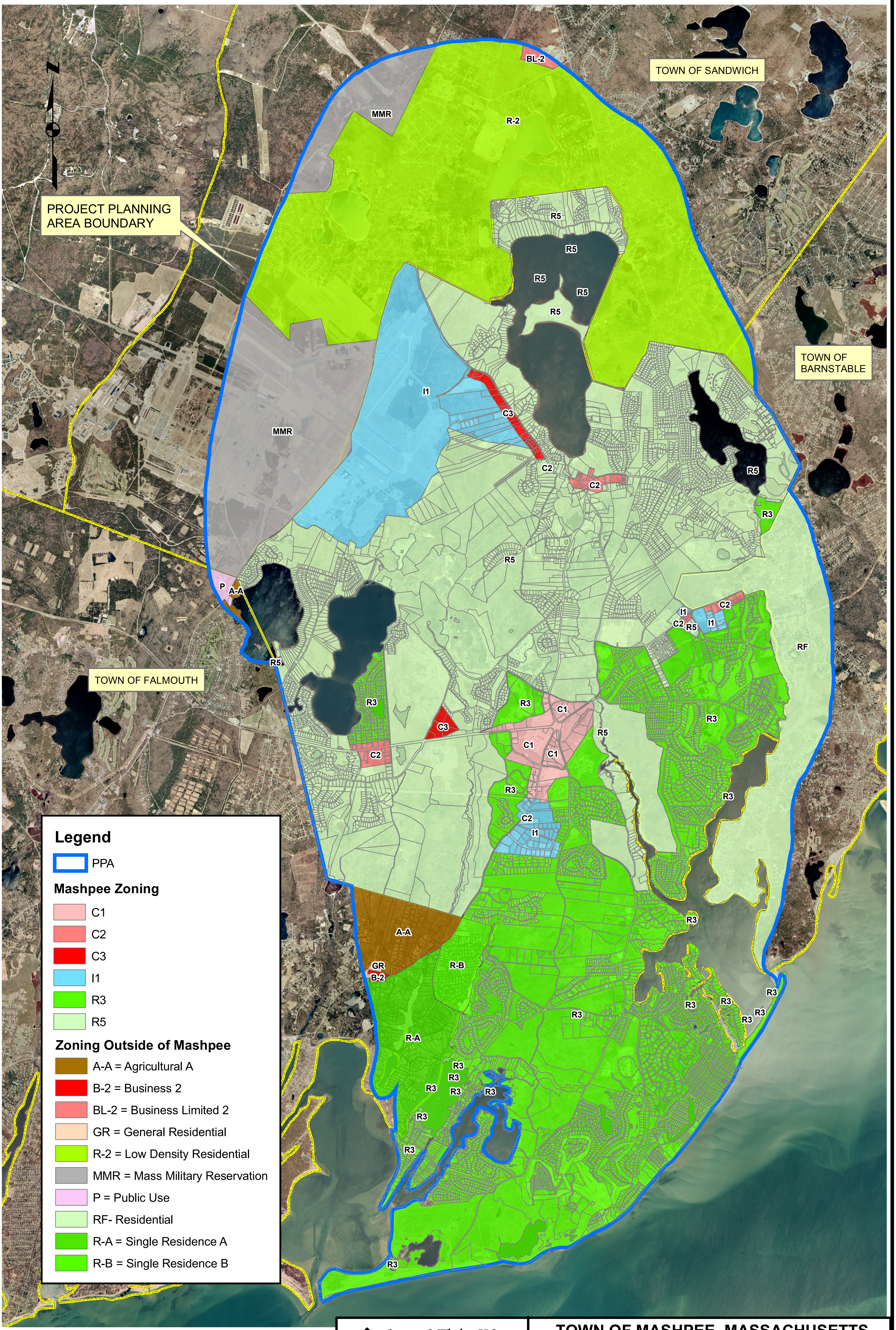

Data Source: Mass GIS, Town of Barnstable Zoning Map dated 4/14/2005 (Town GIS Dept.), Town of Sandwich Zoning Map by CCC dated 9/19/2005

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Date: 04/2007 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

ZONING MAP

FIGURE 5-11

Chapter 6

Existing Wastewater Infrastructure

CHAPTER 6

EXISTING WASTEWATER INFRASTRUCTURE

6.1 INTRODUCTION

The purpose of this chapter is to review the existing wastewater infrastructure in the PPA. This includes both on-site septic systems and small wastewater treatment plants. The analysis of this infrastructure provides a basis for estimating the nitrogen load resulting from wastewater disposal and developing management plans in the future.

6.2 EXISTING ON-SITE SYSTEMS

A. **Description of systems.** Approximately one quarter of homes in the United States use septic systems for disposal of wastewater. Because there is no municipal wastewater treatment facility in the PPA, the majority of the properties are served by on-site disposal systems, primarily septic systems (nearly 2,000 dwellings/homes are served by small package treatment plants, which will be discussed in a later section of this chapter). Several documents exist that provide useful, easily understood information regarding general operation and maintenance of septic systems. Among these are Cape Cod Homeowners' Guide to Title 5 (1999, Association for the Preservation of Cape Cod, Inc.) and A Homeowner's Guide to Septic Systems (2002, USEPA).

The following describes the most common types of systems used for onsite disposal. The most frequently used in the PPA are the Title 5 systems and Innovative/Alternative (I/A) systems.

1. **Title 5 Systems** are septic systems designed under 310 CMR 15.000 commonly referred to as the Title 5 regulations, as identified in Chapter 3. They are composed of three

main elements: septic tank, distribution box, and soil absorption system. Septic tanks remove floatable and settleable solids from the waste stream, and can act as an anaerobic digester to digest (remove) solids or as a flow equalization tank. The tank is usually constructed of concrete and consists of baffled chambers, or it has inlet and outlet tees designed to isolate the solids in the tank and eliminate short-circuiting of floatable materials (scum, oil, grease, and other buoyant waste materials). The distribution box receives the effluent from the septic tank and distributes it evenly throughout the leaching system. The distribution box is typically a small watertight concrete structure with one inlet and several outlets. The soil absorption system is used to infiltrate the septic tank effluent into the ground. Soil absorption systems come in many forms including leaching trenches, leaching pits, leaching galleries, and leaching fields. The selection of a particular type of soil absorption system for a particular design will depend upon the specific site considerations and costs.

The system is very effective at removing settleable solids and getting the effluent into the ground; however very limited treatment is provided by this system.

2. **Cesspools** are tanks with open joints or holes in the walls and bottom through which the wastewater percolates into the ground. Solids collect in the bottom of the tank where they decompose or can be removed as septage. They are considered a substandard septic system, and often require replacement at the time of property transfers.

3. **Advanced Septic Systems** are systems that use advanced technology to provide a higher level of treatment than regular Title 5 systems. Advanced septic systems are commonly referred to by the Massachusetts Department of Environmental Protection (MADEP) as I/A systems. The Title 5 regulations allow a variance for smaller soil absorption systems (leaching area) to be constructed when I/A systems are used. These systems can be used to reduce the Biochemical Oxygen Demand (BOD) and nitrogen in the septic tank effluent. There are over 200 I/A systems in Mashpee alone, including Amphidrome, Bioclere, FAST, Waterloo Biofilters, RUCK, Recirculating Sand Filters, SeptiTech, Singulair, and Nitrex systems. In addition, there

are two composting toilet systems. These I/A systems often have more monitoring requirements than a regular Title 5 system. I/A systems are usually requested and approved when a property owner has minimal space for a soil absorption system, when the property is located in a MADEP-specified nitrogen sensitive area, or as required by the Board of Health, Conservation Commission, Planning Board, or Cape Cod Commission.

4. **Tight Tanks** are non-discharge systems that collect and store the wastewater until it can be removed. All the wastewater goes directly into the tight tank. The tank has a level indicator with an alarm, and a signal is transmitted when the liquid level reaches a certain height. When the tank is full, a septage hauler empties the tank and transports the contents to a treatment facility. Tight tanks are usually approved by MADEP only as an interim measure to meet a health risk. There is currently only one known tight tank in Mashpee, and it is used for industrial, non-hazardous purposes. There are no tight tanks that are used for sanitary waste.

5. **Communal Systems** are often Title 5 systems that treat and dispose wastewater from more than one property. They can use common septic tanks, as well as common soil absorption systems. Communal systems with flows greater than 10,000 gallons per day (gpd) are required to obtain a groundwater discharge permit, and they are then required to treat wastewater to a high enough degree to meet Class I groundwater standards. Any increases resulting in design flows greater than 10,000 gpd or changing the design flow of a system already designed for 10,000 gpd require variances.

Campgrounds are permitted to have design flows in excess of 10,000 gpd provided that the facility only receives temporary use; each system is Title 5-compliant; no single system is designed for more than 10,000 gpd; the campground does not receive sewage from mobile home tight tanks that have been chemically treated; and the systems are inspected and maintained so as to protect public health and safety and the environment.

When separate facilities are combined after construction is complete and the resultant flow is more than 10,000 gpd, an inspection of all the systems must be performed within one year of the change. In no way can ownership of facilities be split up for the purpose of circumventing Title 5 requirements. MADEP may take “any action necessary to protect public health, safety, welfare, or the environment” if it is determined that steps were taken to circumvent requirements.

6.3 EXISTING WASTEWATER TREATMENT FACILITIES

A. **Introduction**

The purpose of this section is to discuss the performance, capacity, and expandability for all of the existing package wastewater treatment facilities (WWTFs) in the PPA. There are currently eight (8) package WWTFs in the Town of Mashpee, located at Mashpee Commons, Mashpee High School, New Seabury, Willowbend, South Cape Village, Southport, Stratford Ponds, and Windchime Point, and one at the Forestdale School in Sandwich.

It should be noted that a permit for construction has been granted for a proposed Chapter 40B development in the Town of Barnstable, on the Mashpee town line. This development will include 124 single-family homes on 50.44 acres of land. It was permitted under the name Scrimshaw Village, but has been renamed Cotuit Meadows. The development, with an anticipated daily wastewater flow of 40,920 gpd, will include a WWTF designed to treat the wastewater to below 5 parts per million (ppm) of nitrogen. The effluent will be disposed of in the Popponesset Bay watershed. However, as construction is still in progress, it is simply noted for consideration as the Watershed Nitrogen Management Plan (WNMP) moves forward.

B. **General Process Description**

Several system components are common to all small wastewater treatment facilities. These components are required by MADEP’s design guidelines or are required as part of a well-equipped treatment facility that can be easily operated and maintained during its design life. The main components of a small wastewater treatment facility are presented in Figure 6-1 and described below.

1. **Pretreatment / Preliminary Treatment.** Usually, for package WWTFs, pretreatment is accomplished as part of the primary treatment process. Pretreatment involves the removal of screenings, grit, large objects, grease, and floatables, which can damage pumping systems and other unit processes. The small wastewater treatment facilities in the PPA typically do not have a dedicated pretreatment system.

2. **Primary Treatment.** Primary treatment usually occurs in settling tanks, but large septic tanks or primary clarifiers are also used. The settling tanks help reduce the organic loading to the biological nitrogen removal process by removing the settleable solids and the floatables. The raw wastewater flows through the clarifier or septic tank and the solids settle to the bottom, where they are collected and removed for disposal. MADEP's design guidelines require the installation of primary clarifiers on all small wastewater treatment facilities, though they are not generally used with Sequencing Batch Reactor (SBR) processes.

3. **Flow Equalization.** Flow equalization is required to equalize the daily variations of wastewater flows and associated loadings that are conveyed to a small wastewater treatment facility. A flow equalization tank stores the variable flows that occur periodically during the day, and equalization pumps convey a relatively constant flow from the equalization tank to the biological treatment process.

4. **Secondary Treatment / Nutrient Removal.** This process utilizes a large concentrated population of microorganisms to treat the wastewater. The microorganisms are mixed with (or brought into contact with) the wastewater in an aerobic environment, and biodegradable waste is metabolized by the microorganisms to new cell mass and carbon dioxide. This first step is commonly referred to as BOD removal. The second step is nitrification, during which ammonia in the wastewater is converted to nitrate-nitrogen under aerobic conditions.

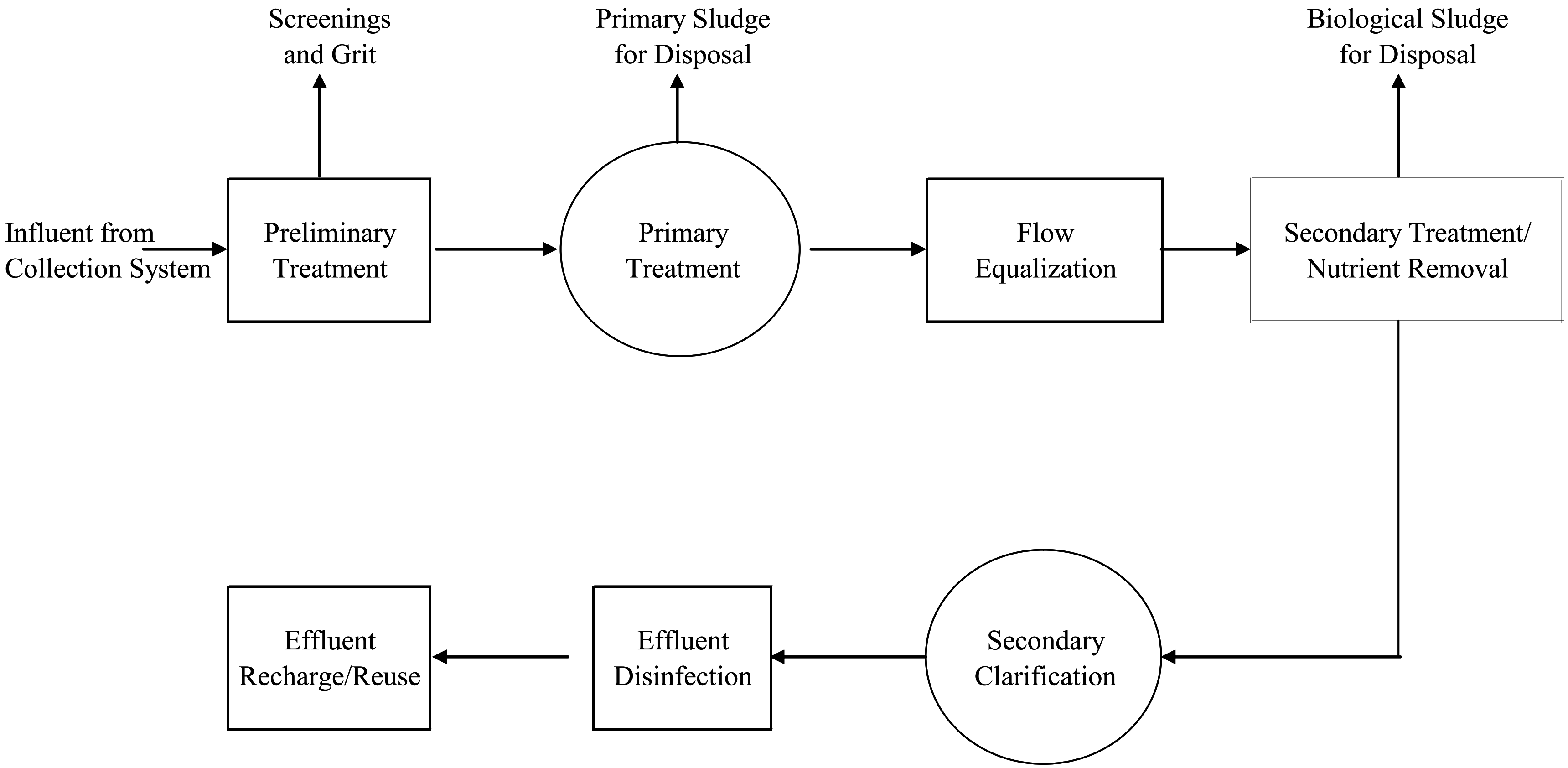
These two steps are both aerobic and generally occur at the same time. When nitrogen removal is incorporated with biological treatment, a third step is required, where the amount of oxygen entering the process is limited and the microorganism environment becomes anoxic. The anoxic environment causes the microorganisms to obtain oxygen by converting the nitrate-nitrogen to nitrogen gas, which removes the nitrogen from the wastewater and releases it into the atmosphere. A carbon source such as methanol is commonly added to the process to support the conversion of nitrate-nitrogen to nitrogen gas. This third step is called “denitrification”.

The biological nitrogen removal process is usually either a suspended growth process, where a concentrated microorganism population is suspended in the wastewater, or a fixed-film process, in which the microorganisms adhere to a supporting media, and the wastewater is cycled through.

5. **Secondary Clarifiers.** Secondary clarifiers are an integral component of the activated sludge and Rotating Biological Contactor (RBC) nitrogen removal processes, but are not typically required for SBR or Amphidrome systems. These clarifiers are used to separate the biological solids (sludge) from the treated wastewater, and they operate similarly to the previously described primary clarifiers.

6. **Disinfection.** Disinfection may be required prior to discharging the treated effluent to the groundwater. For the small facilities in Mashpee, disinfection is usually accomplished by exposing the effluent to ultraviolet light, which inactivates (essentially kills) the bacteria in the effluent.

7. **Effluent Disposal Facilities.** These facilities are required to discharge and distribute the treated effluent to the ground. The two most common methods used in Mashpee are sand infiltration beds and subsurface leaching. There are a number of effluent technologies that are available and these will be discussed in the next phase of the project. When sand infiltration beds are used, the effluent is piped to a sand bed, where the effluent percolates into



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TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Componets of Small WWTF
Flow Schematic

FIGURE 6-1

the ground through the open sand surface. When subsurface leaching systems are used, the effluent is piped to one of three types of distribution systems, namely fields, trenches, or chambers, where the effluent percolates into the ground.

C. Existing Wastewater Treatment Facilities

In this section, the eight existing small wastewater treatment facilities are discussed, with reference to the general processes discussed above.

1. Mashpee Commons Wastewater Treatment Facility

Identification and History. The WWTF serving Mashpee Commons and the surrounding areas is located off of Great Neck Road, south of the Mashpee rotary. The facility was originally constructed in 1986 and upgraded in 1995. Currently the WWTF services a variety of land uses at Mashpee Commons, including retail, theater, restaurant, office, residential, and governmental uses. The WWTF also collects wastewater from Phase I of the nearby North Market Street development, which includes a Stop & Shop grocery store, a bank, a liquor store, a video rental, and other small retailers. The Mashpee Commons WWTF is in the Mashpee River subwatershed of Popponesset Bay.

Based on future growth and development plans in the area, another upgrade to the facility is proposed in the Mashpee Commons Master Plan. This proposed facility upgrade is likely going to change the process from an RBC to a Membrane Bio-Reactor (MBR). As of December 2006, the upgrade is still several years away from implementation. The following Mashpee Commons Neighborhoods are proposed to be served by the upgraded WWTF: Whitings Road, East Steeple Street, Jobs Fishing Road, North Market Street (Phase II), Great Neck Road South, and Trout Pond. These neighborhoods are not yet built and may still be 10 to 20 years away from buildout conditions.

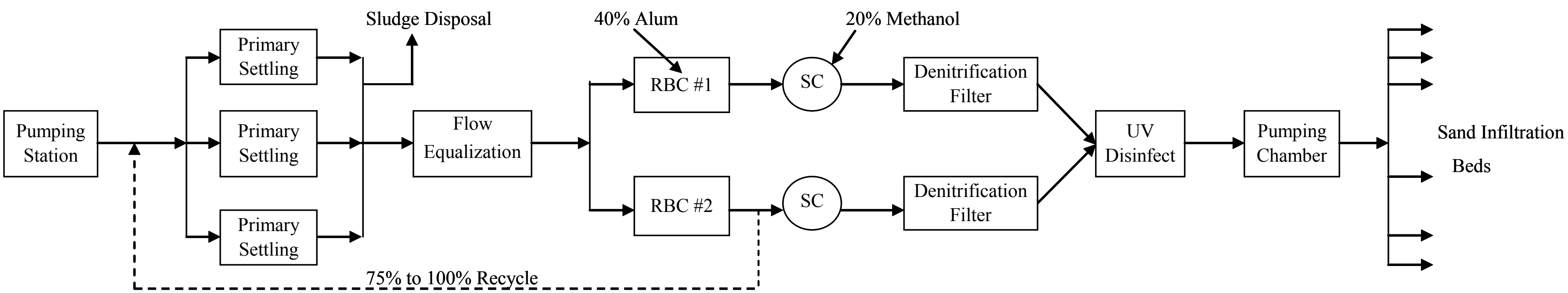
The police department, the fire department, and the Senior Citizen's Center have been connected to the Mashpee Commons WWTF. The Mashpee Commons WWTF is also proposed to collect wastewater from the following sites in the Town of Mashpee by the year 2015:

- Elementary and Middle Schools
- Homeyer Village
- Existing and Proposed Town Libraries
- Christ the King Church
- Boys & Girls Club

Process Description. The WWTF at Mashpee Commons is comprised of the following main components: primary settling tanks, flow equalization tank, RBCs for secondary treatment, secondary clarifiers, denitrification filters, UV disinfection, and an effluent disposal facility. Figure 6-2 outlines this process.

Currently, sewage is received from a pumping station located near Steeple Street and distributed to three (3) 23,000-gallon primary settling tanks, where it is combined with returned sludge for primary treatment. These tanks are pumped twice yearly to remove sludge that is later processed off-site. The primary effluent is then pumped through a 30,000-gallon flow equalization tank and into the two (2) aerobic RBC treatment trains. Each RBC unit is 12 feet in diameter by 26 feet long, and provides a site for nutrient uptake by microorganisms. The rotating shaft brings the microorganisms in contact with both the organic matter in the wastewater and the oxygen in the atmosphere and keeps the system mixed. Alum is added at this point as a source of alkalinity to keep the pH of the system at the desired level.

Part of the RBC effluent is recycled back to the primary settling tanks, while part continues on to secondary clarification. There are two (2) secondary clarifiers; each is 12 feet in diameter by 8 feet high, and is used to remove floatable and settleable solids from the wastewater. Methanol is added here to provide an additional carbon source, which will be used in the denitrification



<u>Legend:</u> SC = Secondary Clarifier

RBC = Rotating Biological Contactor

UV Disinfect = Ultraviolet Disinfection

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TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Mashpee Commons
Flow Schematic

FIGURE 6-2

process. (For a time, methanol was replaced by MicroC as the supplemental carbon source; however, the wastewater treatment system performance suffered. The operator identified that using MicroC in a system with high dissolved oxygen levels created a much higher chemical demand and sludge generation without the performance seen with using methanol. The operators have since reverted back to methanol use.) After leaving the secondary clarifier, the clarified effluent in each train passes through a 20 ft^2 denitrifying filter that anaerobically removes nitrate and also filters out any remaining suspended solids. After flowing through this filter, the effluent from the two treatment trains is recombined to undergo ultraviolet (UV) disinfection before being sent to a 15,000-gallon effluent pumping chamber. The final effluent is pumped from the effluent pumping chamber to four sand infiltration beds that provide a total leaching area of 8,100 ft^2.

The WWTF at Mashpee Commons currently has both treatment trains in operation.

Flow Capacity. The facility currently operates under Discharge Permit No. 306, with a permitted flow of 180,000 gpd, although the facility is currently seeing an average annual flow of 22,000 gpd – only 12% of its capacity. The current peak day flow is less than 43,000 gpd, which is only 24% of the plant’s capacity. However, according to the plant operator, the denitrification filters are currently operating close to capacity. The proposed upgrade to the plant is anticipated to treat a peak flow of 180,000 gpd and achieve an average of 4 mg/L Total Nitrogen, which is below the limit of the discharge permit. In addition, the ultimate effluent disposal capacity of the sand infiltration beds (based on soil permeability) is estimated at 300,000 gpd.

Estimates of the Mashpee Commons build-out average annual flows were made using build-out information provided by the Mashpee Planning Department and the estimating methods described in more detail in Chapter 7. According to these estimates, the future average annual flow to Mashpee Commons will be nearly 120,000 gpd. The following table summarizes the existing peaking factors (relationship between average annual flow and peak flows) and how the peaking factors affect the estimated future flow.

TABLE 6-1

MASHPEE COMMONS PEAKING FACTORS

	Maximum Month	Peak Day
Peaking Factor	1.5	2.0
Estimated Future Flow (gpd)	170,000	230,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

As shown in Table 6-1, the estimated maximum month flow will be within the permit limits, but the estimated build-out peak day flow may exceed the permit and the design flow. The Mashpee Commons WWTF is not anticipated to have available flow capacity at buildout conditions. If additional flow capacity were to be added at the Mashpee Commons WWTF, the existing building would require expansion. The area surrounding the WWTF is mostly wooded, with an electric utility easement on one side of the property. However, it is likely that there is room on the site for expansion. Additional capacity may also be designed into the new system in the future. Additionally, the sand infiltration beds have existing capacity for 300,000 gpd of effluent discharge and would therefore be able to handle additional flows. The biggest concern would be the operator’s identification that the existing denitrification filters may be approaching capacity and therefore the facility may require an upgrade to address this issue as additional flow is added to the system.

Performance. The following table summarizes the discharge permit limits, and the average annual influent and effluent concentrations (October 2004-October 2005 data) for the various wastewater characteristics analyzed.

<u>TABLE 6-2</u>

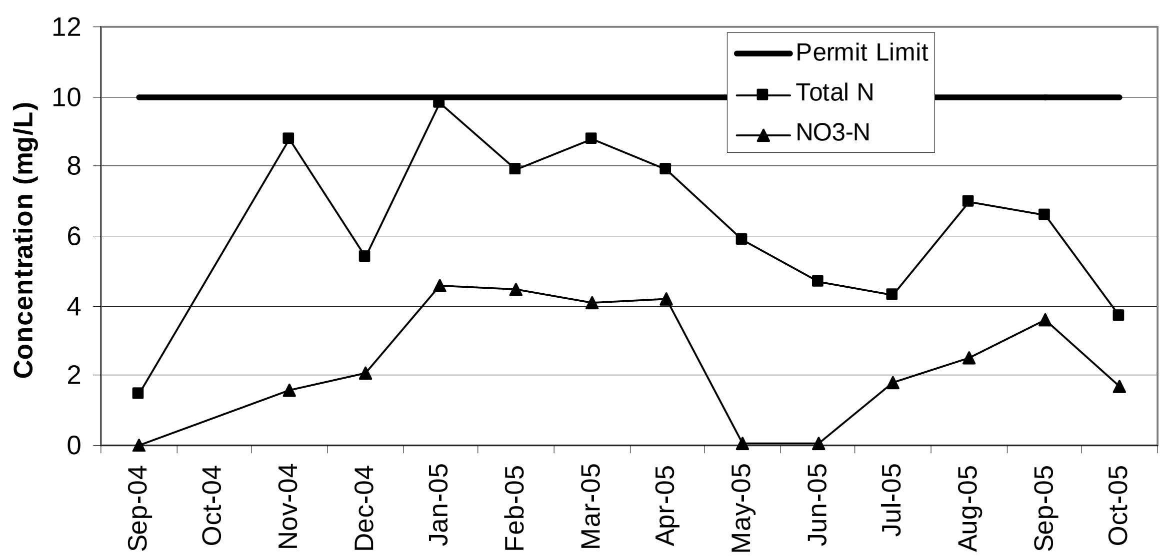
MASHPEE COMMONS TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	457.7	14.2	97%
TSS	30	200.8	14.0	93%
Total N	10	52.4	6.3	88%
Nitrate-N	10	0.1	2.4	-
Oils & Grease	15	95.8	0	100%

On an average annual basis, the facility was in compliance with all the discharge permit limits listed above. In addition, the percent removals for BOD, Total Suspended Solids (TSS), and Oil & Grease were very high. On a monthly basis, however, BOD limits were exceeded on two occasions (May and June 2005).

The following figure shows the monthly effluent Nitrogen values for the analysis period.

Figure 6-3 - Mashpee Commons Nitrogen Concentrations



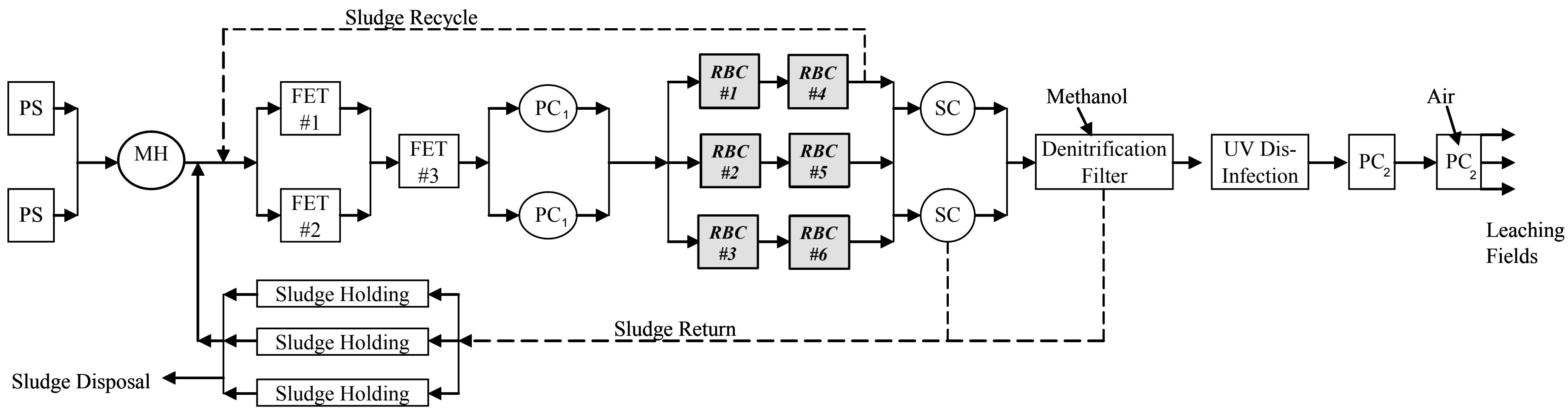
As is shown in Figure 6-3, there were no exceedances of Total Nitrogen during the analysis period.

2. New Seabury Wastewater Treatment Facility

Identification and History. The WWTF at New Seabury was constructed in 2000 to centralize the wastewater collection, treatment, and disposal of various existing and proposed properties owned by New Seabury Properties, LLC. New Seabury is located on the 2,700-acre Great Neck peninsula, bounded by Waquoit Bay, Nantucket Sound, and Ockway Bay, and includes single and multi-family residential neighborhoods, two golf courses, and some commercial development. Development in the area has occurred under the provisions of a "special permit" since 1964 that subdivided New Seabury into 25 sections, each with different land use requirements. The WWTF was designed to treat wastewater from the failed on-site septic system at the Popponesset Inn as well as the New Seabury Country Club and a number of proposed commercial and residential projects, which discharge into a Zone II aquifer protection area. The New Seabury WWTF is not in either of the two MEP watersheds (Waquoit Bay East and Popponesset Bay).

Process Description. The following main components make up the New Seabury WWTF: two (2) pumping stations, a flow equalization tank, sludge holding tanks, aerobic RBCs for secondary treatment, secondary clarifiers, denitrification filter, pumping chambers, and effluent disposal (see Figure 6-4).

Sewage is collected by gravity sewers and force mains into two pumping stations, located at the Clubhouse (servicing the expanded Clubhouse and surrounding residential developments currently permitted by the New Seabury Special Permit) and the Popponesset Inn (servicing the Popponesset Inn, the Cabana Club, the Beach Club, the Market Place and surrounding vacant areas designated for residential development). The wastewater is then combined with supernatant generated at the three (3) 31,000-gallon sludge holding tanks where recycled sludge



<u>Legend:</u>

PS = Pumping Station
FET = Flow Equalization Tank
PC = Primary Clarifier
MH = Manhole
SC = Secondary Clarifier
PC = Pumping Chamber
= equipment not currently in use

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Watershed Nitrogen Management Plan

New Seabury
Flow Schematic

FIGURE 6-4

from the RBC treatment trains is returned. (The sludge holding tanks are pumped every six months and the wasted sludge is transported to an off-site treatment facility.) This mixture is pumped by a duplex pumping system through two (2) 34,700-gallon flow equalization tanks and one (1) 10,700-gallon flow equalization tank to ensure a constant rate of flow into the primary clarifiers. The two (2) primary clarifiers, each 20 feet in diameter by 10 feet deep are used to remove suspended solids. The primary effluent then flows through three (3) trains made up of two (2) aerobic RBC units each (see process flow schematic). RBCs #1, #2, and #3 have a first stage surface area of 48,500 ft^2 and a second stage surface area of 60,000 ft^2, while RBCs #4, #5, and #6 have first and second stage surface areas of 71,250 ft^2, providing a total effective surface area of 753,000 ft^2. The RBCs are approximately 40 percent submerged into the wastewater and provide the site for biological BOD removal. From the second RBC in each train, a portion of the flow is recycled back to the flow equalization tanks at the head end of the WWTF, and the effluent wastewater flows into two (2) 20-ft diameter secondary clarifiers where any remaining sludge or suspended solids are settled out. Accumulated sludge from the secondary clarifiers is returned to the sludge holding tanks. Flow from the two (2) treatment trains is recombined at this point and passed through six (6) 34.82 ft^2 multi-media denitrification filter cells, where MicroC is added (for supplemental carbon) and nitrate is converted to nitrogen gas. This effluent is pumped through a Trojan UV disinfection system (rated at 208 gallons per minute) and into the 15,000-gallon effluent pumping chamber #1. From pumping chamber #1, the effluent is pumped into the 10,700-gallon pumping chamber #2, where air is diffused throughout the effluent, providing post-aeration to the final effluent. From pumping chamber #2, the effluent is discharged via three (3) forcemains to 120 leaching trenches (each 100-ft long), which are divided among four (4) leaching fields. These fields provide a total effective leaching area of 100,000 ft^2, and a maximum effluent loading rate of 3.0 gpd/ft^2 (a total effluent disposal capacity of 300,000 gpd).

Flow Capacity. The development at New Seabury was designed to treat (and permitted to discharge) 300,000 gpd. However, the wastewater flows actually received at the plant are significantly below that value. The average annual flow is just over 8,000 gpd (3% of total capacity) and the maximum daily flow is approximately 40,000 gallons (13% of total capacity). These low flows require only one of the treatment trains and one primary clarifier to be in operation for adequate treatment. The 2001 Final Environmental Impact Report for New Seabury indicated that the 300,000 gpd design would provide "modest excess capacity", although "the actual amount of this excess will not be known until the entire New Seabury Development has been completed and is fully occupied.".

Based on information provided by the Town Planning Department, estimated average annual future flows will be 69,000 gpd. Table 6-3 shows the peaking factors that were used to estimate the maximum month and peak day future flows for the New Seabury WWTF.

TABLE 6-3

NEW SEABURY PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.4	2.2
Estimated Future Flow (gpd)	100,000	210,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

The estimates shown above were obtained using average peaking factors rather than site-specific factors. The peaking factors currently experienced by the New Seabury WWTF are considerably higher than average. This is assumed to be a result of the highly seasonal nature of the properties currently connected to the treatment plant and the limited number of total connections. The future wastewater flows come from the build-out analysis, which includes an increase in the number of properties connected to the facility. Based on these estimates, it appears that there is significant capacity available at the New Seabury WWTF. However, prior to determining the capacity of the New Seabury WWTF, several more years worth of data should be evaluated to determine a more accurate peaking factor for the peak month (this number is exceptionally high). Additionally, consideration should be given to the properties considered during the design phase as potentially tying in to the WWTF. One of the purposes in constructing the New Seabury WWTF was to provide a solution for failing septic systems. It would appear that a minimal number of residential properties have tied in to the treatment plant. It may be necessary for more regulatory action to be taken in order to mandate connection to the facility.

An additional limitation to consider before expansion is the existing facility site. Expansion of the plant would require additional structures because of limited remaining space in the existing building. Also, the effluent disposal facilities are designed for 300,000 gpd. Any expansion to the WWTF would require a corresponding expansion of the disposal facilities.

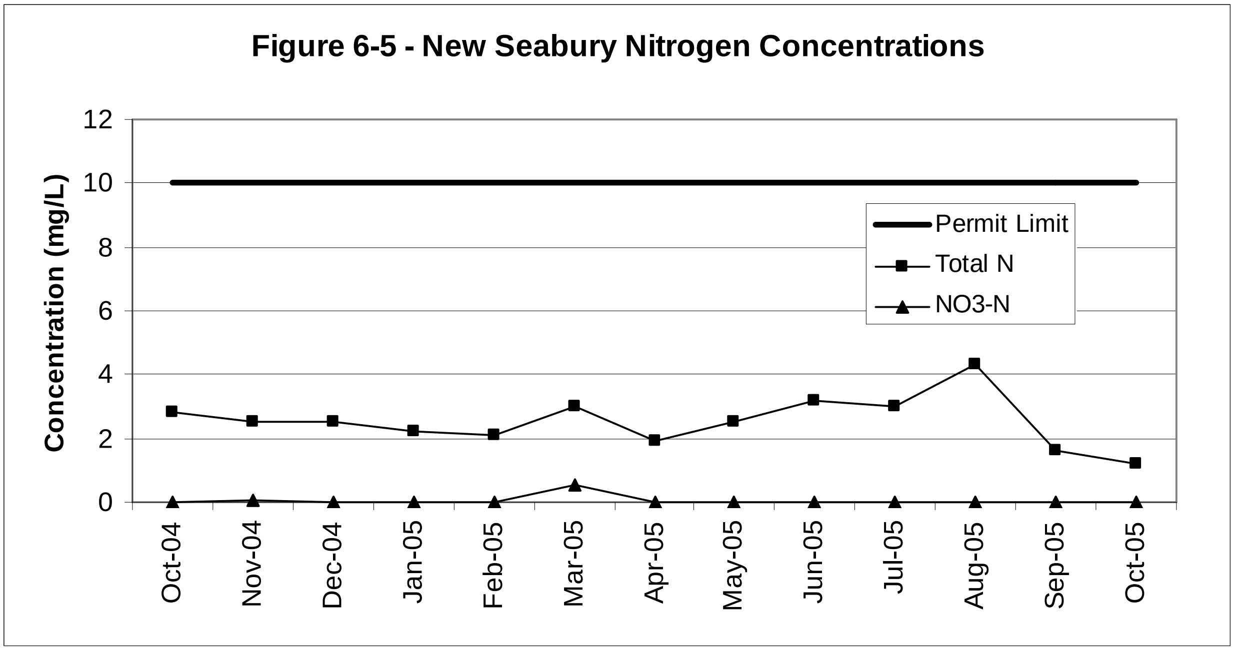
Performance. The WWTF at New Seabury operates under Discharge Permit 698 with a flow limit of 300,000 gpd. The discharge permit limits and average annual influent and effluent wastewater characteristics are presented below for October 2004-October 2005 data.

TABLE 6-4

NEW SEABURY TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	446.0	11.8	97%
TSS	30	207.3	2.2	99%
Total N	10	35.8	2.5	93%
Nitrate-N	10	1.6	0.1	94%
Oils & Grease	15	39.2	0.4	99%

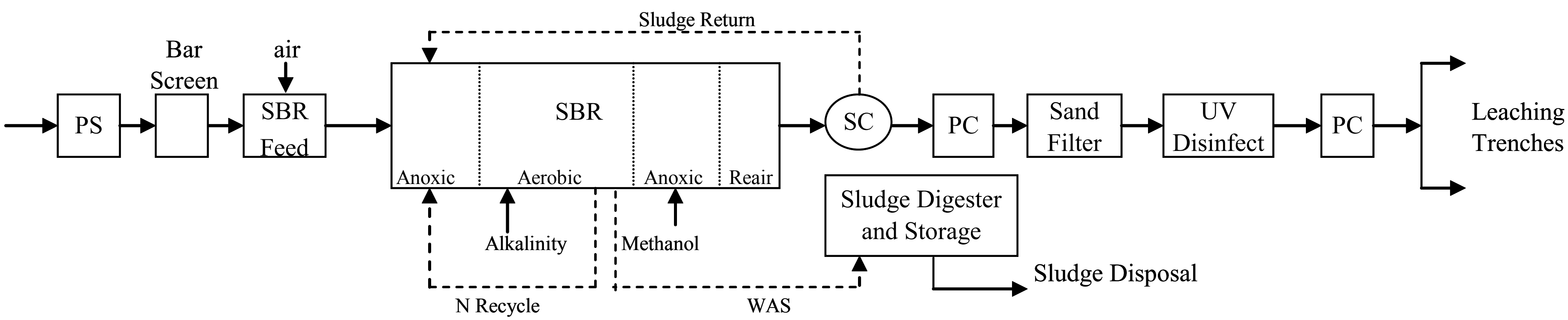
New Seabury had one exceedance. Effluent BOD had a concentration of 36 mg/L in October 2005. There were no exceedances of nitrogen limits, as illustrated on Figure 6-5. The nitrogen levels were consistently low and well below the permit level. A large part of the reason why this facility is achieving such high effluent water quality is the fact that it is receiving significantly smaller flows than the design flows. This represents a significant treatment capacity that is not being utilized. As discussed, the Town should consider mandating connection to maximize treatment and minimize environmental impacts. Figure 6-5 illustrates the effluent nitrogen concentrations.



3. Mashpee High School Wastewater Treatment Facility

Identification and History. The SBR facility located off Route 151 at the back of the Mashpee High School was designed and permitted in 1995. The permit (#608) expired in 2000 and has not been renewed because the High School is appealing the terms of the renewal. The WWTF has been managed by Earth Tech since 1999, and currently serves students and faculty for grades seven though twelve in Mashpee. The Mashpee High School WWTF is in the Quashnet River subwatershed of Waquoit Bay East.

Process Description. The wastewater treatment facility at Mashpee High School is comprised of the following processes: influent pumping station, SBR-feed tank, an SBR for nutrient removal, secondary clarification, sand filtering, and effluent disposal (see Figure 6-6).



Legend: PS = Pumping Station
SBR = Sequencing Batch Reactor
SC = Secondary Clarifier
WAS = Waste Activated Sludge
PC = Pumping Chamber

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Watershed Nitrogen Management Plan

Mashpee High School
Flow Schematic

FIGURE 6-6

Wastewater that has been collected from the school flows from Sewer Manhole #8 into the influent pumping chamber, where it is pumped through a bar screen and into the 9,000-gallon SBR-feed tank. The purpose of the bar screen is to prevent rocks, rags, or other large objects from entering the treatment facility. The SBR feed tank is used for flow equalization and preliminary aeration before wastewater is pumped into the 3,750-gallon anoxic zone of the SBR. In this zone, flow is mixed prior to entering the 18,000-gallon aerobic zone of the SBR. The system then runs on a 6-hour react cycle schedule. Flow from the aeration zone is recycled back to the primary anoxic zone. Alkalinity is also added in the aerobic zone. This zone is followed by a second small (2,250-gallon) anoxic zone, which includes a mixer and methanol feed for enhanced nitrogen removal. Flow is then re-aerated in a 750-gallon zone of the SBR prior to discharge to the secondary clarifier.

After re-aeration, the reactor settles for 90 minutes. The sludge that has collected after this time is pumped to a sludge digester and the effluent is decanted and discharged into the 10-ft diameter secondary clarifier. Any additional sludge that has collected during secondary clarification is then recycled back to the first anoxic zone of the SBR. The clarified effluent then flows to the filter feed pump chamber where it is pumped through a rapid sand filter. The final effluent then flows into the final effluent pump chamber where it is pumped to two distribution boxes. Each distribution box discharges effluent to six (6) leaching trenches that are each 81-ft. long x 3-ft. wide.

The WWTF at Mashpee High School is currently utilizing all process components described above except the UV disinfection.

Flow Capacity. This plant is permitted to discharge 18,000 gpd, but is currently operating at a maximum monthly flow of 3,000 to 3,500 gpd, according to the operator and recorded data. The school was designed for a maximum capacity of 1,180 students. As of December 2006, there were 947 students and approximately 125 faculty and staff members. Additionally, the facility is used for community education classes in the evenings.

Based on the maximum capacity of 1,180 students, the estimated future flow will be 3,540 gpd. The current peaking factors and future peak flows are shown in the following table.

TABLE 6-5

MASHPEE HIGH SCHOOL PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.4	3.5
Estimated Future Flow (gpd)	4,800	13,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

These estimates indicate that there is nearly 30% available capacity at this WWTF. The facility site location is likely amenable to expansion. However, half of the High School's discharge area is located within a Zone II recharge area. As a result, any expansion of the plant will require further analysis. If permits are sought for additional flows, it is likely that a higher level of effluent treatment will be required, or the discharge area could be relocated outside of the Zone II area. This may require treatment processes beyond what is currently used. As is shown in the following paragraphs, treatment performance does not consistently meet permit requirements. Expansion of this plant to include year round residential flows may result in an improvement in performance.

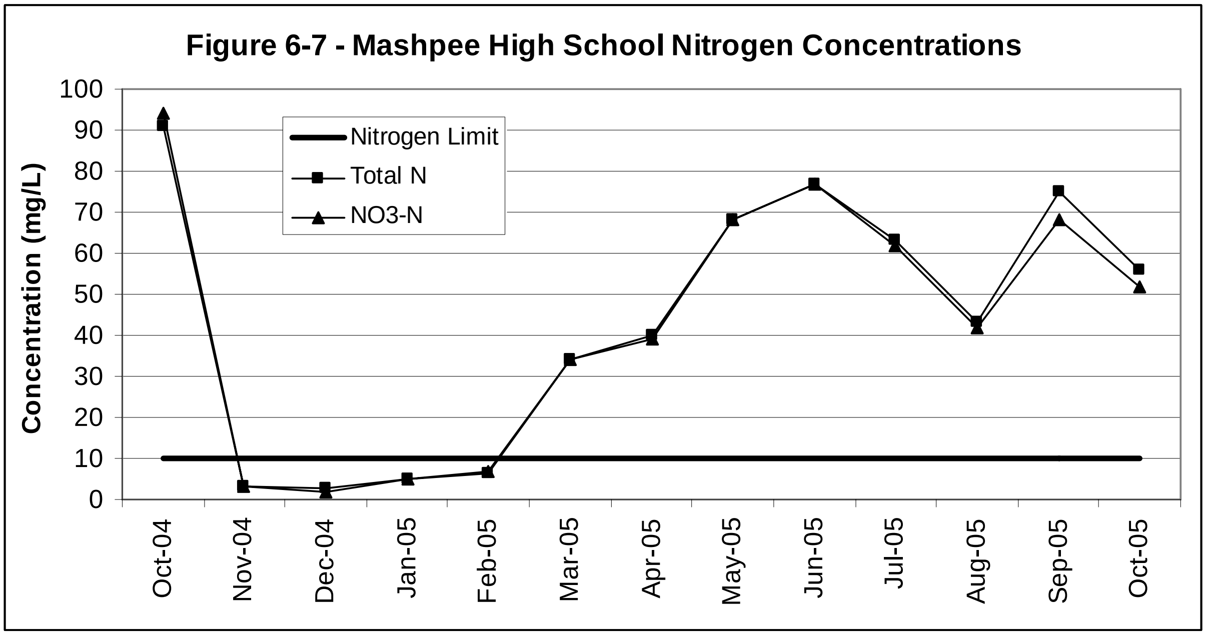
Performance. The facility at Mashpee High School operates under discharge permit No. 608. These discharge limits are summarized in the following table along with October 2004-October 2005 influent and effluent data.

TABLE 6-6

MASHPEE HIGH SCHOOL TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	289.3	2.6	99%
TSS	30	220.6	0.8	99%
Total N	10	99.8	43.5	56%
Nitrate-N (1)	10	-	42.5	-
Oil & Grease	15	44.6	0	100%
(1) Influent wastewater is not typically sampled for Nitrate-Nitrogen				

Based on the average annual effluent data analyzed, the WWTF does not consistently operate within the permit effluent limits. Total Nitrogen and Nitrate Nitrogen exceeded permit limits for 9 of the 13 months analyzed. However, the other permit limit requirements did not appear to be exceeded. Figure 6-7 shows the Total Nitrogen and Nitrate Nitrogen levels.



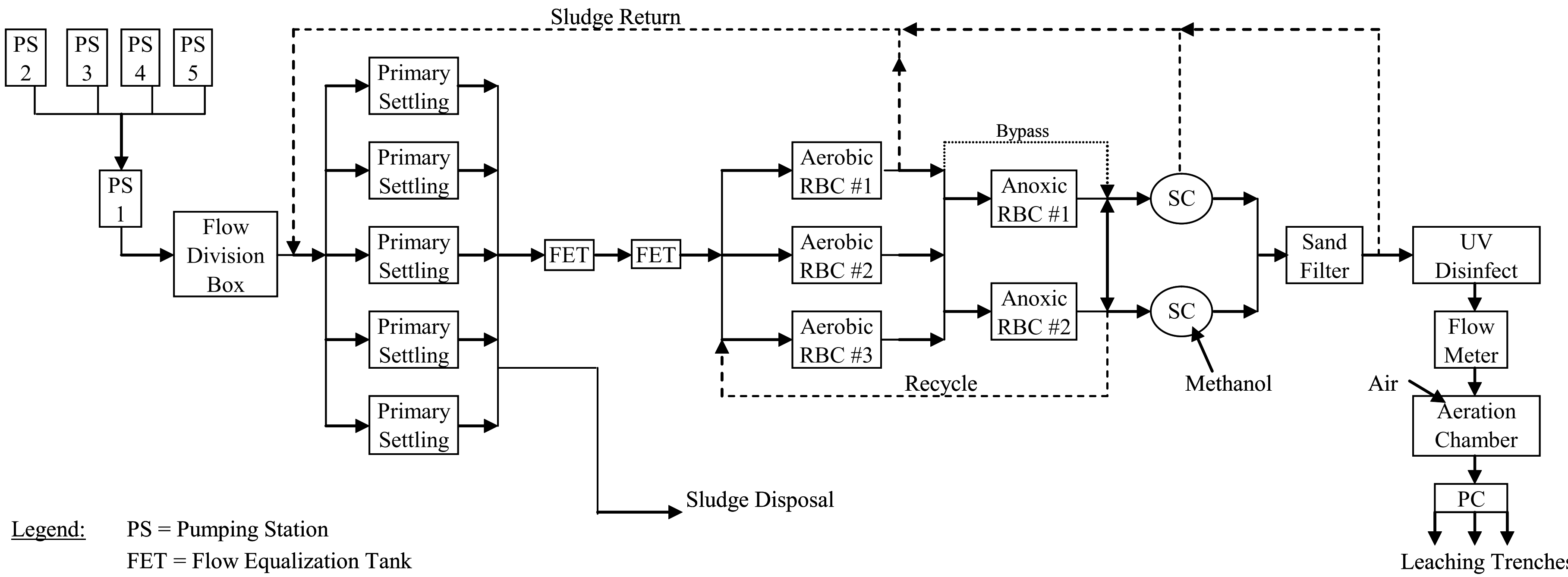
As this chart illustrates, effluent nitrogen concentrations ranged from nearly 100 mg/L to as low as 3 mg/L.

4. Willowbend Wastewater Treatment Facility

Identification and History. The WWTF at Willowbend is located off Quippish Road, near the Willowbend Golf Course. The facility has been in operation since 1994, and services primarily residential homes along Dunrobin Road, Willowbend Road, Eagle Drive, The Heights and the neighboring Cotuit Bay Condominiums. The Willowbend WWTF is in the Shoestring Bay subwatershed of Popponesset Bay.

Process Description. The components involved in this process include: primary settling, flow equalization, aerobic and anoxic RBCs, secondary clarification, rapid sand filters, UV disinfection, and effluent disposal. The flow schematic is illustrated in Figure 6-8.

Sewage is collected from four pumping stations that feed into the larger pumping station #1 and



<u>Legend:</u>

PS = Pumping Station

FET = Flow Equalization Tank

PC = Pumping Chamber

SC = Secondary Clarifier

RBC = Rotating Biological Contactor

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Watershed Nitrogen Management Plan

Willowbend
Flow Schematic

FIGURE 6-8

into the plant. The flow is then equally divided among five (5) 27,000-gallon settling tanks for primary treatment (the total primary treatment capacity is 133,500-gallons). The primary effluent then flows through two (2) 22,750-gallon flow equalization tanks arranged in series, equipped with duplex pumps. This step ensures that an equalized flow will enter the biological treatment train. For this WWTF, aerobic and anoxic RBC units are used for nutrient removal. Wastewater is first distributed between three aerobic RBCs, each with an effective surface area of 98,800 ft^2. In this step, BOD is removed and organic nitrogen is converted to ammonia. The effluent from the aerobic RBCs is then redistributed to two (2) anoxic RBCs, each with an effective surface area of 23,600 ft^2. Activated sludge leaving the anoxic RBCs is recycled back to the aerobic RBCs at this point. The facility has also been designed with a bypass around the anoxic RBCs, to allow wastewater to flow directly from the aerobic RBC units to the secondary clarifiers (see schematic). The two secondary clarifiers are each 14 feet in diameter by 10 feet deep and are used to separate sludge from the treated wastewater. Methanol is also added. The clarified effluent that leaves the secondary clarifiers is then passed through a rapid sand filter containing four (4) 25 ft^2 dual media filter cells. The filter unit has four 5-HP backwash pumps and two 0.75-HP mudwell pumps. Sludge from the aerobic RBCs, secondary clarifiers, and the rapid sand filter are all recycled back to the primary settling tanks.

The effluent is then passed through a UV disinfection system and a flow-metering device before collecting in the first effluent aeration chamber. This chamber holds 2,500 gallons and provides 15 minutes of aeration time for the final effluent. Following aeration, the effluent flows into the 10,000-gallon effluent pumping chamber. From here, three pumps alternately discharge the final effluent to three leaching areas. Each leaching area contains 27 trenches that are 100-ft long x 3-ft wide. This provides a total leaching area of 82,950 ft^2.

Flow Capacity. The WWTF at Willowbend is permitted to discharge 113,000 gpd, although the average annual flow is only 25,000 gpd (about 22% of total permitted capacity). Maximum month flow is 46,000 gpd and peak day is 73,000 gpd. Based on Mashpee Planning Department information, the estimated average annual future flow for this WWTF is 60,000 gpd, which includes the 86-unit Cotuit Bay Condominium Complex. Application of the peaking factors based on flows observed at the Willowbend WWTF is shown in Table 6-7.

TABLE 6-7

WILLOWBEND PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.8	2.9
Estimated Future Flow (gpd)	110,000	175,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

According to the WWTF operator, the Willowbend development is nearing its buildout. If that is true, the future flows (based on the current flow of 25,000 gpd) will be significantly lower than the projected average annual flow of 60,000. However, it is noted that the Willowbend development consists of a large number of seasonal residents. The buildout projection is based on the assumption that all of the residences are used year round. This means that the peaking factors may decrease as the development becomes more year round. If the average annual flow reaches the build-out estimates, the facility will be operating within 10% of its capacity. If the average annual flows are lower than expected, as indicated by the current averages and status of build-out, it is possible that there will be additional capacity. This should be evaluated in more detail when build-out status is confirmed.

During winter conditions, only one treatment train is in operation. During the summer, two (2) of the treatment trains are operating, indicating that there is some limited capacity available.

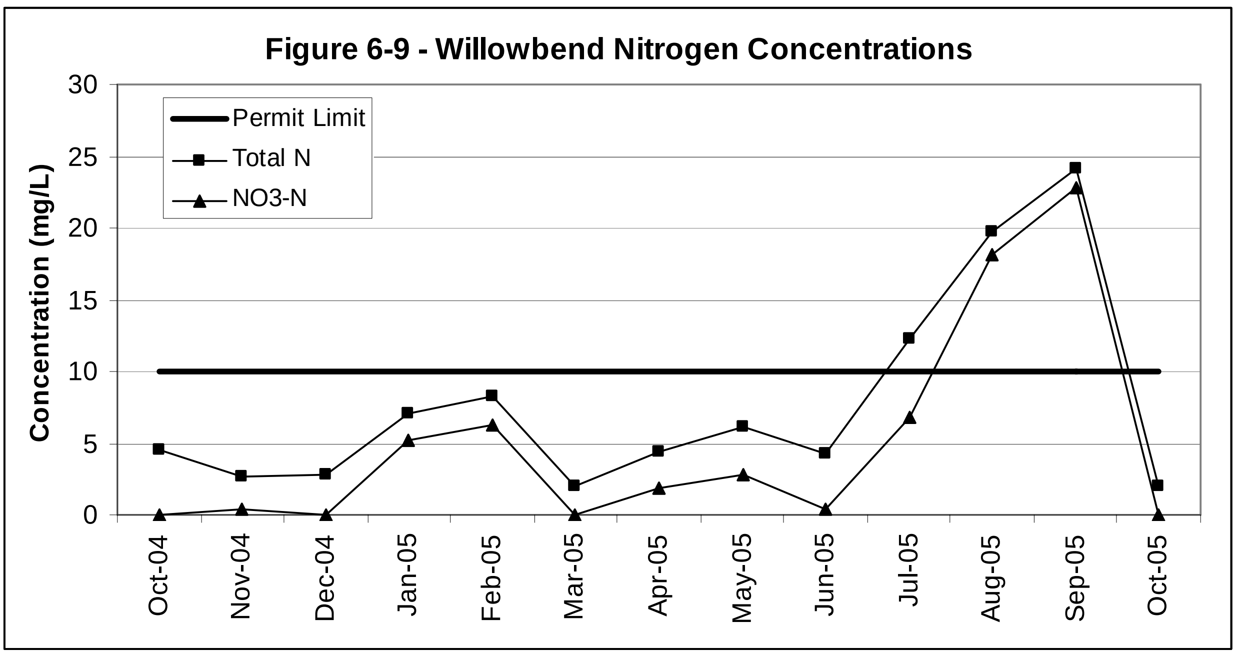
Performance. The discharge limits established under permit No. 577 for the Willowbend WWTF are presented below along with the average annual influent and effluent sampling data for October 2004-October 2005.

TABLE 6-8

WILLOWBEND TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	121.5	15.2	87%
TSS	30	90.1	8.4	90%
Total N	10	28.9	7.7	73%
Nitrate-N	10	1.1	5.0	-
Oils & Grease	15	15.2	0.2	99%

In general, the facility is performing very well. However, there were some Total Nitrogen exceedances in July, August, and September 2005. The nitrogen concentrations for the 12 month analysis period are illustrated in Figure 6-9.



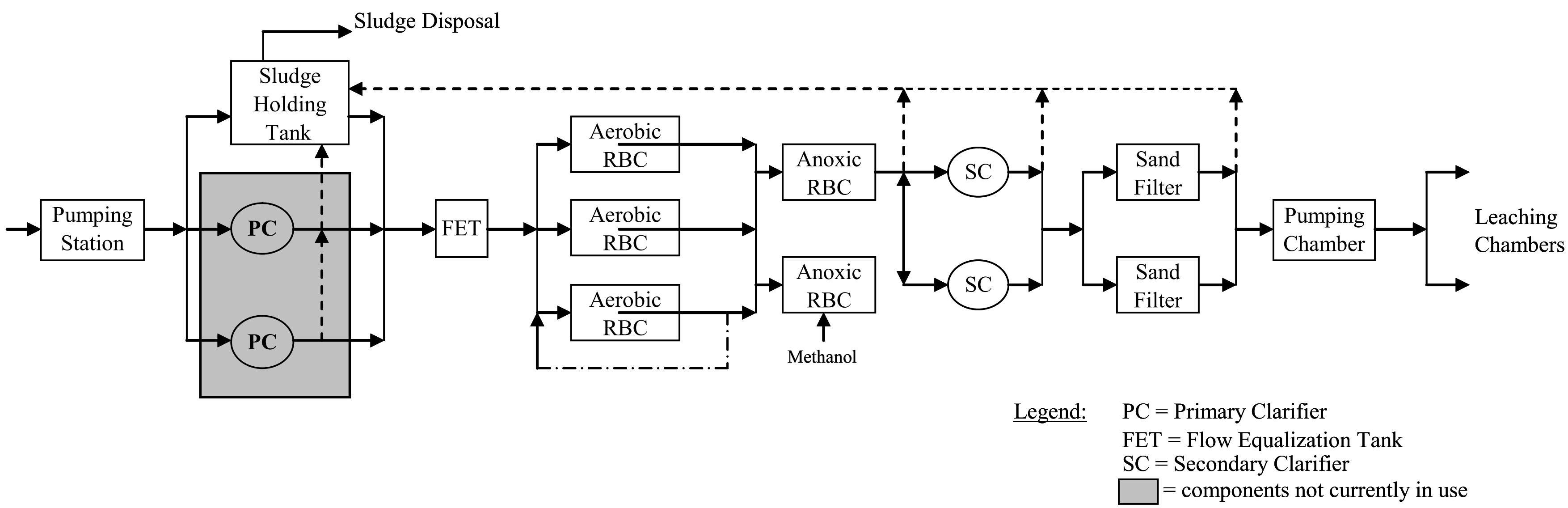
5. Southport Wastewater Treatment Facility

Identification and History. The WWTF at Southport was originally permitted and constructed in 1987 under the name Pine Hill Estates (SE# 0-272, July 1987). The facility was renovated and started back up in 1998, with a renewed groundwater discharge permit (SE# 272). The Southport WWTF is in the Quashnet River subwatershed of Waquoit Bay East.

Process Description. The major components of this facility include: primary clarifiers, sludge holding, flow equalization, aerobic and anoxic RBCs, secondary clarifiers, rapid sand filtration, and effluent disposal (see Figure 6-10).

Sewage is collected by gravity sewer and flows to one pumping station. This pumping station currently serves 35 units. The WWTF was originally designed so that wastewater would flow into the two (2) 15-ft diameter primary clarifiers for primary treatment. Sludge from these clarifiers would then be transported to the 23,000-gallon sludge holding tank and the effluent would travel to the 22,000-gallon flow equalization tank. The process has been altered from its original design, however, in that the Sludge Holding Tank and Flow Equalization tank are now used for primary treatment. As is illustrated in the previous diagram, raw wastewater currently flows directly into the sludge holding tanks, and the primary clarifiers remain unused.

Following primary treatment, the effluent is pumped from the flow equalization tank and distributed between the three aerobic RBC units, each with an effective surface area of 100,750 ft^2, where BOD is removed and ammonia is converted to nitrate. The wastewater then flows through two submerged anoxic RBCs where methanol is added and nitrate-nitrogen is converted to nitrogen. Each anoxic RBC unit has an effective surface area of 49,000 ft^2. Following nutrient removal in the RBC units, the effluent flows into the two 15-ft diameter clarifiers, where suspended solids are settled out. Sludge is collected and combined with sludge from the anoxic RBCs to be pumped back to the sludge holding tank. After leaving the clarifier, the secondary effluent is passed through two (2) rapid sand filters, each with a filter cell area of 28 ft^2. The



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Watershed Nitrogen Mangement Plan

Southport
Flow Schematic

FIGURE 6-10

filtrate then proceeds on to the 5,000-gallon effluent pumping chamber where duplex pumps discharge the effluent to leaching chambers divided over ten (10) leaching areas. The total available leaching area is 86,000 ft^2.

Flow Capacity. The facility is currently operating well below its flow capacity. The average annual flow is approximately 30,000 gpd (20% of its total flow capacity), with maximum month and peak daily flows of around 40,000 gpd and 50,000 gpd – 25% and 30%, respectively, of the total design capacity of 172,000 gpd. According to the operator, the development is approximately 75% complete. Buildout projections for Southport (based on Town Planning information) estimate a future flow of 105,000 gpd. Table 6-9 demonstrates the estimated future maximum month and peak day flows based on the peaking factors calculated from existing flow.

<u>TABLE 6-9</u>

SOUTHPORT PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.3	1.6
Estimated Future Flow (gpd)	140,000	170,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

The difference between estimated future flow (peak day) and design capacity is less than 3%. That indicates that expandability of the existing plant is limited. Additionally, expansion of the physical plant would be difficult due to the topography of the site and the existing facilities in the vicinity of the site. The WWTF is located within a Zone II and the effluent discharge site is partially within the Zone II. Any expansion of the plant would therefore require compliance with the MADEP Interim Guidelines for Reclaimed Water Use and more detailed analysis of the existing system's ability to meet these requirements. Effluent water quality limits are typically more stringent within Zone II areas, depending on the exact location of the discharge. This would need to be taken into consideration before planning an expansion of this WWTF.

Performance. The discharge limits established under permit No. 272 for the Southport WWTF are presented below, along with the average annual influent and effluent sampling data.

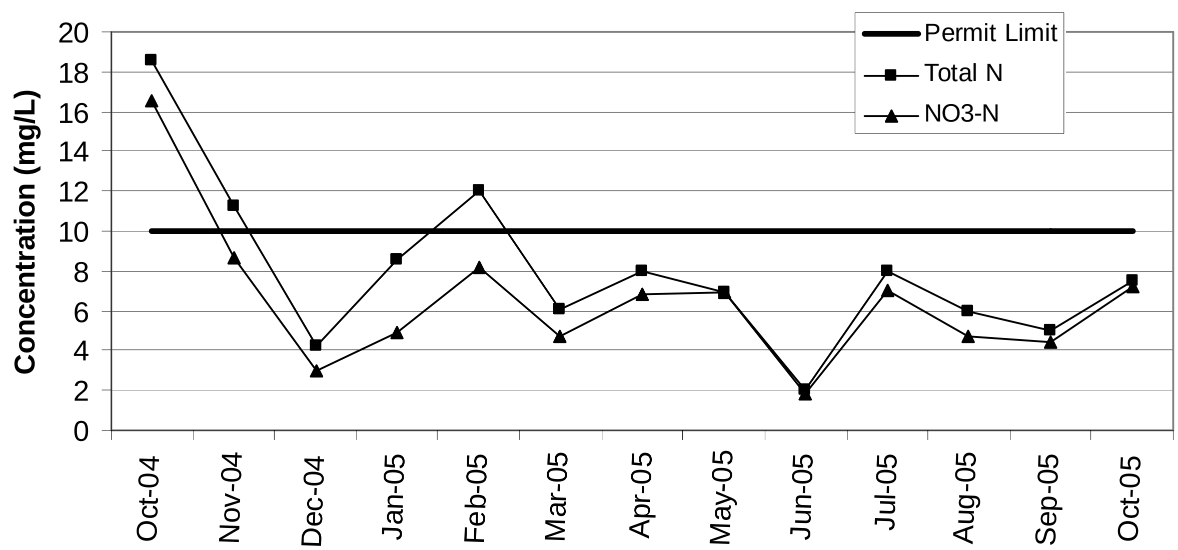
TABLE 6-10

SOUTHPORT TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	250.2	4.7	98%
TSS	30	96.3	1.5	98%
Total N (1)	10	-	8.0	-
Nitrate-N (1)	10	-	6.5	-
Oils & Grease	15	40.6	0	100%
(1) Influent wastewater is not typically sampled for Total Nitrogen or Nitrate-Nitrogen				

Average annual concentrations for all parameters were below the limits, although there were occasional monthly Nitrate Nitrogen and Total Nitrogen exceedances, as shown in Figure 6-11.

Figure 6-11 - Southport Nitrogen Concentrations



6. Stratford Ponds Wastewater Treatment Facility

Identification and History. The wastewater treatment facility at Stratford Ponds was built in 1996 and services most of the Stratford Ponds housing development. The Stratford Ponds WWTF is in the Shoestring Bay subwatershed of Popponesset Bay.

Process Description. The major components of the WWTF facility at Stratford Ponds include a lifting station, primary settling tanks, Amphidrome™ reactors, clearwells, Amphidrome™ Plus reactors, and effluent disposal (see Figure 6-12).

Wastewater is pumped from one lifting station and flows into two Amphidrome™ treatment trains. The Amphidrome™ process is a fixed-film, sequencing batch type process designed for nitrogen removal. It combines biofilter technology with an anoxic settling tank, a clearwell, and a denitrification process. Primary treatment for each treatment train occurs in an anoxic settling tank. Tank "A" holds 37,440-gallons and Tank "B" holds 33,600-gallons. Wastewater then flows by gravity from the settling tank through the biofilter in the 9.5' x 10' x 4' aerated Amphidrome™ reactor and into the 11,000-gallon clearwell. The Amphidrome™ reactor alternates between aerobic and anoxic treatment as the cycle is repeated. Sludge is collected and returned to the primary settling tank. In addition, wastewater flows to a 4-ft diameter anoxic Amphidrome™ Plus reactor, which contains a Tetra denitrification filter. The denitrified effluent then cycles back to the clearwell. The final effluents from the clearwells of the two treatment trains are combined at this point and discharged to 20 leaching pits. Each pit is 16 feet in diameter, has an effective depth of 12 feet, and has a leaching surface area of 800 ft^2.

The treatment process has also been designed so that methanol can be fed to the Amphidrome™ Plus reactors in the future, but it is not currently used.

Flow Capacity. This facility is permitted to discharge 35,500 gpd (no design flow data was available beyond what was identified on the permit). The 2004/2005 data showed a peak flow of

28,000 gpd, with the average annual flow around 12,000 gpd. These figures are 80% and 35%, respectively, of the permitted flow. The average annual flow at buildout is estimated to be 21,000 gpd. Table 6-11 shows the effect that existing peaking factors would have on the estimated buildout flow.

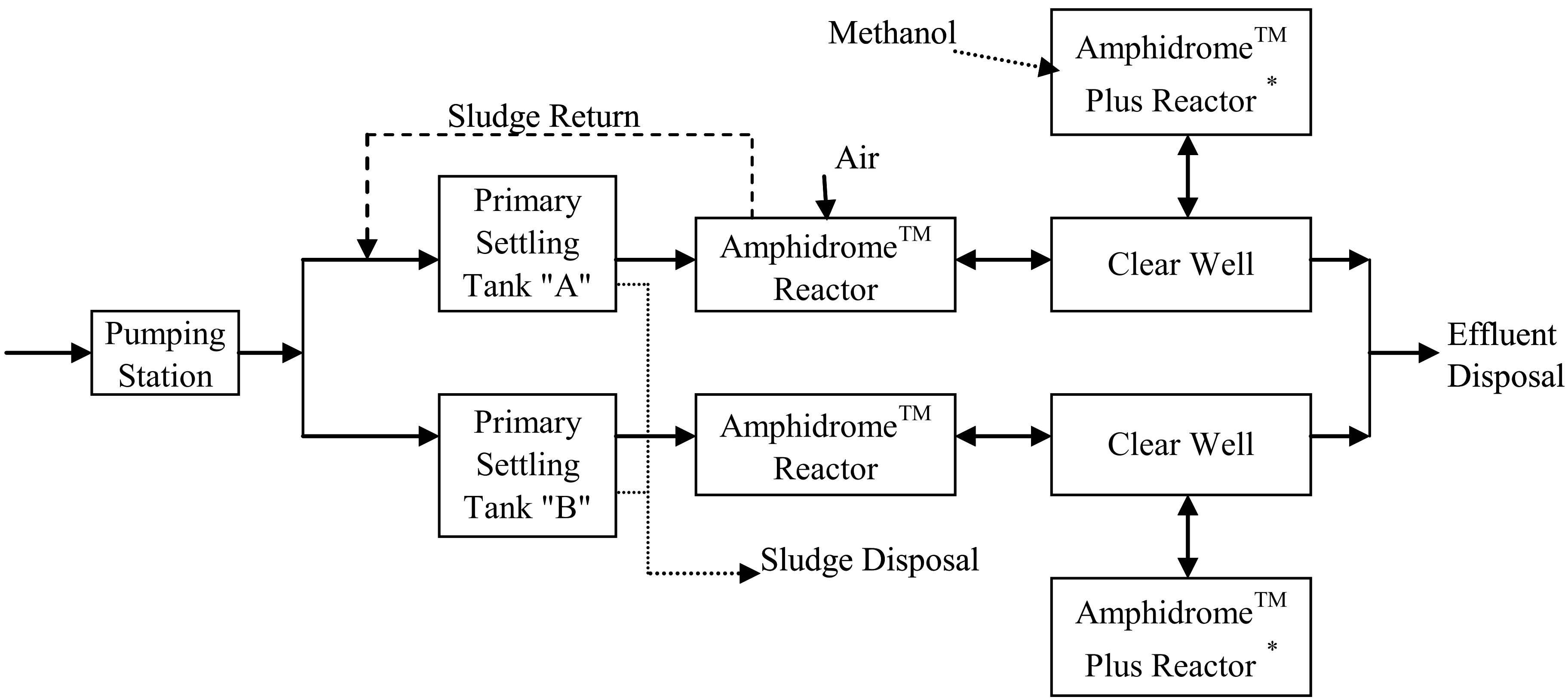
TABLE 6-11

STRATFORD PONDS PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.3	2.4
Estimated Future Flow (gpd)	28,000	51,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

Although the estimated peak day for buildout conditions is approximately 70% higher than the permitted flows, this can likely be attributed to the seasonal nature of the existing residences. As the current residences convert to year round use, peaking factors may decrease. Based on the permitted flow and existing data, it appears that the Stratford Ponds WWTF is currently operating close to its flow capacity. An additional factor that would make expansion of this plant less feasible is the location of the WWTF within a Zone II. Permits for additional capacity would likely require that a higher level of effluent treatment be achieved. This may require treatment processes beyond what is currently used. Design and permitting for the relocation of the leaching area is currently underway. The relocation will move the leaching area out of the Zone II area and is being done as an alternative to WWTF upgrades that would be required by MADEP if the leaching facility remained in the Zone II area.

Performance. The Amphidrome™ facility at Stratford Ponds operates under discharge permit No. 382. These permit limits are displayed below along with the average annual influent and effluent wastewater characteristics:



* Amphidrome™ Plus Reactors are Denitrification Filters

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Watershed Nitrogen Mangement Plan

Stratford Ponds
Flow Schematic

FIGURE 6-12

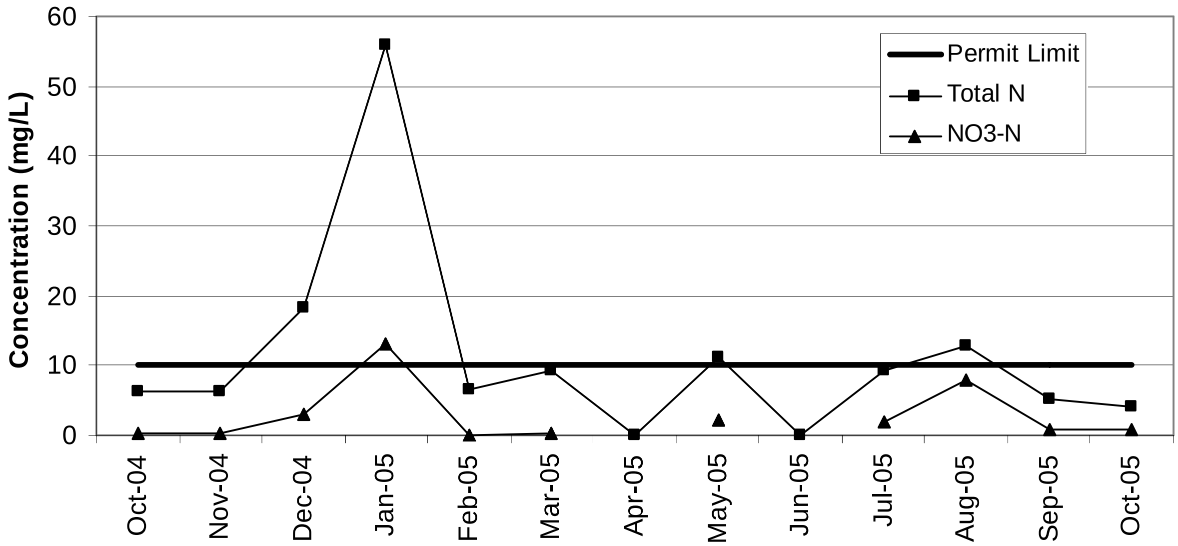
TABLE 6-12

STRATFORD PONDS TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	310.6	35.0	89%
TSS	30	126.9	4.4	97%
Total N [1]	10	-	11.2	-
Nitrate-N	10	0.2	2.8	-
Oils & Grease	15	50.6	0.9	98%
(1) Influent wastewater is not typically sampled for Total Nitrogen				

Based on the data, the facility does not consistently achieve permit compliance. BOD limits were exceeded for 6 of the 13 months analyzed. Additionally, Total Nitrogen limits were exceeded four (4) times, as shown in Figure 6-13.

Figure 6-13 - Stratford Ponds Nitrogen Concentrations



7. Windchime Point Wastewater Treatment Facility

Identification and History. The WWTF at Windchime Point provides wastewater treatment for a total of 145 units. The Windchime Point development is located off of Great Neck Road, with the WWTF located at the eastern end of the development. The Windchime Point WWTF is in the Mashpee River subwatershed of Popponesset Bay.

Process Description. The process at this Amphidrome™ facility is similar to the facility at Stratford Ponds, with the addition of two pumping chambers and a UV disinfection system (see Figure 6-14).

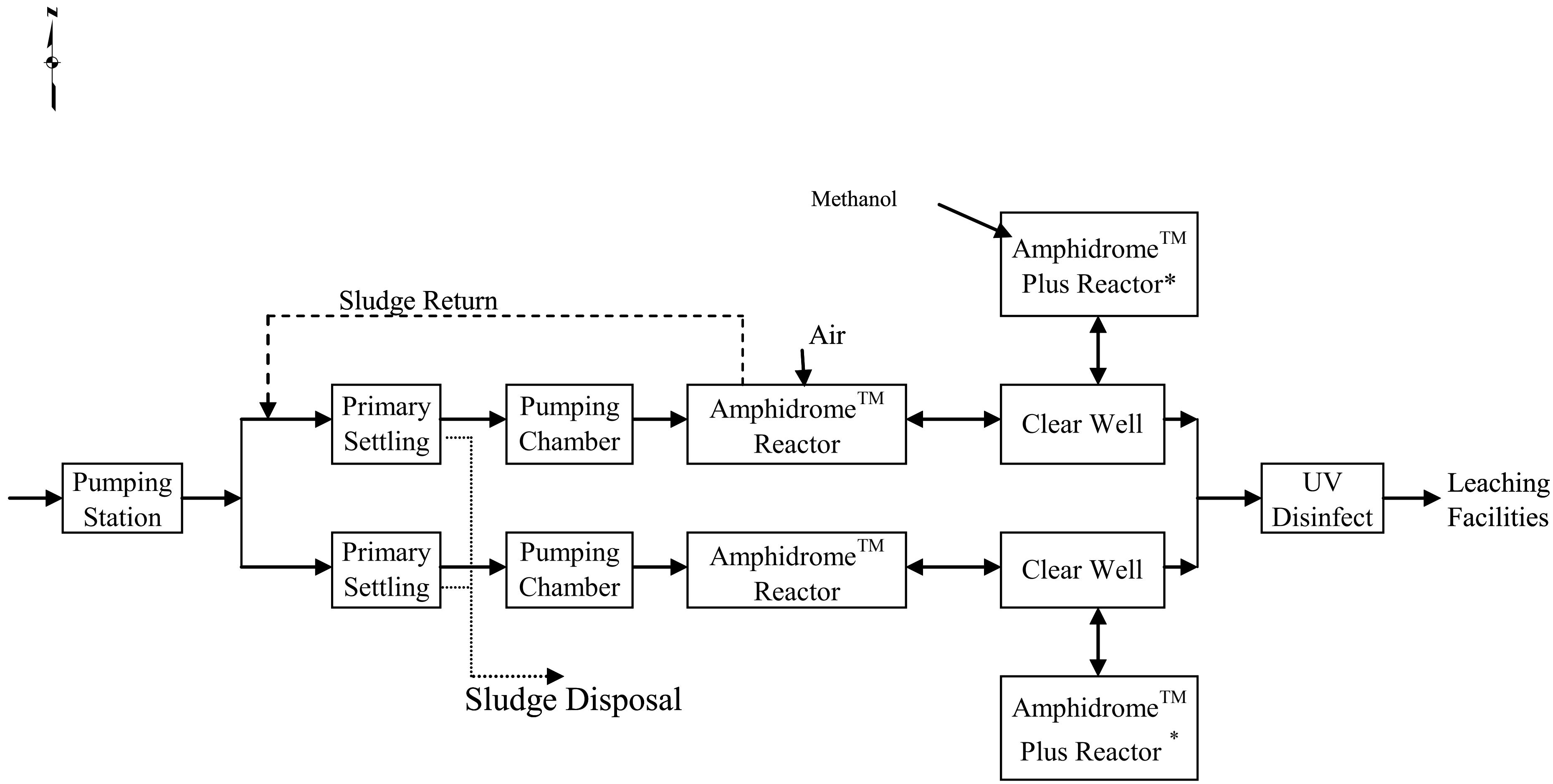
Flow Capacity. This Amphidrome™ facility is permitted to discharge 40,000 gpd (also the design flow). The average annual flow is around 10,000 gpd – only 25% of the permitted limit. The maximum flow was only 60% of the permitted limit – 24,000 gpd. The estimated buildout flow for the Windchime Point development is 22,000 gpd (based on Planning Department information). The following table summarizes the estimated future peak flows.

TABLE 6-13

WINDCHIME POINT PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.4	2.4
Estimated Future Flow (gpd)	30,000	52,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

These estimated values indicate that the WWTF will be operating at its flow capacity when buildout conditions are reached. It is possible that there is room for expansion of the building (where the control systems are housed), though a more detailed analysis of the property would be required to determine the possibility of expanding the underground process tanks.



* Amphidrome™ Plus Reactors are Denitrification Filters

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Watershed Nitrogen Management Plan

Windchime Point Flow Schematic

FIGURE 6-14

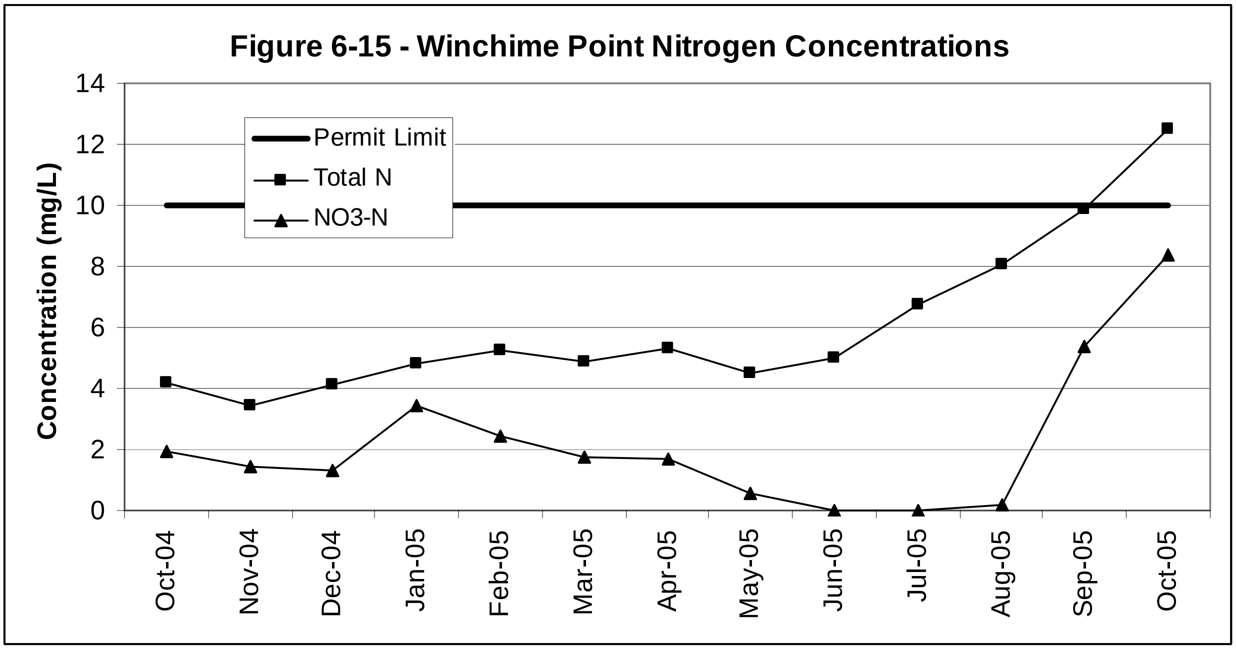
Performance. Discharge permit No. 263 was issued for this facility. The discharge permit limits and flow characteristics from October 2004-October 2005 are summarized in Table 6-14.

TABLE 6-14

WINDCHIME POINT TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	273.4	15.7	94%
TSS	30	251.5	10.6	96%
Total N	10	-	6.0	-
Nitrate-N	10	-	2.2	-
Oils & Grease	15	31.1	0.5	98%

In 2005-2006 the Windchime Point facility performed well and had only one permit exceedance – Total Nitrogen in October 2005. However, the months prior to that exceedance showed a consistent rise in both Nitrate Nitrogen and Total Nitrogen. Without further data, it is not certain whether or not this facility was having operational problems or if the nitrogen levels began decreasing again.



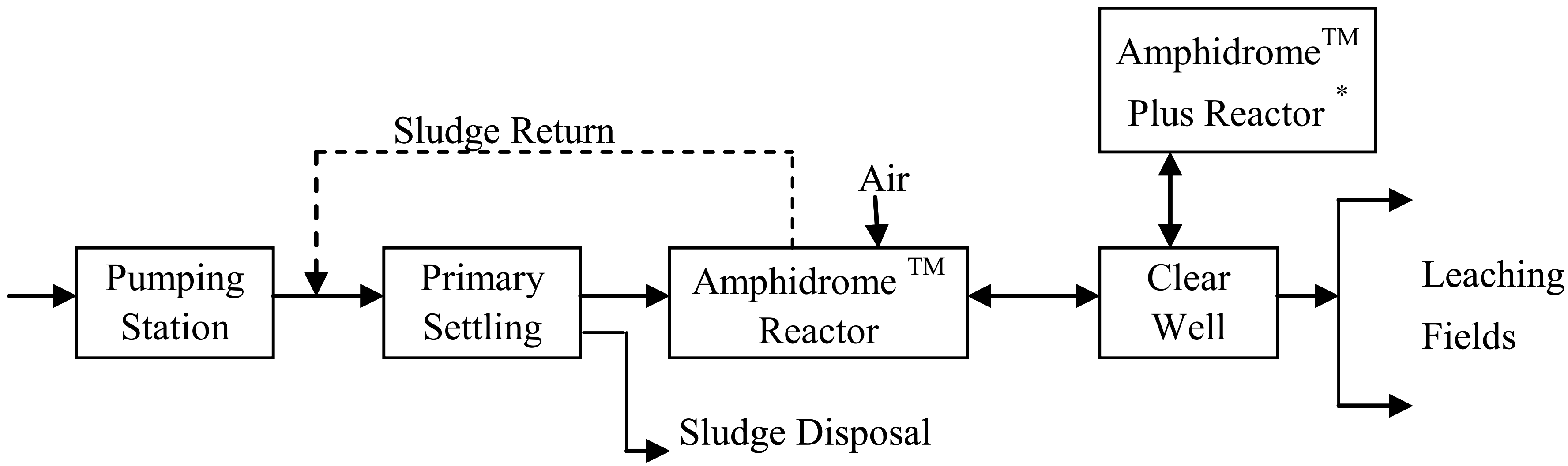
8. South Cape Village Wastewater Treatment Facility

Identification and History. This facility is located along Donna's Lane in Mashpee, near the intersection of Route 28. The WWTF was designed in 1999 and permitted in 2001 to accommodate a variety of land uses from both on-site and off-site flows. Onsite flows are contributed from 160,000 square feet of building area, and off-site flows coming from the Life at Mashpee residential development, Liquor Warehouse, and some office space. South Cape Village and its WWTF are in the Mashpee River subwatershed of Popponesset Bay.

Process Description. The main components of the facility at South Cape include primary settling, nutrient removal using Amphidrome™ and Amphidrome™ Plus Reactors, a clearwell, and effluent disposal, as shown on Figure 6-16.

On-site wastewater flows by gravity through a sewer system located along South Street into a wet well and submersible pumping system in the southwesterly parking area. This flow is combined with off-site flows to enter the 31,000-gallon primary settling tank. Wastewater then cycles through the Amphidrome™ Reactor, the 16,000-gallon clearwell, and the Amphidrome™ Plus Reactor (with denitrification filter), as was described for the Stratford Ponds WWTF. Final effluent is pumped from the clearwell through two (2) forcemains to two (2) leaching sites. The leaching sites have a total of 16 trenches that are each 100 feet long, providing a total leaching area of 9600 ft^2.

Flow Capacity. The facility is designed with a flow of 24,000 gpd, although average annual flows are approximately 8,500 gpd, with a maximum month of 8,900 gpd. The peak day flow for the 2004/2005 analysis period was 14,222 gpd, which represents 60% of the treatment facility's capacity. The buildout wastewater flow estimate generated by means of Planning Department information is nearly 16,000 gpd, just less than double the currently observed flows. However, if the peaking factor for the maximum day is applied to that flow, the difference between the design flow (24,000 gpd) and the peaked estimated flow is less than 10% (as shown



* Amphidrome™ Plus Reactor is a Denitrification Filter

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Watershed Nitrogen Management Plan

South Cape Village
Flow Schematic

FIGURE 6-16

in Table 6-15), indicating that the plant is appropriately sized with minimal room for expansion.

TABLE 6-15

SOUTH CAPE VILLAGE PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	1.1	1.7
Estimated Future Flow (gpd)	17,000	27,000
Note: Peaking factors are based on flow data from October 2004 – October 2005 and are the ratio of maximum month or peak flow to average annual flow.		

Another concern when evaluating expansion potential at the South Cape Village WWTF is the location of the facilities. The majority of the treatment processes are in underground tanks, located under a shopping plaza parking lot. The control building is also in the parking area, fairly close to the grocery store building and a sizeable stormwater detention pond, limiting room to expand depending on where new structures would go as the plaza is expanded.

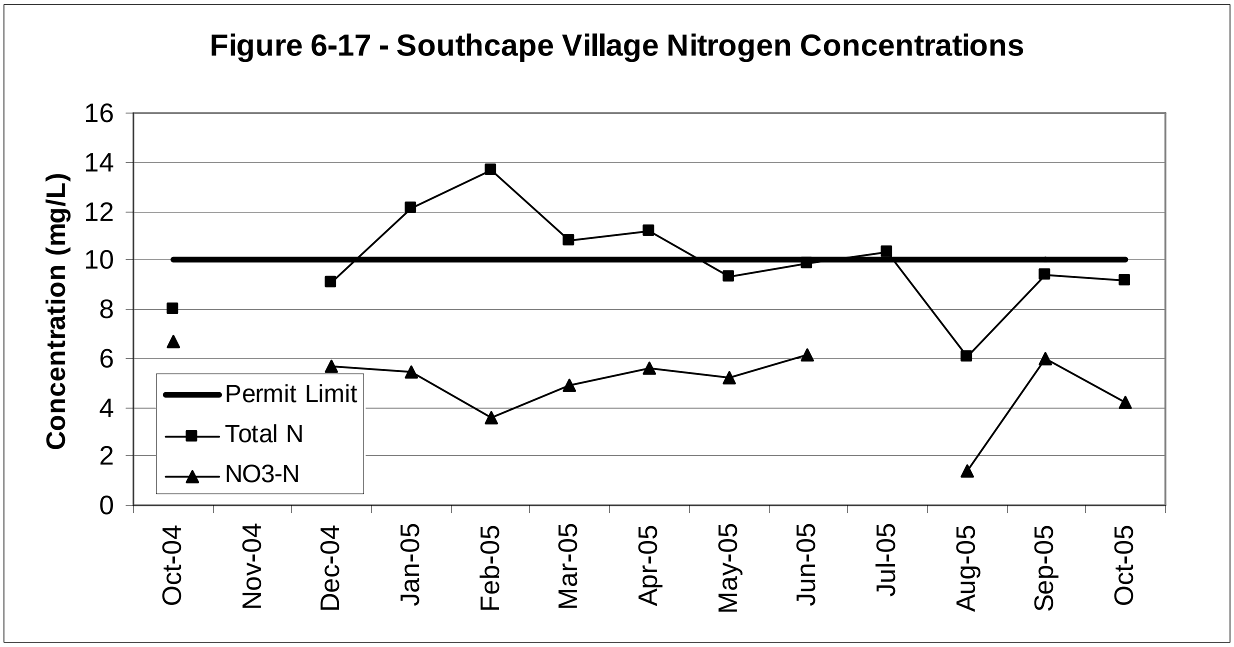
Performance. Because of incomplete data in the monthly monitoring reports, it is unclear how consistently the facility is meeting all of the permit limits. Only five months of complete data were available. Although water quality parameters were available for most months, daily flow data was not provided. Table 6-16 summarizes the permit limits and the water quality characteristics based on the provided information.

TABLE 6-16

SOUTH CAPE VILLAGE TREATMENT PERFORMANCE

Wastewater Characteristic	**Permit Limit (mg/L)**	**Average Annual Influent (mg/L)**	**Average Annual Effluent (mg/L)**	**Percent Removal**
BOD	30	412.5	13.5	97%
TSS	30	165.4	12.7	92%
Total N	10	-	9.5	-
Nitrate-N	10	-	5.0	-
Oils & Grease	15	84.9	6.1	93%

Figure 6-17 illustrates the nitrogen levels for the months that had data. Total Nitrogen exceeded the permit limit multiple times; Nitrate Nitrogen did not exceed the limit. The only other permit exceedance was a BOD exceedance in October 2005.



9. **Forestdale School Wastewater Treatment Facility**

Identification and History. The Forestdale School WWTF has been operating since 1990. The WWTF is located behind the Forestdale Elementary School on Route 130 in the Town of Sandwich. In addition to providing treatment for wastewater from the school, the WWTF receives approximately 3,500-4,500 gallons per month of septage from Town Hall for treatment. The Forestdale School is in the Fresh Water subwatershed of Popponesset Bay.

Process Description. The components that make up the treatment process are the primary settling tank, an equalization tank, one (1) RBC, a secondary clarifier, two (2) polishing filters, and effluent discharge via leaching pits.

Sewage collects in the 15,000-gallon primary settling tank, which is also where the septage is received. From the settling tank, the primary effluent flows to a 10,000-gallon equalization tank to ensure equalized flow entering the treatment train. The primary effluent is pumped from the equalization tank by means of two (2) 14 gpm pumps to the aerobic RBC. The RBC provides 68,400 effective square feet of media area. The RBC stage is where BOD, TSS, and ammonia are reduced. A ten-foot diameter secondary clarifier follows the RBC. After most of the sludge is settled out in the secondary clarifier, effluent flows through one of two polishing filters.

After the treatment process, effluent is pumped to the discharge field. The discharge field consists of twenty four (24) leaching pits located under the school's soccer fields. The leaching pits are eight feet in diameter with an additional two feet of stone surrounding the structure, thereby providing an effective diameter of twelve feet and an effective depth of six feet.

No chemicals are added to the treatment process. The flow schematic is shown in Figure 6-18.

Flow Capacity. The Forestdale School WWTF was designed to treat 20,000 gpd of wastewater. However, average annual flow is just over 1,000 gpd (about 10% of the design flow), indicating substantial room for expansion. Even when the maximum month (2,400 gpd) and the peak day (6,600 gpd) flows are evaluated, there is considerable room for expansion. The peak day flow is approximately 30% of the design flow.

TABLE 6-17

FORESTDALE SCHOOL PEAKING FACTORS

	Maximum Month	**Peak Day**
Peaking Factor	2.1	5.7
Note: Peaking factors are based on flow data from December 2005 – January 2007 and are the ratio of maximum month or peak flow to average annual flow.		

Any expansion to this facility should take into consideration the seasonal fluctuations in the flow that are experienced. Flows in the summer months can drop to 0 for several days at a time.

Additionally, the Forestdale School and its WWTF are located within a Zone II area. This would mean that any expansion would be required to meet stricter effluent water quality limits.

Performance. The permit for the Forestdale School limits BOD to 30 mg/L, TSS to 30 mg/L, and Oil and Grease to 15 mg/L; there is no nitrogen limit stipulated in the permit. Based on the monitoring data that was reviewed, there were no exceedances of the permit limits at this facility. Although the permit limit for oil and grease has not been exceeded, there have been months when the oil and grease concentration in the effluent has been higher than the concentration in the influent. If the results are not a result of analytical error, the effluent leaching pits may be impacted by oil and grease. In addition, it should be noted that there is no nitrogen limit in the GWDP for this facility; therefore, nitrogen is not monitored.

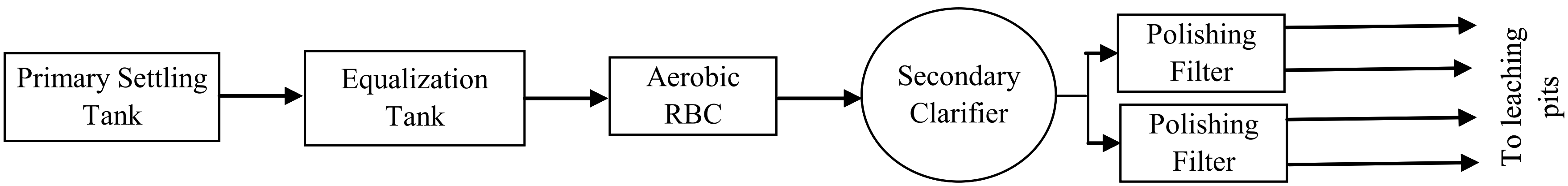
The treatment performance is summarized below in Table 6-18.

TABLE 6-18

FORESTDALE SCHOOL TREATMENT PERFORMANCE

Wastewater Characteristic	Permit Limit (mg/L)	Average Annual Influent (mg/L)	Average Annual Effluent (mg/L)	Percent Removal
BOD	30	137.0	4.0	88%
TSS	30	1159.8	10.6	87%
Oils & Grease	15	10.5	2.5	39%

According to the operator, there was a denitrification filter planned at one point. If additional flows to the Forestdale School WWTF are considered, addition of a denitrification filter may be required. The treatment building would likely require significant expansion if additional flows were added. The existing treatment train provides minimal redundancy. A minimum of one (1) additional treatment train should be considered when considering adding flow to this WWTF.



RBC=Rotating Biological Contactor

Data Source: Mass GIS
File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\00074F6-18.mxd

Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

Date: 3/2007 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Forestdale School Flow Schematic

FIGURE 6-18

10. Massachusetts Military Reservation Wastewater Treatment Facility

Identification and History. Although this facility is located outside of the PPA, it is mentioned for the purposes of this document because it is close to the Mashpee border and Mashpee is interested in investigating the feasibility of using the force main and sandbeds for disposal of some of the Town's treated wastewater. The WWTF that serves the Reservation is not in either of the MEP watersheds.

The Massachusetts Military Reservation WWTF was designed by Camp Dresser & McKee and has been in operation since 1995. It serves units on the Military Reservation.

Process Description. The process consists of pretreatment, primary settling, aerated oxidation ditches, secondary clarification with recycle, and effluent disposal (see Figure 6-19).

Flow Capacity. The facility has a maximum monthly design capacity of 0.43 mgd and a maximum daily design capacity of 0.80 mgd. If the Town chooses to seek additional flow capacity outside the Town, this facility may be evaluated further to establish if there is any available capacity and to evaluate the possibility of negotiating for use of some of that capacity.

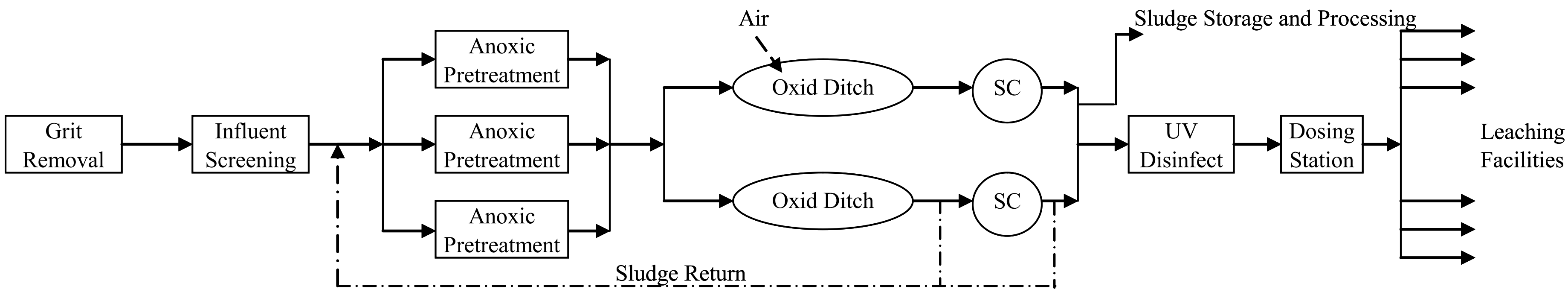
D. Summary

The following table summarizes the percent of flow capacity that is currently used at each of the WWTFs and the estimated amount of flow capacity that will be used under buildout conditions.

TABLE 6-19

USED WWTF CAPACITY

WWTF	Design Flow (gpd)	Existing Flows		
		Average Annual	Maximum Month	Peak Day
Mashpee Commons	180,000			
Percent of Capacity – Existing		11%	16%	22%
Percent of Capacity – Future		59%	88%	117%
New Seabury	300,000			
Percent of Capacity – Existing		3%	5%	13%
Percent of Capacity – Future		23%	32%	69%
Mashpee Senior High School	18,000			
Percent of Capacity – Existing		15%	20%	52%
Percent of Capacity – Future		20%	27%	70%
Willowbend	113,000			
Percent of Capacity – Existing		22%	41%	65%
Percent of Capacity – Future		53%	98%	155%
Southport	172,000			
Percent of Capacity – Existing		17%	23%	28%
Percent of Capacity – Future		61%	81%	97%
Stratford Ponds	35,500			
Percent of Capacity – Existing		34%	44%	80%
Percent of Capacity – Future		60%	78%	144%
Windchime Point	40,000			
Percent of Capacity – Existing		25%	35%	61%
Percent of Capacity – Future		55%	76%	131%
South Cape Village	24,000			
Percent of Capacity – Existing		35%	37%	59%
Percent of Capacity – Future		66%	69%	110%
Forestdale School	20,000			
Percent of Capacity – Existing		6%	12%	33%



Legend: Oxid Ditch = Aerated Oxidation Ditches
SC = Secondary Clarification
UV Disinfect = Ultra-Violet Disinfection

Data Source: Mass GIS
File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\00074F6-20.mxd

Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

Date: 3/2007 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Massachusetts Military Reservation
Flow Schematic

FIGURE 6-19

Based on the factors considered previously in this chapter, the following package wastewater treatment plants are recommended for further consideration to evaluate expansion potential:

- Mashpee Commons (capacity of denitrification filters needs to be evaluated)
- New Seabury (Zone II requirements need to be considered)
- Mashpee High School (Zone II requirements need to be considered)
- Southport (Zone II requirements need to be considered; actual flows should be considered once build-out is achieved)
- Forestdale School (consideration should be given to addition of denitrification filters and any Zone II requirements)

Willowbend and Windchime Point may possibly be considered for expansion. More data will need to be obtained from the Windchime Point facility to determine more accurate average flows. Willowbend will need more extensive evaluation to determine the percent of the development that is seasonal, how much more construction is expected, and more long-range average flows.

Stratford Pond and South Cape Village should not be considered for further expansion. Stratford Pond is currently within a Zone II and projected build-out conditions will likely approach the plant's capacity. South Cape Village has limited room for expansion, and future flows will likely approach the plant's capacity.

These various possibilities will be incorporated into later phases of this project as alternative solutions are developed and evaluated.

The capacities evaluated as part of this study were based on design data and sampling data from October 2004 through October 2005. The peaking factors were also obtained from the flow information from that time period. Typically, data for several years is evaluated when analyzing performance and capacity of treatment facilities. Some facilities, such as Windchime Point, have not been in operation long enough to accumulate enough data. Other facilities, such as New Seabury, are currently operating so far below their operating capacity that a true evaluation of their performance is impossible at this time. Additionally, the available capacity of these plants could not be determined until more of the treatment capacity is being used (50-80% of permitted flow).

It should also be noted that the capacity analyses performed evaluated only the flow capacity of the treatment plant. The collection systems would need to be evaluated more closely before considering expansion of any of the existing facilities. Also, a number of these facilities are approaching or have exceeded their permit expiration. Those facilities that discharge within a Zone II will require additional evaluation and possible upgrade to achieve the existing guidelines as identified in the Interim Guidelines for Reclaimed Water Use.

Chapter 7

Wastewater Flows and Nitrogen Loading

CHAPTER 7

WASTEWATER FLOWS AND NITROGEN LOADINGS

7.1 INTRODUCTION

The wastewater flows and nitrogen loads developed as part of the Needs Assessment and discussed in this chapter present what the estimated conditions would be if development continued without taking any further wastewater management steps. This scenario presents the greatest nitrogen loads throughout project planning area (PPA).

7.2 BUILD-OUT ANALYSIS

In order to obtain a Town-wide, long range view of the nitrogen and other issues in Mashpee, a build-out analysis was performed by the Mashpee Planning Department. The build-out analysis is based on existing building permits, known (proposed) projects, zoning, and numerous other aspects that impact development.

The Mashpee Planning Department identified on a parcel-by-parcel basis the Town's development potential. This build-out approach was applied and a Build-out Dwelling Unit (DU) number was assigned to each residential parcel or parcel with residential development potential, based on the Town's assessment of the lot. This number represents the number of individual residences that are possible on a lot if developed to full potential and includes existing development. Commercial and industrial zoned lots are assigned a DU of 0, but the Town's analysis provided estimates of possible future uses (retail, office, warehouse, etc.) and potential building sizes.

Both the MEP analysis (to an extent) and the Needs Assessment analysis used the Town's build-out estimates to determine future wastewater flows and nitrogen loads. Build-out for Falmouth and Sandwich were based on MEP efforts associated with those towns; Barnstable build-out estimates were based on information from the Barnstable Town Planner.

7.3 WASTEWATER GENERATION AND NITROGEN LOADINGS

The MEP analyses, as discussed in Chapter 4, focus on watersheds, which are not necessarily Town boundaries. Significant portions of both the Popponesset Bay and Waquoit Bay watersheds are within the boundaries of the Town of Mashpee. However, both watersheds include portions of neighboring towns – Barnstable, Sandwich, and/or Falmouth.

Although the watershed-based MEP analyses are the basis for the Town's management plan, the WNMP evaluates wastewater and nitrogen issues throughout the entire Town of Mashpee and the PPA, not just the areas that are within the Popponesset Bay and Waquoit Bay watersheds. The MEP analyses identified one scenario with discrete nitrogen removal levels necessary to maintain estuary health. With those nitrogen removal levels as the target, the WNMP will evaluate various alternatives that will meet the goals of the MEP and address the Town's needs (including areas that are not within the boundaries of either MEP watershed) in subsequent phases of the project. Because the MEP is the basis of the WNMP, the WNMP will, where appropriate, identify and address wastewater and nitrogen issues in neighboring towns. The WNMP analysis will follow the general framework of the MEP analysis.

As discussed in Chapter 6 of this report, Title 5 septic systems make up a significant portion of the wastewater treatment in the PPA. These systems typically discharge effluent with total nitrogen (TN) concentrations in the neighborhood of 35 mg/L, of which approximately 75% reaches the groundwater table (as identified by MEP). Even I/A technologies, which produce average effluent concentrations of 19mg/L TN (approximately 75% of which reaches the groundwater table), will not achieve drinking water standards of 10 mg/L. The permits governing the operation of small wastewater treatment plants in the PPA typically limit total nitrogen to 10 mg/L, which is based on accepted drinking water standards and regulated by MADEP. The estuaries have reached their nutrient-impacted conditions under these current practices; therefore, these concentrations must be reduced to see improvements in estuary health.

The means for reducing these concentrations and ultimately the TN loadings to the coastal embayments will be discussed in subsequent reports.

The MEP analysis generated wastewater flow estimates using average water use data for the years 1997 through 1999 (for Mashpee), 2000 (for Falmouth), or 1998-2000 (for Sandwich and Barnstable). The same data was used for the purposes of the WNMP analysis. However, the relevant data was obtained for *all* parcels in the Town of Mashpee. The same analysis methods used by MEP were followed for the WNMP analysis in order to obtain consistent flow and loading estimates PPA-wide. The following discussion describes the data and estimates used.

A. **Development of Existing Wastewater Flows**

- For properties with water consumption data, 90 percent of a property’s water use is estimated to become wastewater.

- Properties without water consumption data were assigned an average water use based on either MEP assumptions or the land use type. The MEP reports used the following assumptions in their analysis:

TABLE 7-1

MEP WATER USE ASSUMPTIONS [1]

Land Use Type	Water Use	Wastewater Flow
Residential	154 gpd	90% of water use
Commercial/Industrial	81.5 gpd/1000 sq. ft. of building	90% of water use
(1) From Table IV-4 of the MEP technical reports.		

The following table summarizes the water use estimates used in this Report for the wastewater analysis. These averages are based on existing water users in Town. Obtaining an average for a commercial use category was desirable to obtain a more accurate estimate of nitrogen loading within the Town.

TABLE 7-2

WNMP WATER USE ASSUMPTIONS

Land Use Type	Water Use	Wastewater Flow
Residential	155 gpd	140 gpd
Restaurant(1)	200 gpd/1,000 sq. ft. of building	180 gpd/1,000 sq. ft. of building
Hotel/Motel(1)	60 gpd/room	55 gpd/room
Other (Retail, Office, Industrial, etc.)(1)	83 gpd/1,000 sq. ft. of building	75 gpd/1,000 sq. ft. of building
(1) Water use averages for these categories were based on averages from Mashpee water use data in order to obtain more accurate build-out estimates.		

- The majority of properties without water data were single family residential parcels. These properties were assumed to consume 155 gpd of water. The water use average was multiplied by 90% and rounded to obtain a wastewater generation of 140 gpd.

- The "Other" commercial properties (as listed in Table 7-2) can be further divided into office/retail, warehouse/industrial, and miscellaneous. The wastewater generation for these uses (based on properties that have water use data) are 60, 90, and 80 gpd/1,000 square feet of building, respectively. These values were rounded to 75 gpd/1,000 square feet for calculation purposes. The difference between using the use-specific flows and the average for these types of properties is insignificant in the total commercial wastewater generation estimates.

B. Development of Future Wastewater Flows

- Undeveloped properties were assigned a water use/wastewater flow based on the same estimates described in Table 7-2.

- Future use and development potential of residential parcels was based on the Town's build-out analysis.

- Residential future flows equaled the greater of either 140 gpd or the existing wastewater flow. This was to account for seasonal properties that may become year round residences in the future.

- Existing commercial/industrial parcels with water data were estimated to remain at the same water use levels.

- New commercial and industrial properties created from vacant commercial and industrial properties were assigned a flow based on the use category, as described in the previous section.

After each parcel was assigned an appropriate wastewater generation estimate, the parcels were grouped according to land use. Table 7-3 summarizes the existing and future average annual wastewater flows, developed as described above.

TABLE 7-3

EXISTING AND FUTURE AVERAGE ANNUAL WASTEWATER FLOWS(1)

Land Use	Existing Flow (gpd)(2)	Future Flow (gpd)(2)
Multi-use	2,900	4,100
Residential	1,400,000	2,400,000
Commercial	93,000	200,000
Industrial	14,000	72,000
Institutional	15,000	67,000
Total	**1,600,000**	**2,700,000**

(1) Flows for the entire PPA.

(2) All numbers rounded to 2 significant figures.

After assigning wastewater flows to each parcel, nitrogen loads were determined. Wastewater nitrogen loadings were based on the following assumptions.

- Properties with a standard Title 5 septic system were assumed to have an effluent Total Nitrogen (TN) concentration of 35 mg/L. This concentration has been used regionally for several facilities planning projects. The MEP analysis assumes a level of nitrogen removal through a standard septic system; however, for planning purposes no reduction is considered in these evaluations. If wastewater is treated by means of a sewer system, no reduction of nitrogen will occur in the septic system and disposal field – all nitrogen reduction will be performed via the treatment plant.

- For those properties that were identified as connected to one of the wastewater treatment facilities (WWTF) in the PPA, the flow was assigned to the WWTF parcel, with a corresponding nitrogen concentration based on data provided for that particular WWTF. No flow or nitrogen load was assigned to the individual parcel connected to the WWTF. The effluent nitrogen concentration at each WWTF parcel was determined based on 12 months of reports (2004-2005) from the respective treatment plant. For example, the parcel where the Willowbend WWTF discharges its treated wastewater would be assigned a nitrogen concentration of 7.7 mg/L. The load would be based on that concentration and the associated flow. The TN concentrations used for each WWTF are summarized in Table 7-4.

- Properties with an advanced (I/A) septic system were assumed to achieve an effluent concentration of 19 mg/L TN.

TABLE 7-4

OCTOBER 2004-OCTOBER 2005 WWTF TOTAL NITROGEN CONCENTRATIONS

Wastewater Treatment Facility	**TN (mg/L)**
New Seabury	2.5
Willowbend	7.7
Southport	8.4
Southcape	9.5
Stratford Ponds	11.2
Mashpee Commons	6.3
High School(1)	43.5
Windchime Point	6.0
Forestdale School	NA
(1) For the Report, the High School nitrogen load was based on current performance. The permit limit for this facility is less than 10 mg/L TN.	

This approach takes into consideration that, if nitrogen issues were addressed with a wastewater treatment plant serving a portion of a planning zone, those properties with existing I/A systems are already providing some level of nitrogen removal and may or may not be required to immediately connect to a WWTP.

Wastewater nitrogen loads were developed for each parcel by converting the daily estimated wastewater flow and the estimated total nitrogen concentration to a load in kilograms (of nitrogen) per year (kg/yr). It is noted that in the following paragraphs, when reference is made to high, medium, and low nitrogen loading rates (kg/acre/yr), these are relative terms used to compare one planning zone to another as discussed below.

C. Figure 7-1 – Planning Zone Loading Map

Figure 7-1 displays the average wastewater nitrogen loads per acre per planning zone. This figure is based on the total nitrogen load in kilograms of nitrogen per year divided by the total acreage of the given planning zone (PZ). As discussed in previous chapters, there are 161 planning zones identified by the Mashpee Planning Department and 12 planning zones in the surrounding towns (identified as planning zones for this report only).

This map was generated to identify PZs that have or are expected to have high nitrogen loads relative to other PZs. The map is color coded based on these application rates, red indicating the highest loads (greater than 30 kg/acre/year) and yellow indicating the lowest loads (less than 10 kg/acre/year). The locations of the WWTFs are provided for reference on the map and indicate approximate location of individual wastewater treatment plant effluent recharge sites.

The following table provides a breakdown of the nitrogen loading rates of the planning zones.

TABLE 7-5

SUMMARY OF PLANNING ZONE LOADING RATES[1]

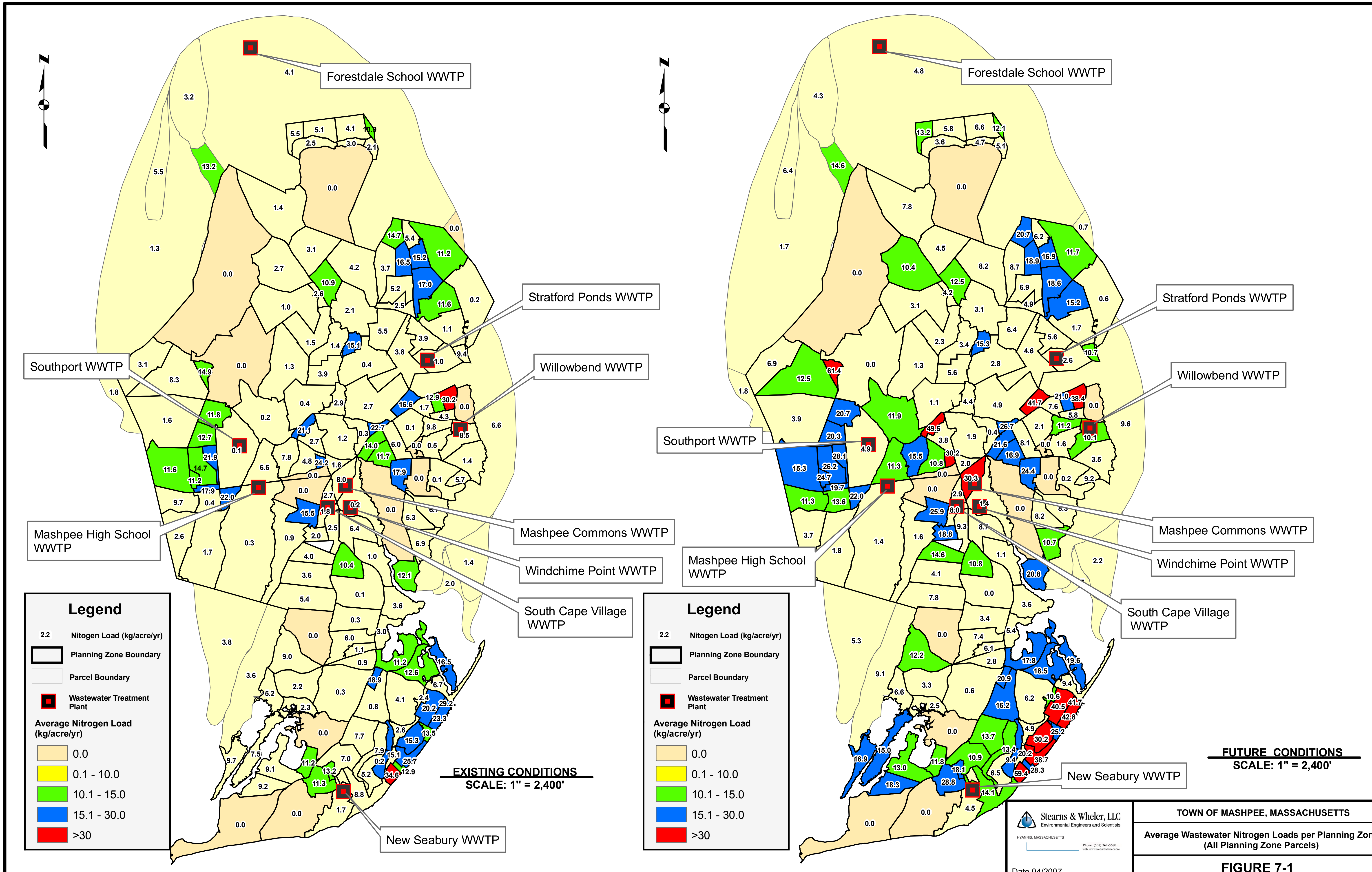
Relative Loading[2]	**Number of PZs (Existing conditions)**	**Number of PZs (Future conditions)**
High (Red – more than 30 kg/acre/yr)	2	12
Medium-High (Blue – 15.1-30 kg/acre/yr)	21	35
Medium (Green – 10.1-15 kg/acre/yr)	24	27
Low (Yellow – less than 10 kg/acre/yr)	112	87
No Wastewater Nitrogen Load	14	12

(1) Wastewater nitrogen loads only.

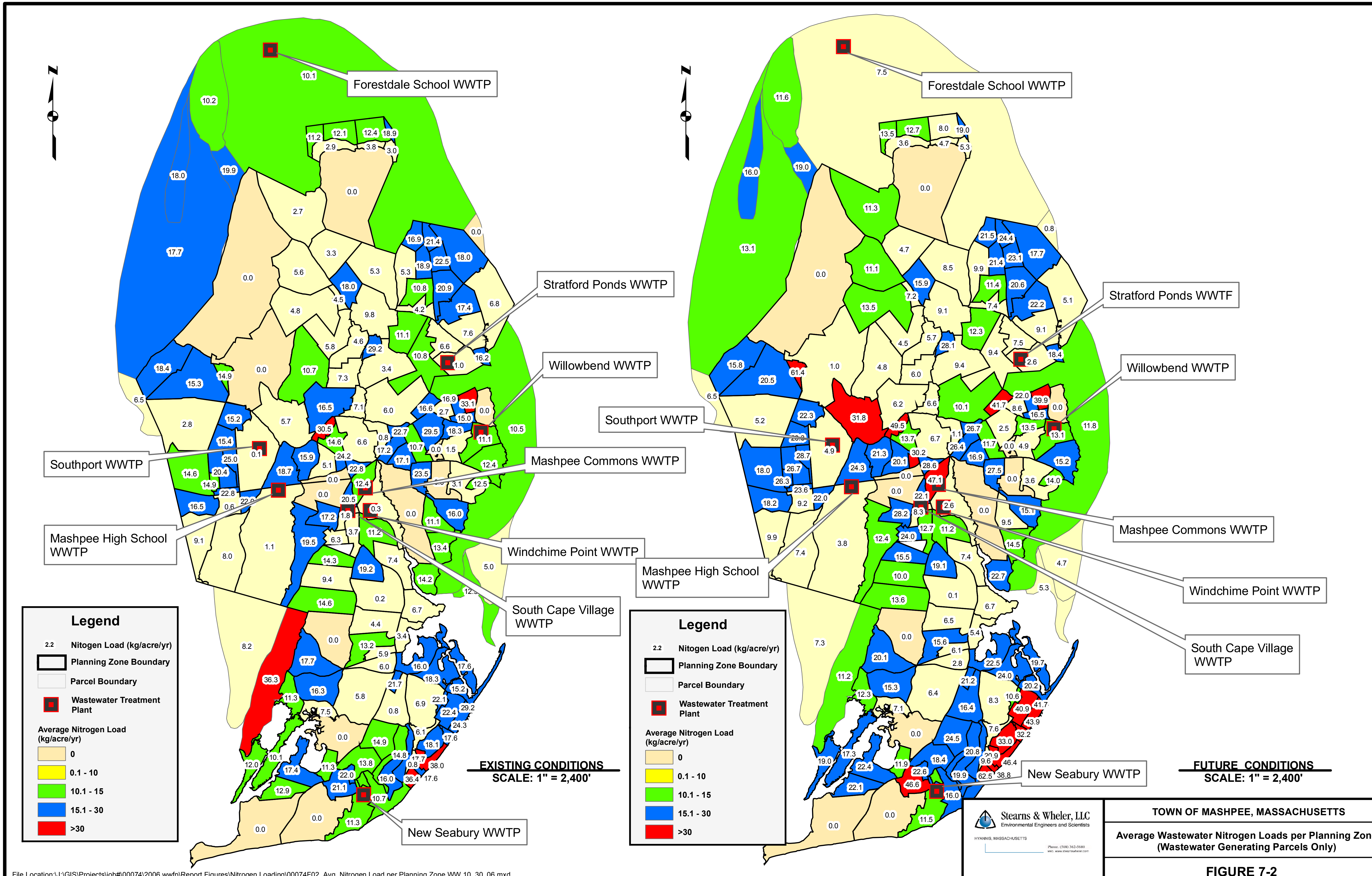
(2) Total wastewater load per year divided by total planning zone acreage.

D. Figure 7-2 – Wastewater Generator Loading Map

Figure 7-2 is a variation of the PZ Loading Map. However, the wastewater nitrogen load is divided by the total acreage of *only* the wastewater-generating parcels within a given PZ. For



File Location:\J:\GIS\Projects\job#\00074\2006 wwfp\Report Figures\00074F07-1 Nitrogen Load per Planning Zone 11x17.mxd



Forestdale School WWTP
Stratford Ponds WWTP
Willowbend WWTP
Southport WWTP
Mashpee Commons WWTP
Mashpee High School WWTP
Windchime Point WWTP
South Cape Village WWTP
New Seabury WWTP
Stratford Ponds WWTF
Legend
2.2 Nitogen Load (kg/acre/yr)
Planning Zone Boundary
Parcel Boundary
Wastewater Treatment Plant
Average Nitrogen Load (kg/acre/yr)
0
0.1 - 10
10.1 - 15
15.1 - 30
>30
EXISTING CONDITIONS
SCALE: 1" = 2,400'
FUTURE CONDITIONS
SCALE: 1" = 2,400'
Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS
TOWN OF MASHPEE, MASSACHUSETTS
Average Wastewater Nitrogen Loads per Planning Zone
(Wastewater Generating Parcels Only)
FIGURE 7-2
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example, a PZ may have a total of 100 acres, but there may be 50 acres of conservation land or other non-wastewater generating land in the PZ. Therefore, the nitrogen load per acre would be calculated by dividing the total nitrogen load by 50 acres (the wastewater nitrogen generating parcels) rather than the entire 100 acres.

This figure is also color coded to indicate PZs with high nitrogen loads. In addition to identifying PZs with high nitrogen loading, this figure will be used to identify which areas have or are projected to have dense development. Densely developed areas are typically the most cost-effective areas to consider for future sewering because larger numbers of homes can be connected while minimizing the total length of sewer.

In some PZs, the existing (developed) land use may not meet current zoning requirements and therefore the average nitrogen load per acre is relatively high. Future conditions are based upon full development of currently unoccupied lots and larger parcels that could be subdivided. It is presumed that the larger lots would be subdivided in conformance with existing zoning regulations. This would have the effect of lowering the average nitrogen loading per acre within the respective PZ.

For example, if a certain PZ has a total nitrogen load of 1000 kg/year and that nitrogen is generated by parcels totaling 100 acres, the average nitrogen load is 10 kg/acre/year. In the future, the total nitrogen load of that PZ may increase to 1200 kg/year, but the parcels to be developed in the future may be larger, resulting in a total area increase to 200 acres. This would result in a *decrease* in average nitrogen load to 6 kg/acre/year.

For most of the PZs that have a lower future average nitrogen load, the reason is that the average to-be-developed parcel size is generally larger than the average existing parcel size. For others, one high wastewater producer in the PZ (such as a hotel) may be counterbalanced by much smaller wastewater producers in the future, decreasing the average nitrogen load per acre.

The following table provides a breakdown of planning zones.

TABLE 7-6

SUMMARY OF WASTEWATER GENERATOR LOADING RATES[1]

Relative Loading[2]	Number of PZs (Existing conditions)	Number of PZs (Future conditions)
High (Red – more than 30 kg/acre/yr)	5	16
Medium-High (Blue – 15.1-30 kg/acre/yr)	60	62
Medium (Green – 10.1-15 kg/acre/yr)	38	26
Low (Yellow – less than 10 kg/acre/yr)	56	57
No Wastewater Nitrogen Load	14	12

(1) Wastewater nitrogen loads only.

(2) Total wastewater load per year divided by total acreage of wastewater generating parcels.

The following table illustrates the nitrogen load per acre that might be expected for some typical residential property sizes at various wastewater flows. This table illustrates the "sensitivity" of various sized parcels. For example, an average residential flow is 140 gpd. Based on the table, this can result in a relatively low loading rate on a two acre parcel to a much higher loading rate on a ¼ acre parcel.

TABLE 7-7

WASTEWATER NITROGEN LOADS FOR VARIOUS PARCELS (kg/acre/yr)

Wastewater Flow (gpd)	Lot Size (Acre)			
	1/4	**1/2**	**1**	**2**
50	9.7	4.8	2.4	1.2
100	19.4	9.7	4.8	2.4
150	**29.1**	14.5	7.3	3.6
300	58.1	**29.1**	14.5	7.3

Note: Colors correspond to loading range colors used in loading maps

1. **Non-Wastewater Nitrogen Loads**

Although wastewater is the primary source of nitrogen within a watershed, it is not the only source. Both the MEP and this WNMP considered the other primary contributors to nitrogen within a watershed – impervious surface runoff, direct precipitation, and lawn fertilizer.

Table 7-8 summarizes the factors used by both MEP and the WNMP for estimating non-wastewater nitrogen loads.

TABLE 7-8

NON-WASTEWATER NITROGEN SOURCES(1)

Nitrogen Source	Nitrogen Concentration or Load	Recharge Rate
Pavement Runoff	1.5 mg/L	40 in/year
Roof Runoff	0.75 mg/L	40 in/year
Precipitation to Natural Areas	0.072 mg/L	27.25 in/year
Lawn Fertilizer	0.49 kg/lawn(2)	NA
(1) From Table IV-4 of the MEP technical reports. (2) MEP used 1.08 lb/lawn. The Nitrogen Load is shown as kg/lawn to correlate with the concentrations in mg/L.		

Non-wastewater nitrogen loads were estimated on the planning zone level. For Mashpee and Falmouth parcels, GIS data was used to obtain road, driveway, sidewalk, parking, and roof areas. Lawn areas were estimated at 5,000 square feet of lawn per residential parcel, consistent with MEP. Golf courses were also identified due to the increased fertilization rates that are used on golf courses. Natural areas were accounted for by subtracting the total impervious surfaces and the total lawn/golf course areas from the total planning zone area. For the parcels in Sandwich and Barnstable (which had less GIS data available), the majority of the non-wastewater loads were estimated using the same methodology used by MEP – 5,000 square feet of lawn per residential parcel, 1,500 square feet of roof area per residential parcel, and 1,500 square feet of driveway area per residential parcel. The road areas for Sandwich and Barnstable were identified in the GIS files, which provided the area that was used for nitrogen loads resulting from paved roads.

The nitrogen concentrations and recharge rates, as listed above, were applied to obtain estimates of nitrogen loads (in kg/year) from each respective source. These nitrogen estimates were added to wastewater nitrogen to determine total nitrogen loads for each planning zone. To illustrate the predominance of wastewater nitrogen, the percent of total nitrogen load that comes from wastewater was calculated. Table 7-9 details the wastewater and non-wastewater nitrogen loads and the percentage of the nitrogen load that comes from wastewater. The analysis performed for this Report included the entire PPA, which includes portions of Towns outside of Mashpee.

TABLE 7-9

SUMMARY OF TOTAL NITROGEN LOADS PER TOWN(1)

	Wastewater Nitrogen Load (kg/yr)		**Non-Wastewater Nitrogen Load (kg/yr)**		**Total Nitrogen Load (kg/yr)**		**% Wastewater Nitrogen Load(2)**	
Town	**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	7,700	8,100	36,000	50,000	78%	82%
Other	9,000	16,000	1,800	1,900	11,000	18,000	82%	89%
Total	51,000	87,000	15,000	16,000	66,000	100,000	77%	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%

(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.

7.4 SUMMARY

The calculations performed as part of the WNMP were compared with the calculations performed for the MEP. The following table (Table 7-10) summarizes the daily nitrogen loads by subwatershed.

It can be seen from Table 7-10 that the results of the MEP analysis and this WNMP analysis, although when comparing the first two sets of numbers appear significantly different, are relatively close when the first and third sets of numbers are compared. The predominant reasons for the differences in nitrogen loads are the assumption of a nitrogen reduction in the septic system and natural attenuation through freshwater systems. Natural attenuation is important to consider when evaluating the health of water resources. However, natural attenuation is not considered for wastewater facility planning purposes. Natural attenuation would only be considered for on-site system treatment; when considering treatment at a facility requiring a Groundwater Discharge Permit, any facilities designed to treat wastewater nitrogen would need to account for all of the wastewater nitrogen that could be generated. The most significant differences between MEP and WNMP values are in the subwatersheds that receive groundwater flow from freshwater ponds. As discussed above, this is primarily due to the assumption of natural attenuation as septic system effluent flows through the ponds. This attenuation was not considered for either the WNMP analysis or the adjusted WNMP analysis (which only considered the 25% reduction of nitrogen from Title 5 septic systems).

As shown in Table 7-9, the predominant source of nitrogen is wastewater effluent. The percentage of nitrogen that comes from future wastewater ranges from 80% to 90%. These percentages are similar to the percentages obtained in MEP's analysis.

The percentages shown in Table 7-9 indicate the overwhelming need to address wastewater management issues, both within Mashpee and within surrounding towns.

TABLE 7-10

DAILY NITROGEN LOADS BY SUBWATERSHED

Subwatershed	MEP Results[1]		WNMP Results[2,3]		Adjusted WNMP[3,4] Results	
	Existing Load (kg/day)	Build-out Load (kg/day)	Existing Load (kg/day)	Build-out Load (kg/day)	Existing Load (kg/day)	Build-out Load (kg/day)
Popponesset Bay System						
Popponesset Bay	1.82	1.98	2.3	2.9	1.8	2.2
Popponesset Creek	4.94	5.35	6.3	9.1	4.9	7.1
Pinquickset Cove	0.76	0.98	1.1	1.6	0.9	1.3
Ockway Bay	3.15	4.25	4.1	7.4	3.3	5.7
Mashpee River[5,6]	27.67	54.2	75	110	59	87
Shoestring Bay[7]	30.77	39.55	38	55	30	43
Waquoit Bay System						
Hamblin Pond[8]	9.26	14.23	16	27	13	21
Jehu Pond[9]	8.35	10.23	10	15	7.7	12
Quashnet River[5, 10]	25.95	50.74	41	73	33	57

Notes:

(1) Total Nitrogen loads (all sources) from MEP reports (Table VI-4 of MEP's *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Popponesset Bay, Mashpee and Barnstable, Massachusetts*, September 2004 and Table VI-5 of MEP's *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*, January 2005). Natural attenuation is considered for septic loads, meaning that these calculations assumed a wastewater nitrogen concentration of 26.25 mg/L.

(2) Total Nitrogen loads (all sources) from WNMP analysis. Nitrogen reduction in the septic system is not considered for septic loads, meaning that these calculations assumed a wastewater nitrogen concentration of 35 mg/L. WNMP analysis did not split parcels in the same manner that the MEP analysis did. WNMP analysis did not subtract public water supply withdrawals from the total nitrogen loads.

(3) All WNMP figures are rounded to two significant figures.

(4) The WNMP figures were adjusted *for comparison purposes only* by reducing the wastewater nitrogen load by 25% (from 35 mg/L to 26.25 mg/L) and leaving all other loads the same.

(5) This subwatershed includes freshwater subwatersheds. MEP values include attenuation as groundwater flows through the freshwater system. WNMP calculations are higher because they did not include any attenuation resulting from flow through the freshwater system, which likely accounts for the large discrepancy in nitrogen loads.

(6) Includes surface water loads from Mashpee River.

(7) Includes surface water loads from Santuit River and Quaker Run River.

(8) Includes subembayments of Red Brook, Upper Hamblin Pond, and Hamblin Pond.

(9) Includes subembayments of Little River, Upper Great River, Lower Great River, and Jehu Pond.

(10) Includes subembayments of Moonakis River, Upper Quashnet River, and Lower Quashnet River.

Chapter 8

Development of Wastewater Nitrogen Priority Areas

CHAPTER 8

DEVELOPMENT OF WASTEWATER NITROGEN PRIORITY AREAS

8.1 INTRODUCTION

Previous chapters discussed the environmental resources, existing and future development conditions, and identification of nitrogen removal needs. This chapter will discuss the factors used in determining the priority areas for nitrogen removal and developing the management plan. The goal of identification of these areas is to guide the nitrogen management planning process. Identifying these areas helps focus the approach to dealing with nitrogen issues within the PPA along with setting the framework for the development of alternatives and, ultimately, the development of a recommended plan.

Although this will establish areas in the PPA where nitrogen removal efforts might be focused, this will also consider the proximity of these areas to existing wastewater treatment facilities, the feasibly and continuity of possible collection system expansion, and the Town of Mashpee's goals of addressing year round developed areas first.

The term Priority Area is used as a planning tool to provide an initial ranking of areas of the PPA with the goal of identifying high need areas first. The advantage of the planning process is that as the Town of Mashpee approaches the final development of a recommended plan, these areas can be refined. This refinement process will be a result of the Town's reviews, State reviews, and public comments.

8.2 DELINEATION OF PRIORITY AREAS

A. **Determining Factors.** The following factors were the primary considerations used in identifying planning zones that are priorities for implementation of a nitrogen remediation plan.

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

As discussed in previous chapters, MEP performed detailed evaluations of the Popponesset and Waquoit Bay watersheds, both of which have substantial segments within Mashpee's boundaries. The results of the MEP work led to development of nitrogen TMDLs, which provide target nitrogen loading levels for each subwatershed. Planning zones that lie within the boundaries of MEP subwatersheds with high nitrogen removal requirements were identified as a higher priority. In addition, the further down in the watershed the planning zone is located, the higher the priority because less natural attenuation is available for those areas.

It should be re-stated that the MEP removal rates for septic nitrogen load were a presentation of one potential scenario to achieve the target nitrogen concentrations necessary to restore watershed health. Although these recommendations were used as part of the prioritization process, they are not the only way to achieve the target nitrogen concentrations and are therefore not binding. Alternative ways to reach the target nitrogen concentrations are possible.

Nitrogen load calculations (in kg/acre/year) were performed as described in Chapter 7. The results of those calculations led to the sorting of planning zones from low to high nitrogen loading rates. Planning zones with high nitrogen loading rates that also fell predominantly within subwatersheds to the Popponesset Bay and Waquoit Bay watersheds identified by MEP as areas requiring high nitrogen removals were classified as higher priorities. The nitrogen loading rates are ranked as follows:

TABLE 8-1

RELATIVE RANKING OF NITROGEN LOADING RATES

Nitrogen Loading Rate (kg/acre/year)	Relative Ranking
0-10	Low
10.1-15	Moderate
15.1-30	Moderately High
>30	High

Further identification and ranking of priority planning zones was done by evaluating the seasonality of the planning zones. Estimates of the seasonality were developed by the Mashpee Planning Department, based on the 2000 US Census. Census data indicated whether or not a home was occupied at the time of the census. The Mashpee Planning Department used this information to calculate percentage occupancy rates for each planning zone. Planning zones with 100% occupancy are assumed to consist completely of year-round residences. On the other end of the spectrum, planning zones with 0% occupancy are assumed to be entirely seasonal properties (with the exception of entirely commercial planning zones, which would have no residences). Highly seasonal planning zones tend to have higher nitrogen loading rates due to the typically smaller lot size. However, the predominantly year round areas will provide consistent flows to any resultant treatment plant.

The factors discussed above resulted in identification of a relatively small number of priority planning zones, most of which were scattered throughout the PPA. In order to identify larger priority areas, nitrogen loads from all sources were considered. The non-wastewater sources included road, roof, sidewalk, driveway, and parking lot runoff, lawn fertilizer, and precipitation on natural areas. The values and assumptions used for this calculation are discussed in Chapter 7. The wastewater and non-wastewater nitrogen loads were combined, and nitrogen load per acre of planning zone was calculated. Again, the planning zones with relatively high nitrogen loading rates were identified.

B. **Prioritization.** The planning zones that met the previously mentioned criteria were identified and grouped into Priority Areas consisting of multiple planning zones. Some of the

Priority Areas include planning zones of a relatively low priority; however, the Priority Areas were set up to include these areas based on the fact that there are nitrogen concerns to some degree in every part of the PPA. In addition, proximity to existing WWTF facilities was considered in deciding which planning zones were included in a Priority Area. Future phases of this project will include development of alternative scenarios for addressing the nitrogen loading issue and refining these areas as part of a comprehensive plan to address the Town's nitrogen loading issues. These scenarios will likely incorporate maximization of existing treatment capacity. Therefore, areas near existing WWTFs may be included in Priority Areas regardless of the nitrogen loading rate.

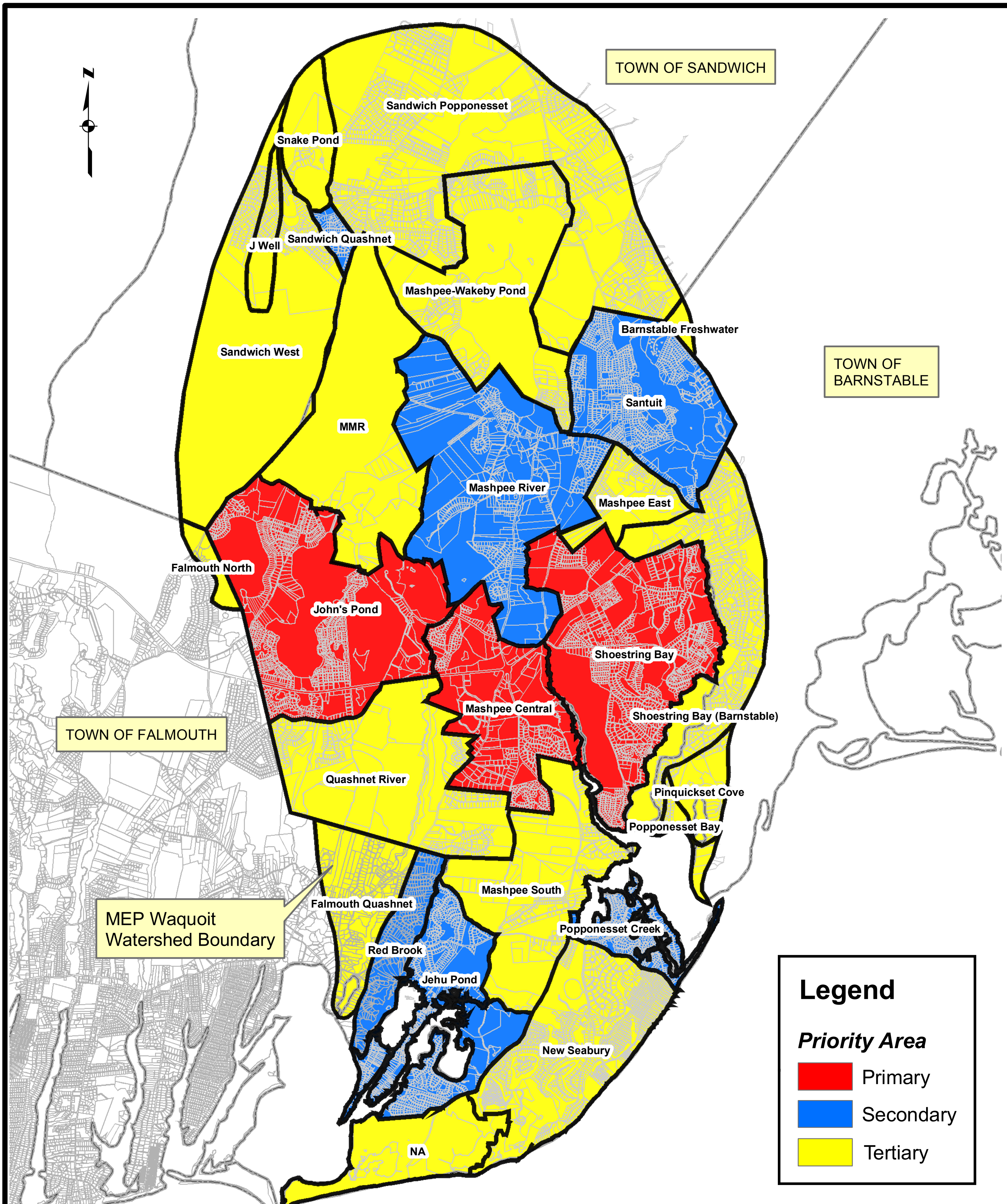
Once Priority Areas were delineated, they were identified as primary, secondary, or tertiary priority. It should be noted that these rankings are purely relative. As mentioned, there are nitrogen concerns throughout the PPA. The rankings were designated for planning purposes.

1. **Primary Priority Areas.** The following primary Priority Areas were identified (shown in red on Figure 8-1):

Area M-1 "Johns Pond" – this Priority Area is located on the western side of Mashpee and includes planning zones 1511, 1611, 1621, 1622, 1632, 1641, 1651, 1652, 1661, 1671, 1672, 1673, 1681, 1682, 2111, 2121, and 2131. The following factors resulted in the classification of this as a primary Priority Area:

- Within the Waquoit Bay watershed
- Large number of planning zones with moderately high to high nitrogen loading rates
- Relatively high concentration of year round residents and businesses
- There is an existing WWTF within this priority area (Southport), which may be suitable for expansion

Area M-2 "Mashpee Central" – this Priority Area is located in the center of Mashpee, including the Mashpee rotary and Mashpee Commons, and includes planning zones 1522, 1531, 1541,



Data Source: Mass GIS
File Location: J:\GIS\GIS Project Folder\Job#\00074 Mashpee\2006 WWFP\Report Figures\00074F08-1priority.mxd

Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

Date: 04/2007 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Priority Areas

FIGURE 8-1

1542, 1551, 1552, 1571, 2211, 2221, 2231, 2241, 2242, 2243, 2251, 2252, 2271, 2272, and 2421. The following factors resulted in the classification of this as a primary Priority Area:

- Within the Popponesset Bay watershed; relatively far downstream in the watershed
- The majority of planning zones have moderately high or high nitrogen loading rates
- Relatively high concentration of year round residents and businesses
- There are three existing WWTFs in this priority area (Mashpee Commons, Southcape Village, and Windchime Point), some of which may be suitable for expansion

Area M-3 "Shoestring Bay" – this Priority Area is located on the eastern side of Mashpee and includes planning zones 1432, 1442, 1451, 2501, 2511, 2521, 2522, 2531, 2532, 2533, 2541, 2542, 2543, 2544, 2551, 2552, 2561, 2562, 2563, 2564, 2571, 2572, 2581, 2582, 2591, and 2592. The following factors resulted in the classification of this as a primary Priority Area:

- Within the Popponesset Bay watershed; relatively far downstream in the watershed
- Many of the planning zones have moderately high or high nitrogen loading rates
- Many of the planning zones consist of year round residences
- A portion of a public supply well watershed is within the priority area
- There is an existing WWTF in this priority area (Willowbend), which may be considered suitable for expansion after further evaluation

2. **Secondary Priority Areas.** The following secondary Priority Areas were identified (shown in blue on Figure 8-1):

Area M-4 "Santuit Pond" – this area is located on the northeastern corner of the Town, including Santuit Pond, and includes planning zones 1311, 1321, 1322, 1331, 1332, 1341, 1351, 1352, 1361, 1371, 1372, 1381, and 1382. The following factors were considered in prioritization:

- The majority of the planning zones have moderately high nitrogen loading rates
- The Town has identified phosphorous loading issues in Santuit Pond

- The planning zones are all predominantly year round residences
- The watershed for a public supply well falls within this area

Area M-5 "Mashpee River" – this Priority Area is in the north-central part of Town and includes much of the Mashpee River and its recharge area. This Priority Area includes planning zones 1213, 1221, 1222, 1223, 1241, 1251, 1252, 1253, 1261, 1271, 1411, 1431, 1441, 1521, 1561, and 1562. The following factors were considered in prioritization:

- Within the Popponesset Bay watershed
- The planning zones within this area are predominantly year round residences
- The Mashpee zoning bylaws have established a Mashpee River Protection District to protect the water resources

Area M-6 "Jehu Pond" – located on the southwestern side of Town, this Priority Area includes Jehu Pond and Hamblin Pond. It includes planning zones 2321, 3421, 3422, 3431, 3441, 3511, 3512, 3521, 3531, and 3541. The following factors were considered in classifying this as a secondary Priority Area:

- Moderately high nitrogen loading in most of the planning zones in the area
- Located in the lower portions of the Waquoit Bay watershed

Area M-7 "Popponesset Creek" – this Priority Area is located around the Popponesset Bay and Popponesset Creek and includes planning zones 3111, 3121, 3131, and 3141. The following were considered:

- Located in the furthest downstream section of the Popponesset Bay watershed
- All planning zones in this area have moderately high nitrogen loading per acre

Area F-1 "Red Brook" **–** this area consists of the Falmouth portion of the PPA that is within the Red Brook subwatershed. This Priority Area was identified based on the following criteria:

- Located far downstream in the Waquoit Bay East watershed
- Has moderate nitrogen loading rates (high existing rates)

Area S-4 "Sandwich Quashnet" – this portion of Sandwich is not in a freshwater subwatershed; groundwater flows directly into the Quashnet River subwatershed. This was identified as a secondary Priority Area based on:

- Moderately high nitrogen loading rates
- Most residences are year round
- Located in a Zone II area

3. **Tertiary Priority Areas.** The following Priority Areas were considered tertiary priorities (shown as yellow on Figure 8-1):

Area M-8 "Mashpee-Wakeby Pond" – this area is located at the very northern tip of Mashpee and includes planning zones 1111, 1112, 1113, 1121, 1122, 1131, 1141, 1151, 1211, 1212, and 1231. The factors resulting in tertiary prioritization include:

- Far upstream in the Popponesset Bay watershed (a large portion of the nitrogen load is naturally attenuated as groundwater flows through the Mashpee-Wakeby Pond)
- Low nitrogen loading per acre

Area M-9 "MMR" – this area consists of the portion of the Massachusetts Military Reservation within Mashpee (planning zone 4111) and planning zone 1631. The factors resulting in tertiary prioritization include:

- Far upstream in the Waquoit Bay watershed
- Low nitrogen loading per acre
- Majority of the area is open space
- Connected to treatment plant with discharge outside the PPA

Area M-10 "Mashpee East" – this Priority Area is located on the eastern edge of Mashpee, bordering the village of Cotuit (Town of Barnstable). It includes planning zones 1412, 1421, and 1422. The factors resulting in tertiary prioritization include:

- Low nitrogen loading per acre
- The existing WWTF in this priority area (Stratford Ponds) may have minimal potential for expansion

Area M-11 "Quashnet River" – this area lies in the Quashnet River and Red Brook watersheds in Mashpee and includes planning zones 2141, 2151, 2161, 2261, 2281, and 2291. The reasons for its tertiary prioritization include:

- Located somewhat upstream in the Waquoit Bay watershed
- Low to moderate nitrogen loading per acre
- Large portions are open space
- There is an existing WWTF in this priority area (Mashpee High School), which may be suitable for expansion

Area M-12 "Mashpee South" – this area lies in the Mashpee River, Ockway Bay, Hamblin Pond, and Jehu Pond watershed in Mashpee and includes planning zones 2311, 2411, 2422, 2431, 2432, 2441, 2442, 2443, 2451, and 3411. The reasons for its tertiary prioritization include:

- Located somewhat upstream in the Waquoit Bay watershed
- Mostly low nitrogen loading per acre
- Large portions are open space

Area M-13 "New Seabury" – this area consists mostly of properties considered part of the New Seabury development. This includes planning zones 3211, 3221, 3222, 3223, 3224, 3225, 3231, 3232, 3241, 3242, 3311, 3312, 3321, 3331, 3341, 3342, 3343, 3344, 3351, 3361, 3362, 3371, and 3372. Although most of the area has relatively high nitrogen loading rates, the reasons for its tertiary prioritization include:

- Not located in either Waquoit Bay or Popponesset Bay watersheds
- Predominantly seasonal residences
- There is an existing WWTF (New Seabury) in this priority area, which may be suitable for expansion
- Located in the Zone II area of a public supply well

Area F-2 "Falmouth Quashnet" – this area consists of the Falmouth portion of the PPA that is within the Quashnet River subwatershed. The following considerations resulted in this tertiary prioritization:

- Predominantly seasonal residences
- Relatively low nitrogen loading rates

Area F-3 "Falmouth North" – this area of Falmouth is within the subwatershed that flows through Ashumet Pond. The following considerations resulted in this tertiary prioritization:

- Located high up in the Waquoit Bay East watershed
- Relatively low nitrogen loading rates

Area S-1 "Sandwich West" – this is the portion of Sandwich that flows through freshwater ponds in Mashpee prior to flowing into the Quashnet River subwatershed. The following considerations resulted in this tertiary prioritization:

- Located high up in the Waquoit Bay East watershed
- Relatively low nitrogen loading rates

Area S-2 "J Well" – this small portion of Sandwich is the subwatershed to a public water supply well. This was considered a tertiary Priority Area based on the following considerations:

- Located high up in the Waquoit Bay East watershed
- Moderately high nitrogen loading rates

Area S-3 "Snake Pond" – groundwater in this portion of Sandwich flows through Snake Pond in Sandwich prior to flowing into the Quashnet River subwatershed. The following criteria were considered for this Priority Area:

- Located high up in the Waquoit Bay East watershed
- Moderate nitrogen loading rates
- Located in a Zone II area

Area S-5 "Sandwich Popponesset" – this is the portion of Sandwich that contributes to the Popponesset Bay watershed. All of the groundwater in this priority area flows through a freshwater pond. This was classified as a tertiary Priority Area based on the following considerations:

- Located high up in the Popponesset Bay watershed
- Relatively low nitrogen loading rates
- Located in a Zone II area

Area B-1 "Barnstable Freshwater" – this is the portion of Barnstable that contributes to Popponesset Bay's freshwater subwatershed. Following are some of the characteristics of this Priority Area:

- Located high up in the Popponesset Bay watershed
- Relatively low nitrogen loading rates

Area B-2 "Shoestring Bay Barnstable" – this area of Barnstable is part of the Shoestring Bay subwatershed.

- Moderate nitrogen loading rates

Area B-3 "Pinquickset Cove" – this part of Barnstable makes up the entire Pinquickset Cove subwatershed.

- Relatively low nitrogen loading rates
- Primarily seasonal residences

Area B-4 "Popponesset Bay" – this is the portion of the Popponesset Bay subwatershed that is contributed by parcels in Barnstable.

- Relatively low nitrogen loading rates
- Primarily seasonal residences

Mashpee planning zones 3451 and 3381 were not included in the Priority Areas due to the lack of wastewater nitrogen loads. These areas are predominantly beach area.

8.3 SUMMARY

The following table summarizes the total nitrogen loads for all of the priority areas, both within and outside Mashpee. These numbers are nitrogen totals (kg/yr), not loading rates (kg/acre/yr). The loading rates were evaluated on the planning zone level and used for prioritization. The table presents the total wastewater flow for the priority area, the nitrogen load that results from that flow, and the non-wastewater nitrogen from that priority area. Priority areas labeled B-# are in the Town of Barnstable; areas labeled S-# are in the Town of Sandwich; areas labeled F-# are in the Town of Falmouth. The locations of all of these priority areas are shown on Figure 8-1.

TABLE 8-2

SUMMARY OF NITROGEN LOADS BY PLANNING AREA

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	4,000	4,100	11,000	19,000
M-2 Mashpee Central	94,000	210,000	4,700	10,000	3,800	3,800	8,500	14,000
M-3 Shoestring Bay	150,000	240,000	7,800	12,000	13,000	16,000	21,000	29,000
M-4 Santuit Pond	110,000	140,000	5,100	6,900	4,600	12,000	9,700	18,000
M-5 Mashpee River	76,000	160,000	3,600	7,000	1,100	2,400	4,700	9,400
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	16,000	16,000	25,000	33,000
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
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
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

Chapter 9

Needs Assessment Summary

CHAPTER 9

NEEDS ASSESSMENT SUMMARY

9.1 INTRODUCTION

The purpose of this Needs Assessment Study is to address nitrogen issues for the project planning area (PPA) and begin the Watershed Nitrogen Management Plan (WNMP) process. Information on existing wastewater facilities (septic systems and small treatment plants), physical features, land use, and regulatory issues affecting wastewater facilities has been discussed in previous chapters. Existing conditions and problems related to environmental resources, nitrogen loadings, and on-site septic systems have been evaluated and summarized. In addition, future conditions of the PPA relating to population, growth, and the potential effects of that growth on any proposed wastewater collection, treatment, and disposal facilities have been evaluated.

The purpose of this chapter is to summarize and integrate the PPA's existing and future conditions, which will in turn establish the nitrogen management needs for the PPA. The needs assessment summary is divided into the following major areas: Priority Area Groupings, Priority Areas in Relation to MEP Findings, Pilot Project, and the Next Steps to Identify Solutions for Nitrogen Management Needs.

9.2 PRIORITY AREA GROUPINGS

Based on the criteria listed discussed in Chapter 8, the Priority Areas were grouped into Primary, Secondary, and Tertiary Areas.

Primary Areas are those areas that are located within MEP watersheds requiring high nitrogen removal, areas with high nitrogen loading rates, areas with predominantly year round residents, and planning zone specific criteria identified by the Town of Mashpee Planning Department (such as phosphorus issues in Santuit Pond and the quality and condition of the Mashpee River).

Secondary Areas include those Priority Areas with some of the same concerns as the Primary Areas. However, the secondary areas typically have lower nitrogen loading rates and more seasonal homes. For these reasons, it is recommended these areas be addressed in a later implementation stage of the ultimate recommended plan to address existing nitrogen loading needs.

Tertiary Areas will need to address nitrogen loading issues in the future, but due to the predominantly seasonal residences and the location within the MEP watersheds (typically far upstream in the watershed or completely outside of watershed lines), it is not anticipated that immediate attention is warranted.

The following list summarizes the Priority Area groups:

<u>Primary Areas</u>

- M-1 "Johns Pond"
- M-2 "Mashpee Central"
- M-3 "Shoestring Bay"

<u>Secondary Areas</u>

- M-4 "Santuit Pond"
- M-5 "Mashpee River"
- M-6 "Jehu Pond"
- M-7 "Popponesset Creek"
- S-4 "Sandwich Quashnet"
- F-1 "Red Brook"

<u>Tertiary Areas</u>

- M-8 "Mashpee-Wakeby Pond"
- M-9 "MMR"
- M-10 "Mashpee East"
- M-11 "Quashnet River"
- M-12 "Mashpee South"
- M-13 "New Seabury"
- S-1 "Sandwich West"
- S-2 "J Well"
- S-3 "Snake Pond"
- S-5 "Sandwich Popponesset"
- B-1 "Barnstable Fresh Water"
- B-2 "Shoestring Bay"
- B-3 "Pinquickset Cove"
- B-4 "Popponesset Bay"
- F-2 "Falmouth Quashnet"
- F-3 "Falmouth North"

Table 9-1 summarizes the main criteria considered when determining priority areas.

TABLE 9-1

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			√		√
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.

9.3 PILOT PROJECT

Mashpee is working with MADEP on the development of case studies in three estuaries. The goal of this "Pilot Project" is to investigate the use of inter-municipal agreements with respect to watershed based permitting and establishing fair share nitrogen management. This project has brought together the Towns of Mashpee, Sandwich, and Barnstable to examine the best methods to achieve TMDL targets for the Popponesset Bay watershed.

This is an important piece of the nitrogen management planning process for the full development of the WNMP and its implementation in the future.

9.4 NEXT STEPS TO IDENTIFY SOLUTIONS FOR NITROGEN MANAGEMENT NEEDS

The next phases of the WNMP process are the screening of technologies and screening of alternatives. As the technologies and alternatives are evaluated and accepted or eliminated, a detailed evaluation can be made and the WNMP can be fully developed. Any remaining issues are then resolved before the final step of environmental and public review.

The Town of Falmouth is currently moving forward with wastewater planning in the Eastern portion of the town, which includes areas that are within the PPA. These efforts can be coordinated with the WNMP, but the Town of Falmouth may wish to use different prioritization criteria for their planning purposes. Additionally, MEP work for the western portion of the Waquoit Bay watershed is still incomplete. The results of this work may have an impact on the findings and recommendations that were outlined in the reports for the Waquoit Bay East watershed. This future work by both the Town and MEP should be taken into consideration as the WNMP process moves forward.

Chapter 10

Funding Opportunities

CHAPTER 10

FUNDING OPPORTUNITIES

10.1 INTRODUCTION

This chapter briefly discusses some of the funding options that may be available to the Town of Mashpee for implementation of the Watershed Nitrogen Management Plan (WNMP). Even though this implementation is several years in the future, obtaining funding will be an important factor in gaining Town approval for implementing the solution.

10.2 STATE REVOLVING FUNDS

The Town of Mashpee is currently taking advantage of this program to develop this WNMP.

Massachusetts has a State Revolving Fund (SRF) that was established in 1989 to provide low interest loans for publicly owned treatment works (POTWs). The goal of the SRF is to aid municipalities in meeting federal and state water quality requirements. This funding is available for the planning, design, and/or construction of new collection, treatment, and discharge facilities. The current interest rate on these loans is 2 percent.

A. **Eligible Projects.** According to MADEP, financial assistance can be obtained for the following types of projects:

- "Tier 1 Wastewater Facilities – These include secondary or advanced wastewater treatment facilities and the major components of wastewater conveyance systems, such as large pumping stations/force mains and interceptor sewers."

- "Tier 2 Wastewater Facilities – These projects are similar in nature to the Tier 1 projects but would generally have difficulty in obtaining funding in competition with

Tier 1 projects due to lower priority points (for example, smaller communities or CSO correction projects), or that may otherwise be ineligible for funding (such as upgrades or additions at facilities that previously received funding). The priority rating system is adjusted for this category, whereby, for example, a lower population can give higher points, or the number of points assigned for a CSO project is higher than in the Tier 1 rating system. (Any Tier 1 project would also satisfy the definition of a Tier 2 project)." (Tier 1 and Tier 2 definitions are quoted directly from MADEP's Clean Water State Revolving Loan Fund Fact Sheet)

- Infiltration/Inflow (I/I) Removal – planning and design or construction projects that are designed to eliminate I/I problems.

- Collection Systems – smaller diameter sewers; preference is given when the project is related to a Tier 1 or Tier 2 project, where there are significant septic system failures, where there are high population densities, and where soils are unfavorable for septic systems; 75% of the projected flow in collection area must have been in existence prior to July 1, 1995.

- Tier 1 Planning and Design – facilities planning and preparation of plans and specifications for Tier 1 projects.

- Non-point Source – projects may include landfill capping, erosion control, and remediation of underground storage tank leaks.

10.3 OTHER STATE FUNDS

A. **Massachusetts Office of Coastal Zone Management (CZM).** CZM is part of the Executive Office of Environmental Affairs (EOEA), and offers several grants aimed at protecting coastal resources from pollution.

The focus of the Coastal Pollutant Remediation (CPR) Program is removal or elimination of point sources of pollution (stormwater outfalls, etc.), especially those that are transportation-related (road runoff, boat pumpout facilities). The CPR grant pays for 75% of the project cost; the Town (or other agency that is applying for the grant) is required to provide a 25% match, either through cash or in-kind services (Town employee wages, etc.). Projects that receive funding have a limited time period in which to complete the work outlined. Requests for responses (RFRs) usually come out in the late spring or early summer and grants are awarded within a few months. The CZM website (http://www.mass.gov/czm/) posts announcements when the RFRs are available. Projects are usually classified as either an assessment or construction. Applicants need to demonstrate that there is a definite pollution problem affecting coastal waters, explain how the project will improve water quality, and show support among various Town departments or local interest groups.

The Coastal Non-point Source (NPS) Grant is similar to the CPR grant. However, the NPS focuses more on nonpoint sources. A 25% match is required and the pollution problem needs to be explained. RFRs for the NPS come out in late spring or early summer and are awarded within a few months. Eligible projects include construction, assessment, and development of NPS management tools that can be used by other organizations and municipalities.

10.4 BARNSTABLE COUNTY EFFORTS

Barnstable County formed the Wastewater Implementation Committee (WIC) as an advisory committee for discussion, education, and coordination on wastewater management planning. The Barnstable County Blue Ribbon Committee was also formed to investigate the feasibility of a regional approach to wastewater management. These committees led to the formation of the Cape Cod Water Quality Collaborative to facilitate the development of wastewater facilities on Cape Cod. The County staff believes that the Collaborative will be successful in acquiring federal money to help fund wastewater projects. It is unknown whether or not federal money will actually be received.

10.5 ESCROW ACCOUNTS AND TOWN CONSENT AGREEMENTS

Following the completion of a WNMP, an extended period of time typically elapses between the planning process, design of the collection, treatment and disposal facilities, and the actual implementation. During that time, numerous septic systems are likely to have some type of failure. In such cases, a homeowner may be reluctant to pay for a new system, only to abandon that system and hook up to Town sewer a few years later. To deal with these situations, some towns have been successful in utilizing escrow accounts. If there is no imminent threat to public health, a failing system could be given a temporary variance or be allowed to make limited repairs to the system until Town sewer is installed. The homeowner would be required to put money into an escrow account and then connect to the sewer when the collection system is installed. Two other Cape Cod towns, Provincetown and Yarmouth, have had success with such a program.

Additionally, some properties within the PPA may have established Wastewater Escrow Accounts as required by the CCC's Development of Regional Impact permitting process.

Appendix A

Certificate of the Secretary of Environmental Affairs

Copies to: - file 00074.5
- file 00074.0
Original to NAW.

The Commonwealth of Massachusetts

Executive Office of Environmental Affairs
251 Causeway Street, Suite 900
Boston, MA 02114-2119

REC'D NOV 18 2001

JANE SWIFT
GOVERNOR

BOB DURAND
SECRETARY

Tel. (617) 626-1000
Fax (617) 626-1181
http://www.magnet.state.ma.us/envir

November 9, 2001

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME	: Comprehensive Nitrogen and Wastewater Management Plan
PROJECT MUNICIPALITY	: Mashpee
PROJECT WATERSHED	: Cape Cod
EOEA NUMBER	: 12615
PROJECT PROPONENT	: Town of Mashpee
DATE NOTICED IN MONITOR	: October 10, 2001

Pursuant to the Massachusetts Environmental Policy Act (G. L. c. 30, ss. 61-62H) and Section 11.03 of the MEPA regulations (301 CMR 11.00), I hereby determine that this project **requires** the preparation of an Environmental Impact Report.

This project involves the development of a comprehensive nitrogen and wastewater management plan for the Town of Mashpee. 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 EIR, 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, which will provide what additional environmental analysis might be required and will address the comments received on the Draft EIR.

The first two reports will be prepared and reviewed prior to submission of the Draft EIR, and their analyses and recommendations will be reflected in that document.

The project is subject to MEPA review and to the Mandatory EIR provisions of the MEPA Regulations (301 CMR 11.03(5)(a)3) since it is presumed that the project will ultimately result in the construction of more than 10 miles of new sewers. The Town is also seeking financial assistance from the Commonwealth under the State Revolving Fund.

The Town has requested that the project be reviewed under the Joint Environmental Review Process established between the Executive Office of Environmental Affairs (EOEA) and the Cape Cod Commission (CCC). Each of the documents filed under this Certificate should be prepared to satisfy both the EIR requirements of MEPA and the Development of Regional Impact (DRI) requirement of the CCC.

The Draft and Final EIR should follow the outline contained at Section 11.07 for form and content. The ENF filed for the project contains a proposed scope for each of the filings anticipated by the process. I find that the scope has provided detailed direction for each and that, with the addition of the several issues that follow, it should ensure that the necessary issues are addressed in appropriate detail. Consequently, I adopt that scope as my own, modified by the scoping items that follow.

RESOURCE DELINEATION

The Town should create a clear delineation of coastal and other resources that might be directly or indirectly affected by the proposed project. This information is necessary to allow designers to avoid or minimize impacts to such resources. The comments of the Office of Coastal Zone Management (CZM) and the CCC provide detailed guidance on what resources need to be identified.

EXECUTIVE ORDER #149; FEMA AND FLOODPLAIN USE

EO#149 directs agencies with permitting responsibilities over project involving construction of infrastructure to evaluate the flood damage potential to these facilities and to consider flood hazards when evaluating infrastructure proposals. The EIR should provide an analysis of the flood damage potential of any facilities that would be located within flood hazard zones and should otherwise show compliance with the intent of EO#149.

EXECUTIVE ORDER #181; BARRIER BEACHES

EO#181 directs agencies that would issue funding for projects to avoid using public monies to encourage growth and development on barrier beaches. The EIR should provide assurances that the project will be consistent with EO#181.

EXECUTIVE ORDER #385; PLANNING FOR GROWTH

Executive Order #385 requires that state and local agencies engage in proactive and coordinated planning oriented towards both resource protection and sustainable development. For reasons both of environmental protection and fiscal prudence, investments in public infrastructure should be carefully targeted toward those areas for which clear existing need has been established and for areas where denser development is appropriate, thereby relieving pressures on open space, agricultural lands, and other valuable natural resources.

Consequently, the EIR should provide a clear delineation of sensitive resources in the project area and should describe the ways in which the project will consider local and regional land use and growth management plans, and ensure consistency with those plans.

COMMENTS

The EIR should contain detailed responses to the issues raised in the public and agency comments received on the ENF, which are listed below.

November 9, 2001
Date

Jay Wickersham for
Bob Durand

Comments received :

Department of Environmental Protection
Coastal Zone Management
Massachusetts Historical Commission
Cape Cod Commission
Edward Baker

BD/rf

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
20 RIVERSIDE DRIVE, LAKEVILLE, MA 02347 508-946-2700

DF

JANE SWIFT
Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

RECEIVED
NOV 5 2001
MEPA

November 1, 2001

Secretary Bob Durand
Executive Office of
Environmental Affairs
251 Causeway Street, 9th Floor
Boston, Massachusetts 02202

RE: MASHPEE – ENF Review
EOEA # 12615 – Watershed
Nitrogen Management Planning
Study
Mashpee, MA

Dear Secretary Durand,

"For Use in Intra-Agency Policy Deliberations"

The Southeast Regional Office and the Boston Office of the Department of Environmental Protection have reviewed the Environmental Notification Form (ENF) for the proposed project for a Watershed Nitrogen Management Planning Study to be located in Mashpee, Massachusetts (EOEA #12615). The project proponent provides the following information for the project:

"The Watershed Nitrogen Management Planning Study (Project) is a comprehensive nitrogen and wastewater management planning project for the Town of Mashpee, the Popponessett Bay Watershed, and Mashpee's portions of the Waquoit Bay Watersheds. The Project Area is illustrated in Figure 1; and Figure 2 illustrates the location of the Project Area on Cape Cod. The Project will result in a comprehensive Nitrogen and Wastewater Management Plan and Environmental Impact Report for the Town.

Because the Project is a study, there is no facility or construction project at this time. Therefore, this document is submitted for the planning process that is proposed to perform the study and the project. The planning process is detailed in the attached Proposed project Scope."

The DEP Cape Cod Watershed Team indicates that the ENF prepared for the nitrogen management planning study presents an acceptable scope of work for the project. The Town of Mashpee and its consultant have worked in close cooperation with DEP and the Cape Cod Commission in developing the proposed plan and is using an appropriate nitrogen-loading model on which to base management options. The Town is proposing a comprehensive review of wastewater management alternatives. The Department is happy to note that Mashpee is actively pursuing the formation of a Citizens Advisory Committee that is representative of the community.

DEP had previously approved a Scope of Work (SOW). The following items are absent from the SOW presented in the ENF and should be addressed. They are:

1. Pg.19: Phase VII. A. The consultant was supposed to have developed a screening process with criteria for rating potential disposal sites.

2. Pg. 19 VII.B. The approved SOW referenced alternatives (as opposed to a single disposal site) for infiltration and was supposed to account for the evaluation of multiple disposal sites.

3. Pg. 21 VII.1. The approved SOW referenced evaluation of more than one discharge site to account for the potential for multiple disposal sites.

The project is a Planning Study and does not propose any construction. To assist the Town of Mashpee during this planning process, disposal sites identified by the Bureau of Waste Site Cleanup(BWSC) in Mashpee are available online at the Department's website at http://www.state.ma.us/dep/bwsc/sites/report.htm

The Department 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.

Very truly yours,

Robert P. Fagan,
Regional Engineer,
Bureau of Resource Protection

RPF/SS/LM

cc: DEP/SERO
ATTN: David DeLorenzo,
Deputy Regional Director

David Johnston,
Deputy Regional Director

John Viola,
Deputy Regional Director

Paul L. Grady Jr.
Service Center Director

Elizabeth Kouloheras
Chief, Wetlands

Jeffrey Gould
Chief, Water Pollution Control

Brian Dudley
SERO Watershed Team Leader

Ronald Lyberger
Project Manager, BMF/Boston

cc: EOEA/SERO
ATTN: Patti Kellogg
EOEA Basin Team Leader
Cape and Islands Watershed

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 CAUSEWAY STREET, SUITE 900, BOSTON, MA 02114-2136
(617) 626-1200 FAX: (617) 626-1240

DF

MEMORANDUM

TO: Bob Durand, Secretary, EOEA
ATTN: Dick Foster, MEPA Unit
FROM: Tom Skinner, Director, CZM
DATE: October 29, 2001
RE: EOEA #12615 – Mashpee Watershed Nitrogen Management; Mashpee

The Massachusetts Office of Coastal Zone Management (CZM) has completed its review of the above-referenced Environmental Notification Form (ENF), noticed in the Environmental Monitor dated October 10, 2001. CZM recommends that the following matters be addressed in the Draft Environmental Impact Report (DEIR)

The Town of Mashpee is undertaking a study to develop a comprehensive nitrogen management plan for the entire town, including Popponesset Bay and the Mashpee watershed to Waquoit Bay, in order to determine the most appropriate means to address its nitrogen overload problem to these estuaries.

Nitrogen Load and Management Plans

CZM commends the Town of Mashpee for including the Towns of Barnstable, Falmouth and Sandwich as members of the Community Advisory Committee set up to oversee the project and to assist in its implementation. Multi-town cooperation will be critical to ensuring that the nitrogen loading limits established through this study will be addressed effectively and fairly across all municipalities impacting the watersheds.

CZM recommends that the methodology for determining critical nitrogen loading values be clearly defined in the Phase VIII reports and that the University of Massachusetts School for Marine Science and Technology (SMAST) allow the state agencies and the Town to participate in the critical loading value determination process, where appropriate.

CZM suggests that, in addition to recommending wastewater management plans, the proponent provide recommendations to achieve target levels of nitrogen by reducing the load from non-wastewater sources (e.g., fertilizers, impervious surface runoff, pet waste, etc.).

Resource Delineation

The initial planning effort includes a limited amount of resource delineation. CZM believes that the information requested below is necessary to facilitate the analysis of potential nitrogen and wastewater management alternatives and will assist the Town and permitting agencies in their assessment of future project proposals resulting from this planning study.

- Delineation of coastal resources including coastal dune, coastal beach, barrier beach, land subject to coastal storm flowage, salt marsh, coastal bank, and endangered species habitat overlaid onto proposed project plans;

- A description of alternatives considered to avoid potential adverse impacts to resource areas. If impacts are unavoidable, a description of measures that will be taken to minimize short-term and long-term impacts as well as any mitigation plan to address those impacts;

- If there are no alternatives to siting any infrastructure within flood zones, documentation that any proposed infrastructure is protected from flood and erosion-related damage and that any utility connections will be capable of withstanding storm forces without damage or contamination of natural resource areas;

- Preliminary construction plans and cross-sections, with elevations and relevant resource delineations of any proposed infrastructure;

- Construction sequencing and methodology, including appropriate erosion and sedimentation controls.

As the project progresses and alternatives are considered, CZM recommends that the proponent address the applicability of Executive Orders 149, 181, and 385 to any proposed activities.

Executive Order 149: FEMA and Floodplain Use, directs state agencies responsible for the administration of grant or loan programs involving the construction of infrastructure to evaluate potential flood hazards to such facilities and the need for future state expenditures for flood protection and disaster relief. The Order also directs state agencies reviewing such proposals to take flood hazards into account when evaluating plans.

Executive Order 181: Barrier Beaches, states that state funds and federal grants for construction projects shall not be used to encourage growth and development in hazard prone barrier beach areas. CZM notes that there are six mapped barrier beach units within Mashpee.

Executive Order 385: Planning For Growth, emphasizes the importance of balancing economic development and resource protection. It also states that infrastructure should not result in or contribute to avoidable loss of environmental quality and resources.

- In light of Executive Orders 149, 385, and 181, as outlined above, CZM recommends that the proponent explore mechanisms to address growth and development that may be able to occur based upon the implementation of a selected nitrogen management alternative. Depending on the selected alternative and based on the wording in Massachusetts General Law Chapter 83, special legislation may be necessary for the implementation of growth controls.

CZM is available to provide technical assistance to the Town and other permitting agencies to assist in the planning process and address the issues raised in this memorandum.

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 Jane W. Mead, Senior Project Review Coordinator, at 617-626-1219 or visit the CZM web site at www.state.ma.us/czm/fcr.htm.

TWS/tpc/wq

cc: Nathan Weeks, Senior Project Manager
Stearns and Wheeler, LLC, 255 Stevens St., PO Box 975, Hyannis, MA 02601
Mashpee Sewer Commission
Mashpee Conservation Commission
Truman Henson
CZM Cape and Islands Regional Coordinator
Elizabeth Kouloheras, Section Chief
DEP Southeast Regional Office
Patti Kellogg, Team Leader
Cape and Islands Watershed
Sharon Pelosi, Section Chief
Waterways Program, MA DEP
Karen Kirk Adams, Chief
Regulatory Branch, US Army Corps of Engineers

CAPE COD COMMISSION

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RECEIVED
OCT 29 2001
MEPA

October 25, 2001

Mr. Bob Durand, Secretary
Executive Office of Environmental Affairs
Attn: MEPA Office,
Richard Foster, EOEA No:12615
251 Causeway Street, Suite 900,
Boston, MA 02114

Attention:

RE: Mashpee Watershed Nitrogen Management Plan
EOEA #: 12615
CCC: JR#20076

Dear Secretary Durand:

The proposed Mashpee Watershed Nitrogen Management Plan is being reviewed jointly by the Executive Office of Environmental Affairs (EOEA) – 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. The Commission received an Environmental Notification Form on September 26, 2001. A joint public hearing/scoping session for the Commission and EOEA was held on October 16, 2001 in Mashpee, MA.

The proposed project is intended to develop a comprehensive nitrogen and wastewater management plan for the Town of Mashpee. The purpose of the study is to ascertain the most feasible options for addressing the nitrogen overload problems that have been identified in the Popponesset Bay Watershed and Mashpee's portion of the Waquoit Bay Watershed. These estuarine systems have shown significant signs of degradation attributable to excessive inputs of nitrogen from a variety of sources.

The ENF included a comprehensive draft scope of services for the planning process. The plan will identify the existing and projected nitrogen inputs to the watersheds from wastewater and other sources, identify alternative solutions to address any needs with a detailed evaluation of the feasible alternatives, followed by a recommended plan to address the Town's needs. No facilities or construction are proposed at this time.

DF

RECEIVED
OCT 31 2001
MEPA

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

October 30, 2001

Secretary Bob Durand
Attn.: MEPA Office
Executive Office of Environmental Affairs
251 Causeway Street, 9th Floor
Boston, MA 02114-2150

ATTN: Richard Foster

RE: Watershed Nitrogen Management Planning Study, Mashpee, MA. MHC #RC.29581. **EOEA #12615.**

Dear Secretary Durand:

Staff of the Massachusetts Historical Commission have reviewed the Environmental Notification Form (ENF) for the proposed project referenced above and have the following comments.

The Watershed Nitrogen Planning Study (WNPS) is now in the preliminary planning stage, and specific project alternatives that may affect specific geographical areas have yet to be identified. Once specific project alternatives have been determined, project information should be submitted to the MHC. Typically, the information submitted should consist of completed Project Notification Form (available online at http://www.state.ma.us/sec/mhc/), a photocopy of the appropriate section of the US Geological Survey quadrangle map with the boundaries of the project area(s) clearly indicated, and scaled project plans showing existing and proposed conditions within the project area(s). Current, representative photos of the project area(s) and any buildings or objects that may be located there are also helpful for MHC review of the project(s).

If they have not already done so, the project proponents should also contact the Mashpee Historical Commission, the Wampanoag Tribe of Gay Head (Aquinnah), and the Mashpee Wampanoag Tribal Council Inc. These groups may wish to participate in the project planning activities and may wish to have representatives on the Community Advisory Committee now in formation.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800), Massachusetts General Laws, Chapter 9, Sections 26-27C as amended by Chapter 254 of the Acts of 1988 (950 CMR 71), and MEPA (301 CMR 11). If you have any questions, please feel free to contact Margo Muhl Davis at this office.

Sincerely,

Brona Simon

Brona Simon
State Archaeologist
Deputy State Historic Preservation Officer
Massachusetts Historical Commission

xc: Ron Lyberger, DEP/BRP
Steve Hallem, DEP/BRP
Cape Cod Commission
Mashpee Historical Commission
Mashpee Wampanoag Tribal Council Inc.
Mark Harding, Deputy THPO, WTGHA

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

A Commission subcommittee has reviewed the proposed scope and offers the following comments:

General

1. As the project is currently only a planning study, with no construction or locations specified, specific comments regarding issue areas are limited. However, as specific sites and facilities are considered as potential alternatives, the impacts on resources protected under the Regional Policy Plan will need to be more closely and comprehensively studied and addressed. For instance, impacts on land use, economic development, community character, historic preservation and transportation may vary depending on the final plan recommendations.

2. The subcommittee would like to ensure that project reviewers are aware that the Commission is in the process of completing some of the activities indicated in the scope. Using a portion of a state Department of Environmental Protection grant and in coordination with the School for Marine Science and Technology (SMAST), Sterns &Wheler, and the Mashpee Town Planner, the Commission has gathered together the parcel and water use information that will be used to assess the nutrient management needs within the town. Staff previously consulted with the USGS under the state grant to provide a revised watershed for Popponesset Bay, including groundwater time of travel bands and pond recharge area delineations. These delineations, and revised delineations developed by Commission staff in the project's portion of the Waquoit Bay watershed, are being combined through the use of the Commission's Geographic Information System (GIS) with parcel, assessors, and wateruse information from Mashpee, Falmouth, Barnstable, and Sandwich. This information will be used to calibrate the SMAST water quality models of Waquoit and Popponesset Bays. Buildout information developed by the Town Planner will also be incorporated into the GIS in order to assess potential future conditions. Most of these activities are described under Phase I of the scope of services attached to the ENF.

3. The scope of services indicates that the Mashpee Sewer Commission will provide direction for preparation of the plan, and that the town is also forming a Community Advisory Committee (CAC) to oversee the details of the project and to assist in the implementation. The subcommittee recommends that the town clarify the role of each of these committees in the planning process.

Natural Resources

4. The nitrogen management strategy developed in Mashpee will likely result in the development of infrastructure that may pose impacts to sensitive resources, including wetlands, rare species habitat and other wildlife and plant habitats. The EIR should address both how the nitrogen management strategy may have beneficial impacts on these sensitive resources (i.e. reductions in nitrogen that may improve water quality in degraded areas), and how the installation of infrastructure may negatively impact sensitive habitats. Where infrastructure development may pose adverse impacts the

project should be designed to minimize those impacts, and where impacts to sensitive resources are unavoidable, appropriate mitigation should be proposed.

5. The subcommittee supports the proposal in the scope to consider growth management strategies to address future nitrogen loading potential. This may include changes in local zoning and regulations and a focus on open space acquisition.

Marine Resources
6. The scope proposes investigating the feasibility of dredging as a means for increasing flushing within nitrogen sensitive embayments. Although new dredging is typically prohibited in the Regional Policy Plan (RPP), new dredging to improve water quality may be permitted in certain instances. However, dredging of this kind may only alleviate the short-term effects unless appropriate nitrogen reduction and wastewater treatment strategies are in place. Therefore, the plan should only recommend dredging as part of a comprehensive overall strategy.

Thank you for the opportunity to comment,

Sincerely,

Jay Schlaikjer

Jay Schlaikjer
Subcommittee Chair

cc: Subcommittee Members
Tom Fudala, Mashpee Town Planner
Nate Weeks, Stearns and Wheler
Ed Baker, 197 Captains Row, Mashpee, MA 02640

Edward A. Baker
197 Captains Row
Mashpee, MA 02649

October 16, 2001

Bob Durand, Secretary
Executive Office of Environmental Affairs
Attn: MEPA Office
Mr. Richard Foster, EOEA No. 12615
251 Causeway Street, Suite 900
Boston, MA 02114

Re: Watershed Nitrogen Management Planning Study, Environmental Notification Form (ENF)

Dear Secretary Durand,

I am concerned that the proposed study will not yield the information needed to develop an adequate road map to the solution of Mashpee's Nutrient overload problem.

Although it is obvious that major gains may be accomplished via reductions in wastewater nutrient concentrations and movement of infiltration sites to less sensitive areas, that is only a partial solution. Reduction of existing levels and nutrient growth controls for Mashpee's already impaired waters will require actions for all nutrient sources

If, in fact, there are only minor activities for items such as flushing improvements, estuarine regeneration reductions, stormwater and fertilizers as the ENF seems to suggest; it may be appropriate for the Town to undertake additional activities in areas not currently covered in an adequate manner for the development of a realistic plan.

1. A minor correction to the ENF to include the Town of Mashpee, Conservation Commission representative as a committee member is needed.
2. The review of existing data should include, Rapid Formation And Degradation Of Barrier Spits In Areas With Low Rates Of Littoral Drift, Aubrey, D.G. and Gaines Jr., A.G., 1982, Marine Geology 49 (1982): 257-278 and Coastal Sediment Transport Popponesset Beach, MA, Aubrey, D.G. and Goud, M.R., 1983, Woods Hole Oceanographic Institution, WHOI-83-26.
3. The review of existing data should also include Cape Cod Commission Non-wastewater nitrogen-loading data prepared for the various Developments of Regional Impact (DRI's) located within the study area.
4. I am concerned regarding the use of CCC TB91-001 if occupancy rates, critical load formula or volumetric estimating portions are utilized.
5. I would suggest that the location of nitrogen inputs from non-wastewater sources be identified at least down to the Planning Zone level. Areas of greatest stormwater or fertilizer nitrogen inputs may become important. If a target Nitrogen load for some watersheds cannot be met at a zero wastewater level, these other sources rise in importance.
6. Critical loading values for subembayments are to be based in part on "desired water Quality". The target for "desired water quality" should be in the ENF. I hope it is at least swimable and open to shell fishing (SA?).

7. Phase IV scenarios should include acquisition and enlargement of the MMR STP facility using the max capacity of the existing piping to the infiltration filters as a guide. A scenario that moves treated wastewater from the Stratford Ponds-Willowbend-Pheasant Run area to the Phase VII disposal site and transfers any rotary local excess to MMR disposal seems logical to me.
8. Phase IV scenarios should include volume impact identifications to help in the determination of phase VII requirements.
9. Vacuum sewer technology should be included in phase III. It might be useful in places like the islands where a low-lying area could be connected to a community system. Remember Seconsett is surrounded by water and Falmouth on the land side.
10. A lot of these sewage treatment systems produce sludge. Sludge disposal technologies and preparation of sludge volume estimates should be addressed in the ENF. You need to get rid of it somehow, somewhere.
11. The Buzzards Bay Project appears to have established that flushing times are important. Partial implementation of Poppy Bay channel ideas in line with WHOI-83-26, Aubrey & Goud should be evaluated. Mashpee River residents have long discussed and complained about the negative flow impacts of other Bay internal dredging. Implementing these changes could have other positive results, i.e. spit protection. Meadow Point protection and shellfish bed restoration.
12. I would suggest public awareness start now. The ENF could have the Town supporting distribution and cable TV exposure of the new CCC video that discusses nutrient impacts. The Town can certainly afford to make copies for distribution to local groups that could in turn utilize them for public education.
13. Although, a plea for charitable donations sent out with tax bills was unpopular, the potential for a "stuffer" with the 4/year mailing has been established. Shouldn't the plan include evaluation of this public information potential?
14. As the difficulty in minimizing nutrient impacts increases with treated wastewater disposal volumes, both in terms of increased infiltration requirements and the difficulty in reducing further already reduced concentrations. It seems appropriate to include a review of potential methods for minimizing total volumes.

Sincerely,

Ed Baker

Edward A. Baker

Cc: Town of Mashpee Sewer Commission, attn: F. T. Fudala
Stearns & Wheler, attn: N.C. Weeks
Cape Cod Commission, attn: Phil Dascombe (JR#20076)

Appendix B

Excerpts of Response to Comments
Final Environmental Impact Report – New Seabury Development Project
March 2001

discharge area. This projected mound height quickly dissipates too less than five inches outside the discharge area. The predicted groundwater mound in the vicinity of SeaQuarters and Gleneagle Drive is between two and five inches. Conservatively, the separation between the base of the septic systems and the high water table in these areas is 30 feet or greater. Using the worst-case mound height, the separation would remain no less than 30 feet.

Beyond Promontory Point, Fairway Lane, SeaQuarters and Gleneagle Drive, the projected mound height would be less than three inches. Again, the separation between existing septic systems and the high water table is estimated to be greater than 20 feet.

Near West Shore Drive and Triton Way, the projected mound height is less than one inch. The groundwater discharge will have no effect on shoreline erosion or septic systems.

Under normal operating conditions (lower flows with irrigation wells operating) projected mounding would be significantly less.

MMRO-5 – Concerned/curious about town's proposal to dispose of 500,000 gpd of wastewater at New Seabury. How would this happen on private property?

RESPONSE – The town of Mashpee has no firm proposal to dispose of wastewater effluent at New Seabury. Some time ago, the town identified the area in the vicinity of the New Seabury Wastewater Treatment Facilities (WWTF) as an ideal location for effluent disposal, and has articulated a long-range concept plan for conveyance of wastewater effluent from other parts of town to this location for disposal by means of deep-well injection. It should be noted that, at this time, no actual plans exist for this, nor is funding in place for the several-mile-long sewer force main that would be required to make this a workable option. Moreover, deep well injection of wastewater effluent is not yet a fully accepted technology in Massachusetts.

Were this scheme to be advanced by the town of Mashpee, the town would have to negotiate for the purchase of the land required for the deep-wells and their associated facilities, or it would have to take the land by eminent domain in which case the owner(s) would be paid for the land based on an appraisal of its value. Should the owner(s) believe that the price paid in eminent domain, the pro tanto, is not representative of the land's true value, the owner may appeal to superior court and may secure additional compensation as determined by the jury.

MMRO-6 – Is background nitrogen adequately considered? CCC uses 5 mg/l but DEIR uses 10 mg/l as its criterion. What is the required standard and will the WWTF meet it?

facility has been relocated. At that time, groundwater monitoring will continue once annually for a period of 3 years at which time monitoring will cease.

The final screen lengths, well depths and screen will be based on site specific soil conditions encountered at each site. Well locations and parameters analyzed for may change based on discussions with the MWD.

SEA-44 - 3.3 Wastewater – Report recommends additional modeling scenarios: Effluent discharge at 300,000 gpd, MWD Wells #2 and #3 pumping at 1 mgd each, and irrigation wells off; same scenario, but with irrigation wells on. Run until steady state condition is reached.

RESPONSE – The Zone II modeling scenarios described are not necessary. The Zone II designation itself contemplates planning purposes and is therefore inherently conservative. Zone II conditions assume that the water supply wells would be pumping under Zone II conditions (maximum pumping capacity at each well with no rainfall recharge) for 6 months. Even if modeling these scenarios were to indicate that the Zone II boundary would change, the treated wastewater-impacted groundwater could not travel from the discharge area to the Rock Landing Wells #2 and #3 within that 6-month period. The time it would take for treated wastewater-impacted groundwater to travel from the discharge location to the Rock Landing Wells would be on the order of several years to tens of years. In other words, Zone II conditions would need to be maintained for this prolonged period of time. Under the scenarios described, saltwater intrusion would be of much greater concern than wastewater migration to the wells.

As previously described herein, the DEP-approved Zone II boundary for the Rock Landing Wells represents a simulated groundwater divide resulting from the Zone II modeling simulation. Numerical modeling indicates that discharge from the WWTF would not flow within 1,000 feet of the Zone II boundary, even under the conservative assumptions of discharging 300,000 gpd continuously with the irrigation wells off.

It should also be noted that at its highest point, directly under the effluent discharge area, the groundwater mound at sustained flows of 300,000 gpd with all irrigation wells off is projected to be approximately 0.8 feet. Groundwater elevations between the discharge area and the Rock Landing Wells are in excess of the 0.8 foot projected mound. Considering that flows from the WWTF will, in all likelihood, be less than the Title 5 flows and that Zone II pumping conditions over a prolonged period of time are unlikely, it is difficult to foresee a scenario where groundwater conditions could change significantly enough to allow wastewater to be captured by the Rock Landing Wells.