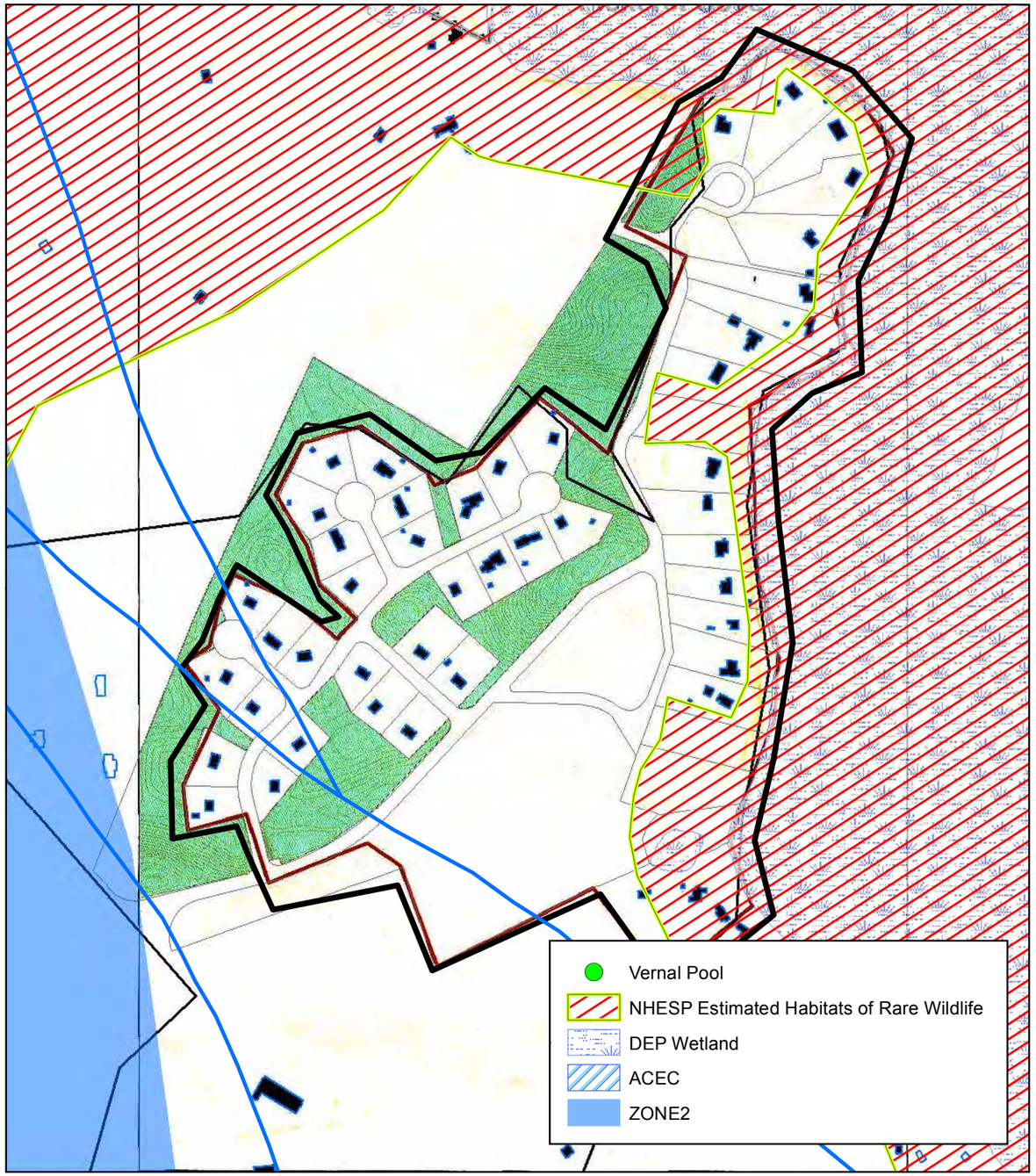

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Pickerel Cove

Figure 6-4

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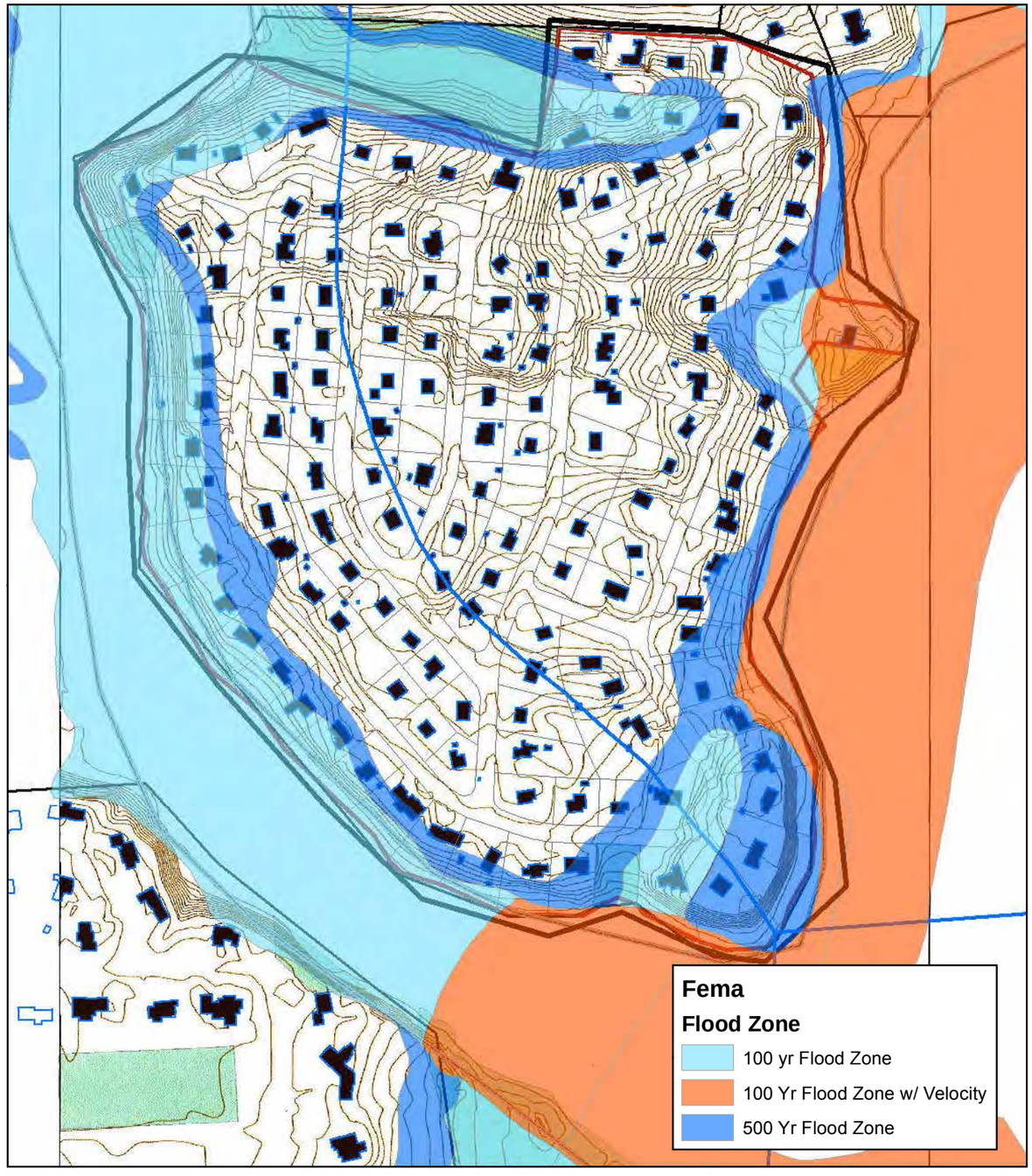

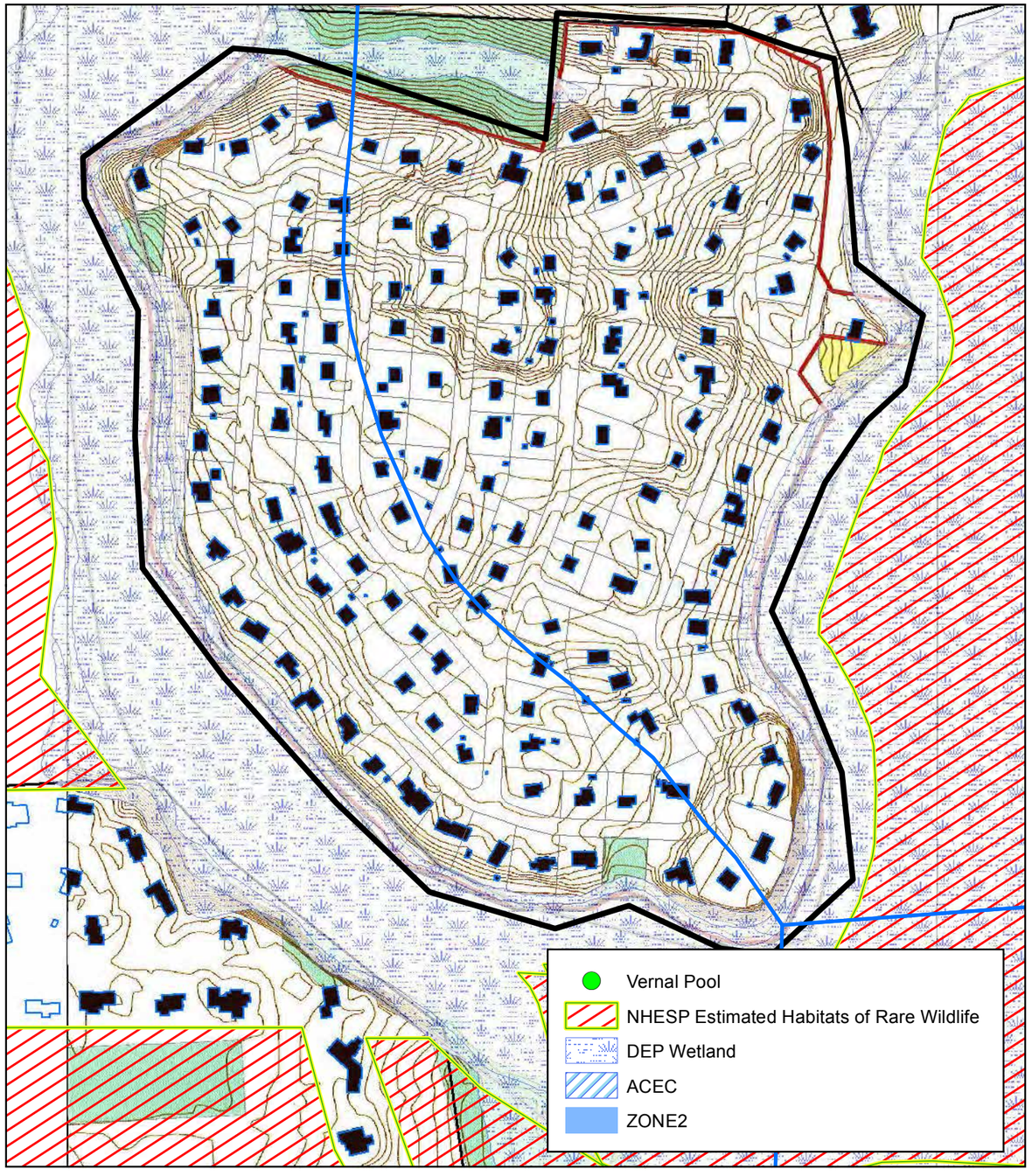

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Watershed Nitrogen Management Plan

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Date 08 Aug 2013

Pirates Cove

Figure 6-5

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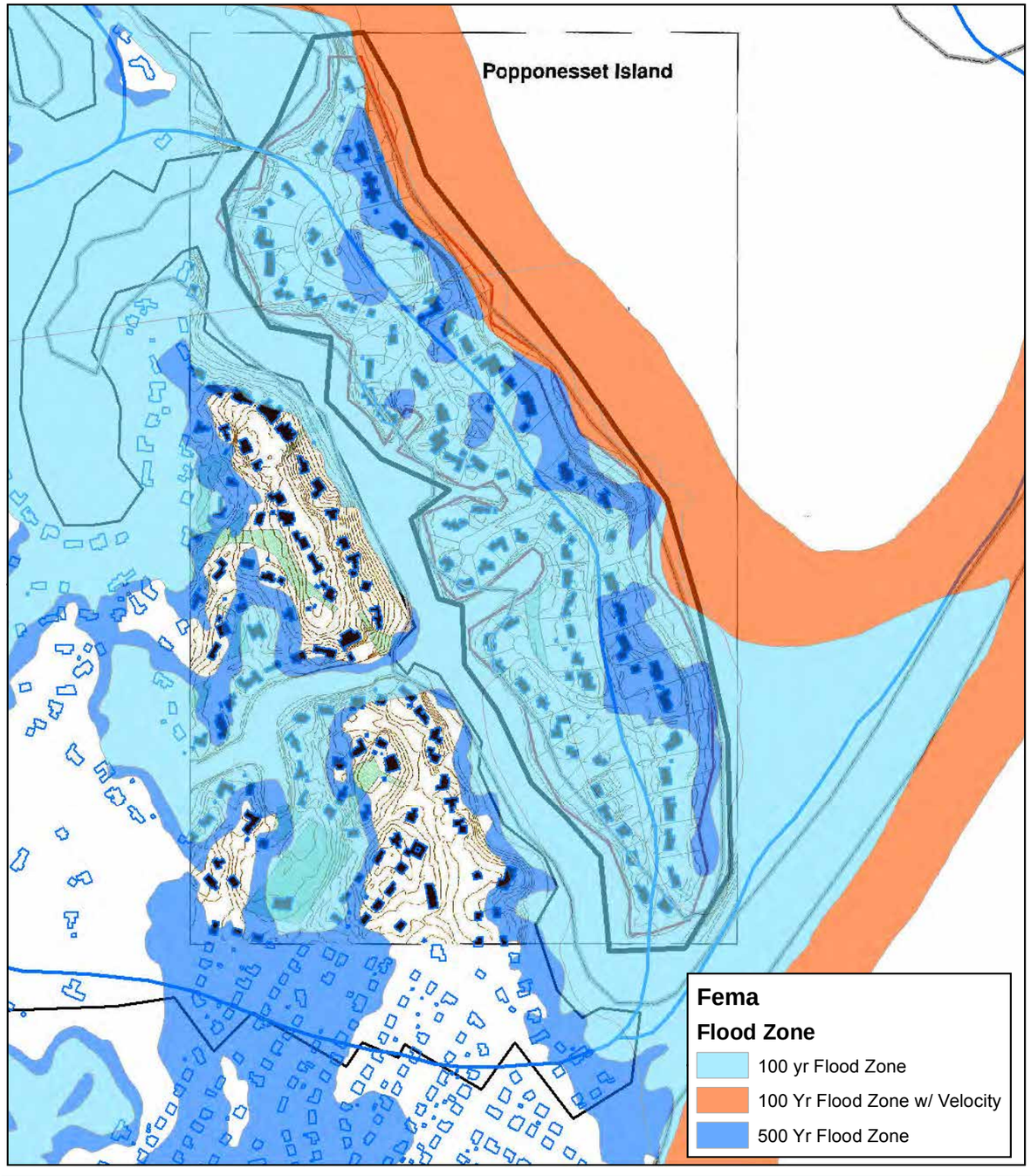

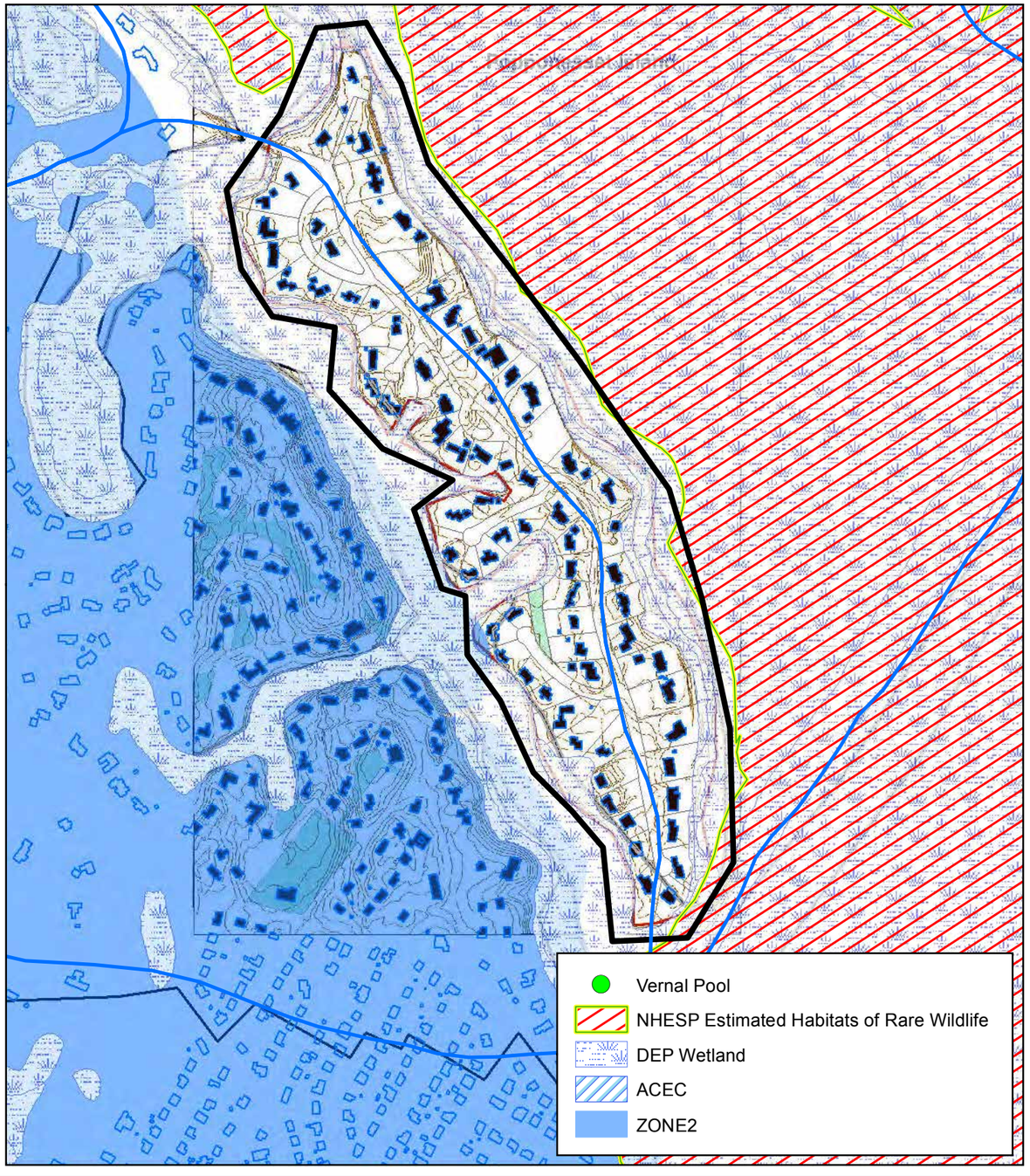

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Popponesset Island

Figure 6-6

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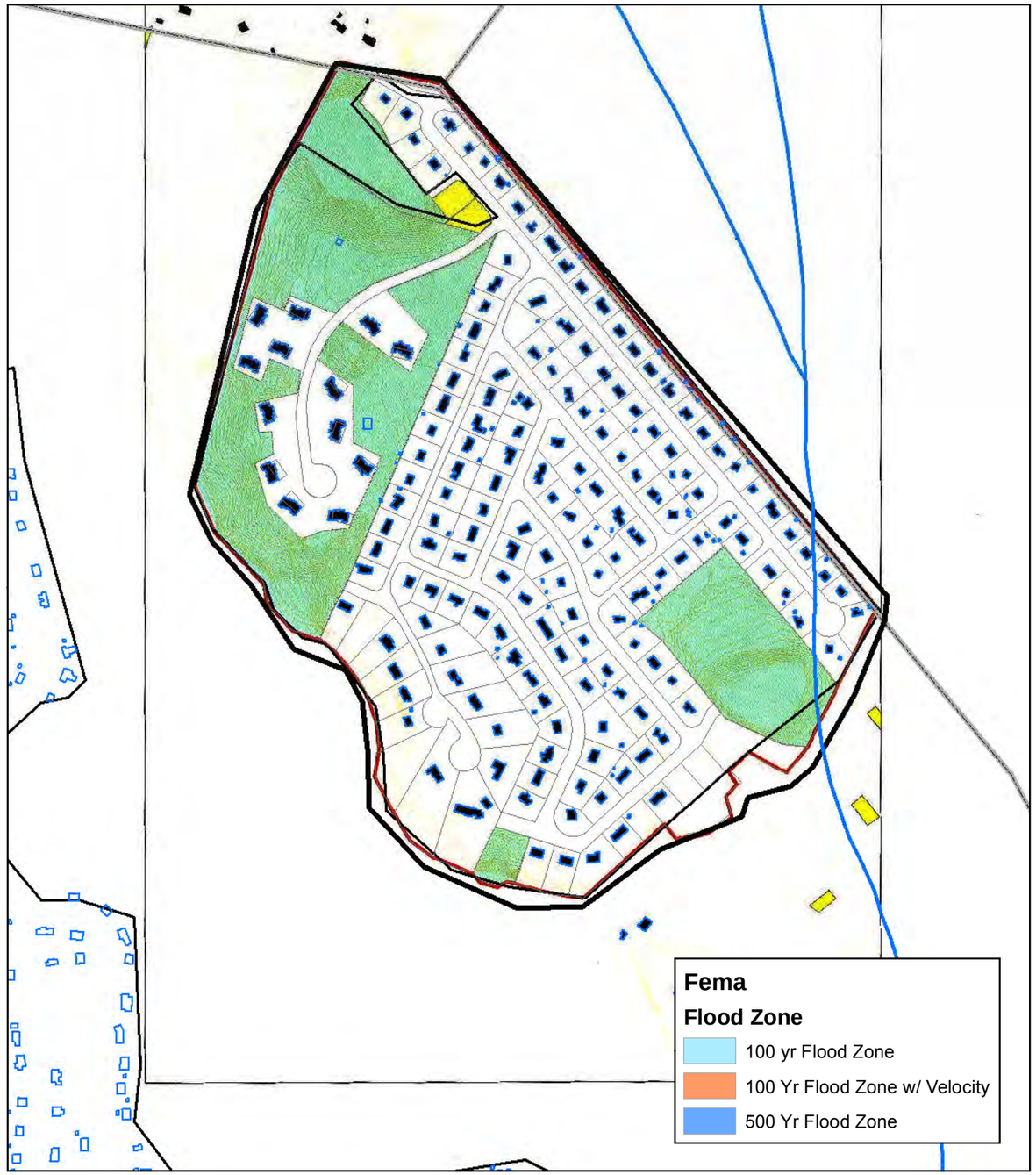

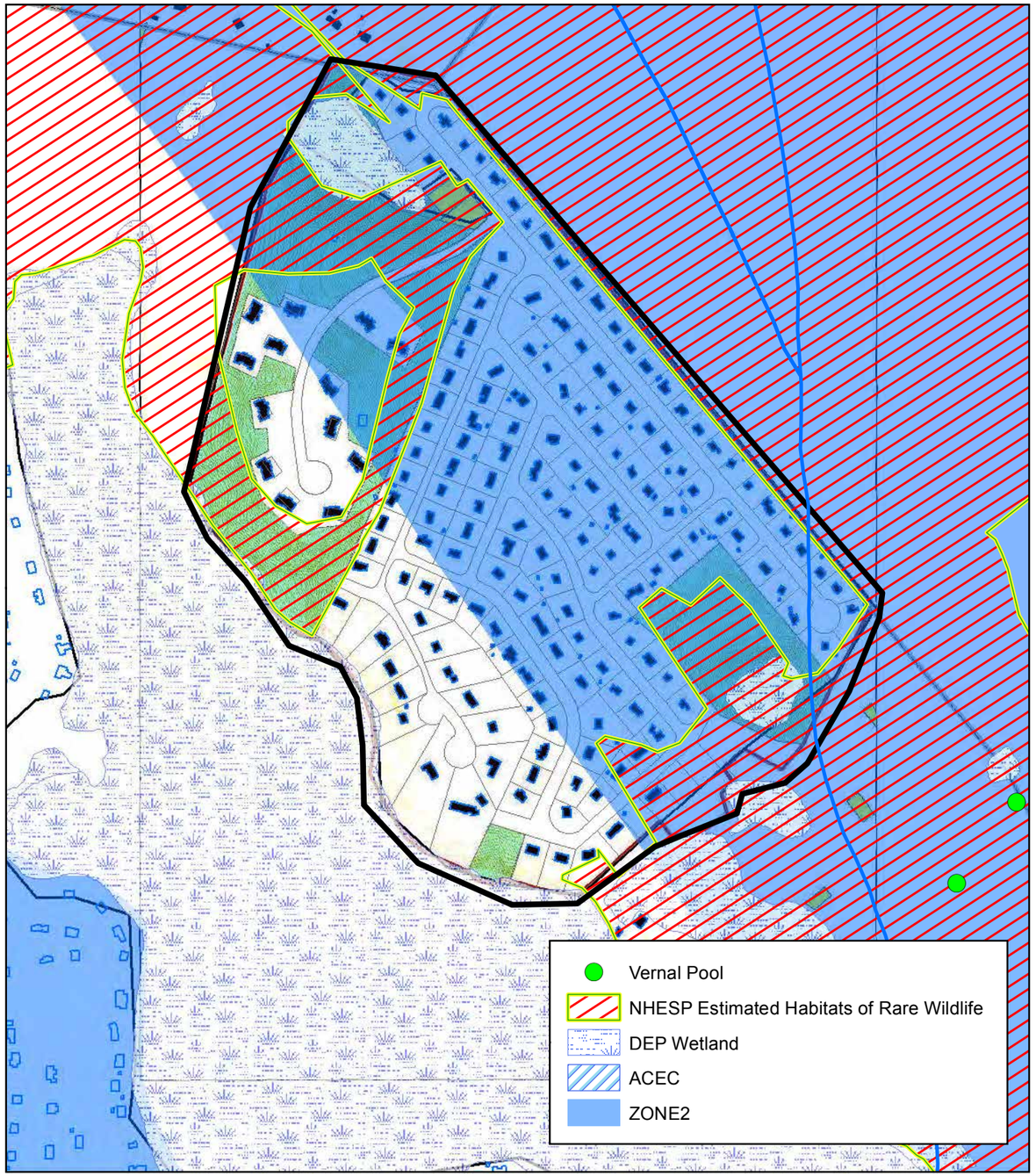

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Santuit Pond

Figure 6-7

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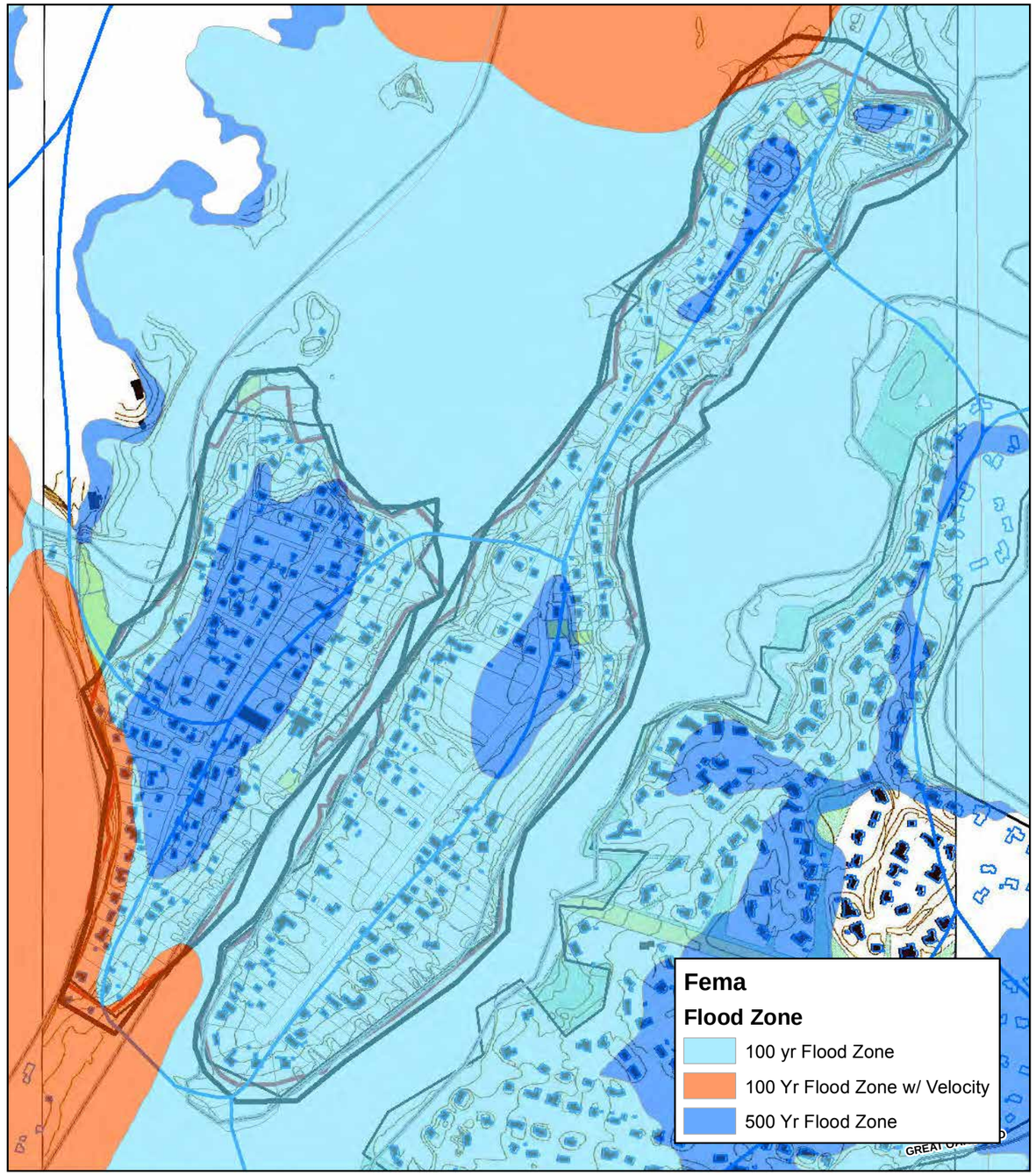

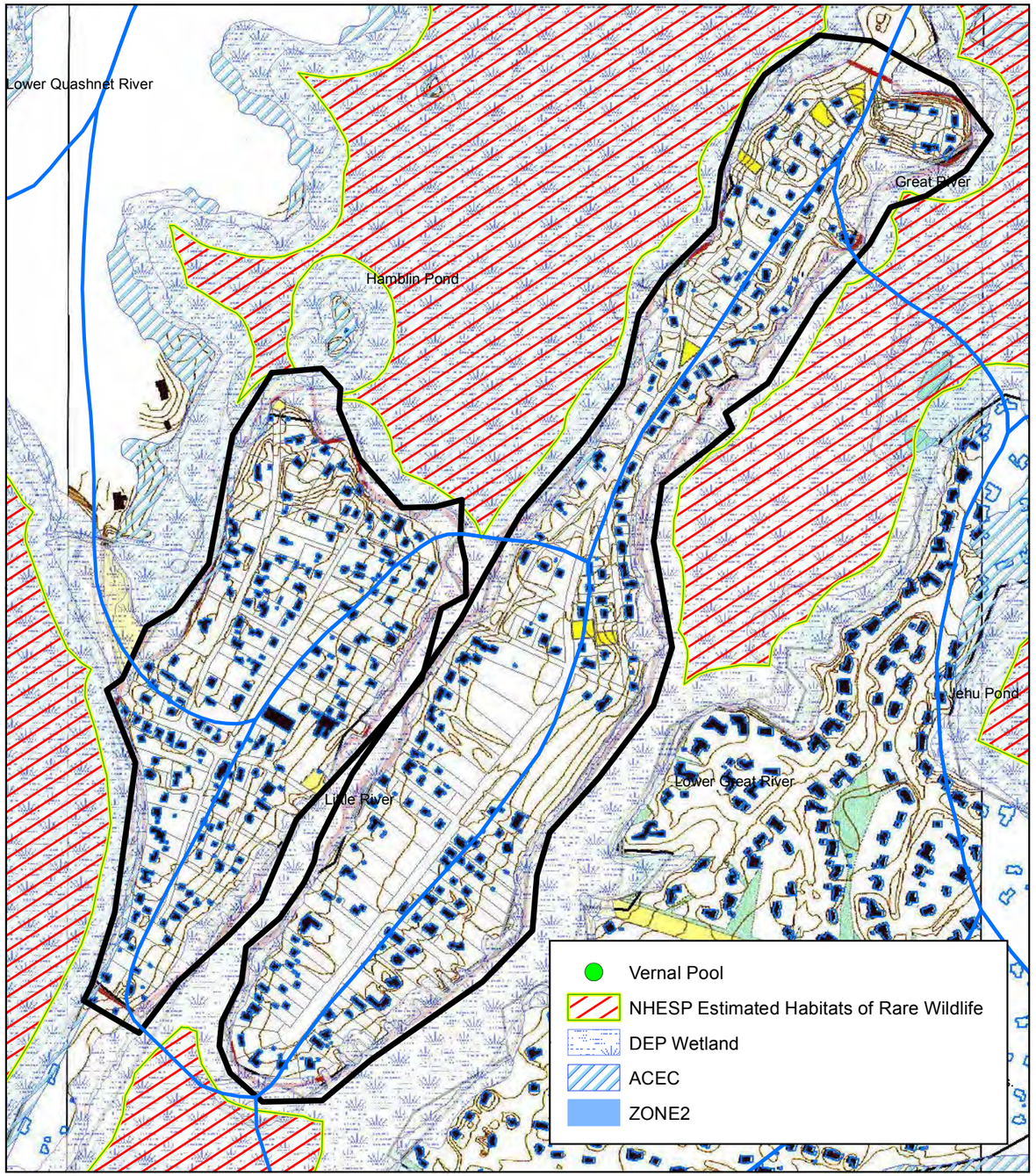

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Monomoscoy Island

Figure 6-8

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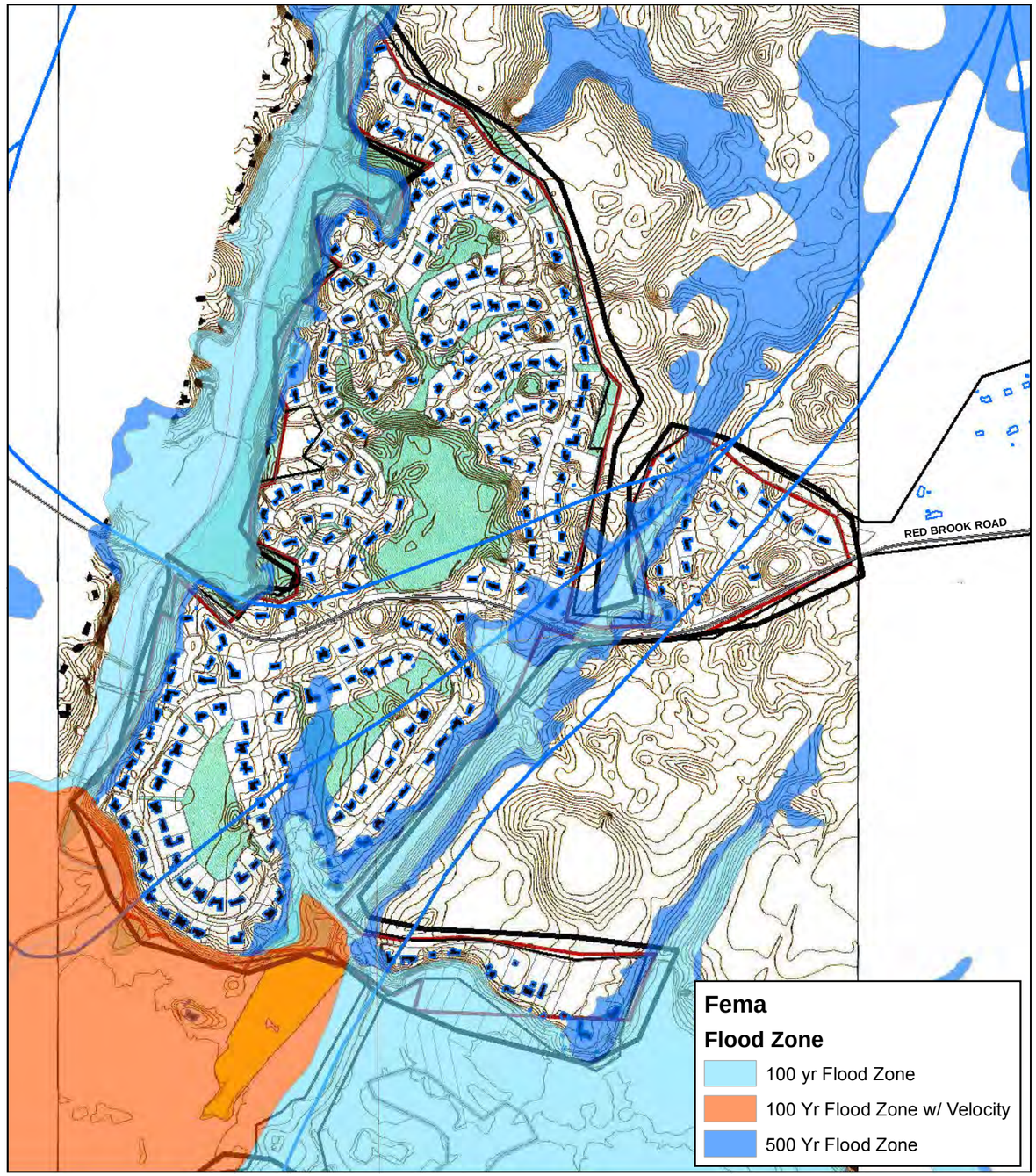

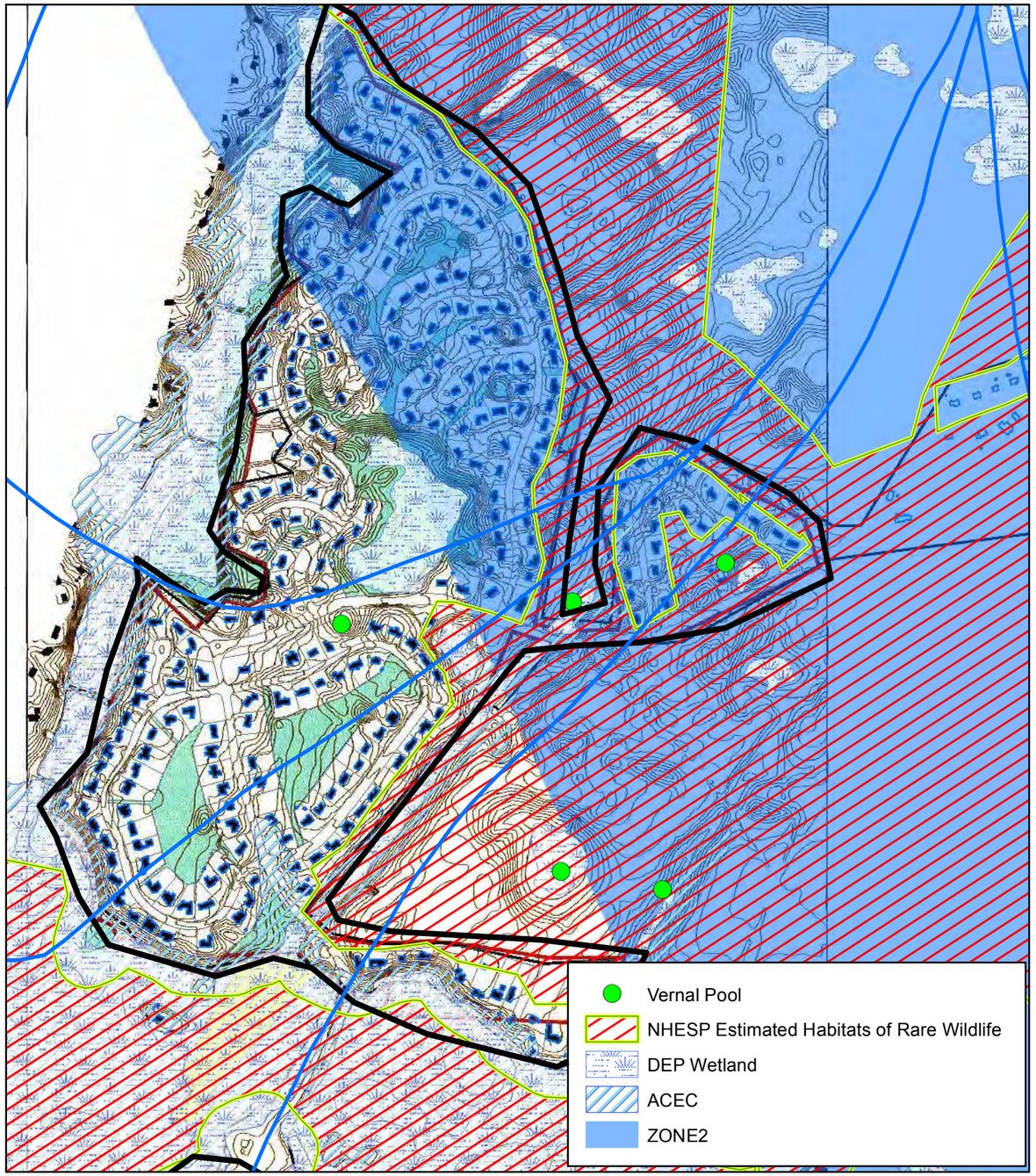

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Town of Mashpee Sewer Commission
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The Seabrooks

Figure 6-9

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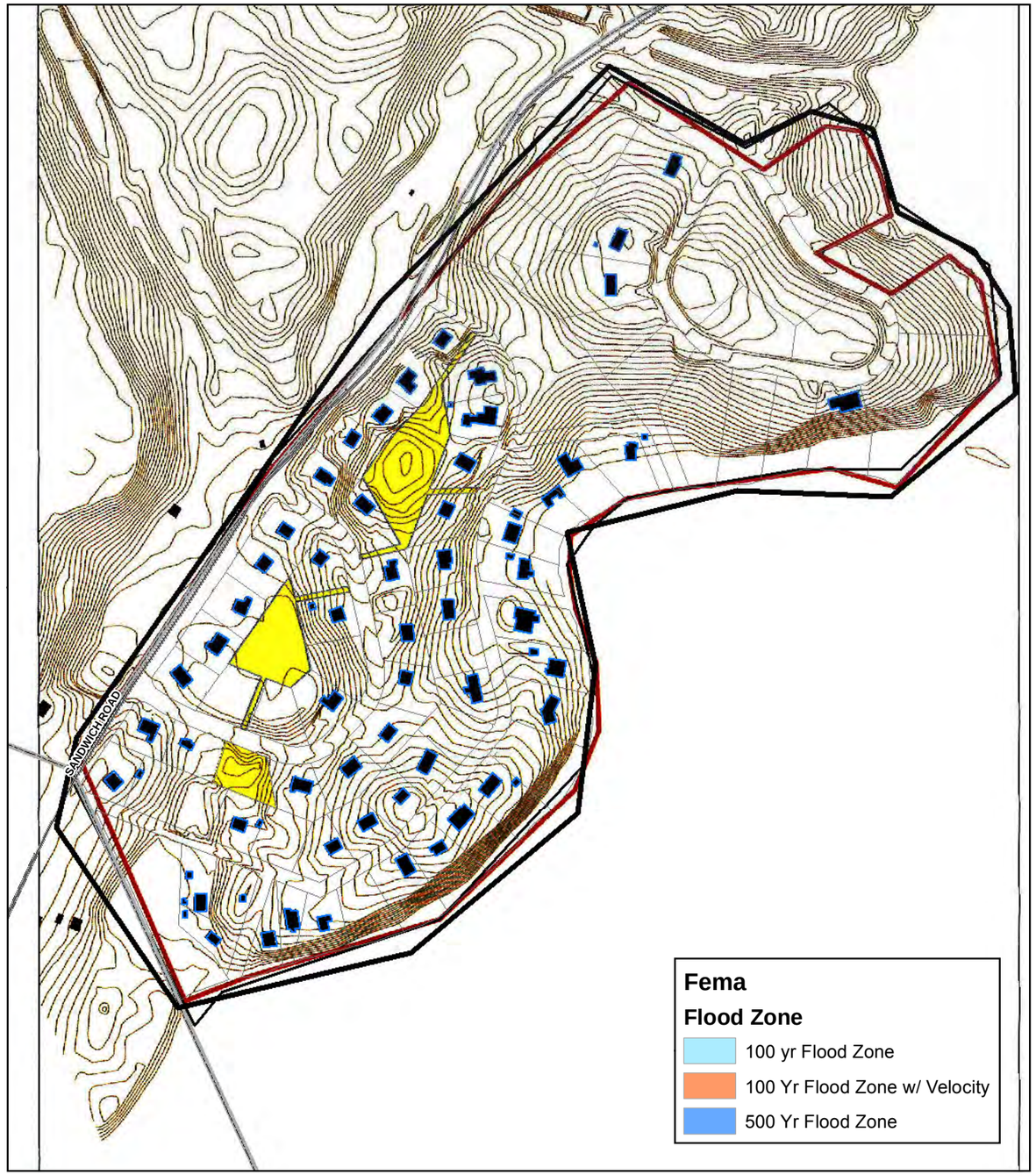

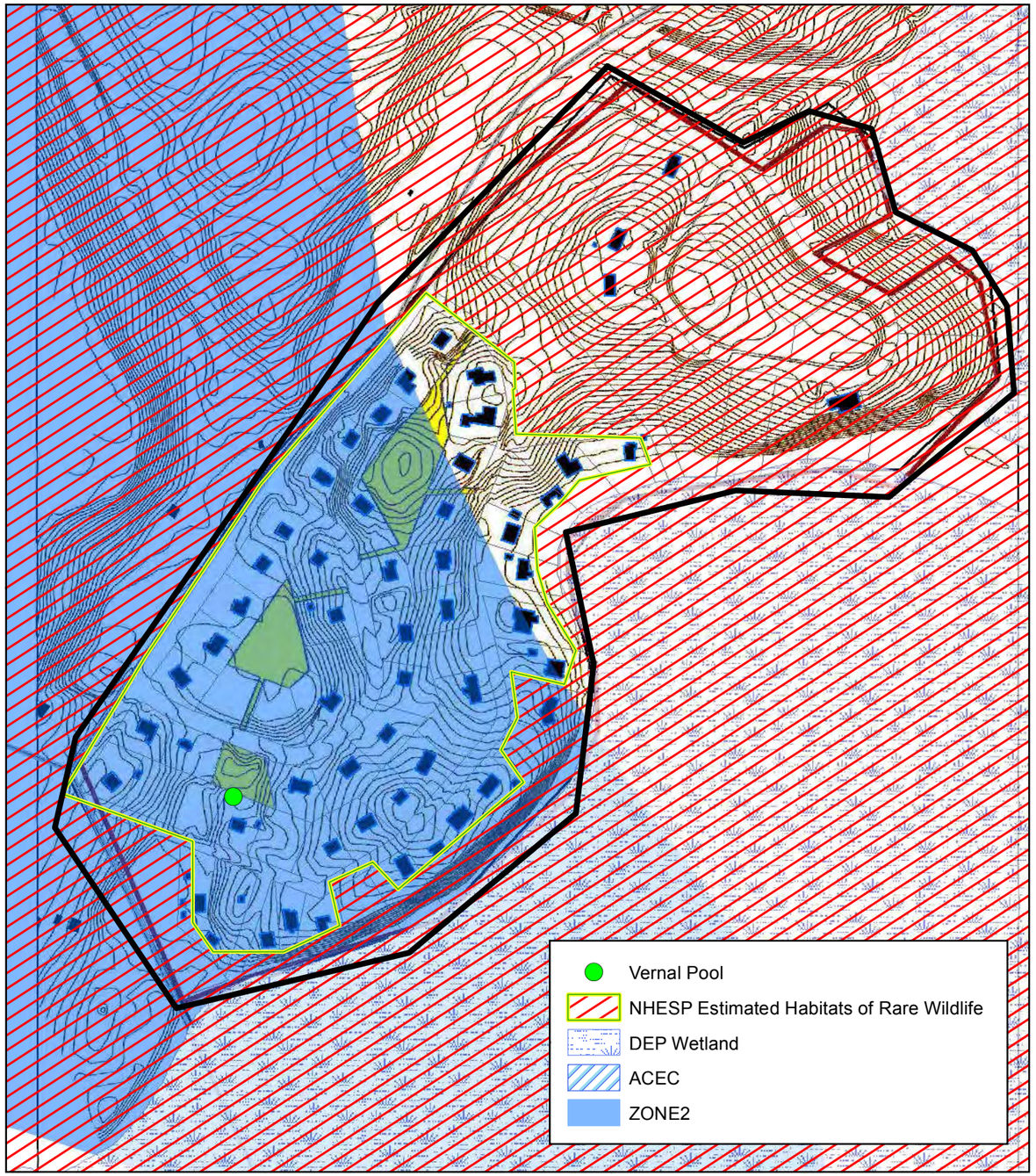

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Tri-Town Circle Area

Figure 6-10

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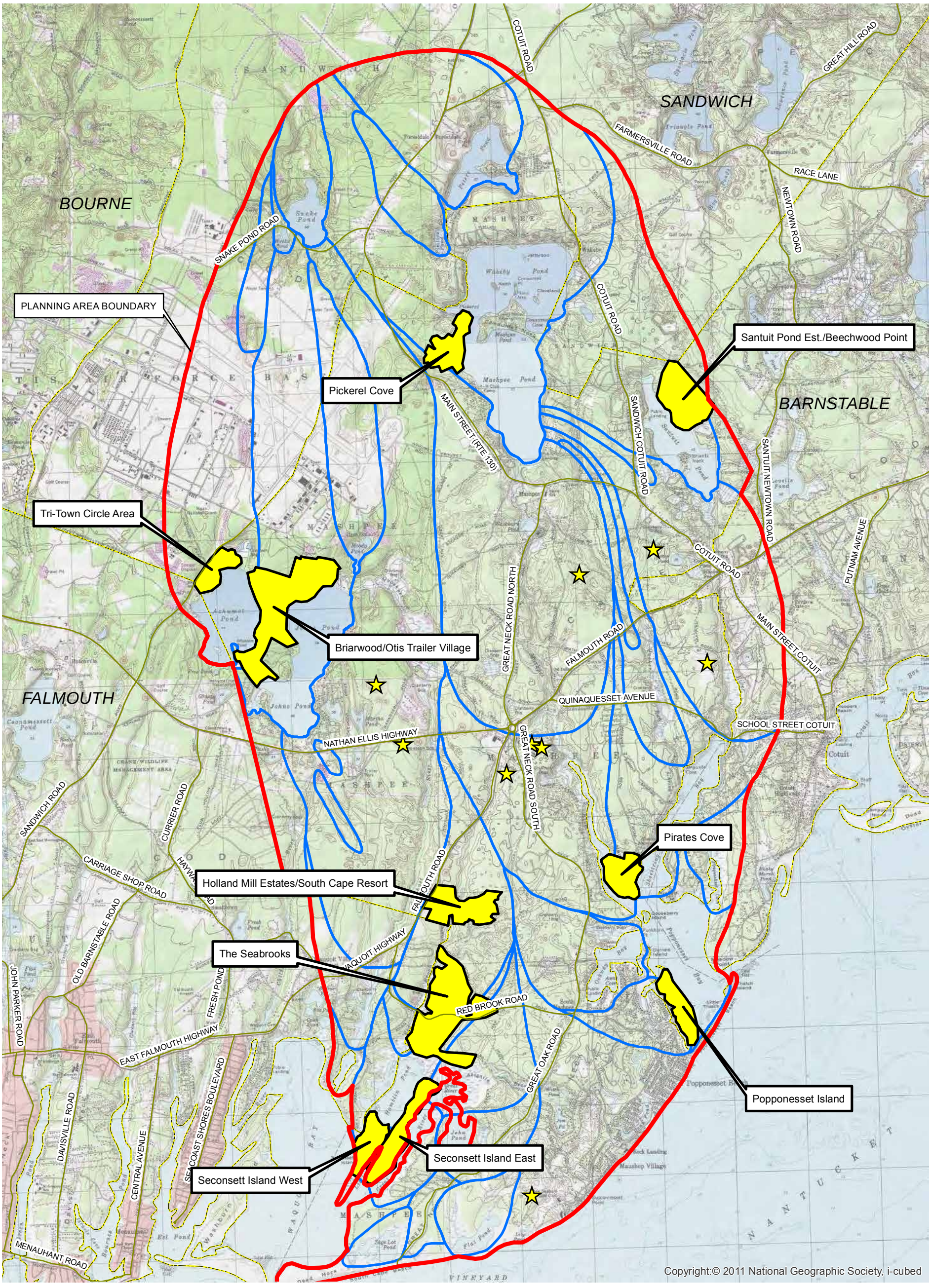

Legend

Planning Area Boundary ☆ Existing Private WWTP Potential Cluster System

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Watershed Nitrogen Management Plan

CLUSTER SYSTEM LOCATIONS

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Revision A
Date 08 Aug 2013

Figure 6-1

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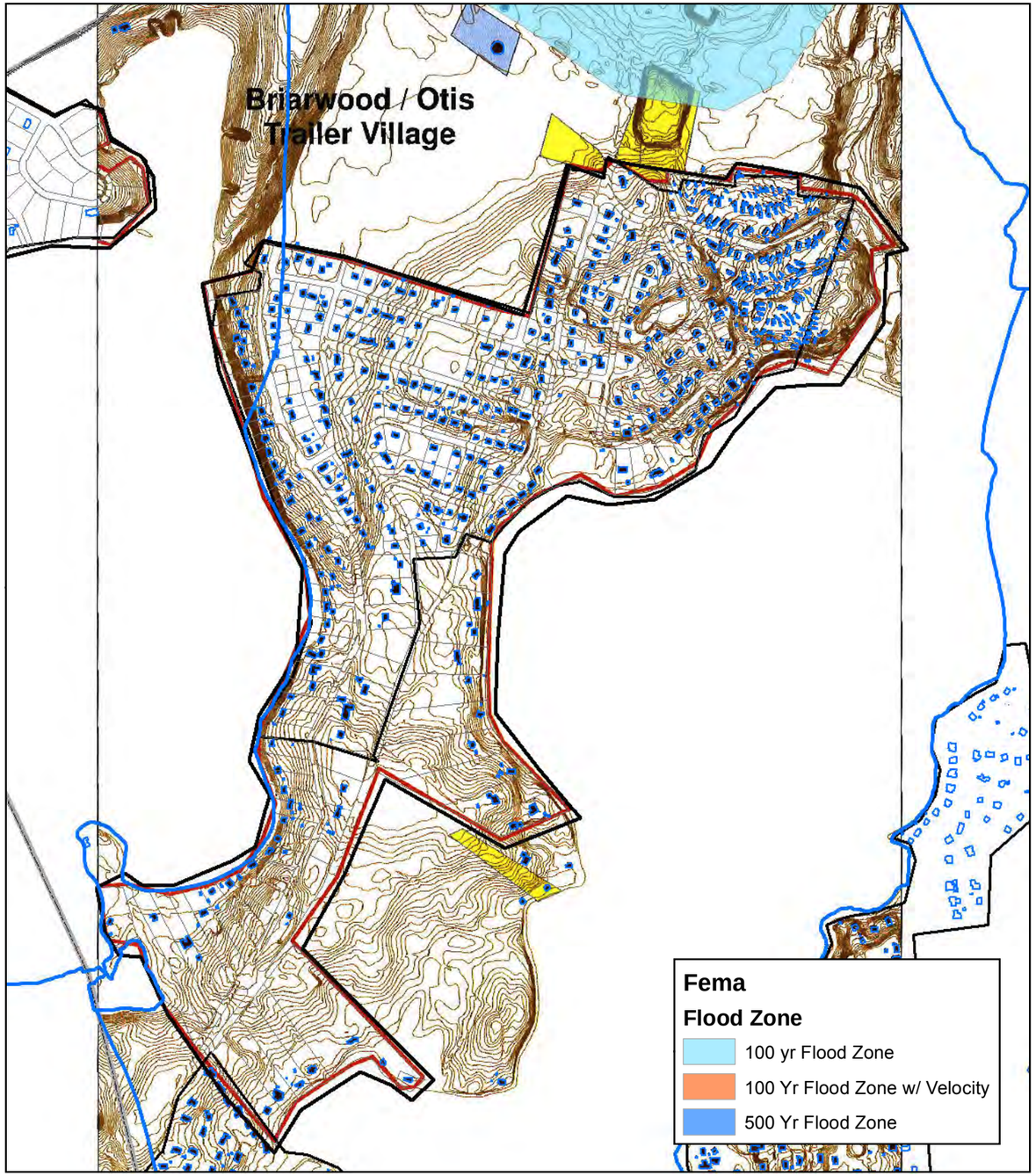

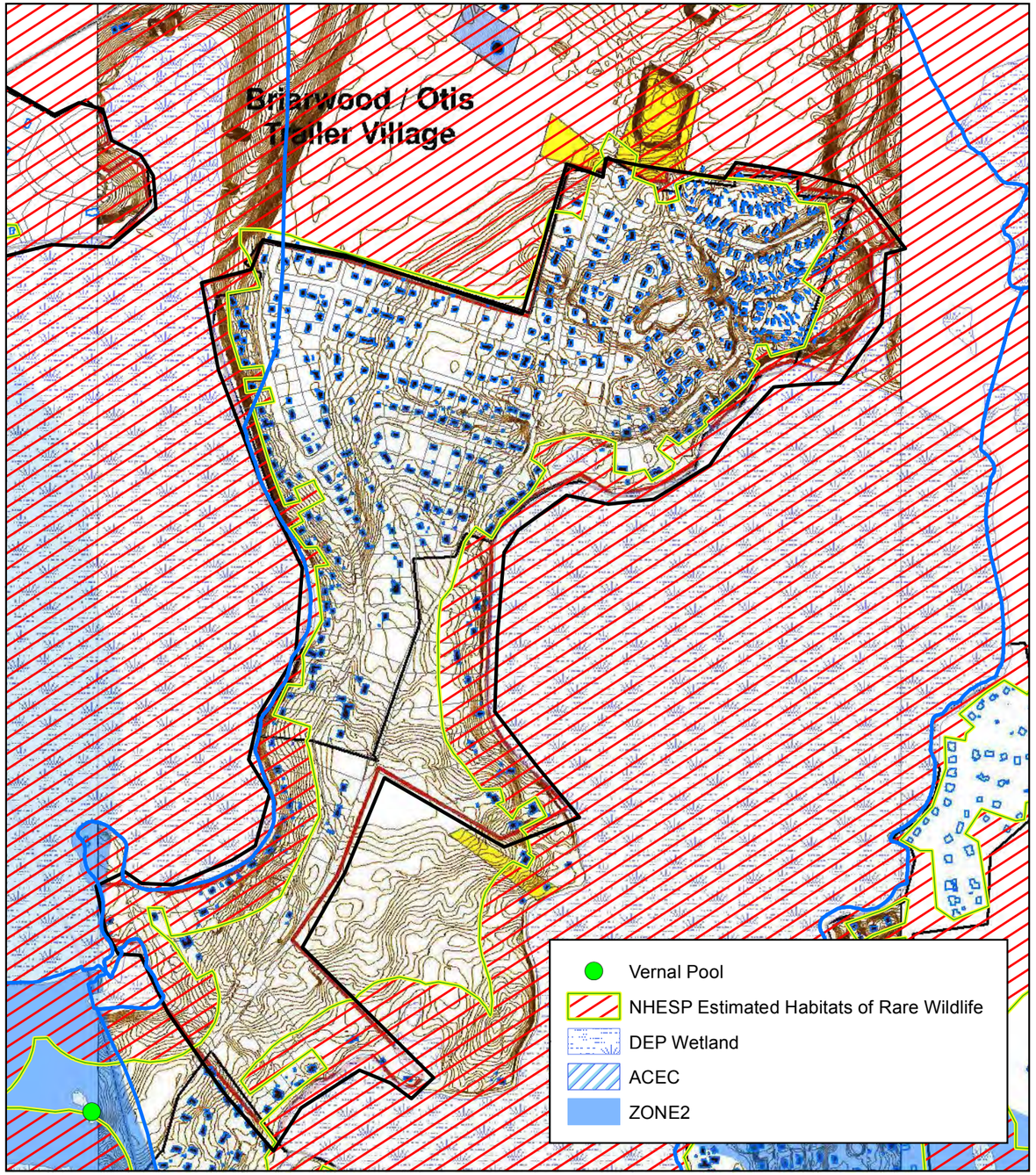

Paper Size ANSI B

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Briarwood

Figure 6-2

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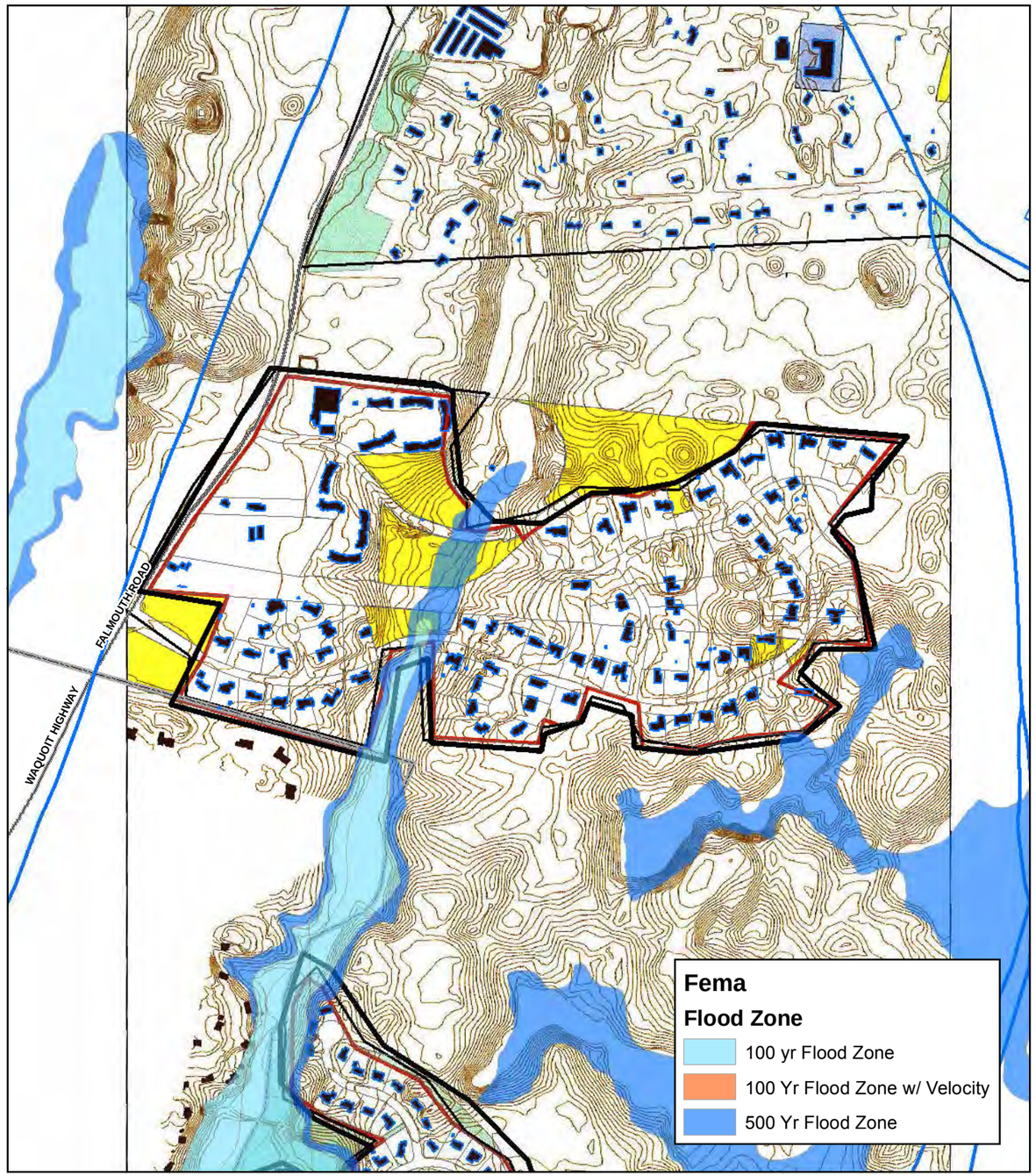

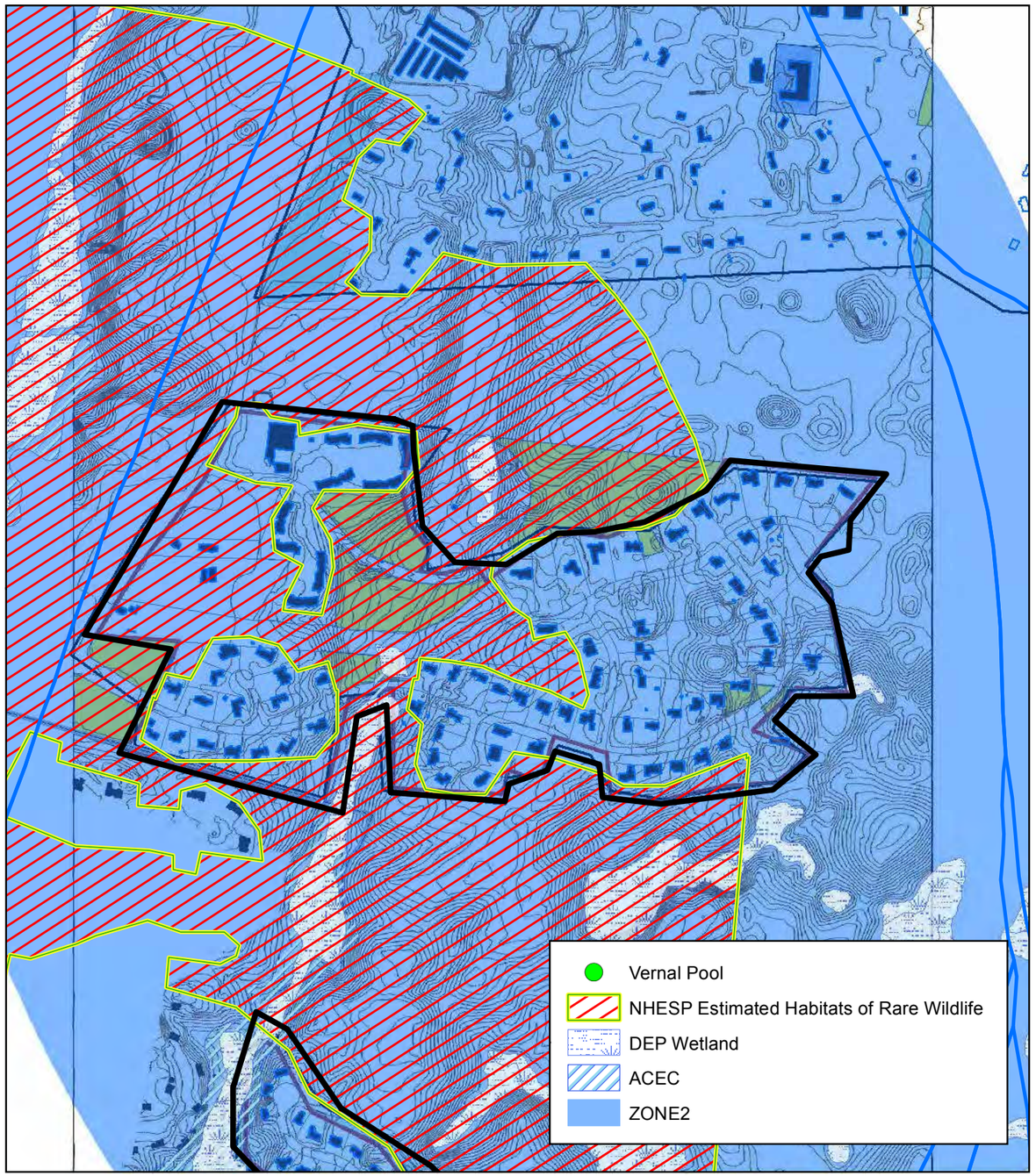

Paper Size ANSI B

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

Town of Mashpee Sewer Commission
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Holland Mills

Figure 6-3

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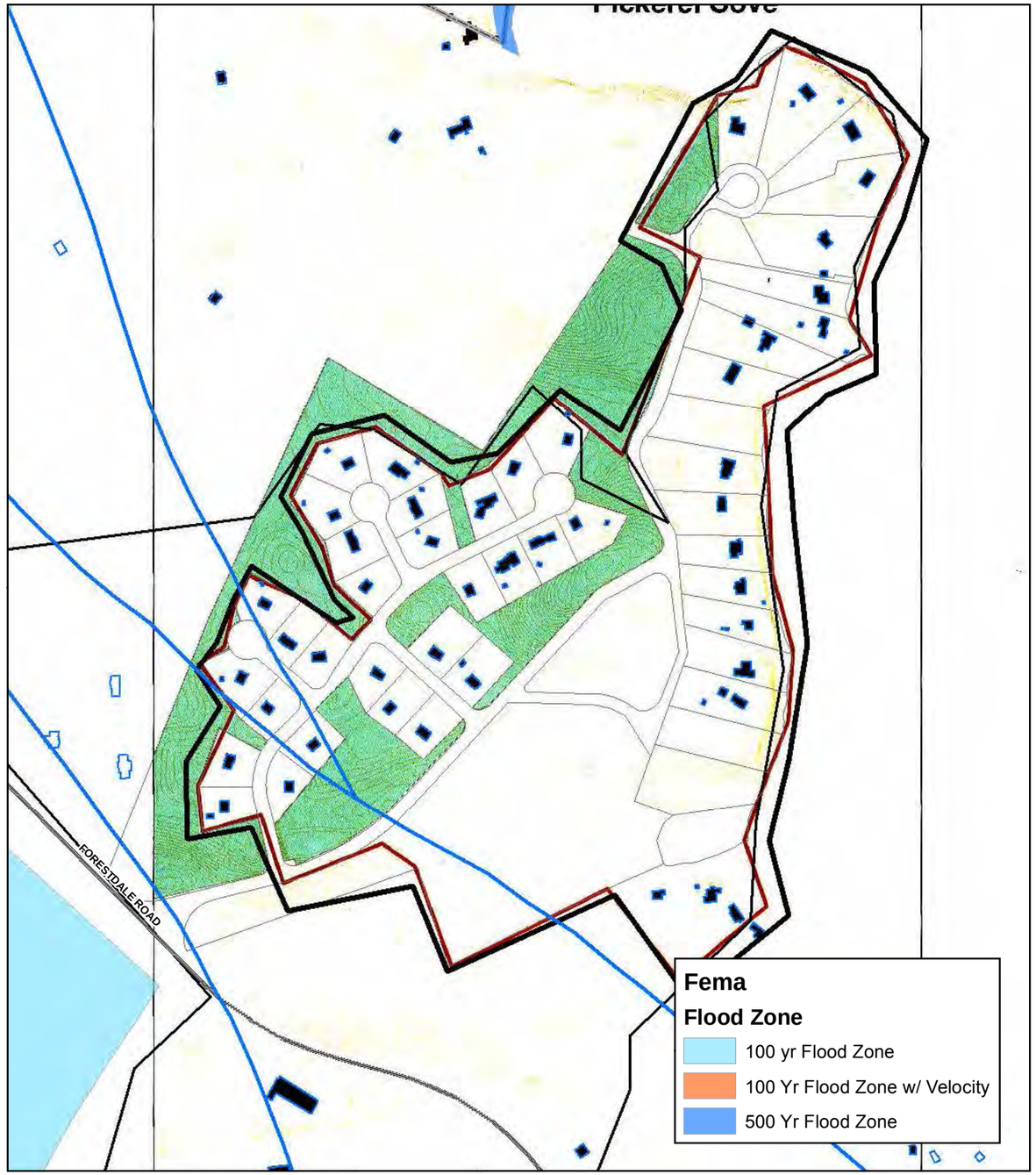

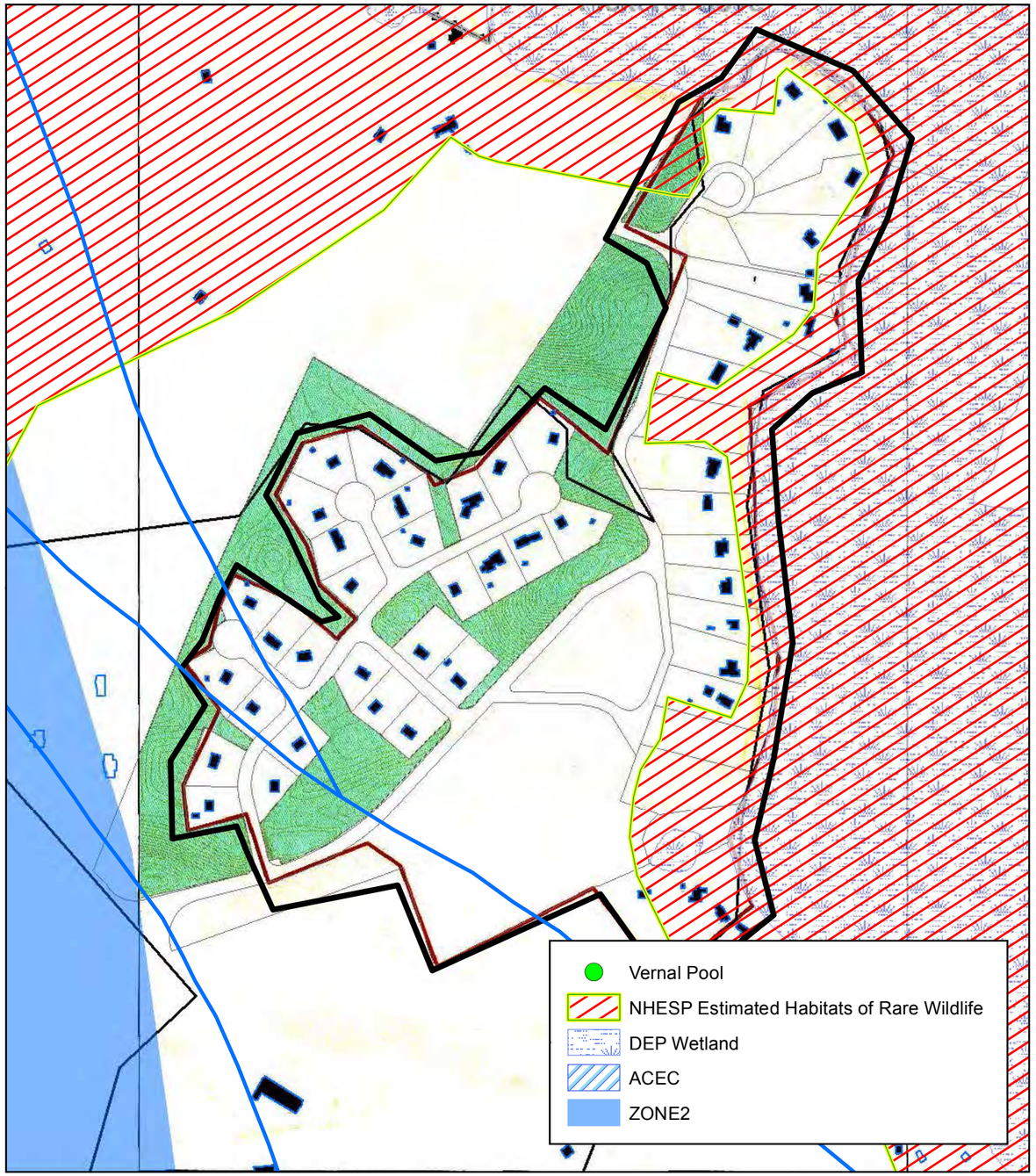

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Date	08 Aug 2013

Pickerel Cove

Figure 6-4

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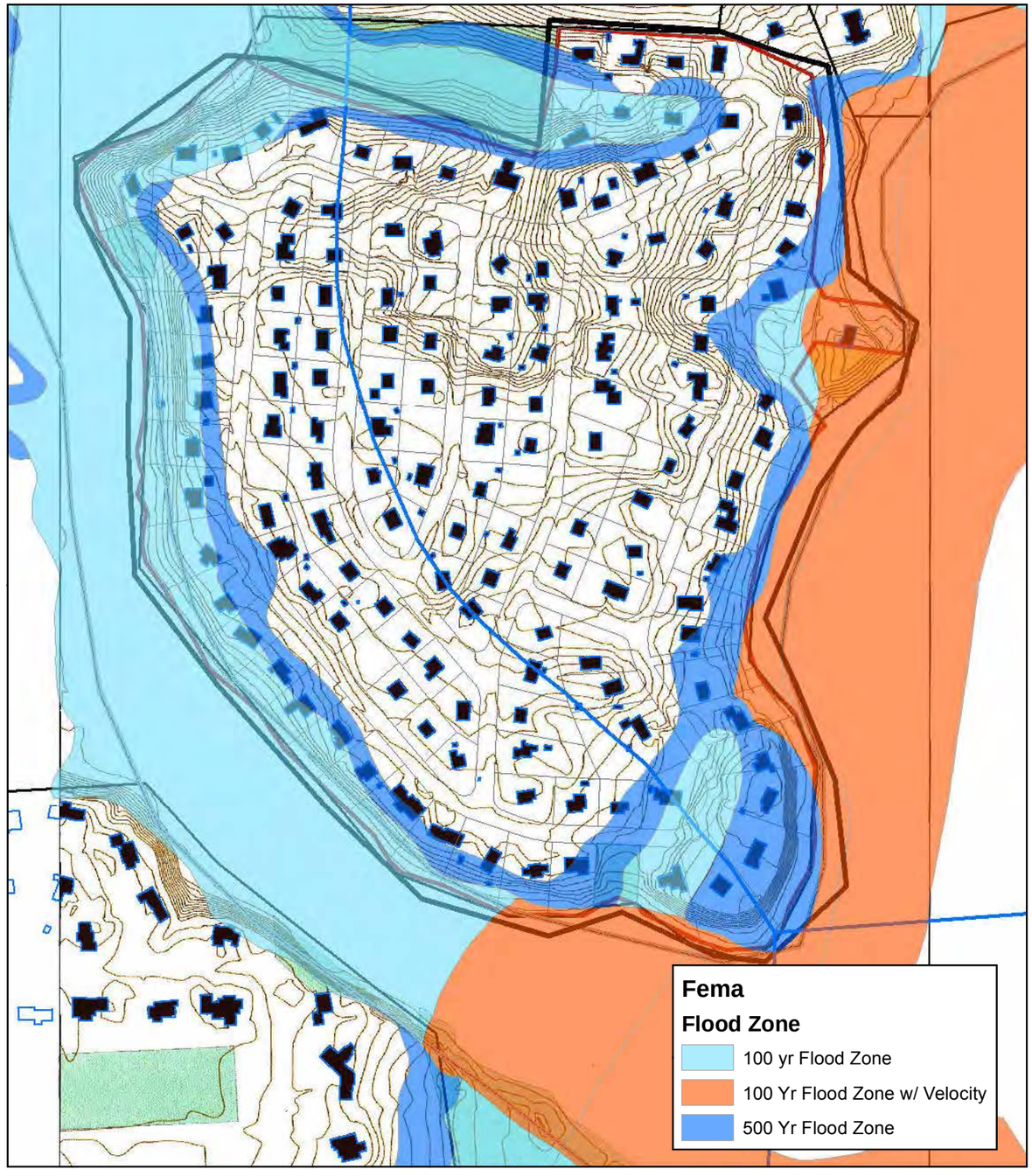

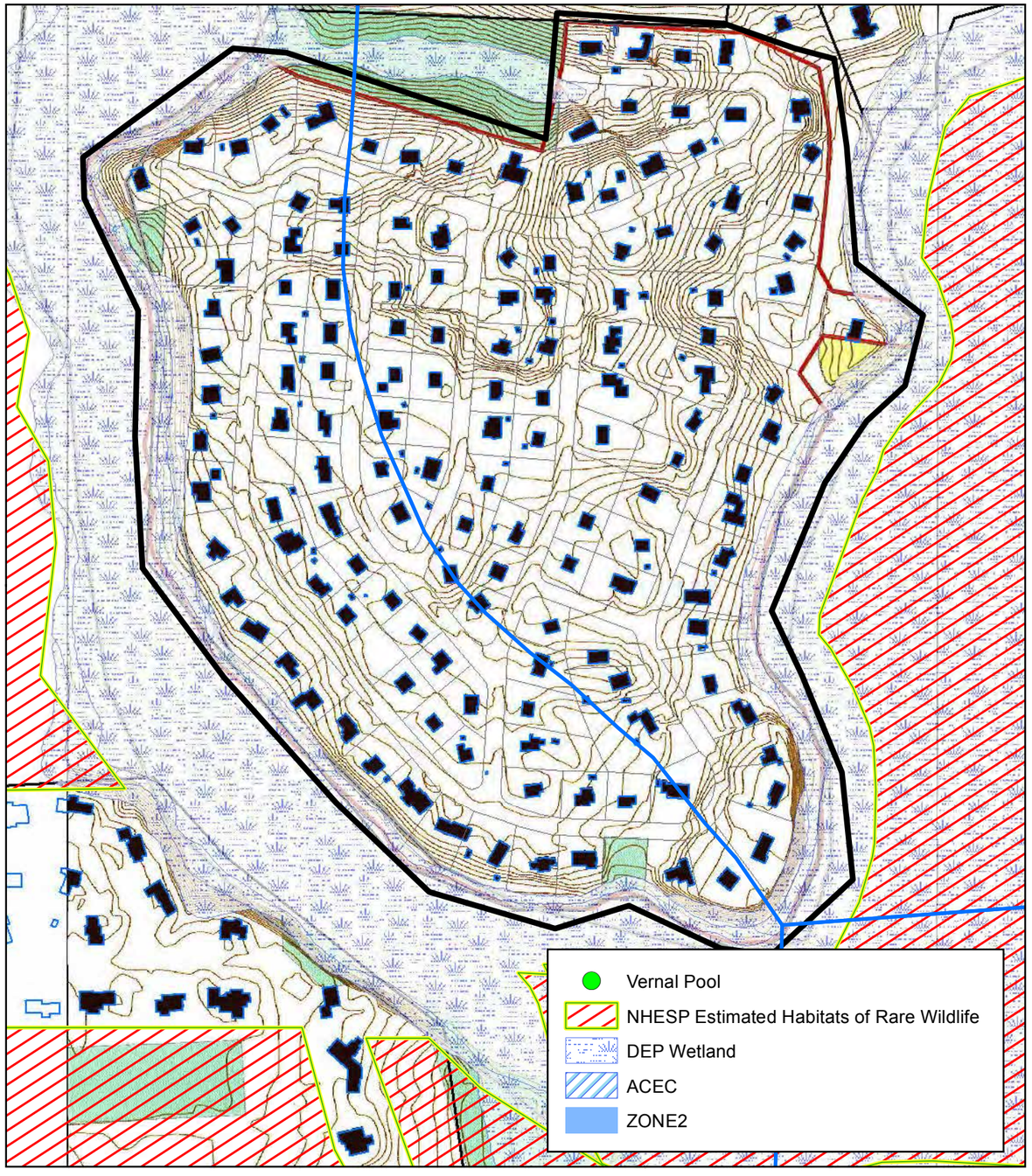

Paper Size ANSI B

1 inch = 300 feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
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Date 08 Aug 2013

Pirates Cove

Figure 6-5

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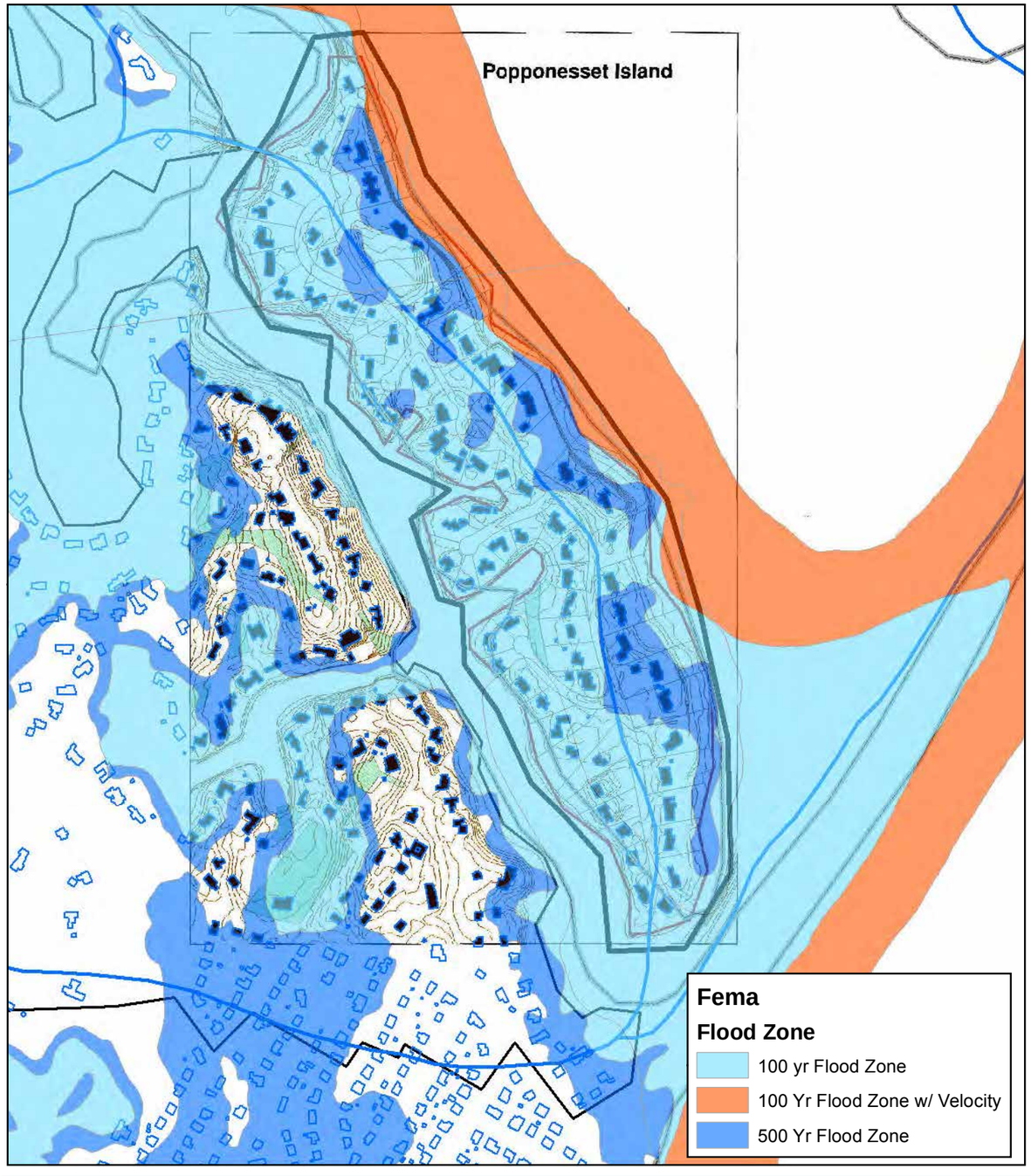

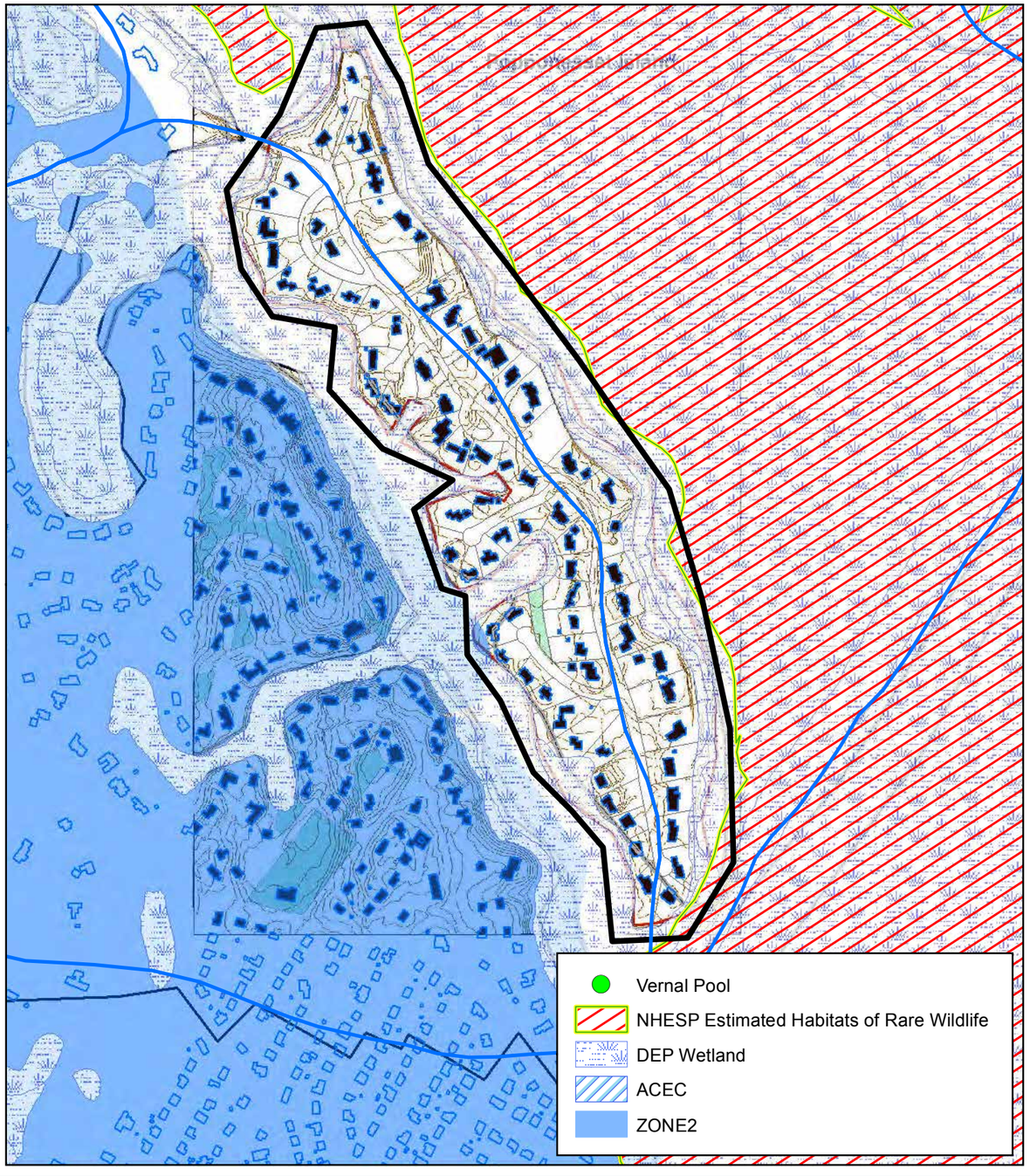

Paper Size ANSI B

1 inch = 500 feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Job Number 86-12001
Revision A
Date 08 Aug 2013

Popponesset Island

Figure 6-6

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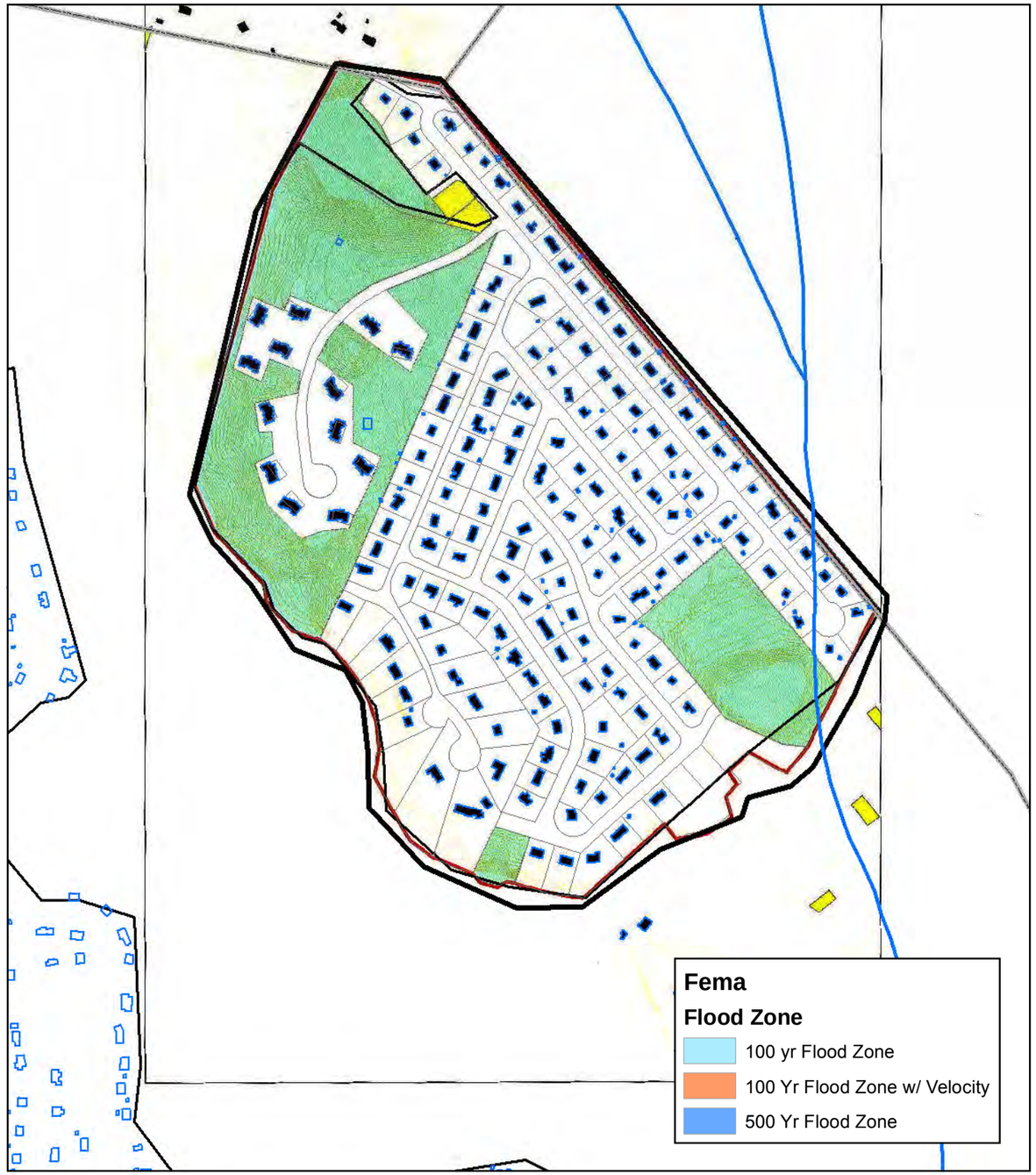

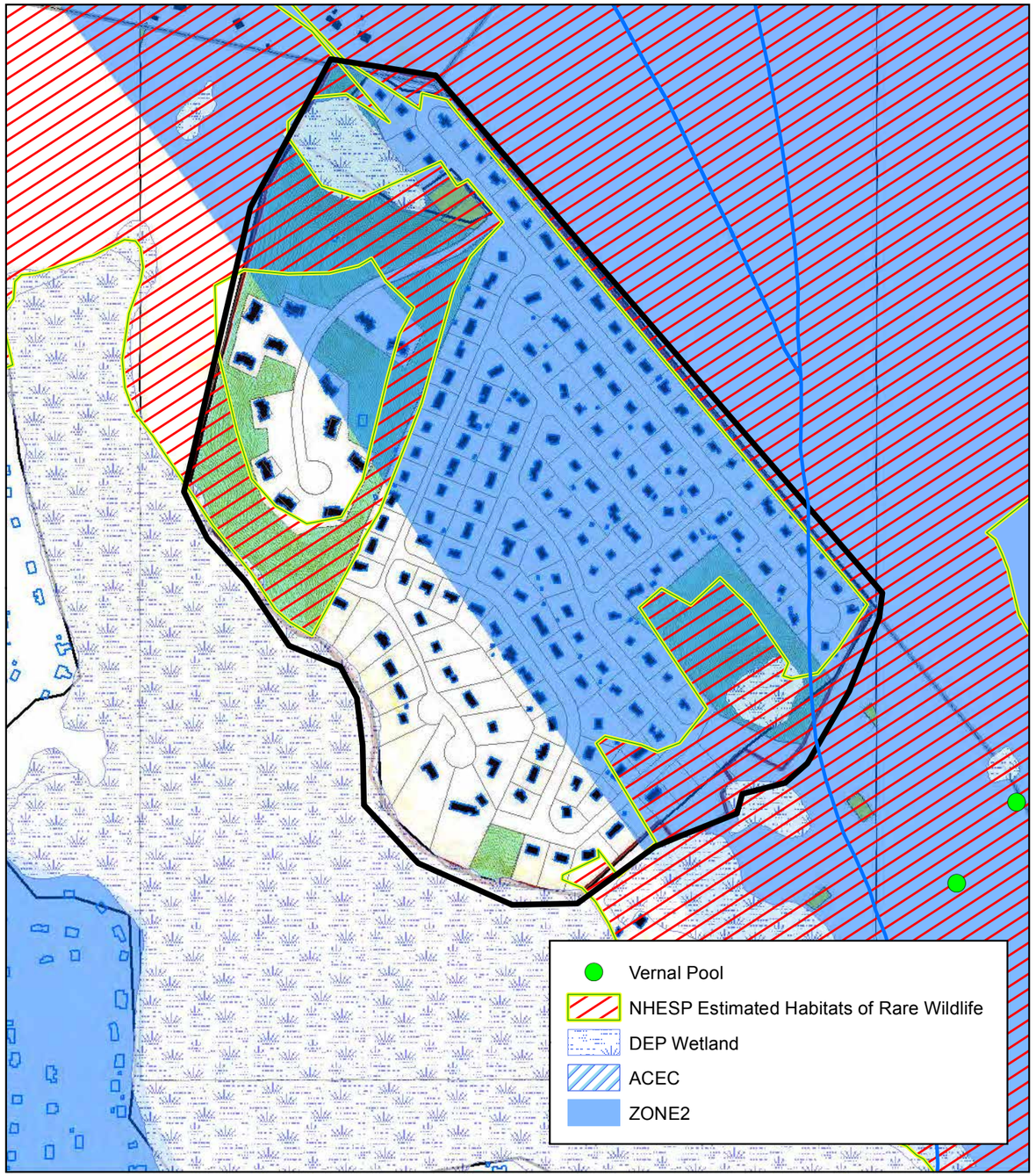

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
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Date 08 Aug 2013

Santuit Pond

Figure 6-7

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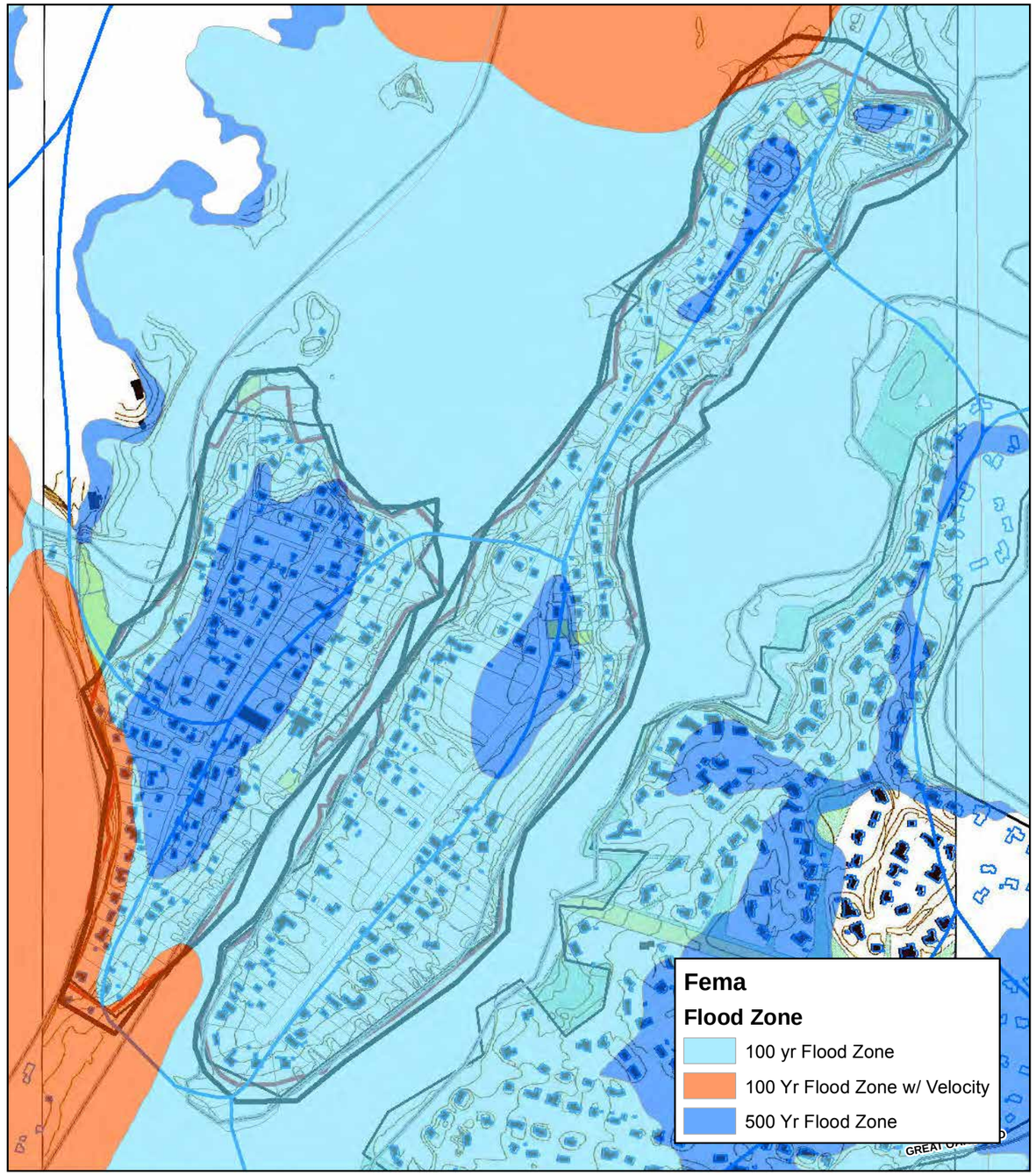

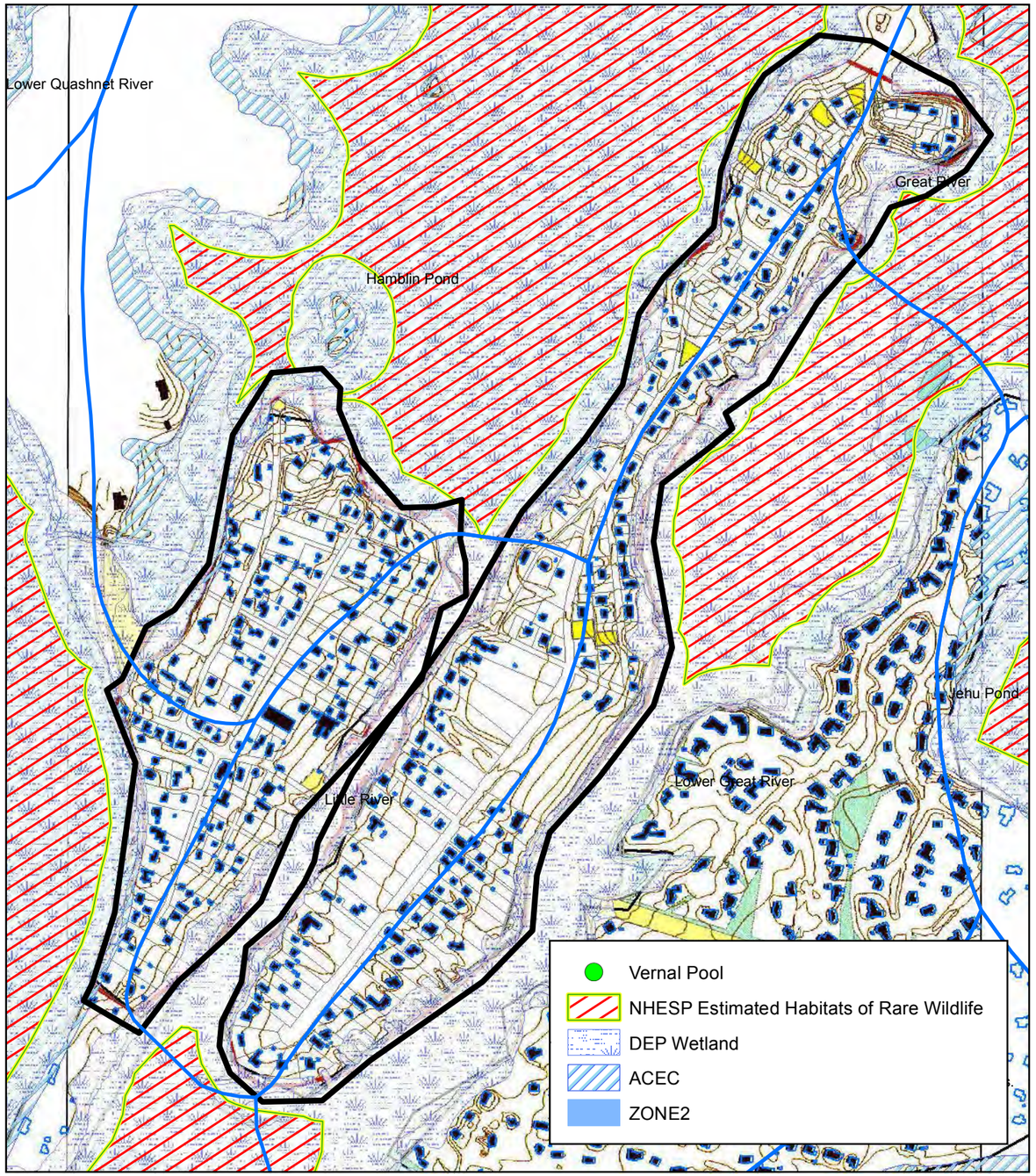

Paper Size ANSI B

1 inch = 600 feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Date	08 Aug 2013

Monomoscoy Island

Figure 6-8

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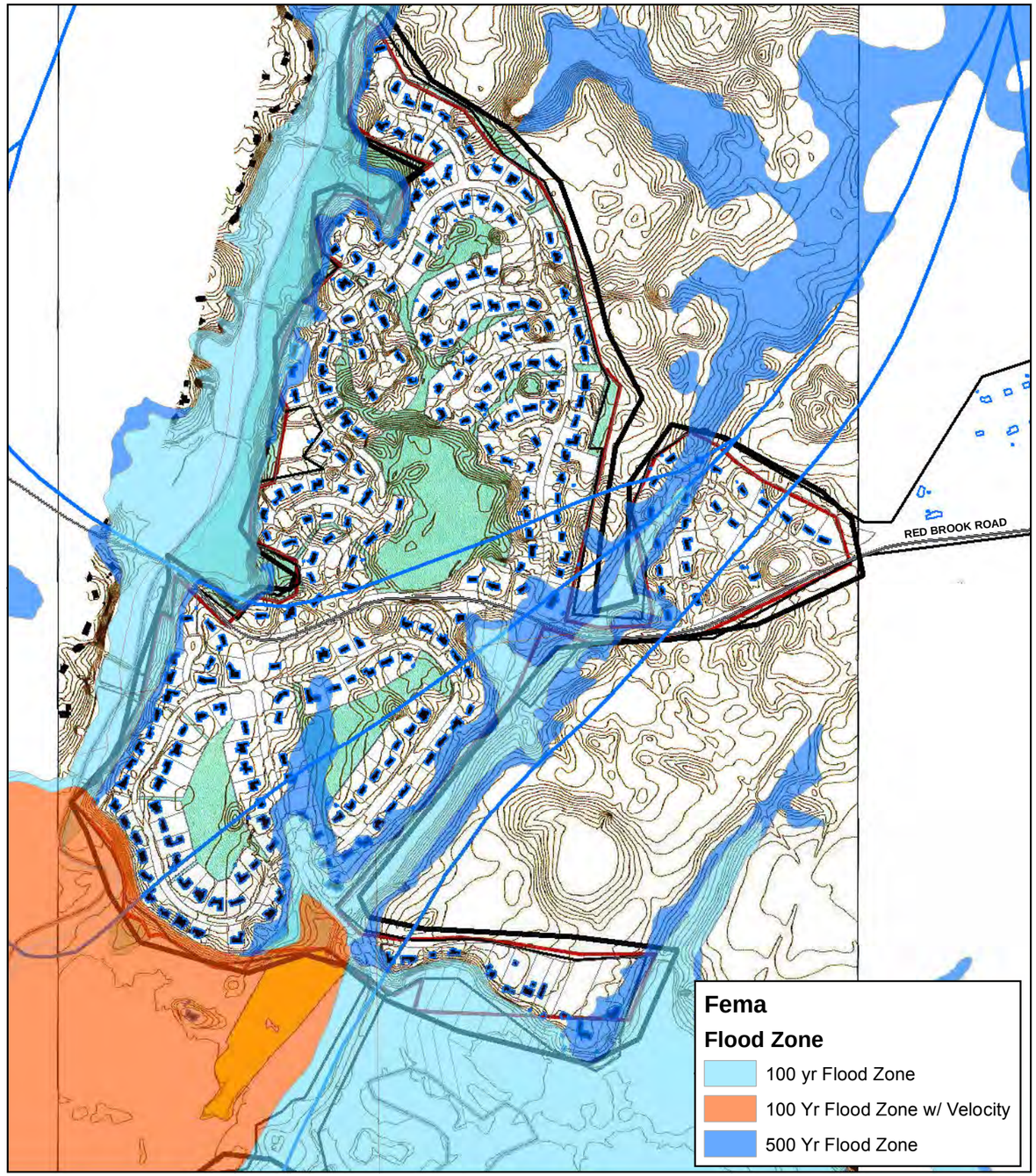

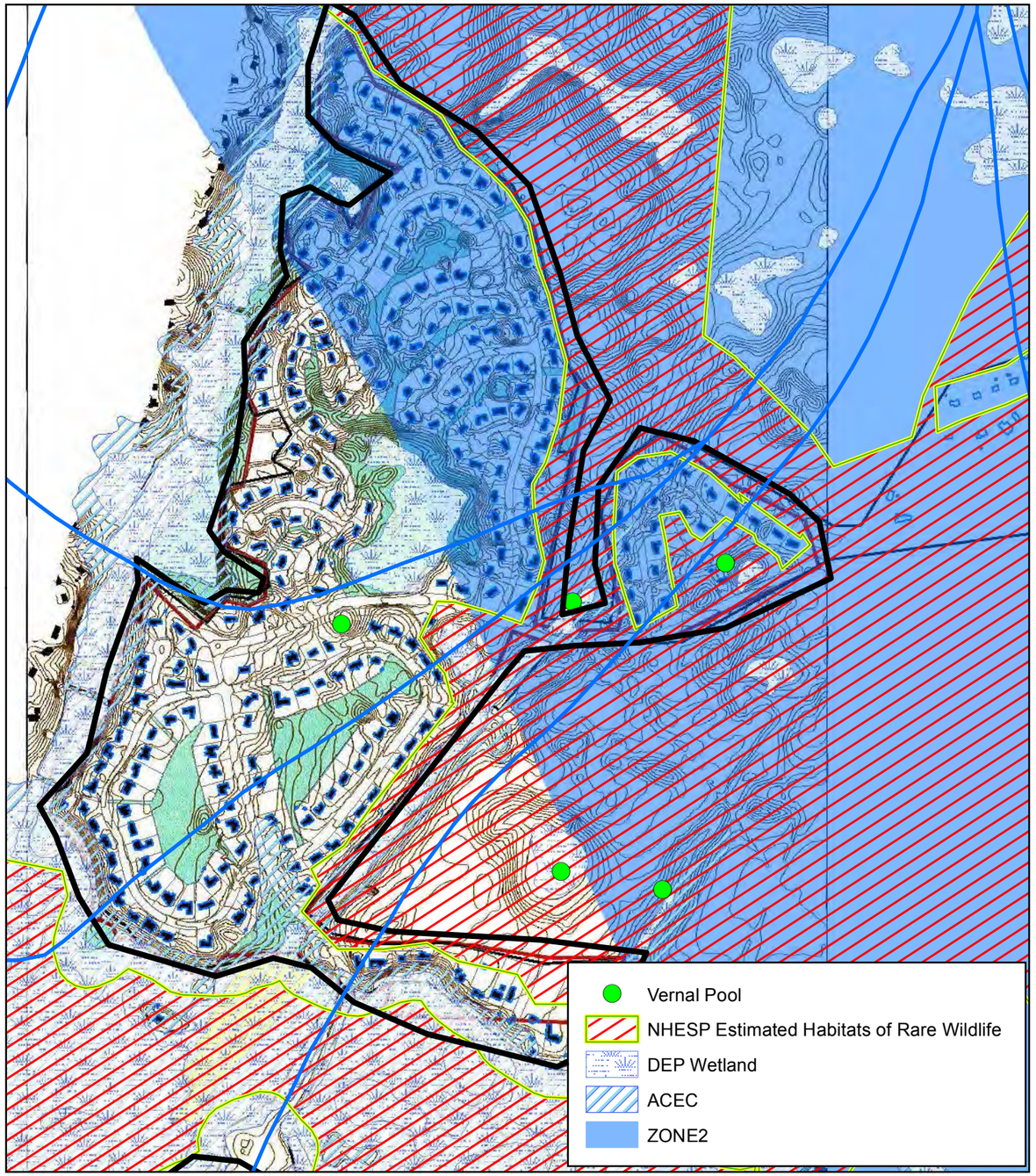

Paper Size ANSI B

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Job Number	86-12001
Revision	A
Date	08 Aug 2013

The Seabrooks

Figure 6-9

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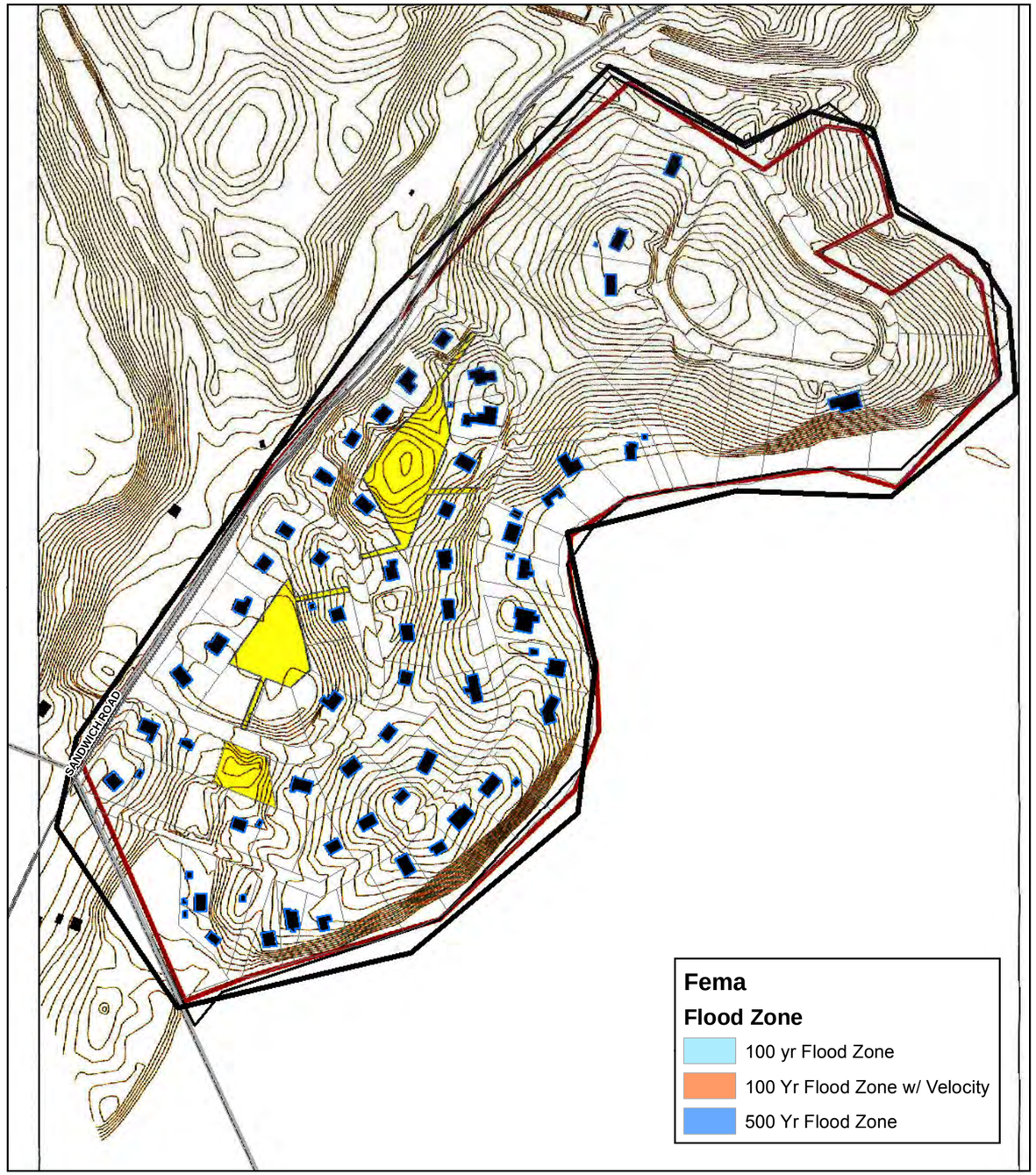

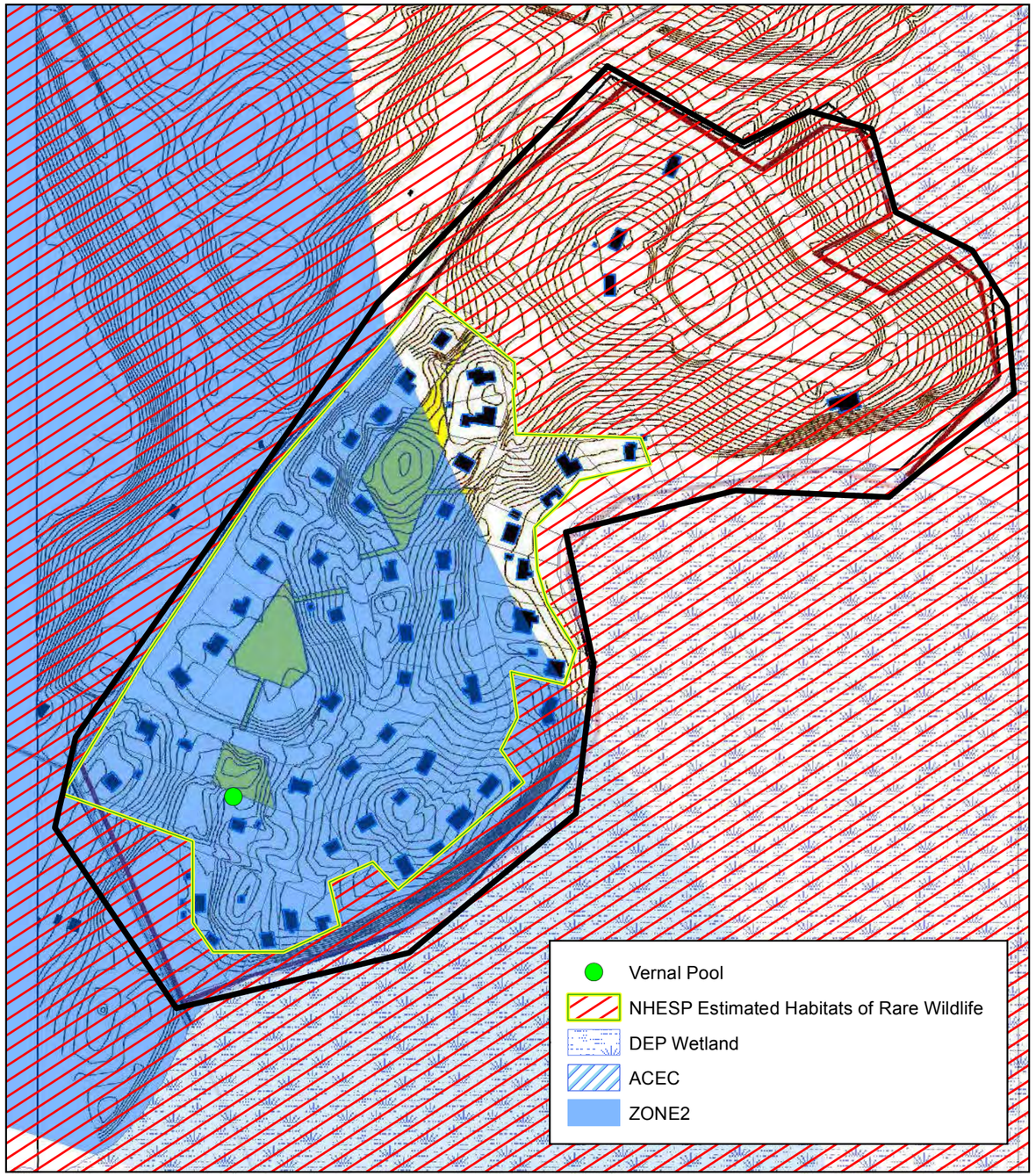

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

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Revision	A
Date	08 Aug 2013

Tri-Town Circle Area

Figure 6-10

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7 Draft Recommended Plan and Draft Environmental Impact Report Outline

This Chapter provides an outline of the Draft Recommended Plan and Draft Environmental Impact Report.

Chapter 1 Introduction

This chapter would review the project scope and background, and discuss the various steps the Town of Mashpee has taken regarding the regulatory and public review process.

Chapter 2 Summary of Previous Documents Prepared as Part of Mashpee's Watershed Nitrogen Management Plan (WNMP)

This chapter would outline the various studies, memorandums, reports, and documents relative to the work performed on this project, including pilot project efforts, MEP model runs and reports, TMDLS, and the various reports prepared and submitted as part of this project.

Chapter 3 Public Participation and Outreach

This chapter would elaborate on the public participation and outreach programs engaged in by the Mashpee Sewer Commission including their Citizens Advisory Committee (CAC), web page development, publicly televised Commission meetings, informational flyers that will have been developed and distributed as part of the project, and informational kiosks.

Chapter 4 Recommended Plan Framework (from ASAR)

This chapter would summarize the items discussed in the ASAR and discuss Source Removal, Direct Environmental Mitigation, and Land Management Strategies for the development of the Recommended Plan, and identify those items screened from further consideration.

Chapter 5 Evaluation of Recommended Plan Variables

This chapter would focus on discussion and description of the No Action Alternative, the previous MEP model run efforts, and comparisons on a monetary and non-monetary basis of various components that will make up the recommended plan, including:

- No Action Alternative
- Centralized vs. cluster developments
- Regional solutions
  - Use of MMR
  - Development of Memorandum of Understanding (MOU)
  - Potential joint/regional facilities within Mashpee
- Existing WWTFs
  - Upgrade or reconstruction/replacement of existing WWTF
  - Public versus private ownership and operations
- Traditional vs. Hybrid Solutions
  - Shellfish propagation
  - PRB use

- Bog and wetland restoration

Chapter 6 Environmental Impact Report

This chapter will identify the potentially impacted resources and environments, and consider the impact of each of these variables in the development of the recommended plan.

Chapter 7 Recommended Plan

This chapter will combine the findings of the Chapter 5 evaluation of variables with the Chapter 6 Environmental Impact Report results, and develop the Recommended Plan and its associated costs.

Chapter 8 Draft Section 61 Findings

This chapter would discuss and summarize the Draft Section 61 Findings for State Agency Action. It will also identify planned mitigation measures, implementation schedule of these measures, and any associated costs not captured as part of the recommended plan.

Chapter 9 Phasing and Implementation

This chapter will outline the phases of implementation of the plan over a 20- to 40-year planning period and summarize the estimated financial resources required to implement each phase. Phasing will be considered adjustable based on the implementation of Adaptive Management. Several pieces of the Recommended Plan will be integral parts of the Adaptive Management Plan as outlined in Chapter 11.

Chapter 10 Adaptive Management Plan Framework

This chapter will summarize the framework of the Adaptive Management Plan that will need to be created as a follow-up to the development of the Recommended Plan. This chapter will also discuss various different efforts to reduce nitrogen loading that would be part of the Adaptive Management Plan of the Town to help mitigate the need for sewering. These efforts would include those nontraditional methods as discussed in Chapter 5 such as:

- Shellfish propagation
- Bog restoration
- Waterless/Eco-toilets

And will discuss other features like:

- Water conservation
- Infiltration and Inflow reduction
- Stormwater mitigation
- Land management

Chapter 11 Next Steps

Key steps in the facilities planning process that will help shape the recommended plan will be:

- Cape Cod Commission and MassDEP direction on the enforcement and permitting issues associated with the TMDLs, such that each Town within the Project Planning Area will have a clear understanding of their regulatory obligation and therefore will be able to create the

necessary structure to monitor, manage, and enforce TMDL compliance, whether that be through a Board of Health, Sewer Commission, Department of Public Works, Sewer Department, Sewer District, or other structure.

- Development of a monitoring program. Because the groundwater travel patterns and times and estuary flushing conditions are influenced by a number of factors, an appropriate plan will need to be developed by the towns and the regulatory agencies to monitor the effectiveness of the plan in meeting the TMDLs.
- Development of a flexible management approach that allows change based on the permitting and monitoring requirements identified above. As part of the WNMP, it is anticipated that a cost-effective approach to water quality improvement in the estuaries will be established, setting the framework of fiscally achievable goals with a long-term plan (likely greater than 20 years) to work towards TMDL compliance.
- Need to discuss ownership of collection systems, management options, development versus build-out impact on costs.
- Discuss cost of phasing and bonding in increments.

Other items to be prioritized include:

- The plan's funding mechanism
- Development of an Adaptive Management Plan and Long-Term TMDL Monitoring (fresh and salt water)
- Private Facilities Acquisition/Ownership/Operations/Maintenance
- Additional Effluent Disposal Site Evaluations (including outside of the PPA)
- Securing of facility, cluster, and PRB sites and pumping station locations
- Development of Sewer Regulations
- Development of Sewer Rate Structure
- Phosphorus Removal Considerations (upgradient of fresh water systems)
- Development of Town fertilizer regulations

STEARNS & WHELER LLC
Environmental Engineers & Scientists

REPORT ADDENDUM

To: Mashpee Sewer Commission

From: J. Jefferson Gregg, P.E. - Stearns & Wheler, LLC

Date: December 3, 2007

Re: Final Needs Assessment Report – April 2007
Addendum
Tables 7-9 and 8-2

The following Addendum for the Final Needs Assessment Report is being issued.

The 2007 Needs Assessment Report summarized the nitrogen loads by town and by planning area. Table 7-9 from the Needs Assessment Report summarizes the total nitrogen load per town. Table 8-2 from the Needs Assessment Report summarizes these loads by planning area. Following submittal of the 2007 Needs Assessment Report, it was determined that the infiltration load on golf courses was overestimated and therefore this Addendum is being issued with the revised tables. These Tables were revised for the Final Technology Screening Report issued November 2007, and reissued as part of that report (Chapter 2). The information in these two tables will become the basis of alternative scenario development of this project and subsequent phases of work.

TABLE 7-9 (REVISED)

SUMMARY OF TOTAL NITROGEN LOADS PER TOWN[1]

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Town	Wastewater Nitrogen Load (kg/yr)		Non-Wastewater Nitrogen Load (kg/yr)		Total Nitrogen Load (kg/yr)		% Wastewater Nitrogen Load[2]	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Mashpee								
Waquoit Bay East	14,000	29,000	5,600	5,900	20,000	35,000	70%	83%
Popponesset Bay	28,000	41,000	**8,900**	**9,300**	**37,000**	**51,000**	78%	82%
Other	9,000	16,000	1,800	1,900	11,000	18,000	82%	89%
Total	51,000	86,000	**16,000**	**17,000**	**68,000**	100,000	76%	87%
Falmouth								
Waquoit Bay East	3,200	5,800	800	1,000	4,100	6,800	78%	85%
Sandwich								
Waquoit Bay East	4,500	5,400	1,200	1,300	5,700	6,700	79%	81%
Popponesset Bay	12,000	14,000	2,300	2,500	14,000	16,000	86%	88%
Barnstable								
Popponesset Bay	5,700	8,500	1,200	1,300	7,000	9,800	81%	87%
PLANNING AREA TOTAL	76,000	120,000	22,000	23,000	99,000	140,000		

Notes:

1. The nitrogen loads presented in this table do not assume any natural attenuation. Wastewater nitrogen loads are based on septic system nitrogen concentrations of 35 mg/L. All numbers are rounded to two significant figures.
2. Percent of total nitrogen load that comes from wastewater sources.
3. Nitrogen loads were calculated as discussed in this chapter.
4. Non-wastewater nitrogen loads were recalculated to include golf course fertilizer loads.
5. Numbers in **bold** have changed from the original Table 7-9.

TABLE 8-2 (REVISED)

SUMMARY OF NITROGEN LOADS BY PLANNING AREA

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Priority Area	Wastewater Flow (gpd)		WW Nitrogen Load (kg/yr)		Non-Wastewater Nitrogen Load (kg/yr)		Total Nitrogen Load (kg/yr)	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Mashpee								
M-1 Johns Pond	140,000	380,000	6,600	15,000	**1,600**	**1,700**	**8,200**	**16,000**
M-2 Mashpee Central	94,000	210,000	4,700	10,000	**960**	**1,000**	**5,700**	**11,000**
M-3 Shoestring Bay	150,000	240,000	7,800	12,000	**2,000**	**2,200**	**9,700**	**14,000**
M-4 Santuit Pond	110,000	140,000	5,100	6,900	**1,100**	**1,500**	**6,200**	**8,300**
M-5 Mashpee River	76,000	160,000	3,600	7,000	**890**	**1,000**	**4,500**	**8,000**
M-6 Jehu Pond	95,000	150,000	4,600	7,200	980	1,100	5,600	8,300
M-7 Popponesset Creek	57,000	83,000	2,800	4,000	490	520	3,300	4,500
M-8 Mashpee-Wakeby Pond	44,000	99,000	2,100	4,800	690	750	2,800	5,500
M-9 MMR	0	140	0	7	350	350	350	360
M-10 Mashpee East	20,000	45,000	880	1,200	250	260	1,100	1,500
M-11 Quashnet River	45,000	78,000	2,200	3,600	640	700	2,900	4,300
M-12 Mashpee South	25,000	42,000	1,200	2,100	480	500	1,700	2,600
M-13 New Seabury	190,000	380,000	9,100	18,000	**2,100**	**2,200**	**11,000**	**20,000**
TOTAL	1,000,000	2,000,000	51,000	92,000	13,000	14,000	63,000	104,000
Barnstable								
B-1 Barnstable Fresh Water	0	560	30	30	30	30	30	60
B-2 Shoestring Bay	110,000	140,000	5,400	6,700	1,000	1,100	6,400	7,800
B-3 Pinquickset Cove	5,100	9,300	250	450	150	160	400	620
B-4 Popponesset Bay	3,900	5,900	190	290	80	85	270	370
TOTAL	120,000	160,000	5,900	7,500	1,300	1,400	7,100	8,900
Sandwich								
S-1 Sandwich West	48,000	61,000	2,300	3,000	750	800	3,100	3,700
S-2 J Well	19,000	22,000	920	1,100	170	180	1,100	1,300
S-3 Snake Pond	2,700	3,600	130	170	40	40	170	220
S-4 Sandwich Quashnet	22,000	25,000	1,100	1,200	190	190	1,300	1,400
S-5 Sandwich Popponesset	240,000	280,000	12,000	14,000	3,300	3,500	15,000	17,000
TOTAL	330,000	390,000	16,000	19,000	4,500	4,700	21,000	24,000
Falmouth								
F-1 Red Brook	23,000	58,000	1,100	2,800	310	380	1,400	3,200
F-2 Falmouth Quashnet	42,000	59,000	2,000	2,900	310	390	2,400	3,300
F-3 Falmouth North	1,700	1,700	80	80	30	30	120	120
TOTAL	67,000	120,000	3,200	5,800	670	800	3,900	6,600
PLANNING AREA TOTAL	1,500,000	2,700,000	76,000	120,000	19,000	21,000	95,000	140,000

Figures in **bold indicate figures that changed as a result of recalculation of golf course nitrogen loads.

The Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Deval L. Patrick
GOVERNOR

Timothy P. Murray
LIEUTENANT GOVERNOR

Ian A. Bowles
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/envir

November 26, 2007

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
NOTICE OF PROJECT CHANGE

PROJECT NAME:	Comprehensive Nitrogen and Wastewater Management Plan
PROJECT MUNICIPALITY:	Mashpee
PROJECT WATERSHED:	Cape Cod
EEA NUMBER:	12615
PROJECT PROPONENT:	Town of Mashpee
DATE NOTICED IN MONITOR:	October 27, 2007

Pursuant to the Massachusetts Environmental Policy Act (M. G. L. c. 30, ss. 61-62H) and Section 11.10 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change (NPC) and Needs Assessment Report submitted for this project and hereby determine that the Scope for the Environmental Impact Report (EIR) issued for the project on November 9, 2001 still stands.

Project Description

As originally outlined in the Environmental Notification Form (ENF) submitted in October of 2001, the project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee. The Plan is intended to address the Town's needs for reducing nitrogen impacts to its coastal embayments and to evaluate all options for restoring those embayments.

As stated in the Secretary's Certificate on the ENF dated November 9, 2001, the project is expected to proceed in phases with the submission of reports dealing with four major work

elements: (1) a Needs Assessment Report, defining those areas that need nitrogen and wastewater management and establishing project flows from those areas; (2) an Alternatives Screening Analysis Report, evaluating the various means of meeting the wastewater requirements of the needs areas; (3) the Nitrogen and Wastewater Management Plan and Draft Environmental Impact Report (DEIR), which will identify a proposed management plan and assess the potential environmental impacts of that plan; and, (4) the Nitrogen and Wastewater Management Plan and Final EIR (FEIR), which will provide any additional environmental analysis required and will respond to comments submitted on the DEIR. The Certificate on the ENF directed the Proponent to prepare and submit for review the first two reports prior to the submission of the DEIR.

The project is subject to MEPA review and to the Mandatory EIR provisions of the MEPA regulations at 301 CMR 11.03(5)(a)(3) because it is presumed that the project will ultimately result in the construction of more than 10 miles of new sewers. The Proponent is seeking financial assistance from the Commonwealth under the State Revolving Fund (SRF); therefore, MEPA has broad scope jurisdiction over the project. The project is being reviewed under a Joint Environmental Review Process established between the Executive Office of Energy and Environmental Affairs (EEA) and the Cape Cod Commission.

Review of the NPC/Needs Assessment Report

The NPC currently under review includes the final Needs Assessment Report, which is the first of the review documents for the project. The Proponent submitted the NPC with the report in accordance with the MEPA regulations for a lapse of time, at 301 CMR 11.10(2). Following the submission of the ENF, the project was put on hold as the Proponent awaited the results of the Massachusetts Estuaries Project (MEP). The MEP's reports relevant to the Project Planning Area (PPA) were released in 2004 and 2005, and will be used by the Proponent in the development of the nitrogen management needs and management plan.

The Needs Assessment Report provides information on existing wastewater facilities; physical features, land use and regulatory issues affecting wastewater facilities; and existing conditions related to environmental resources, nitrogen loadings and on-site septic systems. The report also identifies the impacts of population growth in the PPA on wastewater collection, treatment and disposal facilities. The Proponent has identified a number of priority areas for nitrogen removal and nitrogen management and has established three levels of rankings for these sites.

I commend the Town of Mashpee for its efforts and for the comprehensive nature of the Needs Assessment Report. Comments submitted to MEPA on the NPC indicate that the report is an excellent foundation from which to develop the Watershed Nitrogen Management Plan. The Proponent should incorporate responses to technical comments submitted on the NPC from the Cape Cod Commission, the Department of Environmental Protection, the Office of Coastal Zone Management and the Massachusetts Historical Commission into the Alternatives Screening Analysis Report.

November 26, 2007
Date

Ian A. Bowles

Comments Received:

10/29/2007	Massachusetts Historical Commission
11/9/2007	Office of Coastal Zone Management
11/16/2007	Department of Environmental Protection, Southeast Regional Office
11/16/2007	Cape Cod Commission

IAB/BA/ba

BA

RECEIVED

OCT 30 2007

MEPA

October 29, 2007

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth

Massachusetts Historical Commission

Secretary Ian A. Bowles
Executive Office of Energy & Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Attn.: Briony Angus

RE: Watershed Nitrogen Management Planning Study, Mashpee, Popponesset Bay & Waquoit Bay East Watersheds. MHC #RC.29581. **EEA #12615.**

Dear Secretary Bowles:

Staff of the Massachusetts Historical Commission have reviewed the Notice of Project Change filed with the planning document submitted for the project referenced above.

In Chapter 3 (Section 3.2, Federal Regulatory Issues), Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800) will also apply to review of projects proposed, as federal funding and permitting is anticipated.

In Chapter 5 (Page 5-10), since the 1988 plan, two additional properties (for a total of six properties) are subject to Preservation Restrictions (MGL c. 184, ss. 31-33) held by the MHC and all are listed in the State Register of Historic Places. Another property (the Sophronia Young House Site in the area of New Seabury) is proposed for a Preservation Restriction and listing in the State Register. In Mashpee, there are many properties in the Inventory of Historic and Archaeological Assets of the Commonwealth, which gives an indication of the likelihood of many other, as yet unidentified historic and archaeological resources in the town.

MHC looks forward to review of project information when plans for preferred alternatives to address the priority areas are developed.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800), MGL c. 9, ss. 26-27C (950 CMR 71), and MEPA (301 CMR 11). Please contact me if you have any questions.

Sincerely,

Edward L. Bell
Senior Archaeologist
Massachusetts Historical Commission

xc:
F. Thomas Fudala, Mashpee Sewer Commission
Nathan Weeks, Stearns & Wheeler, LLC
Ron Lyberger, DEP-BRP
Sara Korjeff, Cape Cod Commission
George Green, Jr. THPO, Mashpee Wampanoag Tribe

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

MEMORANDUM

TO: Briony Angus, Environmental Reviewer, MEPA Unit

THROUGH: Jonathan Hobill, Acting Deputy Regional Director,
Bureau of Resource Protection
David Johnston, Deputy Regional Director, BWP
Millie Garcia-Serrano, Deputy Regional Director, BWSC
Gary Moran, Regional Director

CC: Elizabeth Kouloheras, Chief, Wetlands and
Team Leader, Cape Cod Watershed
Brian Dudley, Chief, Wastewater Management, Cape Cod Watershed
Jeffrey Gould, Chief, Water Pollution Control
Richard Rondeau, Chief, Water Supply
Richard Keith, Chief, Municipal Services

FROM: Sharon Stone, SERO MEPA Coordinator

DATE: November 16, 2007

RE: NPC EOEA #12615 – MASHPEE – Watershed Nitrogen Management Planning Study

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"For Use in Intra-Agency Policy Deliberations"

The Southeast Regional Office of the Department of Environmental Protection (MassDEP) has reviewed the Notice of Project Change (NPC) for the proposed nitrogen management planning study project for the Cape Cod Watershed located in Massachusetts (EOEEA #12615). The project proponent provides the following information for the project:

"The Notice of Project Change is submitted solely for a lapse of time; there is no substantial project change."

MassDEP is pleased to see that the Needs Assessment Report has incorporated planning on a watershed-wide basis and includes consideration of the towns of Sandwich and Barnstable. MassDEP also notes that the preliminary prioritization of Priority Area groups takes into account the findings of the Massachusetts Estuaries Project (MEP). However, as alternatives analysis proceeds, any recommended alternative will have to demonstrate that it will be able to reduce nitrogen loads sufficiently to meet the target threshold nitrogen concentration at the sentinel stations in the respective watersheds.

The MassDEP Southeast Regional Office appreciates the opportunity to comment on this proposed project. If you have any questions regarding these comments, please contact Sharon Stone at (508) 946-2846.

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 Causeway Street, Suite 800, Boston, MA 02114-2136
(617) 626-1200 FAX (617) 626-1240

MEMORANDUM

TO:	Ian A. Bowles, Secretary, EOEEA
ATTN:	Briony Angus, MEPA Unit
FROM:	Leslie-Ann McGee, Director, CZM
DATE:	November 9, 2007
RE:	EOEA 12615 – Mashpee Comprehensive Watershed Nitrogen Management Plan, Needs Assessment Report and Notice of Project Change

The Massachusetts Office of Coastal Zone Management (CZM) has completed its review of the above-referenced Needs Assessment Report and Notice of Project Change, noticed in the Environmental Monitor dated October 27, 2007, and offers the following comments.

Project Description

The project involves the development of a comprehensive nitrogen and wastewater management plan through the Popponesset Bay and Waquoit Bay East Watershed Nitrogen Management Planning Project (EOEA # 12651). The Needs Assessment Report (NAR) is the first phase of this project, as outlined in the Certificate of the Secretary of Environmental Affairs on November 9, 2001. The Certificate requires the submission of four reports, including the NAR, an Alternatives Analysis Screening Report, the Nitrogen and Wastewater Management Plan and Draft Environmental Impact Report (EIR), and the Final Nitrogen Management Plan and Final EIR. The purpose of the Watershed Nitrogen Management Plan (WNMP) is to provide an environmentally and economically sound plan for nitrogen reduction, wastewater treatment, and effluent recharge in the project planning area. The NAR is intended to outline the existing conditions and future conditions within the project planning area, and to identify the wastewater, stormwater and other nitrogen related problems within this area.

Project Comments

CZM commends the Town of Mashpee for it's continued efforts to develop a watershed-based nitrogen management plan. This planning effort has benefited from Mashpee's participation in the Massachusetts Estuaries Project (MEP) and the completion of MEP reports on the Popponesset Bay and Waquoit Bay East watershed systems. The results of these reports have been incorporated into this NAR, and the subsequent development of alternatives and management recommendations will be based upon the findings of MEP Total Maximum Daily Loads.

The NAR is comprehensive and exceeds the Secretary's minimum requirements to identify areas that require nitrogen wastewater management and establish flows for those areas. The NAR provides background information on existing wastewater infrastructure, natural resources, land use and associated regulatory issues within the project planning area. In addition to characterizing existing flow and nitrogen loadings, estimates of future flow and nitrogen loadings are presented. These flow estimates are well described and are based on build-out information developed from the MEP analysis and from town sources.

The NAR identifies a number of priority areas for nitrogen removal and nitrogen management and establishes three levels of rankings for these sites. The rationale and factors used to identify and prioritize these sites are clearly presented. CZM believes the rationale is sound, and that this initial prioritization is a necessary first step in this planning process. CZM recognizes that this initial prioritization of sites will be evaluated further as more data is developed through the ongoing planning process

One of the factors used in the identification of priority areas is proximity to any of the eight existing Waste Water Treatment Facilities (WWTF) within the project planning areas, and potential future expansion of these facilities. The NAR identifies potential excess capacity at many of these WWTF facilities, however the majority of them are privately owned. CZM recommends that the proponent develop and present a process to engage with these private facilities in an effort to ensure the potential for future expansion. This process should be incorporated into the future Alternatives Screening Analysis Report.

Federal Consistency

The proposed project may be subject to CZM federal consistency review, in which case the project must be found to be consistent with CZM's enforceable program policies. For further information on this process, please contact, Robert Boeri, Acting Project Review Coordinator, at 617-626-1050 or visit the CZM web site at www.state.ma.us/czm/fcr.htm.

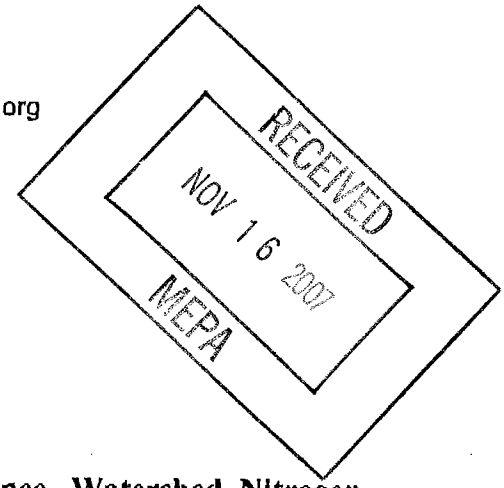
LM/sm

cc: Stephen McKenna,
CZM Cape & Islands Regional Coordinator
Brian Dudley, Section Chief
MA DEP-Hyannis, 973 Iyannough Road, Hyannis, MA 02601
Thomas Fudala, Chairman, Mashpee Sewer Commission
16 Great Neck Road, Mashpee, MA 02648

CAPE COD COMMISSION

3225 MAIN STREET
P.O. BOX 226
BARNSTABLE, MA 02630
(508) 362-3828
FAX (508) 362-3136
E-mail: frontdesk@capecodcommission.org

BA



November 16, 2007

Secretary Ian Bowles
Executive Office of Energy and Environmental Affairs
MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: **Notice of Project Change, Town of Mashpee, Watershed Nitrogen Management Plan and Needs Assessment Report for Popponessett Bay and Waquoit Bay-East Watersheds**
EOEEA: #12615
CCC: JR#20076
ATTN: **Briony Angus**

Dear Secretary Bowles:

The Cape Cod Commission (the Commission) has received a Notice of Project Change (NOPC) for the Watershed Nitrogen Management Plan for the Town of Mashpee. The NOPC was accompanied with a report entitled, "Town of Mashpee, Popponessett Bay and Waquoit Bay-East Watersheds, Needs Assessment Report." The NOPC was noticed in the Environmental Monitor on October 10, 2007.

The proposed Mashpee Watershed Nitrogen Management Plan is being reviewed jointly by the Executive Office of Energy and Environmental Affairs (EOEEA) – MEPA Unit, and by the Cape Cod Commission as a Development of Regional Impact (DRI) in accordance with the Memorandum of Understanding (MOU) between the Commission and EOEA. This NOPC is being submitted by the town because more than three years have passed since the 2001 MEPA Certificate on the project.

Although the Commission has not taken a formal position on the NOPC, staff has reviewed the 2001 scope of Watershed Nitrogen Management Plan and with the updates incorporated into the 2007 Needs Assessment supports the requested extension of time to complete the project.

Staff has reviewed the Needs Assessment that will be incorporated into the Draft Environmental Impact Report and offers the following general and technical comments as an attachment.

The Cape Cod Commission looks forward to continuing our participation with the Town of Mashpee, and its neighboring towns, as it moves forward in its Watershed Nitrogen Management Plan.

Please contact me or Tom Cambareri of my staff if you have any comments or questions.

Sincerely,

Paul Niedzwiecki
Executive Director

Cc: Joyce Mason, Mashpee Town Administrator
Thomas Fudala, Mashpee Town Planner/Sewer Commissioner
Nate Weeks, Stearns and Wheler
Ernest Virgilio, CCC, Mashpee Representative
Jay Zavala, CCC- Falmouth Representative
Brian Dudley, MassDEP
Mark Ells, Barnstable DPW
Royden Richardson, CCC- Barnstable Representative
David Mason, Sandwich Health Agent
Robert Jones, CCC- Sandwich Representative
Lindsey Counsell, 3Bays Preservation
Brian Howes, SMAST, UMass Dartmouth, MEP Project Manager

General

The Needs Assessment Report documents the significant level of effort that has gone into the determining the Total Maximum Daily Load (TMDL) of nitrogen for the two subject embayments over the course of the last six years. This has included participation in the Massachusetts Estuary Project (MEP) consisting of town-supported water quality monitoring, assessment of sediments, plants and fauna, land use assessments, compilation of water use from Mashpee Water District, hydrodynamic modeling of the estuaries and use of the Linked Water Quality Model to determine the nitrogen thresholds. The MEP technical reports for Popponesset Bay and East Waquoit Bay were completed in April 2004 and July 2004, respectively. Regulatory review to establish the MassDEP TMDL took over two years for Popponessett Bay and have not yet been finalized for Waquoit Bay East (a draft TMDL was released in July 2005). Final EPA approval of the DEP TMDLs have not been completed.

During that period of time the Town took advantage of a number of opportunities including the DEP Pilot Project and the Cape Cod Commission TMDL Implementation Project, which were both funded through EPA. Through these projects, Mashpee, together with representatives of Barnstable and Sandwich, has been able to participate in the drafting of a TMDL nitrogen loading allocation for each town and have discussions on potential nutrient trading opportunities. Mashpee was also able to run a number of MEP alternative nitrogen loading scenarios and to have an assessment of cranberry bogs and streams for potential additional Natural Attenuation.

The town also received wastewater grant funds from Barnstable County to 1) model sewer collection systems in the Popponessett watershed and 2) to receive technical assistance from the US Geological Survey and Commission water staff, to use a groundwater model to evaluate potential wastewater disposal sites.

Technical

The Needs Assessment recognizes the appropriate water resources minimum performance standards from the Regional Policy Plan.

The Town should continue to make use of its Citizens Advisory Committee (CAC) and Pilot Project group to obtain input on it proposed the nitrogen removal scenarios.

The identification of priority areas uses the Mashpee Planning areas as its fundamental building block. It is noted that areas of Barnstable in the Popponessett Bay watershed appear to have a similar density characteristic of the higher nitrogen loading rates of the Mashpee planning areas. The town should continue to work through its CAC Barnstable Representative to obtain input about the priority ranking of neighborhoods in the adjacent towns.

The Needs Assessment identifies the Zone IIs and Groundwater Protection District of the town as discusses contamination from the MMR. It would seem appropriate if the Needs Assessment also included a characterization of the water quality in terms of nitrogen and the potential for any local impacts from wastewater disposal on drinking water quality.

The Needs Assessment identifies Santuit Pond as being listed on the Clean Water Act 303d list of "impaired waters" and that the Cape Cod Pond Atlas identifies another 18 additional fresh water ponds that are impaired. The next listing of impaired waters by the DEP is scheduled for 2008 and it is likely that a number of these additional ponds will be included on the updated 303d list. We agree that a more definitive assessment of the water quality of Santuit Pond is warranted and that a plan for the assessment of the additional ponds should be considered.

The Needs Assessment contains a good characterization of the Private Sewage Treatment Facilities, including treatment efficiency and excess capacity. The WNMP calculates build out numbers showing that future wastewater flows will approach and/or exceed permitted capacity at most of the facilities. As such, private facilities that are identified for expansion are ones where new or expanded infrastructure can physically be accommodated. Were Title 5 flows used for build out? Is it possible that capacity may be available on a phased basis at any of the facilities? For instance, Provincetown built a facility using Title 5 design flows, but found after several years of operation, that the actual use was only 70% of the capacity thereby making that capacity available for sewer expansion.

The section on existing infrastructure also includes a brief discussion on Innovative and Alternative septic systems. We anticipate that the subsequent report on technology evaluation will have a characterization on the performance of the IAs that will make use of findings from the Barnstable County Health Department and MEP model scenarios about IA systems from the pilot project.

The wastewater flows and nitrogen loading section indicates that IA systems were assumed to have a treated concentration of 19 mg/l nitrogen. The BCDHE white paper on these systems indicates the median treatment efficiency of 19 mg/l for 60% of the samples evaluated. This performance is less than required by MassDEP goals and it is likely that most of these systems will be assigned effluent concentrations higher than 19 ppm.

The Needs Assessment has chosen to use the Planning Zones as the fundamental unit to base nitrogen loading rates. Of the 161 planning areas in the town, 23 were in the high to medium high range. This number increased to 47 of 161 for future conditions. This information was graphically displayed. Elsewhere in the report, the amount of nitrogen removal as per the MEP technical report is shown in tabular form. It would be useful to graphically compare the MEP nitrogen percent removal areas (watersheds) to the loading rates of the planning areas.

It is not exactly clear why the WNMP uses 35 mg/l for nitrogen concentration to calculate nitrogen loads. The WNMP states that it did not want to include the attenuation that takes place in the septic system. If that is the case, then perhaps a concentration of 60 mg/l should be considered since this is more characteristic for flow coming into a septic system. The MEP recommendations for percent removal are based upon a nitrogen concentration of 26.5 mg/l. If the WNMP uses a higher concentration for the same flow then, the plan will need to accordingly increase the amount of wastewater planned to be removed. This approach should be evaluated for consistency with the MEP before alternative nitrogen loading scenarios are prepared.

The WNMP also does not include natural attenuation in its calculations. Natural attenuation in the rivers and freshwater ponds was included in the calibrated MEP model that was used to develop the TMDLs. It is not clear why the WNMP does not use this naturally occurring process. By choosing not to include natural attenuation, the loads assigned to the subwatersheds are higher than what is included in the watershed portion of MEP model. For example, the WNMP adjusted nitrogen load for the Mashpee River is 87 kg/day as compared to the MEP attenuated load of 54.2 kg/day. Since the scenario described in the MEP report indicates that 100% removal of the MEP load is required to meet the TMDL, it is unclear whether the WNMP is making the case that all 87 kg/d needs to be removed or whether 54.2 kg/d (66% of the 87 kg/d) needs to be removed. Clarification of the intended use of the WNMP nitrogen loading calculations is required to understand the goals of these alternative nitrogen loads.

The priority ranking of Planning Areas includes all the appropriate criteria. The methodology resulted in the figure 8-1. The following are some observations about the conclusionary graphic. 1) It is noted that the area upgradient of Ashumet and John's Pond are high priority areas. While the loading rates may be high, natural attenuation that occurs in the pond will reduce that overall loading on the receiving water of concern which is Waquoit-West. 2) The high priority area of Shoestring Bay in Mashpee is not extended across the town boundary into Barnstable. 3) Similarly, the low priority ranking of the Falmouth Quashnet area will be of interest to Falmouth which is just embarking on a wastewater plan of East Falmouth. As noted above, input from neighboring towns on their perspective of priority and participation should be obtained for these shared watersheds. It is recommended to graphically compare the MEP nitrogen percent removal areas (watersheds) to the prioritized planning areas. Because the intent of the prioritization is for sewer collection, it would be helpful to omit surface waters and protected open space from the color scheme.

The Cape Cod Commission staff has participated and provided technical assistance to the DEP Pilot Project stems from a EPA TMDL Implementation Grant to the Cape Cod Commission. Under this grant Commission staff have participated in meetings, prepared TMDL allocations by town and subwatershed and lead discussions on Nutrient Trading opportunities.

EOEE CERT COPY

The Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Deval L. Patrick
GOVERNOR

Timothy P. Murray
LIEUTENANT GOVERNOR

Richard K. Sullivan, Jr.
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/envir

July 6, 2012

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
SECOND NOTICE OF PROJECT CHANGE

PROJECT NAME	:Comprehensive Nitrogen and Wastewater Management Plan
PROJECT MUNICIPALITY	:Mashpee
PROJECT WATERSHED	:Cape Cod
EEA NUMBER	:12615
PROJECT PROPONENT	:Town of Mashpee
DATE NOTICED IN MONITOR	:June 6, 2012

Pursuant to the Massachusetts Environmental Policy Act (M. G. L. c. 30, ss. 61-62I) and Section 11.10 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change (NPC) submitted for this project and hereby determine that the Scope for the Draft Environmental Impact Report (DEIR) issued on November 9, 2001 still stands.

Project Description

As originally described in the Environmental Notification Form (ENF) submitted in October of 2001, the project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee (Mashpee CWMP). The Mashpee CWMP is intended to achieve reductions of wastewater nitrogen loading and meet Total Maximum Daily Loads (TMDLs) for nitrogen loading to the Town's coastal embayments including Popponesset Bay and Waquoit Bay.

Project History

As stated in the Secretary's Certificate on the ENF dated November 9, 2001, the project is

expected to proceed in phases with the submission of reports dealing with four major work elements: (1) a Needs Assessment Report, defining those areas of Mashpee that need nitrogen and wastewater management, identified as the Project Planning Area (PPA) and establishing project flows from the PPA; (2) an Alternatives Screening Analysis Report, evaluating the various means of meeting the wastewater requirements of the needs areas; (3) the Nitrogen and Wastewater Management Plan and Draft Environmental Impact Report (DEIR), which will identify a proposed management plan and assess the potential environmental impacts of that plan; and, (4) the Nitrogen and Wastewater Management Plan and Final EIR (FEIR), which will provide any additional environmental analysis required and will respond to comments submitted on the DEIR. The Certificate on the ENF directed the Town to prepare and submit for review the first two reports prior to the submission of the DEIR.

Notice of Project Change

The Town submitted a Notice of Project Change, together with a final Needs Assessment Report, to the MEPA Office in October 2007 in accordance with the MEPA regulations for a lapse of time, at 301 CMR 11.10(2). As described in the first NPC document, the project was put on hold following the submission of the ENF as the Town awaited the results of the Massachusetts Estuaries Project (MEP). The MEP's reports relevant to the PPA were released in 2004 and 2005, and were to be used by the Town in the development of the nitrogen management needs and management plan. The Needs Assessment Report provided information on existing wastewater facilities; physical features, land use and regulatory issues affecting wastewater facilities; and existing conditions related to environmental resources, nitrogen loadings and on-site septic systems. The report also identified the impacts of population growth in the PPA on wastewater collection, treatment and disposal facilities. The Town has estimated the total amount of wastewater flow from the PPA to be approximately 2.7 million gallons per day (MGD).

Permits and Jurisdiction

The project is subject to MEPA review and to the Mandatory EIR provisions of the MEPA regulations at 301 CMR 11.03(5)(a)(3) because it is presumed that the project will ultimately result in the construction of more than 10 miles of new sewers. The project will require a Groundwater Discharge Permit, a Chapter 91 License, and a 401 Water Quality Certificate from the Department of Environmental Protection (MassDEP). The project must be reviewed by the Natural Heritage Endangered Species Program (NHESP) and the Massachusetts Historical Commission (MHC) because portions of the project occur within Priority Habitat and within or adjacent to recorded archaeological sites and archaeologically sensitive areas, respectively. It may require Federal Consistency Review by the Massachusetts Coastal Zone Management (MCZM) Office. It may also require a Construction Access Permit from the Massachusetts Highway Department. The project may be required to obtain a Section 404 Permit from the U.S. Army Corps of Engineers. The project will require an Order of Conditions from the Mashpee Conservation Commission (and, on appeal only, a Superseding Order from MassDEP). The project should comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for stormwater discharges from a construction site.

The Town is seeking Financial Assistance from the Commonwealth under the State Revolving Fund (SRF); therefore, MEPA has broad scope jurisdiction over the project. The project is being reviewed under a Joint Environmental Review Process established between the Executive Office of Energy and Environmental Affairs (EEA) and the Cape Cod Commission (CCC).

REVIEW OF THE SECOND NOTICE OF PROJECT CHANGE

The Town has submitted this second Notice of Project Change (2nd NPC) in accordance with the MEPA regulations at 301 CMR 11.10(2)(b)(2) because more than three years have elapsed between the publication of the ENF and commencement of non-construction related project work or activity.

As described in the 2nd NPC document, subsequent to the issuance of the Secretary's Certificate on the 1st NPC (November 26, 2007), the United States Environmental Protection Agency (EPA) established Total Daily Maximum Loads (TMDLs) of nitrogen for the Popponesset Bay and the East Waquoit Bay estuaries (Quashnet River, Hamblin Pond, Little River, Jehu Pond and Great River). According to the Town, the TMDLs for Waquoit Bay (Childs River, Eel River) are currently being reviewed by the US Environmental Protection Agency (EPA). The Town is currently conducting an analysis of alternative scenarios for the targeted collection, treatment and disposal of wastewater flows located in the PPA to address the water quality requirements and TMDLs of the Town's marine and freshwater water resources. These wastewater treatment and disposal alternatives include: 1) the conveyance of wastewater flows to existing and proposed privately-owned wastewater treatment facilities (WWTFs); 2) relocation of existing public water supply wells; and 3) shared regional approaches to wastewater treatment and disposal with the Towns of Barnstable, Sandwich and Falmouth.

Conclusion

I commend the Town of Mashpee for its ongoing efforts to design a comprehensive approach to achieve reductions of wastewater nitrogen loading and meet nutrient TMDLs to the Town's coastal embayments including Popponesset Bay and Waquoit Bay. Comments submitted on the 2nd NPC indicate that a timely implementation program and a prioritized targeted watershed restoration plan are important factors to incorporate into the analysis of the Mashpee CWMP program alternatives. The DEIR should include a response to comments submitted on the 2nd NPC from the CCC, MassDEP and NHESP. I strongly encourage the Town to work closely with the MassDEP and the CCC during the Town's preparation of the alternatives analysis for this project.

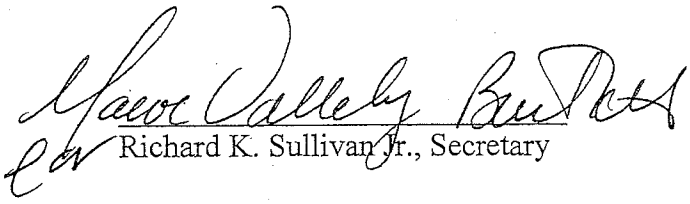
Because the Town of Mashpee shares a portion of the Popponesset Bay and Waquoit Bay watersheds with the Towns of Falmouth to the west, the Town of Barnstable to the east, and Sandwich to the North, I ask the Town of Mashpee to work with these neighboring Towns, and with MassDEP and the CCC to continue discussions meant to identify possible opportunities to

integrate the Town of Mashpee's wastewater treatment planning efforts with the planning efforts that are currently being undertaken by those neighboring towns. In a separate section of the DEIR, the Town should include an update of the Town's efforts to identify regional strategies for reducing the nutrient loading to coastal embayments and freshwater ponds in Barnstable, Mashpee, Sandwich and Falmouth.

Circulation

The DEIR should be circulated in compliance with Section 11.16 of the MEPA regulations and copies should also be sent to the list of "comments received" below and to town officials from the Towns of Barnstable, Eastham and Brewster. A copy of the DEIR should be made available for public review at the Barnstable, Sandwich and Falmouth Public Libraries.

July 6, 2012
Date



Richard K. Sullivan Jr., Secretary

Comments Received:

06/26/2012	Department of Environmental Protection (MassDEP), Southeast Regional Office – SERO
06/26/2012	Natural Heritage and Endangered Species Program (NHESP)
06/21/2012	Cape Cod Commission (CCC)

RKS/NCZ/ncz
2nd NPC #12615

MEMORANDUM

TO: Nicholas Zavolas, Environmental Reviewer, MEPA Unit

THROUGH: Jonathan Hobill, Regional Engineer, Bureau of Resource Protection
Martin Suuberg, Regional Director
David Johnston, Deputy Regional Director,
Bureau of Resource Protection
Maria Pinaud, Acting Deputy Regional Director, BWP
Millie Garcia-Serrano, Deputy Regional Director, BWSC
Brenda Chabot, Deputy Regional Director, ADMIN

CC: Elizabeth Kouloheras, Chief, Wetlands and Waterways and
Team Leader, Cape Cod Watershed
Jeffrey Gould, Chief, Water Pollution Control
Brian Dudley, Wastewater Management, Cape Cod Watershed
Richard Rondeau, Chief, Water Supply
Richard Keith, Chief, Municipal Services
Pamela Truesdale, Municipal Services
Leonard Pinaud, Chief, Site Management
Julia Sechen, Site Management

FROM: Sharon Stone, SERO MEPA Coordinator

DATE: June 26, 2012

RE: NPC EOEEA #12615 – MASHPEE – Watershed Nitrogen Management Plan, 16 Great Neck Road North

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"For Use in Intra-Agency Policy Deliberations"

The Southeast Regional Office of the Department of Environmental Protection (MassDEP) has reviewed the Notice of Project Change (NPC) for the proposed Watershed Nitrogen Management Plan developed for the Town of Mashpee, Massachusetts (EOEEA #12615). The project proponent provides the following information for the project:

"As originally outlined in the Environmental Notification Form (ENF) submitted in October of 2001, the project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee. The Plan is intended to address the Town's needs for reducing nitrogen impacts to its coastal embayments and to evaluate all options for restoring those embayments."

Water Pollution Control Program Comments
Mashpee has been pursuing due diligence in its evaluation of appropriate nitrogen mitigation strategies in order to address impaired coastal water bodies. MassDEP supports the request for an extension in order to provide the Town the opportunity to develop an optimal plan that is both cost effective and adequately protective of the environment and public health.

Bureau of Waste Site Cleanup
In considering the need for upgrading the infrastructure in town, the assessment should include the potential for encountering contamination associated with waste sites (both known and unidentified) throughout the town if excavation is necessary for the installation of the collection system/or distribution system. The filing of a Utility Release Abatement Plan would be required to excavate in contaminated areas. The location of known sites should be taken into consideration when conducting the assessment to upgrade the infrastructure.

The Project Proponent is advised that, if oil and/or hazardous material is identified during the implementation of this project, notification pursuant to the Massachusetts Contingency Plan (310 CMR 40.0000) must be made to MassDEP, if necessary. A Licensed Site Professional (LSP) may be retained to determine if notification is required and, if need be, to render appropriate opinions. The LSP may evaluate whether risk reduction measures are necessary or prudent if contamination is present. The BWSC may be contacted for guidance if questions regarding cleanup arise.

Proposed s.61 Findings
The "Certificate of the Secretary of Energy and Environmental Affairs on the Notice of Project Change" may indicate that this project requires further MEPA review and the preparation of an Environmental Impact Report. Pursuant to MEPA Regulations 301 CMR 11.12(5)(d), the Proponent will prepare Proposed Section 61 Findings to be included in the EIR in a separate chapter updating and summarizing proposed mitigation measures. In accordance with 301 CMR 11.07(6)(k), this chapter should also include separate updated draft Section 61 Findings for each State agency that will issue permits for the project. The draft Section 61 Findings should contain clear commitments to implement mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and contain a schedule for implementation.

The MassDEP Southeast Regional Office appreciates the opportunity to comment on this proposed project. If you have any questions regarding these comments, please contact Sharon Stone at (508) 946-2846.

IN 2

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CAPE COD
COMMISSION

By Email to Analyst and Regular Mail

June 21, 2012

Secretary Richard K. Sullivan
Executive Office of Energy and Environmental Affairs
100 Cambridge Street
Suite 900
Boston, MA 02114

RE: MEPA Unit Project Number 12615
Mashpee Watershed Nitrogen Management Plan Notice of Project Change
MEPA Nicholas Zavolas

Dear Secretary Sullivan:

On June 4, 2012, the Cape Cod Commission (Commission) staff received a copy of a Notice of Project Change (NPC) from F. Thomas Fudala, Chairman of the Mashpee Sewer Committee and Paul Gobell, the Mashpee Sewer Administrator. The NPC is to request an extension of time from the Executive Office of Energy and Environmental Affairs for Mashpee's Watershed Management Plan.

Commission Water Resources staff has reviewed the NPC and supports the Town's continuing efforts on their Comprehensive Wastewater Management Plan. The NPC submittal refers to three options with collection and treatment ranging from 1.76 to 1.91 million gallons a day (MGD) which have been formatted for Massachusetts Estuaries Project (MEP) scenario analysis. These scenarios will provide the Town with additional information in order to identify where flows and loads are collected, treated and discharged. Commission Water Resources staff encourages the Sewer Commission to incorporate the suggestion below as part of their work, seek technical input and keep Commission staff apprised of their efforts.

In regard to the filing, Commission Water Resources staff found little to review other than three graphical descriptions of alternatives under review. The Town provided a February 15, 2012 and October 3 2011memos from GHD that describes option 1A, 1B and 1C. Commission Water Resources staff has reviewed and summarized the options and provides the following comments.

The presented options are variations on targeted wastewater collection areas and where the treated water would be discharged. The total amount of flow in the Planning Area is 2.7 MGD. These options include:

Option 1A – Send a majority of wastewater flow (1.03 MGD) to the Rock Landing Well Site under the assumption that the public supply wells could be relocated in the future. Continued and expanded use of four existing wastewater treatment facilities (WWTFs), use of three proposed WWTFs; Wastewater from Falmouth, Sandwich and Barnstable would be treated by those towns out-of –watershed.

Rock Landing:	1.03 MGD - new
Johns Pond	0.37 MGD - new
Existing WWTF:	0.34 MGD
Proposed Private WWFT:	0.05 MGD
	1.79 MGD
F + S + B:	0.40 MGD (all out)
Title 5 and IA:	0.52 MGD
	0.92 MGD
Total:	~2.7 MGD

Option 1B – Managing wastewater flow within the watersheds that generate the flow, sothat 4 new large WWTF sites would receive 1.67 MGD with the majority in the eastern portion of Town going to Willowbend. This option includes Sandwich and Barnstable flows remaining in the Popponessett watershed, with the latter flows being treated at Willowbend (except for the Barn-39 sector) and Falmouth flows being taken out-of – watershed. Less flow remains to be treated with Title 5 system in this alternative.

Keeter	.34 MGD - new
WillowBend:	.63 MGD - new
Johns Pond	.37 MGD - new
Central Mashpee:	.33 MGD - new
Existing WWFT:	.16 MGD
Proposed Private:	.09 MGD
	1.92 MD
S + F + B:	.42 MGD (Sand in, Fal-out, Barn in-B39)
Title5 + IA:	.37 MGD
	.80 MGD
Total:	~2.7 MGD

Option 1C – This is similar to Option 1A but includes wastewater in the neighboring towns being managed like Option 1B.

There are a number of additional qualifications and caveats to the proposed alternatives that are being forwarded to the MEP for model scenarios such as existing private treatment facilities that will remain and improve treatment to 3 ppm nitrogen and IA systems that will achieve a treatment level of 19 ppm.

The Town has conducted pre-run accounting indicating how the rearrangement and treatment of wastewater can achieve the numerical amount of nitrogen to be removed according to the MEP thresholds and Total Maximum Daily Load (TMDL). This is a reasonable approach that the Commission anticipates illustrating with the WatershedMVP tool.

Commission staff suggests the Town should re-examine the Town's water supply infrastructure including rates of withdrawal, and water quality and evaluate options of potential sources including new wells and/or purchase from the Upper Cape Water Collaborative. Commission Water Resources staff notes that according to the 2008 Annual Statistic Report over 46% of the Town's supply was pumped form the Rock Landing wells. Given that a large percentage of the Town's supply comes from this area raises the question whether this alternative could be implemented within a reasonable period.

Considering wastewater infrastructure construction time frames of 20 or more years, the time of implementation and setting priorities for targeted watershed restoration are important factors to incorporate into the analysis. It is recommended that the Town work with the Commission staff, MEP and DEP to gage the incremental water quality restoration benefits of a targeted watershed approach with expedited wastewater collection for unattenuated nitrogen loads in priority areas.

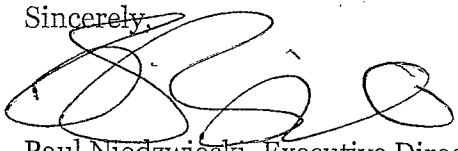
In regard to the Popponessett watershed, it appears that Option 1B includes regional treatment options for the Barnstable portion of the watershed which is a good aspect of a targeted approach. Sandwich is presently evaluating both public and private partnership approaches for the Triangle Area and other adjacent properties for treatment outside of the Popponessett watershed. Commission staff suggests the tables accompanying the Memo dated October 2011showing the amount of flow and load after treatment should also contain a column with the existing attenuated loads so the degree of nitrogen removal can be relative to the contribution. This would likely recast the need for widespread collection in an area of the watershed that gets a high proportion of nitrogen removed from natural attenuation such as the Sandwich area. Adaptive Management should be factored into the alternatives so that less crucial areas can be deferred depending on monitoring.

A high volume of wastewater, of 1 MGD discharged at the Keeter Site 6 could be problematic due to mounding and flow into the Rock Wells and the Waquoit area. Commission Water Resources staff notes that option 1B has a lower amount of 335,000 gpd, which should be evaluated.

The new format for the identification of Sewer planning areas is a good step for comparing phased options for collection and treatment or trading from one area to another.

Commission Water Resources staff is available to answer any questions that you may have about this letter.

Sincerely,



Paul Niedzwiecki, Executive Director

Cc (Regular Mail):

Ernest Virgilio, Mashpee Commission Member
F. Thomas Fudala, Mashpee Sewer Committee Chair
Paul Gobell, Mashpee Sewer Administrator

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

June 26, 2012

Ian A. Bowles, Secretary
Executive Office of Environmental Affairs
Attention: MEPA Office
Nicholas Zavolas, EEA No. 12615
100 Cambridge St.
Boston, Massachusetts 02114

Project Name:	*Watershed Nitrogen Management Plan*
Proponent:	*Sewer Commission, Town of Mashpee*
Location:	*Town of Mashpee*
Document Reviewed:	*Notice of Project Change*
EEA No.:	*12615*
NHESP No.:	*12-31134 (formerly 01-9528)*

Dear Secretary Bowles:

The Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries & Wildlife has reviewed the *Notice of Project Change* (NPC) for the proposed Watershed Nitrogen Management Plan for the Town of Mashpee and would like to offer the following comments with regard to state-listed species and their habitats.

Portions of the Town of Mashpee and associated infrastructure improvements for the nitrogen management plan are mapped as *Priority* and *Estimated Habitat* in accordance with the *13th Edition of the MA Natural Heritage Atlas*. The NHESP is supportive of the Town's plan to manage nitrogen, as at least ten (10) of the twenty-seven (27) species listed in accordance with the Massachusetts Endangered species Act (MGL c. 131A) rely on aquatic and/or marine habitats for at least one stage of their life cycle and may directly benefit from reduced levels of dissolved nitrogen and improved water quality. These species include the American Brook Lamprey, Eastern Pondmussel, and Pine Barren's Bluet, among others.

The NHESP notes that any portions of the proposed project that occur within *Priority* and *Estimated Habitat*, and that are not exempt pursuant to 321 CMR 10.14, will require review through a direct filing with the NHESP for compliance with the MESA and the rare species provisions of the Wetlands Protection Act. The NHESP encourages the Town to consider design and implementation alternatives which avoid, minimize and mitigate impacts to state-listed species and their habitats, and to consult with the NHESP on the proposed project during the design phase. We appreciate the opportunity to comment on this project, and look forward to working with the Town to proactively address potential concerns related to state-listed rare species.

If you have any questions about this letter, please contact Misty-Anne Marold, Endangered Species Review Biologist, at misty-anne.marold@state.ma.us or 508-389-6356.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D.
Assistant Director

cc: Paul Gobell, Town of Mashpee
Town of Mashpee, Department of Public Works
Town of Mashpee, Conservation Commission
DEP Southeastern Regional Office, Wetlands Program

June 21, 2013

To	Town of Mashpee		
Copy to	F. Thomas Fudala		
From	J. Jefferson Gregg, P.E., BCEE	Tel	774-470-1640
Subject	MEPA – Notice of Project Change(s) Comment Response	Job No.	8612001

This memo is written to address comments received from the public and environmental review process for the Town's Watershed Nitrogen Management Planning (WNMP) Project.

The November 26, 2007 and July 6, 2012 Certificates of the Secretary of Energy and Environmental Affairs on the Notices of Project Change (both) provided written comments with regards to this project.

The written comments are attached at the end of this memo and are discussed in the memo. Excerpts from the comment letters are provided in standard type and then addressed with numbered responses (A.1, A.2 etc.) in ***bold italics***. This memo will be attached in an appendix to the Alternatives Screening Analysis Report (ASAR) with the Secretaries Certificate and the original comment letters. Reviewers will be able to read these items to understand how we have addressed their comments.

We have prepared this Comment Response memo with a broad perspective that is appropriate for the broad scope of this project.

2007 COMMENTS

A. COMMENTS FROM THE MASSACHUSETTS SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS, DATED NOVEMBER 26, 2007.

Pursuant to the Massachusetts Environmental Policy Act (M.G. L. c. 30, ss. 61-62H) and Section 11.10 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change (NPC) and Needs Assessment Report submitted for this project and hereby determine that the Scope for the Environmental Impact Report (EIR) issued for the project on November 9, 2001 still stands.

Project Description

As originally outlined in the Environmental Notification Form (ENF) submitted in October of 2001, the project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee. The Plan is intended to address the Town's needs for reducing nitrogen impacts to its coastal embayments and to evaluate all options for restoring those embayments.

As stated in the Secretary's Certificate on the ENF dated November 9, 2001, the project is expected to proceed in phases with the submission of reports dealing with four major work elements: (1) a Needs Assessment Report, defining those areas that need nitrogen and wastewater management and establishing project flows from those areas; (2) an Alternatives Screening Analysis Report, evaluating the various means of meeting the wastewater requirements of the needs areas; (3) the Nitrogen and Wastewater Management Plan and Draft Environmental Impact Report (DEIR), which will identify a proposed management plan and assess the potential environmental impacts of that plan; and, (4) the Nitrogen and Wastewater Management Plan and Final EIR (FEIR), which will provide any additional environmental analysis required and will respond to comments submitted on the DEIR. The Certificate on the ENF directed the Proponent to prepare and submit for review the first two reports prior to the submission of the DEIR.

The project is subject to MEPA review and to the Mandatory EIR provisions of the MEPA regulations at 301 CMR 11.03(5)(a)(3) because it is presumed that the project will ultimately result in the construction of more than 10 miles of new sewers. The Proponent is seeking financial assistance from the Commonwealth under the State Revolving Fund (SRF); therefore, MEPA has broad scope jurisdiction over the project. The project is being reviewed under a Joint Environmental Review Process established between the Executive Office of Energy and Environmental Affairs (EEA) and the Cape Cod Commission.

Review of the NPC Needs Assessment Report

The NPC currently under review includes the final Needs Assessment Report, which is the first of the review documents for the project. The Proponent submitted the NPC with the report in accordance with the MEPA regulations for a lapse of time, at 301 CMR **11.1** 0(2). Following the submission of the ENF, the project was put on hold as the Proponent awaited the results of the Massachusetts Estuaries Project (MEP). The MEP's reports relevant to the Project Planning Area (PPA) were released in 2004 and 2005, and will be used by the Proponent in the development of the nitrogen management needs and management plan.

The Needs Assessment Report provides information on existing wastewater facilities; physical features, land use and regulatory issues affecting wastewater facilities; and existing conditions related to environmental resources, nitrogen loadings and on-site septic systems. The report also identifies the impacts of population growth in the PPA on wastewater collection, treatment and disposal facilities. The Proponent has identified a number of priority areas for nitrogen removal and nitrogen management and has established three levels of rankings for these sites.

I commend the Town of Mashpee for its efforts and for the comprehensive nature of the Needs Assessment Report. Comments submitted to MEPA on the NPC indicate that the report is an excellent foundation from which to develop the Watershed Nitrogen Management Plan. The Proponent should incorporate responses to technical comments submitted on the NPC from the Cape Cod Commission, the Department of Environmental Protection, the Office of Coastal Zone Management and the Massachusetts Historical Commission into the Alternatives Screening Analysis Report.

A1. We appreciate your support and understanding of this complex project involving Mashpee and its neighboring communities. This comment response addresses those technical comments and where appropriate they have been addressed in the text or identified as work to be completed as part of the Recommended Plan development and Environmental Impact Report.

B. COMMENTS FROM THE MASSACHUSETTS HISTORICAL COMMISSION, DATED OCTOBER 29, 2007.

Staff of the Massachusetts Historical Commission have reviewed the Notice of Project Change filed with the planning document submitted for the project referenced above.

In Chapter 3 (Section 3.2, Federal Regulatory Issues), Section I 06 of the National Historic Preservation Act of 1966 as amended (36 CPR 800) will also apply to review of projects proposed, as federal funding and permitting is anticipated.

B1. This will be incorporated into the Draft and Final Recommended Plan/ Environmental Impact Report(s) under the Chapter discussing the Draft Section 61 Findings.

In Chapter 5 (Page 5-10), since the 1988 plan, two additional properties (for a total of six properties) are subject to Preservation Restrictions (MGL c. 184, ss. 31-33) held by the MHC and all are listed in the State Register of Historic Places. Another property (the Sophronia Young House Site in the area of New Seabury) is proposed for a Preservation Restriction and listing in the State Register. In Mashpee, there are many properties in the Inventory of Historic and Archaeological Assets of the Commonwealth, which gives an indication of the likelihood of many other, as yet unidentified historic and archaeological resources in the town.

B2. We understand and appreciate that this number may have increased again since this comment was made. As specific sites for any types of facilities are considered in the future the Town /District will be reviewing these listed resources again and also will engage in the use of archeological surveyors to expand upon the work done as part of our initial site investigation at Site 4 (transfer station) and the work done by PALs for the Town in general regarding historically significant and archeologically sensitive areas.

MHC looks forward to review of project information when plans for preferred alternatives to address the priority areas are developed.

B3. As specific sites are selected for final consideration, these will be submitted formally for MHCs review. As identified in Chapter 2 of this document and Chapter 6, several of the sites of interest have been identified, however work still continues.

C. COMMENTS FROM SHARON STONE, SERO MEPA COORDINATOR, DATED NOVEMBER 16, 2007

The Southeast Regional Office of the Department of Environmental Protection (MassDEP) has reviewed the Notice of Project Change (NPC) for the proposed nitrogen management planning study project for the Cape Cod Watershed located in Massachusetts (EOEEA #12615). The project proponent provides the following information for the project:

"The Notice of Project Change is submitted solely for a lapse of time; there is no substantial project change."

MassDEP is pleased to see that the Needs Assessment Report has incorporated planning on a watershed-wide basis and includes consideration of the towns of Sandwich and Barnstable. MassDEP also notes that the preliminary prioritization of Priority Area groups takes into account the findings of the Massachusetts Estuaries Project (MEP). However, as alternatives analysis proceeds, any recommended alternative will have to demonstrate that it will be able to reduce nitrogen loads sufficiently to meet the target threshold nitrogen concentration at the sentinel stations in the respective watersheds.

The MassDEP Southeast Regional Office appreciates the opportunity to comment on this proposed project. If you have any questions regarding these comments, please contact Sharon Stone at (508) 946-2846.

C1. As shown in Chapters 3 and 4 this effort has been done to show each alternatives ability to meet the TMDLs under build-out conditions as modeled by MEP.

D. COMMENTS FROM THE MASSACHUSETTS OFFICE OF COASTAL ZONE MANAGEMENT, DATED NOVEMBER 9, 2007

The Massachusetts Office of Coastal Zone Management (CZM) has completed its review of the above-referenced Needs Assessment Report and Notice of Project Change, noticed in the Environmental Monitor dated October 27, 2007, and offers the following comments.

Project Description

The project involves the development of a comprehensive nitrogen and wastewater management plan through the Popponesset Bay and Waquoit Bay East Watershed Nitrogen Management Planning Project (EOEA # 12651). The Needs Assessment Report (NAR) is the first phase of this project, as outlined in the Certificate of the Secretary of Environmental Affairs on November 9, 2001. The Certificate requires the submission of four reports, including the NAR, an Alternatives Analysis Screening Report, the Nitrogen and Wastewater Management Plan and Draft Environmental Impact Report (EIR), and the Final Nitrogen Management Plan and Final EIR. The purpose of the Watershed Nitrogen Management Plan (WNMP) is to provide an environmentally and economically sound plan for nitrogen reduction, wastewater treatment, and effluent recharge in the project planning area. The NAR is intended to outline the existing conditions and

future conditions within the project planning area, and to identify the wastewater, storm water and other nitrogen related problems within this area.

Project Comments

CZM commends the Town of Mashpee for it's continued efforts to develop a watershed-based nitrogen management plan. This planning effort has benefited from Mashpee's participation in the Massachusetts Estuaries Project (MEP) and the completion of MEP reports on the Popponesset Bay and Waquoit Bay East watershed systems. The results of these reports have been incorporated into this NAR, and the subsequent development of alternatives and management recommendations will be based upon the findings of MEP Total Maximum Daily Loads.

The NAR is comprehensive and exceeds the Secretary's minimum requirements to identify areas that require nitrogen wastewater management and establish flows for those areas. The NAR provides background information on existing wastewater infrastructure, natural resources, land use and associated regulatory issues within the project planning area. In addition to characterizing existing flow and nitrogen loadings, estimates of future flow and nitrogen loadings are presented. These flow estimates are well described and are based on build-out information developed from the MEP analysis and from town sources.

The NAR identifies a number of priority areas for nitrogen removal and nitrogen management and establishes three levels of rankings for these sites. The rationale and factors used to identify and prioritize these sites are clearly presented. CZM believes the rationale is sound, and that this initial prioritization is a necessary first step in this planning process. CZM recognizes that this initial prioritization of sites will be evaluated further as more data is developed through the ongoing planning process

One of the factors used in the identification of priority areas is proximity to any of the eight existing Waste Water Treatment Facilities (WWTF) within the project planning areas, and potential future expansion of these facilities. The NAR identifies potential excess capacity at many of these WWTF facilities, however the majority of them are privately owned. CZM recommends that the proponent develop and present a process to engage with these private facilities in an effort to ensure the potential for future expansion. This process should be incorporated into the future Alternatives Screening Analysis Report.

D1. The issue of ownership of these private facilities continues to be a priority for the Town as they are such an integral part of the planning process. The Town has maintained active communications with these facilities; however the process is currently complicated by the Town's work with the Mashpee Water District in the formation of a Water/Sewer District. Once these details have been resolved a more clear approach on ownership and use of these facilities can be incorporated into the Draft and Final WNMP/EIR.

Federal Consistency

The proposed project may be subject to CZM federal consistency review, in which case the project must be found to be consistent with CZM's enforceable program policies. For further information on this process, please contact, Robert Boeri, Acting Project Review Coordinator, at 617-626-1050 or visit the CZM web site at www.state.ma.us/czm/fcr.htrn.

D2. As the recommended plan is developed we will begin more active conversations with CZM to address any concerns regarding the project.

E. COMMENTS FROM THE CAPE COD COMMISSION, DATED NOVEMBER 16, 2007

The Cape Cod Commission (the Commission) has received a Notice of Project Change (NOPC) for the Watershed Nitrogen Management Plan for the Town of Mashpee. The NOPC was accompanied with a report entitled, "Town of Mashpee, Popponessett Bay and Waquoit Bay-East Watersheds, Needs Assessment Report." The NOPC was noticed in the Environmental Monitor on October I 0, 2007.

The proposed Mashpee Watershed Nitrogen Management Plan is being reviewed jointly by the Executive Office of' Energy and Environmental Affairs (EOEEA) - MEPA Unit, and by the Cape Cod Commission as a Development of Regional Impact (DRI) in accordance with the Memorandum of Understanding (MOU) between the Commission and EOEA. This NOPC is being submitted by the town because more than three years have passed since the 2001 MEPA Certificate on the project.

Although the Commission has not taken a formal position on the NOPC, staff has reviewed the 2001 scope of Watershed Nitrogen Management Plan and with the updates incorporated into the 2007 Needs Assessment supports the requested extension of time to complete the project.

Staff has reviewed the Needs Assessment that will be incorporated into the Draft Environmental Impact Report and offers the following general and technical comments as an attachment.

The Cape Cod Commission looks forward to continuing our participation with the Town of Mashpee, and its neighboring towns, as it moves forward in its Watershed Nitrogen Management Plan.

Please contact me or Tom Cambareri of my staff if you have any comments or questions.

<u>General</u>

The Needs Assessment Report documents the significant level of effort that has gone into the determining the Total Maximum Daily Load (TMDL) of nitrogen for the two subject embayments over the course of the last six years, This has included participation in the Massachusetts Estuary Project (MEP) consisting of town-supported water quality monitoring, assessment of sediments, plants and fauna, land use assessments, compilation of water use from Mashpee Water District, hydrodynamic modeling of the estuaries and use of the Linked Water Quality Model to determine the nitrogen thresholds. The MEP technical reports for Popponesset Bay and East Waquoit Bay were completed in April 2004 and July 2004, respectively. Regulatory review to establish the MassDEP TMDL took over two years for Popponessett Bay and have not yet been finalized for Waquoit Bay East (a draft TMDL was released in July 2005). Final EPA approval of the DEP TMDLs have not been completed.

During that period of time the Town took advantage of a number of opportunities including the DEP Pilot Project and the Cape Cod Commission TMDL Implementation Project, which were both funded through EPA. Through these projects, Mashpee, together with representatives of Barnstable and Sandwich, has been able to participate in the drafting of a TMDL nitrogen loading allocation for each town and have discussions on potential nutrient trading opportunities. Mashpee was also able to run a number of MEP alternative nitrogen loading scenarios and to have an assessment of cranberry bogs and streams for potential additional Natural Attenuation.

The town also received wastewater grant funds from Barnstable County to 1) model sewer collection systems in the Popponessett watershed and 2) to receive technical assistance from the US Geological Survey and Commission water stuff, to use a groundwater model to evaluate potential wastewater disposal sites.

Technical

The Needs Assessment recognizes the appropriate water resources minimum performance standards from the Regional Policy Plan.

The Town should continue to make use of its Citizens Advisory Committee (CAC) und Pilot Project group to obtain input on it proposed the nitrogen removal scenarios.

The identification of priority areas ·uses the Mashpee Planning areas as its fundamental building block. It is noted that areas of Barnstable in the Popponessett Bay watershed appear to have a similar density characteristic of the higher nitrogen loading rates of the Mashpee planning areas. The town should continue to work through its CAC Barnstable Representative to obtain input about the priority ranking of neighborhoods in the adjacent towns.

E1. The Town has participated in several pilot projects dealing with regionalization and fair share allocation. The Sewer Commission is active in engaging the adjacent Towns. Currently the Sewer Commission Administrator sits on the Town of Barnstable CAC. The Sewer Commission also actively invite the neighboring Town's to their monthly meetings as well, and have held joint meetings with the neighboring Towns and their associated wastewater /nutrient management committees. The Sewer Commission and staff have also worked with the Cape Cod Water Protection Collaborative's consultants on these issues.

The Needs Assessment identifies the Zone IIs and Groundwater Protection District of the town as discusses contamination from the MMR. It would seem appropriate if the Needs Assessment also included a characterization of the water quality in terms of nitrogen and the potential for any local impacts from wastewater disposal on drinking water quality.

E2. Groundwater water quality characterization related to drinking water supplies is currently not in the GHD scope of the project as submitted in the ENF and Notices of Project Change(s); however groundwater protection related to the Town/District's water resources is an important consideration that is addressed in the review of recharge areas and the parcel by parcel nitrogen loading analysis performed as part of the Needs Assessment with a focus on addressing onsite septic systems which contribute to this degradation of water quality.

The Needs Assessment identifies Santuit Pond as being listed on the Clean Water Act 303d list of "impaired waters" and that the Cape Cod Pond Atlas identifies another 18 additional fresh water ponds that are impaired. The next listing of impaired waters by the DEP is scheduled for 2008 and it is likely that a number of these additional ponds will be included on the updated 303d list. We agree that a more definitive assessment of the water quality of Santuit Pond is warranted and that a plan for the assessment of the additional ponds should be considered.

E3. Water quality assessment of Santuit Pond and additional freshwater ponds is also not currently part of the GHD scope as the focus of the Watershed Nitrogen Management Plan is nitrogen and not phosphorus; however the Town has been taking active steps outside of this project to address the issues of Santuit Pond, and phosphorus mitigation is an important factor regarding the ultimate recharge location(s) selected and the collection and treatment of wastewater using advanced wastewater treatment (beyond septic system effluent) will also help to mitigate this issue.

The Needs Assessment contains a good characterization of the Private Sewage Treatment Facilities, including treatment efficiency and excess capacity. The WNMP calculates build out numbers showing that future wastewater "flows will approach and/or exceed permitted capacity at most of the facilities. As such, private facilities that are identified for expansion are ones where new or expanded infrastructure can physically be accommodated. Were Title 5 flows used for build out? Is it possible that capacity may be available on a phased basis at any of the facilities? For instance, Provincetown built a facility using Title 5 design flows, but found after several years of operation, that the actual use was only 70% of the capacity thereby making that capacity available :for sewer expansion.

E4. Build-out flows were based on water usage data, and the MEP data and build-out information provided from Falmouth, Mashpee, and Barnstable (Sandwich was based on MEP). Design flows would be determined for each facility once the recommended plan is developed and the level of treatment and location is determined. They would be based on the water usage data with applicable peaking factors, but not based on Title 5 which is already considered a peaked flow.

The section on existing infrastructure also includes a brief discussion on Innovative and Alternative septic systems. We anticipate that the subsequent report on technology evaluation will have a characterization on the performance of the IAs that will make use of findings from the Barnstable County Health Department and MEP model scenarios about IA systems from the pilot project.

The wastewater flows and nitrogen loading section indicates that IA systems were assumed to have a treated concentration of 19 mg/l nitrogen. The BCDHE white paper on these systems indicates the median treatment efficiency of 19 mg/l for 60% of the samples evaluated. This performance is less than required by MassDEP goals and it is likely that most of these systems will be assigned effluent concentrations higher than 19 ppm.

E5. This is discussed in the Technology Screening Report issued in 2007 and summarized in Chapter 1 of this report, in addition to the discussion over performance of I/A technologies. Based on the amount of nitrogen removed for TMDL compliance, a higher level of operational oversight of these types of facilities would be required, and therefore a higher level of consistent performance should be achieved.

The Needs Assessment has chosen to use the Planning Zones as the fundamental unit to base nitrogen loading rates. Of the 161 planning areas in the town, 23 were in the high to medium high range. This number increased to 47 of 161 for future conditions. This information was graphically displayed. Elsewhere in the report, the amount of nitrogen removal as per the MEP technical report is shown in tabular form. It would be

useful to graphically compare the MEP nitrogen percent removal areas (watersheds) to the loading rates of the planning areas.

E6. Planning areas were used initially, however the focus has been on neighborhoods and "sewersheds" to better reflect implementation feasibility in alternatives analysis. In general, the comparison of these areas to the percent removals was done on the Matrix table included in the NAR and in Chapter 1 of this document; however it is important to note that the MEP percent removals are only ONE approach to meeting the TMDLs and they are based on existing conditions.

It is not exactly clear why the WNMP uses 35 mg/L for nitrogen concentration to calculate nitrogen loads. The WNMP states that it did not want to include the attenuation that takes place in the septic system. If that is the case, then perhaps a concentration of 60 mg/L should be considered since this is more characteristic for flow coming into a septic system. The MEP recommendations for percent removal are based upon a nitrogen concentration of 26.5 mg/L. If the WNMP uses a higher concentration for the same flow then, the plan will need to accordingly increase the amount of wastewater planned to be removed. This approach should be evaluated for consistency with the MEP before alternative nitrogen loading scenarios are prepared.

E7. As we developed the Scenarios/Options for the ASAR we used the 26.25 mg/L TN value for those facilities located within the watershed. The balance of water was assigned an effluent concentration (most often 3 mg/L TN if discharged within one of the two watersheds) for modeling purposes. At the time in the NAR the 35 mg/L was being carried as an average concentration that a WWTF might see on the influent side, but it was prematurely stated.

The WNMP also does not include natural attenuation in its calculations. Natural attenuation in the rivers and freshwater ponds was included .in the calibrated MEP model that was used to develop the TMDLs. It is not clear why the WNMP does not use this naturally occurring process. By choosing not to include natural attenuation, the loads assigned to the subwatersheds are higher than what is included in the watershed portion of MEP model. For example, the WNMP adjusted nitrogen load for the Mashpee River is 87 kg/day as compared ·to the MEP attenuated load of 54.2 kg/day. Since the scenario described in the MEP report indicates that 100% removal of the MEP load is required to meet the TMDL, it is unclear whether the WNMP is making the case that all 87 kg/d needs to be removed or whether 54.2 kg/d (66% of the 87 kg/d) needs to be removed. Clarification of the intended use of the WNMP nitrogen loading calculations is required to understand the goals of these alternative nitrogen loads.

E8. Natural attenuation is considered in the MEP model runs for each of the Scenarios/Options we developed in order for the project to demonstrate TMDL compliance. We understand the ultimate goals of the project, however the Needs Assessment Report wasn't identifying solutions and therefore natural attenuation wasn't being examined as closely as it is when we consider alternatives analysis. Because there is variability in any modeling, our goal during the Needs Assessment was to identify the total loads in the watershed (regardless of attenuation). If it is determined through later analysis that the attenuations have changed or the nitrogen sinks have "reduced", then by not going through this exercise we could potentially underestimate the nitrogen loads within the watersheds.

The priority ranking of Planning Areas includes all the appropriate criteria. The methodology resulted in the figure 8-I. The following are some observations about the conclusionary graphic. I) It is noted that the area upgradient of Ashumet and John's Pond are high priority areas. While the loading rates may be high, natural attenuation that occurs in the pond will reduce that overall loading on the receiving water of concern which is Waquoit-West. 2) The high priority area of Shoestring Bay in Mashpee is not extended across the town boundary into Barnstable. 3) Similarly, the low priority ranking of the Falmouth Quashnet area will be of interest to Falmouth which is just embarking on a wastewater plan of East Falmouth. As noted above, input from neighboring towns on their perspective of priority and participation should be obtained for these shared watersheds. It is recommended to graphically compare the MEP nitrogen percent removal areas (watersheds) to the prioritized planning areas. Because the intent of the prioritization is for sewer collection, it would be helpful to omit surface waters and protected open space from the color scheme.

E9. This was done in Chapter 9 Table 9-1 is the Priority Area Criteria Summary which considered area relative to sensitive watersheds as well as the other criteria. A more detailed approach on "prioritization" will be performed during the Draft Recommended Plan/Draft EIR.

The Cape Cod Commission staff has participated and provided technical assistance to the PEP Pilot Project stems from a EPA TMDL Implementation Grant to the Cape Cod Commission, Under this grant Commission staff have participated in meetings, prepared TMDL allocations by town and subwatershed and lead discussions on Nutrient Trading opportunities.

E10. The Town of Mashpee continues to be interested in the concept of Nitrogen Trading. It is their hope that the Cape Cod Commission and DEP will construct a framework for all of Cape Cod to create this mechanism so that it is fair for all Towns across Cape Cod. It is important to note that under build-out conditions, some Towns like Mashpee might not have much additional nitrogen to take based on the MEP model runs performed to date, due to their limited discharge locations and capacities.

2012 COMMENTS

F. COMMENTS FROM THE MASSACHUSETTS SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS, DATED JULY 6, 2012

Pursuant to the Massachusetts Environmental Policy Act (M. G. L. c. 30, ss. 61-62) and Section 11.10 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change (NPC) submitted for .this project and hereby determine that the Scope for the Draft Environmental Impact Report (DEIR) issued on November 9, 2001 still stands.

Project Description

As originally described in the Environmental Notification Form (ENF) submitted in October of 2001, the project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee (Mashpee CWMP). The Mashpee CWMP is intended to achieve reductions of wastewater nitrogen loading and meet Total Maximum Daily Loads (TMDLs) for nitrogen loading to the Town's coastal embayments including Popponesset Bay and Waquoit Bay.

Project History

As stated in the Secretary's Certificate on the ENF dated November 9, 2001, the project is expected to proceed in phases with the submission of reports dealing with four major work elements: (1) a Needs Assessment Report, defining those areas of Mashpee that need nitrogen and wastewater management, identified as the Project Planning Area (PPA) and establishing project flows from the PPA; (2) an Alternatives Screening Analysis Report, evaluating the various means of meeting the wastewater requirements of the needs areas; (3) the Nitrogen and Wastewater Management Plan and Draft Environmental Impact Report (DEIR), which will identify a proposed management plan and assess the potential environmental impacts of that plan; and, (4) the Nitrogen and Wastewater Management Plan and Final EIR (FEIR), which will provide any additional environmental analysis required and will respond to comments submitted on the DEIR. The Certificate on the ENF directed the Town to prepare and submit for review the first two reports prior to the submission of the DEIR.

Notice of Project Change

The Town submitted a Notice of Project Change, together with a final Needs Assessment Report, to the MEPA Office in October 2007 in accordance with the MEP A regulations for a lapse of time, at 301 CMR 11.10(2). As described in the first NPC document, the project was put on hold following the submission of the ENF as the Town awaited the results of the Massachusetts Estuaries Project (MEP). The MEP's reports relevant to the PPA were released in 2004 and 2005, and were to be used by the Town in the development of the nitrogen management needs and management plan. The Needs Assessment Report provided information on existing wastewater facilities; physical features, land use and regulatory issues affecting wastewater facilities; and existing conditions related to environmental resources, nitrogen loadings and on-site septic systems. The report also identified the impacts of population growth in the PPA on wastewater collection, treatment and disposal facilities. The Town has estimated the total amount of wastewater flow from the PPA to be approximately 2.7 million gallons per day (MGD). .

Permits and Jurisdiction

The project is subject to MEPA review and to the Mandatory EIR provisions of the MEPA regulations at 301 CMR 11.03(5)(a)(3) because it is presumed that the project will ultimately result in the construction of more than 10 miles of new sewers. The project will require a Groundwater Discharge Permit, a Chapter 91 License, and a 401 Water Quality Certificate from the Department of Environmental Protection (MassDEP). The project must be reviewed by the Natural Heritage Endangered Species Program (NHESP) and the Massachusetts Historical Commission (MHC) because portions of the project occur within Priority Habitat and within or adjacent to recorded archaeological sites and archaeologically sensitive areas, respectively. It may require Federal Consistency Review by the Massachusetts Coastal Zone Management (MCZM) Office. It may also require a Construction Access Permit from the Massachusetts Highway Department. The project may be required to obtain a Section 404 Permit from the U.S. Army Corps of Engineers. The project will require an Order of Conditions from the Mashpee Conservation Commission (and, on appeal only, a Superseding Order from MassDEP). The project should comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for storm water discharges from a construction site.

The Town is seeking Financial Assistance from the Commonwealth under the State Revolving Fund (SRF); therefore, MEP A has broad scope jurisdiction over the project. The project is being reviewed under a Joint

Environmental Review Process established between the Executive Office of Energy and Environmental Affairs (EEA) and the Cape Cod Commission (CCC).

REVIEW OF THE SECOND NOTICE OF PROJECT CHANGE

The Town has submitted this second Notice of Project Change (2nd NPC) in accordance with the MEPA regulations at 301 CMR 11.1 0(2)(b)(2) because more than three years have ·elapsed between the publication of the ENF and commencement of non-construction related project work or activity. ·

As described in the 2nd NPC document, subsequent to the issuance of the Secretary's Certificate on the 1" NPC (November 26, 2007), the United States Environmental Protection Agency (EPA) established Total. Daily Maximum Loads (TMDLs) of nitrogen for the Popponesset Bay and the East Waquoit Bay estuaries (Quashnet River, Hamblin Pond, Little River, Jehu Pond and Great River). According to.the Town, the TMDLs for Waquoit Bay (Childs River, Eel River) are currently being reviewed by the US Environmental Protection Agency (EPA). The Town is currently conducting an analysis of alternative scenarios for the targeted collection, treatment and disposal of wastewater flows located in the PP A to address the water quality requirements and TMDLs of the Town's marine and freshwater water resources. These wastewater treatment and disposal alternatives include: 1) the conveyance of wastewater flows to existing and proposed privately-owned wastewater treatment facilities (WWTFs); 2) relocation of existing public water supply wells; and 3) shared regional approaches to wastewater treatment and disposal with the Towns of Barnstable, Sandwich and Falmouth.

Conclusion

I commend the Town of Mashpee for its ongoing efforts to design a comprehensive approach to achieve reductions of wastewater nitrogen loading and meet nutrient TMDLs to the Town's coastal ernbayments including Popponesset Bay and Waquoit Bay. Comments submitted on the 2nd NPC indicate that a timely Implementation program and a prioritized targeted watershed restoration plan are important factors to incorporate into the analysis of the Mashpee CWMP program alternatives. The DEIR should include a response to comments submitted on the 2nd NPC from the CCC, MassDEP and NHESP. I strongly encourage the Town to work closely with the MassDEP and the CCC during the Town's preparation of the alternatives analysis for this project.

F1. Comments from original NPC are included above. The Town has actively engaged both MassDEP and the CCC in their work, and they are invited to participate at each of their monthly meetings as well.

Because the Town of Mashpee shares a portion of the Popponesset Bay and Waquoit Bay watersheds with the Towns of Falmouth to the west, the Town of Barnstable to the east, and Sandwich to the North, I ask the Town of Mashpee to work with these neighboring Towns, and with MassDEP and the CCC to continue discussions meant to identify possible opportunities to integrate the Town of Mashpee's wastewater treatment planning efforts with the planning efforts that are currently being undertaken by those neighboring towns. In a separate section of the DEIR, the Town should include an update of the Town's efforts to identify regional strategies for reducing the nutrient loading to coastal embayrnents and freshwater ponds in Barnstable, Mashpee, Sandwich and Falmouth.

F2. An update on adjacent Towns can be included in the Draft EIR.

Circulation

The DEIR should be circulated in compliance with Section 11.16 of the MEPA regulations and copies should also be sent to the list of "comments received" below and to town officials from the Towns of Barnstable, Eastham and Brewster. A copy of the DEIR should be made available for public review at the Barnstable, Sandwich and Falmouth Public Libraries.

F3. Once the DEIR is drafted, copies will be sent to the distribution list and shall include the Libraries of the adjacent Towns.

G. COMMENTS FROM SHARON STONE, SERO MEPA COORDINATOR DATED JUNE 26, 2012

The Southeast Regional Office of the Department of Environmental Protection (MassDEP) has reviewed the Notice of Project Change (NPC) for the proposed Watershed Nitrogen Management Plan developed for the Town of Mashpee, Massachusetts (EOEEA #12615). The project proponent provides the following information for the project:

"As originally outlined in the Environmental Notification Form (ENF) submitted in October of 2001, the project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee. The Plan is intended to address the Town's needs for reducing nitrogen impacts to its coastal embayments and to evaluate all options for restoring those embayments."

Water Pollution Control Program Comments

Mashpee has been pursuing due diligence in its evaluation of appropriate nitrogen mitigation strategies in order to address impaired coastal water bodies. MassDEP supports the request for an extension in order to provide the Town the opportunity to develop an optimal plan that is both cost effective and adequately protective of the environment and public health.

Bureau of Waste Site Cleanup

In considering the need for upgrading the infrastructure in town, the assessment should include the potential for encountering contamination associated with waste sites (both known and unidentified) throughout the town if excavation is necessary for the installation of the collection system/or distribution system. The filing of a Utility Release Abatement Plan would be required to excavate in contaminated areas. The location of known sites should be taken into consideration when conducting the assessment to upgrade the infrastructure.

The Project Proponent is advised that, if oil and/or hazardous material is identified during the implementation of this project, notification pursuant to the Massachusetts Contingency Plan (31 0 CMR 40 .0000} must be made to MassDEP, if necessary. A Licensed Site Professional (LSP) may be retained to determine if notification is required and, if need be, to render appropriate opinions. The LSP may evaluate whether risk reduction measures are necessary or prudent if contamination is present. The BWSC may be contacted for guidance if questions regarding cleanup arise.

G1. The Sewer Commission will further identify this under the mitigation measures to be identified in the Draft EIR.

Proposed s.61 Findings

The "Certificate of the Secretary of Energy and Environmental Affairs on the Notice of Project Change" may indicate that this project requires further MEPA review and the preparation of an Environmental Impact Report. Pursuant to MEPA Regulations 301 CMR 11.12(5)(d), the Proponent will prepare Proposed Section 61 Findings to be included in the EIR in a separate chapter updating and summarizing proposed mitigation measures. In accordance with 301 CMR 11.07(6)(k), this chapter should also include separate updated draft Section 61 Findings for each State agency that will issue permits for the project. The draft Section 61 Findings should contain clear commitments to implement mitigation measures; estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and contain a schedule for implementation.

The MassDEP Southeast Regional Office appreciates the opportunity to comment on this proposed project. If you have any questions regarding these comments, please contact Sharon Stone at (508) 946-2846.

G2. As stated in Chapter 7 of this document, the Proposed Chapter 8 of the Draft Recommended Plan and Draft EIR will include the "Draft Section 61 Findings", which would discuss and summarize the Draft Section 61 Findings for State Agency Action. It will identify the planned mitigation measures, implementation schedule of those measures and will work to identify associated costs not captured as part of the recommended plan.

H. COMMENTS FROM THE CAPE COD COMMISSION DATED JUNE 21, 2012

On June 4, 2012, the Cape Cod Commission (Commission) staff received a copy of a Notice of Project Change (NPC) from F. Thomas Fudala, Chairman of the Mashpee Sewer Committee and Paul Gobell, the Mashpee Sewer Administrator. The NPC is to request an extension of time from the Executive Office of Energy and Environmental Affairs for Mashpee's Watershed Management Plan.

Commission Water Resources staff has reviewed the NPC and supports the Town's continuing efforts on their Comprehensive Wastewater Management Plan. The NPC submittal refers to three options with collection and treatment ranging from 1.76 to 1.91 million gallons a day (MGD) which have been formatted for Massachusetts Estuaries Project (MEP) scenario analysis. These scenarios will provide the Town with additional information in order to identify where flows and loads are collected, treated and discharged. Commission Water Resources staff encourages the Sewer Commission to incorporate the suggestion below as part of their work, seek technical input and keep Commission staff apprised of their efforts.

In regard to the filing, Commission Water Resources staff found little to review other than three graphical descriptions of alternatives under review. The Town provided a February 15, 2012 and October 3 2011 memos from GHD that describes option lA, 1B and 1C. Commission Water Resources staff has reviewed and summarized the options and provides the following comments.

The presented options are variations on targeted wastewater collection areas and where the treated water would be discharged. The total amount of flow in the Planning Area is 2.7 MGD. These options include:

Option 1A - Send a majority of wastewater flow (1.03 MGD) to the Rock Landing Well Site under the assumption that the public supply wells could be relocated in the future. Continued and expanded use of four existing wastewater treatment facilities (WWTFs), use of three proposed WWTFs; Wastewater from Falmouth, Sandwich and Barnstable would be treated by those towns out-of-watershed.

Rock Landing:	1.03 MGD - new
Johns Pond:	0.37 MGD - new
Existing WWTF:	0.34 MGD
Proposed Private WWFT:	0.05·MGD
	1.79 MGD
F + S + B:	0.40 MGD (all out)
Title 5 and IA:	0.52 MGD
	0.92 MGD
Total:	~2.7 MGD

Option 1B - Managing wastewater flow within the watersheds that generate the flow, so that 4 new large WWTF sites would receive 1.67 MGD with the majority in the eastern portion of Town going to Willowbend. This option includes Sandwich and Barnstable flows remaining in the Popponessett watershed, with the latter flows being treated at Willowbend (except for the Barn-39 sector) and Falmouth flows being taken out-of-watershed. Less flow remains to be treated with Title 5 system in this alternative.

Keeter	.34 MGD - new
Willow Bend:	.63 MGD - new
Johns Pond	.37 MGD - new
Central Mashpee:	33 MGD - new
Existing WWFT:	.16 MGD
Proposed Private:	.09 MGD
	1.92 MD
S + F + B:	.42 MGD (Sand in, Fal-out, Barn in-B39)
Title 5 + IA:	.37 MGD
	.80 MGD
Total:	~2.7 MGD

Option 1C-This is similar to Option 1A but includes wastewater in the neighboring towns being managed like Option 1B.

There are a number of additional qualifications and caveats to the proposed alternatives that are being forwarded to the MEP for model scenarios such as existing private treatment facilities that will remain and improve treatment to 3 ppm nitrogen and IA systems that will achieve a treatment level of 19 ppm.

The Town has conducted pre-run accounting indicating how the rearrangement and treatment of wastewater can achieve the numerical amount of nitrogen to be removed according to the MEP thresholds and Total Maximum Daily Load (TMDL). This is a reasonable approach that the Commission anticipates illustrating with the WatershedMVP tool.

Commission staff suggests the Town should re-examine the Town's water supply infrastructure including rates of withdrawal, and water quality and evaluate options of potential sources including new wells and/ or purchase from the Upper Cape Water Collaborative. Commission Water Resources staff notes that according to the 2008 Annual Statistic Report over 46% of the Town's supply was pumped form the Rock Landing wells. Given that a large percentage of the Town's supply comes from this area raises the question whether this alternative could be implemented within a reasonable period.

H1. As identified in Chapter 6 of the ASAR, the Rock Landing Site was removed from consideration based on several factors including its rated capacity; however the Town will continue to consider future sites for all its water and wastewater needs. Evaluation of the Water District's withdrawals, etc. goes beyond the current scope of the WNMP as currently drafted.

Considering wastewater infrastructure construction time frames of 20 or more years, the time of implementation and setting priorities for targeted watershed restoration are important factors to incorporate into the analysis. It is recommended that the Town work with the Commission staff, MEP and DEP to gage the incremental water quality restoration benefits of a targeted watershed approach with expedited wastewater collection for unattenuated nitrogen loads in priority areas.

H2. The Town and Sewer Commission will continue this coordination through the development of its phasing and implementation plan in addition to its adaptive management approach to be carried forward following completion of the WNMP.

In regard to the Popponessett watershed, it appears that Option 1B includes regional treatment options for the Barnstable portion of the watershed which is a good aspect of a targeted approach. Sandwich is presently evaluating both public and private partnership approaches for the Triangle Area and other adjacent properties for treatment outside of the Popponessett watershed. Commission staff suggests the tables accompanying the Memo dated October 2011 showing the amount of flow and load after treatment should also contain a column with the existing attenuated loads so the degree of nitrogen removal can be relative to the contribution. This would likely recast the need for widespread collection in an area of the watershed that gets a high proportion of nitrogen removed from natural attenuation such as the Sandwich area. Adaptive Management should be factored into the alternatives so that less crucial areas can be deferred depending on monitoring.

H3. We would be happy to discuss our approach to scenario development regarding nitrogen removal and the MEP models. In general our approach was to assume "all" wastewater nitrogen was removed from the watershed and then iteratively add load back in to the watersheds to achieve the TMDLs under build-out conditions. Tables 1, 2, and 3 from the memo

reflect the estimated load at the recharge point at a specific concentration (treatment level) relative to the recharge point and is not removal vs contribution. It is a redistributed contribution as water is not being recharged necessarily where it originated and is an aggregate of multiple watersheds and subwatersheds with differing attenuation. Accounting for attenuation is best captured through the use of the MEP "rainbow spreadsheets" (landuse model) to assess the best location for recharge and the best location to see the reduction in load. The most recent scenarios and those previously prepared by GHD were prepared as such. All our scenarios have shown that under build-out conditions large quantities of load (attenuated or not) from Sandwich need to be removed as well as from Barnstable and Mashpee in order to achieve the TMDLs.

A high volume of wastewater, of 1 MGD discharged at the Keeter Site 6 could be problematic due to mounding and flow into the Rock Wells and the Waquoit area. Commission Water Resources staff notes that option 1B has a lower amount of 335,000 gpd, which should be evaluated.

H4. This site was evaluated as a fall-back if New Seabury/Rock Landing/Outside the watershed alternatives could not be achieved. It is understood that the impacts of a recharge site at Site 6 would require much more in-depth analysis and hydraulic modeling to consider their impacts on the adjacent watersheds/subwatersheds and well recharge locations and a higher level of treatment.

The new format for the identification of Sewer planning areas is a good step for comparing phased options for collection and treatment or trading from one area to another.

Commission Water Resources staff is available to answer any questions that you may have about this letter.

H5. The Town and Sewer Commission appreciate the Commissions support in their efforts to address this very complicated and important project.

I. COMMENTS FROM THE DIVISION OF MARINE FISHERIES DATED JUNE 26, 2012

The Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries & Wildlife has reviewed the Notice of Project Change (NPC) for the proposed Watershed Nitrogen Management Plan for the Town of Mashpee and would like to offer the following comments with regard to state-listed species and their habitats.

Portions of the Town of Mashpee and associated infrastructure improvements for the nitrogen management plan are mapped as Priority and Estimated Habitat in accordance with the 13th Edition of the MA Natural Heritage Atlas. The NHESP is supportive of the. Town's plan to manage nitrogen, as at least ten (10) of the twenty-seven (27) species listed in accordance with the Massachusetts Endangered species Act (MGL c. 131A) rely on aquatic and/ or marine habitats for at least one stage of their life cycle and may directly benefit from reduced levels of dissolved nitrogen and improved water quality. These species include the American Brook Lamprey, Eastern Pondmussel, and Pine Barren's Bluet, among others.

The NHESP notes that any portions of the proposed project that occur within Priority and Estimated Habitat, and that are not exempt pursuant to 321 CMR 10.14, will require review through a direct filing with the NHESP for compliance with the MESA and the rare species provisions of the Wetlands Protection Act The

NHESP encourages the Town to consider design and implementation alternatives which avoid, minimize arid mitigate impacts to state-listed species and their habitats, and to consult with the NHESP on the proposed project during the design phase. We appreciate the opportunity to comment on this project, and look forward to working with the Town to proactively address potential concerns related to state-listed rare species.

If you have any questions about this letter, please contact Misty-Anne Marold, Endangered Species Review Biologist, at misty-anne.marold@state.ma.us or 508-389-6356.

I1. The Town and Sewer Commission will make final submittals for review as they finalize their plans and site selection, and look forward to working with NHESP on this important project.

STEARNS & WHELER LLC
Environmental Engineers & Scientists

REPORT ADDENDUM

To: Mashpee Sewer Commission

From: J. Jefferson Gregg, P.E. - Stearns & Wheler, LLC

Date: December 3, 2007

Re: Final Needs Assessment Report – April 2007
Addendum
Tables 7-9 and 8-2

The following Addendum for the Final Needs Assessment Report is being issued.

The 2007 Needs Assessment Report summarized the nitrogen loads by town and by planning area. Table 7-9 from the Needs Assessment Report summarizes the total nitrogen load per town. Table 8-2 from the Needs Assessment Report summarizes these loads by planning area. Following submittal of the 2007 Needs Assessment Report, it was determined that the infiltration load on golf courses was overestimated and therefore this Addendum is being issued with the revised tables. These Tables were revised for the Final Technology Screening Report issued November 2007, and reissued as part of that report (Chapter 2). The information in these two tables will become the basis of alternative scenario development of this project and subsequent phases of work.

TABLE 7-9 (REVISED)

SUMMARY OF TOTAL NITROGEN LOADS PER TOWN[1]

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Town	Wastewater Nitrogen Load (kg/yr)		Non-Wastewater Nitrogen Load (kg/yr)		Total Nitrogen Load (kg/yr)		% Wastewater Nitrogen Load[2]	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Mashpee								
Waquoit Bay East	14,000	29,000	5,600	5,900	20,000	35,000	70%	83%
Popponesset Bay	28,000	41,000	**8,900**	**9,300**	**37,000**	**51,000**	78%	82%
Other	9,000	16,000	1,800	1,900	11,000	18,000	82%	89%
Total	51,000	86,000	**16,000**	**17,000**	**68,000**	100,000	76%	87%
Falmouth								
Waquoit Bay East	3,200	5,800	800	1,000	4,100	6,800	78%	85%
Sandwich								
Waquoit Bay East	4,500	5,400	1,200	1,300	5,700	6,700	79%	81%
Popponesset Bay	12,000	14,000	2,300	2,500	14,000	16,000	86%	88%
Barnstable								
Popponesset Bay	5,700	8,500	1,200	1,300	7,000	9,800	81%	87%
PLANNING AREA TOTAL	76,000	120,000	22,000	23,000	99,000	140,000		

Notes:

1. The nitrogen loads presented in this table do not assume any natural attenuation. Wastewater nitrogen loads are based on septic system nitrogen concentrations of 35 mg/L. All numbers are rounded to two significant figures.
2. Percent of total nitrogen load that comes from wastewater sources.
3. Nitrogen loads were calculated as discussed in this chapter.
4. Non-wastewater nitrogen loads were recalculated to include golf course fertilizer loads.
5. Numbers in **bold** have changed from the original Table 7-9.

TABLE 8-2 (REVISED)

SUMMARY OF NITROGEN LOADS BY PLANNING AREA

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Priority Area	Wastewater Flow (gpd)		WW Nitrogen Load (kg/yr)		Non-Wastewater Nitrogen Load (kg/yr)		Total Nitrogen Load (kg/yr)	
	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Mashpee								
M-1 Johns Pond	140,000	380,000	6,600	15,000	**1,600**	**1,700**	**8,200**	**16,000**
M-2 Mashpee Central	94,000	210,000	4,700	10,000	**960**	**1,000**	**5,700**	**11,000**
M-3 Shoestring Bay	150,000	240,000	7,800	12,000	**2,000**	**2,200**	**9,700**	**14,000**
M-4 Santuit Pond	110,000	140,000	5,100	6,900	**1,100**	**1,500**	**6,200**	**8,300**
M-5 Mashpee River	76,000	160,000	3,600	7,000	**890**	**1,000**	**4,500**	**8,000**
M-6 Jehu Pond	95,000	150,000	4,600	7,200	980	1,100	5,600	8,300
M-7 Popponesset Creek	57,000	83,000	2,800	4,000	490	520	3,300	4,500
M-8 Mashpee-Wakeby Pond	44,000	99,000	2,100	4,800	690	750	2,800	5,500
M-9 MMR	0	140	0	7	350	350	350	360
M-10 Mashpee East	20,000	45,000	880	1,200	250	260	1,100	1,500
M-11 Quashnet River	45,000	78,000	2,200	3,600	640	700	2,900	4,300
M-12 Mashpee South	25,000	42,000	1,200	2,100	480	500	1,700	2,600
M-13 New Seabury	190,000	380,000	9,100	18,000	**2,100**	**2,200**	**11,000**	**20,000**
TOTAL	1,000,000	2,000,000	51,000	92,000	13,000	14,000	63,000	104,000
Barnstable								
B-1 Barnstable Fresh Water	0	560	30	30	30	30	30	60
B-2 Shoestring Bay	110,000	140,000	5,400	6,700	1,000	1,100	6,400	7,800
B-3 Pinquickset Cove	5,100	9,300	250	450	150	160	400	620
B-4 Popponesset Bay	3,900	5,900	190	290	80	85	270	370
TOTAL	120,000	160,000	5,900	7,500	1,300	1,400	7,100	8,900
Sandwich								
S-1 Sandwich West	48,000	61,000	2,300	3,000	750	800	3,100	3,700
S-2 J Well	19,000	22,000	920	1,100	170	180	1,100	1,300
S-3 Snake Pond	2,700	3,600	130	170	40	40	170	220
S-4 Sandwich Quashnet	22,000	25,000	1,100	1,200	190	190	1,300	1,400
S-5 Sandwich Popponesset	240,000	280,000	12,000	14,000	3,300	3,500	15,000	17,000
TOTAL	330,000	390,000	16,000	19,000	4,500	4,700	21,000	24,000
Falmouth								
F-1 Red Brook	23,000	58,000	1,100	2,800	310	380	1,400	3,200
F-2 Falmouth Quashnet	42,000	59,000	2,000	2,900	310	390	2,400	3,300
F-3 Falmouth North	1,700	1,700	80	80	30	30	120	120
TOTAL	67,000	120,000	3,200	5,800	670	800	3,900	6,600
PLANNING AREA TOTAL	1,500,000	2,700,000	76,000	120,000	19,000	21,000	95,000	140,000

Figures in **bold indicate figures that changed as a result of recalculation of golf course nitrogen loads.

TABLE 4-2

SUMMARY OF DECENTRALIZED TREATMENT TECHNOLOGIES
Watershed Nitrogen Management Plan
Mashpee Sewer Commission

NON-NITROGEN REMOVAL [(1)] SYSTEMS

Alternative	Regulatory Requirements	Suitability	Implementability	Performance	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Relative Capital Costs	Relative O&M Costs	Selected for Further Evaluation
General Systems											
Septic system (Certified Title 5)	In accordance with 310 CMR 15.00, Title 5 regulations.	Primary means of wastewater disposal in Mashpee – will not result in improved conditions.	Well known technology; no regulatory changes necessary.	Nitrogen removal range 10 to 40 percent (typically assumed to be 25 percent)	Does not require energy for operation; may require effluent pump.	Moderate compared to other systems. Not allowed for use with reduced leaching area.	High, although high groundwater areas may require less appealing raised leaching fields.	Well-known technology with minimal potential problems.	Low, no filters are required and usually no pumps are required.	Low; no training or equipment operation required. Tank must be pumped every few years.	No, due to lack of nitrogen removal.
Peat system	MassDEP may require additional full-scale testing before General Use approval. Only approved for Remedial Use.	May not be suitable for naturally acidic waters of Cape Cod.	Long track record in Maine. Simple system, no moving parts.	Test sites on Cape Cod have low nitrogen removal rates (30-40%). Good BOD and TSS removals.	Does not require energy if site does not require pumping.	Similar to other I/A systems, may allow for reduction in leaching area.	High.	Known technology in Maine.	Moderate to High, will be more expensive than a standard Title 5 system.	Low; minimal training requirements. Tank must be pumped every few years.	No, due to inconsistent performance data on Cape Cod.
Glendon Upflow Filter	MassDEP may require additional full-scale testing. Not an approved I/A technology.	May not result in any improvement over existing conditions.	Not listed as I/A technology by MassDEP.	Minimal data available	Requires a small pump.	Higher than septic system	High.	Low because it is a relatively new technology with no New England applications. Requires further testing.	Moderate, will be more expensive than a standard Title 5 system.	Low; no training or equipment operation required. Tank must be pumped every few years.	No, due to lack of data, potential lack of public acceptance, and lack of MassDEP permitting approval.
MassDEP-Approved I/A Systems											
JET aerobic wastewater systems	Approved for General Use. Not Credited for Nitrogen Removal.	High quality effluent (BOD and TSS); currently only suitable for flows less than 1,500 gpd.	More complicated system than typical Title 5 due to numerous moving parts. Would require maintenance agreement.	Nitrogen removal information not available for this technology.	Moderate energy use due to pumps and other mechanical equipment.	Similar to other I/A systems, may allow for reduction in leaching area.	High.	Similar to Title 5 systems, although will be more expensive.	Moderate to High, will be more expensive than a standard Title 5 system.	Pumping requirements, maintenance of equipment, and additional electrical requirement add to moderate O&M costs.	No.
Orenco intermittent sand filter	Approved for General Use. Not Credited for Nitrogen Removal.	May achieve nitrogen reduction when properly maintained.	Can be installed in new septic system or retrofit into existing one.	Flexible operation; may reduce nitrogen; may be sensitive to winter temperatures	Moderate energy use due to pumps and other mechanical equipment.	Similar to other I/A systems, may allow for reduction in leaching area.	High.	Similar to Title 5 systems, although will be more expensive.	Moderate to High, will be more expensive than a standard Title 5 system.	Pumping requirements, maintenance of equipment, and additional electrical requirement add to moderate O&M costs.	No.

Note (1): These systems remove nitrogen to varying degrees. However, none of them are credited by MassDEP for nitrogen removal in nitrogen sensitive areas.

NON-DISCHARGE SYSTEMS

Alternative	Regulatory Requirements	Suitability	Implementability	Performance	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Relative Capital Costs	Relative O&M Costs	Selected for Further Evaluation
Tight Tanks	MassDEP will only approve as a short-term solution.	Suitable as a short-term solution.	Simple installation; regulatory approval required.	Moves problem to a different location.	Tanks may leak after many years.	Minimal, leaching system is not used.	Low; high potential for odors due to frequent pumping.	Poor to moderate acceptance due to odors, frequent pumping requirements, and lack of MassDEP approval.	Low installation costs.	High pumping and disposal costs.	No, typically this would only be approved by MassDEP as a short-term solution.
Waterless Toilets	May require BOH approval	High nutrient removal for black water only.	Requires some repiping and remodeling for existing homes or structures.	Reduces wastewater flows and loads.	High energy use for incinerating type.	Land required for gray water disposal systems are less than a standard Title 5 system.	Low; high potential for odors; requires contact with composted waste.	Poor to moderate, since it is a non-traditional system.	Low installation cost, but must handle gray water separately.	Moderate; weekly maintenance and removal of solids required.	No.

NITROGEN REMOVAL SYSTEMS

Alternative	Regulatory Requirements	Suitability	Implementability	Performance	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Capital Costs Beyond Title 5 System (2)	O&M Costs	Selected for Further Evaluation
Recirculating Sand Filter (non-proprietary)	Certified for use in nitrogen sensitive areas when designed in accordance with MassDEP guidelines.	Capable of nitrogen removal, already in use in the PPA.	Most have moderate to long track records and are used in the PPA already.	Nitrogen removal ranges from 40 to 90 percent. Good BOD and TSS removals. Sensitive to winter temperatures.	Require energy for pump operation.	Land requirements are slightly more than for Title 5.	High.	High, proven technology.	Moderate due to additional components including filters and pumps.	Moderate; pumping requirements and replacement and maintenance of filter media add costs.	Yes.
RUCK® System	Certified for use in nitrogen sensitive areas when designed in accordance with MassDEP guidelines.	Capable of nitrogen removal, already in use in the PPA. Approved for flows less than 2,000 gpd.	Most have moderate to long track records and are used in the PPA already.	Nitrogen removal ranges from 40 to 80 percent. Good BOD and TSS removals.	Require energy for pump operation.	Land requirements are slightly greater than Title 5.	High.	High, proven technology.	$15,000	Moderate; pumping requirements and replacement and maintenance of filter media add costs. Required annual inspection adds cost of $250. Additional monitoring required for systems located in a Zone II.	Yes.
APPROVED FOR PROVISIONAL USE IN NITROGEN SENSITIVE AREAS											
Bioclere	O&M Agreement, quarterly monitoring. 50 system limit has been reached.	Capable of nitrogen removal, already in use in the PPA.	Well established, reliable technology.	70-85% nitrogen removal. Good BOD and TSS removals.	Energy for pumping; maintenance contract	Similar to Title 5. Eligible for reduced leaching area outside nitrogen sensitive areas.	Tops of tanks are above ground, blowers can be noisy.	High.	$8,000	Moderate; similar to other I/A systems.	Yes.
FAST	O&M Agreement, quarterly monitoring, limit of 50 systems.	Capable of nitrogen removal, already in use in the PPA.	Well established, reliable technology.	50-70% nitrogen removal. Good BOD and TSS removals.			Tops of tanks are above ground, blowers can be noisy.	High.	$4,100-$4,500	Energy costs for pumps and blowers, maintenance contract	Yes.
Amphidrome	O&M Agreement, quarterly monitoring, limit of 50 systems.	Capable of nitrogen removal, already in use in the PPA.	Has General, Provisional, and Remedial use approvals.	Up to 75% nitrogen removal.			Blowers can be noisy.	High.	$8,000 (assuming standard Title 5 tank is 2,000 gallons)	$1,100 per year for inspection and monitoring, energy costs estimated to be $2 per month per occupant.	Yes.
Waterloo	O&M Agreement, quarterly monitoring, limit of 50 systems.	Capable of nitrogen removal, already in use in the PPA.	Well established, reliable technology. Approaching Provisional Use installation limit.	60-90% nitrogen removal rates. Good BOD and TSS removals.			Blowers can be noisy.	High.	$11,255 (includes technician to oversee installation)	$1,500 per year for inspection and monitoring, energy costs for pumps, control panel, etc.	Yes.
Advantex	O&M Agreement, quarterly monitoring, limit of 50 systems.	Capable of nitrogen removal.	Established technology.				Filter lid is at ground level.	High.		An average of $2 per month for electricity.	Yes, but less favorable due to limited local performance data.
Nitrex™	O&M Agreement, quarterly monitoring, limit of 50 systems.	Capable of nitrogen removal, already in use in the PPA.	Established technology.	Up to 95% nitrogen removal. Good BOD and TSS removals.			High.	High.	$4,000 for Nitrex™ components.	Maintenance contract	Yes.
APPROVED FOR PILOT USE IN NITROGEN SENSITIVE AREAS											
OAR	O&M Agreement, monthly monitoring for first 6 months, then quarterly monitoring, limit of 15 systems.	Capable of nitrogen removal	Established technologies; MassDEP-recognized technologies, although still in the piloting phase, which limits the number of systems until provisional use is obtained.	Limited performance data for local applications.	Energy for pumping and other equipment; maintenance contract	Similar to Title 5. Eligible for reduced leaching area outside nitrogen sensitive areas.	Blowers can be noisy.	High.	Moderate due to additional components including filters and pumps.	High; pumping requirements and replacement and maintenance of filter media add costs. Additional bacteria required.	Yes, but less favorable due to limited local performance data.
RUCK® CFT	O&M Agreement, monthly monitoring for first 6 months, then quarterly monitoring, limit of 15 systems.	Capable of nitrogen removal		Reportedly as high as 90% nitrogen removal.		More than Title 5.	Blowers can be noisy.	High.		High; pumping requirements and replacement and maintenance of filter media add costs. Supplemental carbon source required.	
Cromaglass	O&M Agreement, monthly monitoring for first 3 months, then quarterly monitoring, limit of 15 systems.	Capable of nitrogen removal		Limited performance data for local applications.		Similar to Title 5. Eligible for reduced leaching area outside nitrogen sensitive areas.	Blowers can be noisy.	High.		Moderate. Similar to other I/A systems.	
Norweco Singulair	O&M Agreement, monthly monitoring for first 3 months, then quarterly monitoring, limit of 15 systems.	Capable of nitrogen removal, already in use in the PPA.		40-70% nitrogen removal.		Similar to Title 5. Eligible for reduced leaching area outside nitrogen sensitive areas.	Blowers can be noisy.	High.	$6,500	$2,125 annually.	Yes.
Omni	O&M Agreement, monthly monitoring for first 3 months, then quarterly monitoring, limit of 15 systems.	Capable of nitrogen removal		40-90% nitrogen removal.		Similar to Title 5. Eligible for reduced leaching area outside nitrogen sensitive areas.	High.	High.	Moderate due to additional components including filters and pumps.	Moderate. Similar to other I/A systems.	Yes, but less favorable due to limited local performance data.
SeptiTech	O&M Agreement, monthly monitoring for first 3 months, then quarterly monitoring, limit of 15 systems.	Capable of nitrogen removal, already in use in the PPA.		40-60% nitrogen removal.		Similar to Title 5. Eligible for reduced leaching area outside nitrogen sensitive areas.	High.	High.	$12,000	Moderate. Similar to other I/A systems.	

Note (2): Dollar values provided when available from manufacturers.

TABLE 5-1

SMALL WASTEWATER TREATMENT FACILITIES (PACKAGE PLANTS)

Watershed Nitrogen Management Plan
Town of Mashpee Sewer Commission

Alternative	Regulatory Requirements[1]	Suitability	Implementability	Performance	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Relative Capital Costs	Relative O&M [2] Costs (annually)	Selected for Further Evaluation
Rotating Biological Contactor	Needs MassDEP and BOH approval. Requires typical effluent discharge permit. These technologies are in use in MA and are well-accepted technologies.	Good reliability and proven performance. Many existing facilities in the PPA use this technology.	Easy to construct, most systems are modular or are designed using prefabricated tanks.	6-10 mg/L TN	Low; simple system.	Highest of package treatment plants; may require building or tank covers.	Moderate – system is enclosed in a building.	Moderate – many existing facilities with these technologies in the PPA; additional site location may be difficult.	More cost effective for lower flows due to requirements for covering tanks.	No major difference between RBC, SBR, Amphidrome, FAST, and Bioclere.	Yes. Town of Mashpee currently has or will have these types of technologies.
Sequencing Batch Reactor [3]		Good reliability and proven performance. Can achieve high nitrogen removal. One existing facility in the PPA uses this technology.		6-10 mg/L TN (<6 mg/L TN possible without additional processes)	Operator control of processes allows flexibility. Aeration and pumping requirements.	Lowest of package treatment plants; no final settling required.	Moderate.		In general, more expensive at lower flows due to cost of pre-cast concrete vs. cast-in-place concrete.		
Amphidrome		Good reliability and proven performance. Some existing facilities in the PPA use this technology.		6-10 mg/L TN	More complex systems; typically based on proprietary equipment, making replacement parts and costs dependent on manufacturers.	Moderate, but all below grade.	High – tanks can be below ground, allowing secondary use of land.		At larger flows, tank costs become prohibitive.		
Zenon (Membrane Bioreactor) [3]	Needs MassDEP and BOH approval. Requires typical effluent discharge permit. Relatively new technology with few local, large-scale facilities.	Can achieve high nitrogen removal. Effluent is typically of a high quality. One of the existing facilities in the PPA will likely be switching to an MBR.		6-10 mg/L TN (<6 mg/L TN possible without additional processes)		Lower than some of the package treatment plants; no final settling required.	Moderate – system is often enclosed in a building.	Moderate – effluent can be re-used for irrigation or other purposes, increasing its appeal.	Technology costs are typically more expensive than other technologies.	Higher O&M based on operating complexity and membrane replacement.	
FAST	Needs MassDEP and BOH approval. Requires typical effluent discharge permit. These technologies are in use in MA and are well-accepted technologies.	Moderate reliability and performance.		6-10 mg/L TN		Moderate; requires final settling, which can be located below grade.	Moderate – can be located below grade.	Moderate – siting facilities may be difficult.	Technology is more cost effective at lower flows due to the "prefabrication" components.	No major difference between RBC, SBR, Amphidrome, FAST, and Bioclere.	No major advantage of these over other technologies currently used in Mashpee.
Bioclere				6-10 mg/L TN		Moderate; most located below grade.	Moderate – top of tanks may be above ground.				

Notes:

(1) Additional permit requirements will be necessary for discharge within a Zone II.
(2) O&M = operation and maintenance.
(3) Can achieve less than the 6 mg/L TN without additional processes.

TABLE 5-3

SUMMARY OF SECONDARY/ADVANCED TREATMENT TECHNOLOGIES

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Alternative	Regulatory Requirements [1]	Suitability	Implementability	Performance (TN)	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Relative Capital Costs	Relative O&M [2] Costs (annually)	Selected for Further Evaluation
Activated Sludge MLE Process/Extended Aeration	All these processes need MassDEP approval and require an effluent discharge permit.	Good reliability and proven performance.	Requires construction of new facilities.	Effluent N, 3 to 10 mg/l (Carrousel and Orbal oxidation ditches can meet 3-6 mg/L TN)	Moderately complex; high flexibility with good process control.	Moderate due to tank sizes and building requirements.	Moderate/low due to open tanks.	Moderate.	Moderate to other technologies due to large tank requirements.	Aeration costs are higher than RBCs.	Yes, but will be highly dependent on site size constraints and chosen performance.
Rotating Biological Contactor (RBC)			Several package plants in Town use this technology.	Effluent N, 6 to 10 mg/L.	Relatively easy operations; minimal process control.	High for large covered process.	Moderate – can be hidden by buildings.	Moderate.	High capital costs due to requirement to cover tanks.	Lower O&M costs due to minimal aeration and pumping requirements.	No; same performance with smaller structures can be achieved with other technologies for larger facilities.
Sequencing Batch Reactor (SBR)			Requires construction of new facilities.	Can meet 3 to 10 mg/L total nitrogen.	High reliability and proven performance at limited number of facilities. Good process control allows adjustable performance.	Relatively small; no final settling required.	Moderate/low due to open tanks.	Moderate.	Often less than others due to smaller tank requirement.	Higher due to operational considerations.	Yes; small footprint and high nitrogen removal performance.
Membrane Bioreactors (Zenon, Enviroquip)			Requires construction of new facilities.	Effluent N, 3 to 6 mg/L.	Need to clean membrane filters. More complex operations.	Relatively small; no final settling required.	Moderate.	Moderate.	Higher costs associated with membrane technology.	Higher due to membrane replacement costs and operational considerations.	Yes; small footprint and high nitrogen removal performance.
Aerated Biological Filter (Biofor, Biostyr)			Requires construction of new facilities.	Typically provides nitrification but not denitrification without additional process tanks.	Relatively simple filter operations and maintenance; less flexibility and process control.	Relatively small.	Moderate.	Moderate.	Moderate capital costs.	Moderate.	No.
Denitrification Filter		Can be added to end of various treatment trains easily.	Requires construction of new facilities.	Process can meet 3 to 5 mg/L total nitrogen (and reduce BOD and TSS) with methanol feed and upstream nitrification.	High reliability and proven performance. Relatively simple operations.	Relatively small, but is only a process component of a larger facility.	Moderate.	Moderate.	Moderate capital costs when used in conjunction with other nitrogen removal processes.	Moderate for methanol feed.	Yes. Denitrifying filters can reliably produce an effluent of 3 to 5 mg/L total nitrogen and should be considered for effluent polishing.
Constructed Wetlands	These processes need MassDEP approval and require an effluent discharge permit. They may also need pilot testing.	Likely to have lower quality effluent in winter. Extensive sitework required to accommodate all the area needed.	Requires construction of new facilities.	Not expected to reliably produce a high quality effluent year-round.	Simple system with minimal process control; can be expanded for additional flows.	Very high compared to other centralized alternatives.	Odors are possible.	Moderate; systems are typically popular because they use natural processes, but have high capital costs.	High costs for site work and facility construction.	Low due to low energy requirements and vegetation harvesting.	No, due to high land requirements, siting issues, and the inability of process to provide consistent effluent quality year-round.
Solar Aquatics		Likely to have lower quality effluent in winter. Extensive sitework required to accommodate all the area needed.	Requires construction of new facilities.	Not expected to reliably produce a high quality effluent year-round.	High operations and maintenance requirements.	High compared to other centralized alternatives.	Odors are possible.	Moderate; systems are typically popular because they use natural processes, but have high capital costs.	High costs for site work and facility construction.	Moderate due to energy use and high maintenance requirements.	No, due to high land requirements, siting issues, and the inability of process to provide consistent effluent quality year-round.

Notes:
1. Additional permit requirements will be necessary for discharge within a Zone II.
2. O&M = operation and maintenance.
3. Can achieve less than the 6 mg/L TN without additional processes.

TABLE 5-4

SUMMARY OF DISINFECTION TECHNOLOGIES

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Alternative	Regulatory Requirements	Suitability	Implementability	Performance [1]	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Estimated Capital Costs [2]	Estimated O&M Costs [2, 3] (annually)	Selected for Further Evaluation
Chlorination using Sodium Hypochlorite	Chemical storage requirements	Not suitable for treating water that will be discharged in a Zone II area.	Will require MassDEP approval.	<200 cfu/100 mL. Can produce trihalomethanes.	Chemical storage; equipment and tank maintenance.	Requires chlorine contact tank.	High, if sufficient precautions are taken in case of chemical release.	Low – risk of groundwater contamination; risk of chemical spills.	$800,000 - $1,000,000 (contact tanks and feed equipment)	$60,000 - $70,000	No.
Disinfection with ozone	Chemical storage requirements	Suitable for achieving disinfection.	Will require MassDEP approval.	<200 cfu/100 mL. Can produce toxic and/or carcinogenic compounds.	Chemical storage; equipment maintenance.	Minimal.	High, if sufficient precautions are taken in case of chemical release.	Low – risk of groundwater contamination; risk of chemical spills.	$500,000 - $600,000 (ozone equipment)	$20,000 - $30,000	No.
Disinfection with UV radiation	None	Suitable for all discharge areas.	This technology is most favorable to MassDEP.	<200 cfu/100 mL.	Bulb cleaning and replacement; equipment maintenance.	Minimal.	High public acceptance.	High.	$500,000 - $600,000 (UV radiation equipment)	$20,000 - $30,000	Yes.

Notes:
1. cfu = colony forming units
2. Based on typical costs for an estimated wastewater flow of 1 mgd (for comparison purposes only).
3. O&M = operations and maintenance.

TABLE 6-1

SUMMARY OF SEWER SYSTEM TECHNOLOGIES

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Alternative	Suitability	Implementability	Performance	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Relative Capital Costs [1]	Relative O&M [2, 3] Costs (annually)	Selected for Further Evaluation
Gravity sewers and pumping stations	Can be expanded to serve additional areas. Initial flows not critical.	Most difficult implementation due to deeper excavations and the need for constant slope.	Not applicable – collection systems do not perform nitrogen removal.	Pumping stations require energy and typically have emergency generators to keep system operational.	Sewer typically located in street. Land may be required for pumping stations. Easements may be required for sewers.	High; low chance of backups into structures; pumping stations can be undesirable.	Well-known technology. Deep excavations can cause traffic disruption.	$200 - $450	$20 - $30	Yes, due to wide use, simplicity, reliability of technology, and low maintenance requirements.
Pressure sewers and grinder pumps	Can be expanded. Initial flows not critical.	Easier installation due to shallower excavations and less critical slopes.		Pumps require energy for operation. System cannot be operated during power failures unless each pump has standby power.	Sewers typically located in street or road ROWs. No land requirements. Easements may be required for sewers.	Moderate; each home or group must have a pump.	Power outage can cause backup into structures and reduce potential public acceptance.	$280 - $350	$20 - $25	Yes, due to adaptability in areas of varying topography and low construction costs.
Septic tank effluent pump system	They are not suitable for nitrogen removal treatment systems that require organic solids to attain denitrification.	Easier installation due to shallower excavations and less critical slopes. May impact nitrogen removal at a treatment plant.	Not applicable – collection systems do not perform nitrogen removal, although these two technologies can have a negative impact on the nitrogen removal processes at a treatment plant.	Pumps require energy for operation. System cannot be operated during power failure unless each pumping station has standby power.	Sewers typically in street. Land requirements for septic tanks and pumps may be on individual properties. Easements may be required for sewers.		Each home must have a pump and septic tank. Odor potential may reduce public acceptance.	Similar to pressure sewer; however, additional money is required for septic tank improvements.	Similar to pressure sewer with additional costs related to septic tank pumping.	No, due to poor compatibility with nitrogen removal treatment systems as required on Cape Cod.
Septic tank effluent gravity system	They are not suitable for nitrogen removal treatment systems that require organic solids to attain denitrification.	Easier installation due to shallower excavations, but constant slopes must be maintained. Not feasible where septic tank elevations are low. May impact nitrogen removal at a treatment plant.		Sewers do not require energy. Pumping stations require energy and typically have generators to keep system operational.	Sewers typically in street. Land requirements for septic tanks and pumps may be on individual properties. Easements may be required for sewers.		Each home must have a septic tank. Odor potential may lower acceptance. Chance of backup is minimal.	Similar to gravity sewer, but on the lower end as pipes are smaller.	Similar to gravity sewer with additional costs related to septic tank pumping.	No, due to poor compatibility with nitrogen removal treatment systems as required on Cape Cod.
Vacuum sewers	Difficult to expand. Initial flows must be accurately estimated and expansion is limited. More difficult to make future connections if not planned ahead.	Shallower excavations than gravity sewers; however, more complex system with critical design features that must be installed properly for the system to function properly. High level of testing required during sewer installation.	Not applicable – collection systems do not perform nitrogen removal.	Energy is required to maintain vacuum. Power typically supplied by generator during outages. Otherwise no power needed at the valve pits.	Sewers in street or road rights-of-way. Land will be required for vacuum station. Easements required for sewers.	Moderate; each home or group must have a valve pit.	Requires large number of easements. Valve pits are required at each property and vents are required on each gravity lateral reducing public acceptance.	$310 - $400	$35 - $50	No, due to its limitations for existing developed areas.

Notes:

1. Average cost per linear foot of sewer. Construction costs only.
2. O&M = operations and maintenance.
3. Average annual cost per linear foot of sewer.

TABLE 6-2

SUMMARY OF EFFLUENT DISCHARGE TECHNOLOGIES

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

Alternative	Regulatory Requirements	Suitability	Implementability	Performance	Long Term Maintenance	Land Use	Aesthetic Appeal	Public Acceptance/Political Feasibility	Capital Costs (per mgd) [1]	Annual O&M Costs [2, 3]	Selected for Further Evaluation
Sand infiltration beds	Permitting and monitoring of effluent discharges. Disinfection may be required by MassDEP.	Flexibility is possible with multiple beds. Low energy requirements.	Relatively simple to implement.	Effluent is already treated and sand beds provide some additional treatment.	Effluent discharge is reliable throughout the year and easy to maintain.	Moderate at large wastewater flows when compared to subsurface leaching.	Moderate due to large areas of land that may require clearing.	Potential for low acceptance from residents who are impacted by bed siting and construction.	Relatively low due to low land area and easier construction.	Low due to low energy requirements and minimal maintenance.	Yes; the technology is simple and reliable. O&M requirements are minimal.
Subsurface infiltration	Disinfection is not required prior to discharge, unless required to meet the Interim Guidelines for Reclaimed Water Use.	Accepted, proven technology.	Relatively simple to implement.	Effluent is already treated and infiltration facilities provide additional treatment. Effluent should be filtered before discharge.	Repair of the beds would be difficult because they are below the surface.	Relatively high. Land surface above the infiltration system can be used for other purposes	High; secondary use of land adds to appeal.	Acceptance should be high due to minimal visual impacts and potential reuse of land area.	Relatively high due to high land area requirements.	High due to pumping requirements and potentially higher repair/cleaning costs.	Yes; technology is reliable and provides secondary use of discharge area.
Spray irrigation	Permitting and monitoring of effluent discharges and design requirements. Disinfection may be required by MassDEP.	May be suitable to handle additional summer flows.	Must have redundant back-up facilities for winter discharge.	Spray irrigation provides further uptake of nitrogen in the effluent.	Moderate maintenance to maintain piping. Spray irrigation cannot be used in freezing weather.	Relatively high. Land above system can be used for other purposes when spray irrigation is turned off.	High; secondary use of land adds to appeal.	The public will want to see recycling of the effluent though they may be concerned about possible health threats.	Relatively low due to minimal excavation, and minimal need to reshape the land. May require additional money for winter facilities.	Moderate due to maintenance and pumping requirements.	Yes; it provides additional nitrogen uptake and reuse of the effluent.
Drip irrigation	Permitting and monitoring of effluent discharges and design requirements. Disinfection may be required by MassDEP.	May be suitable to handle additional summer flows.	May require redundant back-up facilities for winter discharge.	Potential for further uptake of nitrogen.	Moderate maintenance to maintain piping. Spray irrigation cannot be used in freezing weather.	Can be used for fields or open space.	High; secondary use of land adds to appeal.	The public will want to see recycling of the effluent though they may be concerned about possible health threats.	Relatively higher due to low application rates.	Moderate due to maintenance and pumping requirements.	Yes; it provides additional nitrogen uptake and reuse of the effluent.
Deep well injection and wick wells	Permitting and monitoring of effluent discharges and design requirements. MassDEP is not supportive of this technology.	Not suitable, due to MassDEP's position on technology.	Difficult due to MassDEP's position on technology.	Effluent must be well treated (filtered and chlorinated) before discharge.	Uncertain reliability due to few operating installations and increased maintenance due to the potential of plugging of injection point with solids.	Relatively low compared to sand infiltration beds and subsurface leaching.	High.	Land area requirements and visual impacts are minimal.	Relatively low due to minimal excavation, and minimal need to reshape the land.	Moderate due to pumping requirements and maintenance needs.	No; MassDEP is resistant to support the technology due to the need to chlorinate the effluent.
Ocean Outfall	The Massachusetts Ocean Sanctuaries Act prohibits discharge of municipal wastewater into an ocean sanctuary.	Prohibited by the Ocean Sanctuaries Act.	Only possible as last resort.	Disinfection may be required for the outfall.	Maintenance similar to a large force main.	Minimal.	Low.	Low, based on the opposition to the Deer Island outfall and the Ocean Sanctuaries Act.	Relatively high due to extensive permitting and pumping requirements and potential pipe construction.	Moderate due to pumping requirements.	No.
Wetland Restoration	Possible extensive wetland permitting depending on the type of restoration. Permitting and monitoring of effluent discharges.	Could provide additional nitrogen removal.	MassDEP regards this as an innovative technology, which may effects its ability to be implemented.	Effluent must be well treated (phosphorus removal in addition to standard nitrogen removal, disinfection before discharge)	Very low maintenance requirements and low operations complexity.	Would make use of an existing extensive land area. The restoration efforts would occur in specific flow control and infiltration areas.	Moderate, due to perceived potential contact with wastewater.	Could be favorable due to understanding that the technology/concept is a restoration effort and the project could restore proper hydraulic balance to the watershed.	Relatively low due to minimal excavation, and minimal need to reshape the land.	Moderate due to pumping requirements and maintenance needs.	Yes, possibly in relation to the Pilot Project.

Notes:

1. Based on *Effluent Disposal and Reuse Planning Guidance Document and Case Study Report, February 2005*, Table 3-1.
2. Based on *Effluent Disposal and Reuse Planning Guidance Document and Case Study Report, February 2005*, Table 3-1. Various flow ranges are included.
3. O&M = operations and maintenance.

TABLE 7-1

SUMMARY OF STORMWATER TREATMENT TECHNOLOGIES

Watershed Nitrogen Management Plan
Mashpee Sewer Commission

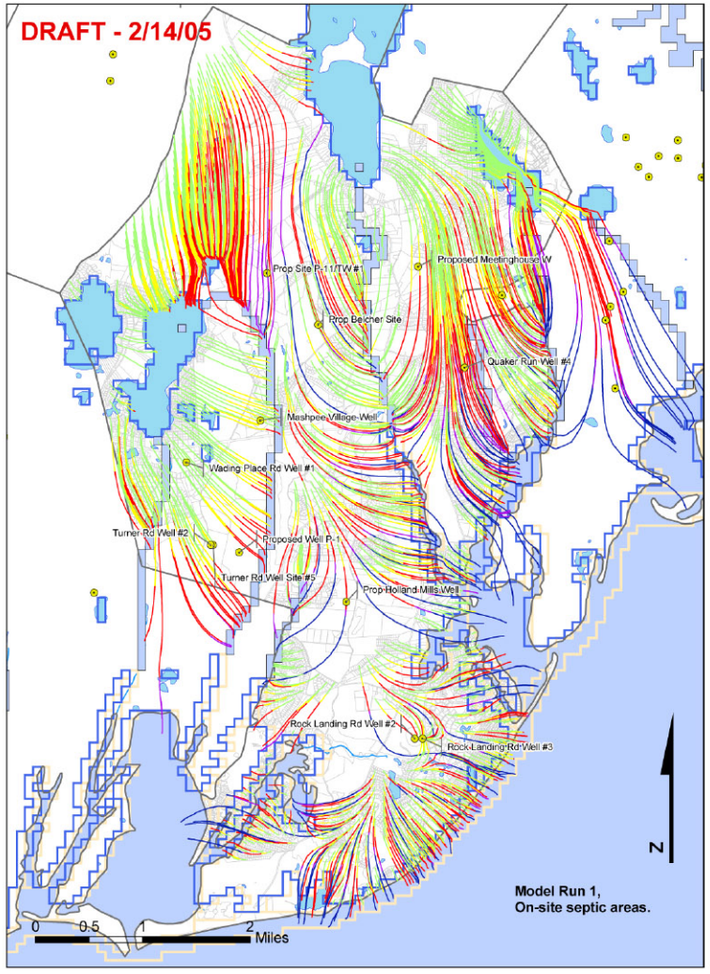
Alternative	Total Nitrogen Reduction [1,2]	Nitrate Reduction [1,2]	Maintenance [3]	Land Use	Aesthetic Appeal	Costs per Acre of Catchment Area [4]	Other Advantages	Other Disadvantages
Dry Detention Pond	5-30%	10-40%	High	High	Low	$25,000	Long lived facility	Tendency to fail by clogging
Wet Retention Pond	30-35%	25-60%	High	High	High	$14,000	May increase property values Long lived facility	May pose drowning risks Possible mosquito breeding ground Freezing can present problems
Infiltration Basins	55-60%		High	High	Low	Moderate	Simple system	High rate of failure
Gravel Wetlands	20%	80-99%	Low	High	Low	$22,300	Suitable in high groundwater areas	Maintenance of vegetation
Stormwater Wetlands	20-50%	40-70%	Low	High	High	Involves extensive sitework and vegetation maintenance		Freezing can present problems Possible mosquito breeding ground
Rain Gardens	50%	15-40%	Moderate	Low	High	$25,000	Ideal for urban areas and parking lots	Freezing can present problems
Vegetated Swales	10-90%	40-90%	Moderate	Low	Moderate	Low	Provides groundwater recharge	Proper slope is critical to pollutant removal ability
Porous Pavement	80%		High	Low	Moderate	More expensive than traditional paving, with additional maintenance costs	Replaces otherwise completely impervious areas	High rate of failure Not appropriate for areas with high commercial traffic Freezing can present problems
Infiltration Trenches	30-60%	10%	High	Low	Moderate	$12,500	Adaptable to a variety of sites	Requires pretreatment High rate of failure
On Lot Treatment	Varies	Varies	Moderate	Low	Moderate	Varies depending on treatment alternative, although homeowner bears the costs	Reduces amount of stormwater runoff	Requires education of homeowners Relatively small portion of impervious area treatment

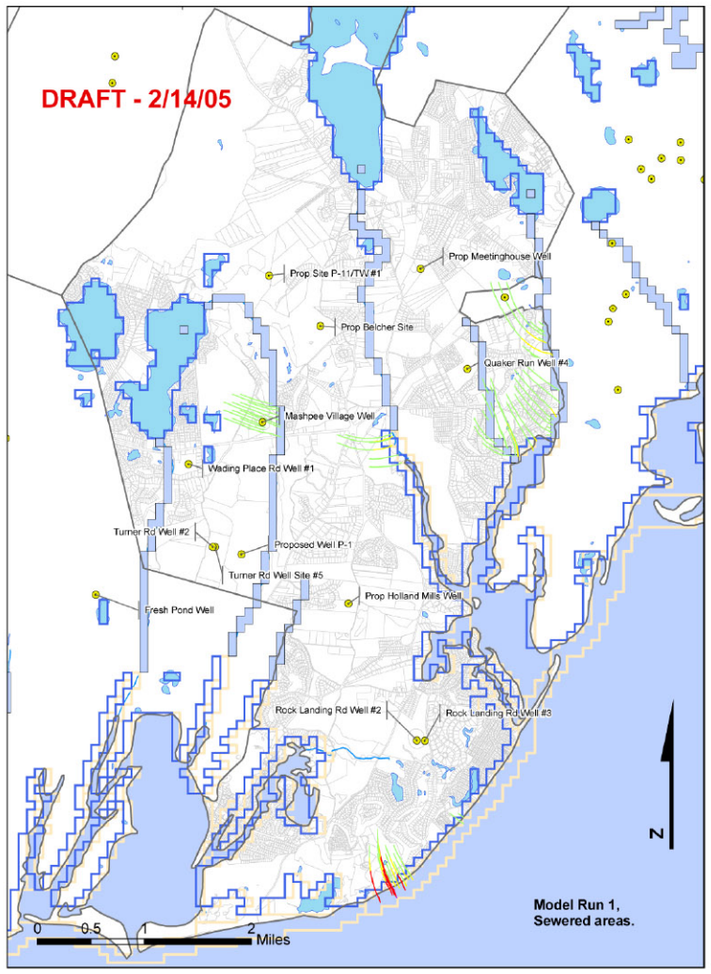
Sources:

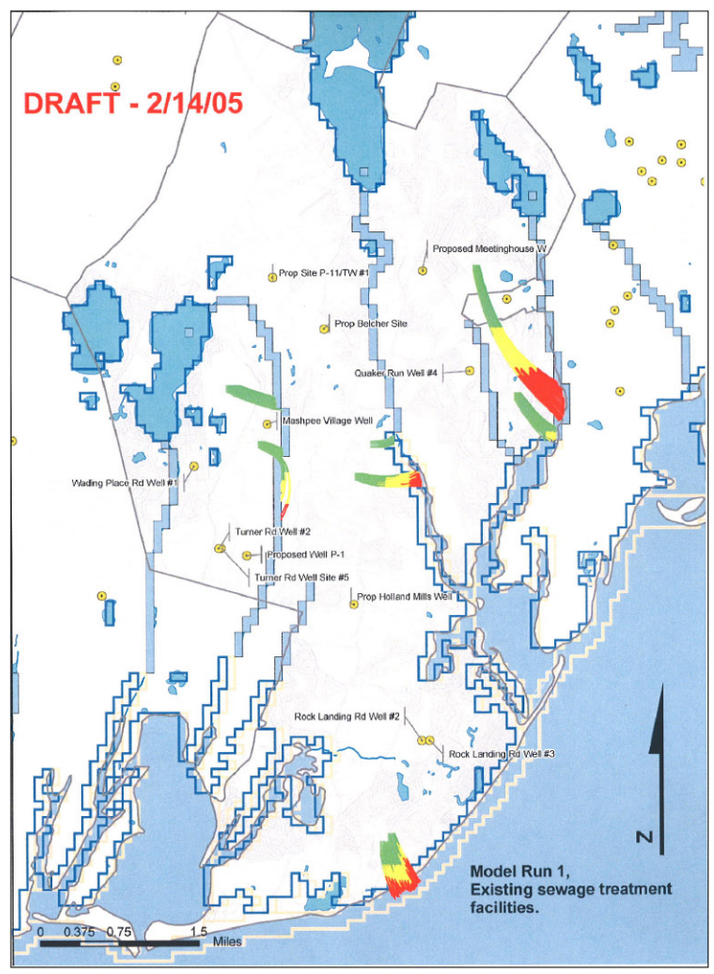
Stormwater Management Volume Two: Stormwater Technical Handbook (MADEP, 1997)
2005 Data Report – University of New Hampshire Stormwater Center
National Pollutant Removal Performance Database for Stormwater Treatment Practices, March 2000
National Pollutant Discharge Elimination System Stormwater Menu of BMPs (USEPA)
Stormwater Technology Fact Sheet (USEPA)

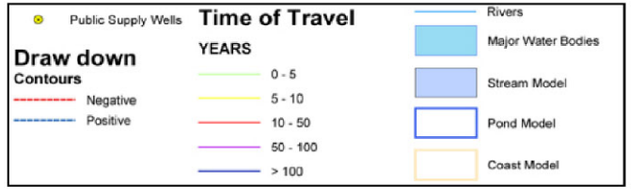
Notes:

1. Nitrogen and Nitrate reduction values reflect the reduction in runoff reaching surface waters. Many of these practices still allow nitrogen to infiltrate into the groundwater, which will eventually reach the estuaries.
2. Only one information source was available for technologies that do not show pollutant removal rates as a range of values.
3. Specific maintenance items necessary for each alternative are discussed in the text.
4. Technologies with actual costs are based on the UNH Data Report. Other cost considerations are summarizations of required implementation activities.









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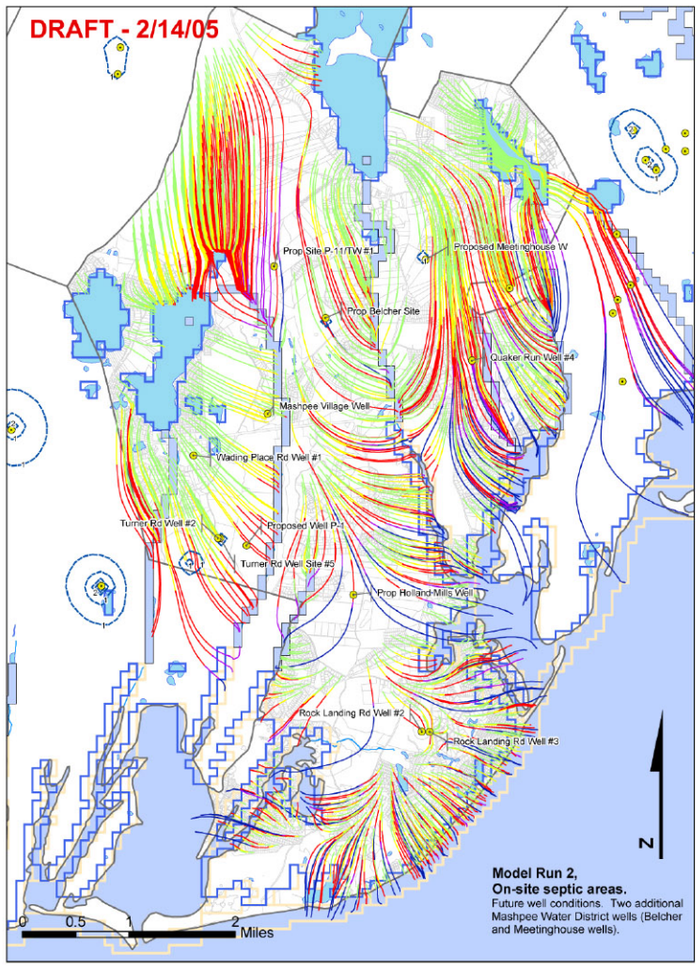
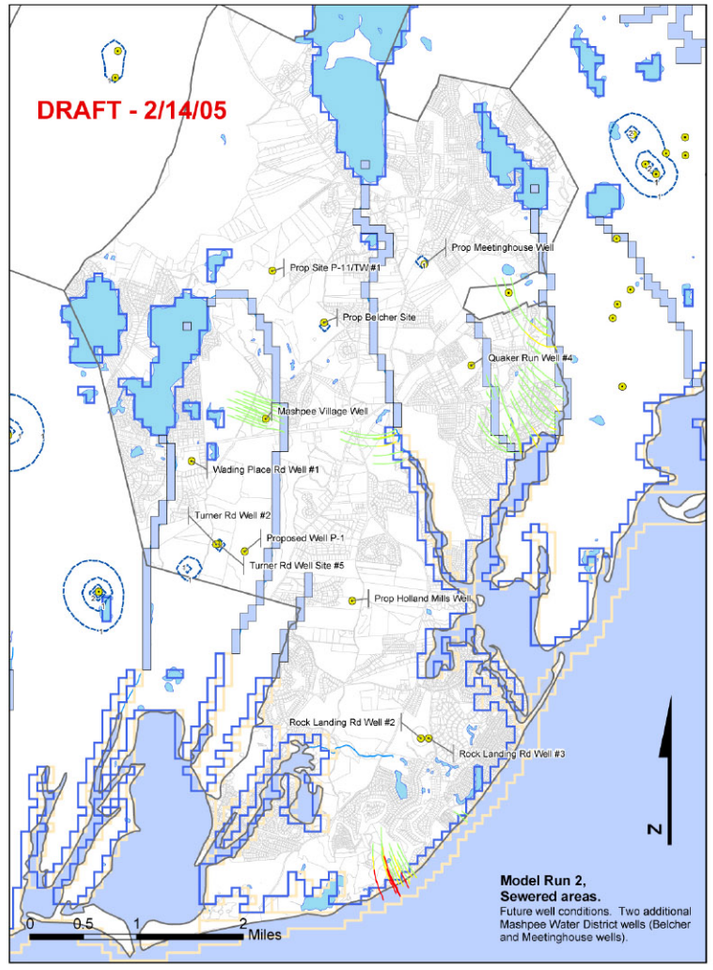
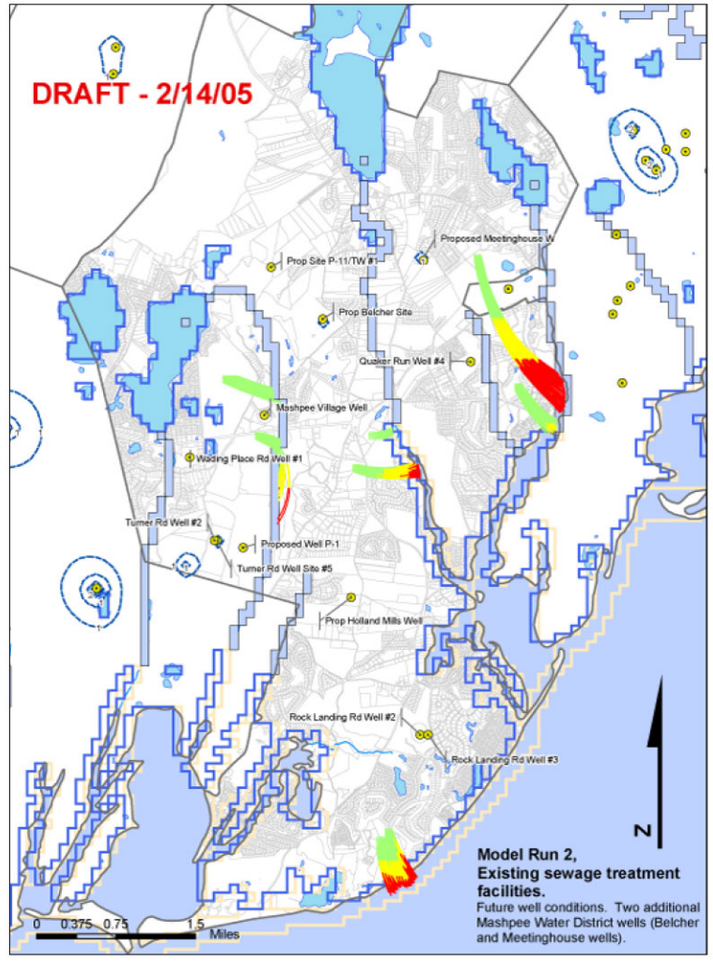
MODEL RUN 1

FIGURE 2-2







Public Supply Wells

Draw down Contours
- Negative
- Positive

Time of Travel
YEARS
- 0 - 5
- 5 - 10
- 10 - 50
- 50 - 100
- > 100

- Rivers
- Major Water Bodies
- Stream Model
- Pond Model
- Coast Model

Data Source: USGS

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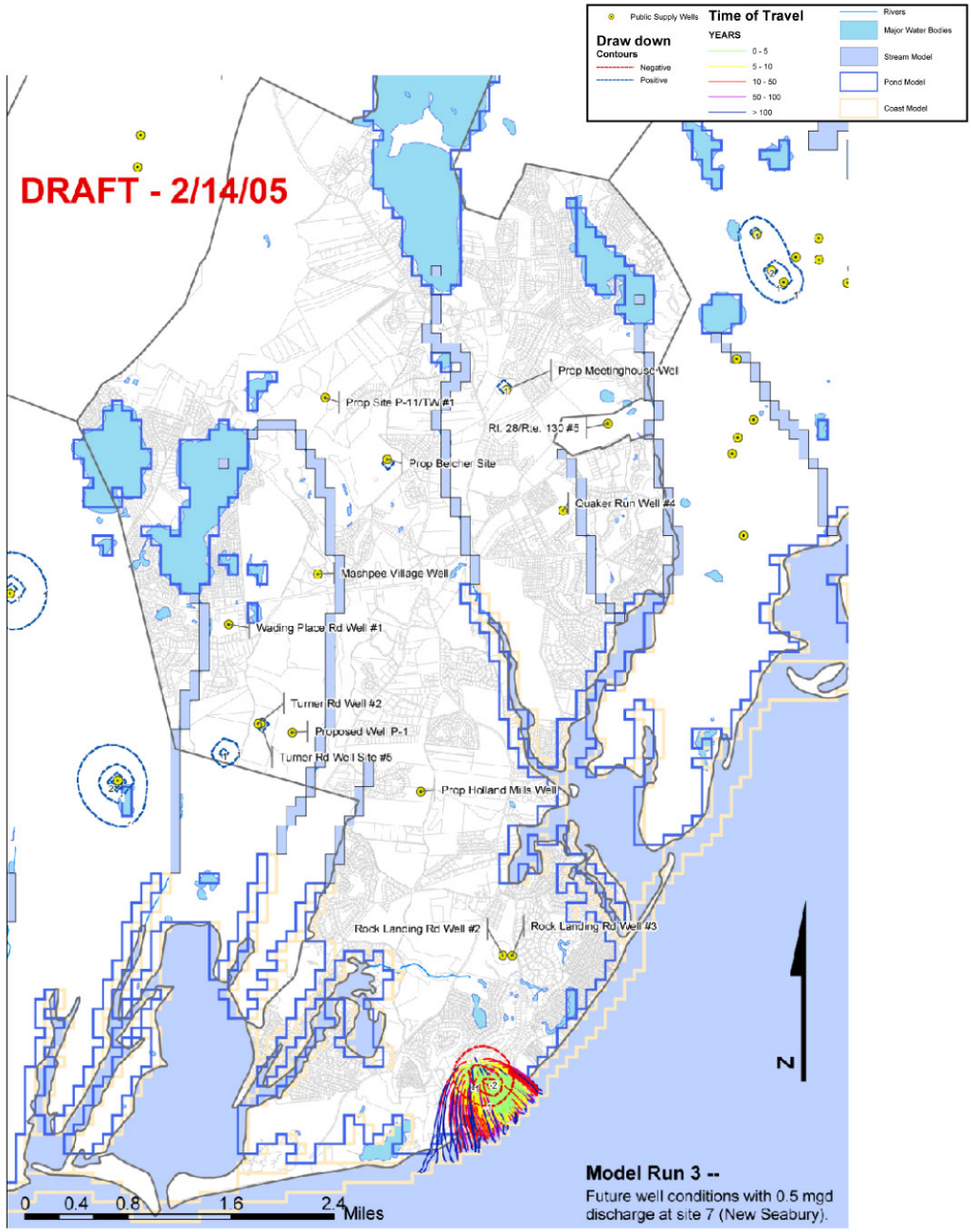
MODEL RUN 2

FIGURE 2-3



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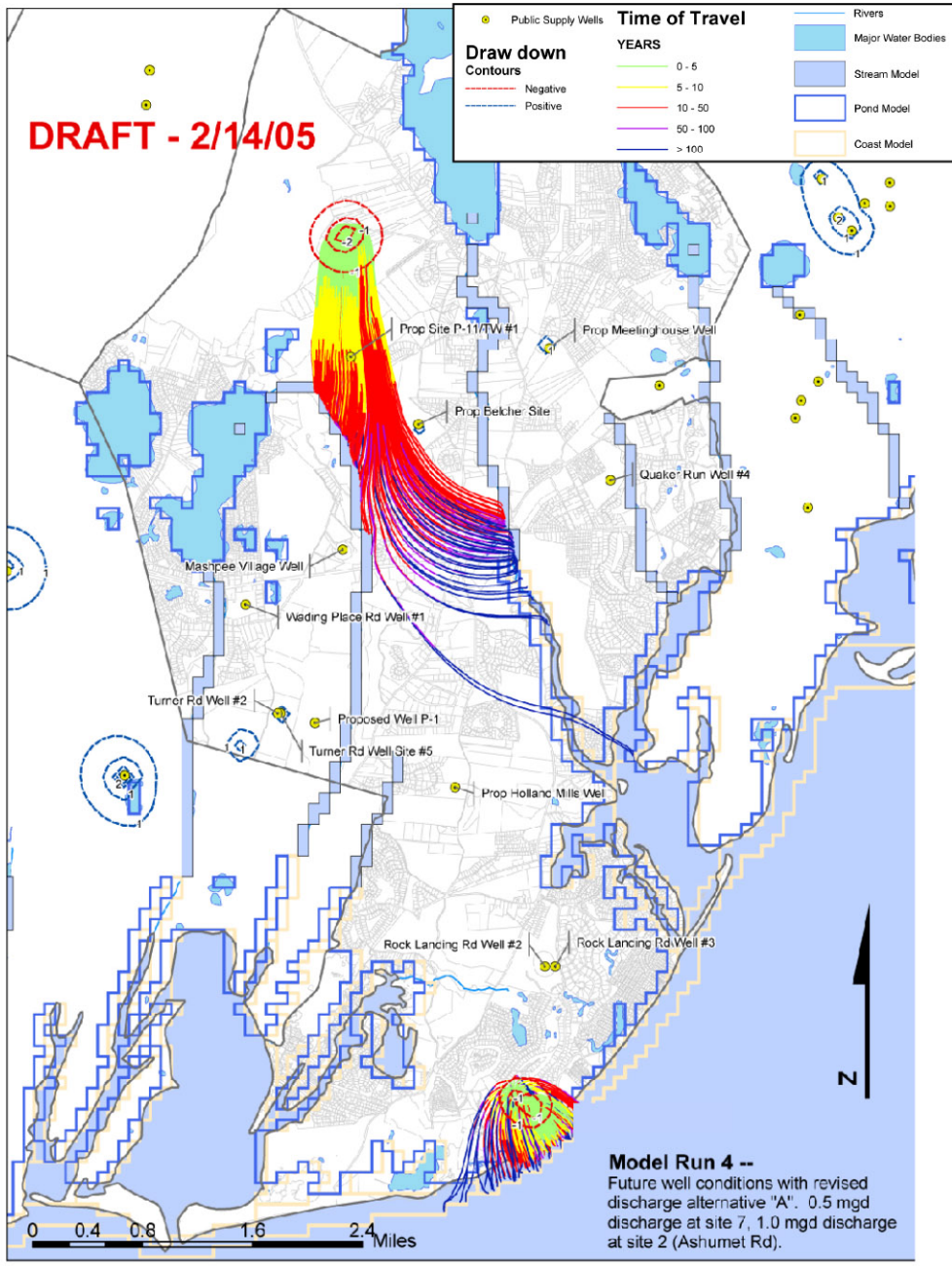
MODEL RUN 3
FIGURE 2-4



Data Source: USGS

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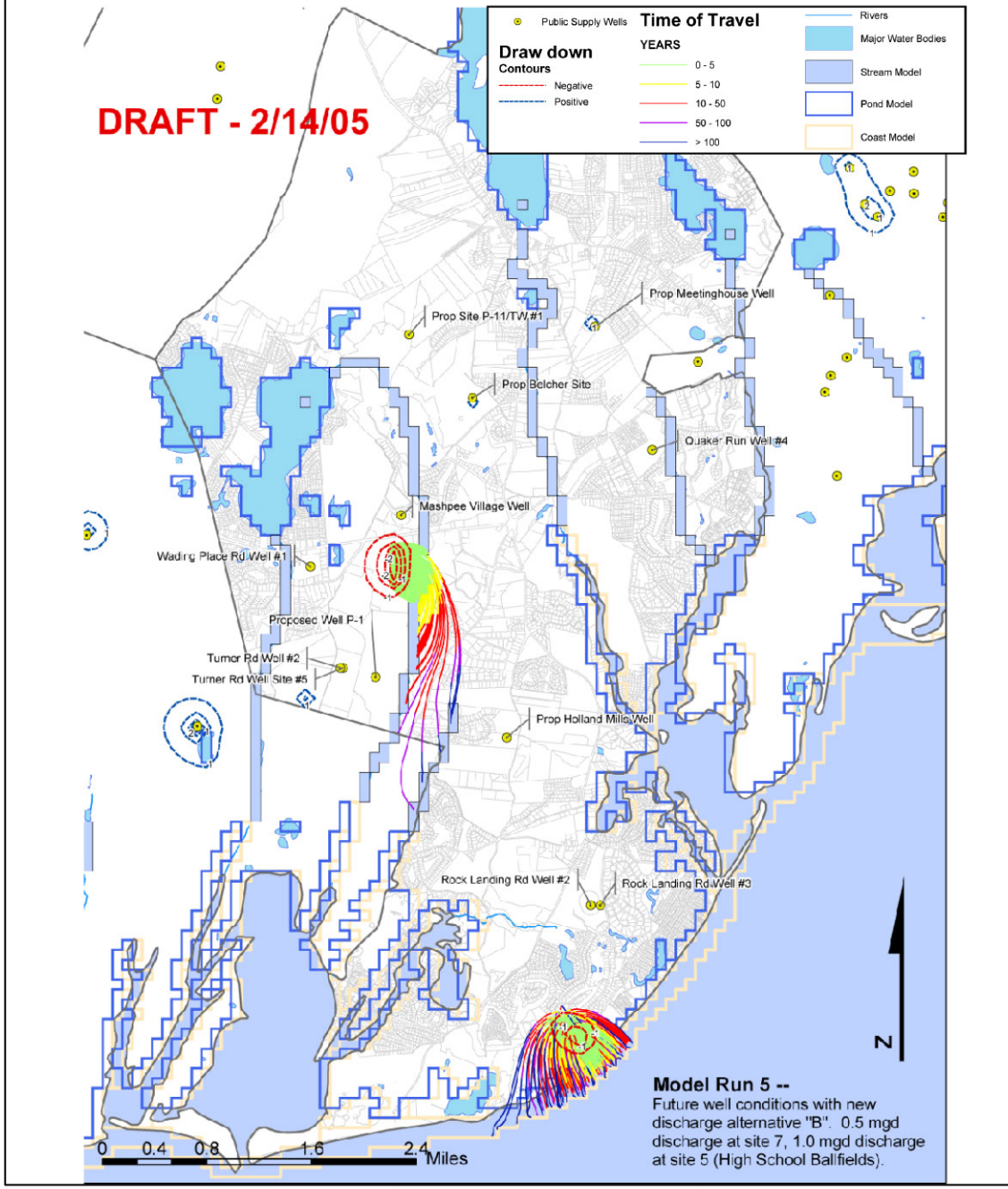
MODEL RUN 4

FIGURE 2-5



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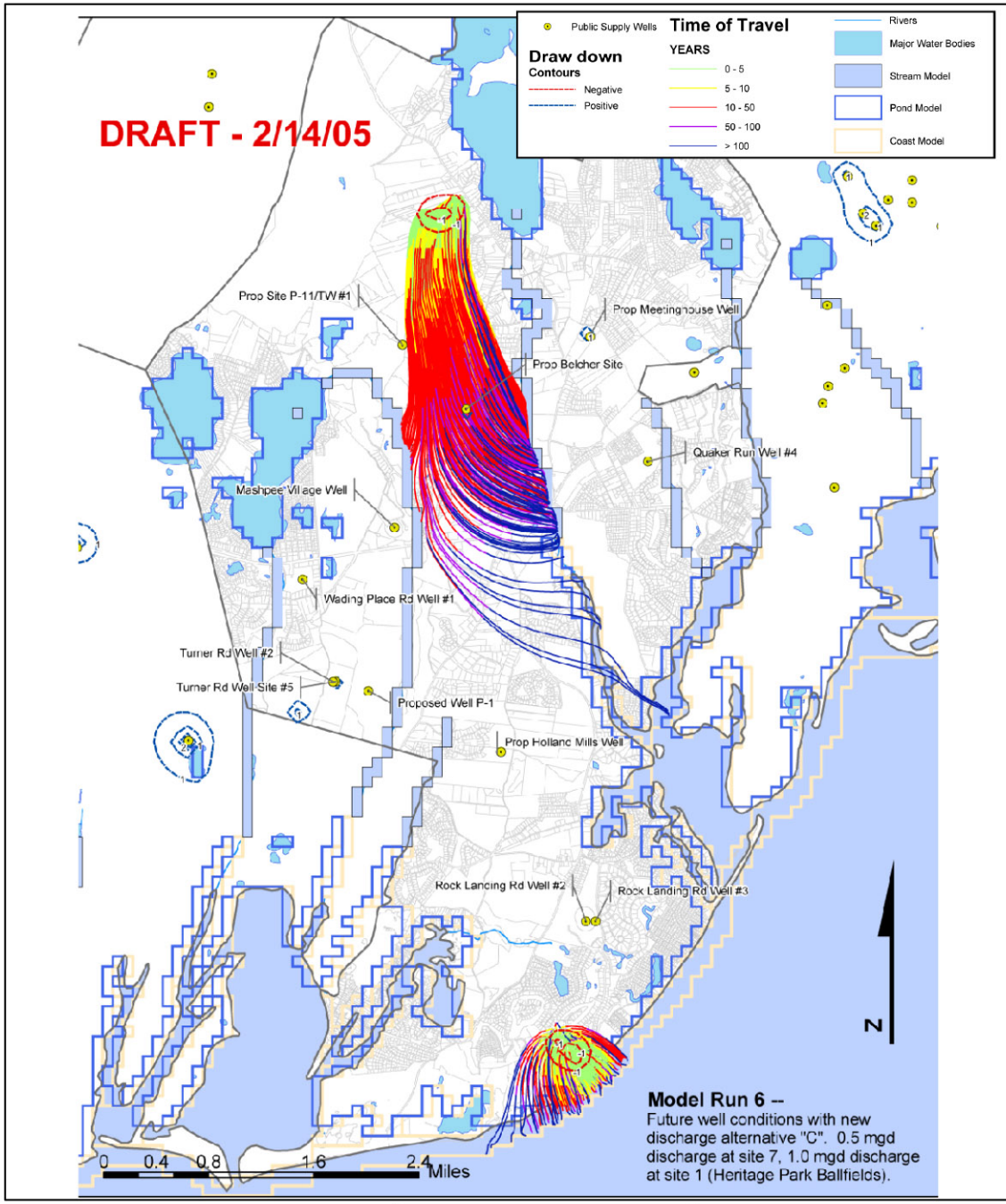
MODEL RUN 5
FIGURE 2-6



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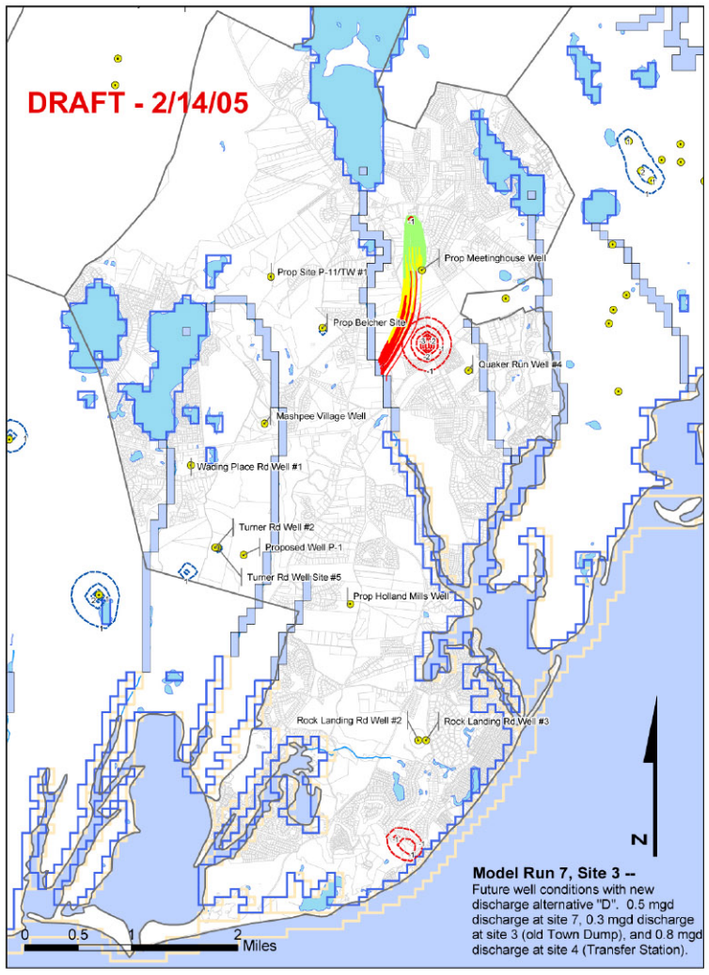
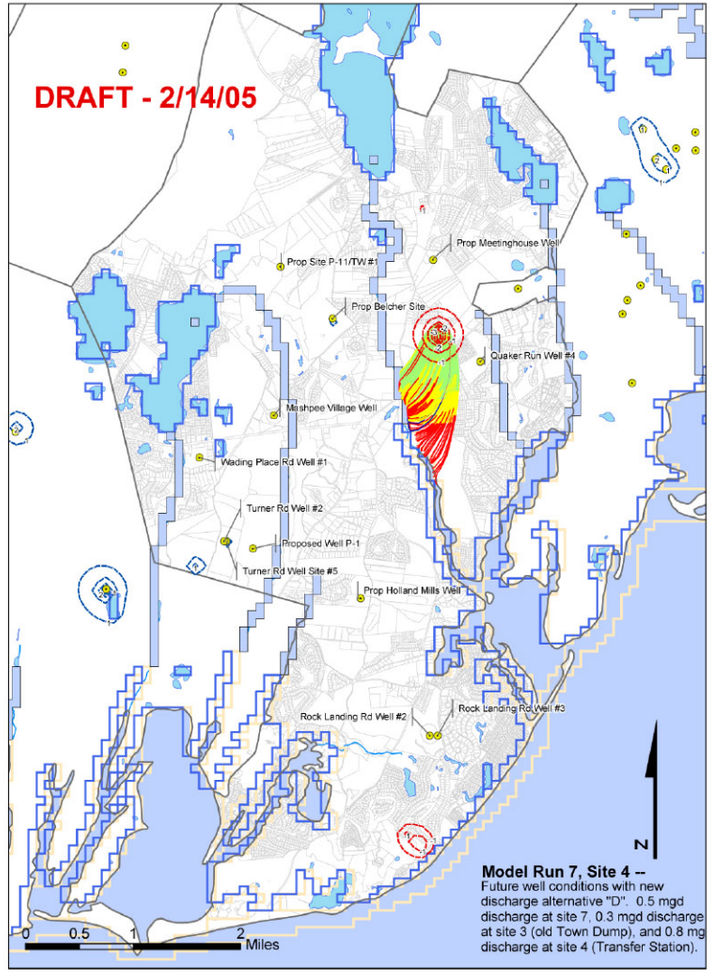
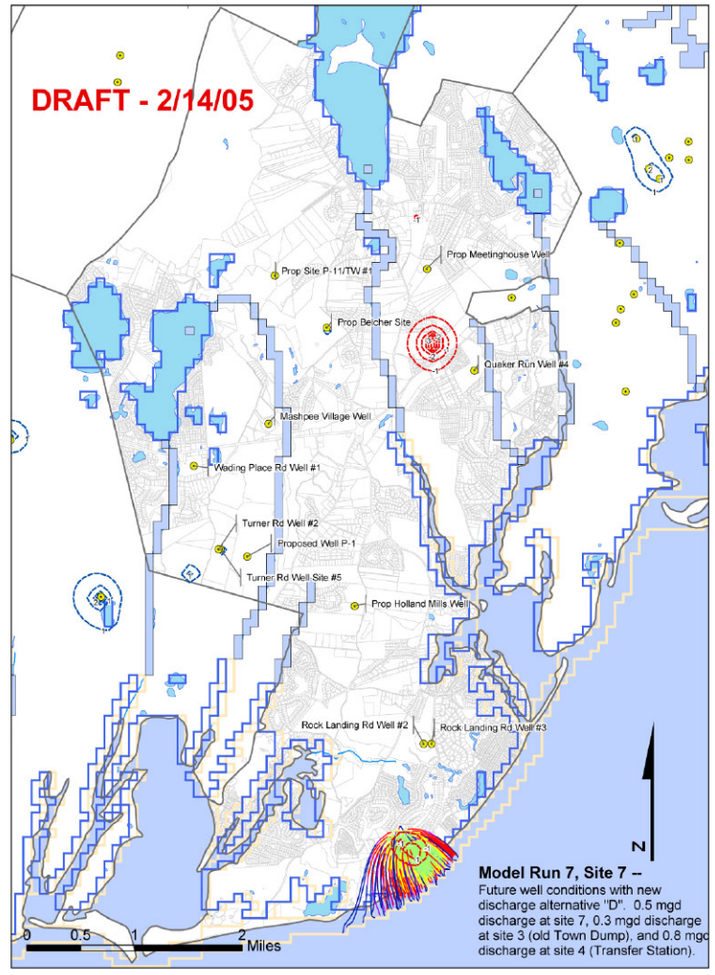
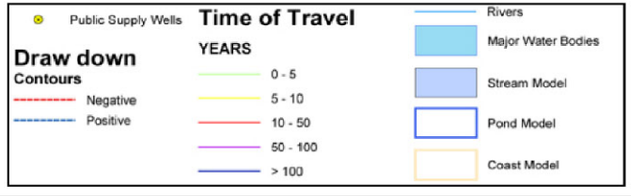
MODEL RUN 6

FIGURE 2-7









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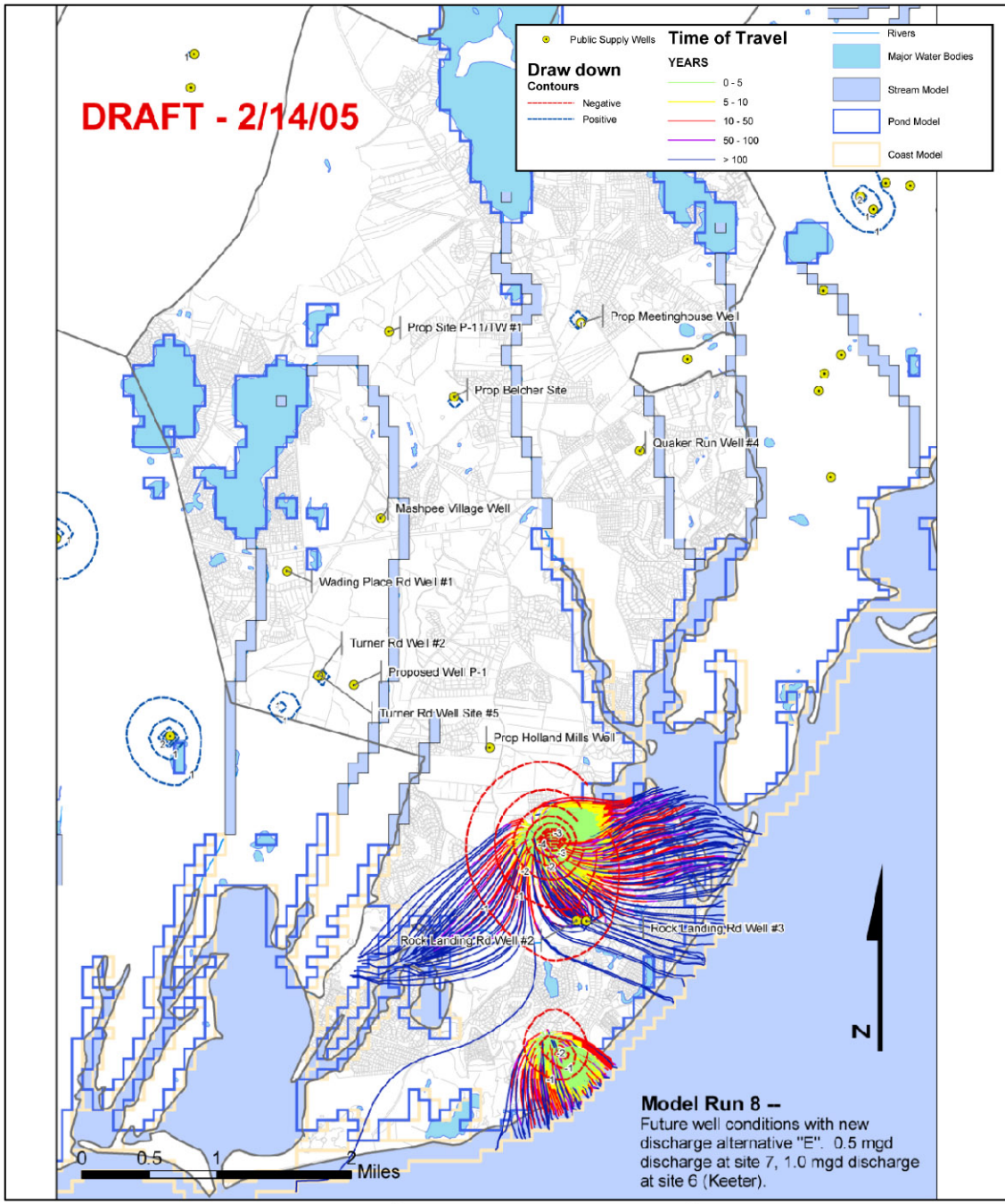
MODEL RUN 7

FIGURE 2-8



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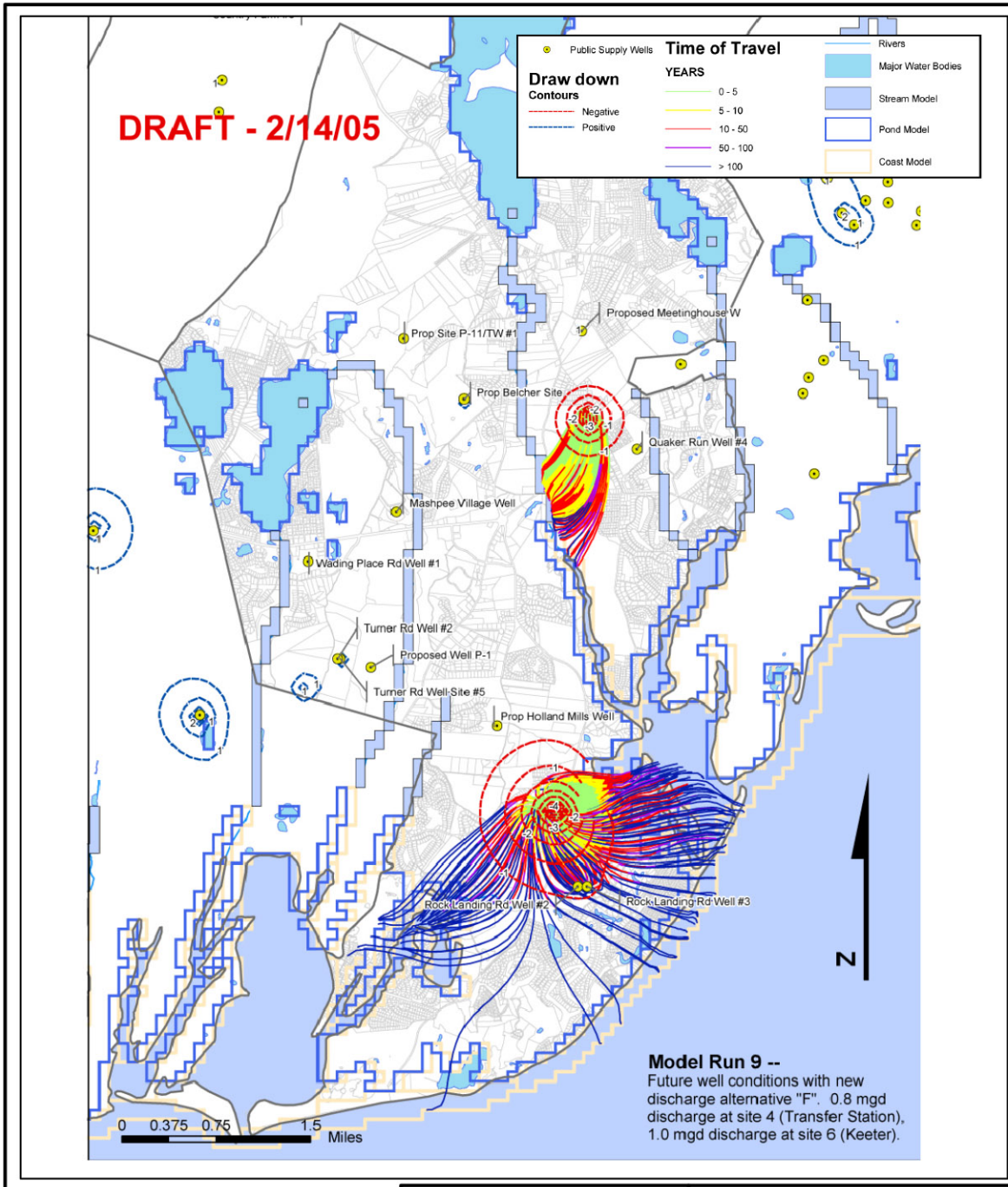
MODEL RUN 8

FIGURE 2-9



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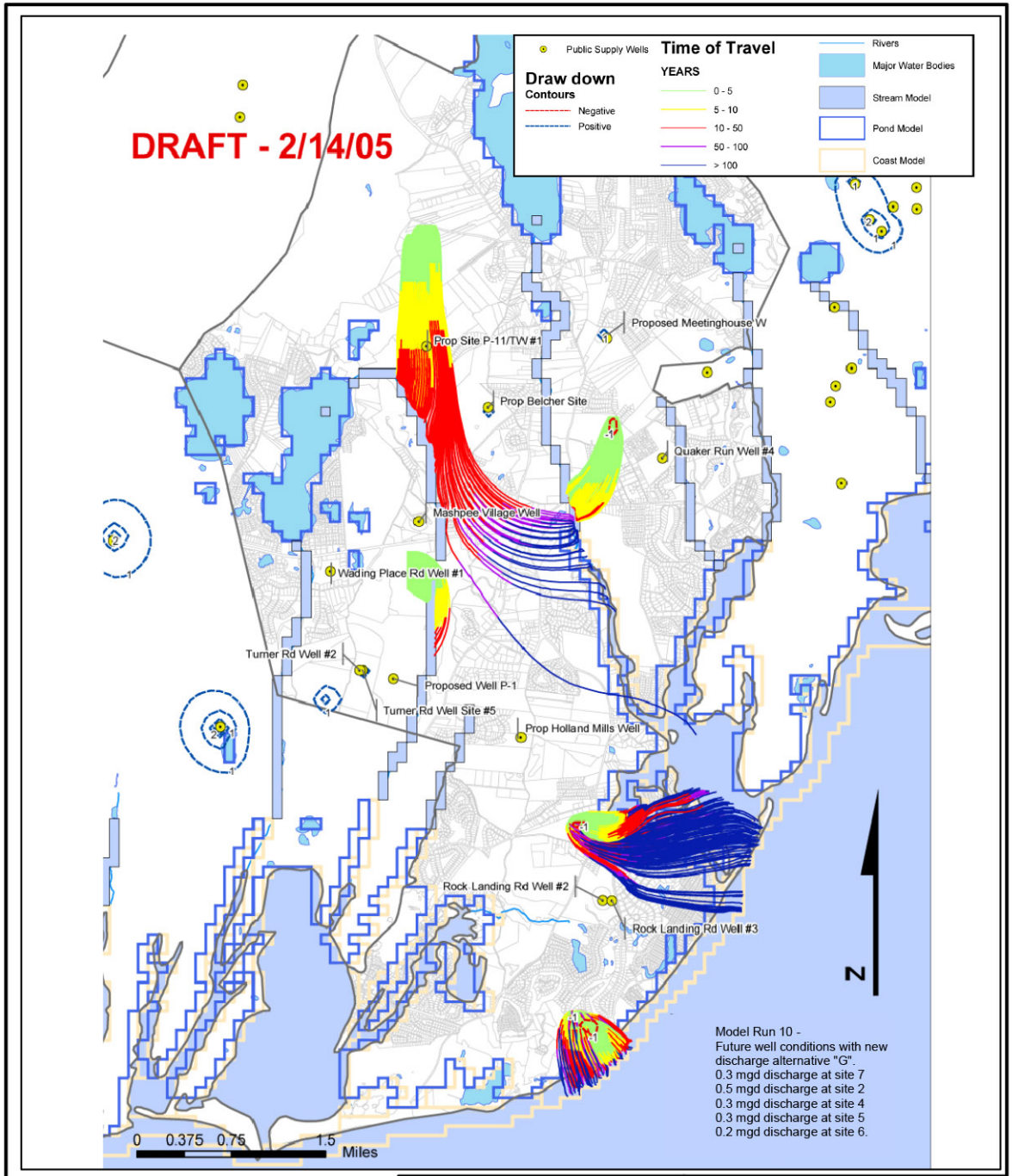
MODEL RUN 9

FIGURE 2-10



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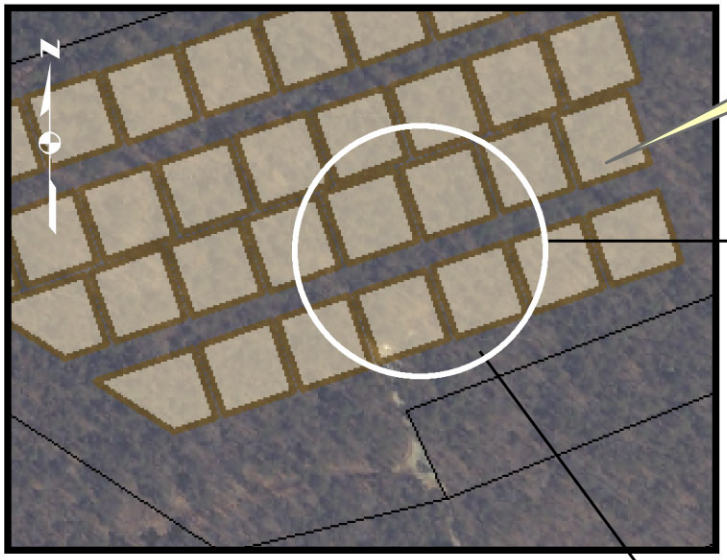
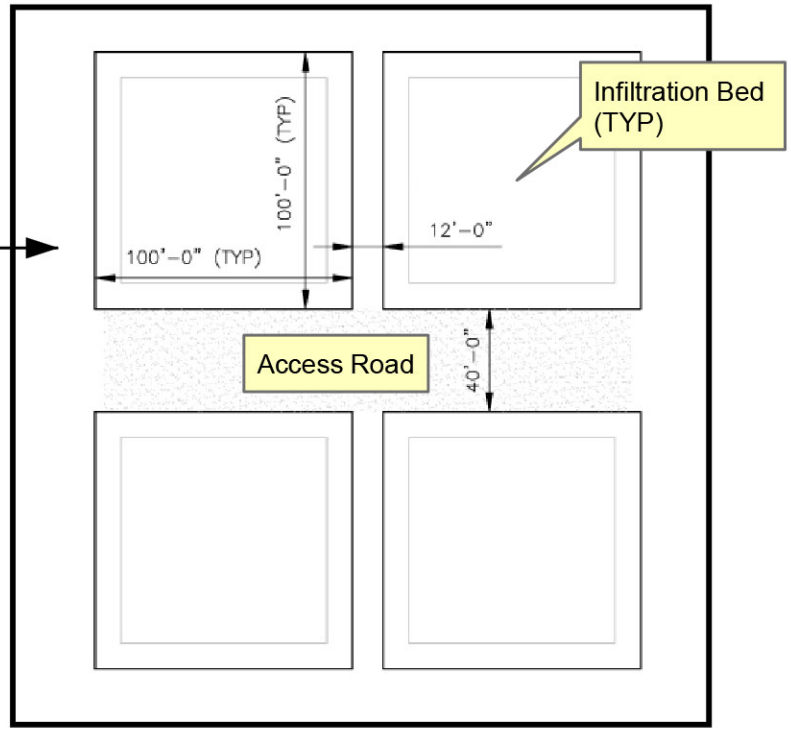
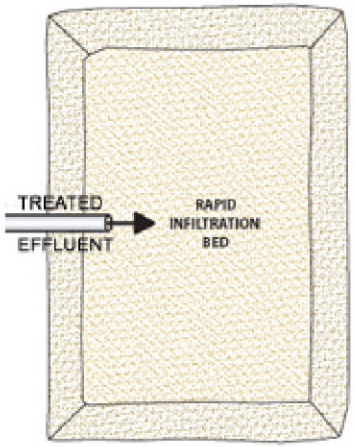
MODEL RUN 10

FIGURE 2-11



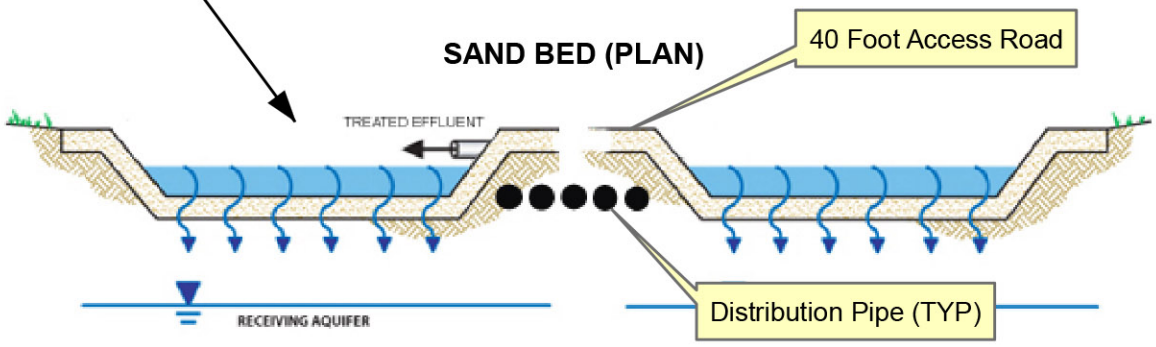
SITE 2 - PLAN (TYP)





PLAN VIEW

SAND BED (PLAN)



CROSS SECTION VIEW

Legend

Sand Bed

Data Source: Mass GIS/Town of Mashpee GIS

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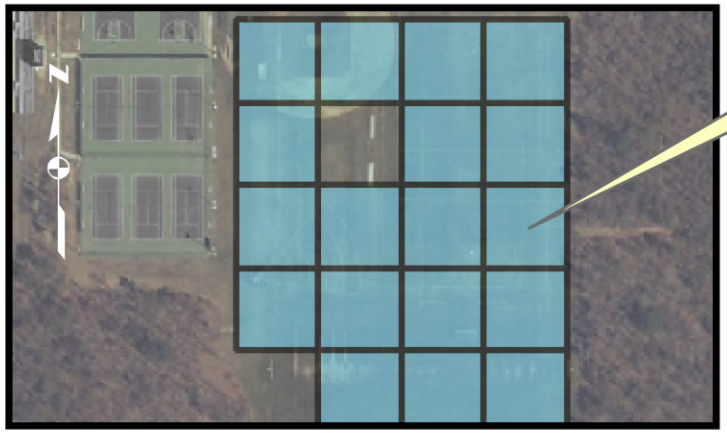
TYPICAL SAND BED LAYOUT

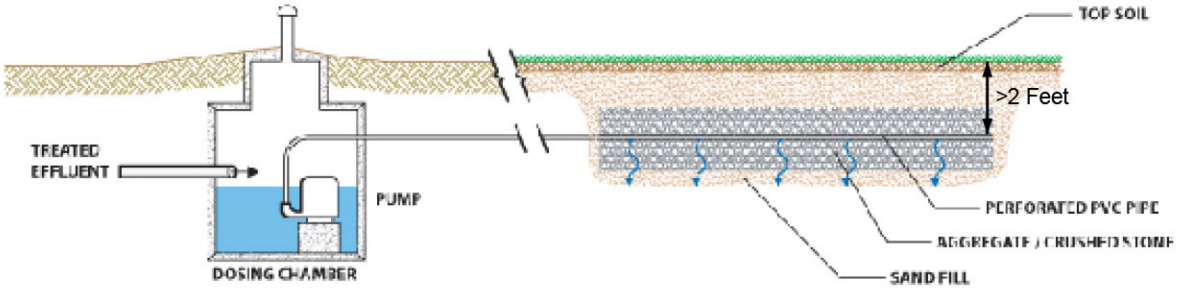
FIGURE 2-12

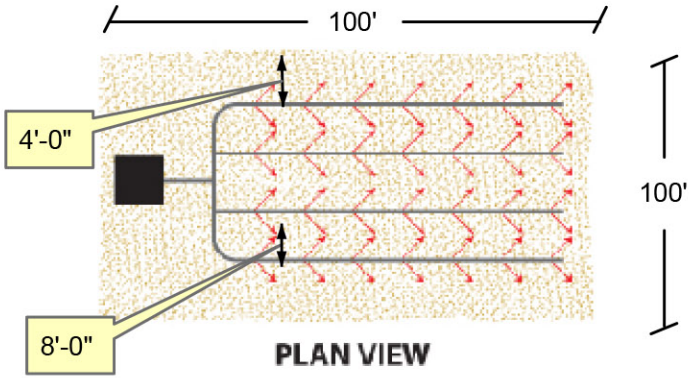


SITE 5 - PLAN (TYP)

SUBSURFACE INFILTRATION (PRESSURE DOSING)

CROSS SECTION VIEW





PLAN VIEW

Legend

Subsurface Infiltration

Data Source: Mass GIS/Town of Mashpee GIS

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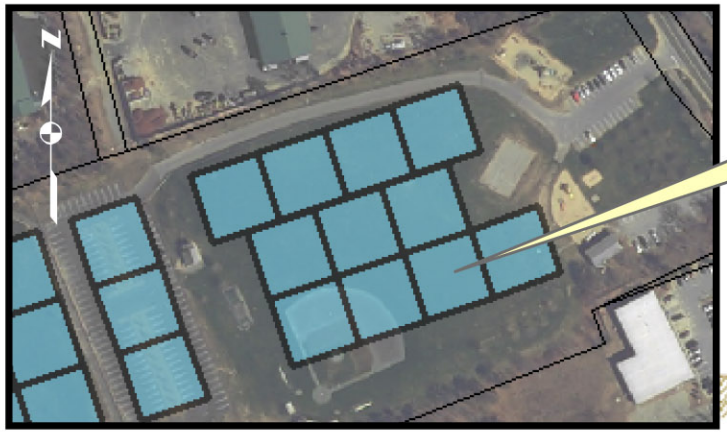
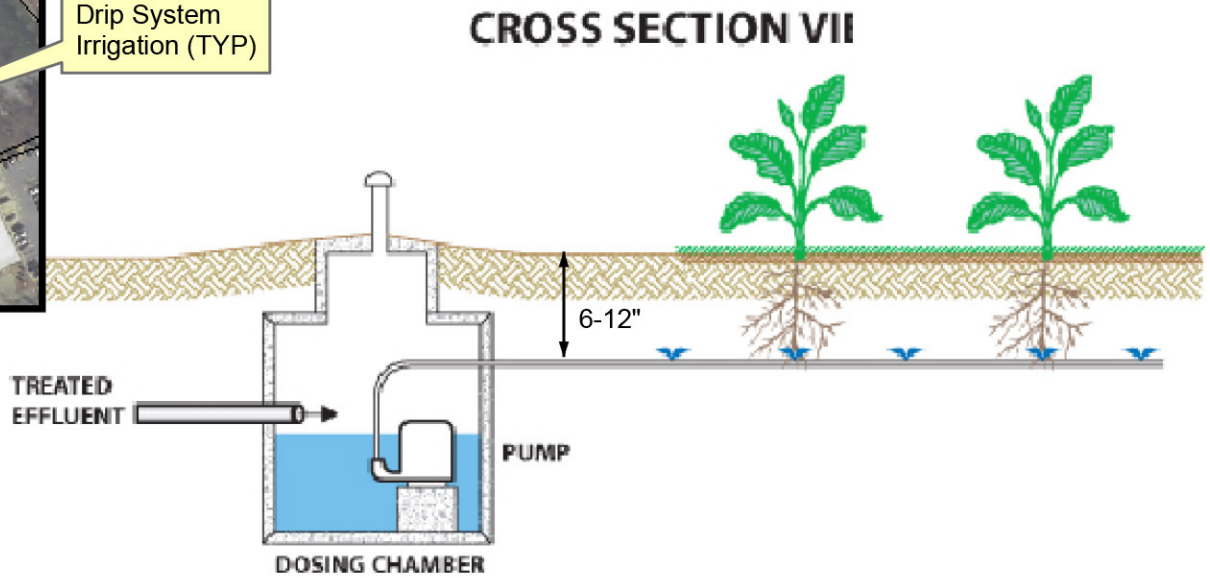
TYPICAL SUB SURFACE INFILTRATION LAYOUT

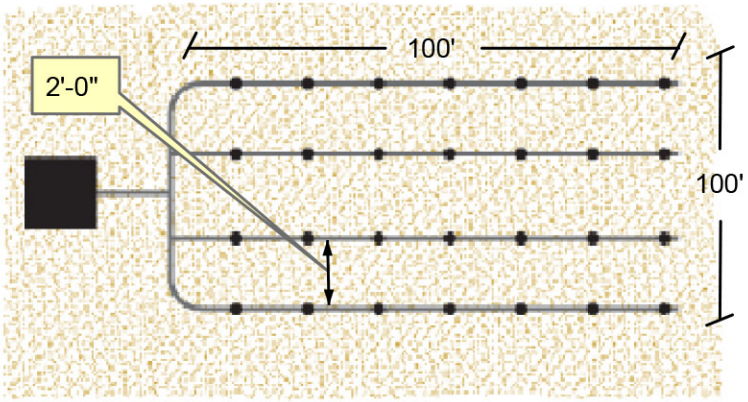
FIGURE 2-13

DRIP SYSTEM IRRIGATION



SITE 1- PLAN





PLAN VIEW

Legend

Subsurface Infiltration

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TYPICAL DRIP SYSTEM IRRIGATION

FIGURE 2-14

TABLE 2-3

PRELIMINARY SITE IDENTIFICATION

Site ID	Description	Map Parcel	Town	Area [2] (acres)	Owner Type	Availability of Land [3]	Existing Land Use	Estimated Soil Type [4]	Estimated Site Access	Abutting Land Use [5]	Sensitive Receptors					Watershed			Potential Aesthetic Impacts (visual, noise, odors)	
											In ACEC	Contains Estimated and Priority Habitats	Contains Wetlands	In Groundwater Protection District	In ZoneII	Name	MEP Removal Requirement (%) [6]	Attenuation	Low; Moderate; High	Historic District
1	Heritage Park Ballfields	27-25	Mashpee	27	Town	Available	Open/Playing Field	Silt Loam	Available	Res/Com	No	Yes	No	Yes	Partially	Mashpee River	41%	Yes	High	No
2	Ashumet Road	26-10	Mashpee	19	Town	Available	Open Space	Silt Loam	Available	Res/Inst	No	Yes	No	Yes	Yes	Quashnet River	67%	No	Moderate	No
3	Old Town Dump	36-39	Mashpee	6	Town	Available	Open Space	Sand	Limited	Res/Com	No	No	No	No	Yes	Mashpee River	41%	Yes	Low	No
4	Transfer Station	61-3	Mashpee	53	Town	Available	Open Space	Loamy Sand	Available	Res	No	No	No	Yes	No	Mashpee River	41%	Yes	High	No
5	High School Ballfields	73-45	Mashpee	135	Town	Available	Open/Playing Field	Loamy Sand	Available	Res/Inst	No	Yes	No	Yes	Yes	Quashnet River	67%	No	High	No
6	Keeter Property	104-2	Mashpee	28	Town	Available	Open Space	Sand	Available	Res	No	Yes	No	Yes	Yes	Ockway Bay	100%	No	Low	No
7	New Seabury Country Club	127-17	Mashpee	16	Private [8]	Not	Golf Course	Sand	Available	Res/Inst	No	Yes	Yes	No	No	No Watershed	0%	No	High	No
8	Great Neck South	95-5,6	Mashpee	57	Conservation	Not	Open Space	Sand	Available	Res, Inst	No	No	No	No	No	Mashpee River (Lower)	100%	No	Low	No
9	Great Hay Road [1]	34-9,10,11	Mashpee	55	Town	Available	Open Space	Loamy Sand	Limited	Res, Inst	No	Yes	No	Yes	Yes	Mashpee River, Quashnet River	67%	No	Low	No
10	72 Cotuit Rd - Sandwich	8-198	Sandwich	106	Conservation	Not	Open Space	Silt Loam	Available	Res, Inst, Agr	No	Yes	No	X [7]	No	Santuit Pond	0%	Yes	Low	No
11	168 Route 130 - Sandwich	17-130	Sandwich	117	Conservation	Potentially	Open Space	Silt Loam	Available	Res, Com, Inst	No	Partially	No	X	Yes	Peter's Pond	0%	Yes	Low	No
12	Bartlett Property	94-3	Mashpee	10	Town	Available	Open Space	Coarse Sand; Sandy Loam	Limited	Conservation	No	Partially	Partially	Partially	Partially	Ockway Bay	100%	No	Low	No
13	Adjacent to HS	79-17	Mashpee	60	Town	Available	Open Space	Sandy Loam	Available	Inst, Res	No	Yes	Yes	Yes	Yes	Quashnet River	67%	No	Low	No

Notes:

1. Multiple lots associated with these sites
2. Estimated based on GIS information
3. Land Availability is based on the type of owner of the property
4. Soil Type based on MassGIS data and the Barnstable County Soil Survey
5. Abutting Land Use:
   - Residential (Res)
   - Commercial (Com)
   - Institutional (Inst) - Municipal, State, Federal, not for profit, etc.
   - Agricultural (Agr)
6. Sites located in multiple watersheds assumes most restrictive nitrogen removal requirement
7. Groundwater Protection Districts are for Mashpee only
8. The New Seabury Country Club is privately owned; however, the Town has indicated that use of this site may be a feasible alternative

TABLE 2-4

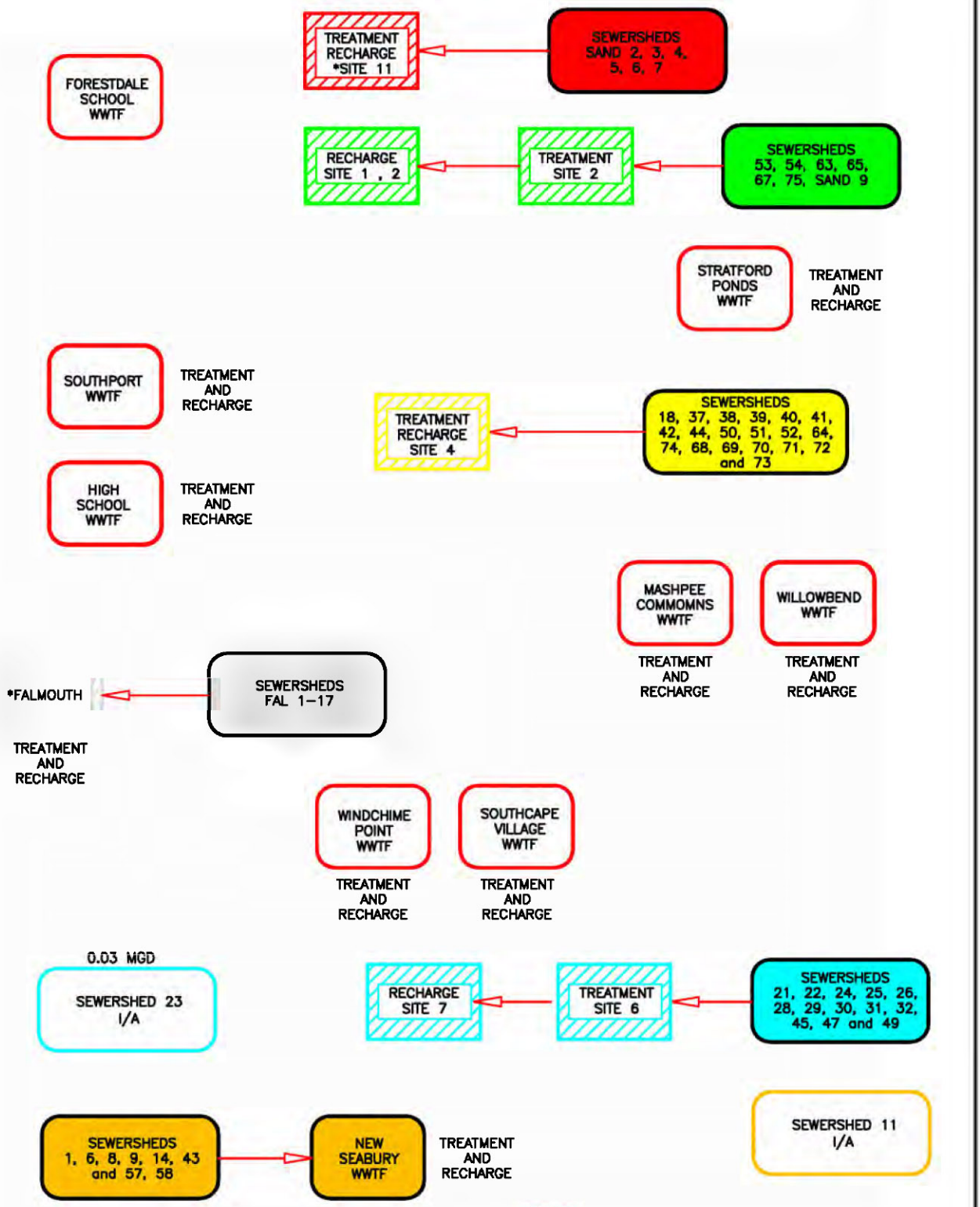
PRELIMINARY SITE SCREENING ANALYSIS [1]

Site ID	Description	Map - Parcel	Town	Owner Type	Availability of land	Soil Type	Estimated Site Access	Abutting Land Use	Sensitive Receptors					Watershed			Potential aesthetic impacts (visual, noise, odors)	Historic District/Site	Total Score [2]	Screening Rank
Mashpee Sites						Estimated			In ACEC	Contains Estimated and Priority Habitats	Contains Wetlands	In Water Protection District	In Zone II	Name	MEP Nitrogen Removal Requirement	Attenuation				
3	Old Town Dump	36-39	Mashpee	0	0	0	5	5	0	0	0	0	10	Mashpee River	20	0	1	0	41	1
4	Transfer Station	61-3	Mashpee	0	0	0	0	10	0	0	0	10	0	Mashpee River	20	0	3	0	43	2
5	High School Ballfields	73-45	Mashpee	0	0	0	0	5	0	10	0	10	10	Quashnet River	10	0	3	0	48	3
8	Great Neck South	95-5,6	Mashpee	5	10	0	0	5	0	0	0	0	0	Mashpee River	20	10	1	0	51	4
2	Ashumet Road	26-10	Mashpee	0	0	5	0	5	0	10	0	10	10	Quashnet River	10	0	2	0	52	5
12	Bartlett Property		Mashpee	0	0	0	5	0	0	5	5	5	5	Ockway Bay	20	10	1	0	56	6
1	Heritage Park Ballfields	27-25	Mashpee	0	0	5	0	5	0	10	0	10	5	Mashpee River	20	0	3	0	58	7
7	New Seabury Country Club	127-17	Mashpee	10	10	0	0	5	0	10	10	0	0	No Watershed	0	10	3	0	58	8
13	Adjacent to HS		Mashpee	0	0	5	0	5	0	10	10	10	10	Quashnet River	10	0	1	0	61	9
9	Great Hay Road	34-9,10,11	Mashpee	0	0	0	5	5	0	10	0	10	10	Mashpee River, Quashnet River	10	10	1	0	61	9
6	Keeter Property	104-2	Mashpee	0	0	0	0	10	0	10	0	10	10	Ockway Bay	20	10	1	0	71	11
Sandwich Sites																				
11	168 Route 130 - Sandwich	17-130	Sandwich	5	5	5	0	5	0	5	0	0	10	Peter's Pond	10	0	1	0	46	1
10	72 Cotuit Rd - Sandwich	8-198	Sandwich	5	10	5	0	5	0	10	0	0	0	Santuit Pond	10	0	1	0	46	1

Notes:

1. Relative ranking based on estimated or known conditions; used for preliminary screening purposes.
2. Total score is the sum of screening values assigned to each category.

RATINGS LEGEND	(The lower the number, the more favorable the rating)
CATEGORY	
Owner Type	Town = 0; Conservation = 5; Private = 10
Estimated Availability of Land	Available = 0; Potential= 5, Not Available = 10
Estimated Soil Type	Good (Sand and Loamy Sand) = 0; Moderate (Sands and Silty Loam) = 5; Poor (Silt or Clay) = 10
Estimated Site Access	Available = 0; Limited = 5, None = 10
Typical Abutting Land Use	All Town = 0; Multiple uses =5; All residential =10
In ACEC	Yes = 10; Partially = 5; No = 0
Priority Habitats	Yes = 10; Partially = 5; No = 0
Wetlands	Yes = 10; Partially = 5; No = 0
In Zone II	Yes = 10; Partially = 5; No = 0
Water Protection District (WPD)	Yes = 10; Partially = 5; No = 0
MEP Nitrogen Removal Requirement (based on MEP septic load reduction %)	0% = 0; 1%-49% = 5; 50%-89% = 10; >90% = 20
Attenuation	Yes = 0; No = 10
Potential Aesthetic Impacts	Low = 1; Medium = 2; High = 3
Historic District or Site	Yes = 10; No = 0



*NOTE:
FINAL SITES TO BE IDENTIFIED BY RESPECTIVE TOWNS AS PART OF THEIR CWMP PROCESS.

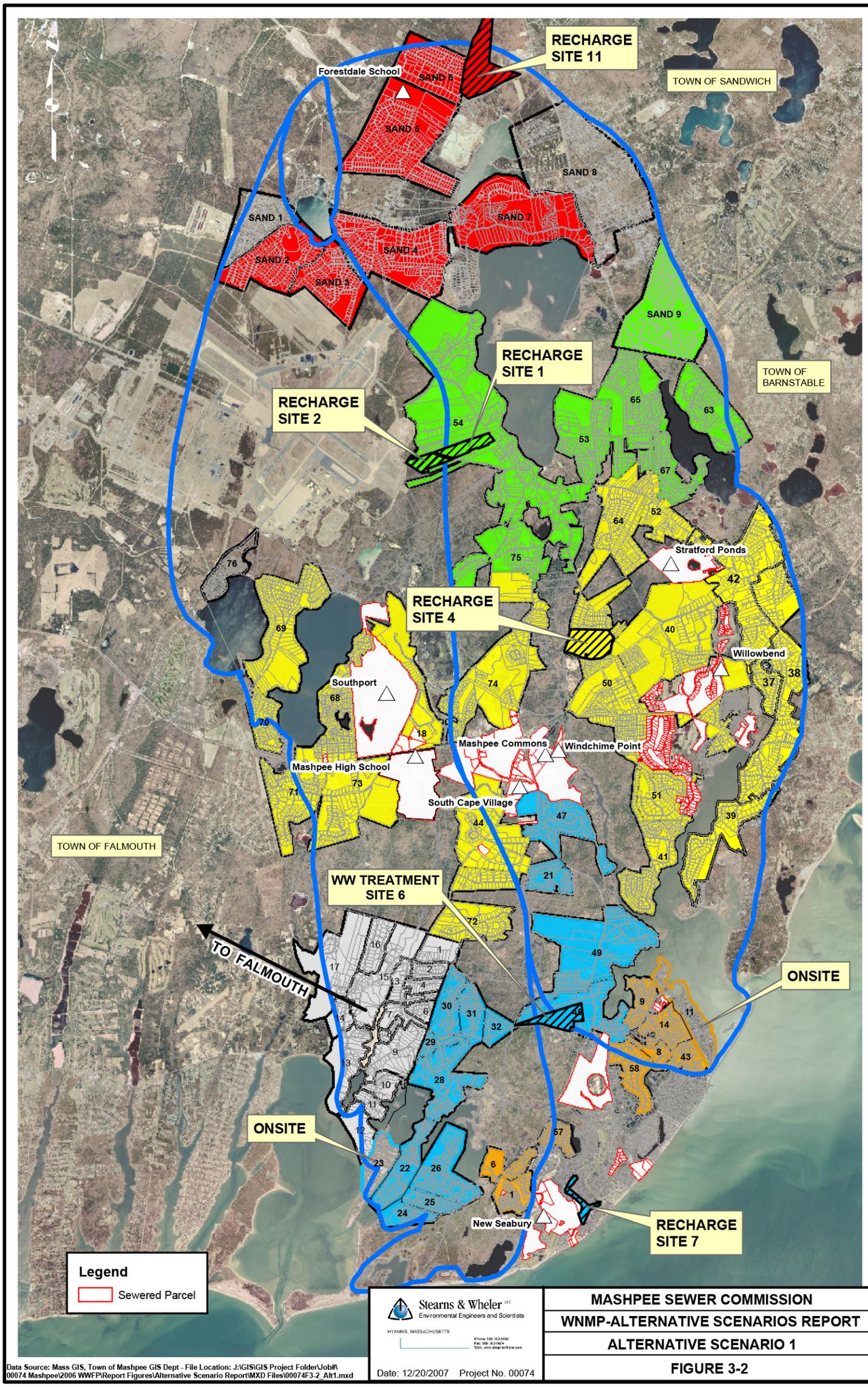
Stearns & Wheler, LLC
Environmental Engineers and Scientists

HYANNIS, MA

DATE:03/08 JOB No.:00074

MASHPEE SEWER COMMISSION
WNMP – ALTERNATIVE SCENARIOS REPORT

FIGURE 3–1
SCENARIO 1 SCHEMATIC



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Data Source: Mass GIS, Town of Mashpee GIS Dept - File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\Alternative Scenario Report\MXD Files\00074F3-2_Alt1.mxd

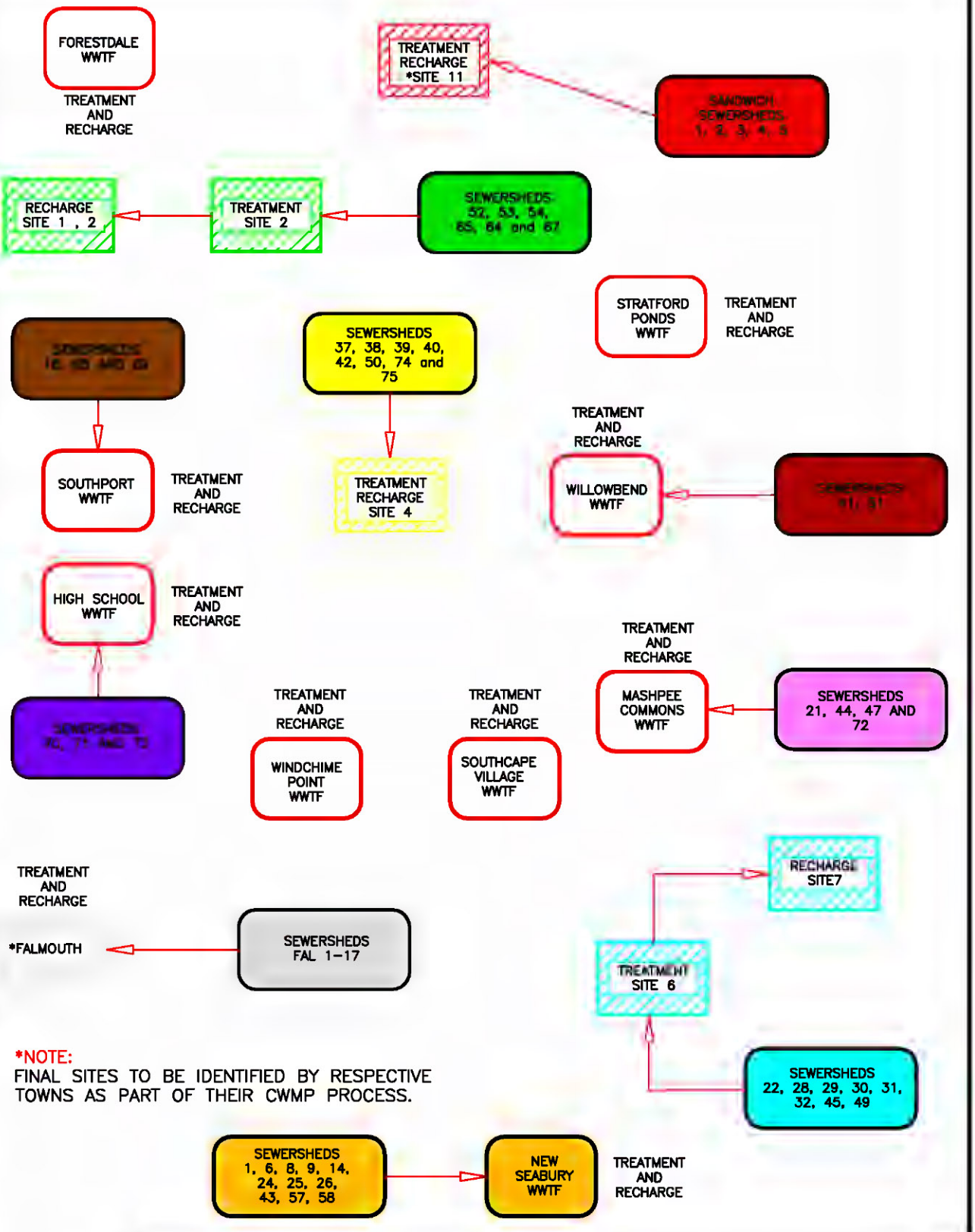
Date: 12/20/2007 Project No. 00074

MASHPEE SEWER COMMISSION

WNMP-ALTERNATIVE SCENARIOS REPORT

ALTERNATIVE SCENARIO 1

FIGURE 3-2



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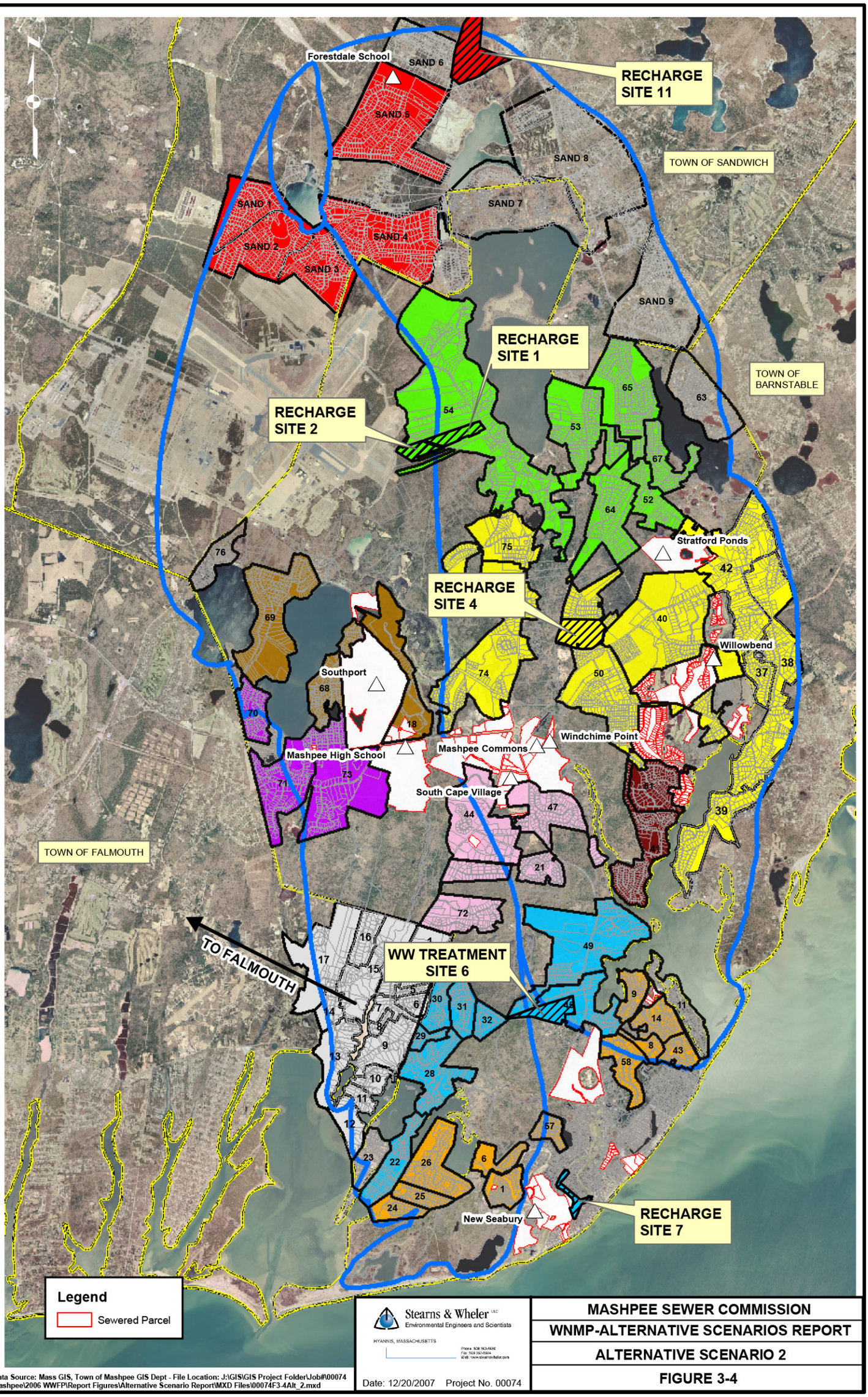
DATE:03/08 JOB No.:00074

MASHPEE SEWER COMMISSION
WNMP – ALTERNATIVE SCENARIOS REPORT

FIGURE 3-3
SCENARIO 2 SCHEMATIC



Data Source: Mass GIS, Town of Mashpee GIS Dept - File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\Alternative Scenario Report\MXD Files\00074F3-4Alt_2.mxd

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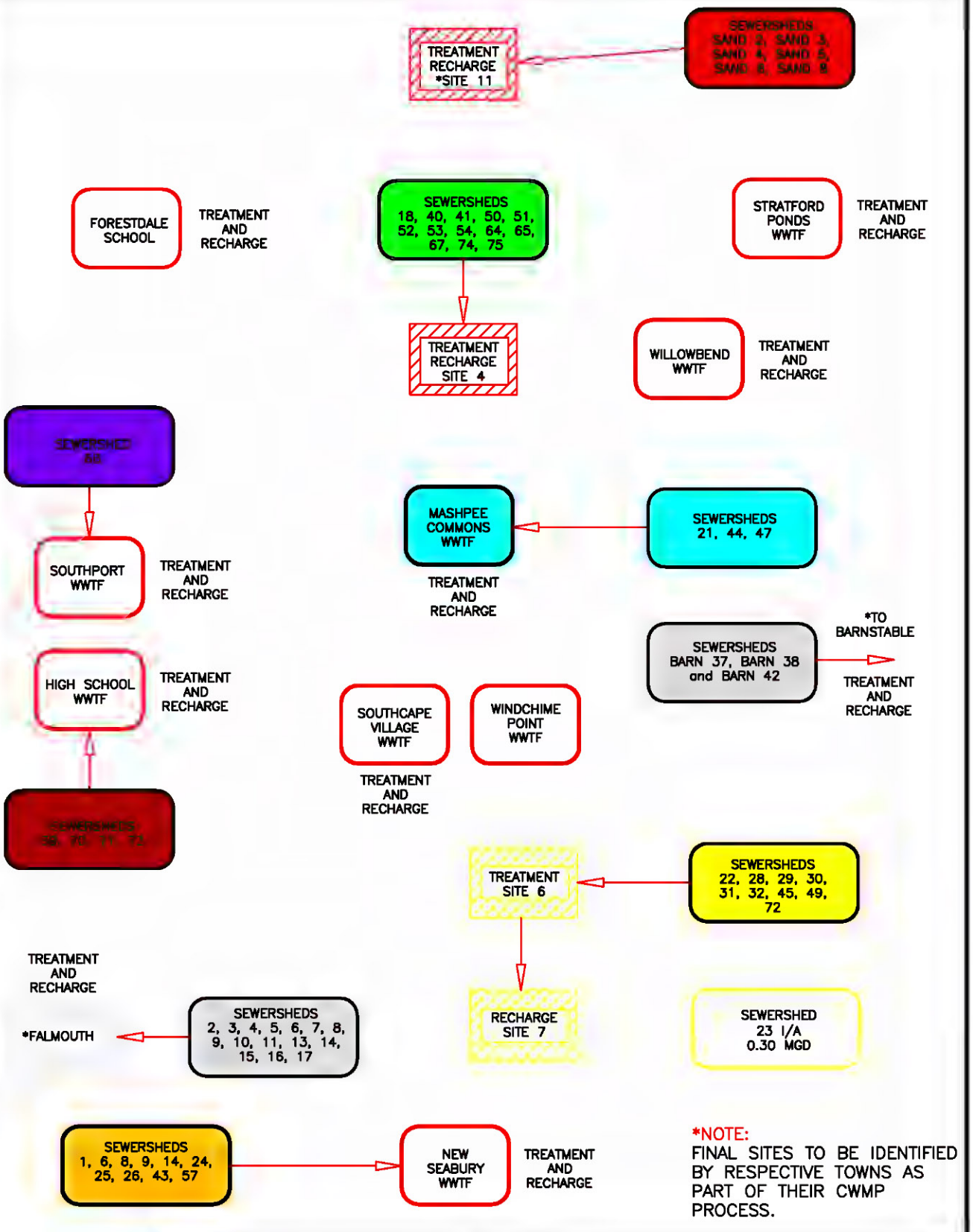
Date: 12/20/2007 Project No. 00074

MASHPEE SEWER COMMISSION

WNMP-ALTERNATIVE SCENARIOS REPORT

ALTERNATIVE SCENARIO 2

FIGURE 3-4



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DATE:03/08 JOB No.:00074

MASHPEE SEWER COMMISSION
WNMP – ALTERNATIVE SCENARIOS REPORT

FIGURE 3–5
SCENARIO 4 SCHEMATIC

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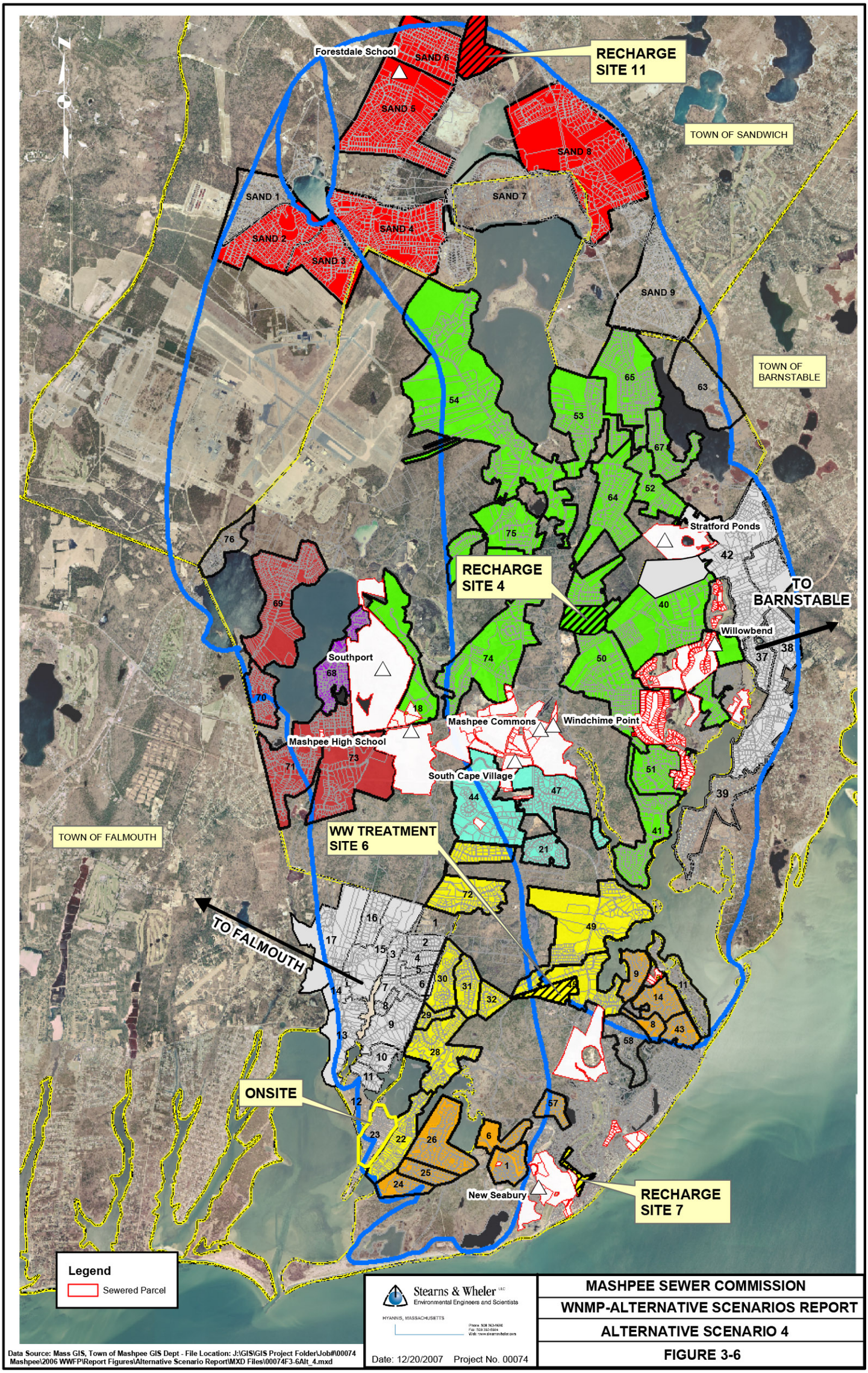
JJO HYANNIS 3/08



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HYANNIS, MASSACHUSETTS

Date: 12/20/2007 Project No. 00074

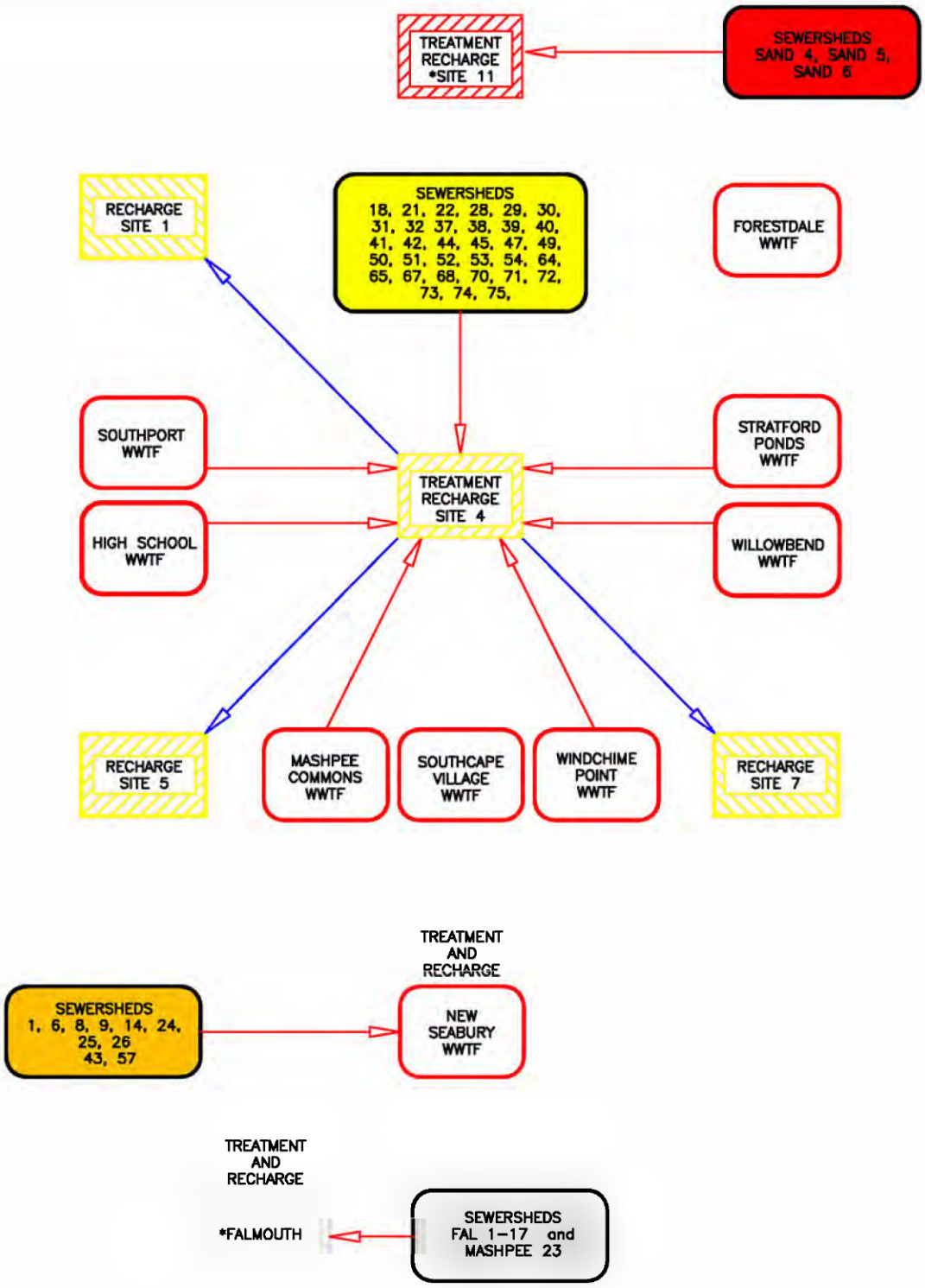
Data Source: Mass GIS, Town of Mashpee GIS Dept - File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\Alternative Scenario Report\MXD Files\00074F3-6Alt_4.mxd

MASHPEE SEWER COMMISSION

WNMP-ALTERNATIVE SCENARIOS REPORT

ALTERNATIVE SCENARIO 4

FIGURE 3-6



* NOTE:
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Environmental Engineers and Scientists

HYANNIS, MA

DATE:03/08 JOB No.:00074

MASHPEE SEWER COMMISSION
WNMP – ALTERNATIVE SCENARIO REPORT

FIGURE 3-7
SCENARIO 5 SCHEMATIC

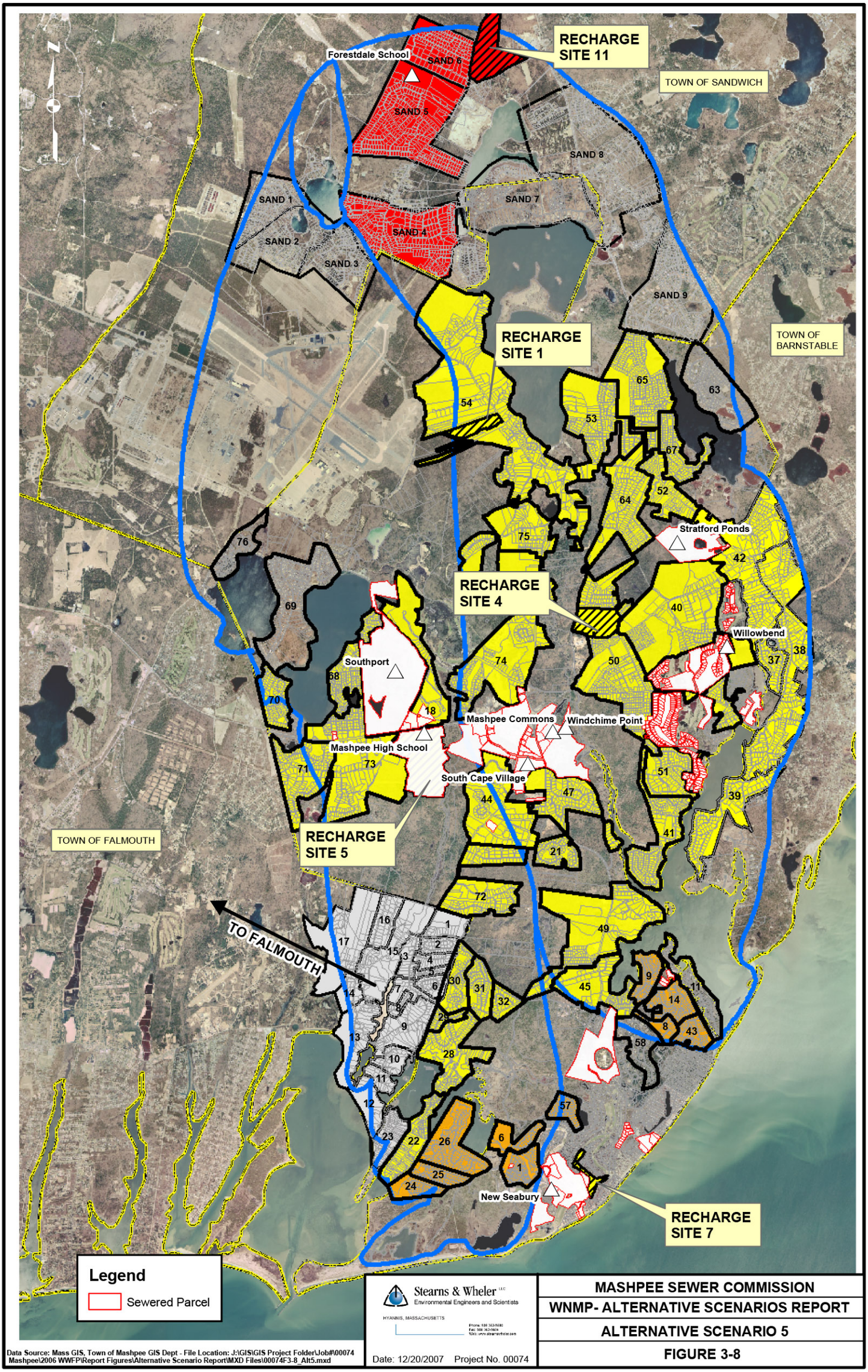

RECHARGE SITE 11
Forestdale School
SAND 6
SAND 5
TOWN OF SANDWICH
SAND 8
SAND 1
SAND 7
SAND 4
SAND 2
SAND 3
SAND 9
RECHARGE SITE 1
TOWN OF BARNSTABLE
Stratford Ponds
RECHARGE SITE 4
Willowbend
Southport
Mashpee Commons
Windchime Point
Mashpee High School
South Cape Village
RECHARGE SITE 5
TOWN OF FALMOUTH
TO FALMOUTH
New Seabury
RECHARGE SITE 7
Legend
Sewered Parcel
Data Source: Mass GIS, Town of Mashpee GIS Dept - File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\Alternative Scenario Report\MXD Files\00074F3-8_Alt5.mxd
Stearns & Wheler LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS
Date: 12/20/2007 Project No. 00074
MASHPEE SEWER COMMISSION
WNMP- ALTERNATIVE SCENARIOS REPORT
ALTERNATIVE SCENARIO 5
FIGURE 3-8

TABLE 3-3

SUMMARY OF WASTEWATER TREATMENT AND RECHARGE

		Scenario 1		Scenario 2		Scenario 4		Scenario 5	
Facility Name/Location	**Permitted Flow (existing facilities)**	**Average Annual (gpd)**	**Maximum Month (gpd)**	**Average Annual (gpd)**	**Maximum Month (gpd)**	**Average Annual (gpd)**	**Maximum Month (gpd)**	**Average Annual (gpd)**	**Maximum Month (gpd)**
Wastewater Treatment Facilities									
Southport	172,000	110,000	140,000	260,000	330,000	130,000	170,000	-	-
High School	18,000	4,000	5,000	110,000	150,000	160,000	230,000	-	-
Windchime Point	40,000	22,000	31,000	22,000	31,000	22,000	30,000	-	-
Willowbend	113,000	60,000	108,000	105,000	188,000	60,000	110,000	-	-
New Seabury	300,000	180,000	250,000	210,000	300,000	200,000	280,000	200,000	280,000
Forestdale School	20,000	1,000	2,100	1,000	2,100	1,000	2,100	-	-
South Cape Village	24,000	16,000	18,000	16,000	18,000	16,000	20,000	-	-
Stratford Ponds	35,500	21,000	27,000	21,000	27,000	21,000	30,000	-	-
Mashpee Commons (upgrading to MBR)	180,000	120,000	180,000	270,000	400,000	230,000	350,000	-	-
Falmouth	-	100,000	150,000	100,000	150,000	94,000	140,000	100,000	150,000
Barnstable	-	-	-	-	-	93,000	140,000	-	-
Site 2	-	470,000	690,000	290,000	430,000	-	-	-	-
Site 4	-	810,000	1,190,000	390,000	580,000	690,000	1,000,000	1,500,000	2,200,000
Site 6	-	200,000	290,000	100,000	150,000	130,000	200,000	-	-
Site 11	-	260,000	390,000	220,000	330,000	270,000	400,000	150,000	220,000
Total Treated	**-**	**2,400,000**	**3,500,000**	**2,100,000**	**3,100,000**	**2,100,000**	**3,100,000**	**2,000,000**	**2,900,000**
Treated Water Recharge Sites	**Estimated Capacity**								
Site 1 (subsurface)	640,000	340,000	495,000	-	-	-	-	200,000	880,000
Site 2 (sand)	1,700,000	130,000	198,000	290,000	430,000	-	-	-	-
Site 4 (sand)	1,200,000	810,000	1,190,000	390,000	580,000	690,000	1,000,000	1,000,000	1,000,000
Site 5 (subsurface)	470,000	-	-	-	-	-	-	66,000	97,000
Site 7 (subsurface)	250,000	200,000	290,000	100,000	150,000	130,000	200,000	200,000	200,000
Site 11 (sand)	1,200,000	260,000	390,000	220,000	330,000	270,000	400,000	150,000	220,000
Falmouth	-	100,000	150,000	100,000	150,000	94,000	140,000	100,000	150,000
Barnstable	-	-	-	-	-	93,000	140,000	-	-
Southport	170,000	110,000	140,000	260,000	330,000	130,000	170,000	-	-
High School	20,000	3,500	5,000	110,000	150,000	160,000	230,000	-	-
Windchime Point	40,000	22,000	31,000	22,000	31,000	22,000	30,000	-	-
Willowbend	110,000	60,000	110,000	100,000	190,000	60,000	110,000	-	-
New Seabury	300,000	180,000	250,000	210,000	300,000	200,000	280,000	200,000	280,000
South Cape Village	20,000	16,000	18,000	16,000	18,000	16,000	18,000	-	-
Stratford Ponds	40,000	21,000	27,000	21,000	27,000	21,000	27,000	-	-
Mashpee Commons (upgrading to MBR)	180,000	120,000	180,000	270,000	400,000	230,000	350,000	-	-
Total Recharged	**-**	**2,400,000**	**3,500,000**	**2,100,000**	**3,100,000**	**2,100,000**	**3,100,000**	**1,900,000**	**2,800,000**

TABLE 4-1

SCENARIO 1 INFRASTRUCTURE SUMMARY

Sewershed	Wastewater Flows (gpd)		Pipe length(ft)	Pumping Stations	Gravity Sewer (lf)	Pressure Sewer (lf)	Properties on Gravity Sewer	Properties on Pressure Sewer	Force Main Length (lf)
	Existing	Future							
1	15,000	43,400	5,700	1	5,700	0	116	0	3,300
6	9,700	11,000	4,500	1	2,500	1,900	42	5	1,000
8	1,200	1,800	3,100	1	3,100	0	16	0	12,000
9	10,000	12,000	5,000	1	4,400	600	101	10	3,000
14	15,000	16,000	6,400	1	6,400	0	113	0	700
18	13,000	73,000	9,500	1	3,400	6,200	1	8	4,500
22	10,000	13,000	5,500	1	5,500	0	102	0	5,000
24	5,000	6,000	3,600	1	3,600	0	75	0	2,100
25	6,000	8,000	3,400	1	3,400	0	54	0	3,100
26	18,000	20,000	5,400	1	5,400	0	81	0	13,000
28	13,000	16,000	9,200	1	8,500	700	136	10	1,100
29	4,000	5,000	14,000	1	4,900	9,500	69	41	1,100
30	10,000	12,000	1,900	1	1,900	0	34	0	1,500
31	10,000	12,000	6,600	1	4,300	2,400	69	14	800
32	2,000	3,000	4,800	1	4,300	400	80	1	3,800
37(Barnstable)	12,000	12,000	2,400	1	2,400	0	25	0	2,700
38(Barnstable)	47,000	47,000	5,600	1	3,900	1,700	51	11	3,300
39(Barnstable)	20,000	20,000	46,000	1	8,700	37,000	68	193	1,900
40	46,000	110,000	15,000	1	11,000	3,600	101	21	3,400
41	24,000	27,000	17,000	1	8,700	8,300	62	14	4,600
21	14,000	14,000	24,000	1	11,000	13,000	105	110	2,000
42(Barnstable)	35,000	35,000	42,000	1	2,800	39,000	40	179	4,300
43	9,000	9,000	5,900	1	5,900	0	94	0	700
44	31,000	77,000	22,000	1	6,700	16,000	40	35	5,500
45	8,000	14,000	13,000	1	7,200	5,600	60	34	2,300
47	14,000	23,000	10,500	1	8,800	1,600	81	34	5,500
49	18,000	27,000	22,000	1	8,800	13,000	71	61	700
50	66,000	83,000	57,000	1	20,000	37,000	272	189	5,700
51	12,000	18,000	6,600	1	6,600	0	86	0	1,600
52	9,000	12,000	11,000	1	6,000	4,600	63	28	100
53	28,000	38,000	26,000	1	13,000	13,000	164	80	2,000
54	57,000	140,000	17,000	1	7,200	9,300	57	194	4,700
57	7,000	8,000	4,600	1	4,600	0	87	0	2,800
58	8,000	10,000	6,000	0	6,000	0	65	0	2,500
63	29,000	32,000	14,000	1	9,000	4,800	150	13	4,100
64	23,000	31,000	19,000	1	12,000	6,400	139	24	4,200
65	41,000	45,000	32,000	1	16,000	16,000	217	113	1,000
67	24,000	24,000	16,400	1	11,000	5,300	152	36	7,100
68	22,000	26,000	23,000	1	7,700	16,000	137	100	1,800
69	29,000	52,000	31,000	1	12,000	19,000	197	106	4,200
70	15,000	16,000	11,000	1	6,700	4,400	91	34	5,400
71	21,000	25,000	14,000	1	11,000	3,400	140	25	5,200
72	24,000	31,000	26,000	1	4,400	21,000	48	90	2,900
73	35,000	65,000	34,000	1	5,100	29,000	54	127	4,000
74	38,000	74,000	29,000	1	18,000	11,000	167	64	4,200
75	12,000	18,000	16,000	1	3,900	12,000	36	68	2,200
Fal 1	6,500	6,200	3,400	1	2,000	1,300	15	14	1,200
Fal 10	4,600	3,800	1,700	1	1,700	0	22	0	2,300
Fal 11	3,800	2,800	930	1	900	0	16	0	1,100
Fal 12	3,400	3,400	2,000	1	2,000	0	20	0	2,200
Fal 13	7,900	9,300	4,500	1	2,400	2,200	27	25	2,400
Fal 14	3,800	3,600	1,600	1	1,600	0	13	0	1,400
Fal 15	9,000	11,000	6,300	1	3,300	3,100	31	20	1,100
Fal 16	7,700	7,000	2,300	1	2,300	0	26	0	3,000
Fal 17	9,000	17,000	10,000	1	6,900	3,500	49	36	0
Fal 2	6,100	7,800	3,200	1	3,200	0	45	0	1,400
Fal 3	3,400	4,100	1,900	1	1,900	0	24	0	1,100
Fal 4	2,300	4,100	1,300	1	1,300	0	24	0	1,200
Fal 5	2,400	3,100	1,300	1	1,300	0	18	0	1,500
Fal 6	3,900	4,900	1,900	1	1,900	0	27	0	700
Fal 7	1,800	3,200	1,400	1	1,400	0	17	0	800
Fal 8	1,800	2,600	1,100	1	1,100	0	13	0	1,400
Fal 9	5,900	8,700	4,300	1	4,300	0	48	0	700
Sand 2	34,000	41,000	17,000	0	0	17,000	0	191	600
Sand 3	27,000	35,000	13,000	0	0	13,000	0	159	1,800
Sand 4	47,000	61,000	30,000	0	0	30,000	0	314	5,000
Sand 5	48,000	55,000	25,000	0	0	25,000	0	264	3,500
Sand 6	29,000	31,000	14,000	0	0	14,000	0	138	4,300
Sand 7	26,000	39,000	20,000	0	0	20,000	0	42	3,800
Sand 9	33,000	36,000	22,000	0	0	22,000	0	206	2,400
Mashpee Total	810,000	1,300,000	610,000	41	320,000	300,000	4,000	1,700	150,000
Barnstable Total	110,000	110,000	96,000	4	18,000	78,000	180	380	12,000
Sandwich Total	240,000	300,000	140,000	0	0	140,000	0	1,310	21,000
Falmouth Total	80,000	100,000	49,000	17	40,000	10,000	440	100	24,000
Total	**1,200,000**	**1,800,000**	**900,000**	**62**	**380,000**	**530,000**	**4,600**	**3,500**	**210,000**

TABLE 4-2

SCENARIO 2 INFRASTRUCTURE SUMMARY

Sewershed	Wastewater Flows (gpd)		Pipe length(ft)	Pumping Stations	Gravity Sewer (lf)	Pressure Sewer (lf)	Properties on Gravity Sewer	Properties on Pressure Sewer	Force Main Length (lf)
	Existing	Future							
1	15,000	43,000	5,700	1	5,700	0	120	0	3,300
6	9,700	11,000	4,500	1	2,500	1,900	42	5	1,000
8	1,200	1,800	3,100	1	3,100	0	16	0	12,000
9	10,000	12,000	5,000	1	4,400	570	100	10	3,000
14	15,000	16,000	6,400	1	6,400	0	110	0	700
18	13,000	73,000	9,500	1	3,400	6,200	1	8	2,800
22	10,000	13,000	5,500	1	5,500	0	100	0	5,000
24	4,900	5,700	3,600	1	3,600	0	75	0	2,100
25	5,900	7,900	3,400	1	3,400	0	54	0	3,100
26	18,000	20,000	5,400	1	5,400	0	81	0	13,000
28	13,000	16,000	9,200	1	8,500	720	140	10	1,100
29	3,600	4,800	14,000	1	4,900	9,500	69	41	1,000
30	9,600	12,000	1,900	1	1,900	0	34	0	1,500
31	10,000	12,000	6,600	1	4,300	2,400	69	14	800
32	2,400	3,000	4,800	1	4,300	410	80	1	3,800
37 (Barnstable)	12,000	12,000	2,400	1	2,400	0	25	0	7,100
38 (Barnstable)	47,000	47,000	5,600	1	3,900	1,700	51	11	3,300
39 (Barnstable)	20,000	20,000	46,000	1	8,700	37,000	68	190	1,900
40	46,000	110,000	15,000	1	11,000	3,600	100	21	3,400
41	24,000	27,000	17,000	1	8,700	8,300	62	14	4,600
21	14,000	14,000	24,000	1	11,000	13,000	110	110	4,500
42 (Barnstable)	35,000	35,000	42,000	1	2,800	39,000	40	180	4,300
43	8,600	9,300	5,900	1	5,900	0	94	0	700
44	31,000	77,000	22,000	1	6,700	16,000	40	35	4,900
45	7,700	14,000	13,000	1	7,200	5,600	60	34	2,300
47	14,000	23,000	10,000	1	8,800	1,600	81	34	5,900
49	18,000	27,000	22,000	1	8,800	13,000	71	61	700
50	66,000	83,000	57,000	1	20,000	37,000	270	190	5,700
51	12,000	18,000	6,600	1	6,600	0	86	0	11,000
52	9,000	12,000	11,000	1	6,000	4,600	63	28	3,300
53	28,000	38,000	26,000	1	13,000	13,000	160	80	2,000
54	57,000	140,000	17,000	1	7,200	9,300	57	190	4,700
57	7,100	7,700	4,600	1	4,600	0	87	0	2,800
58	8,300	10,000	6,000	0	6,000	0	65	0	2,500
64	23,000	31,000	19,000	1	12,000	6,400	140	24	6,100
65	41,000	45,000	32,000	1	16,000	16,000	220	110	1,000
67	24,000	24,000	16,000	1	11,000	5,300	150	36	2,800
68	22,000	26,000	23,000	1	7,700	16,000	140	100	3,100
69	29,000	52,000	31,000	1	12,000	19,000	200	110	14,000
70	15,000	16,000	11,000	1	6,700	4,400	91	34	5,400
71	21,000	25,000	14,000	1	11,000	3,400	140	25	5,200
72	24,000	31,000	26,000	1	4,400	21,000	48	90	2,900
73	35,000	65,000	34,000	1	5,100	29,000	54	130	3,900
74	38,000	74,000	29,000	1	18,000	11,000	170	64	4,200
75	12,000	18,000	16,000	1	3,900	12,000	36	68	2,400
Fal 1	6,500	6,200	3,400	1	2,000	1,000	15	14	1,200
Fal 10	4,600	3,800	1,700	1	1,700	0	22	0	2,300
Fal 11	3,800	2,800	900	1	930	0	16	0	1,100
Fal 12	3,400	3,400	2,000	1	2,000	0	20	0	2,200
Fal 13	7,900	9,300	4,500	1	2,400	2,200	27	25	2,400
Fal 14	3,800	3,600	1,600	1	1,600	0	13	0	1,400
Fal 15	8,500	11,000	6,300	1	3,300	3,100	31	20	1,100
Fal 16	7,700	7,000	2,300	1	2,300	0	26	0	3,000
Fal 17	8,800	17,000	10,000	1	6,900	3,500	49	36	0
Fal 2	6,100	7,800	3,200	1	3,200	0	45	0	1,400
Fal 3	3,400	4,100	1,900	1	1,900	0	24	0	1,100
Fal 4	2,300	4,100	1,300	1	1,300	0	24	0	1,200
Fal 5	2,400	3,100	1,300	1	1,300	0	18	0	1,500
Fal 6	3,900	4,900	1,900	1	1,900	0	27	0	700
Fal 7	1,800	3,200	1,400	1	1,400	0	17	0	800
Fal 8	1,800	2,600	1,100	1	1,100	0	13	0	1,400
Fal 9	5,900	8,700	4,300	1	4,300	0	48	0	700
Sand 1	27,000	30,000	12,000	0	0	12,000	0	150	2,600
Sand 2	34,000	41,000	17,000	0	0	17,000	0	190	600
Sand 3	27,000	35,000	13,000	0	0	13,000	0	160	1,800
Sand 4	47,000	61,000	30,000	0	0	30,000	0	310	3,900
Sand 5	48,000	55,000	25,000	0	0	25,000	0	260	5,800
Mashpee Total	780,000	1,300,000	600,000	40	310,000	290,000	3,900	1,700	160,000
Barnstable Total	110,000	110,000	96,000	4	18,000	78,000	180	380	17,000
Sandwich Total	180,000	220,000	97,000	0	0	100,000	0	1,070	15,000
Falmouth Total	80,000	100,000	49,000	17	40,000	10,000	440	100	24,000
Total	**1,200,000**	**1,700,000**	**840,000**	**61**	**370,000**	**480,000**	**4,500**	**3,300**	**220,000**

TABLE 4-3

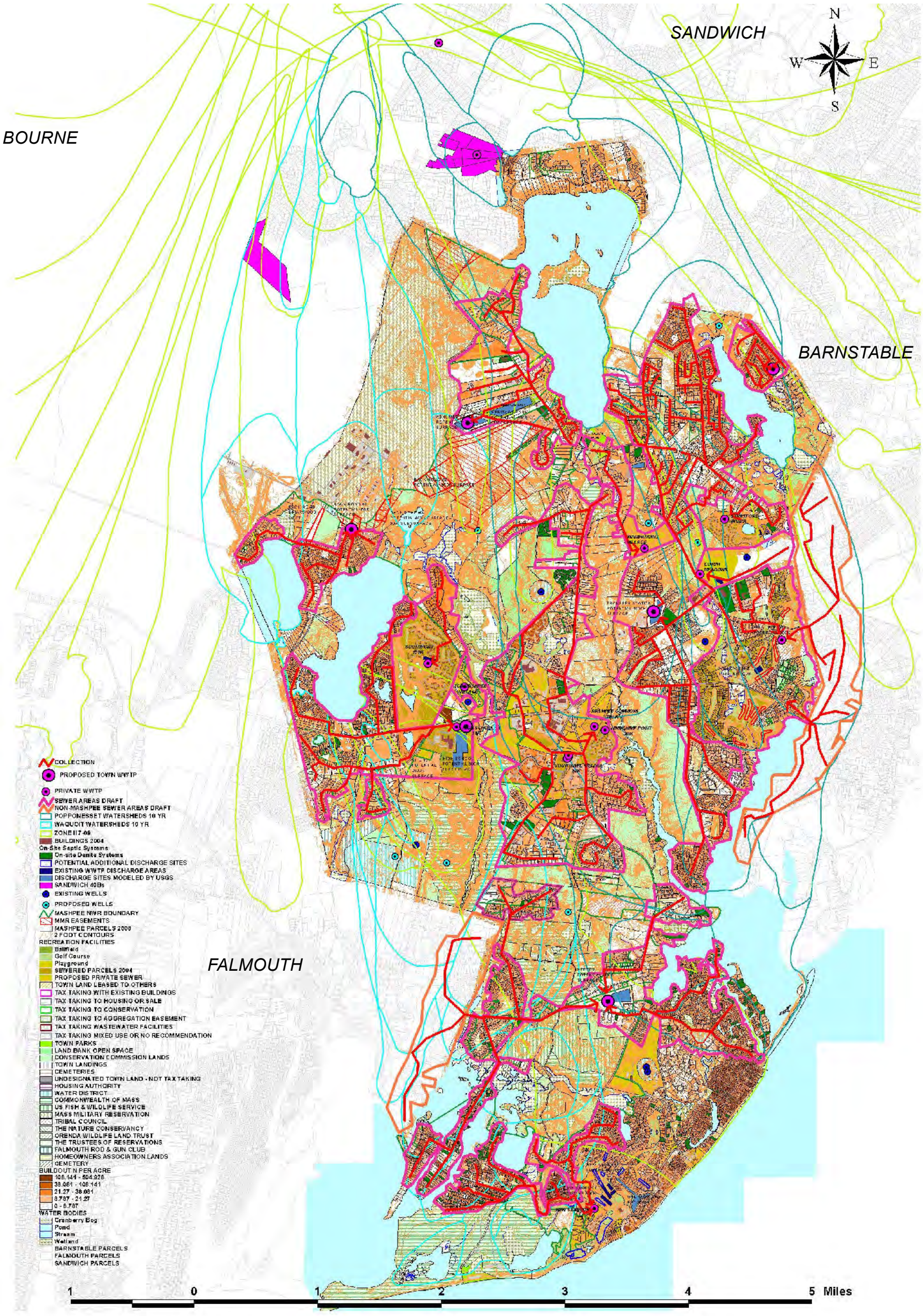
SCENARIO 4 INFRASTRUCTURE SUMMARY

Sewershed	Wastewater Flows (gpd)		Pipe length(ft)	Pumping Stations	Gravity Sewer (lf)	Pressure Sewer (lf)	Properties on Gravity Sewer	Properties on Pressure Sewer	Force Main Length (lf)
	Existing	Future							
1	15,000	43,000	5,700	1	5,700	0	120	0	3,300
6	9,700	11,000	4,500	1	2,500	1,900	42	5	1,000
8	1,200	1,800	3,100	1	3,100	0	16	0	12,000
9	10,000	12,000	5,000	1	4,400	570	100	10	3,000
14	15,000	16,000	6,400	1	6,400	0	110	0	700
18	13,000	73,000	9,500	1	3,400	6,200	1	8	4,500
22	10,000	13,000	5,500	1	5,500	0	100	0	5,000
24	4,900	5,700	3,600	1	3,600	0	75	0	2,100
25	6,000	8,000	3,400	1	3,400	0	54	0	3,100
26	18,000	20,000	5,400	1	5,400	0	81	0	4,300
28	12,500	15,700	9,000	1	8,500	720	140	10	1,000
29	3,600	5,000	14,500	1	4,900	9,500	69	41	1,100
30	9,600	12,000	1,900	1	1,900	0	34	0	1,500
31	10,000	12,300	6,600	1	4,300	2,400	69	14	800
32	2,000	3,000	4,800	1	4,300	410	80	1	3,800
37(Barnstable)	12,000	12,000	2,400	1	2,400	0	25	0	7,100
38(Barnstable)	47,000	47,000	6,000	1	3,900	1,700	51	10	3,300
40	46,000	110,000	15,000	1	11,000	3,600	100	21	3,400
41	24,000	27,000	17,000	1	8,700	8,300	62	14	4,600
21	14,000	14,000	24,000	1	11,000	13,000	110	110	4,500
42(Barnstable)	35,000	35,000	42,000	1	2,800	39,000	40	180	0
43	8,600	9,300	5,900	1	5,900	0	94	0	700
44	31,000	77,000	22,000	1	6,700	16,000	40	35	4,900
45	7,700	14,000	13,000	1	7,200	5,600	60	34	2,300
47	14,000	23,000	10,000	1	8,800	1,600	81	34	5,900
49	18,000	27,000	22,000	1	8,800	13,000	71	61	700
50	66,000	83,000	57,000	1	20,000	37,000	270	190	5,700
51	12,000	18,000	6,600	1	6,600	0	86	0	2,000
52	9,000	12,000	11,000	1	6,000	4,600	63	28	3,300
53	28,000	38,000	26,000	1	13,000	13,000	160	80	2,000
54	57,000	140,000	17,000	1	7,200	9,300	57	190	4,700
57	7,100	7,700	4,600	1	4,600	0	87	0	2,800
64	23,100	31,000	19,000	1	12,400	6,400	140	24	6,100
65	41,000	45,000	32,000	1	16,000	16,000	220	113	1,000
67	24,000	24,000	16,000	1	11,000	5,000	150	36	2,300
68	22,000	26,000	23,000	1	8,000	16,000	140	100	3,100
69	29,000	52,000	31,000	1	12,100	19,000	200	110	4,200
70	15,000	16,000	11,000	1	7,000	4,400	90	30	5,400
71	21,000	25,000	14,000	1	11,000	3,400	140	25	5,200
72	24,000	31,000	26,000	1	4,400	21,000	50	90	10,800
73	35,000	65,000	34,000	1	5,100	29,000	54	130	3,900
74	38,000	74,000	29,000	1	18,200	11,000	170	60	4,800
75	12,000	18,000	16,000	1	4,000	12,000	36	68	2,200
Fal 10	5,000	4,000	2,000	1	1,700	0	22	0	2,300
Fal 11	3,800	2,800	900	1	900	0	16	0	1,100
Fal 13	7,900	9,300	4,500	1	2,400	2,200	27	25	2,400
Fal 14	3,800	3,600	1,600	1	1,570	0	13	0	1,400
Fal 15	8,500	11,200	6,300	1	3,300	3,100	31	20	1,100
Fal 16	7,700	7,000	2,300	1	2,300	0	26	0	3,000
Fal 17	8,800	17,000	10,000	1	6,900	3,500	49	36	0
Fal 2	6,100	8,000	3,200	1	3,200	0	45	0	1,400
Fal 3	3,400	4,100	1,900	1	1,900	0	24	0	1,100
Fal 4	2,300	4,000	1,000	1	1,300	0	24	0	1,200
Fal 5	2,400	3,100	1,300	1	1,300	0	18	0	1,500
Fal 6	3,900	4,900	1,900	1	1,900	0	27	0	700
Fal 7	1,800	3,200	1,400	1	1,400	0	17	0	800
Fal 8	1,800	2,600	1,100	1	1,100	0	13	0	1,400
Fal 9	5,900	8,700	4,300	1	4,300	0	48	0	700
Sand 2	34,000	41,000	17,000	0	0	17,000	0	191	600
Sand 3	27,000	35,000	13,000	0	0	13,000	0	159	1,800
Sand 4	47,000	61,000	30,000	0	0	30,000	0	314	3,900
Sand 5	48,000	55,000	25,000	0	0	25,000	0	260	5,800
Sand 6	29,000	31,000	14,000	0	0	14,000	0	140	1,500
Sand 8	38,000	45,000	26,000	0	0	26,000	0	220	8,100
Mashpee Total	770,000	1,300,000	590,000	40	300,000	290,000	3,800	1,700	140,000
Barnstable Total	94,000	94,000	50,000	3	9,000	41,000	120	190	10,000
Sandwich Total	220,000	270,000	125,000	0	0	130,000	0	1,280	22,000
Falmouth Total	73,000	94,000	44,000	15	35,000	9,000	400	80	20,000
Total	**1,200,000**	**1,800,000**	**810,000**	**58**	**340,000**	**470,000**	**4,300**	**3,300**	**190,000**

TABLE 4-4

SCENARIO 5 INFRASTRUCTURE SUMMARY

Sewershed	Wastewater Flows (gpd)		Pipe length(ft)	Pumping Stations	Gravity Sewer (lf)	Pressure Sewer (lf)	Properties on Gravity Sewer	Properties on Pressure Sewer	Force Main Length (lf)
	Existing	Future							
1	15,000	43,400	5,700	1	5,700	0	120	0	3,300
6	9,700	11,000	4,500	1	2,500	1,900	42	5	1,000
8	1,200	1,800	3,100	1	3,100	0	16	0	12,000
9	10,000	12,000	5,000	1	4,400	570	100	10	3,000
14	15,000	16,000	6,400	1	6,400	0	110	0	700
18	13,000	73,000	9,500	1	3,400	6,200	1	8	2,800
22	10,000	13,000	5,500	1	5,500	0	100	0	5,000
23	12,000	14,000	11,000	1	3,200	8,100	73	57	2,000
24	5,000	6,000	4,000	1	3,600	0	75	0	2,100
25	6,000	8,000	3,400	1	3,400	0	54	0	3,100
26	18,000	20,000	5,400	1	5,400	0	81	0	13,000
28	13,000	16,000	9,200	1	8,500	720	140	10	1,100
29	4,000	5,000	14,000	1	4,900	9,500	69	41	1,100
30	10,000	12,000	2,000	1	1,900	0	34	0	1,500
31	10,000	12,000	6,600	1	4,300	2,400	69	14	800
32	2,000	3,000	4,800	1	4,300	410	80	1	15,000
37(Barnstable)	12,000	12,000	2,400	1	2,400	0	25	0	2,800
38(Barnstable)	47,000	47,000	5,600	1	3,900	1,700	51	11	3,300
39(Barnstable)	20,000	20,000	46,000	1	8,700	37,000	68	190	1,900
40	46,000	110,000	15,000	1	11,000	3,600	100	21	3,400
41	24,000	27,000	17,000	1	8,700	8,300	62	14	4,600
21	14,000	14,000	24,000	1	11,000	13,000	110	110	2,000
42(Barnstable)	35,000	35,000	42,000	1	3,000	39,000	40	180	4,300
43	8,600	9,300	5,900	1	5,900	0	94	0	700
44	31,000	77,000	22,000	1	6,700	16,000	40	35	2,300
45	7,700	14,000	13,000	1	7,200	5,600	60	34	4,600
47	14,000	23,000	10,000	1	8,800	1,600	81	34	4,400
49	18,000	27,000	22,000	1	8,800	13,000	71	61	700
50	66,000	83,000	57,000	1	20,000	37,000	270	190	7,600
51	12,000	18,000	7,000	1	6,600	0	86	0	1,600
52	9,000	12,000	11,000	1	6,000	4,600	63	28	100
53	28,000	38,000	26,000	1	13,000	13,000	160	80	1,700
54	57,000	140,000	17,000	1	7,000	9,300	57	190	3,600
57	7,100	7,700	5,000	1	4,600	0	87	0	2,800
64	23,000	31,000	19,000	1	12,000	6,400	140	24	4,000
65	41,000	45,000	32,000	1	16,000	16,000	220	110	1,000
67	24,000	24,000	16,000	1	11,000	5,300	150	36	2,300
68	22,000	26,000	23,000	1	7,700	16,000	140	100	3,100
70	15,000	16,000	11,000	1	6,700	4,400	91	34	5,400
71	21,000	25,000	14,000	1	11,000	3,400	140	25	5,200
72	24,000	31,000	26,000	1	4,400	21,000	48	90	3,000
73	35,000	65,000	34,000	1	5,000	29,000	54	130	3,900
74	38,000	74,000	29,000	1	18,000	11,000	170	64	4,800
75	12,000	18,000	16,000	1	3,900	12,000	36	68	2,200
Fal 1	6,500	6,200	3,400	1	2,000	1,300	15	14	1,200
Fal 10	4,600	3,800	1,700	1	1,700	0	22	0	2,300
Fal 11	3,800	2,800	930	1	900	0	16	0	1,100
Fal 12	3,400	3,400	2,000	1	2,000	0	20	0	2,200
Fal 13	7,900	9,300	4,500	1	2,400	2,200	27	25	2,400
Fal 14	3,800	3,600	1,600	1	1,600	0	13	0	1,400
Fal 15	9,000	11,000	6,300	1	3,300	3,100	31	20	1,100
Fal 16	7,700	7,000	2,300	1	2,300	0	26	0	3,000
Fal 17	9,000	17,000	10,000	1	6,900	3,500	49	36	0
Fal 2	6,100	7,800	3,200	1	3,200	0	45	0	1,400
Fal 3	3,400	4,100	1,900	1	1,900	0	24	0	1,100
Fal 4	2,300	4,100	1,300	1	1,300	0	24	0	1,200
Fal 5	2,400	3,100	1,300	1	1,300	0	18	0	1,500
Fal 6	3,900	4,900	1,900	1	1,900	0	27	0	700
Fal 7	1,800	3,200	1,400	1	1,400	0	17	0	800
Fal 8	1,800	2,600	1,100	1	1,100	0	13	0	1,400
Fal 9	5,900	8,700	4,300	1	4,300	0	48	0	700
Sand 4	47,000	61,000	30,000	0	0	30,000	0	310	3,900
Sand 5	48,000	55,000	25,000	0	0	25,000	0	260	5,800
Sand 6	29,000	31,000	14,000	0	0	14,000	0	140	1,500
Mashpee Total	750,000	1,200,000	570,000	40	290,000	280,000	3,700	1,600	140,000
Barnstable Total	110,000	190,000	73,000	4	30,000	42,000	310	220	9,000
Sandwich Total	120,000	150,000	70,000	0	0	70,000	0	710	11,000
Falmouth Total	80,000	100,000	49,000	17	40,000	10,000	440	100	24,000
Total	**1,100,000**	**1,600,000**	**760,000**	**61**	**360,000**	**400,000**	**4,500**	**2,600**	**180,000**



Notes:
1. Developed by the Town of Mashpee Sewer Commission

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CLIENTS | PEOPLE | PERFORMANCE

Client Name: Town of Mashpee, Massachusetts
Project Name: Masshpee Sewer Commision

12/13/10 Preliminary Layout

Job Number 86-12001
Revision A
Date 24 Jan 2012

Figure 1

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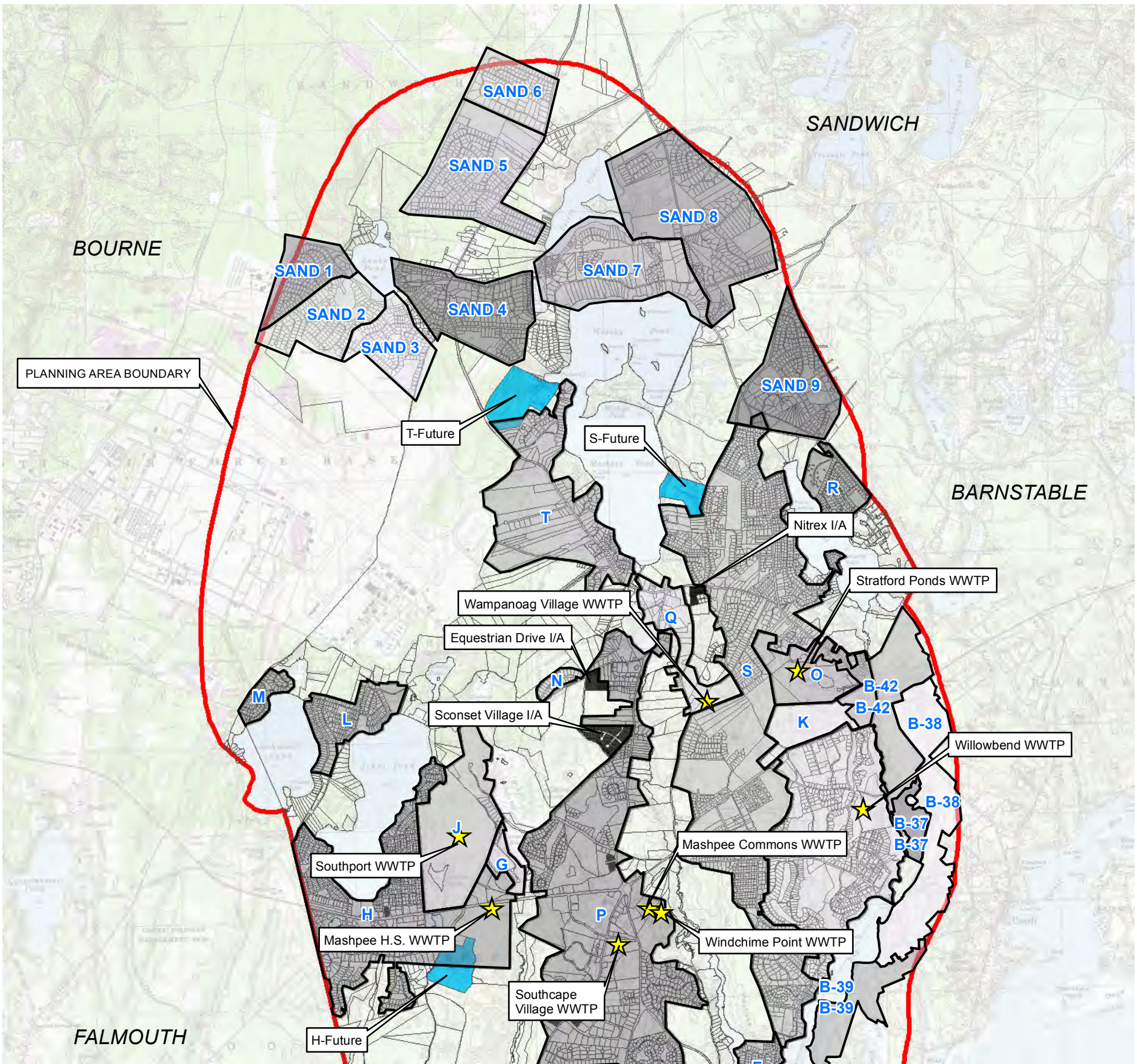

Notes:
1. Some future areas not shown.
2. Map does not show I/A clusters (As shown on Figures 1A through 1C)
3. Some areas have been further subdivided for analysis purposes (Not shown for clarity)
4.Greyscales and colors shown on map for clarity purposes only.

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Client Name: Town of Mashpee, Massachusetts
Project Name: WNMP

Sewer Planning Areas

Job Number	86-12001
Revision	A
Date	09 Feb 2012

Figure 2

G:\86\12001\GIS\00074 Mashpee\2012 Figures\Wastewater Removal Area Revisions\Revisions _2012\Sewer Planning Areas Figure 2.mxd

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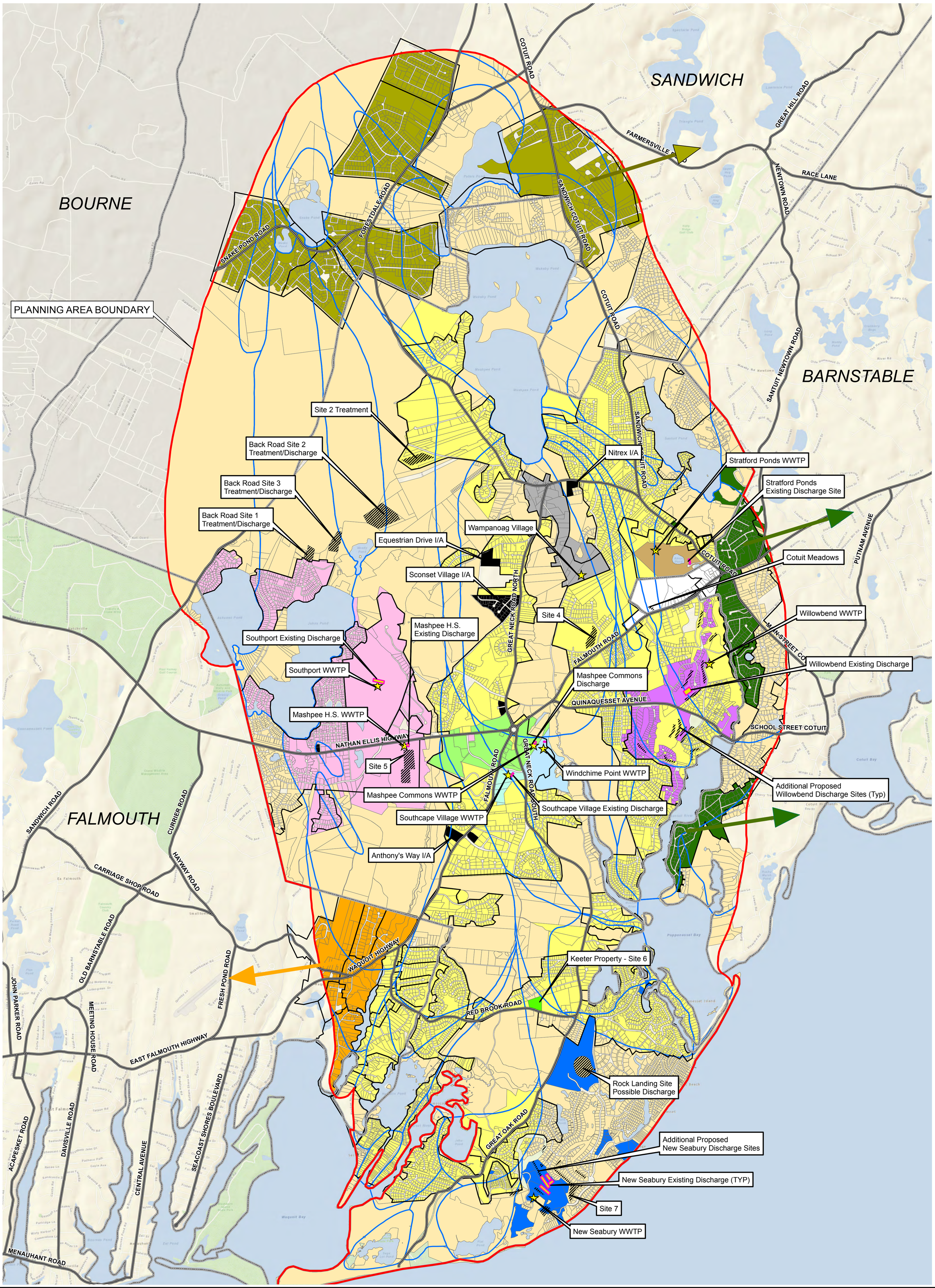

Legend

- Planning Area Boundary
- Town Boundaries
- Proposed Discharge Site
- Existing Discharge Site
- Existing Private WWTP
- Watershed Lines

Sewer Planning Areas

- Barnstable Outside Watershed
- Cotuit Meadows WWTF
- Falmouth Outside Watershed
- I/A Systems (Cluster Only)
- Johns Pond Region
- MSPA
- Mashpee Commons WWTF
- New Seabury Existing and Future connections
- Sandwich Outside Watershed
- Septic
- South Cape Village WWTF
- Stratford Ponds
- Wampanoag Village WWTF
- Willowbend WWTF
- Windchime Point

Paper Size ARCH D

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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Client Name: Town of Mashpee, Massachusetts
Project Name: WNMP

OPTION 1A
Wastewater Removal Areas

Job Number	86-12001
Revision	A
Date	09 Feb 2012

Figure 3

G:\86\12001\GIS\00074 Mashpee\2012 Figures\Wastewater Removal Area Revisions\Revisions _2012\Alternative 1A_ Figure 3.mxd

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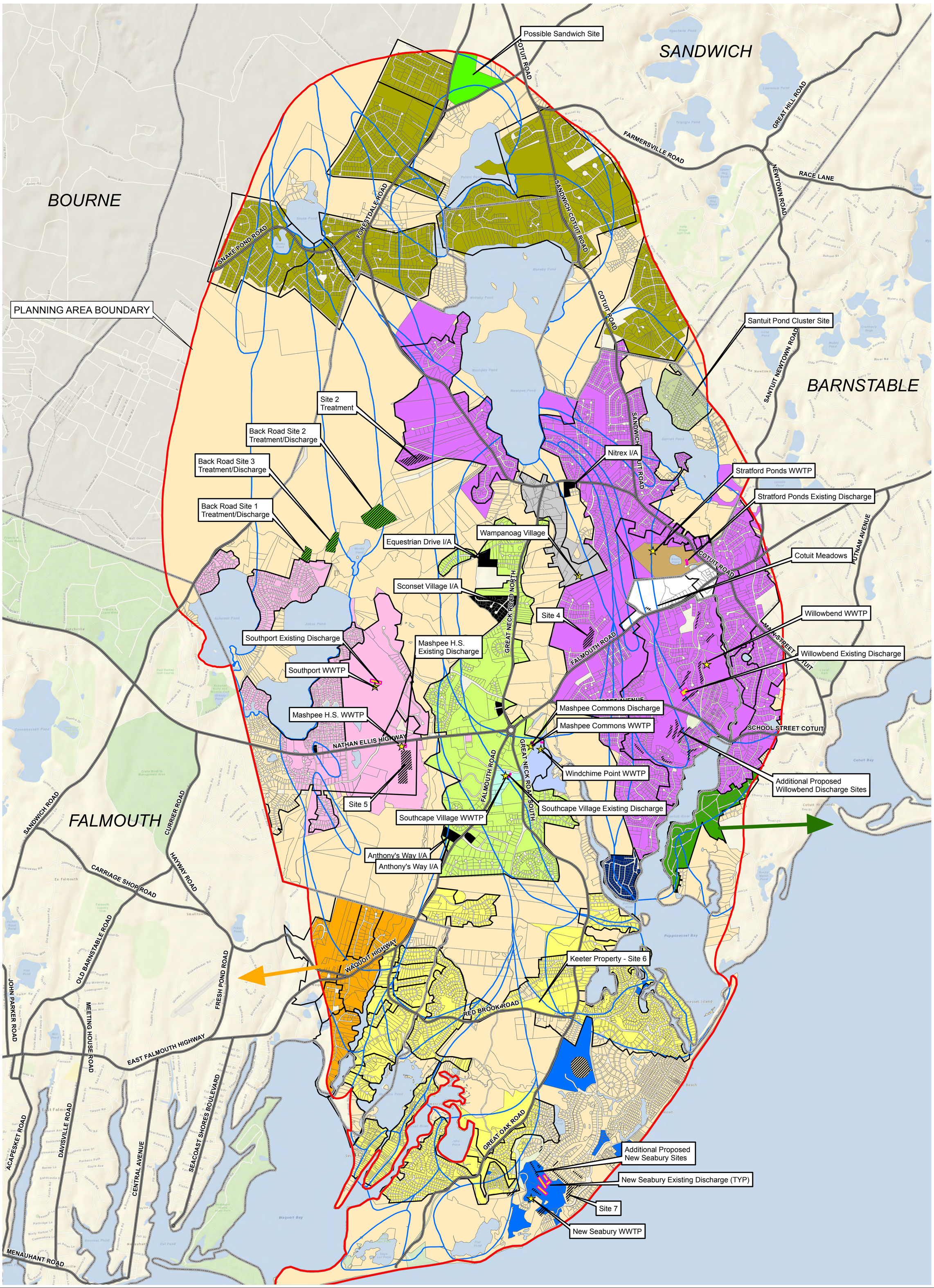

Legend

- Planning Area Boundary
- Existing Private WWTP
- Existing Discharge Site
- Proposed Discharge Site
- Town Boundaries
- Watershed Lines

Sewer Planning Areas

- Barnstable Outside Watershed
- Central Mashpee
- Cotuit Meadows WWTF
- Eastern Mashpee
- Falmouth Outside Watershed
- I/A Systems (Cluster Only)
- Johns Pond Region
- New Seabury Existing and Future connections
- Pirates Cove
- Sandwich
- Santuit Pond Cluster
- Septic
- South Cape Village WWTF
- Southern Mashpee/Falmouth East
- Stratford Ponds
- Wampanoag Village WWTF
- Windchime Point

Paper Size ARCH D

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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CLIENTS | PEOPLE | PERFORMANCE

Client Name: Town of Mashpee, Massachusetts
Project Name: WNMP

OPTION 1B
Wastewater Removal Areas

Job Number	86-12001
Revision	A
Date	09 Feb 2012

Figure 4

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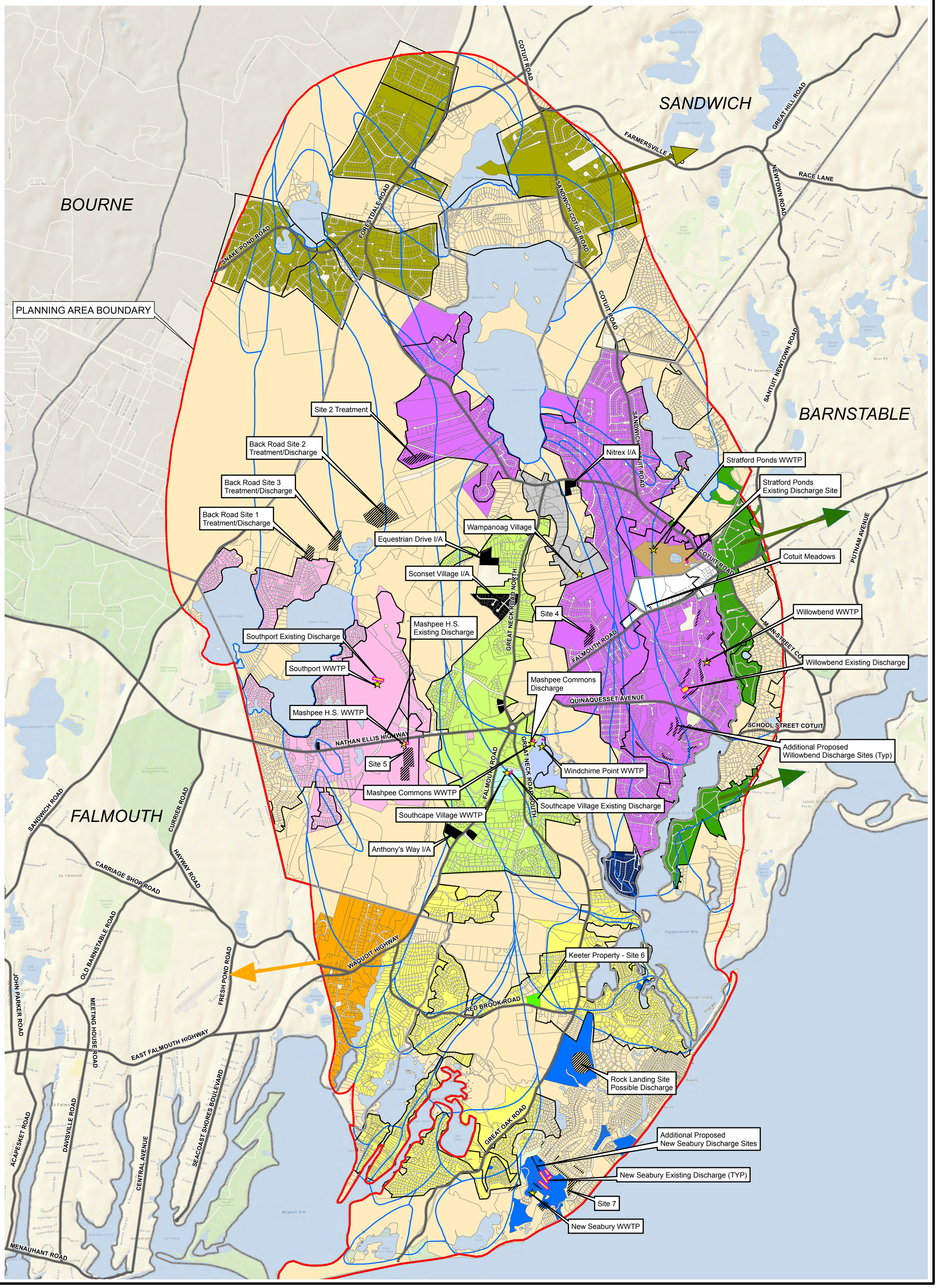
1545 Iyannough Road Hyannis Massachusetts T 774 470-1630 F 774 470-1631 Web www.ghd.com

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by:jjobrien



Legend

- Planning Area Boundary
- Town Boundaries
- Proposed Discharge Site
- Existing Discharge Site
- Existing Private WWTP
- Watershed Lines

Sewer Planning Areas

- Barnstable Outside Watershed
- Central Mashpee
- Cotuit Meadows WWTF
- Eastern Mashpee
- Falmouth Outside Watershed
- I/A Systems (Cluster Only)
- John's Pond Region
- New Seabury Existing and Future Connections
- Pirates Cove
- Sandwich Outside Watershed
- Septic
- South Cape WWTF
- Southern Mashpee/Falmouth East
- Stratford Ponds
- Wampanoag Village WWTF
- Windchime Point

Paper Size ARCH D

0 1,000 2,000 4,000 Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

GHD
CLIENTS | PEOPLE | PERFORMANCE

Client Name: Town of Mashpee, Massachusetts
Project Name: WNMP

OPTION 1C
Wastewater Removal Areas

Job Number	86-12001
Revision	A
Date	16 Feb 2012

Figure 5

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1545 Iyannough Road Hyannis Massachusetts T 774 470-1630 F 774 470-1631 Web www.ghd.com

Table 1 - Option 1A Summary of Flows

Service Areas	Proposed Treatment Site	Treatment level (TN mg/L)	TN Concentration (note)	Proposed Discharge Site	Future flow Average Annual (gpd)	Nitrogen Load (kg/y) (10)	Discharge Watershed
Major Sections of Planning Area (1)	Site 6, New Seabury, Site 4 and Site 2	10	mg/L (may differ depending on Zone II)	Rock Landing	1,017,544	N/A	Outside watershed
South Cape Village WWTF	South Cape Village WWTF	3	mg/L	South Cape Village WWTF	12,000	50	Lower Mashpee River GT 10
New Seabury Existing and Future connections	New Seabury WWTF	10	mg/L (may differ depending on Zone II)	New Seabury	107,647	N/A	Outside Watershed
Johns Pond Region (2)	Backroads, HS and Southport	3	mg/L	Back Roads	370,198	1,535	Johns Pond LT 10
Mashpee Commons WWTF	Site 4 (Transfer Station)	3	mg/L	Site 4 (Transfer Station)	107,180	444	Upper Mashpee River LT10
Willowbend WWTF	Willowbend	3	mg/L	Willowbend	66,387	275	Santuit River LT 10
Windchime Point WWTF	Windchime Point WWTF	3	mg/L	Windchime Point WWTF	21,840	91	Lower Mashpee River LT 10
Stratford Ponds WWTF	Stratford Ponds WWTF	3	mg/L	Stratford Ponds WWTF	21,420	89	Santuit River LT 10
Cotuit Meadows WWTF (3)	Cotuit Meadows WWTF	3	mg/L	Cotuit Meadows WWTF	36,549	152	Santuit River GT 10
Wampanoag Village WWTF (4)	Wampanoag Village WWTF	3	mg/L	Wampanoag Village WWTF	14,382	60	Upper Mashpee River LT 10
Sandwich Outside Watershed (5)	Sandwich	10	mg/L (or Community Driven)	Sandwich Outside Watershed	298,111	N/A	Outside Watershed
Barnstable Outside Watershed (6)	Barnstable Outside Watershed	10	mg/L (or Community Driven)	Barnstable Outside Watershed	76,676	N/A	Outside Watershed
Falmouth Outside Watershed (7)	Falmouth Outside Watershed	10	mg/L (or Community Driven)	Falmouth Outside Watershed	48,354	N/A	Outside Watershed
I/A Systems (cluster only) (8)	Various	19	mg/L	Various	19,007	499	Various
Balance of Project Planning Area (both in and outside of watersheds) (9)	Various	23.63	mg/L	Various	480,049	16,040	Various
				Total Future Flow	2,697,344		

Notes:

1 Major Sections of Planning Area includes areas: A, B, C, D, E, F, Fal-2 thru Fal-11, Popponesset Island, N, I, O, P, S and T
2 Johns Pond Region includes areas: G, H, L, M, J, Mashpee High School, and Southport WWTF
3 Cotuit Meadows WWTF includes a small portion of adjacent properties
4 Wampanoag Village includes area Q
5 Sandwich Outside Watershed includes Sand-1 thru Sand-6 and Sand-8
6 Barnstable Outside Watershed includes "sewersheds": Barn-37,39 and Barn-42
7 Falmouth Outside Watershed includes "sewersheds" Fal-13 thru Fal-17
8 I/A systems only include the larger I/A systems including the Nitrex System, Sconsett Village and several commercial developments
9 All other areas within the watershed are assumed to remain on septic systems.
10 N/A - Not applicable - Nitrogen load is estimated outside the watershed

Table 2 - Option 1B Summary of Flows

Service Areas	Proposed Treatment Site	Treatment level (TN mg/L)	TN Concentration (note)	Proposed Discharge Site	Future flow Average Annual (gpd)	Nitrogen Load (kg/y) (12)	Discharge Watershed
Southern Mashpee and Falmouth East (1)	Site 6 (Keeter Property)	3	mg/L	Site 6 (Keeter Property)	341,096	1,408	Popponesset Bay, Great River, Hamblin Pond, Outside Watershed
Pirates Cove	Pirates Cove	3	mg/L	Pirates Cove	13,908	58	Shoestring Bay LT10, Lower Mashpee River LT10
South Cape Village WWTF	South Cape Village WWTF	3	mg/L	South Cape Village WWTF	12,000	50	Lower Mashpee River GT 10
New Seabury Existing and Future connections	New Seabury WWTF	10	mg/L (may differ depending on Zone II)	New Seabury	107,647	N/A	Outside Watershed
Johns Pond Region (2)	Backroads, HS and Southport	3	mg/L	Back Roads	370,198	1,535	Johns Pond LT 10
Central Mashpee (3)	Site 4 (Transfer Station)	3	mg/L	Site 4 (Transfer Station)	329,661	1,367	Upper Mashpee River LT12
Eastern Mashpee (4)	Willowbend and Site 2 (Ashumet)	3	mg/L	Willowbend Existing and Golf Course	617,464	2,560	Santuit River LT 10
Windchime Point WWTF	Windchime Point WWTF	3	mg/L	Windchime Point WWTF	21,840	91	Lower Mashpee River LT 10
Stratford Ponds WWTF	Stratford Ponds WWTF	3	mg/L	Stratford Ponds WWTF	21,420	89	Santuit River LT 10
Cotuit Meadows WWTF (5)	Cotuit Meadows WWTF	3	mg/L	Cotuit Meadows WWTF	36,549	152	Santuit River GT 10
Wampanoag Village (6)	Wampanoag Village WWTF	3	mg/L	Wampanoag Village WWTF	14,382	60	Upper Mashpee River LT 10
Santuit Pond Cluster	Santuit Pond Cluster	3	mg/L	Santuit Pond Cluster	29,120	121	Santuit Pond LT 10
Sandwich Watershed (7)	Sandwich	3	mg/L (or Community Driven)	Sandwich Golden Triangle	367,246	1,523	Peters Pond GT10
Falmouth Outside Watershed (8)	Falmouth Outside Watershed	10	mg/L (or Community Driven)	Falmouth Outside Watershed	48,354	N/A	Outside Watershed
Barnstable Outside Watershed (9)	Barnstable	10	mg/L (or Community Driven)	Barnstable Outside Watershed	26,065	N/A	Outside Watershed
I/A Systems (cluster only) (10)	Various	19	mg/L	Various	19,007	466	Various
Balance of Project Planning Area (both in and outside of watersheds) (11)	Various	23.63	mg/L	Various	321,387	10,550	Various
				Total	2,697,344		

Notes:

1 Southern Mashpee and Falmouth East includes areas: A, B, C, D, E, Fal-2 thru Fal-11, and Popponesset Island
2 Johns Pond Region includes areas: G, H, L, M, J, Mashpee High School, and Southport WWTF
3 Central Mashpee includes areas:Mashpee Commons, N, P
4 Eastern Mashpee includes areas: Willowbend, I, S, Barn-37, Barn-42, Barn-38, O and T
5 Cotuit Meadows WWTF includes a small portion of adjacent properties
6 Wampanoag Village includes area Q
7 Sandwich Watershed includes Sand-1 thru Sand-9 (Sand-9 includes northern most part of Mashpee)
8 Falmouth Outside Watershed includes "sewersheds" Fal-13 thru Fal-17
9 Barnstable Outside Watersheds includes Barn- 39
10 I/A systems only include the larger I/A systems including the Nitrex System, Sconsett Village and several commercial developments
11 All other areas within the watershed are assumed to remain on septic systems.
12 N/A - Not applicable - Nitrogen load is estimated outside the watershed

Table 3 - Option 1C Summary of Flows

Service Areas	Proposed Treatment Site	Treatment level (TN mg/L)	TN Concentration (note)	Proposed Discharge Site	Future flow Average Annual (gpd)	Nitrogen Load (kg/y) (12)	Discharge Watershed
Southern Mashpee and Falmouth East [1]	Site 6 (Keeter Property)	3	mg/L (may differ depending on Zone II)	Site 6 (Keeter Property)	341,096	1,414.44	Popponesset Bay, Great River, Hamblin Pond, Outside Watershed
Pirates Cove	Pirates Cove	3	mg/L	Pirates Cove	13,908	58	Shoestring Bay LT10, Lower Mashpee River LT10
South Cape Village WWTF	South Cape Village WWTF	3	mg/L	South Cape Village WWTF	12,000	50	Lower Mashpee River GT 10
New Seabury Existing and Future connections	New Seabury WWTF	10	mg/L (may differ depending on Zone II)	New Seabury	107,647	N/A	Outside Watershed
Johns Pond Region [2]	Backroads, HS and Southport	3	mg/L	Back Roads	370,198	1,535	Johns Pond LT 10
Central Mashpee [3]	Site 4 (Transfer Station)	3	mg/L	Site 4 (Transfer Station)	329,661	1,367	Upper Mashpee River LT10
Eastern Mashpee [4]	Willowbend and Site 2 (Ashumet)	3	mg/L	Willowbend Existing and Golf Course	506,447	2,100	Santuit River LT 10
Windchime Point WWTF	Windchime Point WWTF	3	mg/L	Windchime Point WWTF	21,840	91	Lower Mashpee River LT 10
Stratford Ponds WWTF	Stratford Ponds WWTF	3	mg/L	Stratford Ponds WWTF	21,420	89	Santuit River LT 10
Cotuit Meadows WWTF [5]	Cotuit Meadows WWTF	3	mg/L	Cotuit Meadows WWTF	36,549	152	Santuit River GT 10
Wampanoag Village [6]	Wampanoag Village WWTF	3	mg/L	Wampanoag Village WWTF	14,382	60	Upper Mashpee River LT 10
Barnstable Outside Watershed [7]	Barnstable	10	mg/L (or community driven)	Barnstable Outside Watershed	76,676	N/A	Outside Watershed
Sandwich Watershed [8]	Sandwich	10	mg/L (or community driven)	Sandwich Outside Watershed	298,111	N/A	Outside Watershed
Falmouth Outside Watershed [9]	Falmouth Outside Watershed	10	mg/L (or community driven)	Falmouth Outside Watershed	48,354	N/A	Outside Watershed
I/A Systems (cluster only) [10]	Various	19	mg/L	Various	19,007	499	Various
Balance of Project Planning Area (both in and outside of watersheds) [11]	Various	23.63	mg/L	Various	480,049	15,680	Various
				Total	2,697,344		

Notes:

1 Southern Mashpee and Falmouth East includes areas: A, B, C, D, E, Fal-2 thru Fal-11, and Popponesset Island
2 Johns Pond Region includes areas: G, H, L, M, J, Mashpee High School, and Southport WWTF
3 Central Mashpee includes areas:Mashpee Commons, N, P
4 Eastern Mashpee includes areas: Willowbend, I, S, Barn-37, Barn-42, Barn-38, O and T
5 Cotuit Meadows WWTF includes a small portion of adjacent properties
6 Wampanoag Village includes area Q
7 Barnstable Outside Watersheds includes Barn-37, 39, and Barn-42
8 Sandwich Watershed includes Sand-1 thru Sand-9 (Sand-9 includes northern most part of Mashpee)
9 Falmouth Outside Watershed includes "sewersheds" Fal-13 thru Fal-17
10 I/A systems only include the larger I/A systems including the Nitrex System, Sconsett Village and several commercial developments
11 All other areas within the watershed are assumed to remain on septic systems.
12 N/A - Not applicable - Nitrogen load is estimated outside the watershed

Table 4 ESTIMATED COMPARED TO TMDLs

Scenario Watershed Nitrogen Loads: Popponesset Bay and Waquoit Bay

				Option 1A	Option 1B	Option 1C	Scenario 3/3R
Embayment	sub-embayment	MEP Buildout load (kg/day)	Threshold (kg/day)	Future (kg/day)	Future (kg/day)	Future (kg/day)	Future (kg/day)
Popponesset Bay							
	Popponesset Bay	7.33	2.8	1.7	2.3	2.3	2.7
	Pinquickset Cove	0.98	0.8	0.7	0.7	0.7	0.6
	Ockway Bay	3.16	0.8	0.9	0.9	0.9	0.9
	Mashpee River	47.44	16.2	13.7	15.9	15.4	18.0
	Shoestring Bay	36.93	19.7	14.3	15.1	17.4	18.7
	MEP THRESHOLD TOTAL	*95.84*	*40.18*	*31.29*	*34.90*	*36.80*	*40.92*
Waquoit Bay East							
	Little River/Hamblin Pond	15.50	3.84	2.37	3.01	3.01	2.16
	Great River/Jehu Pond	8.96	1.88	2.08	2.73	2.73	2.10
	Jehu/Hamblin Threshold TOTAL	*24.46*	*5.72*	*4.45*	*5.74*	*5.74*	*4.26*
	Quashnet River TOTAL	50.73	15.92	15.89	15.89	15.89	14.20

Appendix O

Voluntary National Guidelines for Management of Onsite and Clustered Wastewater Treatment Systems

TABLE 4-5

INFRASTRUCTURE SUMMARY BY TOWN AND SCENARIO

Town	Wastewater Flows (gpd)		Pipe length(ft)	Pumping Stations	Gravity Sewer (lf)	Pressure Sewer (lf)	Properties on Gravity Sewer	Properties on Pressure Sewer	Force Main Length (lf)
	Existing	Future							
SCENARIO 1									
Mashpee Total	810,000	1,300,000	610,000	41	320,000	300,000	4,000	1,700	150,000
Barnstable Total	110,000	110,000	96,000	4	18,000	78,000	180	380	12,000
Sandwich Total	240,000	300,000	140,000	0	0	140,000	0	1,310	21,000
Falmouth Total	80,000	100,000	49,000	17	40,000	10,000	440	100	24,000
Total	**1,200,000**	**1,800,000**	**900,000**	**62**	**380,000**	**530,000**	**4,600**	**3,500**	**210,000**
SCENARIO 2									
Mashpee Total	780,000	1,300,000	600,000	40	310,000	290,000	3,900	1,700	160,000
Barnstable Total	110,000	110,000	96,000	4	18,000	78,000	180	380	17,000
Sandwich Total	180,000	220,000	97,000	0	0	100,000	0	1,070	15,000
Falmouth Total	80,000	100,000	49,000	17	40,000	10,000	440	100	24,000
Total	**1,200,000**	**1,700,000**	**840,000**	**61**	**370,000**	**480,000**	**4,500**	**3,300**	**220,000**
SCENARIO 4									
Mashpee Total	770,000	1,300,000	590,000	40	300,000	290,000	3,800	1,700	140,000
Barnstable Total	94,000	94,000	50,000	3	9,000	41,000	120	190	10,000
Sandwich Total	220,000	270,000	125,000	0	0	130,000	0	1,280	22,000
Falmouth Total	73,000	94,000	44,000	15	35,000	9,000	400	80	20,000
Total	**1,200,000**	**1,800,000**	**810,000**	**58**	**340,000**	**470,000**	**4,300**	**3,300**	**190,000**
SCENARIO 5									
Mashpee Total	750,000	1,200,000	570,000	40	290,000	280,000	3,700	1,600	140,000
Barnstable Total	110,000	190,000	73,000	4	30,000	42,000	310	220	9,000
Sandwich Total	120,000	150,000	70,000	0	0	70,000	0	710	11,000
Falmouth Total	80,000	100,000	49,000	17	40,000	10,000	440	100	24,000
Total	**1,100,000**	**1,600,000**	**760,000**	**61**	**360,000**	**400,000**	**4,500**	**2,600**	**180,000**

Note: Does not include build-out flows from existing WWTF which is approximately 0.5 mgd.

TABLE 4-7

COMPARISON OF ESTIMATED SCENARIO COSTS (SCENARIOS 1, 2, 4, AND 5) (1)

ESTIMATED COLLECTION SYSTEM COSTS	Scenario 1	Scenario 2	Scenario 4	Scenario 5
Collection System Construction Cost (2)	$ 210,000,000	$ 200,000,000	$ 190,000,000	$ 190,000,000
Force Mains (from Pump Stations, and to Treated Water Recharge Site	$ 19,000,000	$ 21,000,000	$ 18,000,000	$ 25,000,000
SubTotal	*$ 230,000,000*	*$ 220,000,000*	*$ 210,000,000*	*$ 220,000,000*
General Conditions	$ 35,000,000	$ 33,000,000	$ 32,000,000	$ 33,000,000
Total Construction Cost	*$ 270,000,000*	*$ 250,000,000*	*$ 240,000,000*	*$ 250,000,000*
Contingency	$ 81,000,000	$ 75,000,000	$ 72,000,000	$ 75,000,000
Fiscal, Legal	$ 41,000,000	$ 38,000,000	$ 36,000,000	$ 38,000,000
Engineering (Design and Construction)	$ 38,000,000	$ 35,000,000	$ 34,000,000	$ 35,000,000
Total Collection System Capital Cost	***$ 430,000,000***	***$ 400,000,000***	***$ 380,000,000***	***$ 400,000,000***
ESTIMATED WWTF COSTS	**Scenario 1**	**Scenario 2**	**Scenario 4**	**Scenario 5**
Construction Cost for Modification to Existing WWTFs (3)	$ -	$ 8,500,000	$ 9,000,000	$ 700,000
Construction Cost for New WWTFs (5)	$ 47,000,000	$ 33,000,000	$ 32,000,000	$ 33,000,000
Construction of Treated Water Recharge Facilities (4)	$ 4,200,000	$ 3,500,000	$ 2,300,000	$ 4,400,000
SubTotal Wastewater Treatment Facility Construction Costs	*$ 51,000,000*	*$ 45,000,000*	*$ 43,000,000*	*$ 38,000,000*
General Conditions	$ 7,700,000	$ 6,800,000	$ 6,500,000	$ 5,700,000
Total Construction Cost	*$ 59,000,000*	*$ 52,000,000*	*$ 50,000,000*	*$ 44,000,000*
Contingency	$ 18,000,000	$ 16,000,000	$ 15,000,000	$ 13,000,000
Fiscal, Legal	$ 9,000,000	$ 7,800,000	$ 7,500,000	$ 6,600,000
Engineering (Design and Construction)	$ 8,000,000	$ 7,300,000	$ 7,000,000	$ 6,200,000
Total WWTF Capital Cost	***$ 94,000,000***	***$ 83,000,000***	***$ 80,000,000***	***$ 70,000,000***
ESTIMATED INDIVIDUAL SYSTEM UPGRADE COSTS	**Scenario 1**	**Scenario 2**	**Scenario 4**	**Scenario 5**
Individual I/A Systems Construction Costs	$ 8,000,000	$ 1,100,000	$ 2,800,000	$ 2,600,000
Total Construction Cost	*$ 8,000,000*	*$ 1,100,000*	*$ 2,800,000*	*$ 2,600,000*
Contingency	$ 2,400,000	$ 330,000	$ 840,000	$ 780,000
Engineering (Design)	$ 560,000	$ 77,000	$ 200,000	$ 180,000
Total Capital Cost	***$ 11,000,000***	***$ 1,500,000***	***$ 3,800,000***	***$ 3,600,000***
2008 TOTAL SCENARIO CAPITAL COST	**$ 540,000,000**	**$ 480,000,000**	**$ 460,000,000**	**$ 470,000,000**

Notes:

1. Costs rounded to two significant figures. Based on 2008 ENR of 8094. Based on future build-out condition.
2. Collection System Costs include pumping station. Costs do not include land acquisition. Force main costs are based on estimated lengths of force mains from pumping station to pumping station or WWTF. Costs also include force main from WWTF to treated recharge site.
3. Does not include costs associated with acquiring the facility.
4. Costs do not include the siting and construction of new wastewater treatment facilities in Barnstable or Falmouth.
5. Costs include facilities at new sites and estimated expansion on some existing sites. Does not include costs associated with land acquisition.

TOWN OF MASHPEE — OFFICE OF SELECTMEN

16 Great Neck Road North
Mashpee, Massachusetts 02649
Telephone - (508) 539-1401
bos@mashpeema.gov

GHD

MAR 29 2013

RECEIVED

BY: _____

March 27, 2013

Colonel Anthony Schiavi, Executive Director
Massachusetts Military Reservation
3132 Richardson Road
Camp Edwards, MA 02542

Re: Town of Mashpee Wastewater Planning

Dear Colonel Schiavi:

On behalf of the Town of Mashpee, I would like to express the Town's interest in exploring the potential of regional wastewater solutions with the MMR.

As part of the CH2MHill study, the Town provided information related to the potential expansion of the wastewater service area into Mashpee. This preliminary information was incorporated into the report and was evaluated along with other options.

Mashpee is currently in the process of comprehensive wastewater planning for both the Popponesset and Waquoit Bay (East) watersheds. The Waquoit Bay watershed contains a part of the MMR within the upper reaches of the watershed.

We believe there is great benefit to working cooperatively with the MMR and the surrounding towns in reaching the best possible wastewater solutions.

We look forward to discussing this further.

Sincerely,

Michael Richardson, Chairman
Board of Selectmen

Carter Hunt, Mass. Office of Business Development
GHD Engineering
Cape Cod Commission, Sharon Rooney
Mashpee Water District
Mashpee Sewer Commission