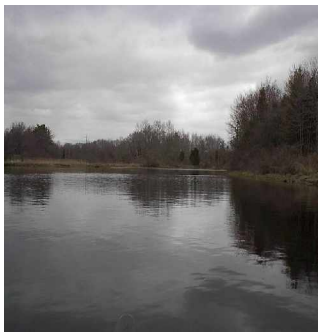
# APPENDIX A

# ALTERNATIVES DEVELOPMENT METHODOLOGY



# NEW HAMPSHIRE SEACOAST REGION WASTEWATER MANAGEMENT FEASIBILITY STUDY

## ALTERNATIVES DEVELOPMENT METHODOLOGY

**Date:** 2/6/06

**To:** NHDES, Great Bay Estuary Commission

**From:** Metcalf & Eddy

**Subject:** Alternatives Development Methodology

**Distribution:** Cc: ENSR, GC&G, Appledore Engineering, Steve Jones, TF Moran, File

### PURPOSE

The purpose of this memorandum is to summarize the methodology used to establish the preliminary alternatives for consideration for the NH Seacoast Wastewater (WW) Management Feasibility Study. The objective of the methodology is to develop and conduct a preliminary screening of potential alternatives to provide wastewater management for the communities of the Great Bay Watershed. The development of alternatives is based on the information collected during preliminary data collection efforts as summarized in the *Final Preliminary Findings Report (December 2005),* although it should be noted that additional relevant information regarding existing conditions will be obtained as available.

### INTRODUCTION

A summary of the data collected on current wastewater management practices and conditions in the seacoast study area was presented in the *Final Preliminary Findings Report*. The presentation included a discussion of existing wastewater treatment facilities (WWTFs) and septage handling, population served, development trends in the study area communities, and water quality and natural resource conditions in the

receiving waters. Figure 1-1 (attached) shows the communities and WWTFs in the study area. The purpose of this next stage of the effort is to identify alternative concepts for wastewater management in the study area communities. These alternative concepts will be presented at a Charrette scheduled for March 25, 2006 to solicit input from the communities, regulatory agencies, the general public, and other interested stakeholders as to the key issues that should be addressed when evaluating which four wastewater management alternatives will be carried forward for more detailed analysis in the subsequent evaluation phase of the project.

Each of the alternatives for wastewater management must contain three components for the existing 17 WWTFs:

- Treatment: how the wastewater is treated to reduce pollutants
- Conveyance: how or where the treated (or untreated) wastewater is conveyed to final discharge (or in the case of untreated wastewater, final treatment and subsequent discharge) location
- Discharge location: the final discharge location for treated wastewater

More detail on each of these components is provided below.

**Treatment**

There are several categories of treatment available for the wastewater flow from the study area communities. These include conventional secondary and advanced wastewater technologies, constructed wetlands, composting toilets or other on-site alternatives, and decentralized treatment system (cluster and satellite systems). The type of treatment to be employed is dependent upon the permitted discharge limits of various wastewater constituents. The permitted discharge limits are dependent upon the discharge location. See Appendix L of the Final Preliminary Findings Report for the Methodology for Development of Future WWTF Permit Limits.

**Conveyance**

There are two primary concepts for conveyance of wastewater. The first is local discharge to either a surface water or land application disposal point. In this concept the locally treated wastewater from a WWTF would be conveyed to a discharge location handling the flow from that community only. The second option would be to convey the treated or untreated wastewater flow from various communities to a regional facility. In the case of receiving untreated wastewater the regional facility would provide treatment and subsequent discharge of the wastewater, or in the case of the wastewater being treated at the local facilities the treated wastewater would be conveyed to a regional facility for disposal.

**Discharge**

There are three discharge concepts under consideration. The first would be to maintain the current surface water discharge locations (river, estuary or Gulf of Maine) for each local facility. The second option would be to discharge treated flow (from either local facilities or a regional facility) to the Gulf of Maine. The third option would be to discharge the treated effluent (from the individual facilities or from a regional facility) to the land (spray irrigation, infiltration beds, etc.).

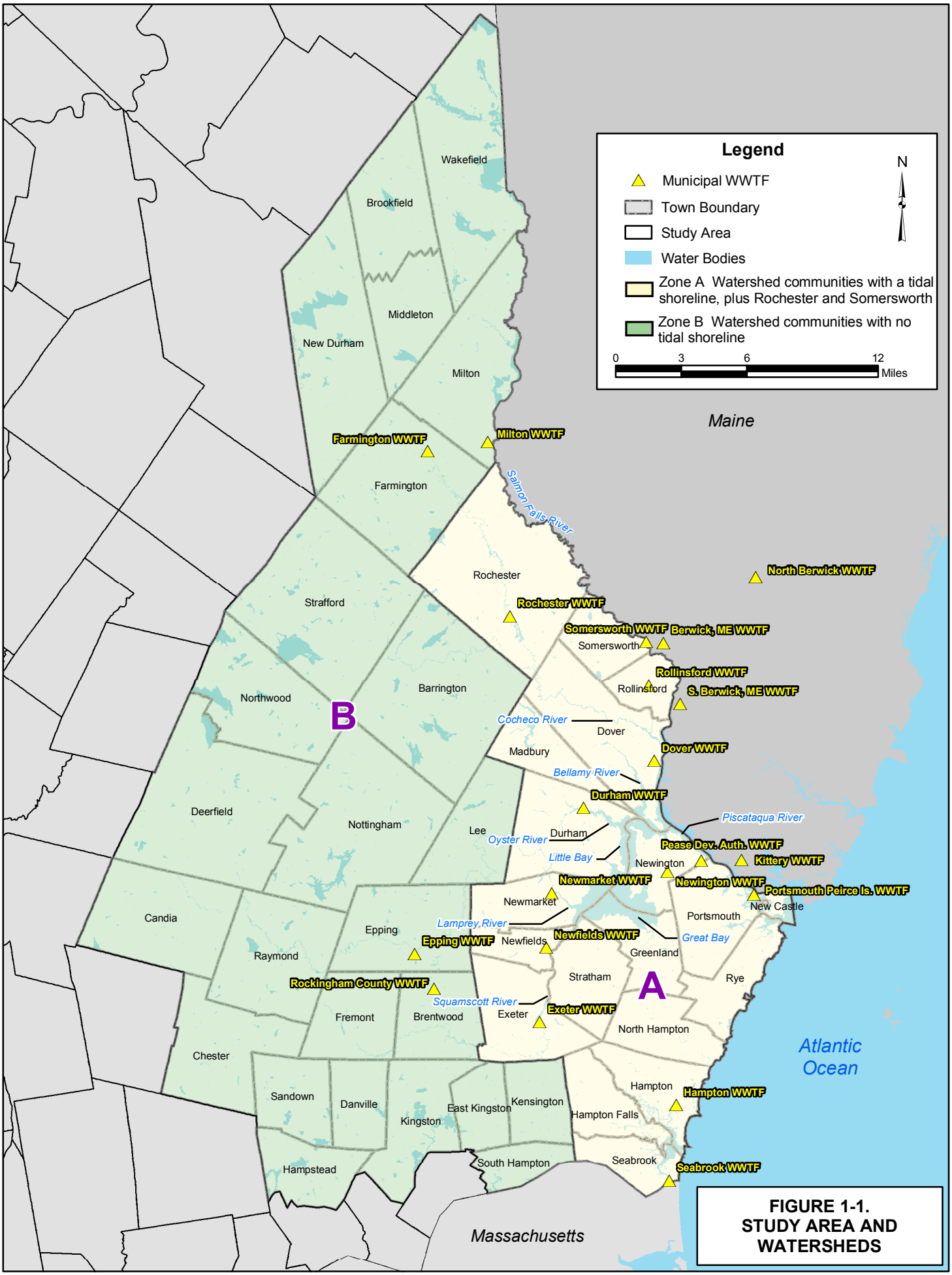



**FIGURE 1-1.**
**STUDY AREA AND WATERSHEDS**

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## DEVELOPMENT OF PRELIMINARY ALTERNATIVES

Each preliminary alternative should contain all three of the aforementioned components (i.e. treatment, conveyance, and discharge). A combination of the components noted above, is presented below in nine basic alternatives. These alternatives assume that all communities would select the same general treatment, conveyance, and disposal methods. It should be noted that all flow from a specific WWTF would be handled in the same manner (i.e. there would be no splitting of flows for different treatment, conveyance, or discharge from a specific WWTF).

Alternative 1. Treatment at existing facilities, discharge at existing surface water discharge locations.
Alternative 2. Treatment at existing facilities, discharge at local individual land application sites if deemed reasonable* or at existing surface water discharge locations.
Alternative 3. Treatment at existing facilities, conveyance to a regional discharge facility for discharge to the Gulf of Maine
Alternative 4. Treatment at existing facilities and conveyance to a regional discharge facility(s) for land application*.
Alternative 5. Collection of untreated wastewater from existing facilities, and conveyance to a regional treatment facility and subsequent discharge to the Gulf of Maine
Alternative 6. Collection of untreated wastewater from existing facilities and conveyance to a regional treatment facility and subsequent discharge to a regional discharge facility(s) for land application*.
Alternative 7. Constructed wetlands alternatives.
Alternative 8. Composting toilets or other on-site alternatives.
Alternative 9. Decentralized wastewater system alternatives (e.g. satellite or cluster systems).

*The general locations of land application sites for treated wastewater will be attempted to be identified in the alternatives development and analysis stage of the study. The reasonableness and favorability of these sites relative to the WWTF location and total estimated wastewater flow will be evaluated in light of the land application area available and volume of flow that area can accommodate.

Alternative Number 1 is essentially the “No Action” alternative, where each individual community would continue to treat and dispose of its own wastewater flow in accordance with existing and future discharge limits imposed by the regulating agencies.

Also, septage disposal for the study area in 2025 (i.e. the 20-year planning period) will be addressed in the alternatives analysis phase of the study. For a discussion on future septage generation and disposal issues in 2025 please see Section 11 of the *Final Preliminary Findings Report*.

## BASIS FOR SCREENING

The basis for the screening criteria of the alternatives presented above and in the subsequent text was the application of professional engineering judgment. It is noted that there are impacts and concerns regarding planning and environmental issues

related to all of these potential alternatives. Also, it should be noted that the four alternatives selected after the Project Charrette for analysis in subsequent phases of the study will be examined for a number of issues (e.g. cost, environmental, water quality) in addition to engineering. However, professional engineering judgment will be the primary screening criteria used to develop a number of possible alternatives to be considered prior to the Charrette.

**Screening Level I Criteria**

Screening Level I Criteria addressed treatment, conveyance, and discharge. Primary consideration in Screening Level I was given to the following factors: whether the treatment technology had a proven track record in this part of the country, whether this technology has been used for this size application, and whether required discharge standards could be reasonably achieved.

**Screening Level II Criteria**

Screening Level II criteria addressed the practicality of collecting and conveying the flow from the more remote WWTFs to an adjacent or a regional facility. To accomplish this, a core and independent set of WWTFs was identified. Alternatives in addition to those that passed the level I screening will be developed once the set of core and independent WWTFs are identified.

Collection and conveyance of flow from WWTFs were examined to determine the ratio of flow to distance (i.e. millions of gallons per day divided by miles) for conveyance. This ratio of flow to distance considered the amount of flow that would need to be conveyed over a distance to combine with other plant flows. A higher ratio would indicate a more cost effective conveyance of flow than a lower ratio. For example it is more cost effective to convey 5 MGD of flow over 1 mile (ratio = 5) than 1 MGD of flow over 5 miles (ratio = 0.20). WWTFs with low flow to distance ratios were considered to be potential independent facilities while those with higher ratios were identified as potential core WWTFs. However, some WWTFs with low flow to distance ratios were still considered for core WWTFs if they were surrounded or “bookended” by WWTFs with more favorable ratios. Adjacent WWTFs with more favorable flow to distance ratios could potentially convey flow from adjacent WWTFs with less favorable ratios as part of a regional solution if desired.

**Screening Level III Criteria**

Screening Level III addressed the identification of core vs. independent WWTFs based on the relative need for specific WWTFs to provide upgrades to their treatment processes to meet assumed discharge limits at future 2025 flow and loads. WWTFs that had predicted capacity to meet future 2025 limits with minimal improvements were identified and were considered to be potential independent facilities. WWTFs that would require significant upgrades (e.g. additional tankage, significant process changes (ex. upgrade from an aerated lagoon to an activated sludge process), a new treatment process (addition of filters, etc.) were identified as WWTFs that might benefit from a regional solution in lieu of conducting upgrades at the local level.

## RESULTS OF SCREENING

### Screening Level I Results

Level I screening considered the following factors: whether the technology has a proven track record in this part of the country, whether this technology has been used for this size application, and whether required discharge standards could be reasonably achieved.

Three of the alternatives noted above (i.e. Alternatives Numbers 7-9) were eliminated from future consideration based on the application of these screening factors. These included the constructed wetlands, composting toilets and other on-site systems, and decentralized wastewater system alternatives.

**Constructed Wetlands**. Constructed wetlands were not considered to be a viable alternative for use in all communities since some type of conventional or advanced wastewater treatment would still be required because constructed wetlands typically only remove 75 percent of total suspended solids, 45 percent of phosphorus, and 25-35 percent of total nitrogen (*NHEP Management Plan 2000*); nitrogen removal is impaired by cold temperatures (*EPA 9/00*), thus use of constructed wetlands may be seasonally restricted and storage facilities may be required. Additionally, size requirements are variable and can range from as low as 2 acres per mgd to as high as 200 acres per mgd of flow (*EPA Constructed Wetlands Treatment of Municipal Wastewater 9/00*). However, it is generally recognized that treatment via constructed wetlands is a fairly land intensive venture. For these reasons, constructed wetlands are not recommended for further consideration for community wide wastewater treatment. There may, however, be an opportunity for use on a small scale within an individual community if that community is not part of a regional strategy.

**Composting Toilets or Other On-Site Systems**. Implementation of composting toilets as well as other on-site systems (septic tanks, etc.) would result in substantial burden for individual users to install and/or retrofit existing plumbing or service connections. Additionally the operation and maintenance of these systems would fall on the users including a significant number of issues that would need to be resolved for institutional users. Additionally, composting toilets were eliminated from further consideration since it would not provide treatment for all wastewater currently generated in a community, and thus some treatment facilities would still be required to handle industrial flow and grey water from residential and non-residential uses. For these reasons, it was determined that composting toilets or other on-site systems would not be a viable alternative for communities in the study area. However, as with constructed wetlands, individual communities or institutional users (such as universities) may want to consider implementation on a small scale basis.

**Decentralized Wastewater Systems.** Decentralized wastewater systems include individual on-lot systems, cluster systems and satellite systems. Cluster or satellite systems typically handle flow from smaller systems. A cluster system typically handles between 1,000 gpd and 10,000 gpd, while satellite systems generally handle flows in excess of 10,000 gpd. The discharges from these facilities are typically sub-surface. These systems are typically employed for new development (housing, nursing homes, and shopping centers). It would not be practical to separate the existing wastewater collection and treatment systems in the study area into a large number of cluster or

satellite systems or into individual on-lot systems. While cluster, satellite, and on-lot systems should be considered for new growth areas in the study area communities, as conditions permit, they are not likely to be used in currently sewered areas. It should be noted that none of the study area communities indicated their desire to provide major sewer extension or the addition of sewer to an unsewered community in the future.

After the Level I screening of alternatives, alternatives numbers 7 through 9 were eliminated from further consideration.

## DEVELOPMENT OF ADDITIONAL ALTERNATIVES

Other alternatives were developed in addition to, and as variations of, alternative numbers 1 through 6 based on identifying "core" WWTFs and "independent" WWTFs. The core WWTFs would be included in a regional solution (treatment, conveyance, discharge) while the independent WWTFs would provide treatment, conveyance and discharge on a WWTF specific basis. WWTFs were eliminated from the core WWTF group by using Screening Level II and III screening criteria.

### Screening Level II Results

Screening Level II criteria looked at the practicality of collecting and conveying the flow from the more remote WWTFs to an adjacent or regional facility. Collection and conveyance of flow from facilities were examined to determine the ratio of flow to distance for conveyance. This ratio of flow to distance looked at the amount of flow that would need to be transported over a distance to be combined with flows from other WWTFs. Ratios less than 0.15 were considered to be unreasonable unless WWTFs with more favorable ratios surrounded that WWTF. Table 1 shows the flow to distance ratios for the study area WWTFs relative to adjacent WWTFs.

**Results.** After the Level II screening was performed the following WWTFs were determined to be eliminated from the core WWTFs and were put into the independent WWTFs category.

- **Epping WWTF**
- **Farmington WWTF**
- **Milton WWTF**
- **Rockingham County WWTF**

## Table 1 - Screening Level II Results

| | FACILITY | Projected 2025 Flow, MGD | Closest WWTF | Distance, mi | Flow Per Mile, MGD/mi | Next Closest WWTF | Distance, mi | Flow Per Mile, MGD/mi | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DOVER WWTF | 2.8 | Durham | 4 | 0.70 | Rollinsford / Newington | 5 | 0.56 | |
| 2 | DURHAM WWTF | 1.1 | Dover | 4 | 0.28 | Newmarket | 4.5 | 0.24 | |
| 3 | EPPING WWTF | 0.216 | Rockingham | 2 | **0.11** | Newfields | 6.5 | **0.03** | < 0.15 |
| 4 | EXETER WWTF | 2.1 | Newfields | 4.0 | 0.53 | Rockingham | 5.5 | 0.38 | |
| 5 | FARMINGTON WWTF | 0.26 | Milton | 4 | **0.07** | Rochester | 9 | **0.03** | < 0.15 |
| 6 | HAMPTON WWTF | 2.8 | Seabrook | 4 | 0.70 | Exeter | 7 | 0.40 | |
| 7 | MILTON WWTF | 0.06 | Farmington | 4 | **0.02** | Rochester | 7.5 | **0.01** | < 0.15 |
| 8 | NEWFIELDS WWTF | 0.054 | Newmarket | 2.5 | **0.02** | Exeter | 4 | **0.01** | < 0.15, but between Exeter and Newmarket |
| 9 | NEWINGTON WWTF | 0.16 | Pease | 1 (shared outfall) | - | Peirce Island | 3.5 | **0.05** | < 0.15, but between Dover, Pease and Peirce Island |
| 10 | NEWMARKET WWTF | 0.77 | Newfields | 2.5 | 0.31 | Durham | 4.5 | 0.17 | |
| 11 | PEASE DEVELOPMENT AUTHORITY WWTF | 0.52 | Newington | 1 (shared outfall) | - | Peirce Island | 3 | 0.17 | |
| 12 | PEIRCE ISLAND WWTF | 5.2 | Pease | 3 | 1.73 | Newington | 3.5 | 1.49 | |
| 13 | ROCHESTER WWTF | 3.5 | Somersworth | 6 | 0.58 | Rollinsford | 7 | 0.50 | |
| 14 | ROCKINGHAM COUNTY WWTF | 0.112 | Epping | 2 | **0.06** | Exeter | 5.5 | **0.02** | < 0.15 |
| 15 | ROLLINSFORD WWTF | 0.11 | Somersworth | 1.5 | **0.07** | Dover | 5 | **0.02** | < 0.15, but between Somersworth and Dover |
| 16 | SEABROOK WWTF | 1.2 | Hampton | 4 | 0.30 | NA | | | |
| 17 | SOMERSWORTH WWTF | 1.3 | Rollinsford | 1.5 | 0.87 | Dover | 6 | 0.22 | |

Note – WWTFs in bold had flow to distance rations less than 0.15 and were considered to be independent WWTF

**Screening Level III Results**

Level III screening looked at the relative need for the remaining "core" WWTFs to provide upgrades to their treatment processes to meet discharge limits at future 2025 flow and loads. WWTFs that had sufficient capacity to meet future limits with minimal facility improvements were identified and were considered to be potential independent facilities. WWTF that require significant upgrades (additional tankage, significant process changes, etc.) to meet the future 2025 limits were identified as WWTF that might benefit from a regional solution instead of conducting upgrades at the local level. These WWTFs were identified as "core" WWTFs with some exceptions. Table 2 summarizes the Screening Level III results.

**Results.** After the Level III screening was performed the following WWTFs were identified as requiring minor or no upgrades and were put into the independent WWTF category.

- **Newington WWTF**
- **Pease Development Authority WWTF**
- **Rochester WWTF**
- **Rollinsford WWTF**
- **Seabrook WWTF**

**Exceptions**. There were some exceptions to the results of Level III screening that changed the grouping of some identified "core" WWTFs to or independent WWTFs or vice versa. These exceptions are described below.

**Peirce Island WWTF** – It is anticipated that this WWTF will need a major upgrade to meet the assumed effluent limits in year 2025. Site space is limited. Due to space limitations, if a new facility was built on site it would likely not be designed to accommodate flow from other WWTFs as it could use any additional capacity to help maximize its peak flow capacity. This WWTF is also located at a considerable distance from the identified core WWTFs (in many cases on the opposite side of the Great Bay). Therefore, this WWTF is being grouped with the independent WWTFs.

**Somersworth WWTF -** Although the analysis of the Somersworth WWTF predicted that the WWTF may not be able to meet 2025 effluent limits it should be noted that the WWTF has recently undergone a significant upgrade. The criteria developed to evaluate the different WWTFs were developed to provide a general uniform analysis of the different WWTFs for the purposes of comparison. These criteria may be underestimating the capacity of this facility, potentially due the specialized MUCT (modified University of Cape Town) treatment process being used for nutrient removal. Therefore, it is reasonable to assume that due to the WWTF recently undergoing a major upgrade (design year 2020) that this facility will have capacity to meet the 2025 effluent limits. This WWTF will be regrouped with the independent WWTFs.

**Hampton WWTF –** Hampton was identified as a WWTF requiring some upgrades to meet 2025 discharge limits. This criterion would categorize this WWTF in the independent category. However, if a Gulf of Maine discharge was considered for a core WWTF alternative, the pipeline route to an outfall would likely need to pass through a coastal area. Therefore, in the case of the alternatives with the core WWTFs discharging to the Gulf of Maine, the Hampton WWTF will be considered part of the core

**Table 2 - Screening Level III Results**

| | FACILITY | Projected 2025 Flow, MGD | Projected 2025 Existing Surface Water and Land Application Discharge Upgrade Requirements | Upgrade Significance |
|---|---|---|---|---|
| 1 | DOVER WWTF | 2.8 | Secondary Tankage (Aeration and Clarifiers), Total Nitrogen Removal Modifications | Significant |
| 2 | DURHAM WWTF | 1.1 | Primary Tankage, Aeration tankage, disinfection upgrade, Total Nitrogen Removal Modifications, Filtration | Significant |
| 3 | EPPING WWTF | 0.216 | Screened out in Level II | - |
| 4 | EXETER WWTF | 2.1 | Major Secondary Process Upgrade w/ Total Nitrogen Removal Capability | Major |
| 5 | FARMINGTON WWTF | 0.26 | Screened out in Level II | - |
| 6 | HAMPTON WWTF | 2.8 | Secondary Tankage (Aeration), Sludge Processing Capacity | Minor |
| 7 | MILTON WWTF | 0.06 | Screened out in Level II | - |
| 8 | NEWFIELDS WWTF | 0.054 | Major Secondary Process Upgrade w/ Total Nitrogen Removal Capability | Major |
| 9 | NEWINGTON WWTF | 0.16 | Total Nitrogen Removal Modifications and Aeration Capacity | Minor |
| 10 | NEWMARKET WWTF | 0.77 | Major Secondary Process Upgrade w/ Total Nitrogen Removal Capability, Additional Secondary Clarifier Capacity, Disinfection Capacity | Major |
| 11 | PEASE DEVELOPMENT AUTHORITY WWTF | 0.52 | Disinfection capacity | Minor |
| 12 | PEIRCE ISLAND WWTF | 5.2 | Major Secondary Process Upgrade w/ possible Total Nitrogen Removal Capability, limited collection system capacity (CSOs) | Major |
| 13 | ROCHESTER WWTF | 3.5 | Secondary Clarifier Capacity (already have filters) | Minor |
| 14 | ROCKINGHAM COUNTY WWTF | 0.112 | Screened out in Level II | - |
| 15 | ROLLINSFORD WWTF | 0.11 | None | None |
| 16 | SEABROOK WWTF | 1.2 | Aeration Capacity | Minor |
| 17 | SOMERSWORTH WWTF | 1.3 | Analysis indicated need for significant upgrade | Assumed Minor |

Note: The upgrade requirements is the most to the least significant in the following order Major > Significant > Minor > None

WWTFs. However, for core WWTF alternatives that do not include a Gulf of Maine discharge, the Hampton WWTF will be grouped with the independent WWTFs.

## ADDITIONAL ALTERNATIVES

Table 3 shows Alternative numbers 1- 6, which resulted from the Level I screening in which all communities would select the same general treatment, conveyance, and disposal methods. Table 3 also summarizes additional alternative (Alternative numbers 7-10) which resulted from the Level II and III Screening. Alternatives numbers 7-10 were developed based on placing the individual WWTFs into either a core WWTF group or an independent WWTF group. In Alternatives 7-10 the core WWTFs would employ a regional solution with all of the core WWTFs employing the same treatment, conveyance and discharge solution on a regional level and the independent WWTFs would provide their own treated discharge to either their existing receiving water or to a land discharge. Table 4 provides a summary list of the core and independent WWTFs for Alternatives numbers 7-10.

It is noted that there are concerns regarding planning and environmental issues related all of these potential alternatives. The four alternatives selected after the Project Charrette for analysis in subsequent phases of the study, will be examined for a number of issues in addition to engineering that will address these concerns. Should additional information relative to the various issues examined indicate that a specific WWTF should or should not be in the currently identified group of either core or independent WWTFs, then that WWTF's group may be adjusted at that time.

## SUMMARY OF ALTERNATIVES

The 10 alternatives presented are categorized and summarized as follows:

- Alternative Numbers 1 and 2 – All study area WWTFs provide treatment and discharge independently.
    - Alternative 1 is essentially a "No-Action" alternative (current discharge location).
    - Alternative 2 will examine land application of individual WWTF discharges.

- Alternative Numbers 3-6 – All study area WWTFs will employ a regional solution combining the following components:
    - Treatment at either all local WWTFs or at regional WWTF.
    - Regional effluent discharge to the Gulf of Maine or via land application.

- Alternative Numbers 7 -10 – All study area WWTFs will be identified as either core or independent WWTFs
    - The independent WWTFs will provide treatment and discharge independently and;
    - The core WWTFs will employ a regional solution combining the following components:
        - Treatment at either all the core WWTFs or at a regional WWTF.

- Regional effluent discharge to the Gulf of Maine or via land application.

**Table 3—Preliminary Wastewater Management Alternatives**

| Alternative Number | Description | | |
|---|---|---|---|
| **1** | Treatment at existing facilities, discharge at existing surface water discharge locations. | | |
| **2** | Treatment at existing facilities, discharge at local individual land application sites if deemed reasonable* or at existing surface water discharge locations. | | |
| **3** | Treatment at existing facilities, conveyance to a regional discharge facility for discharge to the Gulf of Maine | | |
| **4** | Treatment at existing facilities and conveyance to a regional discharge facility(s) for land application*. | | |
| **5** | Collection of untreated wastewater from existing facilities, and conveyance to a regional treatment facility and subsequent discharge to the Gulf of Maine | | |
| **6** | Collection of untreated wastewater from existing facilities and conveyance to a regional treatment facility and subsequent discharge to a regional discharge facility(s) for land application*. | | |
| **Alternative Number** | **Core Community Treatment** | **Core Community Discharge** | **Independent Community Treatment and Discharge** |
| **7** | Existing WWTF | Regional Gulf of Maine Discharge | Treatment at existing WWTF with discharge to either existing surface water or land application site if reasonable*. |
| **8** | Existing WWTF | Regional Land Discharge | Treatment at existing WWTF with discharge to either existing surface water or land application site if reasonable*. |
| **9** | Regional WWTF | Regional Gulf of Maine Discharge | Treatment at existing WWTF with discharge to either existing surface water or land application site if reasonable*. |
| **10** | Regional WWTF | Regional Land Discharge | Treatment at existing WWTF with discharge to either existing surface water or land application site if reasonable*. |

*The general locations of land application sites for treated wastewater will be attempted to be identified in the alternatives development and analysis stage of the study. The reasonableness and favorability of these sites relative to the WWTF location and total estimated wastewater flow will be evaluated in light of the land application area available and volume of flow that area can accommodate.

**Table 4 – WWTF Grouping for Alternatives 7-10**

| Core WWTFs | Independent WWTFs |
|---|---|
| Dover<br>Durham<br>Exeter<br>Hampton (for ocean discharge only)<br>Newfields<br>Newmarket | Epping<br>Farmington<br>Hampton (land discharge core alternatives only)<br>Milton<br>Newington<br>Pease Development Authority<br>Peirce Island<br>Rochester<br>Rockingham County<br>Rollinsford<br>Seabrook<br>Somersworth |