



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

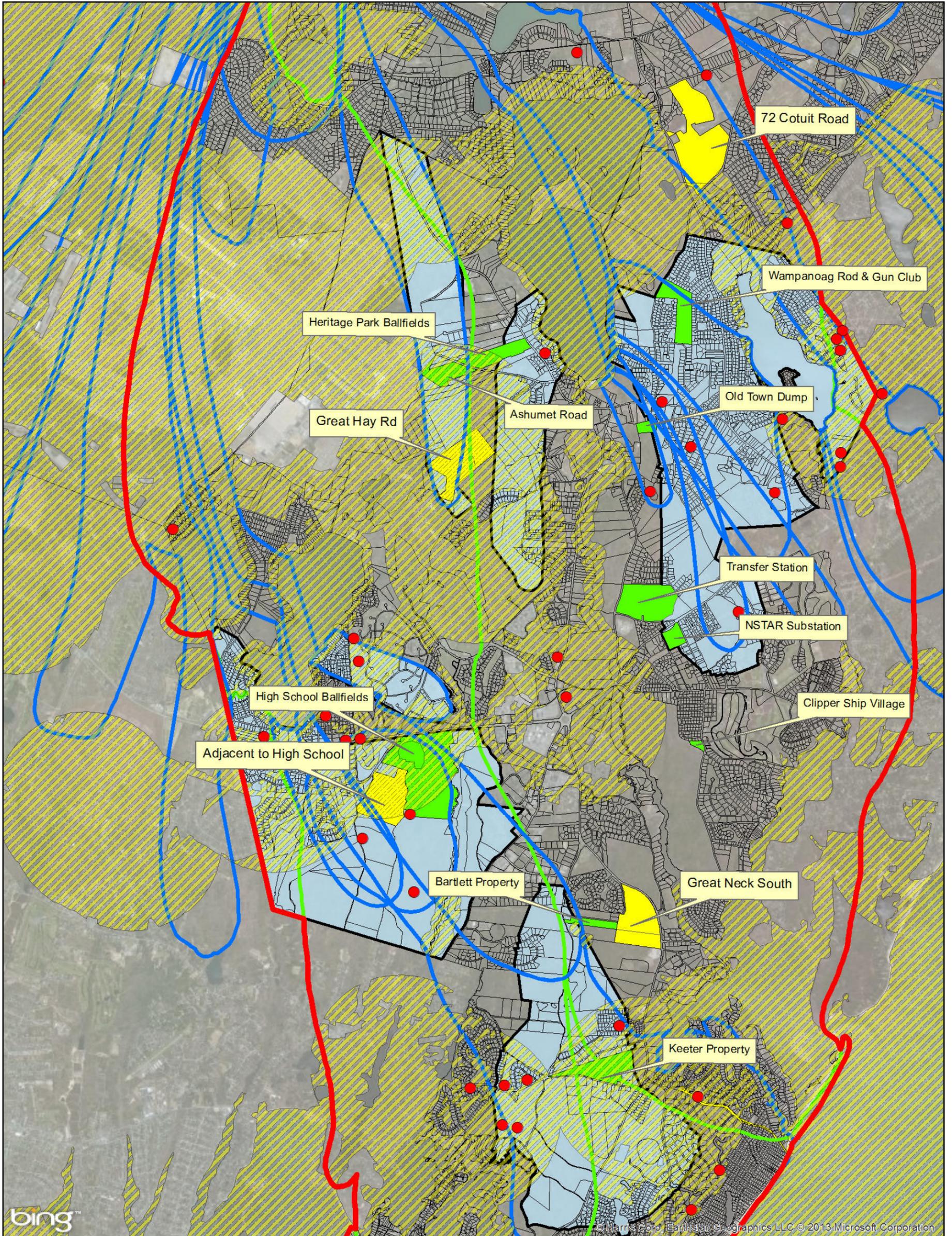


- b. Back Road Sites
- c. Site 4—Transfer Station
- d. Site 6—Keeter Property
- e. Willowbend Golf Course

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

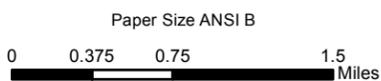
2.10 Findings

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.

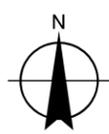


LEGEND

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



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

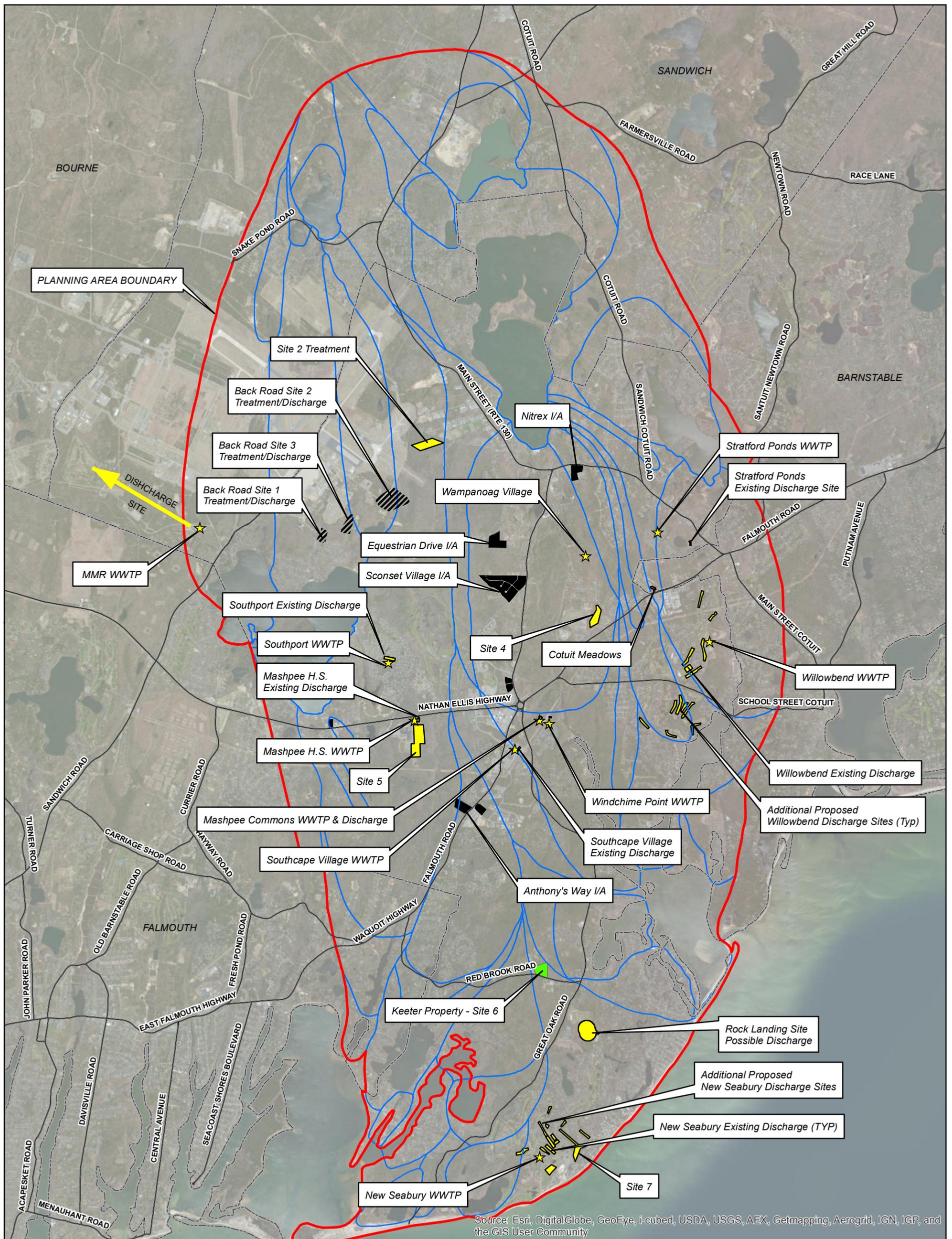


Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Job Number	86-12001
Revision	A
Date	17 Apr 2013

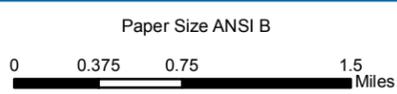
Potential Effluent Recharge Sites

Figure 2-1



LEGEND

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



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

Town of Mashpee Sewer Commission
Watershed Nitrogen Management Plan

Job Number | 86-12001
Revision | A
Date | 07 Aug 2013

Wastewater Removal Areas

Figure 2-2