CDM Camp Dresser & McKee

Report

Town of Plymouth, Massachusetts

Wastewater Treatment Facilities Plan/
Environmental Impact Report
Phase IIIA
Volume 5—Preliminary Draft Report
EOEA #8228

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Section 2
Definition of Wastewater Management Needs

2.1 Introduction

More than 70 percent of households and businesses in Plymouth rely on on-site wastewater disposal systems. This section evaluates the town's existing on-site system and septage waste disposal management practices. It provides the basis for a recommendation that on-site systems continue to serve most of the households and businesses in the town. Section 3 will develop wastewater flow estimates for areas of Plymouth connected or proposed to be connected to the town's wastewater collection system. This section addresses the following specific issues:

- Existing conditions—on-site wastewater disposal systems, septage hauling and disposal practices;
- Investigation of problem areas;
- Description and comparison of Plymouth's Board of Health wastewater treatment and disposal requirements and state Title 5 requirements;
- Alternative solutions, including innovative/alternative technologies, system costs;
- Future septage quantities; and
- Recommended on-site system and septage management plan, including monitoring improvements, system replacement assistance, maintenance and education programs.

2.2 Description of Existing Conditions

2.2.1 On-Site Wastewater Disposal Systems

On-site wastewater disposal systems separate liquids and solids in a septic tank or cesspool. The liquid waste flows into the ground via leaching systems, or through openings in the walls of the cesspool. The remaining solids, called septage, must be removed periodically.

Prior to the implementation of Massachusetts' Title 5 subsurface wastewater disposal regulations in 1978, many on-site disposal systems in Plymouth were cesspools or included septic tanks with capacities of less than 1,000 gallons. Table 2-1 presents Plymouth Planning Department statistics on the number of homes constructed in Plymouth through March 1990. Since 1990, Plymouth has been growing at a rate of more than 200 homes per year, and the number of homes now totals approximately 20,000. Three-quarters of the existing homes in Plymouth were constructed prior to 1978. Since 1978, homeowners have been required to install Title 5 systems. Nearly all of the homes constructed since 1978 lie outside the town's sewered area.

Table 2-1
Number of Homes in Plymouth

Period	*Number of New Homes*	*Total Number of Homes*
Before 1940	—	3,832
1940 - 1949	971	4,803
1950 - 1959	2,065	6,868
1960 - 1969	2,472	9,340
1970 - 1979	5,735	15,075
1980 - 1984	1,636	16,711
1985 - 1988	2,208	18,919
1989 - March 1990	739	19,658

As of March 31, 1995, Title 5 requires septic tanks with minimum capacities of 1,500 gallons and does not permit new construction of or repair of cesspools. A cesspool is a covered pit with openings in the walls. Raw wastewater discharges to the pit and the liquid portion leaches into the surrounding soil. Solids settle to the bottom where partial decomposition occurs. Cesspools provide much less treatment and are more susceptible to clogging and failure than a conventional Title 5 system.

The typical Title 5 septic system consists of three parts: a septic tank, distribution box, and leaching system (Figure 2-1). The tank pretreats the wastewater through solids settling and decomposition by bacteria. Settled solids form a sludge blanket on the bottom of the tank. Floatable material such as grease, oil, and scum forms a layer on the liquid surface above the outlet pipe and remains in the septic tank. The wastewater liquid overflows to the distribution box and leaching system through the outlet pipe.

Leaching systems are pits, galleries, chambers, trenches, or fields. These underground systems distribute the wastewater so that it percolates through soil and is further purified by filtration and decomposition by microorganisms. Unsaturated soils adsorb viruses, bacteria, and nutrients. However, some nutrients, such as nitrogen in the form of nitrates, pass through to the groundwater. The new Title 5 regulations, promulgated September 1994, require 4 to 5 feet of soil between the stone underlying the leaching system and the maximum groundwater level.

2.2.2 Septage Hauling and Disposal Practices

Homeowners periodically have their on-site wastewater disposal systems pumped by private septage hauling companies. Plymouth Board of Health records indicate that 18 septage hauling companies with a total of 23 trucks currently serve Plymouth. Thirty percent of them are from Plymouth and the others are from Carver, Wareham, Marshfield, Halifax, Kingston, Sagamore, Scituate and Stoneham.

Licensed haulers truck septage to a receiving facility located on Long Pond Road adjacent to the former Department of Public Works facility. Thirteen of the 18 septage hauling companies that serve Plymouth hold a license to dispose of septage at the receiving facility. The facility accepts septage until 3:30 p.m. on weekdays and until noon on Saturdays and Sundays. Currently, the town is limited to receiving a maximum of 50,000 gallons per day (gpd) of septage. The average daily volume in any one week shall not exceed 35,000 gpd. These limits were revised by DEP in 1994. Previously, the town was limited to a maximum per day limit of 35,000 gpd of septage, which sometimes caused an early closing time, particularly during summer months. Septage flow is recorded at the facility and the septage is immediately discharged by gravity to the sewer located in Long Pond Road. The septage becomes diluted in the sewer and flows to the wastewater treatment plant on Water Street for treatment.

Plymouth charges haulers 5.5 cents per gallon for disposal. Haulers charge homeowners an average of $125 for pumping and disposal of 1,000 gallons of septage (12.5 cents per gallon), and $240 for pumping and disposal of 2,500 gallons (9.6 cents per gallon).

Septage flow at the Plymouth wastewater treatment plant (WWTP) is less than 1 percent of the total wastewater flow (Figure 2-2). The revenue from septage disposal fees is a larger percent-

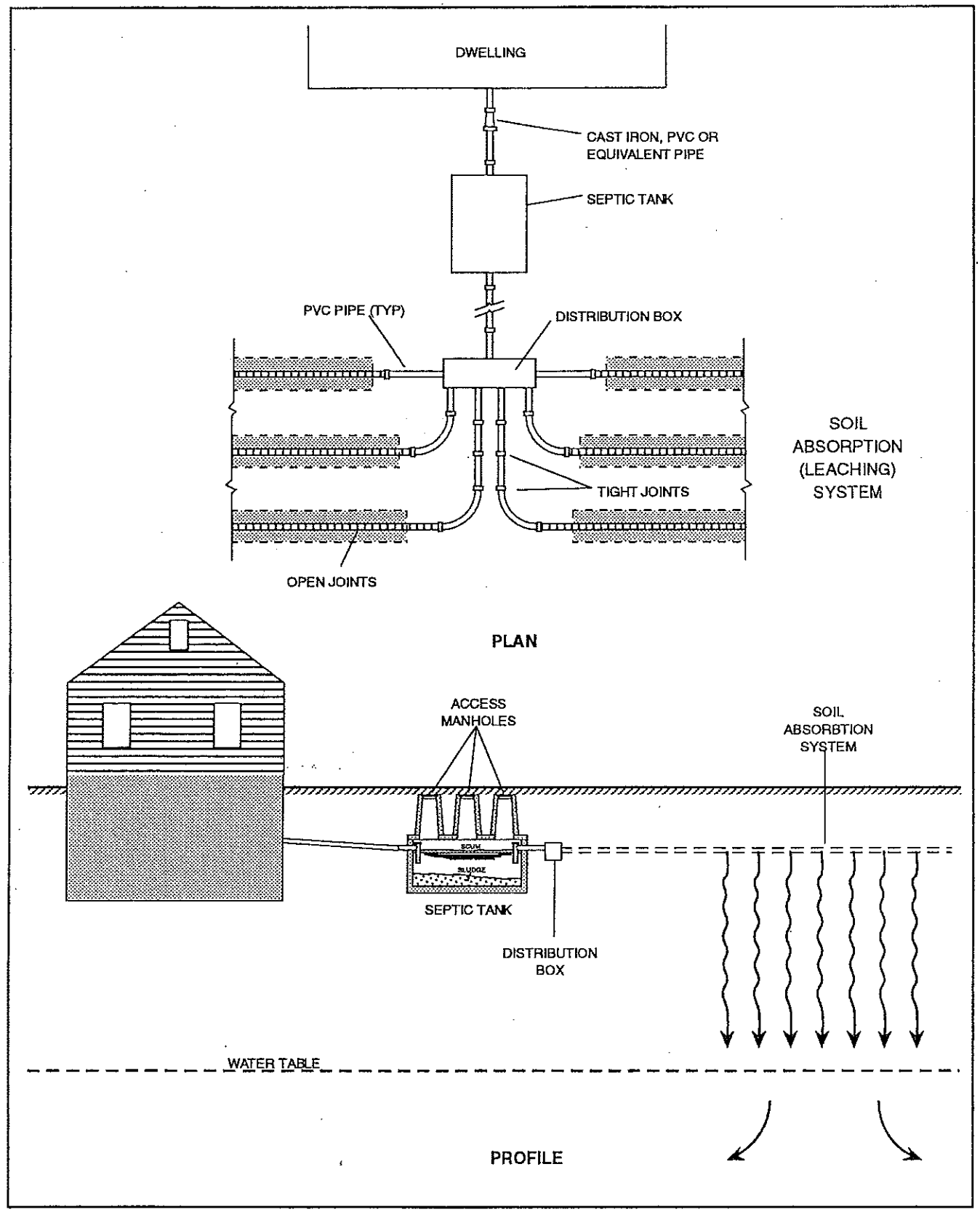


Figure 2-1
Typical Three-Part Septic System
Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

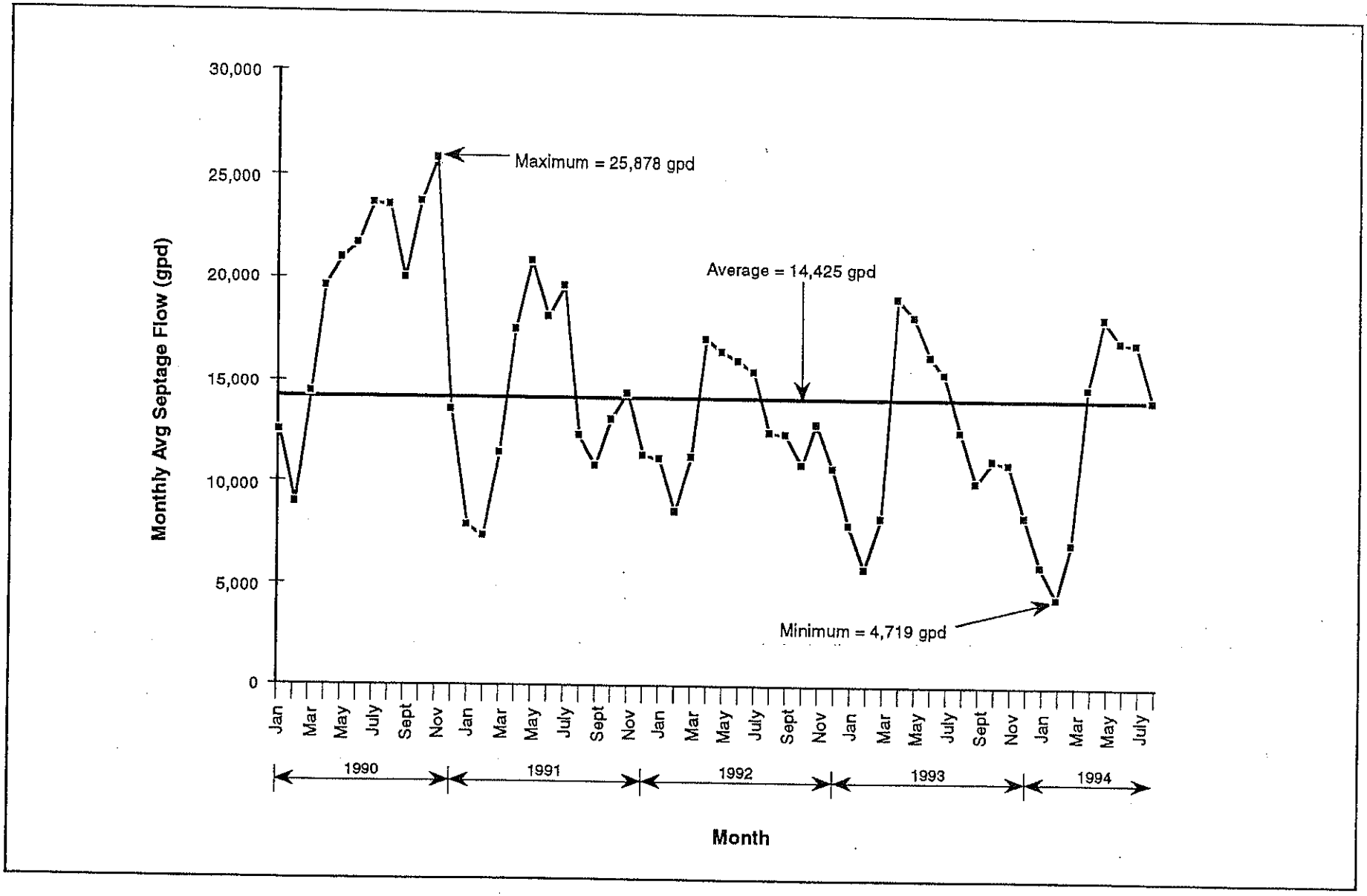


Figure 2-2
Historical Septage Flows
Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

age, more than 40 percent, of the total wastewater treatment plant operating budget. The average septage flow at the plant from January 1990 to August 1994 was 432,744 gal/month (14,425 gpd). This is equivalent to approximately $290,000 per year (at 5.5 cents per gallon) in revenues from septage disposal.

The first private septage treatment facility in the state is scheduled to open soon in the adjacent Town of Carver. The 100,000-gpd facility will dewater septage and provide nitrogen removal, tertiary polishing, and UV disinfection of the effluent prior to disposal to open sand beds. Five private septage haulers, including haulers that serve Plymouth, have reserved 80 percent of the capacity of the facility. Haulers will pay 8 cents per gallon for disposal. One incentive for haulers to pay a higher price in Carver is that the facility will accept restaurant grease, which is not allowed at the Plymouth facility. Among the facilities that will accept grease are the Upper Blackstone Water Pollution Control Facility (WPCF) in Millbury and the Fitchburg WPCF; both are significant distances from Plymouth.

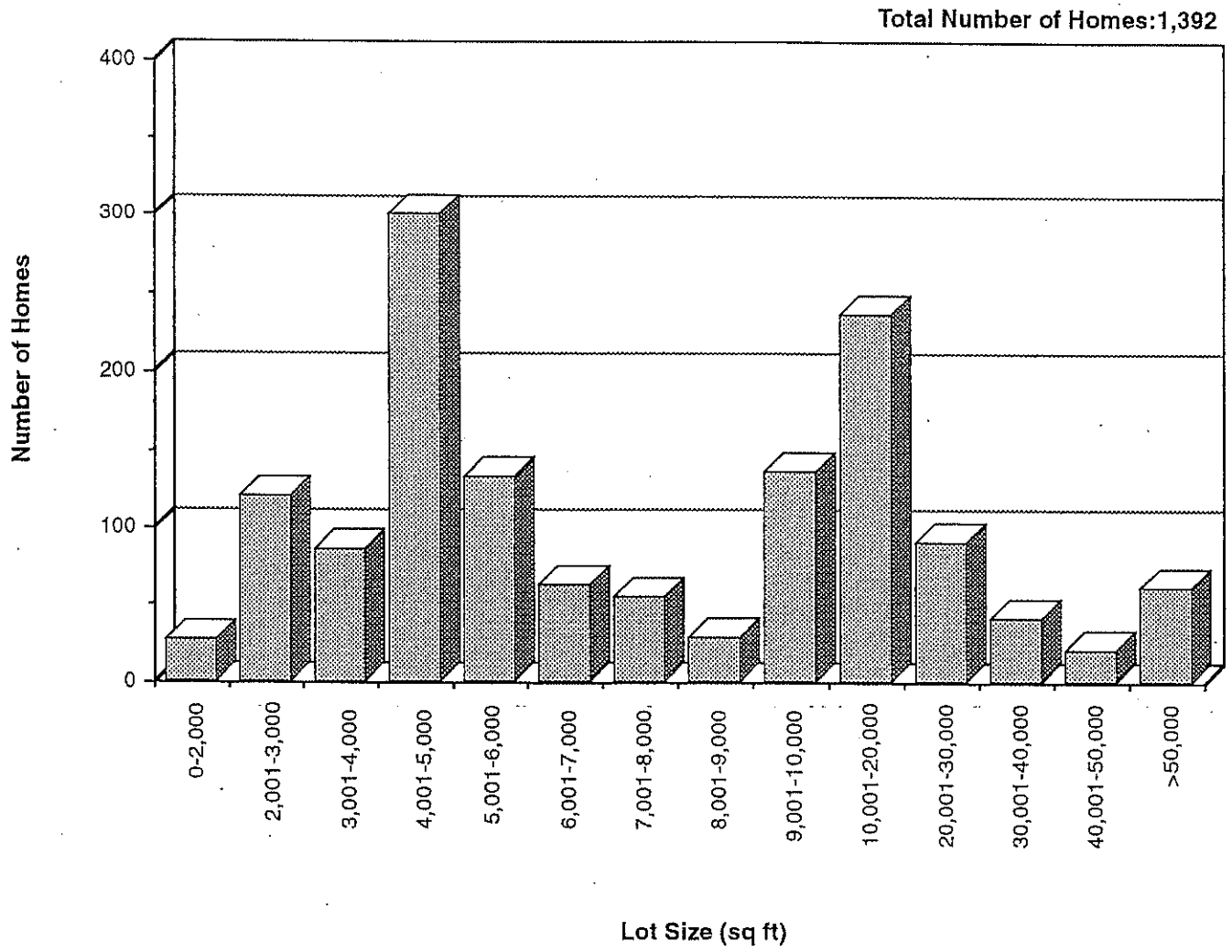
2.3 Investigation of Problem Areas

Massachusetts' Title 5 subsurface wastewater disposal regulations suggest pumping on-site wastewater disposal systems once every three years and define systems that have to be pumped four or more times per year as failed systems. The Plymouth wastewater treatment plant staff collects septage pumping tickets and notifies the Health Department of frequent pumpers. The Health Department sends a questionnaire to homeowners who pump their system more than four times per year to determine whether they have more than one pit or whether they have problems with their systems. Appendix B includes the questionnaire and a follow-up memorandum the Health Department sends to the Sewer Department.

Phases I and II of this facilities plan examined two years of septage pumping records (April 1991 through March 1993) and approximately one year of Board of Health on-site system requirement waivers (January 1992 through March 1993). The following summarizes the pumping records, Board of Health records and investigations conducted in this phase:

- *Manomet*. Forty percent of the homes in the Priscilla Beach, White Horse Beach, and Bartlett Pond sections of Manomet are on densely developed lots of 5,000 square feet or less (Figure 2-3). The physical size and configuration of the lots in Manomet make it difficult to upgrade to Title 5 and Plymouth Board of Health standards without waivers. Ninety-five lots are located in an environmentally sensitive barrier beach. Over the years, many of the seasonal homes in Manomet, served by cesspools or tanks smaller than 1,000 gallons, have been converted to year-round use, placing more stress on the wastewater disposal systems. Pumping records from April 1992 through March 1993 show 26 on-site systems in this area were pumped two or more times per year, and 73 of the systems pumped were cesspools. More than 30 percent of the 80 waivers granted in 1992 occurred in the White Horse Beach area.

- *South Manomet*. The 1,350-acre, mostly residential area of Manomet Bluffs, Fishermans Landing, and Churchill Landing in South Manomet also have a relatively high rate of septage pumping. Septage pumping data from April 1992 through March 1993 indicated this area relies heavily on cesspools. Forty-one systems required excessive pumping, and 119 of the pumped systems were cesspools. Approximately 15 percent of the waivers



Source: 1994 Plymouth Assessor's Data

Figure 2-3
Lot-Size Distribution of Homes in Manomet
Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

granted in 1992 were in this area. However, almost all the waivers were for setback requirements, and not depth to groundwater or sizing criteria, which would be more critical to the performance of the on-site disposal systems.

- *West Plymouth*. Septage pumping records for the residentially-zoned 2,600-acre area of West Plymouth north of South Meadow Road and Summer Street show that approximately 6 percent of homes in the Old Colony Estates, Clear Pond, and Jan Marie Drive areas are multiple pumpers. In 1992, a total of approximately 81 systems were pumped two or more times, and 64 cesspools were pumped. Less than 10 percent of the waivers granted in 1992 were in this area, mostly for setbacks from lot lines.

The Plymouth CAC and town officials promote continued use of on-site systems complying with Title 5, construction of shared systems when needed and the use of innovative technology (discussed in Section 2.5) in these areas. Figure 2-4 shows a typical small lot of 5,000 square feet. Greater than 60 percent of the homes in the densely populated Manomet area are on lots greater than 5,000 square feet. To upgrade a system on lots greater than approximately 4,000 to 5,000 square feet, the typical waivers required from Title 5 are considered to be minor, normally just a relaxation of setback distances from dwellings and property lines. Manomet has a public water distribution system, which eliminates the problem of siting septic systems 100 feet from private wells. Upgrades are possible for very small lots as long as the required depth to groundwater is maintained. Opportunities also exist for homeowners to purchase adjacent parcels to upgrade their systems. Similarly, some upgrades have recently placed the septic system beneath the home footprint as the house elevations was raised to meet flood requirements. There are approximately 700 lots totalling 200 acres in Manomet that do not have houses on them, allowing the opportunity to construct individual or shared systems, if needed.

The Board of Health and town officials prefer use of tight tanks or land takings instead of construction of sewers and a wastewater facility for the Manomet, South Manomet, and West Plymouth areas. The Planning Department views the built-up White Horse Beach area as a temporarily inhabited area. If sewered, the area is likely to be more permanently inhabited and development will expand. If not sewered, the area can eventually return to its natural state, or at least not expand.

2.4 Description and Comparison of Plymouth Board of Health and Title 5 Regulations

2.4.1 Introduction

The state published proposed revisions to Massachusetts' Title 5 (310 CMR 15.00) subsurface wastewater disposal regulations in May 1994. Following public comment, the state promulgated the revised code in September 1994. The alternative systems provisions took effect November 10, 1994, and the soil evaluation requirements will take effect July 1, 1995. All other provisions will take effect March 31, 1995, provided the Department of Environmental Protection (DEP) has approved two additional alternative systems for general use by then. CDM met with

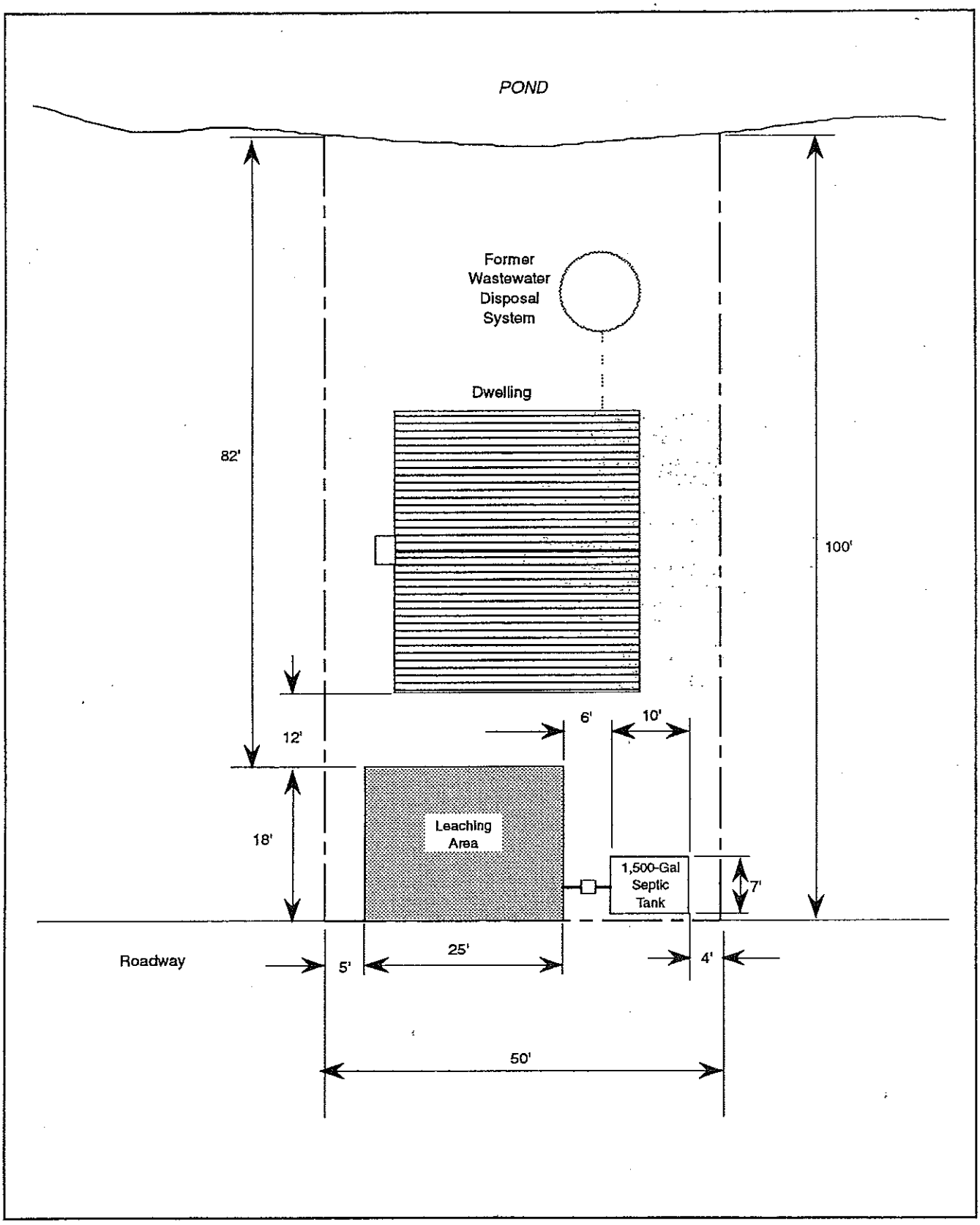


Figure 2-4
Typical Septic System Upgrade with Waivers for a 5,000 Square-Foot Lot
Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

the Plymouth Citizens Advisory Committee (CAC) and held a workshop with several Plymouth representatives in June 1994 to discuss impacts of the proposed revisions on the town and to discuss sewer needs in general.

2.4.2 Comparison of Regulations

Tables 2-2 through 2-4 compare the revised Title 5 regulations to the 1978 Title 5 regulations and to Plymouth's Board of Health Supplementary Rules to assess the impacts of the revisions on Plymouth. Tables 2-2 and 2-3 compare subsurface disposal design criteria and Table 2-4 highlights some of the major revisions. The new Title 5 regulations are expected to have little impact on Plymouth, as the town's supplemental regulations and Aquifer Protection Bylaw are and will remain more stringent for several key design criteria and provisions. One change that will be noticed is that more residences may have to upgrade to Title 5 because inspections will now be required nine months prior to or six months following transfer of property, or when an increase in flow to a system is proposed. Owners of large systems and shared systems will also have to meet inspection schedules described in Table 2-4. Inspection results must be recorded on a particular form, which must be submitted to the Board of Health. The form is attached in Appendix B.

The revisions to the Title 5 design criteria are more stringent than the 1978 Code for 10 of the 22 design criteria listed in Tables 2-2 and 2-3. The revisions are more stringent than Plymouth's rules for only three of the criteria:

- Setbacks from water supply reservoirs;
- Setbacks from public water supply wells; and
- Setbacks from open surface or subsurface drains, excluding foundation drains, when the leaching system is upgradient of the drains.

These more stringent criteria will automatically become part of Plymouth's regulations.

Over the past six years, an average of 118 homeowners per year have received a permit from the Plymouth Board of Health to upgrade their systems. This number will likely increase due to the new inspections required by Title 5. The Plymouth Board of Health will permit a reasonable variance request except for setbacks from wells, the minimum requirement of 4 feet of naturally occurring pervious material below the soil absorption area (unless no other alternatives are feasible, then a minimum of 2 feet may be considered), and when building square footage will be added. The Building and the Health Departments work closely when they receive a permit request for conversion of a seasonal dwelling or an increase in square footage. For example, the Building Department can hold back a building permit for 30 days if a permittee has not applied for an on-site system permit, but must release it after that time. Although the permittee may hold the building permit, the Board of Health can stop occupancy if the person did not apply for an on-site system permit. Often, the Board of Health will place a deed restriction on the allowable building square footage prior to granting a waiver to critical criteria (distance from a well to a septic system, etc.), which limits the building use in the future.

Table 2-2
Comparison of New Title 5 with 1978 Code and Plymouth Board of Health Supplementary Rules

Provision	*1978 Code*	*New Title 5*	*Plymouth Board of Health Supplementary Rules*
	Setback Requirements for Leaching Area		
Water Supply Reservoirs	100 feet	400 feet	200 feet
Tributaries to Reservoirs	100 feet	200 feet	200 feet
Certified Vernal Pools	Not Addressed	100 feet (50 feet if vernal pool is upgradient)	Not Addressed
Bordering Vegetated Wetlands, Salt Marshes, Inland and Coastal Banks	50 feet	50 feet (100 feet if wetlands bordering surface water supply or tributary thereto)	75 feet (100 feet from sewage disposal system of a multiple dwelling; 150 feet if installed upgradient)
Other Surface Waters	50 feet	50 feet	75 feet (100 feet from sewage disposal system of a multiple dwelling; 150 feet if installed upgradient)
Property Line	10 feet	10 feet	20 feet
Cellar Wall	20 feet	20 feet	20 feet
In-Ground Pool	20 feet	20 feet	20 feet
Slab Foundation	Not Addressed	10 feet (25 feet for septic tank)	20 feet (dwelling)
Water Supply Line (Pressure)	10 feet	10 feet	15 feet
Private Water Supply Well or Suction Line	100 feet	100 feet	100 feet (150 feet if installed upgradient)

Table 2-2
Comparison of New Title 5 with 1978 Code and Plymouth Board of Health Supplementary Rules

Provision	*1978 Code*	*New Title 5*	*Plymouth Board of Health Supplementary Rules*
	Setback Requirements for Leaching Area		
Public Water Supply Well *--Gravel Packed* *--Tubular*	100 feet	 400 feet 250 feet	100 feet (150 feet if installed upgradient)
Surface or Subsurface Drains that Discharge to Water Supplies or Tributaries Thereto	100 feet	100 feet	200 feet
Road Catch Basins, Surface or Subsurface Drains, and Drainage Easements (Subsurface)	25 feet	10 feet excluding foundation drains (50 feet if installed upgradient); 25 feet for leaching catch basins and dry wells	25 feet
Leaching Facility	Not Addressed	Not Addressed	10 feet from septic tank
Reserve Area	Area between leaching pits, galleries, or trenches may be used	Area between trenches may be used if greater than or equal to 6 feet apart; new systems shall include a reserve area sufficient to replace the primary soil absorption system	10 feet from replaced system
Edge of Fill	Varies with formula	15 feet; maximum slope 3:1	25 feet from leaching facility; slope 10:1

Table 2-3
Comparison of New Title 5 with 1978 Code and Plymouth Board of Health Supplementary Rules

Provision	*1978 Code*	*New Title 5*	*Plymouth Board of Health Supplementary Rules*
Minimum Design Flow	None	330 gpd (220 allowed if 2-bedroom deed restriction)	400 gpd
Minimum Leaching Area	Dependent on perc rate	Dependent on perc rate and soil type; for some soils, allows smaller leaching areas than 1978 code; for others, requires larger leaching areas	Approximately five times the areas in 1978 code (currently re-evaluating)
Leaching Trenches	Minimum width: 1 foot Maximum length: 100 feet	Minimum width: 2 feet Maximum width: 4 feet Maximum length: 100 feet	Maximum width: 3 feet
Minimum Septic Tank Capacity	1,000 gallons	1,500 gallons	Title 5
Distance from Maximum Groundwater	4 feet to bottom of leaching area; 1 foot from invert of septic tank outlet	4 feet to bottom of stone underlying soil absorption system if perc rate >2 min/in, 5 feet if perc rate <2 min/in	4 feet to bottom of septic tank

Table 2-4
Comparison of New Title 5 with 1978 Code and Plymouth Board of Health Supplementary Rules

Provision	*1978 Code*	*New Title 5*	*Plymouth Board of Health Supplementary Rules*
Definition of Failed System	System suffering breakout or backup, or deemed to pose public health threat	System exhibiting breakout or backup; system located within Zone 1 of public water supply wells, within 100 feet of reservoirs or their tributaries, within 50 feet of a private well, or within 50 feet of surface water bodies; cesspools without at least a half-day capacity; system found to be specific health or environmental threat; systems with excessive pumping (greater than or equal to 4 times/year); cesspool or leaching system is in groundwater table; septic tank is metal or is structurally unsound; cesspool is within 50 feet of a wetland	Title 5; wastewater treatment plant sends on-lot system pumping records to Board of Health
Inspection of Existing	Not Addressed	Required at time of property transfer, change of use, or expansion	Only at time of request for building permit and when they malfunction
Pumping	Recommended annually; widely ignored	Suggested at least every three years	Title 5
Upgrade Standard	Required substandard systems be upgraded to meet requirements of code, or get a variance from the Board of Health and DEP	Where no expansion or change of use proposed, standard is "maximum feasible upgrade," with Board of Health approval; DEP approval needed if system cannot meet groundwater separation or drinking water supply setback requirements, or construction of a basic three-part system	Upgrade required when proposed building improvement can potentially increase discharge
Shared Use	Prohibited	Allowed for upgrade of existing systems, new construction, or for increased flow to an existing system; shared systems shall be inspected annually	Prohibited but will consider variance with contracted agreement
Nitrogen Loading	Not Addressed	One acre of land required to build 4-bedroom house in: recharge areas of public wells, designated (through Surface Water Quality Standards) nitrogen-sensitive areas and coastal embayments, and new developments served by well and septic system on same lot; no new	Not addressed; town bylaw for aquifer protection sets nitrogen discharge limits (less than or equal to 5 mg/l) for multi-family, commercial, and industrial systems in aquifer protection districts; wastewater flow must not exceed 330 gpd per acre

Table 2-4
Comparison of New Title 5 with 1978 Code and Plymouth Board of Health Supplementary Rules

Provision	1978 Code	New Title 5	Plymouth Board of Health Supplementary Rules
Nitrogen Loading (cont.)		system in these areas shall receive greater than 440 gpd per acre	
Alternative Systems	Case-by-case approval	Proposes systematic approach; approves use of recirculating sand filters, composting toilets, and effluent tee filters	Case-by-case approval
Grandfathering Existing Lots	Not Addressed	System serving <10,000 gpd may be constructed in accordance with 1978 code if application for permit is filed prior to 3/31/95, and approved, and system is constructed within three years of permit receipt; if an individual lot was buildable under the1978 code, but cannot fully comply with the new rules, the same flow, up to a 3-bedroom home, will be allowed if the disposal system application is filed on or before January 1, 2000 and the system is built within three years of the receipt of the permit; a larger house may be built with a higher level of treatment	Case-by-case approval
Large Systems	Defined as systems greater than 15,000 gpd	Defined as systems greater than 10,000 gpd (treatment plant required) or systems greater than 2,000 gpd in well recharge areas or within setbacks for water supplies (recirculating sand filter or equivalent alternative system required). Existing systems over 10,000 gpd must be inspected by January 1, 1996, and reinspected at least once every three years thereafter; those located within Zone IIs of public wells, within 400 feet of reservoirs, or 200 feet of their tributaries must upgrade to treatment plant within 5-7 years unless the owner demonstrates that drinking water standards are being met	Title 5

2.4.3 Nitrogen Loading Regulations

The revised Title 5 limits nitrogen loading in certain areas, as shown in Table 2-4. A minimum of one acre of land is required to build a four-bedroom home in a recharge area of a public well, designated nitrogen-sensitive areas and coastal embayments, and new developments served by a well and septic system on the same lot. There are currently no designated nitrogen-sensitive areas in Massachusetts. The nitrogen loading limitation does not apply when the effluent meets the federal Safe Drinking Water Act (SDWA) nitrate standard of 10 ppm through either an approved alternative system or a wastewater treatment facility with a groundwater discharge permit.

Plymouth's existing Aquifer Protection Bylaw, effective May 13, 1981, also requires a minimum of one acre of land to build a home in recharge areas of public wells. Any other residential, commercial, or industrial use in recharge areas must discharge wastewater to a sewerage system, or the discharge must be of only normal domestic wastewater to subsurface disposal systems, at a maximum quantity of 330 gallons per acre per day (gpad), and must not exceed the following quality standards:

- Biochemical oxygen demand (BOD): 10 mg/l
- Suspended solids (TSS) : 10 mg/l
- Total phosphorus (P) : 1 mg/l
- Total nitrogen (N) : 5 mg/l
- Fecal coliform : 200 per 100 ml

2.5 Alternative Solutions

2.5.1 Introduction

Most homes in unsewered areas of Plymouth are on sites with sandy soils and sufficient space to install Title 5 systems, albeit with waivers to required setbacks. Some homes in problem areas, such as Manomet, may have to consider alternative solutions.

This section examines on-site wastewater disposal system alternatives and costs, including:

- System upgrade to meet local and state standards, including shared systems;
- Innovative/alternative systems; and
- Package treatment plants.

2.5.2 System Upgrade to Meet Local and State Standards

Figure 2-4 shows a typical septic system upgrade for a three-bedroom home on a sandy 5,000 square-foot lot, which are the soil type and average lot size in some unsewered areas of Plymouth such as Manomet. The former wastewater disposal system was on the pond side of the dwelling. Locating the new septic system on the roadway side of the house may require water service relocation. An upgrade on this size lot will also require variances for the setbacks from the dwelling and property lines and Plymouth Board of Health leaching area and distance between septic tank and leaching area requirements. The leaching system in Figure 2-4 consists of leaching trenches, which are recommended to be used whenever possible in Title 5. Table 2-5 summarizes the setbacks and areas used and compares them with Title 5 and Plymouth

Table 2-5
Waivers Required for Septic System Upgrade
5,000-Square Foot Lot on Figure 2-4

Provision	*Shown on Figure 2-4*	*Plymouth Board of Health Requirement*	*Title 5 Requirement*
Setbacks from:			
Property Line	0' to 5'	20'	10'
Dwelling	12'	20'	20'
Leaching Area	450 sq ft	2,775 sq ft	450 sq ft
Distance between Septic Tank and Leaching Area	6'	10'	None

Board of Health requirements. Plymouth's current rules require leaching areas six times as large as those required by Title 5. The town is in the process of reevaluating leaching area requirements in the light of the new state requirements.

An alternative for homeowners who cannot upgrade their on-site disposal system to local and state standards due to site constraints is a shared system. The new Title 5 allows the use of shared systems for system upgrades, new construction, or for increased flow to an existing system, subject to DEP approval. This is a viable alternative provided there is an appropriate site and agreeable owner nearby. An application for a shared system permit must include a proposed operation and maintenance plan, a description of ownership with legal documentation, and financial assurance documents such as insurance policies or escrow accounts. Title 5 requires annual inspections of shared systems.

The engineering and construction costs of upgrading an on-site disposal system to a Title 5 system can range from $5,000 to $38,000, depending on soil types, percolation rates, and local market conditions. A DEP Title 5 Finance Task Force estimated these costs in December 1994 based on a statewide survey.

A 1,500-gallon septic tank (minimum size tank allowed) costs approximately $2,000, installed. An installed leaching system costs approximately $3,500 for a three-bedroom home with good soils, no construction difficulties, and no pavement removal or landscaping. Engineering costs add $800 to $1,800 to the construction cost.

The DEP Title 5 Task Force determined the following additional costs could result from construction difficulties:

- Poor site access : Add $1,000 to $5,000
- Poor soils, requiring sand fill for soil replacement: Add $5,000
- Unknown pipes or other obstructions : Add $500 to $5,000
- Pavement removal : Add $500 to $1,500
- Rock removal : Add $500 to $2,500
- Landscaping : Add $500 to $2,500
- Additional treatment such as a sand filter : Add $2,000 to $10,000

In general, the total cost for a system constructed with little difficulty is approximately $6,500, with medium difficulty approximately $12,500, and with great difficulty up to $38,000.

Installation of an improved Title 5 system will likely result in lower maintenance costs as the system will not require emergency pumping but only normal maintenance pumping.

2.5.3 Innovative/Alternative Systems

The revised Title 5 allows the use of innovative and alternative technologies with DEP approval. It also provides an orderly means to facilitate review of proposed alternative systems. Alternative systems are those that provide substitutes or alternatives for one or more of the components of a three-part conventional system, while providing the same degree of environmental and health protection. They include humus or other composting toilets, alternative mounded systems, any system designed to chemically or mechanically aerate, separate, or

pump wastewater and any system designed to control nitrogenous compounds, phosphorus, or pathogenic organisms. The DEP will maintain and publish annually a list of pending and certified alternative systems. Table 2-6 lists and describes innovative/alternative systems currently used in Massachusetts, the number of systems in operation, and costs for the systems estimated by the DEP in September 1994. The revised Title 5 approves recirculating sand filters, humus/composting toilets, and effluent tee filters, described below.

Recirculating sand filters are approved for systems serving facilities with design flows between 2,000 and 10,000 gpd, or systems with design flows below 2,000 gpd that require enhanced nutrient removal. As of January 1995, five systems are in operation in the state. Two other systems have been approved but not yet built.

Typically, a recirculating sand filter system includes a septic tank, a recirculation tank and pump, and an underdrained open sand filter (Figure 2-5). Effluent from the septic tank overflows to the recirculating tank and mixes with effluent returned from the sand filter. The mixture is periodically pumped onto the sand filter and evenly distributed over the filter surface. As shown in Figure 2-5, the sand filter is placed above grade for ventilation purposes. Oxygen available within the pores allows aerobic decomposition of the wastewater. A drain line at the bottom of the sand filter collects the effluent and returns it by gravity to the recirculation tank. If the tank is full, effluent overflows to the distribution box and leaching field.

If properly designed, operated and constructed, recirculating sand filters can produce effluents of very high quality. Table 2-7 compares the results of a demonstration project in Fairhaven, Massachusetts performed by the Buzzards Bay project during the past year, Title 5 effluent quality requirements for recirculating sand filters, and Plymouth Aquifer Protection Bylaw requirements. As shown in the table, the Fairhaven recirculating sand filter met most Title 5 removal requirements, but did not meet effluent quality requirements. This was due in part to treating a relatively high-strength waste. The project also began in winter, which hindered the growth of nitrifying organisms. Table 2-7 also indicates that Plymouth's Aquifer Protection Bylaw requires further treatment in addition to recirculating sand filtration in well recharge areas.

Humus/composting toilets have evolved over the years. The most popular type use wood wastes such as sawdust to provide a composting environment for biodegradation of wastes. These systems are typically equipped with a temperature-controlled fan for aeration. In the past, composters have been used with waterless toilets. Recent innovations include foam flush composting toilets that require one ounce of water and soap per flush, and yard irrigation systems using filtered graywater from sinks, showers, and washing machines. Title 5 requires that composting toilets be designed to store solids for at least two years. Residuals can be buried on-site or at an approved site, covered with 6 inches of earth. They can also be transported to a disposal site. Graywater must discharge to a septic tank or filter system and leaching facility sized for at least 60 percent of the facility's normal design flow.

Effluent tee filters are fiber filters installed at the outlet tee of a septic tank. They enhance treatment and prevent septic tank solids from reaching the leaching system. There are currently hundreds of these filters installed in Massachusetts in conventional septic systems.

Table 2-6
Innovative/Alternative Technologies

Technology	*Description*	*Status in Massachusetts as of 1/95*	*Cost (Single-Family Home)*
Recirculating Sand Filter	Enhanced wastewater treatment, nitrogen reduction	Approved under Title 5 for general use; five in operation, plus two approved	$8,000 installed
Intermittent Sand Filter	Enhanced wastewater treatment	Five systems approved, two in operation	- - -
Peat Filter	Alternative leach field, enhanced treatment, nitrogen reduction	Three systems operating, plus three systems approved	$2,000 to $3,000 installed (in place of leach field)
RUCK System	Enhanced wastewater treatment, nitrogen reduction (parallel septic tanks for gray and black water, filter)	Two systems approved, one in operation	$6,000 more than a conventional system
AWT Bioclere System	Enhanced wastewater treatment, nitrogen reduction (trickling filter concept)	Thirteen systems operating, plus a number approved	$2,700 to $4,600 installed
Cromaglass Wastewater Treatment System	Enhanced wastewater treatment, nitrogen reduction (sequencing batch reactors)	One approved, town and applicant found reporting requirements unacceptable	$10,000 installed, $500/year O&M
Scienco/FAST	Enhanced wastewater treatment, nitrogen reduction (fixed activated sludge treatment)	One of three approved systems installed	$3,500 plus installation
Singulair Wastewater Treatment System	Enhanced wastewater treatment (mechanical aeration)	No approved systems	$3,200 additional cost with conventional system, plus installation

Table 2-6
Innovative/Alternative Technologies

Technology	*Description*	*Status in Massachusetts as of 1/95*	*Cost (Single-Family Home)*
Clearwater Wastewater Treatment System	Enhanced wastewater treatment (attached growth and fixed film system)	No approved systems	- - -
Storm-Treat System	Wastewater treatment using filtration and a constructed wetland	DEP may allow an experimental installation	- - -
Composting Toilets	Composting toilet, reduced leaching field	Approved under Title 5 for general use	- - -
Clivus Multrum Low-Flush Composters	Compatible with 1.6-gallon low-flush toilets, reduced leaching field	Three systems operating	- - -
Clivus Multrum Soilbed and Graywater Filter	Graywater multi-media filter, dosing chamber and pump	Three systems operating	- - -
Wisconsin Mound	Passive treatment and disposal system (fill system elevates in-infiltration surface above wet, slowly draining natural soils)	Two systems operating	- - -
Zabel Filter	Septic tank effluent filter, installed at outlet tee	Conditionally approved, hundreds of filters installed	$140
OSI Effluent Filter	Septic tank effluent filter, installed at outlet tee	Conditionally approved, several filters installed	- - -
Infiltrator	Alternative leach field without stone	Conditionally approved, hundreds installed	$1,000

Table 2-6
Innovative/Alternative Technologies

Technology	*Description*	*Status in Massachusetts as of 1/95*	*Cost (Single-Family Home)*
Bio-Diffuser	Alternative leach field without stone	DEP reviewing application to provisionally approve	- - -
Eljen In-Drain System	Alternative leach field without stone	Conditionally approved, none installed, one approved	$300 to $400 per bedroom
GEO-Flow	Alternative leach field without stone	Provisionally approved, one system installed	$6/foot of leaching trench
Cultec Contactor	Alternative leach field without stone	Provisionally approved	$880
Atlas Grease Recovery System	Mechanical grease removal system for restaurants	Approved for pilot testing for up to 15 locations, seven systems installed	$3,300 for 20 gpm system $17,500 for 150 gpm system

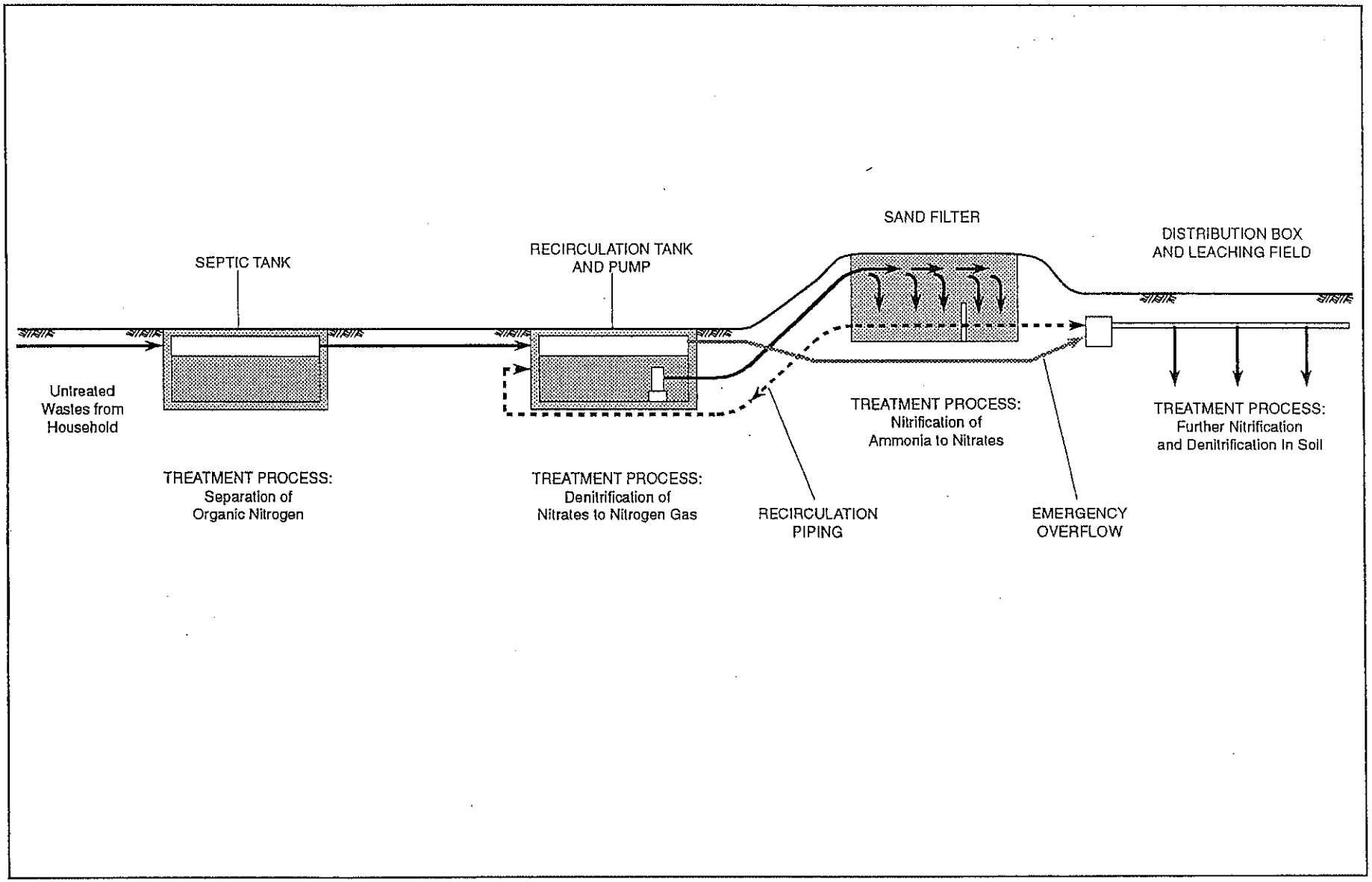


Figure 2-5
Fate of Nitrogen in Recirculating Sand Filter Subsurface Treatment and Disposal Facility

Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

Table 2-7
Recirculating Sand Filter Performance

Parameter	*Recirculating Sand Filter Demonstration Project Fairhaven, MA*	*Title 5 Requirements for Recirculating Sand Filters*	*Plymouth Aquifer Protection Bylaw Requirements*
BOD			
Removals	85% to 95%	85% minimum	
Effluent Quality	<50 mg/l	30 mg/l maximum	10 mg/l maximum
TSS			
Removals	60% to 95%	85% minimum	
Effluent Quality	<40 mg/l	30 mg/l maximum	10 mg/l maximum
Total Nitrogen			
Removals	expect 50% to 60%	40% minimum	
Effluent Quality	40 to 50 mg/l (have had trouble achieving this quality because the project began in winter)	25 mg/l maximum	5 mg/l maximum
Fecal Coliform			
Effluent Quality	1,000 to 10,000 per 100 ml	200 per 100 ml maximum	--
pH			
Effluent Quality	--	Shall not vary more than 0.5 standard units from influent quality	--

2.5.4 Package Wastewater Treatment Facilities

Various types of "package" wastewater treatment facilities may be feasible solutions for single-home, multi-home, or other specific needs in the Town of Plymouth. Some were described in Table 2-6. The term "package" simply refers to the assembly of various individual treatment process equipment such as settling tanks, aerators, and disinfection methods into a compact area. Package plants are usually offered by a single company that is able to install pre-assembled equipment in buried tanks or in small buildings. Package wastewater treatment facilities can achieve the same degree of treatment as municipal wastewater treatment facilities provided their operation is monitored effectively. Two main differences between package plants and municipal plants are that package plants normally have less than 50,000 gallons per day (gpd) capacity whereas most municipal plants are much larger, and package plants are usually automated so that an operator only checks performance and conducts maintenance periodically. Most municipal wastewater treatment facilities have daily coverage, some facilities with personnel required 24 hours per day, 7 days per week. The Town of Plymouth's 1.75-mgd secondary wastewater treatment facility is staffed 8-1/2 hours per day weekdays and approximately three hours spread over the day weekends and holidays.

Many types of wastewater treatment processes may be used in package facilities depending on the desired degree of wastewater treatment. The sequencing batch reactor (SBR) and the rotating biological contactor (RBC) are two common treatment processes. Either method is capable of achieving standard secondary treatment or advanced wastewater treatment. A brief description of these processes follows:

- The SBR process consists of a series of steps using one or more tanks. First, an empty tank fills with untreated wastewater. During this step the wastewater is usually aerated. Once the tank is full, the aeration step is started, supplying enough oxygen to allow conversion of ammonia present to nitrates (nitrification). This step normally takes 12 to 18 hours. If nitrogen removal is required, the aeration system is stopped for an additional 4- to 6-hour period to create anoxic conditions which promote the conversion of nitrates to nitrogen gas and, hence, nitrogen removal from the wastewater. During the next step the treated wastewater is allowed to settle for approximately a 1-hour period, during which time heavier solids (sludge) settle to the bottom of the tank and a clear liquid (effluent) remains in the tank. After settling the effluent is pumped to a disinfection chamber (either chlorination or ultraviolet light) and then discharged, usually to a surface or subsurface land disposal facility. The remaining sludge is recirculated to the aeration tank and occasionally excess sludge is removed by tank truck for disposal at a wastewater treatment facility.

- The RBC process utilizes a fixed culture of natural microorganisms which mechanically rotates on a disk through the wastewater to remove pollutants. To achieve nitrogen removal, two RBCs are normally used in series with one RBC submerged to promote anoxic conditions that foster denitrification. The RBCs are followed by a settling tank, and a sand filter is sometimes required depending on regulatory guidance. Similar to other package wastewater treatment facilities, a disinfection step is required.

Package plants can be installed below or above ground. When below ground, they are installed in concrete, metal, or fiberglass compartments or tanks. Most new, below ground package plants consist of one or more tanks set on a concrete foundation. The tanks are then buried so

plants consist of one or more tanks set on a concrete foundation. The tanks are then buried so that only access hatches are visible from the surface. These systems have been in operation for more than 30 years throughout the United States and in Massachusetts since the 1970s.

Package plants can be installed above ground with fiberglass enclosures, or more commonly, in small buildings. These facilities usually include one or more concrete buried tanks, but most of the equipment is located in a one-story structure that architecturally blends with its surroundings. Above ground package plants typically serve condominium complexes, apartment buildings, and shopping centers. Local examples of aboveground package wastewater treatment facilities include those located at Independence Mall in Kingston, Boston Edison facilities, White Cliffs condominiums, and at Ocean Point condominiums on Taylor Avenue in Manomet.

Costs for package plants vary considerably depending on whether the plant is constructed above or below ground, type of treatment process selected, degree of automation, degree of treatment required, and method of effluent disposal. The following table offers preliminary budget estimates for facilities with flows ranging from 5,000 gpd to 50,000 gpd.

	Unit Costs, $/gallon	
	5,000 gpd	*50,000 gpd*
Above Ground Facility	$60 to $80	$15 to $20
Below Ground Facility	$15 to $20	$15 to $20

2.5.5 Other Solutions

Other alternative solutions to on-site wastewater disposal or septage disposal problems are:

- Mobile septage dewatering;
- Tight tanks; and
- Condemnation of property.

The Hamstern mobile sludge dewatering system is a septage disposal alternative. This disposal method is practiced in Sweden but has yet to gain widespread acceptance in the United States. Truck-mounted septage filtration equipment is used to dewater septage on-site when a septic system is pumped. The process takes approximately 15 minutes from extraction to dewatering and liquid replacement. Liquid removed from the septage is returned to the owner's septic tank. The Hamstern system must be used only when the on-site wastewater system is operating properly.

One benefit of the system is a reduction of the amount of septage to be treated by the town or a private facility. The hauling costs are also reduced and pumpers can serve more customers in one trip because the only item hauled is dewatered septage. The Hamstern system relies on a nearby facility to accept dewatered septage for further treatment or disposal.

The Plymouth Board of Health considers tight tanks the last resort solution for repairing a failed on-site disposal system. Tight tank solutions dictate frequent pumping and transportation of wastewater to an approved treatment facility. There are two tight tank systems currently

approved in Plymouth: one at Full Sails tavern and the other at summer cottages on Ship Pond. Full Sails had two cesspools that collapsed on the bluff to the beach, and the cesspools at Ship Pond were in the pond. Tight tanks require DEP approval, which is given only when no other feasible alternative exists. The minimum size of a tank is 500 percent of the daily wastewater volume using Title 5 design flows, but not less than 2,000 gallons. Tight tank owners must set audio and visual alarms to activate at 60 percent of tank capacity. Aeration or another method of odor control may be required. Title 5 also requires implementation of an operation and maintenance plan that includes system monitoring at least once every three months to ensure proper care of the system.

Plymouth town officials consider land taking or condemnation of property an alternative solution. As noted earlier, such solutions are preferred to construction of sewers and a wastewater facility in congested areas such as White Horse Beach. However, the town has no formal procedures concerning these actions, and will need to develop such guidelines. Issues to consider include:

- Cost of taking property;
- Whether federal or state funds are available for such activities;
- Legal procedures; and
- Documentation that other alternatives, such as innovative/alternative systems, shared systems, or tight tanks are not feasible.

These three solutions—mobile dewatering, tight tanks, and property condemnation—are unlikely to be required initially in Plymouth. Section 2.7 discusses the on-site system and septage management program recommendation for the town.

2.6 Future Septage Quantities

This section provides estimates of the total quantity of septage wastes that will be produced from on-site wastewater disposal systems. Septage estimates are a function of unsewered population. Unsewered areas of Plymouth are mostly residential. The 1990 total population of Plymouth was 45,608. Old Colony Planning Council data indicates the population will increase approximately 38 percent by the year 2010. Table 2-8 shows the Old Colony population projections to 2010, and linearly extrapolates projections to the year 2020. The town population by 2020 is expected to be approximately 72,500 or nearly 50 percent higher than the current population.

Water consumption records and census tract information indicate that approximately 14,500 people are currently connected to the sewer system. The Plymouth Planning Department projects only a 5 to 10-percent increase in population within the sewer service area by 2020. As discussed above, the town prefers continued use of on-site wastewater disposal systems throughout the town, including Manomet, South Manomet and West Plymouth. Hence, the total estimated sewered population in 2020 without any major new sewered areas is approximately 16,000. Sewered population estimates in Table 2-8 for the years between 1995 and 2020 are interpolated linearly. Unsewered population is the difference between the total and

Table 2-8
Future Septage Quantity Estimates Based on Population Growth

Year	Total Population	Sewered Population	Unsewered Population	Number of Unsewered Households[3]	Average Daily Septage Volume[1] (gal/day)	Peak Daily Septage Volume[2] (gal/day)
1990	45,608	13,800	31,808	12,723	14,000	35,000
1995	49,646	14,500	35,146	14,058	15,000	38,000
2000	54,116	14,800	39,316	15,726	17,000	43,000
2005	58,585	15,100	43,485	17,394	19,000	48,000
2010	63,054	15,400	47,654	19,062	21,000	53,000
2015	67,783	15,700	52,083	20,833	23,000	58,000
2020	72,512	16,000	56,512	22,605	25,000	63,000

1 Assumed average pumping frequency is once every three years; average septic tank capacity is 1,200 gallons.

2 Peaking factor is 2.5 based on Plymouth septage receiving facility daily records.

3 Assumed 2.5 people per household.

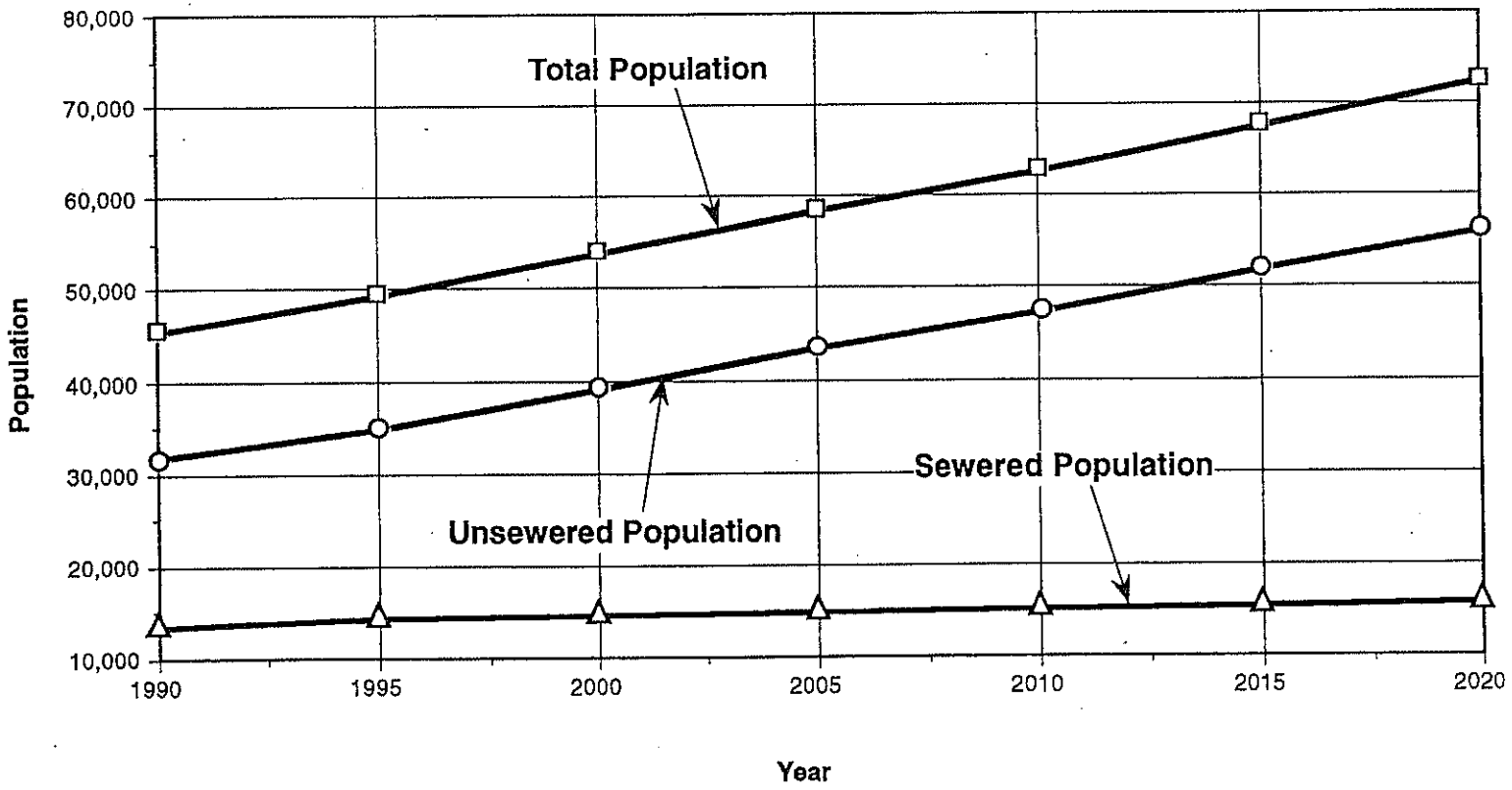


Figure 2-6
Population Projections
Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

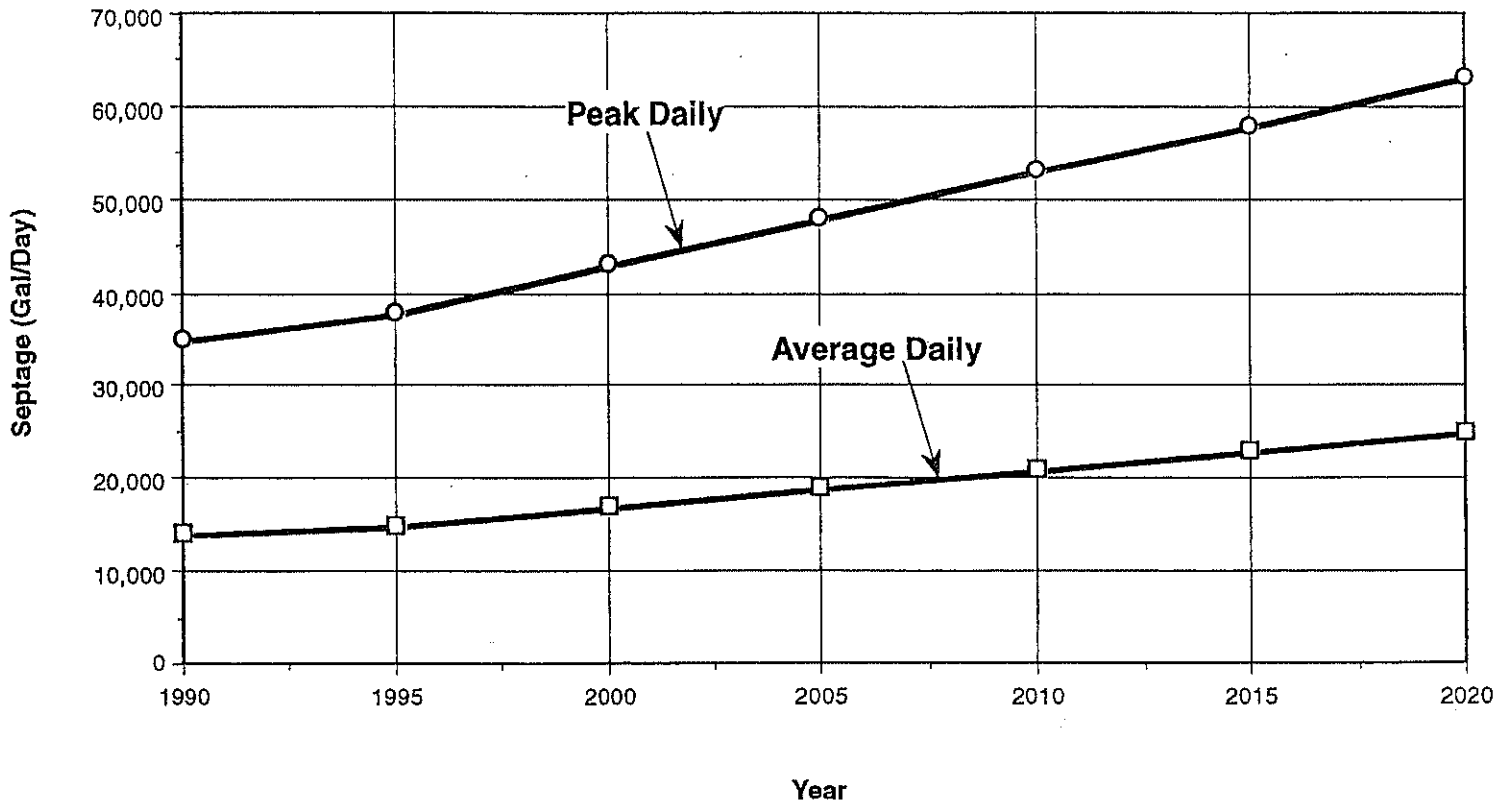


Figure 2-7
Septage Quantity Estimates
Town of Plymouth, Massachusetts
Wastewater FP/EIR Phase IIIA

Manomet, South Manomet, or West Plymouth. The only new sewers recommended are for those areas where dense growth for industry or commercial businesses will be encouraged, as discussed in Section 3.

The goal of the management plan recommended below is to increase environmental and public health protection in unsewered areas of Plymouth through on-site system monitoring improvements, system replacement incentives, maintenance, awareness and education programs. Components of the plan are discussed below.

2.7.2 Monitoring Improvements

The Plymouth Board of Health, Building Department and the DPW wastewater treatment plant staff currently work together to monitor the replacement of failing on-site disposal systems through the building permit and the septage pumping ticket processes. New Title 5 inspection and reporting requirements will improve the Board of Health's monitoring ability. An inspection form (in Appendix B) will have to be filled out and submitted to the Board of Health at the time of property transfer, when a flow increase to a system is proposed, for required annual inspections of shared systems, for required periodic inspections of large systems, and for any other inspections ordered by the Board of Health, DEP, or court.

On-site disposal system monitoring and inter-departmental communication should be further enhanced in Plymouth by formally coordinating information among the Board of Health, DPW, Building Department, Water Department, Planning Board, Conservation Commission, Engineering Department and the Assessor's Office through a common database. In addition, filing of site plans and septic system ties could be improved by developing a microfiche filing system.

Currently, the Assessor's Office keeps its records in a computer data base. Water and sewer records are also in a data base that can be coordinated and matched with the assessor's information by lot and parcel numbers. The Board of Health, Building Department and DPW wastewater treatment plant staff could coordinate their on-site system and septage records with the Assessor's and other Departments' records by maintaining a mutually accessible computer data base. As a minimum, septage pumping records should be computerized to allow better tracking of problem areas.

The Board of Health has plans of all on-site systems installed since 1963. Prior to 1963, records were kept on index cards, some with rough schematics of on-site system locations. Filing of existing and future plans on microfiche would consolidate and improve the organization of Board of Health records. Variances and deed restrictions should be maintained in the same files.

2.7.3 System Replacement Assistance

Plymouth should encourage homeowners to upgrade failing systems by making the public aware of existing incentives such as loan and grant programs. Several loans are currently available to help residents finance repair or replacement of failing on-site wastewater disposal systems:

- The Plymouth Office of Community Development offers affordable rehabilitation loans to eligible households (within HUD income limits), funded by the Massachusetts Small Cities Program. Rehabilitation projects include septic system upgrades, and the work must be performed by approved contractors. There is no interest charged on the loan and payment is deferred until the recipients sell their homes. Plymouth Community Development processed nine loans involving septic system work in 1994.

- The Massachusetts Housing Finance Agency (MHFA), in cooperation with the Executive Office of Communities and Development (EOCD), through the Home Improvement Loan Program (HILP) offers loans up to $15,000 to low and moderate-income homeowners. Improvements can include repair or replacement of failed subsurface disposal systems. Borrowers in Plymouth must have an income of less than $38,000 (one-person household), or $39,600 (two-person household). HILPs are available through the Plymouth Redevelopment Authority in the Town Hall. The Redevelopment Authority's responsibilities include local program marketing to insure that the public is aware of the program; financial counseling and pre-screening; and property inspection.

- MHFA also offers low-interest loans for major home improvements, including repair or replacement of failed subsurface disposal systems, needing more than $15,000 of work, through the Neighborhood Rehabilitation Program. The home must be at least 20 years old and owner-occupied, and the borrower must meet MHFA income guidelines.

- Farmers Home Administration (FmHA) makes Home Improvement Loans and Grants up to $15,000 at one-percent interest to low-income rural homeowners who need to bring their home up to minimum standards, including repairing or replacing failed subsurface disposal systems. Rural homeowners are those who live in a home on a farm, in the open country, or in towns of up to 10,000 population, and in under certain conditions, towns with population between 10,000 and 20,000. The first two criteria apply to Plymouth. Loan and grant amounts depend on income and age. The FmHA held an informational meeting on the loans in Plymouth in May 1994.

- FmHA also provides Home Ownership Loans to people with low and moderate-incomes who cannot obtain a loan elsewhere to buy, build, improve, repair, or rehabilitate rural homes, including repair of inadequate subsurface disposal systems.

The town should consider establishing its own revolving loan fund program to assist people who may not qualify for any of the programs above. Establishment of this program would show the town's real commitment to long-term reliance on on-site disposal systems.

The town may want to consider using this fund to help purchase properties in densely developed areas as they become available. Taking properties off the market through town purchase may be the least costly option in densely built areas that require several on-site system variances. This would help ensure that sewers would not be required in the future.

2.7.4 Maintenance Awareness

Proper operation and maintenance of on-site wastewater disposal systems is essential to minimize public health hazards and to protect the environment. Title 5 suggests pumping the sludge and floating scum from on-site systems at least once every three years to maintain properly functioning systems. The new regulations require submittal of a DEP-approved system pumping form to the Board of Health, noting the condition of the system, whenever a septic tank or cesspool is pumped.

If a septic tank is not pumped regularly, solids may overflow to the leaching system and clog it. This can result in flow back-ups into the building or ponding of septic water at the surface over the leaching area. Both conditions create odors and health hazards. Diseases, such as dysentery and hepatitis, can be spread by human and animal contact with the wastes. Mosquitoes and flies that spread infectious diseases can breed in areas where liquid waste reaches the surface.

Use of garbage grinders adds coarse solids to the tank and increases the sludge buildup by approximately 50 percent. A septic tank must have capacity for 200 percent of the estimated sewage flow, or a minimum of 1,500 gallons, to provide sufficient storage capacity for garbage grinder waste. Title 5 recommends annual pumping for a system with a domestic garbage grinder and prohibits garbage grinders in systems that include an elevated septic tank constructed in a V-zone, such as the barrier beach in Manomet.

A septic tank must be accessible for pumping. The new Title 5 requires at least three 20-inch manholes with readily removable covers placed at the center and over each inlet and outlet tee. For system designs of 1,000 gpd or less, at least one access port must be accessible within six inches of final grade.

Homeowners should avoid disposing of the following damaging materials to their septic systems to prevent system failure:

- Cigarette butts, paper towels, plastics, diapers and grease, which can clog the system;
- Poisons such as gasoline, oil, paint, paint thinner, pesticides and antifreeze; and
- Excessive detergents, cleaning chemicals, and bleach, which may kill helpful bacteria.

The new Title 5 prohibits the use of septic system additives (chemical or enzyme treatments) without prior written determination by the DEP that the additive will not harm the system or adversely affect the environment. There is no proof that additives are effective remedies for a failing system, and they are not a substitute for regular pumping. The DEP intends to maintain and publish a list of allowed septic system additives.

Conserving water can extend the life of a leaching area, as well as lower the risk and extent of ground or surface water pollution. A description of the recommended water conservation program is discussed in Section 3. Directing roof gutters and downspouts away from the leaching area also helps. Other protective measures include planting trees and shrubs at least 10 feet from the leaching area, and preventing heavy vehicles from driving over the system.

Plymouth should encourage homeowners to properly maintain their systems through education (discussed below) and incentives. Incentives may include:

- **Discount Coupons** distributed to homeowners to pump their systems in the fall or winter to help equalize flows to the wastewater treatment plant.

- **Rewards**, such as real estate tax deduction coupons, for using water-saving devices and for pumping regularly.

- **Installment plan for paying pumping bills**: contact septage pumpers about setting up a maintenance program allowing monthly payments (approximately $10 per month if system pumped annually) for customers who cannot afford a single payment of approximately $120 to pump their systems.

- **Information**: inform the public that an on-site system will last longer and improve the local environment if maintained properly, resulting in long-term money savings and cleaner, safer surroundings.

2.7.5 Education

As discussed in Section 3, Water Conservation Program, surveys of utility customers asking how they had obtained conservation information suggest that newspaper, radio news and word-of-mouth are the most frequent sources. Furthermore, the survey showed that customers prefer receiving information from newspaper articles, special television programs or public service announcements, and brochures or literature. Workshops, seminars and other types of active programs were not favored. The following is a discussion of these education alternatives as they apply to Plymouth.

2.7.5.1 Brochures and Pamphlets

The Plymouth Board of Health selectively distributes a comprehensive 14-page brochure entitled *"Your Septic System,"* published by the University of Massachusetts and the U.S. Department of Agriculture, to new homeowners, and to people who visit the Board of Health office with questions or for permits. Information in the brochure includes:

- How a septic system works;
- Why and how to maintain a septic system;
- How to keep maintenance records;
- What to do if a septic system fails;
- What to know when buying or selling a house;
- Considerations when building or remodeling a home;
- Why and how to conserve water; and
- Special considerations for shoreline property owners.

The DEP annually produces and distributes educational materials describing the importance of proper maintenance and operation of on-site systems. Appendix B contains copies of educational pamphlets currently distributed by the DEP.

The town should ensure that homeowners receive these short pamphlets by sending them periodically in tax bills, and by giving them to pumpers, when they apply for a license, to distribute when they pump on-site disposal systems. Homeowners and pumpers should be encouraged to attach a copy of these pamphlets with their system plan and pumping records directly to the waste pipe within their dwelling.

2.7.5.2 Advertising

Multimedia advertising raises the profile of the town's septage management program and its importance. Advertising consists of public service announcements on television and radio, newspaper ads, billboards and bus ads. Television advertising is a relatively expensive education alternative; however, local cable messages produced by volunteers might cost significantly less. An on-site system documentary prepared by town staff (wastewater treatment plant staff, Board of Health, etc.) could be shown periodically on cable television. Contributions or advertising from local pumpers could be used to help finance this "infomercial."

2.7.5.3 Workshops

Periodic informational meetings would provide direct outreach to concerned citizens. This alternative would require setting up a speakers bureau with representatives from the Board of Health, DPW, the DEP, inspectors, soil evaluators, pumpers, manufacturers, or other qualified organizations. These sessions could be taped and shown on cable television. Summary papers could also be prepared and published in local newspapers.

2.7.5.4 School Programs

A very effective means of spreading information is through children and school curriculum. The Plymouth DPW wastewater treatment plant staff has used this approach to educate students on the town's wastewater system. This effort should continue and be expanded to include on-site disposal system education. Educational materials can include brochures and pamphlets distributed by the Board of Health and DEP, and videos distributed by manufacturers of innovative/alternative technologies and other on-site disposal systems. The town should develop a formal program with the schools. Town staff should be encouraged to participate in such an effort.

CDM Camp Dresser & McKee

Report

Town of Plymouth, Massachusetts

Phase IIIB Wastewater Treatment FP/EIR
Volume 7—Draft Supplemental Report
EOEA No. 8228

September 13, 1996

Camp Dresser & McKee Inc.
Ten Cambridge Center
Cambridge, Massachusetts 02142

Section 2
Wastewater Facilities Program

2.1 Introduction

In this section we provide a complete description of the alternatives evaluated in the town's Draft Supplemental Phase IIIB Facilities Plan/Environmental Impact Report (DS FP/EIR). For most of the community, households and businesses will continue to rely on septic systems for wastewater disposal. Major changes in the Massachusetts Title 5 regulations have placed renewed emphasis on proper operation of septic systems. This section describes the new regulations and how they will impact Plymouth residents.

This section also recommends a specific water conservation program. The goal of the program is to reduce water consumption both in the sewered area which will lead to reductions in wastewater treatment costs and throughout the town which will conserve the town's groundwater resources.

The remainder of the section is a description of the technical basis for the five wastewater management plans evaluated in this phase of the DS FP/EIR. Included are detailed discussions of facilities requirements and costs.

2.2 Management Plan for On-Site Wastewater Treatment and Disposal

2.2.1 Introduction

More than 70 percent of households and businesses in Plymouth rely on on-site wastewater treatment and disposal facilities. Section 2 of the Phase IIIA Draft Facilities Plan/Environmental Impact Report (FP/EIR) examined several issues involving on-site systems in detail. Among the specific issues addressed were:

- Description of existing conditions—on-site wastewater disposal systems, septage hauling and disposal practices;
- Investigation of problem areas;
- Description and comparison of Plymouth's Board of Health wastewater treatment and disposal requirements and the state's new Title 5 requirements as of March 31, 1995;
- Alternative solutions, including innovative/alternative technologies;
- Future septage quantities; and
- Recommended on-site system and septage management plan, including monitoring improvements, system replacement assistance, maintenance and education programs.

The purpose of this section is to respond to several additional issues raised since the completion of the Phase IIIA draft report. They are: (1) further revisions to the Massachusetts Department of Environmental Protection's (DEP's) Title 5 regulations (310 CMR 15.00) since the draft report, (2) response to comments received from the Department of Environmental Protection concerning the Manomet area of Plymouth, and (3) further discussion of on-site wastewater management districts.

2.2.2 Revisions to Title 5

This summary reflects the significant changes to Title 5 since March 31, 1995:

1. Certain general failure criteria are replaced with specific criteria for performance [see Title 5 Section 15.303(1)]:

   a. Existing systems with soil adsorption systems within 50 feet of surface (non drinking) water bodies no longer fail automatically.

   b. Within 50 feet of surface (non-drinking) water bodies, bordering vegetated wetlands or salt marshes, existing cesspools and privies no longer fail automatically, unless the Board of Health determines the system is not protective, based on specific criteria.

   c. Within 100 feet of a surface water supply or tributary to a surface water supply, within a Zone I of a public well, or within 50 feet of a private water supply well, existing systems with septic tanks and soil adsorption systems no longer fail automatically if the local Board of Health determines the system is protective, based on specific criteria. Within 100 feet of a surface water supply or tributary, within a Zone I of a public well and within 50 feet of a private well, cesspools and privies still must be replaced.

2. No inspection will be required prior to transfer of title where a certificate of compliance has been issued within the two years prior to transfer. (This includes systems constructed or upgraded before March 31, 1995.) [Section 15.301 (4)(a)]

3. No inspection will be required prior to transfer of title where there is an enforceable agreement to connect to the sewer or to upgrade the system within two years. [Section 15.301 (4)(b)]

4. System upgrades may be deferred if sewers are to be built and connections made within five years. DEP may authorize a community to extend this time frame based on the community's schedule and financial commitment to construct sewers. (Section 15.305)

5. For transfers of title, the inspection time frame is extended from nine months to two years prior to the transfer (three years if the system has been pumped annually during that time.) [Section 15.301 (1)]

6. Generally, system owners now have two years to upgrade a failed system, instead of one year. (Section 15.305)

7. System owners may have voluntary assessments performed without having the results reported to the Board of Health. Absent an enforcement order, such systems requiring upgrades are not subject to the upgrade deadlines in 310 CMR 15.305. [Section 15.301 (10)]

8. To calculate design flow and the design of the system, the number of bedrooms in a condominium will be determined by the number of bedrooms specified in the master deed. (Section 15.203).

9. Inspection of systems on a facility with five or more condominium units is required by December 1, 1996, and then every three years; inspection of systems on a facility with fewer than five condominium units instead may be done at time of transfer of title to a unit, in which case, only the system serving the unit transferred need be inspected. Further, the association will be responsible for the inspection unless the governing documents provide otherwise. [Section 15.301 (3)(a)]

10. Soil evaluators will not be required for system siting and design until January 1, 1996. (Sections 15.004, 15.100, 15.242)

11. Large system (10,000 gallons or more per day) inspections will be required by December 1, 1996 (provided that no other inspection criteria are triggered). [Section 15.301 (6)]

12. System owners will have more kinds of fill to choose from when constructing and repairing systems. Previous strict standards for the composition of fill have been replaced with a more flexible provision that includes sieve analyses. (Section 15.255)

13. For upgrades, the revisions spell out the obligation of the local Board of Health to consider "not only physical possibility as dictated by the conditions of the site, but also the economic feasibility of the upgrade costs" in determining whether full compliance is feasible. (Section 15.405)

14. The revisions specify that transfers between spouses, as well as mortgaging and refinancing by current owners, do not trigger the requirement for an inspection. [Section 15.301 (2)]

15. The revisions allow more time for inspections triggered by certain transfers of title including, for example, those required as a result of inheritance, bankruptcy, and foreclosure. [Section 15.301 (3)]

16. The failure criteria now allow four pump-outs per year before a system fails on pump-out criteria alone. [Section 15.303 (1)(a)(5)]

17. Communities may adopt comprehensive inspection plans, approved by DEP, providing for inspection of all systems once every seven years, in place of inspection at time of transfer. [Section 15.301 (4)(c)]

18. When the footprint of a building is changed with no increase in design flow, inspections are limited to a determination of the location of the system components, rather than a full inspection. [Section 15.301 (5)]

19. The definition of shared system is clarified to provide that a system serving a condominium unit or units located on the same facility is not a shared system. (Section 15.002)

As noted in the Phase IIIA draft report, the Plymouth Board of Health Supplementary Rules and Aquifer Protection bylaws have provisions that are more stringent than the March 31, 1995 version or revised version of the state's Title 5.

2.2.3 Management Plan for Manomet

The Manomet study area as defined in the Phase IIIA draft report, includes approximately 1,300 homes in the Priscilla Beach, White Horse Beach, and Manomet Heights areas of Manomet. These areas are characterized by year-round and seasonal homes located on small lots of generally less than 10,000 ft² (square feet). A significant number of the year-round homes are converted (winterized) seasonal homes.

Typical on-site wastewater treatment and disposal systems in Manomet consist of either cesspools or septic tanks and leaching fields. In spite of the high density of development, recent water quality surveys of the shoreline beaches and Bartlett Pond have not shown impaired water quality. The area is entirely served by public water supplies, eliminating the potential problem of wastewater discharges contaminating private wells. Soils in the area are generally suited for septic systems.

During preparation of the Phase IIIA draft report in 1994, discussions were held with the Citizens Advisory Committee (CAC), Selectmen, Board of Health, Department of Public Works, and Planning Department concerning wastewater management options for Manomet. Based on the situation as described above and considering the options available for individual system upgrades, there was a consensus that the town not provide sewers to this area. This decision reversed plans that called for the town to provide sewers to this area. The major arguments against sewers were their high costs, ability to induce more development, and the likelihood they would allow further conversion of seasonal to year-round homes in sections of Manomet classified by the state as sensitive barrier beaches.

The following is a summary of the wastewater management plan applicable to most homes in Manomet. The options are listed in decreasing degree of preference.

- For a home experiencing a system failure or when a home is expanded, the existing system is replaced with a system meeting full compliance of the Title 5 standards. Typically, this is accomplished by replacing a cesspool with a septic tank, distribution box, and leaching trenches or leaching field.

- For small lots, waivers from certain requirements of Title 5 are necessary from the Board of Health in order to improve on-site systems. These waivers are given routinely. They generally involve relaxation of setback distances from dwellings and property lines.

Provided the depth to groundwater is adequate, these systems achieve the equivalent degree of treatment as systems without waivers. In some circumstances, the Board of Health will grant waivers from the more critical requirements of Title 5 such as distance to a private well or water body. These waivers are normally only allowed when the options are reduced to a consideration of holding tanks and property condemnation. To restrict the further expansion of such an individual residence, the Board of Health normally places a deed restriction on the allowable square footage of the building.

- Approximately 15 percent of the homes in Manomet are located on very small lots of less than 4,000 ft^2 and/or are located on lots with shallow groundwater. Among the options available for this group of homes are a mound system, purchase and use of adjacent properties or operation of shared systems, and use of innovative technology to increase the level of wastewater treatment. There are approximately 700 individual open lots in Manomet totalling greater than 200 acres that might be appropriate for individual or shared wastewater treatment and disposal systems.

  As a contingency plan for some of the homes on small lots with no on-site or nearby solutions, a small wastewater collection and treatment system might be appropriate. Such systems typically consist of individual homes with pumped connections to a small-diameter (2 to 4-inch) pressure sewer with discharge to a package wastewater treatment facility. For a hypothetical 40-home system served by a 13,000-gallon per day (gpd) package plant, only about 20,000 ft^2 of wastewater treatment facility and leaching area is required, not including buffer zone area. Sites might be available in the Manomet area or the undeveloped land adjacent to the Edison Access Road evaluated in earlier phases of the FP/EIR (Site "E") might be considered.

Some homes in Manomet are considered to be located on barrier beaches or velocity zones, as defined by the National Flood Insurance Program. The Massachusetts Coastal Zone Management Office has guidelines that are designed to discourage further growth and development in these areas. Therefore, the individual wastewater management options discussed above will be allowed only in instances of system failure and when upgrading is required. Such options will not be allowed if the action leads to construction of a new home or to an expansion of the dwelling capacity of an existing home.

The DEP has suggested that this policy be made part of the Plymouth Board of Health Supplementary rules or other local bylaw and be applied to only the barrier beach areas designated by the Office of Coastal Zone Management and the velocity zone areas defined by the National Flood Insurance Program. The DEP has also endorsed the Board's policy of deed restrictions for these conditions.

2.2.4 On-Site Wastewater Management District

Areas of the town, which have not yet been sewered or are not planned for sewering, have specific wastewater disposal needs that require immediate and future consideration. The implementation of stringent Massachusetts Title 5 regulations, as well as local on-site wastewater disposal regulations, has placed varying financial, technological, and regulatory

burdens on homeowners with on-site systems. In addition, the responsibility for the administration and enforcement of Title 5 requirements has been placed with the municipalities.

To insure that the needs of the nonsewered portions of the town are met, it may be beneficial to change some on-site system management responsibilities from the private homeowner to the public. In some cases, the formation of on-site wastewater management districts have proven successful for this purpose. Since most of Plymouth will not be sewered, the town may wish to consider the establishment of a public management entity to assist residents with on-site systems. Duties related to the management of on-site systems could be performed through public agencies, such as the Department of Public Works, the Board of Health and/or the entity created to oversee the District.

The authority and function of a District vary greatly and depend on the needs and initiative of individual municipalities. A District would manage public health, environmental needs and institutional needs related to on-site systems, and may provide a wide spectrum of administrative, regulatory, financial, operational and technical services to owners of on-site systems.

The concept of a District is fairly new. Title 5 regulations set guidelines for on-site systems, but do not address management of these systems. In Massachusetts, there are currently no official guidelines on the establishment of a District. However, efforts are underway to establish model guidelines. The principal advantage of a District, as noted above, is that septic system inspections are not required at the time of property transfer provided that the town has an inspection program of inspection once every seven years.

The functions of a District depend on the needs of the community, available finances, and the desires of town officials and residents. According to the draft document entitled *"Managing Wastewater: Prospects in Massachusetts for a Decentralized Approach,"* published by the Ad Hoc Task Force for On-Site Wastewater Management, some functions of a District which may be applicable to the town are listed below:

- A District may create and enforce wastewater management regulations and standards. For example, the District may be charged with the administration of Title 5 regulations and establishing and enforcing operation and maintenance requirements.

- A District may provide inspection, pumping and maintenance of on-site systems.

- A District may issue bonds; obtain loans through the State Revolving Fund (SRF); pursue federal and state grants; conduct betterment assessments, raise funds through taxes, or establish user fees to assist homeowners with rehabilitating or replacing on-site systems.

- A District may approve and permit plans for replacement systems, improvements to existing systems or the implementation of new systems.

- A District may provide homeowners with technical advice on on-site systems and provide public education on the operation and maintenance of on-site systems.

- A District may facilitate the coordination of state and local agencies. A District may develop and implement wastewater management plans for the district.

2.3 Water Conservation Program

Appendix C and Section 3.2 of the Phase IIIA FP/EIR presented a water conservation study for the Town of Plymouth. It examined Plymouth's water consumption and reviewed the results at some successful water conservation efforts in other U.S. communities. Based on local input, the water conservation study recommended a middle course plan between the passive and aggressive programs described in the study. The intent of this section is to further define that recommended plan.

2.3.1 Recommended Water Conservation Program

The passive and aggressive programs, as outlined in Phase IIIA, are shown on Table 2-1 along with the recommended program. The recommended program is based on public input received during Phase IIIA and guidance from the Department of Public Works that an initial annual budget of $50,000 would be made available for the water conservation program.

Discussions have been focused on water conservation within the existing sewer service area. While this should be the initial focus, it is recommended that future efforts be community wide to assist the town in attaining its goal of heavy reliance on on-site disposal systems.

2.3.2 Program Elements

Public Education

To be effective, public education must be more than simply the dissemination of information. It must include having the general public obtain a basic understanding of sound water resources management and an explanation of the associated economic and environmental benefits. Because water conservation requires voluntary participation by the customers, a successful conservation program must educate them on the following three key issues:

- Explain to water customers all the costs associated in providing water, including planning, engineering, construction, operation, maintenance, treatment, wastewater related costs, piping, leak detection, regulatory compliance, staffing, billing and other related costs.

- Show the cost benefit of conserving water versus developing and treating new water supply sources or treating the resulting wastewater.

- Describe the environmental benefits of reducing overall water demand by explaining the linkage between groundwater and surface water and the potential impacts to rivers and streams, fish and wildlife, water recreation facilities, and water quantity and quality.

It is recommended that Plymouth appoint a water conservation coordinator or committee to oversee these educational efforts. The Wastewater and Water Departments should both share in these efforts.

Table 2-1
Summary of Conservation Alternatives

Program Elements	*Passive*	*Aggressive*	*Recommended*
(1) ***Public Education***	Billing Inserts	Billing Inserts, Media Advertising Campaign, School Curriculum	Billing Inserts, Limited Media Advertising Campaign and School Curriculum
(2) ***Residential—Indoor***			
• Retrofit Existing Residential	Depot	Mail/Direct Installation	Mail/Direct Installation
• Ultra Low-Flow Toilet Rebate	No	Yes	No
• New Plumbing Standards	Yes	Yes	Yes
(3) ***Commercial—Indoor***			
• Retrofit Existing Customers	No	Yes, No Subsidy	Yes, No Subsidy
• Ultra Low-Flow Toilet Rebate	No	Yes, No Subsidy	No
• New Plumbing Standards	Yes	Yes	Yes

The education program should utilize a combination of billing inserts, customized brochures, media advertising, cable informational shows, school curriculum and a speakers network. The town should also take advantage of existing brochures and videos available from water conservation vendors and regulatory agencies.

Residential-Indoor

In 1989, Massachusetts revised the State Plumbing Code to incorporate the use of low-flow appliances in new construction. The expected impact from those revisions is shown in Table 2-2. Homes built or significantly modified since 1989 can thus be considered to be up-to-date in terms of use of water efficient plumbing devices.

The existing sewer service area, however, is almost exclusively comprised of homes that predate 1989. Because this area impacts both water consumption and wastewater facilities, these homes should be the primary focus of the initial water conservation program.

As discussed in the Phase IIIA water conservation study, there are approximately 12,000 water billing accounts in Plymouth of which about 2,900 are within the sewer service area. Residential sewer customers represent 2,200 of 2,900 sewer customers. Census data indicates that 5,000 to 6,000 dwelling units are connected to the sewer. This indicates that multiple units are on some billing accounts.

Plymouth water consumption data indicates that a typical dwelling unit utilizes about 75,000 gallons annually with 85 percent returned to a sewer or 63,500 gallons (175 gallons per day). With 2.5 persons per dwelling unit, this approximates 70 gallons of wastewater (85 gallons water) flow per capita per day.

The achievable savings in indoor water use is estimated to range from 10 to 40 percent depending on the measures selected and the participation rate. Based on allocation data from standard industry studies, the pattern of residential use is typically as listed below:

Typical Residential Water Use Pattern

Use	*Percent*
Bathing	26.8
Laundry/Dishes	17.3
Outdoor Use	13.3
Toilet Use	32.3
Other	10.3
TOTAL	**100.00**

It is clear from the above that bathing and toilet use account for about 60 percent of average dry demand. These are the areas that should be targeted in a retrofit program.

Table 2-2
Impacts from Water Conservation Devices

Estimated Impact of Retrofit Devices

Fixture	*Conventional* [1]	*Retrofit*	*Approximate Savings*
Showerheads—Replacement	5 gallons per minute (gpm)	2.5 gpm	50%
Showerheads—Flow Restrictors	5 gpm	2.5 gpm	50%
Toilets—Retrofit	5 to7 gallons per flush (gpf)	3 to 4 gpf[2]	10% to 35%
Toilets—ULF Replacement	5 to7 gpf	1.6 gpf	60% to 70%
Faucets	4 to 5 gpm	3 to 4 gpm	20% to 25%

Notes:

[1]Conventional is for fixtures built and installed prior to the revision to the State Plumbing Code and the enactment of the Energy Conservation Act of 1993.
[2]Assumes retrofit with toilet dam or displacement bag.
ULF = Ultra low-flow toilets.

Impact of Plumbing Code Revisions[1]

Fixture	*Conventional Demand*	*New Requirement*
Showerheads	5 gpm	2.5 gpm
Sink Faucet	3.5 gpm	2.2 gpm
Toilet	5 to 7 gpf	1.6 gpf
Urinal	2.5 to 3.5 gpf	1.0 gpf

Notes:

[1]1989 Massachusetts State Plumbing Code revisions.

Common methods of distributing retrofit kits were presented in the Phase IIIA water conservation study. It is recommended that Plymouth pursue the direct mail method for the existing sewer service area. For selected areas or types of dwelling units, limited installation assistance may also be provided. The town should procure a retrofit kit vendor to customize specific needs. A program in the cost area of $10 per kit is envisioned. It is anticipated that the percent participation would be in the 35 to 65 percent range with this method. A typical kit would include a low-flow showerhead, a toilet dam or displacement device and a faucet aerator.

Institutional and Commercial Customers

Institutional and commercial customers can exert a significant water and wastewater demand. Typically, the bulk of water used by these customers is for heating and cooling and domestic use. They are also impacted by the same plumbing code requirements for water efficient plumbing fixtures. Therefore, the types of initiatives to reduce their demand is similar to that used for the residential areas.

It is recommended that the town identify the largest water users in the institutional and commercial categories and meet directly with them to encourage their participation by explaining the cost benefits of water efficient devices. The smaller uses should receive some type of modified residential program. The municipal buildings, which are not currently billed for water or wastewater services, should also be outfitted with low-flow devices.

It is also recommended that commercial customers pay the direct costs for purchasing and distributing water efficient fixture kits.

2.3.3 Moderate Program Costs

The costs associated with implementing the recommended water conservation program are presented in a phased approach in Table 2-3. The education component would be done annually and would address water conservation on a town-wide basis. The retrofit component would be done on a priority basis as follows: Year 1—water users within the sewer service area; Year 2—water users outside the sewer service area; Year 3—other water users (including wells), and Years 4 and 5—to be determined depending on participation levels. Feedback surveys and monitoring of water demand will help modify the program and determine levels of expenditure in future years.

With the potential to reduce water demand by 25 to 45 gallons per day per residential account with this program, the cost benefit yields a relatively quick payback of months to a few years depending on participation levels. It is expected that a reduction of up to 80,000 gpd within the sewer service area will be realized. As wastewater costs are predicted to significantly increase in the future, the payback will be even shorter. Additional savings outside the sewered area will assist in reducing the future water supply demand.

Table 2-3
Moderate Water Conservation Program Costs

Program Element	*Annual Cost*				
	Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Education					
Billing Inserts/Brochures	$8,000	$8,000	$8,000	$8,000	$8,000
Video/Cable Programs	$7,000	$7,000	$7,000	$7,000	$7,000
Retrofit					
Vendor Procurement/Surveys	$5,000	$5,000	$5,000	TBD	TBD
Retrofit Kit Distribution	$30,000	$30,000	$30,000	TBD	TBD
TOTAL	$50,000	$50,000	$50,000	TBD	TBD

Notes:

TBD = To be determined based on participation levels.