5 Cost Evaluation and Operations and Maintenance Considerations

5.1 Introduction

Cost evaluations as part of this project—and ultimately its implementation—are being performed in multiple steps. The initial step, started in 2008, was used to compare the various alternatives being considered on a macro scale across the entire watershed areas including adjacent communities. The purpose of developing costs at this scale is to consider alternatives on a side-by-side analysis and attempt to provide the large (whole) picture. The second step which will be included in the development of the Recommended Plan and reported in the Draft Recommended Plan/Draft Environmental Impact Report (DEIR) Document will be the further cost effectiveness analysis to refine the Recommended Plan to identify and compare cost-effective alternatives (shellfish aquaculture, PRBs, cluster systems, regional solutions, and ownership/operational issues etc.) for the Town of Mashpee to consider as part of implementation. These costs would then be further refined as part of the Final Recommended Plan/Final Environmental Impact Report (FEIR), and ultimately as part of any design phase and implementation. It is important to understand that costs developed in this Alternatives Screening Analysis Report (ASAR) are for comparing alternatives scenarios developed to date based on traditional implementation methods. It is also important to note that each of these alternatives/options is looking at the nitrogen removal first. Once that is established, these options are compared on this traditional path to set the baseline upon which all other cost refinements can be compared. Because some of these “refinements”—like shellfish, PRBs, etc.—have not been assigned a “nitrogen credit value”, the baseline reflects the regulatory backup if performance is not proven out over long-term implementation.

As the project proceeds to the development of the Recommended Plan, the costs in the Recommended Plan would then be broken into implementation phases, refined to take advantage of phased implementation and financing mechanisms and alternative technologies to maximize the cost-effectiveness of implementation. It is also important to note that costs in the planning phase include a significant contingency (typically on the order of 25- to 30-percent), to deal with unknowns that aren’t typically identified until final design. As the design progresses, these contingency values are typically reduced to 10- to 15-percent, and ultimately the actual cost will come down to the construction bidding climate at the time the project is to proceed. Projects receiving funding from the State Revolving Fund (SRF) will then carry approximately 5-percent contingency into construction to deal with changed conditions.

Because each alternative is dependent on achieving the TMDL, the key factor is how much nitrogen can be recharged within a watershed at a particular location. Each of the alternatives presented to date include some component of reuse of existing septic systems, reuse of existing WWTFs, upgrade of existing WWTF, construction of new WWTFs, and regional solutions, all of which are based on a future build-out condition.

Phasing—for the purpose of these reports—will be defined as how costs will be divided over a projected timeline in the project to achieve TMDL compliance, and the target areas and approaches that will come first versus those implemented in later stages (if necessary) to deal with growth and the findings of adaptive management. Those items will not be presented in this report, but will be addressed in the next report as outlined in Chapters 6 and 7. Density, proximity to sensitive receptors, seasonal/year-round

occupancy, proximity to existing infrastructure, and existing versus build-out projected use will all be considered in the subsequent report.

5.2 2008 Cost Analysis

A detailed cost evaluation was prepared as part of the development of the 2008 scenarios presented in the Draft Alternatives Report. These costs were then used as the basis of discussing the various options to be considered in formulation of the Recommended Plan as described in Chapter 3.

The approach was to look at comparing alternative solutions to an area and showing the relative cost difference between them; this is in contrast to the full development of a cost for every option as there are multiple “choices” that can be considered.

Appendix H includes Table 4-5 which presents a summary of the required infrastructure for each scenario. These infrastructure totals were used to develop costs in order to compare the four scenarios (1, 2, 4, and 5). Scenario 3/3R—Cluster by LAI was evaluated by others and is presented in detail in a document included in Appendix F. For the purpose of the cost evaluations the term “scenario” will refer to costs developed for scenarios 1, 2, 4, and 5. Costs for Scenario 3/3R—Cluster by LAI are included in Appendix F.

Because each scenario could conceivably use any number of technologies identified and recommended as part of the Technology Screening Report analysis, specific technologies were identified in this report so that preliminary (order of magnitude) costs could be developed. The intent of the cost comparison presented here is to be able to compare each of these initial scenarios that have been identified by the Sewer Commission for MEP analysis. This analysis is not intended to represent the final cost or selection of technologies; rather, it is to provide a common basis for evaluating Scenarios 1, 2, 4, and 5. The technologies used as the basis for this cost evaluation are as follows:

- Gravity and pressure (grinder pump) collection systems
- Sand infiltration and subsurface leaching facilities
- Sequencing Batch Reactors and denitrification filters for new facilities
- Allowance for process expansion and modification at existing facilities

The technologies identified above are applied to each scenario equally. Therefore, it is the intent of this analysis that if vacuum or STEP sewer systems were used in place of pressure and gravity sewers that these changes would be made in all scenarios and the relative change would not impact the findings of the cost evaluation, only the bottom line costs. The same methodology is true for the consideration of other wastewater technologies in place of SBRs. The ultimate goal of the development of these scenarios is to achieve the total nitrogen TMDLs. If each scenario achieves the TMDLs following MEP modeling, then the relative cost comparisons would be used as a guide for refining and selecting new scenarios to be evaluated further. As developed, the costs are intended to provide a means of side-by-side comparison.

Additional detailed analysis and cost evaluations will be developed as these scenarios are refined, and when recommended technologies are selected and approved by the Sewer Commission. The refined cost evaluations (as described in Section 5.1—Introduction) for future scenarios, and ultimately the Recommended Plan, will be based on those findings.

Estimated capital costs for each scenario (1, 2, 4, and 5) were developed for the following:

- Individual I/A system costs
- Upgrades to existing facilities
- Collection system costs
- New wastewater treatment facilities
- Treated water recharge facilities

Because a detailed design will not be prepared until after the completion and approval of a Recommended Plan, typical costs are applied. The preliminary collection system layouts created in 2008 allowed for a certain level of detail based on linear feet of pipe, number of pumping stations, etc. Data from the Barnstable County Health Department's report for Eastham, Massachusetts was used as a basis for individual system costs. Allowances were made for additional treatment required to achieve closer to 10 mg/L total nitrogen in the effluent; O&M costs were adjusted to account for additional sampling requirements expected to achieve TMDL compliance.

Wastewater treatment facility costs were based on similar projects and equipment cost quotes from equipment suppliers with allowances for site work, yard piping, electrical and instrumentation, general conditions, etc. Additional allowances were made for engineering, contingencies, and fiscal and legal issues. Costs for the four scenarios did not include allowances for acquisition of private facilities, land, or easements.

Estimates were also made on O&M costs that could be expected for each facility. O&M costs for existing facilities were only presented as "estimated additional" O&M costs that might be expected for a substantial upgrade to an existing system in order to generate a reasonable estimate of present worth. Gravity system O&M cost estimates are based on the gravity system only, and the O&M costs associated with the force mains and pumping stations is included in the force main O&M number. I/A system O&M cost estimates are based on allowances for electrical, maintenance, laboratory analyses, and sludge pumping.

O&M costs are converted into present worth cost in order to calculate an estimated total present worth of each scenario. Present worth analysis is based on February 2008, with a discount rate of 4.875-percent based on U.S. Department of Treasury rates effective for Water Resource Development Act. The rate was applied for a 20-year period using the equation for uniform series present worth.

Estimated total capital costs are presented for each scenario in Appendix H Table 4-7 from the draft 2008 report.

It is important to identify that costs for implementation of any Recommended Plan will be incurred over an extended time period based on the magnitude of the problem and the economic impacts associated with such a solution. Project phasing and actual future growth will also impact costs. Therefore, the use of adaptive management to monitor cost and performance will be discussed in greater depth as part of the Recommended Plan. The monitoring of the embayment systems, implementation of growth controls through land use and zoning, and implementation of best management practices for control of run-off and other non-wastewater nitrogen contributions will all aid in the management of wastewater and may provide for a reduction in sewering. As Towns are forced to achieve higher levels of treatment to achieve nitrogen removal, phosphorus removal, or other wastewater constituents, the costs will likely increase to provide these higher levels of treatment.

5.3 Updated Cost Evaluation

The unit costs used as part of the original 2008 work were then used as a basis to provide a Mashpee-focused cost basis. In 2008, costs included estimates for infrastructure within the other planning area Towns of Barnstable, Falmouth, and Sandwich. Because each of those communities is actively pursuing their own planning efforts in order to develop cost-effective means for each to address their own Town-wide water resource management issues, it was decided by the Sewer Commission to focus on Mashpee costs.

This updated 2013 cost basis was used for an estimated average cost per wastewater generating property served and was applied to the new "service areas" of Options 1A, 1B, and 1C as outlined in Chapter 4. The estimated costs for collection systems were updated based on recently bid projects on Cape Cod adjusted for an ENR index of 9483 for April 2013. An average of $22,500 per property connected was used for the collection system costs, which includes the sewer mains, pumping stations, and road construction. These costs do not include property-owner connection costs, treatment, recharge, force mains, or any of the design or contingencies as outlined in the following Table 5-1. In 2008, the number of estimated parcels served in Mashpee ranged from 5,300 to 5,700 depending on the scenario, and the new options are between 5,900 and 6,100 Mashpee parcels out of approximately 8,000.

Costs were then adjusted to provide a total capital cost estimate, including wastewater treatment and treated water recharge site.

These costs were developed based on traditional implementation methods as identified as part of the 2008 scenarios and in this report. However, a goal of this project as part of the Recommended Plan development (a process as outlined in Chapters 6 and 7 of this report) is to use these costs as the starting point (baseline) and then look at the cost-effectiveness of reducing sewer areas through the use of shellfish aquaculture, potential cost comparisons of using a regional MMR facility or cluster neighborhood systems, or other means.

As described previously, phasing and prioritization will be considered in the Recommended Plan report which will also look at cost-saving approaches.

The following Tables 5-1 through 5-4 present the Engineering Estimate of Project Capital Costs for order of magnitude comparison in millions of dollars for a traditional approach of addressing wastewater in Options 1A, 1B, and 1C. As you will recall, Options 1A, 1B, and 1C do not discuss treatment technologies, they only focus on the concentration of the recharge and the location of that recharge within the watersheds, and what would remain in I/A, septic system, or existing WWTFs throughout the Project Planning Area.

Table 5-1 Comparison of Estimated Scenarios/Options Collection System Costs [1, 2]

Estimated Collection System Costs	Option 1A	Option 1B	Option 1C
Collection System Construction Cost[3]	$130	$134	$130
Force Mains[3]	$21	$19	$21
Subtotal	$151	$153	$151
General Conditions	$23	$23	$23
Total Construction Cost	**$174**	**$176**	**$174**
Contingency	$43	$44	$43
Fiscal, Legal,	$17	$18	$17
Engineering (Design and Construction)	$33	$33	$33
Total Collection System Capital Cost	**$267**	**$271**	**$267**

Notes:

1. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.
2. Costs do not include the siting and construction of new wastewater collection/treatment/recharge facilities in Barnstable, Falmouth, or Sandwich.
3. Collection System Costs include pumping station. Costs do not include land acquisition. Force main costs are based on estimated lengths of force mains from pumping station to discharge point. Costs also include force main from WWTF to treated recharge site. Does not include costs associated with land acquisition.

Table 5-2 Comparison of Estimated Scenarios/Options WWTF Costs[1, 2]

Estimated WWTF Costs	Option 1A	Option 1B	Option 1C
Construction Cost for Modification to Existing WWTFs [3]	$14	$11	$14
Construction Cost for New WWTFs [5]	$28	$37	$28
Construction of Treated Water Recharge Facilities [4]	$8	$9	$9
Subtotal Wastewater Treatment Facility Construction Costs	$50	$57	$51
General Conditions	$8	$9	$8
Total Construction Cost	**$58**	**$66**	**$59**
Contingency	$15	$17	$15
Fiscal, Legal	$6	$7	$6
Engineering (Design and Construction)	$11	$13	$11
Total WWTF Capital Cost	**$90**	**$103**	**$91**

Notes:

1. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.
2. Collection system costs presented in Table 5-1.
3. Does not include costs associated with acquiring the facility.
4. Costs do not include the siting and construction of new wastewater collection/treatment/recharge facilities in Barnstable, Falmouth, or Sandwich.
5. Costs include facilities at new sites and estimated expansion on some existing sites. Does not include costs associated with land acquisition.

Table 5-3 Comparison of Estimated Scenarios/Options I/A Component Costs[1, 2, 3, 4]

Estimated Individual System Upgrade Costs	Option 1A	Option 1B	Option 1C
Individual I/A Systems Construction Costs	$ -	$ -	$ -
Total Construction Cost	$ -	$ -	$ -
Contingency	$ -	$ -	$ -
Engineering (Design)	$ -	$ -	$ -
Total Capital Cost	**$ -**	**$ -**	**$ -**

Notes:

1. Options 1A through 1C were estimated based on traditional collection, treatment, and recharge at a cluster system, new WWTF, or existing WWTF.
2. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.
3. Costs do not include the siting and construction of new wastewater collection/treatment/recharge facilities in Barnstable, Falmouth, or Sandwich.
4. Does not include costs associated with land acquisition.

Table 5-4 presents the summary of estimated capital costs for each Scenario/Option as presented in Tables 5-1 through 5-3 and includes collection, treatment, recharge and individual I/A facilities.

Table 5-4 Comparison of Estimated Scenarios/Options Total Capital Costs [(1)]

Estimated Individual System Upgrade Costs	Option 1A	Option 1B	Option 1C
2013 Total Capital Cost (from Tables 5-1 through 5-3)	$357	$374	$358

Notes:

1. Costs presented in millions of dollars. Based on 2013 ENR of 9483. Based on future build-out condition.

5.4 Operation, Maintenance, and Monitoring of Plan Components

Operation, maintenance, ownership, and monitoring of the components of any plan will also have a significant impact on the system costs. Whether a Town or District owns/operates/maintains each of their system components (pumps, stations, treatment facilities, etc.) or relies on contract operations, private ownership, etc., these all have an impact on costs. The following section discusses some of the options the Town/District will have to consider regarding the management and operation of these systems.

5.4.1 Decentralized Facilities

Although large-scale implementation of denitrifying on-site systems will not meet the total nitrogen TMDLs for the planning area as previously modeled by MEP, there will be areas that will likely remain on some type of "individual" system (i.e. septic system, denitrifying septic system, eco-toilet, etc.). Although these systems will be considered part of the Recommended Plan as individual systems, working to achieve TMDLs for regulatory requirement will require a higher level of operations, maintenance, and monitoring to verify that they are meeting the overall goal of the project. Unfortunately this approach of meeting a TMDL makes regulating the individual operation, maintenance, and monitoring of these systems more complex as the plan is relying on their performance as much as any other system.

Denitrifying systems—and possibly the retrofit of an existing residence or business to eco-toilets—are a larger investment that must be properly operated and monitored if they are expected to achieve (or show compliance with) the required nitrogen removal. They will require operation, maintenance, and monitoring knowledge and skill that was not required for Title 5 systems. Denitrifying systems require additional maintenance and monitoring beyond the typical Title 5 system, and require owners to have a better understanding of their system and its requirements for proper operation. Most town health departments do not have the resources to regulate large-scale implementation of these systems or to provide the continuous monitoring for compliance. Therefore, if left to the private homeowner, these systems (or components of these systems) would have to be operated/monitored by a third party (contract operator or Town/District/County Agency).

As the Town finalizes its legislation allowing the formation of a Water and Sewer District, the town(s) within the planning area may have to consider the possible formation of decentralized management districts to address concerns regarding maintenance, operations, and monitoring of these systems. A decentralized management district could be set up similar to a sewer or water district through special legislation in the Massachusetts Legislature. That legislation would define the limits, function, and responsibility of the district. The district would be staffed to provide the following possible functions:

- On-site system records storage
  - system pumping records
  - system design
  - monitoring and performance data
- System maintenance and repairs
- Regulatory enforcement
- Summary reporting on district (watershed) performance
- Monitoring on other district or watershed issues such as fertilizer usage or stormwater system operations

This type of district could report to the Board of Selectman, Board of Health, Water and Sewer District, or another similar entity.

5.4.2 Larger Private Facilities or Private System Components

Similar to individual home systems, grinder pumps, STEP/STEG pumps and or septic tanks, and some vacuum system components (i.e. valve pits/buffer tanks) could be owned and operated by individual users. Vacuum system manufacturers recommend against this; however some of their components may require installation on private property, or multiple property easements in order to be implemented. Similarly, pumping systems or those requiring access to septic tanks (like STEP/STEG) may also require these types of easements, creating operations and maintenance issues for the Town/District to maintain a fully operational system; therefore, these issues must be considered during the planning stages of the project.

The next section highlights some of the options available for Towns/Districts to deal with these issues. It is important that discussions regarding these issues begin so the phasing and implementation can take these into consideration.

5.5 Options for Ownership and Management of Facilities

Several documents have been developed on the regional, state, and federal level discussing management options that Mashpee will need to consider as they develop an approach to own and operate these facilities.

5.5.1 Federal Guidance

United States Environmental Protection Agency (USEPA) published the “Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems” in March 2003. This document presents five different management models that could be employed by a Town or Regional Management Entity. These could relate to several issues including:

- Grinder/STEP pumping systems
- Package/Cluster Treatment Facilities
- Onsite septic/denitrifying (I/A)/eco-toilet type systems

The five models identified are as follows:

1. **Model 1—Homeowner Awareness Model.** The homeowner/association is educated on their system, including operations and maintenance requirements.
2. **Model 2—Maintenance Contract Model.** The homeowner/association is required to contract with a maintenance company to maintain their system, usually for those onsite systems that would go beyond a standard Title 5 system in Massachusetts.
3. **Model 3—Operating Permit Model.** This would be applicable to those properties in the planning area that would be required to have an I/A system based on their location or the current Water Reuse Regulations. This would be similar to a groundwater discharge permit for each individual property falling into this category.
4. **Model 4—Responsible Management Entity (RME) Operation and Maintenance Model.** This would be similar to Model 3, except a management district/Town department would be responsible for permit compliance, however the system would still be owned by the homeowner/association.
5. **Model 5—RME Ownership Model.** This is taking Model 4 to the next level where the system ownership and maintenance requirements fall on the management district/Town department and the homeowner/association is no longer responsible for the system.

A more detailed summary of the Management Models presented in the above referenced document is included in Appendix H.

5.5.2 State Guidance

MassDEP also prepared a guidance document as part of the Massachusetts Estuaries Project. This document entitled “Embayment Restoration and Guidance for Implementation Strategies” was published in 2003, and discusses several approaches to nitrogen reduction including the formation of management districts. Mashpee has already started this process related to the formation of a Water and Sewer District; however until the legislation regarding that District is completed it is unclear how individual systems and existing systems will fit into this new structure. Their inclusion in this new District is currently being considered.

This state guidance document summarizes the advantages of a “District Approach” in dealing with nitrogen reduction, including the flexibility and funding advantages this type of approach to management could provide. The document also identifies the three legal options for creation of such districts:

1. **Massachusetts General Law**
   - Formation of “Water Pollution Abatement Districts”, as defined under the Massachusetts Clean Water Act
   - Creation of “Independent Water and Sewer Commissions and Inter-municipal Agreements”
   - Creation of “Regional Health Districts” for two or more municipalities
2. **Special Act of the Legislature.** Allows municipalities to file home-rule petitions requesting enactment of a special law. The best example of this on Cape Cod is Provincetown’s legislation on the “checkerboard” approach to sewering.

3. **Municipal Home Rule Authority, Bylaws, and Regulations.** Essentially, this provides the municipality the ability to use Zoning Bylaws, General Bylaws, and Local Boards of Health to regulate wastewater. This is currently being applied in Chatham with the Board of Health's Interim Nitrogen Loading Regulations.

5.5.3 Regional Guidance

The Cape Cod Commission (CCC) also developed a "Cape Cod Comprehensive Regional Wastewater Management Strategy Development Project" Report published in June 2003. This document also discussed Wastewater Management Districts.

The formation of a District or Town department to manage these types of systems will need to be considered as part of any alternative plan.