Chapter 2
Screening Approach and Criteria

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SCREENING APPROACH AND CRITERIA

2.1 INTRODUCTION

As discussed in Chapter 1, the purpose of this report is to identify and screen alternative technologies, sites, and management concepts to be used in a detailed evaluation in the next phase of this Project. This chapter describes the approach and criteria for identifying and screening alternative technologies and sites.

2.2 METHODOLOGY FOR IDENTIFICATION AND SCREENING OF ALTERNATIVE TECHNOLOGIES

The following seven groups of alternative technologies, facility sites, and management concepts will be identified and screened:

1. Individual on-site system and cluster system alternatives.
2. Alternatives for centralized and satellite wastewater facilities and sites.
3. Treated water recharge technologies and sites.
4. Collection system technologies.
5. Flow and loading reduction alternatives.
6. Additional non-wastewater nutrient mitigation alternatives.

Each of these groups is identified and discussed below.

A. **Individual On-site System and Cluster System Alternatives.** These types of wastewater management systems typically have wastewater flows less than 10,000 gallons per day (gpd) and are regulated by MassDEP and local Boards of Health under the Title 5 regulations. These systems are often called "decentralized management" systems though there is no universally accepted definition or flow range for "decentralized management" systems. For the purpose of this report, the following definitions are used to categorize these types of wastewater management systems:

- Individual on-site systems serve one site and do not require a collection (sewer) system. They are privately owned and they are regulated by the Title 5 regulations.
- Cluster systems serve more than one property and require a collection (sewer) system to convey the wastewater from the properties to the treatment and recharge system. They can be privately or municipally owned. They are regulated by the Title 5 regulations and can be used for maximum-day flows up to 10,000 gpd. This maximum-day flow typically corresponds to a maximum of 30 three-bedroom houses. These types of systems are often required to obtain 50 percent nitrogen removal (19 to 25 mg/L total nitrogen, though the exact requirements depend on specific regulating factors.

The following individual on-site system and cluster system treatment technologies will be identified and screened (this list is based on MassDEP's summary of innovative and alternative [I/A] technologies approved for use in Massachusetts as of August 2009).

1. Individual and Multiple Unit Systems for Flows Less Than 10,000 gpd.

   a. On-site systems approved for general use but not credited for nitrogen removal, including Title 5 systems and equivalent approved alternatives.

   b. On-site nitrogen removal systems, also called I/A technologies, which can be grouped into three categories:

      - Nitrogen removal systems approved for general use by MassDEP in nitrogen-sensitive areas, including
        - Recirculating sand filters that comply with Title 5
        - RUCK® systems (for flows less than 2,000 gpd)
        - MicroFAST®, HighStrengthFAST®, and NitriFAST® (for flows less than 2,000 gpd)
      - Nitrogen removal systems approved for provisional use by MassDEP in nitrogen-sensitive areas, including:
        - Bioclere®
        - MicroFAST®, HighStrengthFAST®, and NitriFAST® (for flows greater than 2,000 gpd)
        - Modular FAST®
        - Amphidrome® Process
        - Waterloo Biofilter®

- AdvanTex®
- NITREX®
- SeptiTech®
- Singulair® (for flows less than 2,000 gpd)

◗ Nitrogen removal systems approved for piloting use by MassDEP in nitrogen-sensitive areas, including:

- RUCK CFT®
- Cromaglass WWT System
- OMNI® Recirculating Sand Filter
- OMNI-Cycle® System (flow flows less than 2,000 gpd)
- NITREX® Plus (for flows less than 2,000 gpd)
- BioBarrier® MBR WWT System (for flows less than 2,000 gpd)

2. Non-discharge Systems.
   a. Tight tanks.
   b. Waterless toilets.
   c. Urine source separation.

These technologies will be described and screened based on their suitability for individual unit applications and for cluster systems in Barnstable based on the criteria described in this chapter.

B. **Treatment Alternatives for Centralized and Satellite Wastewater Facilities.** These types of wastewater management systems have wastewater flows greater than 10,000 gallons per day (gpd) and are regulated by MassDEP through their groundwater discharge permit program and must meet more stringent treatment requirements. There is no universally accepted flow definition that separates centralized from satellite systems. We have chosen definitions for these two types of systems that are consistent with general planning guidance as listed below.

◗ Satellite systems serve more than one property and require a collection (sewer) system. They require a MassDEP discharge permit and must provide nitrogen removal to less than 10 mg/L total nitrogen on a maximum daily basis. They may have more stringent nitrogen limits as well depending on the recharge location. They have discharge limits for other pollutant and nutrient parameters as well. They typically have flows in the 10,000 gpd to 300,000 gpd range. In Barnstable, satellite systems could be larger than 300,000 gpd and it is assumed that they would be municipally owned and managed by the Town's

Water Pollution Control Division of the Department of Public Works which is centered at the Hyannis WPCF.

- Centralized systems typically treat flows greater than 300,000 gpd and need to meet stringent discharge limits (as required for a MassDEP discharge permit) for nitrogen as well as other parameters. The Hyannis WPCF is considered the centralized system in Barnstable.

These centralized wastewater treatment technologies are defined as technologies designed to handle flows from various locations/watersheds in the Town or to serve Barnstable on a Town-wide basis.

Standard centralized and satellite treatment system components include preliminary and primary treatment, secondary/advanced treatment, and treated water recharge. Systems may also include flow equalization, effluent filtration, and effluent disinfection depending on the type of treatment process, the facility location, and permitting requirements as set by MassDEP. The following list summarizes the centralized and satellite treatment technologies which will be evaluated and screened in this report:

1. Secondary/Advanced Treatment.
   - Suspended Growth Biological Treatment Alternatives including:
     - Multiple-stage processes for nitrogen and phosphorus removal.
     - Multiple-stage processes for nitrogen removal.
     - Multiple-phase/cyclical aeration.
     - Membrane bioreactors.
     - Oxidation ditches.
     - Sequencing batch reactors.
     - Multiple sludge processes.
   - Attached Growth Treatment Alternatives including:
     - Rotating biological contactors.
     - Denitrifying filters.
     - Biological aerated filters.
     - Amphidrome System®.
     - Integrated Fixed-Film Activated Sludge (IFAS) processes.

- Plant and Biological Systems.
  - Hydroponic systems.
  - Constructed wetlands.
  - Solar Aquatics®.
  - Lagoons

2. Technologies to Achieve Less Than 3 mg/L Total Organic Carbon.
   - Coagulation and filtration.
   - Adsorption technologies
     - Granular Activated Carbon
     - Biological Activated Carbon
     - Powdered Activated Carbon
   - Membrane filtration
     - Reverse osmosis
     - Nanofiltration
   - Ion exchange.
   - Advanced oxidation technologies.
3. Technologies to Achieve Less Than 1 mg/L Total Organic Carbon.
4. Technologies to Achieve Less Than 3 mg/L Total Nitrogen.
5. Phosphorus Treatment Alternatives.
6. Effluent Disinfection Technologies.
   - Chlorination.
   - Ozone.
   - Ultraviolet radiation.
7. Residual Management Alternatives.
   - Sludge thickening and disposal at a regional facility.
   - Sludge dewatering and disposal at a regional facility.
   - Sludge dewatering and composting for distribution to the public.
   - Land application of sludge.
8. Satellite Wastewater Treatment Facilities.
9. Potential New Treatment Plant Sites.
10. Alternatives for Treatment System Expansion and Upgrade at the Hyannis WPCF.

C. **Treated Water Recharge Technologies and Sites.** This group of alternatives will identify and screen technologies and potential sites to recharge the treated water back to the natural environment. The following technologies will be investigated:

1. Sand infiltration beds.
2. Subsurface infiltration.
3. Spray irrigation.
4. Well injection.
5. Wick well technology.
6. Drip irrigation.
7. Ocean outfall.
8. Wetland restoration.

D. **Collection System Technologies.** The following collection system technologies will be evaluated and screened:

1. Gravity sewers and pumping stations.
2. Pressure sewers and grinder pumps.
3. Septic tank effluent sewers.
4. Vacuum sewer systems.

E. **Screening of Wastewater Management Technologies.** The wastewater management technologies will be described to allow the reader to understand the technology and related process. Advantages and disadvantages will be presented. The screened technologies will then have system characteristics summarized with respect to a set of standard criteria to allow a side-by-side comparison. The summary is typically in the form of a tabular matrix and will end with a recommendation to either eliminate the technology or retain it for further evaluation. The following is a summary of the standard criteria that will be used for screening alternative technologies:

1. **Relative Capital Costs.** Relative capital costs for each alternative will be identified and compared to the other alternatives.

2. **Relative Operation and Maintenance Costs.** Costs to operate and maintain a typical installation of an alternative will be identified and compared to other alternatives.

3. **Flexibility.** Flexibility of a treatment system relates to the ability of that system to respond to seasonal or future changes in flows, loads, and effluent requirements.

4. **Energy Use.** Energy used to operate an alternative will be noted and compared to the other alternatives.

5. **Effluent Quality.** Wastewater treatment systems provide various degrees of pollutant removal of BOD, TSS, and nitrogen. The expected effluent quality for each treatment technology will be identified and compared.

6. **Regulatory Requirements.** This criterion includes a discussion regarding the permits, variances, and monitoring requirements of federal, state, and regional regulatory agencies.

7. **Potential for Air Emissions.** The potential for odors and other air emissions from treatment systems will be discussed.

8. **Land Requirements.** The amount of land needed for each alternative treatment system will be discussed.

9. **Anticipated Public Acceptance.** This criterion involves how the public may react to a specific type of treatment system. Major public concerns regarding these alternatives are expected to include relative cost of installation, visibility, potential for odors, operation and maintenance requirements, and the perceived impact of proposed facilities on neighboring residents.

10. **Ease of Implementation.** Implementation issues will be discussed, such as methods the Town could use to monitor and operate on-site systems or treatment plants over the expected lifetime of the treatment system. Management issues to be discussed include public or private ownership of treatment facilities, obtaining land for multiple home treatment sites, and Town regulations needed to address the potential administrative issues.

11. **Maintenance Requirements and Complexity of Operation.** This criterion is related to the complexity and number of mechanical components of each treatment process. Long-term

reliability and the level of skill needed to maintain a technology will be considered. Reliability and technical feasibility of a process or plan is a function of how consistently it is expected to function and to achieve required effluent limits. In general, long-term reliability decreases as the complexity of mechanical equipment increases.

F. **Flow and Loading Reduction Alternatives.** These are alternatives to reduce wastewater flows and loadings and thereby reduce costs for construction and operation of wastewater facilities. The following alternatives and management opportunities will be reviewed for their application in Barnstable:

1. Inflow and infiltration (I/I) reduction.
2. Reduction of household water consumption.
3. Review of the Town's water pricing structure.
4. Wastewater reuse and recycling.
5. Wastewater loading reduction opportunities.
6. Waterless toilets.
7. Growth management regulation.

G. **Non-Wastewater Nitrogen Mitigation Alternatives.** These are non-wastewater alternatives and opportunities to mitigate nitrogen loadings to the watershed and include:

1. Fertilizer and pet waste management.
2. Watershed modifications for improved nutrient attenuation.
3. Stormwater management and treatment.
4. Improved tidal flushing to the coastal ponds through inlet modifications.
5. Modified zoning or sewer use regulation (growth neutral bylaw).
6. Nitrate barrier wall technology.

These alternatives are screened and the feasible options are recommended for further consideration.