SECTION 11

RECOMMENDED PLAN

11.1 INTRODUCTION

The previous ten sections of this report describe:

- the documentation of wastewater management needs;
- the identification and evaluation of available solutions for those needs; and
- the detailed evaluation of three distinct wastewater and nutrient management plans.

All of that evaluation and planning leads up to the identification of a single comprehensive plan which is described in this chapter.

11.2 DEVELOPMENT OF RECOMMENDED PLAN

11.2.1 Activities of the WMSC

The WMSC has met regularly during the development of the CWMP, generally twice per month. At those meetings, the Committee has reviewed numerous technical letters from its consultant, made interim decisions as the planning has progressed, and methodically narrowed its search for the best wastewater management plan.

Section 7 of this report summarizes the three wastewater plans that the Committee has evaluated in detail. Those plans all address the TMDLs that are in place or expected to be adopted to reduce watershed nitrogen loads under the federal Clean Water Act. Those plans are:

- **Plan 1:** Decentralized wastewater treatment at four sites and effluent disposal at eleven sites:
- **Plan 2:** Centralized treatment and disposal at the site of the existing Tri-Town Septage Treatment Facility; and

- **Plan 3:** Centralized treatment and disposal at sites in South Orleans and/or Brewster with summer spray irrigation of Brewster golf courses.

During the period of May to August 2008, those three plans were analyzed with respect to a number of cost, environmental and technical factors, and were the subject of significant public review.

11.2.2 Public Consultation Process

The entire wastewater planning process has benefited from an aggressive program of public consultation, led by both the WMSC and the Citizens Advisory Committee (CAC). That effort is summarized in Appendix C. Public consultation has taken many forms, including:

- Regular meetings of the WMSC that are televised and open to the public;
- Well-attended public meetings on each of three interim reports, at which the public raised many thoughtful concerns and insightful points;
- Periodic WMSC progress reports to the Board of Selectmen, which are televised; and
- A series of weekly workshops held Tuesdays evenings from July 7 to August 19, 2008. Six of the workshops were focused on individual neighborhoods in Orleans, and the last was open to the entire town. A total of 414 people attended.

The workshops included a series of posters describing the project, an overview by members of the WMSC and CAC, and the opportunity for the public to make comments verbally and in writing through a survey form. The posters were available for review at any time that Town Hall was open, and "walk-ins" could complete the same survey form available at the workshops.

The WMSC compiled a listing of all pertinent questions and comments raised at the workshops and then tabulated the survey results. Questionnaires were received from 41% of the 414 attendees. Appendix C contains a summary of the survey results. The principal findings are as follows:

- Plan 2 was the most favorable plan to 70% of the respondents, with its lower cost being the most often-cited supporting factor.
- Plan 1 was the least favored plan to 73% of the respondents. The most commonly cited drawbacks were the high cost and the need to acquire many private parcels of land.
- The effluent reuse aspect of Plan 3 was cited as a desirable feature, but offset by the uncertainties associated with dealing with a neighboring town which had yet to start its wastewater planning process.
- Many people suggested that town-wide sewers should be part of the selected plan, based on the concern that future more stringent environmental regulations may eventually force the Town in that direction, and the perceived fairness of providing comparable service to all residents.

11.2.3 Plan Selection

Based on its intensive deliberation over the three plans, the overall outreach program, and the specific broad-based input from the citizens attending the workshops, the WMSC voted to proceed with a program centered on Plan 2, supplemented with a number of features from Plans 1 and 3. Those supplemental features include the use of selected local treatment systems to allow early nitrogen control in headwaters embayments of Pleasant Bay (where the greatest need exists for nitrogen control), effluent reuse to allow recycling of the water and nutrients, and planning for town-wide sewers. Plan 2, with these supplemental features, is termed the "Recommended Plan".

The Recommended Plan was presented to the public at a well-attended public meeting on October 2, 2008. Public endorsement of the plan occurred at a Special Town Meeting on October 27, 2008. Over 800 people attended that meeting and approximately 70% supported the Recommended Plan.

11.2.4 Review By Outside Entities

Once the Recommended Plan had garnered public support, the draft CWMP was submitted to the Executive Office of Energy and Environmental Affairs (EOEEA) for MEPA review in May of 2009. Many of the modifications to the April 2009 draft CWMP were made to address comments provided by the MEPA office, which included feedback from numerous environmental agencies such as DEP and the CCC. See Appendix N for the EOEEA Certificate issued on July 10, 2009 and the Response to Secretary Comments, dated December 9, 2010.

Concurrent with the MEPA submittal, the April 2009 draft CWMP was submitted to the Cape Cod Commission for review under its Development of Regional Impact (DRI) program. The CCC's DRI comments are addressed as part of the MEPA response letter; see Appendix N.

In the fall of 2010, at the request of the Town, the Cape Cod Water Protection Collaborative provided funding for an independent engineering review of the April 2009 draft CWMP. This engineering review was performed by CH2M Hill. The resulting report is included as Appendix M. This Final CWMP reflects modifications made in response to that report.

11.3 OVERVIEW OF RECOMMENDED PLAN

From the outset of the CWMP process, the WMSC has recognized that a wastewater plan for Orleans must address a number of important issues:

- It must primarily address the significant problem of nitrogen overloading of coastal waters, as well as phosphorus loading threats to freshwater ponds.
- While traditional wastewater collection, treatment and disposal must form the central core of a wastewater plan, every effort should be made to reduce costs by maximizing the benefits of non-structural and non-traditional nutrient management techniques including such programs as control of lawn fertilization, stormwater management, and land use regulations.
- The nitrogen control needs estimated by the Massachusetts Estuaries Project, and implemented as TMDLs by DEP, are still in progress. The TMDLs are based on one

likely nitrogen control scenario involving nitrogen load reductions across one or more sub-watersheds. Others scenarios may be possible and desirable.

- The estuarine environment is ever-changing, as evidenced by the April 2007 breach in North Beach.
- The DEP or other parties will be undertaking a review of the technical basis for the nitrogen control requirements. It is expected that this review process will result in a mechanism for the Town to obtain the underlying models to investigate other control scenarios.
- The magnitude of the costs of nitrogen control dictate that both structural and non-structural steps be implemented in segments over time.
- Regionalization may be beneficial in terms of reducing project costs, and Orleans neighbors are not as far along as Orleans in the wastewater planning process.

Based on these realities, the Orleans WMSC has embraced the concept of "adaptive management". This approach to environmental protection recognizes the need to proceed with nutrient control programs at the same time that the full nature and extent of the problem are being better determined. "Mid-course corrections" are used to adjust the plan to reflect information that becomes available in the future. Accordingly, the Orleans CWMP has the following components:

1. Structural elements that will be constructed in segments within an overall plan;
2. Non-structural elements that will be implemented in a way that first documents their effectiveness and then allows their full application with predictable results and regulatory support, with the overall goal of reducing the cost of the structural elements;
3. Monitoring of surface waters to document the decline of water-column nutrient concentrations and the restoration of key habitats; and
4. Periodic re-assessment of progress toward cleaner waters and healthier habitats that leads to the refinement of the structural and non-structural elements.

The structural and non-nonstructural components of the Recommended Plan are discussed in the immediately following separate sections of this chapter. Monitoring and periodic reassessment are discussed in Sections 11.6, 11.7, and 11.8 entitled "Adaptive Management Plan", "Groundwater and Surface Water Monitoring Plan", and "TMDL Compliance Plan", respectively.

11.4 STRUCTURAL ELEMENTS OF RECOMMENDED PLAN

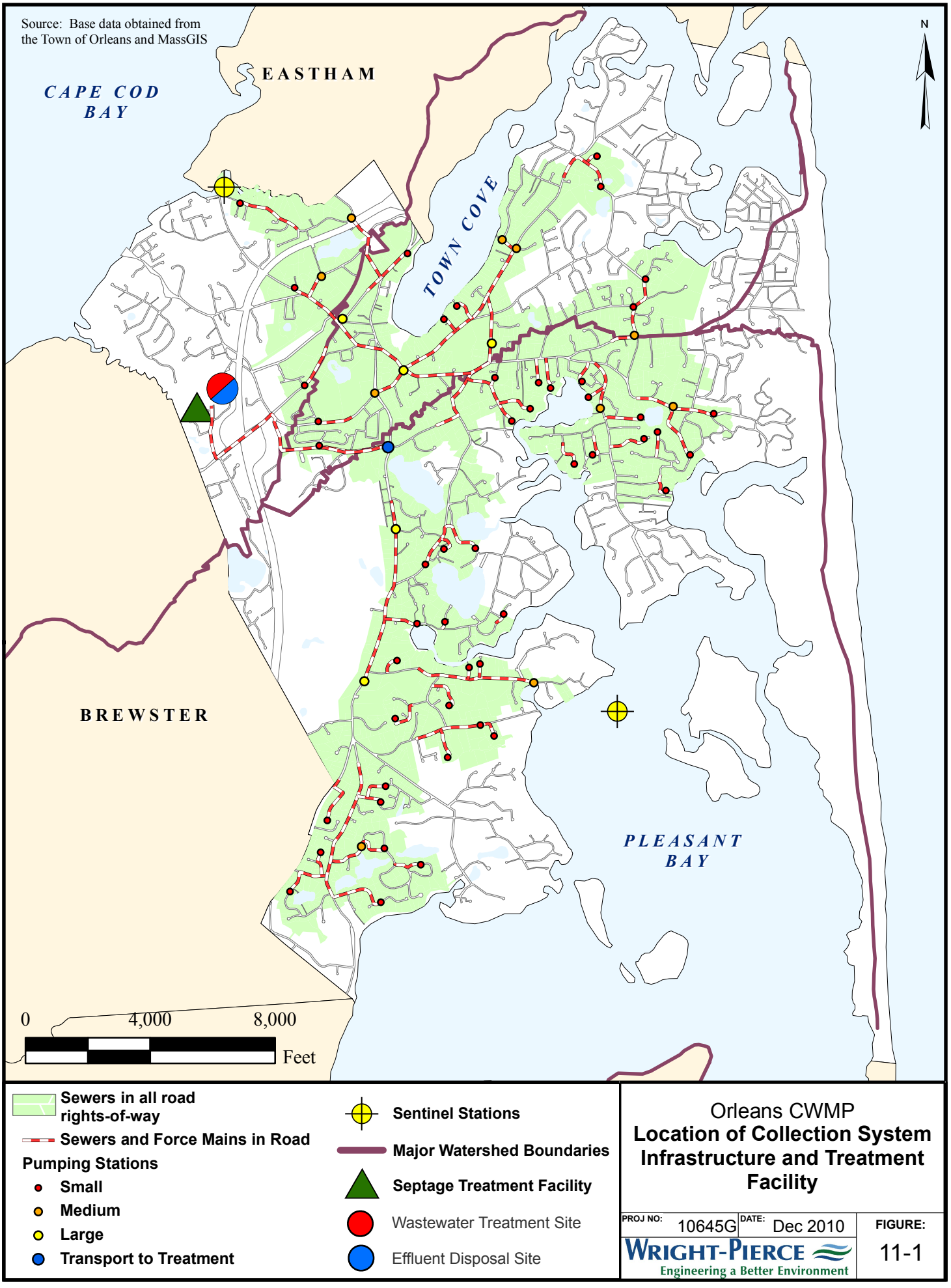
The structural aspects of the Recommended Plan include facilities for wastewater collection, wastewater treatment, effluent disposal and reuse, septage handling, and sludge disposal.

11.4.1 Wastewater Collection System

Wastewater will be collected from selected properties in the nitrogen-sensitive watersheds using traditional gravity sewer systems supplemented by sections of low-pressure sewer and grinder pumps where necessary to overcome steep terrain and difficult-to-access properties. Wastewater will be transported by conventional pump stations and force mains.

The physical extent of the collection system will primarily address nitrogen control needs, and will also allow the elimination of septic systems upgradient of most major freshwater ponds. Figure 11-1 shows an initial assessment of those areas of Orleans where septic systems would be eliminated to meet nitrogen and phosphorus control needs. This sewer service area is based on the goal of collecting as much wastewater nitrogen as necessary with the least amount of infrastructure.

The design of the collection system will reflect the possible eventual full sewering of Orleans should the Town later decide to take this step. Major trunk lines and pump stations will be designed for later expansion to handle the larger wastewater flows, without actually investing capital funds at this time. Enlarged versions of Figure 11-1 are included as Figures D-4, D-5, D-6, D-7, D-8 and D-9 in Appendix D.



Orleans CWMP

Location of Collection System Infrastructure and Treatment Facility

PROJ NO:	DATE:	FIGURE:
10645G	Dec 2010	11-1

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For convenience, the sewered areas shown in Figure 11-1 will be termed the "core" sewer service area, and the remainder of town will be termed the "extended" area. This distinction between the "Core Program" (intended to address documented needs, mostly nitrogen and phosphorus control) and the "Extended Program" (to enable full town sewering) will be carried forward to all aspects of the Recommended Plan.

The Core Program will serve about 2,800 properties with 390,000 feet of sewer pipe and generate an annual average flow of 640,000 gallons per day. The Extended Program, if needed or desired, would result in 1,140,000 gallons per day from about 5,300 properties served by 630,000 feet of sewer pipe.

The principal elements of the collection system (the pump stations and sewer lines) will be located in road rights-of-way. If during preliminary design, it is determined that maintaining construction within those rights-of-way is not feasible and must encroach on undisturbed land, those specific locations will be reviewed with all appropriate parties. Coordination will occur with the Massachusetts Historical Commission and the Massachusetts Natural Heritage and Endangered Species Program to determine what additional reviews may be needed, such as archaeological or habitat surveys. To the extent that the collection system layout encroaches on wetlands or wetland buffers, the Orleans Conservation Commission will be involved to ensure compliance with the Wetland Protection Act and supplemental local wetland regulations.

11.4.2 Wastewater Treatment System

Collected wastewater will be transported to the site of the Tri-Town Septage Treatment Facility, near the intersection of Route 6 and Route 6A, where it will be treated to a high level that reflects the requirements of the DEP Groundwater Discharge Permit program. That high level of treatment includes the reduction of effluent total nitrogen to less than 10 mg/l and the removal of the vast majority of pathogenic organisms.

The treatment process will include the following steps:

- Screening and grit removal;
- Primary settling to remove suspended solids;
- Biological treatment to remove BOD, suspended solids and nitrogen;
- Secondary settling to remove the bacterial cultures created in the biological process; and
- Disinfection using ultraviolet light.

A control building will be provided to house offices, laboratory, electrical and mechanical spaces, and sludge dewatering equipment.

Figure 11-2 depicts the proposed layout of new wastewater facilities at the Tri-Town site as well as the existing septage facility there. Table 11-1 presents a summary of design data for wastewater collection, treatment and disposal. Appendix D contains more detail on treatment process selection and sizing.

In concert with the Town's intent to implement wastewater solutions in segments, the treatment facilities will be built in phases. The first phase will provide capacity for treating one half of the wastewater to be collected in the Core Program. The site layout will also accommodate both the second half of the Core Program treatment capacity and the full treatment capacity needed for the Extended Program.

11.4.3 System for Effluent Disposal and Reuse

Effluent disposal will be accomplished through rapid infiltration, using a series of open basins located on the easterly and northerly portions of the site. Recharged effluent will mix with native groundwater and will flow away from the site toward Cape Cod Bay. The design of the rapid infiltration basins will be based, in part, on soil and groundwater studies conducted in 2007 2008 and 2009. Those studies are summarized later in this chapter.

Existing Septage Treatment Facility *To be removed*

Compost Shed

Headworks and Septage

Namskaket Marsh

Control Building with Solids Handling

Bike Path

Disinfection and Effluent Pumping

Parcel 1

Parcel 1A

9 10 7 8 6 5 3 4 1 2

Route 6

N

Proposed Disposal Basins

- Phase 1
- Phase 4/5

Proposed Wastewater Treatment Plant

- Phase 1
- Phase 4

- Tri-Town Property Line
- Existing Buildings
- Existing Disposal Beds
- Disturbed Area

0 100 200 300 400 Feet

Orleans CWMP

Proposed Wastewater Treatment and Disposal Facilities

PROJ NO:	DATE:	FIGURE:
10645G	Dec 2010	11-2

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TABLE 11-1

WASTEWATER SYSTEM DESIGN DATA FOR CORE PROGRAM

Component	Wastewater System Design Data for Core Program	
Wastewater Collection	Properties Served	
	Pleasant Bay watershed	1,680
	Nauset watershed	880
	Rock Harbor watershed	270
	Total	2,830
	Length of Sewers, feet	390,000
	Number of Pump Stations	
	Wetwell/drywell	6
	Submersible	56
	Grinder pumps	78
Wastewater Treatment	Design flow, gallons per day (including Infiltration and Inflow)	
	Annual average	640,000
	Maximum month	1,090,000
	Maximum 2-day	1,440,000
	Major Treatment Process	Biological Nitrogen Removal
	Effluent quality	
	BOD/TSS, mg/l	30
	Total nitrogen, mg/l	10
	Fecal coliform, col/100ml	200
Effluent Disposal	Method	Rapid Infiltration
	Loading rate, gal/day/square foot	7.7
	Number of basins	
	Total	10
	In use	8
Septage Handling	Participating Towns	
	Tri-Town District	Orleans, Brewster and Eastham
	Others	Based on market
	Design flows, gallons per day	
	Annual average	31,000
	Maximum month	50,000
Sludge Handling	Major Treatment Processes:	Decanting, Dewatering
	Disposal:	Contract Handling Off Site

As with the treatment system, the rapid infiltration system will be constructed in segments. Based on currently available soils and groundwater data, the rapid infiltration basins have been sized on a composite loading rate of 7.7 gallons per day per square foot of infiltrative area. Further testing is needed to confirm this rate, but there appears to be sufficient capacity at the Tri-Town site for all of the effluent from the Core Program and some of the effluent from the Extended Program. Full town sewering, if needed or desired, will require one or more of the following:

- An additional effluent disposal site (or sites);
- The implementation of innovative vertical disposal systems (e.g., wicks) at this site;
- The implementation of an effluent reuse program.

Opportunities for effluent reuse are discussed in Section 10.

11.4.4 Facilities for Septage Handling

Septage disposal will be a continuing need in Orleans unless full town sewering is accomplished. While it is possible for the septage disposal function to be accomplished by the Tri-Town District, it will be more cost effective for the Town of Orleans to build a modern septage receiving station as part of the new wastewater facilities. Those facilities could be sized either for the Town of Orleans alone, for the three towns of the District (Orleans, Brewster and Eastham) or to also include other nearby towns. The septage that is received at the site will be pretreated to remove grit and coarse solids, stored and equalized, and then blended with the incoming wastewater for joint treatment.

11.4.5 Facilities of Sludge Handling

The solids that remain after wastewater and septage treatment will be decanted and dewatered, and trucked off-Cape for suitable reuse or disposal. The Town of Orleans should rely on private haulers for transport of dewatered sludge, and for the grit and screenings removed in the facility's

headworks and in the septage receiving station. Wastewater solids will increase as the sewer system expands, offsetting the parallel reduction in Orleans septage solids.

11.4.6 Local Wastewater Management Systems

While the majority of nutrient removal will occur at new wastewater facilities at the Tri-Town site, the WMSC has chosen to incorporate five local "cluster systems" to provide more focused and rapid removal of nitrogen and phosphorus in certain areas.

Four of the cluster systems serve neighborhoods that are in the watershed of an impacted coastal embayment. The goal of this facet of the Recommended Plan is to reduce watershed nitrogen loading to improve coastal water quality many years before the sewer extensions reach these regions in the later phases. The collection area for each system is, in general terms, immediately upgradient of the water body, thereby providing timely improvement (but not complete remediation) of water quality. (The degree of improvement has not been modeled). It will be the completion of sewering in the Core Plan and conveyance to a centralized facility that will comply with the appropriate nitrogen reduction to meet the TMDLs.

A fifth cluster system will serve the watershed of a freshwater body, unlike the four other cluster systems that reduce nutrient loading to coastal embayments. The Town wishes to protect the good water quality in Bakers Pond whose watershed is not readily served by the proposed Core Plan sewer system, which will service freshwater bodies with impaired water quality. Therefore, a cluster system is proposed for the Bakers Pond watershed, with the goal of significantly reducing phosphorus loading there to forestall the degradation that has occurred in other ponds.

The general characteristics of each cluster system are described as follows (greater detail can be found in Appendix I). Except for Bakers Pond, the wastewater collection infrastructure for each of the cluster systems falls within roadways slated for sewering as part of the Core Plan. Proposed pump station locations for the Core Plan will overlap with those for the cluster systems. The treatment facilities may be contained completely below grade depending on the

technology selected. An above-ground control panel may be the only visible addition post-construction. In other cases, a few above-grade tanks and a small building may be required, but appropriately screened with fencing and landscaping. The proposed effluent disposal technology in all cases is subsurface leaching. The cluster systems will serve approximately 15 to 30 properties each. Wastewater design flows range from about 10,000 gpd to just over 20,000 gpd. The treatment technologies will be designed to achieve 5 to 8 mg/l as an effluent nitrogen concentration. On average, the cluster systems will remove about two-thirds of the nitrogen load required to meet the TMDL.

11.4.7 Alternative Layouts for Tri-Town Site

Four layout alternatives were depicted in the Draft CWMP. These layouts contrasted the availability of land for effluent disposal, the degree of buffering from nearby land uses, the impacts on rare species habitat, and the flexibility to deal with the existing septage handling operations. Illustrations of these layouts are included in Appendix H. With respect to minimizing impacts to rare species habitat, collaboration with NHESP resulted in a fifth and final layout (Figure 11-2). This layout can be described as combining portions of Alternative B (effluent disposal would be sited as far north as possible without requiring the removal of the compost shed) and Alternative C (maximizing reuse of septage facility infrastructure for wastewater treatment). This layout has the support of NHESP because it minimizes the elimination of box turtle habitat such that the expanded development of the Tri-Town site avoids the "take" of endangered species habitat. Additional detail is provided in Section 8.5.7 and Appendix H.

11.5 NON-STRUCTURAL ELEMENTS OF RECOMMENDED PLAN

The nitrogen control needs estimated in the MEP technical reports and set forth as TMDLs by DEP equal or exceed 50% for all nitrogen-sensitive embayments impacted by Orleans. These nitrogen removal percentages are high enough to require municipal sewering. Such structural solutions are expensive and should be supplemented by the non-structural elements discussed

below. While these non-structural elements cannot alone solve the nitrogen problem, and most are not recognized by DEP as fully proven techniques, they can serve as cost-effective supplements to the structural plan. They may allow cost reductions by making later phases of sewer expansion unnecessary. These non-structural elements are discussed in detail in Section 5 and Appendix B.

11.5.1 Fertilizer Control Program

For the Orleans-impacted estuaries studied by the Massachusetts Estuaries Project, about 7% to 10% of the watershed nitrogen load is associated with leaching of fertilizers applied to individual lawns and gardens, town parks and golf courses. If that fertilizer leaching could be avoided, then Orleans would need to eliminate fewer septic systems through its structural program. Fertilizer runoff is also a significant factor in the degradation of freshwater ponds.

The control of fertilizer nutrients will require a multi-pronged approach involving public education, policies on Town park and ball field fertilization, enhancement of subdivision regulations related to allowable lawn area and vegetation type, more controls on private lawn-care companies, and perhaps limitations on the amount or type of fertilizers that can be purchased locally. This multi-faceted program should be developed and implemented as soon as practical, so that its effectiveness can be demonstrated before the later phases of the structural program are initiated. A regional approach is likely to be required. This program must address the identified challenges of fertilizer control, including the import of fertilizer from outside the region, the widespread love of green lawns, the economic burden on certain businesses and the difficulty documenting actual application practices. This topic is currently being discussed by the Pleasant Bay Alliance, and the Town of Orleans should continue its involvement in those discussions to promote a multi-town watershed-wide solution.

11.5.2 Stormwater Management

For the Orleans-impacted estuaries studied by the Massachusetts Estuaries Project, about 8% to 10% of the watershed nitrogen load is associated with stormwater disposal. The Town must improve its stormwater management practices and techniques to comply with its permit under the National Pollutant Discharge Elimination System (NPDES). If these improvements can be implemented in the next few years, and the nitrogen removal effectiveness can be documented, then later phases of the structural program can be scaled back accordingly. Stormwater disposal is a significant contributor of phosphorus to freshwater ponds, and town actions on this front will improve pond water quality as well. The Orleans Board of Selectmen has already identified stormwater management as a high priority task, and regular investments on infrastructure have already begun. The Town is pursuing compliance with its Small MS4 (Municipal Separated Storm Sewer System) General Permit.

11.5.3 Water Conservation Program

Water conservation is a desirable goal because it reduces the Town's impact on groundwater supplies and indirectly saves energy. While water conservation does not reduce the nitrogen load in wastewater, it will reduce wastewater flows and decrease the costs of certain flow-dependent aspects of the structural program. Most important is the impact on effluent disposal facilities. Water conservation will reduce the cost of rapid infiltration, and can help forestall the need for a second effluent disposal location if the Town elects to provide town-wide sewers. The water conservation efforts of the Water Department should serve as the basis for this program and the Town should build on its recent successes. In light of the benefits to the wastewater system, the overall cost savings should be apportioned to both water and wastewater functions, to reflect the loss in Water Department revenues that water conservation can cause.

11.5.4 Flow and Load Reduction Initiatives

In addition to water conservation, the Town should adopt a formal program to promote a reduction in wastewater flows and nitrogen loads.

The Board of Health now strictly enforces the Title 5 requirement to provide larger septic tanks and more leaching capacity for homes with garbage grinders. That program should be extended to include a Town ban on garbage grinders in all homes and a public education program should be initiated to emphasize the benefits to both sewered and unsewered properties. The reduction in nitrogen concentration in the wastewater reaching the new treatment facilities may allow later phases to be somewhat smaller than otherwise. Reducing nitrogen loads from unsewered homes in nitrogen-sensitive watersheds will forestall the need for sewer extensions. As with all these non-structural elements, it will be crucial to set forth a methodology for confirming the nitrogen load reductions that actually occur.

Composting and urine-diverting toilets separate a high-nitrogen waste stream from the rest of the domestic wastewater. If a low-cost reuse or disposal method can be found for the separated urine or compost, then cost savings will accrue to the overall program. Such disposal methods are not now readily available, so the trade-off is between the costs of the municipal wastewater collection system and the cost of trucking the urine or compost to the wastewater treatment plant. To help establish the cost-effectiveness and public acceptability of composting and urine-diverting toilets, the Town should set up a pilot program of about 10 homes that would voluntarily install these systems and allow their wastewater to be sampled and their costs to be formally documented. If that test program could be successfully completed in the early years of the project, then its application to specific neighborhoods could lessen the cost of the structural program.

11.5.5 Enhancement of Embayment Flushing Rates

In certain embayments impacted by Orleans, the Massachusetts Estuaries Project has identified the opportunity to reduce the extent of necessary sewering by altering the hydrodynamics of the natural system. By increasing the flushing rate, the assimilative capacity of the embayment can be increased. In cases where the downstream water body is less nitrogen sensitive, this may be a low-cost measure with manageable side effects.

The benefits of this approach appear to be sufficient for it to be investigated in detail. That investigation would include a confirmation of the flushing rate changes, a detailed analysis of all costs (including dredge spoil disposal), and a frank assessment of the permitting hurdles. DEP has indicated a reluctance to allow a town credit for this technique, in that it may entail periodic destruction of some or all of the habitat that the nitrogen control program is intended to benefit. Further, there may be significant regulatory prohibitions related to new dredging projects in Areas of Critical Environmental Concern. In light of the fact that Rock Harbor and the inlets to Areys, Lonnies and Pah Wah Ponds have been historically dredged, these embayments should receive the first priority in the investigation. Studies should consider dredging both as a short-term measure (while structural elements of the Core Program are being implemented) and as a routine part of an on-going nonstructural plan.

11.5.6 Land Use Controls

Unsewered development in nitrogen-sensitive watersheds is the fundamental driving force behind the nitrogen loading problem. The costs of solving that problem can be reduced if the growth rate over the 20-year planning period is reduced below the 22% increase that has been the basis of planning to date. Further, an important funding mechanism now in place is only available for wastewater plans that are "growth neutral"; that is, plans that allow no more growth than would have occurred anyway under wastewater and zoning rules in place at the time of CWMP approval by DEP.

Three important land use controls have been pursued by the Town: 1) a Board of Health nutrient loading regulation, 2) positioning to establish a "checkerboard" sewer system, and 3) draft language for the future Sewer Use Regulation to ensure "growth neutrality".

The Board of Health's Nutrient Management Regulation was adopted in 2008. It restricts wastewater flow to 110 gpd per 10,000 square feet of lot area, for new development or expanded uses of existing development. It is intended to slow the rate of growth of nitrogen loads in unsewered areas and offset the growth that has already occurred since the start of the CWMP

process and will occur prior to the first phase of the wastewater facilities. Of the 22% growth factor included in the planning process to date, the nutrient loading regulation could offset about 2 to 5 percentage points.

The proposed Sewer Use Regulation will limit flow to the sewer system from a given property to that flow which is allowed under all other state and local regulations. For properties subject to the Board of Health Nutrient Management Regulation, that provision of the sewer use regulation will keep sewered flow less than 110 gpd per 10,000 square feet. For all other properties, the sewered flow will be no more than what is allowed under Title 5. The Sewer Use Regulations will be put in place prior to the initiation of construction in Phase 1.

By accepting Section 1A of MGL Chapter 83, the Town has confirmed its intentions to install public wastewater infrastructure to control nutrient loading, and it can now take advantage of the "checkerboard sewering" concept that is provided for in Sections 1B and 1C of MGL Chapter 83.

Adopted and draft documents are presented in Appendix L. Taken together, these three steps will make the wastewater project "flow neutral". These regulations will constrain the generation of wastewater such that no secondary growth impacts will be realized as a result of sewer construction. For example, a lot that is "unbuildable" today, will not become "buildable" as a result of the project.

Another land-use aspect of the non-structural plan is an accelerated program of acquisition of open space in nitrogen-sensitive watersheds. When one considers the full cost of extending the sewer system to capture future nitrogen loads, it may be cost effective to apply those funds to land acquisition. In some cases, it may be prudent to acquire land so that the nitrogen load from future development can be avoided, as well as to avoid other non-nitrogen impacts such as traffic.

11.5.7 Implementation of Non-Structural Program

With all these non-structural elements, it will be crucial to set forth a methodology for confirming the nitrogen load reductions that actually occur so that regulatory approval can be obtained for reductions in the structural program. DEP officials have instructed the Town to focus its efforts on the structural aspects of this program and not delay progress to evaluate non-structural elements. Nevertheless, well-documented demonstrations of nitrogen removal through non-structural measures may help reduce the cost of later phases of the project.

In the preliminary design phase of the project, a significant effort should be made to refine each element of the Non-Structural Program. That effort should include establishing goals for annual nitrogen removal through non-structural measures, developing metrics to assess effectiveness of the program and allocating funds to the program. This action item is included in the project implementation plan, and associated costs are presented as a line item in the project budget.

11.6 ADAPTIVE MANAGEMENT PLAN

In dealing with complex environmental problems, precisely determining the optimum solution can take many years and require very extensive study. At some point, sufficient information is available to embark on a solution, even though all aspects of the best solution have not been determined. At that point, the risk of inaction is greater than the cost of implementing a non-optimum solution. Adaptive management is the formulation and implementation of a plan that begins to solve the problem while further information is gained to guide later phases toward the best overall solution. The basic elements of a successful adaptive management plan are:

- A solution that can be implemented in phases over time;
- Acquisition of data to show the effectiveness of the early phases of the solution; and
- A mechanism to re-assess the plan and adjust it to reflect the information gathered.

The Orleans Recommended Plan is adjustable in its content and timing so that mid-course corrections do not have large impact on overall cost. The data acquisition program must be

directed at answering the question: "What information is needed about the impacts of Phases 1 and 2 (for example) so that Phases 3 and 4 can be modified if necessary?" The re-assessment of the program must be well planned to be accomplished quickly, and with results that are approvable by the regulatory agencies.

Orleans' Adaptive Management Plan addresses the following uncertainties:

1. How does the reduction in watershed nitrogen loading actually improve the water column nitrogen concentration in the impacted embayment? Is the water column concentration more or less sensitive to watershed load than predicted by the MEP model?
2. How does the eelgrass or benthic community respond to the reduction in water column nitrogen concentration? Are those communities more or less sensitive to water column nitrogen concentration than predicted in the MEP model?
3. The municipal sewer system will lead to a wastewater treatment facility outside the nitrogen-sensitive watersheds. How much nitrogen is removed from those watersheds by sewering the targeted neighborhoods? Are the occupancy and per-capita load assumptions used in the CWMP accurate in comparison with the nitrogen load actually collected?
4. The sewer system will be subject to some infiltration and inflow. How much wastewater is actually received at the treatment facility and how does the facility's capacity compare with the assumptions in the CWMP?
5. With respect to effluent disposal, does the full-scale application of effluent match the expected loading rates, and might additional disposal capacity be needed sooner than expected?
6. Does community growth follow the progression expected through the planning horizon, or might more capacity be needed sooner (or later) than planned?
7. Are non-structural components of the CWMP more or less effective than assumed?
8. For multi-town watersheds (Nauset, Rock Harbor and Pleasant Bay), should one town accelerate or delay phases of its program to match progress in the other towns? Similarly, does progress in other towns allow Orleans to defer or eliminate one phase of the Orleans program?

9. When will neighboring towns be ready to participate in regional solutions? Can the Pleasant Bay Alliance facilitate a multi-town solution for Pleasant Bay?
10. Does new research provide the basis for an expansion of the wastewater needs assessment to address contaminants of emerging concern?
11. Have new, DEP-approved, advanced on-site treatment systems become available and should they be applied in less densely developed neighborhoods in Orleans?
12. Have pilot programs for non-traditional and/or non-structural measures conducted in Orleans produced results which should be applied full-scale in Orleans?
13. Have pilot programs for non-traditional and/or non-structural measures conducted in other communities in the County produced results which could be applied in Orleans?

Table 11-2 outlines the facilities that are proposed to be built in each of the six project phases. This table also shows the information needed before the implementation of each phase. The Town will use the TMDL Compliance Report (discussed in Section 11.8) as a vehicle to document annually its findings in each of these critical areas. The Groundwater and Surface Water Monitoring Program (Section 11.7) will provide key data to support the TMDL Compliance Report. The Board of Water and Sewer Commissioners will be the responsible Town entity for overseeing the Adaptive Management Plan and coordinating it within the Town and with neighboring towns and review agencies.

11.7 GROUNDWATER AND SURFACE WATER MONITORING PLAN

One key element of the Town's Adaptive Management Plan is the proposed Groundwater and Surface Water Monitoring Plan. By careful and systematic monitoring, the Town can accomplish the following goals:

- Document compliance with permits;
- Establish or extend a database of environmental conditions from which to judge future actions;
- Document TMDL compliance;
- Watch for unexpected impacts;

TABLE 11-2
PRELIMINARY PHASING PLAN FOR CORE PROGRAM

Phase	Construction Elements, % of Core Program	Actions and Decisions to be Considered Before Start of Next Phase
		Completion and validation of MEP studies
		Acceptance of TMDL Compliance Plan by DEP
		Resolution of real estate issues with Tri-Town District
		Preliminary design of all facilities
		Final design of Phase 1 facilities
1	50% Treatment	
	50% Disposal	
	20% Collection	
	100% Septage	
	100% Land	
		Final design of Phase 2 facilities
		Modeling of cluster system benefits
		Viability of flushing enhancements
2	15% Collection	
	100% Local Systems	
	(cluster systems)	Final design of Phase 3 facilities
		Viability of flow/load reduction measures
3	15% Collection	
		Final design of Phase 4 facilities
		Results of fertilizer reduction program
		Results of stormwater management program
		Viability of So. Orleans regional facility and commitment from Brewster
		Viability of Nauset regionalization and commitment from Eastham
4	50% Treatment	
	25% Disposal	
	15% Collection	
		Final design of Phase 5 facilities
		Results of full-scale rapid infiltration testing
5	20% Collection	
	25% Disposal	
		Final design of Phase 6 facilities
		Results of all efforts to reduce non-structural program
6	15% Collection	

Note: 1) Annual reports to DEP will document results of water quality monitoring and estimates of reductions in watershed nitrogen loads, both of which will be formally assessed prior to the initiation of each phase.
2) Progress by Eastham and Brewster (toward nitrogen removal in watersheds shared by Orleans) should be monitored throughout the Core Program.

- Continue the monitoring of the existing Tri-Town plume; and
- Establish a basis for adaptations in the plan.

Table 11-3 summarizes the elements of the proposed program. It will involve monitoring at or near the treatment and disposal site, within sensitive coastal embayments and in selected freshwater ponds. It will include not only water quality parameters, but also the plants and animals that the project is intended to protect. It will be important that the results of this program be accurately and promptly reported, via the reporting mechanisms listed in Table 11-3 and discussed in Section 11.8. Coordination will occur with DEP, the Massachusetts Estuaries Project, the USGS (and its ongoing monitoring of Namskaket Marsh), embayment monitoring programs being conducted or coordinated by the Pleasant Bay Alliance, and the pond monitoring program of the Orleans Ponds Coalition and the Orleans Marine and Fresh Water Quality Task Force. The program outlined in Table 11-3 will be expanded during the application for the Groundwater Discharge Permit for the wastewater treatment facility, and in the development of the annual TMDL compliance report discussed in Section 11.8. All of these activities will be coordinated with the Water Resources staff of the Cape Cod Commission.

11.8 TMDL COMPLIANCE PLAN

For many U.S. communities, compliance with surface water quality standards is demonstrated by measuring the flow and contaminant concentrations in the discharge from a single municipal wastewater treatment plant, and comparing the results with a single discharge permit.

The situation is much more complex on Cape Cod, where the nitrogen loads from a series of activities must be considered and compared with the TMDLs. The regulatory framework for demonstrating compliance is just evolving. DEP has made it clear that the ultimate compliance point is the restoration of habitat (eelgrass or bottom fauna), and that a town is not in compliance with the federal Clean Water Act until watershed nitrogen loads have been reduced to the point where that habitat is restored. The difficult regulatory issue is the travel time of nitrogen in the

TABLE 11-3
GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

Location	Media Sampled	Analyses Performed	Frequency of Analyses	Reporting Mechanism	Coordination Needs	Input to Adaptive Management Plan
Tri-Town Site and Vicinity	Effluent	BOD. TSS, N, bacteria	Monthly	GWD Permit DMRs	DEP	
	On-site GW	TS, SpCond, N Water table elevation	Quarterly Quarterly	GWD Permit DMRs	USGS studies DEP	Movement of existing plume Mound height--site capacity
	Off-site GW	TS, SpCond, N Water table elevation	Quarterly Quarterly	GWD Permit DMRs TMDL compliance report	USGS studies DEP	Movement of existing plume Mound height--site capacity
	Namskaket SW	N, P, DO, chlorophyll Macroalgae, infauna	3 times/yr Every 3 years	TMDL compliance report TMDL compliance report	USGS studies MEP studies DEP	Movement of existing plume Assimilative capacity
Coastal Embayments	SW at sentinel stations	N, TSS, DO, chlorophyll salinity, SD Macroalgae, infauna eelgrass	3 times/yr Every 3 years	TMDL compliance report TMDL compliance report	USGS studies MEP studies DEP PBA programs CCC DEP	Extent of nitrogen control Assimilative capacity
Freshwater Ponds	SW	TS, Spec. Cond., P algae, SD	2 times/yr	OPC report	ENSR report PALS program CCC, DEP	Extent of phosphorus control

Notes: Frequency of Analysis for surface water is intended to be only illustrative; a specific program will be developed as part of the Groundwater Discharge Permit application.

Abbreviations:

GW	Groundwater	TSS	Total suspended solids
SW	Surface water	N	Nitrogen species
DMR	Discharge monitoring reports	P	Phosphorus species
BOD	Biochemical oxygen demand	SPCond	Specific conductance
TS	Total solids	SD	Secchi depth

groundwater and the uncertainties associated with estimating how a reduction in watershed load will impact water-column nitrogen concentrations and how that reduction will lead to habitat restoration. Complicating the issue is the fact that the watersheds of most impacted embayments span multiple towns which may be proceeding with nitrogen control on different schedules and at different paces.

It is understood from discussions with DEP staff that achievement of the nitrogen load reductions implicit in the TMDLs is the only substantive mechanism for compliance over the short term. The threshold nitrogen loads that comprise the TMDLs are the only practical measure of progress, even though long-term monitoring may show that somewhat higher or somewhat lower nitrogen loads may lead to habitat restoration. (Elsewhere in this report, the nitrogen load reductions resulting from the Core Program have been shown to be consistent with published or expected TMDLs, and the added load from effluent disposal at the Tri-Town site has been shown not to exceed thresholds in the Namskaket and Little Namskaket systems.)

It is recommended that the Town of Orleans address this regulatory uncertainty through the phased implementation of a DEP-approved CWMP that includes multiple checkpoints and opportunities for "mid course corrections" based on a number of factors. The Town should be protected against enforcement action by state and federal entities under the Clean Water Act (including consent orders and fines) if:

1. DEP approves the CWMP;
2. The Town proceeds with the phased program outlined in the CWMP;
3. The Town complies with the groundwater discharge permit for the wastewater treatment facility;
4. The Town reports to DEP regularly on the information it will collect to document its progress implementing the plan, including monitoring of embayment water quality and habitat condition; and
5. The full implementation of the Core Program, or logical variations of it, results in whatever improved water quality is necessary to restore critical habitat.

To insure that the Town and DEP agree that the CWMP is being properly implemented, it is recommended that the Town submit an annual report to DEP that documents the following:

- The status of all of its activities called for in the CWMP;
- Spreadsheet-based estimates of the watershed nitrogen loads for all nitrogen-sensitive embayments;
- The results of the water quality monitoring program conducted during the year;
- The results of habitat assessments (may not be done every year);
- Documentation of the capital expenditures that have been made and that are expected over the following 5 years, from the Town's Capital Improvement Plan;
- Progress made on non-structural elements of the CWMP; and
- Proposed changes in implementation (such as acceleration or delay of upcoming segments of the plan).

The TMDL Compliance Report should be distributed to DEP, the CCC, the MEP technical team, representatives of neighboring towns and to watershed associations. A core group of these parties should meet annually to review Orleans progress and provide input to possible modifications to the program.

Since water use records form the basis for septic nitrogen loads, the Town should update the analysis reported in the Needs Assessment every five years and include the results in the next annual report to DEP. Similarly, the build-out projections should be updated every five years.

Any significant change from the program contained in the approved CWMP would be submitted to DEP as a formal CWMP amendment after appropriate citizen input and Town Meeting actions. The approved CWMP and approved amendments will document the Town's adaptive management approach.

Prior to the construction of Phase 1, the Town must work with the MEP to model the nitrogen reductions associated with the Recommended Plan to confirm that such reductions will allow TMDL compliance. Such modeling is expected to be a relatively straightforward effort for the Cape Cod Bay and Pleasant Bay portions of the Core Program, because the proposed extent of sewers is closely linked to the percentage nitrogen reduction recommended in the TMDL sub-watershed by sub-watershed. It is expected that the confirmatory modeling of the Nauset System should be straight-forward as well, but cannot be conducted until the TMDL is available for this watershed. Similar efforts may be needed for any multi-town programs, as have been recommended in the Regionalization Study (Appendix K), including nutrient trading.

11.9 PHASING OF FACILITIES CONSTRUCTION

It is recommended that the Town implement the structural and non-structural aspects of this wastewater plan as part of a phased program. The Core Program, aimed at nitrogen and phosphorus control, should be implemented in six steps. Upon completion of the Core Program, and if conditions warrant, an additional four phases could be implemented to effect the Extended Program of town-wide sewers.

The reasons for phased implementation of Orleans' wastewater plan include:

- The very high cost of building all needed facilities over a short time period.
- The potential benefit of adjusting Orleans' program to accommodate wastewater from neighboring towns whose planning is several years behind Orleans' program;
- Uncertainties in the degree and rate of habitat restoration associated with reductions in watershed nitrogen loads.
- Differing degrees of urgency with respect to declining water quality in various sub-embayments;
- Re-prioritization of sewer phases or change in the geographic extent of a single phase;
- Uncertainties in forecasting the location and rate of town growth;

- The need to synchronize watershed load reductions with other towns sharing a given watershed;
- The need to avoid wholesale disruption of large areas of town during sewer construction; and
- The benefits of demonstrating at full scale the potential capabilities of the Tri-Town soils to accept wastewater at higher rates than currently predicted.

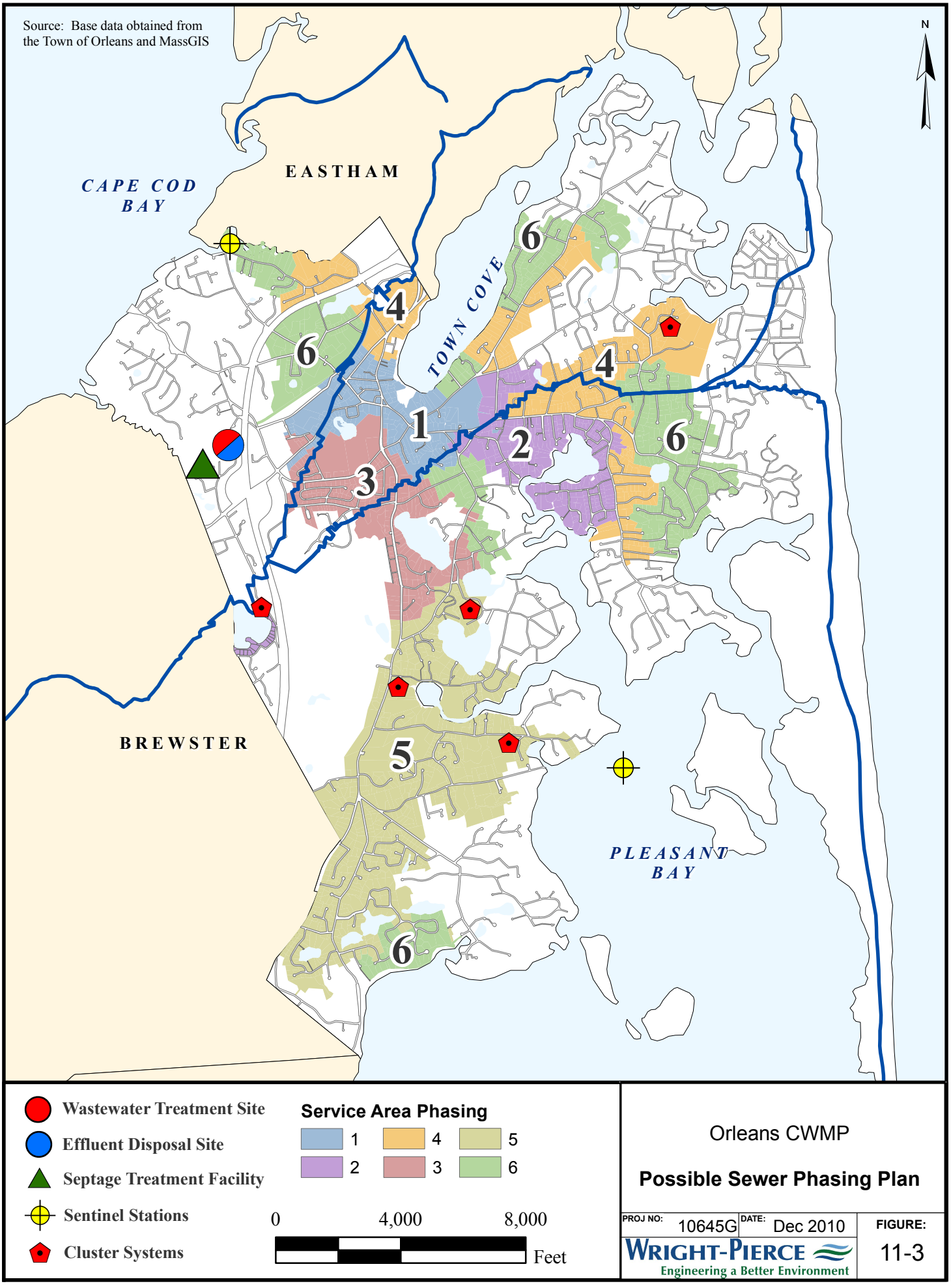
It also should be recognized that phasing has some disadvantages, including:

- The added cost and complexity of segmented construction;
- The risk of missing out on favorable financing that will not be available after 2019.
- The risk that the public bidding process will yield different manufacturers of key treatment equipment from one phase to the next.

While these disadvantages should be considered, they are of less importance than the issues discussed above.

Table 11-2 summarizes a possible phasing plan. It shows the six phases, the structural elements that should be included in each phase, and the activities that should be completed prior to the start of each phase. Phase 1 is the most intensive of the six phases, and includes the construction of one half of the needed capacity for wastewater treatment and disposal, and all of the septage handling capabilities. The remainder of the treatment and disposal capacity would be built in Phases 4 and 5. All of the phases include sewer construction, as the wastewater collection system is gradually expanded to reduce watershed nutrient loads consistent with the available capacity for treatment and disposal.

Figure 11-3 depicts the geographic location of the six sewer phases. The first five phases reflect the sometimes competing goals of: a) logical geographic expansion, and b) the desire to reach the most threatened embayments as soon as possible. The inclusion of cluster systems for



Orleans CWMP

Possible Sewer Phasing Plan

PROJ NO:	DATE:	FIGURE:
10645G	Dec 2010	11-3

WRIGHT-PIERCE
Engineering a Better Environment

Friday, April 24, 2009 7:56:12 AM\\K:\GIS_Development\Projects\10645B-Orleans\10645G\April 2009 Draft Report\Fig11-4.mxd

Lonnies Pond, Arey's Pond, Pah Wah Pond and Mill Pond will help to bridge the gap between these competing priorities. The sixth phase will include extensions of the sewer system throughout the remainder of the areas defined in the Core Plan.

The possible phasing plan shown in Figure 11-3 would focus first on the downtown area, where the most nitrogen can be collected with the least amount of infrastructure. Phase 2 would start to address nitrogen control needs at Meetinghouse Pond and The River, and continue the extension of the collection system in an easterly direction. Progression from phase to phase is dictated by the geography of Orleans, the need to build a logical core of the sewer system, and the location of the most stressed coastal waters.

Table 11-4 shows how the watershed nitrogen and phosphorus loads will be reduced in each phase of the Core Program. Phase 1 will provide some nitrogen removal in the Rock Harbor, and Town Cove watersheds, while providing enough wastewater flow for effective treatment. Substantial removal of nitrogen will be accomplished by Phase 2 for the Meetinghouse Pond watershed, the one with the highest nitrogen control needs. More than 80% of the required nitrogen removal will occur by Phase 4 for the Nauset system, by Phase 5 for Pleasant Bay and by Phase 6 for Rock Harbor. Four of the six high priority ponds will be served by Phase 4. The inclusion of cluster systems in the Pleasant Bay watershed accelerates the progress toward TMDL compliance by about 10 percentage points in Phases 2, 3 and 4.

The reader is cautioned that the sewer phasing depicted in Figure 11-3 is but one of many possible approaches. Other options should be considered during the preliminary design phase of the project, based on further technical studies, financial analyses and public input. The Town is encouraged to undertake a healthy debate over the speed with which TMDL compliance will be reached and the prioritization of expenditures by watershed.

The CCC has suggested that the Cedar Pond watershed be sewered more quickly than indicated in Figure 11-3, in part because the watershed is entirely within Orleans and water quality

TABLE 11-4
NUTRIENT LOAD REDUCTION BY PHASE

	Percentage of Required[(a)] Nitrogen Removal			
Phase	**Pleasant Bay**	**Nauset System**	**Rock Harbor**	**Ponds [(b)]**
1	<1	30	34	
2	24[(c)]	32	34	Bakers*, Reubens
3	31[(c)]	52	39	Crystal*, Boland's*
4	44[(c)]	86	49	Ice House*
5	80	86	49	Pilgrim*, Shoal*, Uncle Seths, Twinings
6	100	100	100	Cedar*, Uncle Harveys

Notes: (a) "Required" is based on Pleasant Bay TMDLs, Rock Harbor MEP technical report and preliminary Nauset estimates.
(b) * Denotes the first and second priority ponds identified in Table 3-4.
(c) Cluster systems represent about 10 percentage points in Phases 2, 3 and 4.

restoration can be achieved without waiting for the actions of other towns. This factor should be considered by the Town in any future adjustments to the initial phasing plan

Phases 1 and 2 of the Core Program are critical early building blocks of this program and should be implemented as soon as is practical. For initial discussion purposes, it is expected that all six phases of the Core Program will be built over 15 to 20 years, and that the Extended Program would require another 15 to 20 years. Detailed financial planning will be needed to determine if the Town can practically meet those broad preliminary goals. To initiate that financial planning, the following schedule is proposed:

Construction of Phase 1	2015 to 2017
Construction of Phase 2	2018 to 2020
Construction of Phase 3	2021 to 2023
Construction of Phase 4	2024 to 2026
Construction of Phase 5	2027 to 2029
Construction of Phase 6	2030 to 2032

This schedule would involve 24 months of construction activity every three years, and would allow completion of the Core Program in 22 years from the date of this report.

11.10 REGIONALIZATION

Significant benefits will accrue to the Town of Orleans if it shares its proposed wastewater facilities with other towns. The two best opportunities are associated with Eastham and Brewster.

The Town of Eastham will be required to remove nitrogen from the Nauset embayment, just as will Orleans. Eastham's options include building its own wastewater facilities and sharing facilities with Orleans. A preliminary estimate of Eastham's nitrogen control needs in that watershed translates to about 160,000 gallons of wastewater per day on an average annual basis. Based on the findings of the Regionalization Study (Appendix K), Orleans should consider reserving capacity for Eastham's wastewater in the proposed new facilities at the Tri-Town site, based on the expected cost advantages to both towns. Since Eastham has just begun formal wastewater planning, its decision-making process may not allow participation in Orleans' first-phase project. It would be prudent however to keep the lines of communication open with Eastham with the possibility of including capacity in a later phase.

Nitrogen loads from the Town of Brewster are estimated to be about 11% of the total nitrogen loads to Pleasant Bay. Those loads exist in the watersheds of sub-embayments that are nitrogen sensitive; consequently some degree of nitrogen control is required. The phased construction of wastewater facilities at the Tri-Town site will allow the Town of Orleans to monitor Brewster's progress with wastewater planning and possibly to participate with Brewster in a Pleasant-Bay focused regional solution, similar to Plan 3, but involving wastewater only from South Orleans. That facility could also include flow from easterly portions of Harwich and northerly neighborhoods of Chatham. The deferral of sewer construction in South Orleans until Phase 5 (see Tables 11-2 and 11-4 and Figure 11-3) is intended to accommodate that decision-making process, based on the expected cost advantages.

Regionalization opportunities also exist with respect to septage. The new Orleans wastewater facilities will include capacity for Orleans septage, and can also provide for septage from Eastham, Brewster and other nearby towns. The regional concept has been successful in the Tri-Town District, and an expansion of that relationship to include cooperation on wastewater management may be beneficial to Orleans, Eastham and Brewster.

11.11 SOIL AND GROUNDWATER STUDIES AT TRI-TOWN SITE

11.11.1 Studies Conducted to Date

To determine the suitability of the Tri-Town site for wastewater disposal, studies have been undertaken to characterize the site soils and to model the local and regional groundwater movement. The first evaluation, including a large-scale hydraulic loading test, was completed in February 2008 and is reported in Appendix E. Appendix F includes a report on the second evaluation, which focused on groundwater mounding and regional groundwater flow, and that was completed in June 2008. Also included in Appendix F are the findings related to soil samples taken in May 2009 to confirm the assumptions of the groundwater mounding analysis.

These studies were conducted to address four potential limitations on effluent disposal at this location. Those potential limitations, and the results of these studies, are as follows:

Surficial Soil Permeability. The surface soils must be sufficiently permeable to accept the quantities of wastewater that will be applied during the highest periods of the design year. Based on preliminary layouts of the site, a loading rate of more than 6.7 gallons per day per square foot is needed to be able to properly dispose of the effluent quantities expected at the completion of the Core Program. Permeabilities were determined to be somewhat variable across the site, but sufficient to allow a composite loading rate of 7.7 gallons per day per square foot. Therefore the site has capabilities for effluent disposal beyond the Core Program.

Mounding. The application of wastewater effluent will cause the groundwater to rise in a mound under the site. Analytical and numerical modeling shows that the top of the

mound will be no closer than 25 feet below the ground surface, well below the 4-foot minimum separation required by DEP.

Local impacts of Mounding. The higher groundwater resulting from effluent application at the site must not cause flooding of the basements of nearby homes, unacceptable reductions in separation of local septic systems from the seasonal high water table, and substantial surface water flow into nearby wetlands. The groundwater modeling shows that the mound dissipates quickly downgradient from the site, and that such impacts will not occur.

Disposition of Effluent-Impacted Groundwater. The wastewater effluent will contain low levels of nitrogen. The regional groundwater flow will carry that nitrogen downgradient to Cape Cod Bay and associated wetlands. Groundwater modeling shows that the new nitrogen loads from effluent disposal will not cause the overall watershed loads to exceed their respective assimilative capacities, as reported in the MEP technical reports. The modeling shows that none of the effluent nitrogen will flow to Town Cove or Rock Harbor, two systems that are believed to be already over their nitrogen thresholds.

11.11.2 Future Testing Program

The testing program at the Tri-Town site has been sufficient to confirm its suitability for the quantities of effluent expected from the Core Program, and a bit beyond. Further, once the first phase of effluent disposal facilities is constructed and placed in operation, those initial rapid infiltration basins should be subjected to full-scale testing as the best way to definitely determine long-term capacity. That testing will be very helpful in the design of later phases of the effluent disposal facilities, with possible cost savings.

11.11.3 Long-term Monitoring Plan

Once operation of the new wastewater facilities begins, the groundwater impacts will be measured through a series of monitoring wells within and around the periphery of the site.

Those monitoring wells will be used to confirm the mounding analysis reported herein and will form the basis for possible future actions. Monitoring wells downgradient from the site will be used to discern any higher-than-expected water table elevations that might impact cellars or septic systems. This long-term monitoring program should be viewed as a very conservative approach. Extensive investigations at the Tri-Town site (spanning several decades) has shown quite definitively the suitability of this location for effluent disposal without significant impact on local groundwater levels.

11.11.4 Potential Disposal Capacity Under Extended and Regional Plans

Table 11-5 shows how that apparent surficial capacity of the Tri-Town site compares with the effluent quantities associated with various development scenarios. The Core Plan (all six phases) will require about 60% of the site's capacity. The Regional Plan, assuming both Eastham and Brewster participate, would require about 90% of the site capacity. If the Town chooses to sewer all of Orleans (the Extended Plan), then the Tri-Town site would not be adequate.

The development of the Tri-Town site for additional effluent disposal capacity is a good example of adaptive management. The true capacity of the site will only be known when more of the site is investigated (some of the potential disposal beds are below 20 feet or more of overburden and cannot be tested by conventional means until Phase 1 is complete) and when full-scale application of effluent occurs. If the site is shown to have more capacity than is currently estimated, then it is possible that the Extended Plan can be accommodated. Conversely, the Core Plan may consume more of the site's capacity than is now estimated, making a second disposal site necessary for even the Regional Plan. The phased development of this project allows these uncertainties to be addressed in early project phases and allows modification in later phases accordingly.

11.11.5 Fate of Effluent Discharged at the Tri-Town Site

Effluent disposal at the Tri-Town site will result in transport of nitrates to Namskaket and Little Namskaket marshes and to Cape Cod Bay. The marshes have been shown to have sufficient

TABLE 11-5

SUMMARY OF FLOWS COMPARED WITH APPARENT SURFICIAL CAPACITY OF TRI-TOWN SITE

	Annual Avg. Flow, mgd	Maximum Month Flow	
		Flow, mgd	Percentage of 1.78 mgd (Surficial Capacity)
Phase 1 of Core Plan			
Septic flow eliminated	0.25		
Wastewater flow (with septage and I/I)	0.32	0.55	31%
Full Core Plan			
Septic flow eliminated	0.504		
Wastewater flow (with septage and I/I)	0.640	1.09	61%
Extended Plan			
Septic flow eliminated	0.950		
Wastewater flow (with septage and I/I)	1.140	2.01	113%
Orleans Core Plan plus Brewster and Eastham			
Septic flow eliminated	0.752		
Wastewater flow (with septage and I/I)	0.945	1.57	88%
Orleans Extended Plan plus Brewster and Eastham			
Septic flow eliminated	1.20		
Wastewater flow (with septage and I/I)	1.45	2.49	140%

Assumptions:

1. Core Plan development at Tri-Town site includes 10 infiltration basins, 8 of which will be active. The composite loading rate will be 7.7 gpd/sf
2. Compost shed is removed to allow construction of future infiltration basins
3. Northerly portion of site (under hill) is comparable to central portion with respect to infiltration rate
4. Core and Extended Plan flows as reported in the CWMP, page 11-6. Eastham and Brewster flows as reported in June 2009 Regionalization Report, Appendix K.

Notes:

Data from January 2009 Hydrogeologic Modeling Report (Appendix F)

1. Maximum monthly flow of 2.07 mgd results in mound that is no closer than 20 feet from the ground surface, and creates no local impacts
2. Annual average flow of 0.74 mgd results in 10% of effluent nitrogen going to the Little Namskaket system and none to Rock Harbor

nitrogen assimilative capacity to prevent any nitrogen overloading at the wastewater flow rates being considered. The nitrates that reach Cape Cod Bay will emerge hundreds of feet from shore and will be immediately diluted well below any concentrations that would cause negative impacts. Pathogenic material will be nearly completely removed at the wastewater treatment

plant by ultraviolet disinfection, and any residual organisms will be removed or die off by passage through the groundwater within a few hundred feet of the site. (The groundwater that currently emerges at or near the Cape Cod Bay beaches originates as recharge from precipitation on the land near the shore. Water quality at the beaches and associated shallow waters may be impacted by near-shore activities (such as septic systems and runoff) or by waterfowl and beachgoers. Water quality there will not be impacted by effluent disposal at the Tri-Town site.)

11.12 IMPLEMENTATION STEPS

The recommended wastewater management plan is a complex one, with multiple phases, structural and non-structural components, and significant financial impact on the Town. Many administrative steps must be taken to properly implement the plan and ensure its efficient and effective operation.

11.12.1 Establishment of a Managing Entity

With no existing wastewater facilities and no public works department, the Town of Orleans must create a management entity for this Plan. The first significant step in this direction was through a change in Town charter that allowed the formation of a Board of Water and Sewer Commissioners, incorporating and building on the existing Board of Water Commissioners. The second step in its formation was a town-wide ballot question in the spring of 2009. The next important step will be the assignment of existing staff or hiring of an individual to serve as Wastewater Superintendent. That person can have a vital role in the implementation of this plan. Other tasks include developing and implementing a staffing plan (including certified operators and a project manager for construction), making arrangements for office space, deciding on a method of internal financial management (enterprise fund versus special revenue fund) and determining appropriate interfaces with other Town departments and boards.

11.12.2 Land Acquisition

It is generally advisable for a town to identify all of the parcels it must acquire for the project and to acquire them (fee simple interest or easement) at the beginning of the project. Parcel

identification should occur as part of preliminary design activities slated to begin in 2011. The extent of sewer construction in private roads should be addressed through a comprehensive easement process.

11.12.3 Regulations, Bylaws and Policies

Existing Town codes should be supplemented with bylaws and regulations that enable the Town to effectively implement the proposed wastewater plan.

One of the most fundamental needs is for a set of Sewer Use Regulations. These would establish policies and procedures related to new sewer connections, allowable and prohibited discharges, user fees, and many administrative matters. These regulations should be drafted by the Water and Sewer Department staff, with assistance from the Town's wastewater consultant, and promulgated during the design phase of the Core Program. The outline of the Proposed Sewer Use Regulations is presented in Appendix L.

The Town should include language within the Sewer Use Regulations that restricts flow from sewered properties to the maximum flow that the parcel could sustain under Title 5. Such a limitation is necessary to obtain the most favorable funding under the State Revolving Fund, and, for consistency with the overall goal of formulating a "growth neutral" wastewater plan. Draft language is presented in Appendix L.

As part of the Sewer Use Regulations, the Board of Water and Sewer Commissioners should detail the requirements and restrictions related to a "checkerboard" sewer system. These provisions should be in accordance with the 2008 Environmental Bond Bill, or the Town's separate special legislation, or both. The Town must have clear authority to reject an application for sewer service if the connection of that property is not in accordance with the CWMP. The clearest example of this restriction is where the wastewater collection system must pass through watersheds that are not nitrogen sensitive, such as the Namskaket and Little Namskaket systems. It may also apply when applications are made to connect lightly developed neighborhoods with a relative high cost of service per foot of collecting pipe. The Town's adoption of Section 1A of Chapter 83A of Massachusetts General Law occurred on May 11, 2009; see Appendix L.

Another important document is the User Charge System. This plan establishes the basis for billing of wastewater services. It should be drafted by the Water and Sewer Department staff, with assistance from the Town's wastewater consultant, and adopted during the design phase of the project.

In November 2008, the Orleans Board of Health has adopted a nutrient control regulation that is intended to slow the growth of nitrogen loading in the watersheds of sensitive embayments and to account for some of the growth in nitrogen load that has occurred since the start of the planning process (and that will continue to occur through the completion of Phase 1 facilities). That regulation is presented in Appendix L.

The Board of Health should adopt a policy that allows the deferral of construction of new septic systems, particularly those that include enhanced treatment systems, for properties to be included in the early phases of sewer construction. Such deferral should be accompanied by placing the avoided costs into an escrow account to be later applied toward that property's betterment assessment.

A policy on private wastewater facilities should also be adopted by the Board of Health. That policy should establish guidelines for the use of nitrogen-removing septic systems in the watersheds of nitrogen-sensitive embayments, and town-wide. In general, the Town should not encourage nitrogen-removing systems on individual lots, since the extent of the sewer system has been formulated to allow all unsewered parcels to get by with simple Title 5 systems, and expenditures for individual nitrogen removing systems are a diversion of capital. Exceptions may be needed for near-shore-areas located in the later phases of the Core Program, where the time needed to provide public sewer may be comparable to the design life of the individual system. Another exception would involve situations where enhanced treatment is needed to address public health issues related to inadequate setbacks or depth to groundwater.

11.12.4 Permitting

There are a number of regulatory programs and permitting requirements that apply to the planning, design and implementation of the Recommended Plan. These include:

- DEP approval of the CWMP.
- DEP Groundwater Discharge Permitting under 314 CMR 5.0. A groundwater discharge permit is required for the new wastewater facilities planned for the Tri-Town site. Depending on the plan for short-term septage management, the existing permit held by the Tri-Town District may need to be extended for two or more years beyond its current 2012 end date.
- Compliance with the federal Clean Water Act through nitrogen-based TMDLs as implemented by DEP.
- DEP Water Reuse Standards will apply to any effluent reuse activities.
- DEP Plan Review is required for the proposed new wastewater treatment facility, once final plans and specifications have been prepared.
- DEP Site Assignment under MGL Chapter 83, Section 6 is required for any publicly-owned wastewater site. The existing site assignment for the Tri-Town site may need to be expanded to account for the proposed wastewater facilities
- DEP Sewer Extension Permits will be needed for system expansion after completion of the first phase.
- Compliance with the Massachusetts Wetlands Protection Act and local supplemental bylaws is necessary for all impacts on protected resources.
- The project must be reviewed under the requirements of the Massachusetts Environmental Policy Act (MEPA) which will require both an Environmental Notification Form and an Environmental Impact Report.
- The project must comply with the Cape Cod Commission's Regional Policy Plan and undergo review as a Development of Regional Impact (DRI).
- Review must be conducted under the Massachusetts Natural Heritage and Endangered Species Program, pursuant to the Massachusetts Endangered Species Act; see Section 8.5.7 for a discussion of issues related to Eastern Box Turtles.

- Review must be conducted under the program of the Massachusetts Historical Commission; see Section 8.5.8 related to archaeological resources.
- All activities must be consistent with the two Areas of Critical Environmental Concern.
- Compliance with the regulations of the Old Kings Highway Regional Historic District is required for above-grade structures located in the District (all areas of Orleans north and west of Route 6A).
- Utility Release Abatement Plans and Contingency Plan Notification may be warranted.
- The Town must issue building permits for treatment facilities and pumping stations after compliance with the State Building Code is demonstrated.
- Permits are required from the Department of Transportation for all construction work in state roads.

Compliance with these programs must be demonstrated at various stages of project development.

11.12.5 Coordination with OBEGWPD on Septage Management and Land Requirements

Septage and grease wastes pumped from properties in Orleans are now disposed of at the Tri-Town Septage Treatment Facility. The buildings, tanks and equipment are owned and operated by the Orleans Brewster Eastham Groundwater Protection District (OBEGWPD). The 26-acre site is owned by the Town of Orleans.

One option for constructing the Phase 1 wastewater facilities at the Tri-Town site would be to utilize land not currently used by the District. This would allow septage handling in District facilities during the construction period. The Phase 1 wastewater facilities should include new modern septage handling facilities, which, once completed, can replace the aging plant and equipment owned by the District. Therefore, the Tri-Town facilities could be abandoned, demolished or partially reused once Phase 1 is complete. The proposed construction by the Town of Orleans on the Tri-Town site would require an amendment to the existing inter-municipal agreement if construction is to occur before 2015. (Resolution of real estate issues with the Tri-Town District will require a full legal review of the inter-municipal agreement and

development of alternatives by the Orleans Board of Selectmen for discussion with its counterparts in Brewster and Eastham.)

New septage handling facilities should be sized for the reduced septage quantities from Orleans. They can also include capacity for septage from Eastham and Brewster, the other members of the District, as well as from other nearby towns. Groundwater modeling and nitrogen mass-balance analyses have demonstrated that a regional septage handling capability will not cause the assimilative capacities of Namskaket and Little Namskaket systems to be exceeded.

To ensure a smooth transition, the Town of Orleans should:

- Make whatever arrangements are needed to build Phase 1 facilities on the land the Town owns at the Tri-Town site that is not currently used by the District.
- Coordinate with Brewster and Eastham Boards of Selectmen on the abandonment, demolition or reuse of District buildings and tanks;
- Support the implementation of a contingency plan to address potential major equipment repairs and funding limitations; and
- Approach towns in the region to discuss providing dedicated capacity in the new wastewater facility for septage receipt and treatment.

Those discussions should begin in the near future, with a goal of obtaining Eastham and Brewster concurrence with the septage management aspects of the Recommended Plan by mid 2011. The contingency plan has been completed and should be put into place immediately. Clear access to the site should be obtained in accordance with the implementation schedule outlined in Table 11-6.

11.12.6 Coordination with Brewster and Eastham on Wastewater Regionalization

The Town of Orleans completed a wastewater regionalization study, see Appendix K, funded by the Cape Cod Water Protection Collaborative, which shows that cost savings can accrue to both Orleans and its neighbors through shared wastewater facilities. The Orleans Selectmen met with their counterparts from Eastham and Brewster on January 29, 2009, September 10, 2009 and

October 12, 2010 to discuss wastewater and septage regionalization issues. While no solid agreements to move forward on regional wastewater management were reached, all towns are still open to the concept. Eastham and Brewster have made less progress in the planning process. The Cape Cod Water Protection Collaborative has offered its assistance in facilitating these discussions. Orleans and Eastham have begun discussions on the possible transport of drinking water from Orleans to Eastham. Orleans should address the recommendations of the Regionalization Study as soon as possible and continue discussions with Eastham and Brewster to be able to adjust the phasing program to reflect possible participation by those towns. These discussions should be part of a DEP-mediated assessment of watershed-wide progress toward TMDL compliance.

11.12.7 Freshwater Pond Monitoring and Evaluation

While wastewater sources of nitrogen dominate the nutrient loading to coastal waters, freshwater ponds receive phosphorus loads from other significant sources such as runoff, waterfowl and benthic recycling. The Town should systematically evaluate all of its major freshwater ponds to determine what other phosphorus controls are needed to supplement the reduction in wastewater loadings effected through the Core Program. Should these future pond studies identify the need for elimination of septic phosphorus loads, changes in the sewering plans may be warranted. This factor should be considered in the preliminary design activities associated with each project phase.

11.12.8 Energy Conservation/Generation and Green Design

Wastewater management facilities use large amounts of energy to run equipment, to heat and ventilate structures and to fuel vehicles. An energy conservation plan should be developed as part of the preliminary design of the structural elements of the Core Program to ensure that all cost-effective energy conservation and generation options are appropriately considered. Such a study is required under MGL Chapter 149, Section 44M. Appendix D contains a list of primary areas for energy conservation that will be evaluated in the preliminary design. At that time, the decision should be made on whether or not to pursue LEED certification (Leadership in Energy

and Environmental Design) of the major buildings associated with the wastewater treatment plant. The LEED program establishes benchmarks against which building design can be judged, and should be pursued to the extent that the program identifies capital expenditures with reasonable pay-back periods.

Appendix J contains an evaluation of options for reducing Greenhouse Gas (GHG) emissions from the project. That evaluation established a project baseline and then considered 20 options for reducing the GHG emissions below that baseline. The options included steps to reduce GHG emission from the wastewater process, from building systems, and through program management. The analysis yielded the following results:

- **Preferred Options**:
  - 5 options that will reduce GHG emissions by 6%
- **Measures to be Re-evaluated During Design**:
  - 11 measures than may reduce GHG emissions by an additional 26%
- **Not Preferred and Not Applicable Options**:
  - 4 options that need not be considered further

While this analysis identified 16 favorable options, there is insufficient information available in a CWMP for the Town to commit to the associated capital expense for most of these alternatives. The 11 options in this category will be subject to re-review during the preliminary design phase of the project; see Section 11.12.10.

The Tri-Town site is being considered as the location for a Town wind turbine. The preliminary design of wastewater facilities should be closely coordinated with the efforts of the Town Renewable Energy/Wind Committee to ensure appropriate synergy.

11.12.9 Water Service to Properties Near Wastewater Disposal Locations

While the design and siting of all new wastewater facilities will be in full accordance with all applicable regulations and codes, it would be prudent for the Town to ensure that public water

service is provided to all developed properties located downgradient from all effluent disposal locations.

11.12.10 Scope of Preliminary Design

With the completion of the CWMP, perhaps the most important next step facing the Town is the preliminary design of the Recommended Plan. In addition to establishing the precise nature and extent of infrastructure that will be included in construction contracts (the subsequent final design), the Preliminary Design serves to confirm and update decisions reached in the planning process. The following list includes the most important planning-related tasks in the Preliminary Design:

- Incorporate the results of the MEP technical report on the Nauset system and any new information on Cedar Pond
- Conduct confirmatory estuary modeling
- Adjust the Recommended Plan to reflect further negotiations among Brewster, Orleans and Eastham related to regionalization of both wastewater and septage facilities
- Conduct archaeological surveys and coordinate with the Massachusetts Historical Commission
- Conduct additional habitat surveys (if needed) and coordinate with the Natural Heritage and Endangered Species Program
- Address potential impacts on wetlands and coordinate with the Orleans Conservation Commission
- Update the project schedule (both in general and with respect to timing of each phase)
- Re-assess the geography of sewer phasing plan (in general and with respect to Cedar Pond)
- If necessary to allow regionalization, plan for additional effluent disposal sites and effluent reuse
- Begin formal implementation of all aspects of the Non-Structural Program
- Develop an energy management plan
- Re-evaluate the options for reduction of greenhouse gas emissions as identified in Appendix J
- Coordinate with the Town's stormwater management efforts

- Coordinate with ongoing pond studies and initiate others as necessary (see Section 3.4.1)
- Re-assess the wastewater capacity needed for downtown growth, and find offsetting growth restrictions to make the overall plan completely growth-neutral
- Consider other growth management tools that will reduce project cost
- Address any CWMP-related requirements that are set by the Cape Cod Commission's Regional Wastewater Management Plan
- Determine how existing private wastewater facilities will be incorporated into the Recommended Plan
- Coordinate the preliminary design for the sewer system with the Town's road maintenance plan and any actions intended to take over private roads that may otherwise be subject to easements.
- Update estimates of capital and O&M costs and use them to develop a more detailed financial plan
- Prepare and submit grant and loan applications
- Continue a strong public consultation program related to all aspects of the Preliminary Design
- Work with DEP to develop a standard approach to the TMDL Compliance Report and prepare the first one
- File a Notice of Project Change under the MEPA program to reflect any significant changes in the Recommended Plan.

When Phase 1 facilities are under construction or complete, and the Town is ready to proceed with Phase 2, an analogous list of tasks should be addressed during the Preliminary Design of Phase 2. This process should continue with each subsequent phase of the project consistent with the Adaptive Management Plan.

11.12.11 Implementation Schedule

With the submittal of the Final CWMP/SEIR in late 2010, the MEPA and DRI reviews should be complete in early 2011. Following those steps, the Town should seek formal approval of the CWMP from DEP and the CCC, and a fully approved plan should be available and ready for implementation by the end of the first quarter of 2011. Some of the many important

implementation steps are summarized in Table 11-6, which includes a preliminary schedule for action.

Table 11-6 lists the key steps in the preliminary and final design processes, leading up to bidding of Phase 1 construction contracts late in 2014, to allow the start of construction in July of 2015. Important administrative steps are also outlined in Table 11-6. These include completing the financing plan in 2012, adopting the Sewer Use Regulation and a User Charge System in 2016 and hiring key operational staff in 2016 and 2017.

The Town's adoption of this measured schedule for moving ahead with project construction reflects the current economic climate, and the related need for bolstering citizen support for this expensive project. To address some citizen concerns that decentralized wastewater systems may offer cost savings, the Board of Selectmen accepted the County offer to conduct an independent review of the April 2009 draft CWMP; the resulting report is contained in Appendix M. As a further step in this direction, the Board of Selectmen have also proposed a more detailed independent review of decentralized systems that may require as long as 18 months to complete. During that time, the MEP technical report for the Nauset system may be completed. Should either the review of decentralized systems or the MEP Nauset report necessitate a substantive change in the Recommended Plan, then modification to this CWMP will be needed, perhaps accompanied by the filing of a Notice of Project Change to the MEPA office and to the CCC. Conducting this review and gaining information on the Nauset system will both provide additional assurance to Orleans citizens and enhance the prospects for project funding at the May 2013 Town Meeting where the first major appropriation article will be addressed.

11.13 FINANCIAL PLAN

11.13.1 Current Estimates of Cost

As a basis for cost estimating, preliminary sizing has been conducted for the various structural elements of the recommended plan, including the collection system, the central treatment system, the effluent disposal facilities, the local treatment and disposal systems, and the septage handling

facilities. This preliminary sizing information (see Appendix D) has been used to estimate the costs to build and operate the structural facilities.

TABLE 11-6
SCHEDULE FOR IMPLEMENTATION

CWMP Completion	
Complete Final CWMP/ SEIR	Dec 2010
Submit CWMP/SEIR to MEPA and to Cape Cod Commission as DRI	Dec 2010
EOEEA Secretary's and CCC's decisions on SEIR	Feb 2011
DEP approval of Final CWMP	Mar 2011
CCC determination that CWMP complies with Regional Wastewater Plan	Mar 2011
Decentralized/Centralized Alternatives Review	May 2011 to Apr 2012
Board of Selectman Approval of Decentralized/Centralized Approach	Apr 2012 to Aug 2012
Receipt of MEP Nauset report	To be determined
Update CWMP, as necessary, for MEP Nauset & Decentralized/Centralized Rpts	To be determined
Filing of MEPA Notice of Project Change (if necessary)	TBD (by August 2012)
Design and Construction	
Implementation of Contingency Plan for Tri-Town Septage Treatment Facility	Jan 2011
Apply for renewal of Tri-Town Groundwater Discharge Permit	Jan 2012
DEP issuance of Tri-Town Groundwater Discharge Permit Renewal	Aug 2012
Phase 1 Design - Engineering Procurement	Nov 2012 to Apr 2013
Annual Town Meeting appropriations for final design and land acquisition	May 2013
Tri-Town Intermunicipal Agreement termination notice	May 2013
Phase 1 Design - Treatment and Collection	July 2013 to Nov 2014
Preliminary design; see Section 11.12.10	
Archaeological surveys for collection system and cluster sites	
Confirmatory estuary modeling	
Land identification, easements and acquisition	Nov 2013 to Apr 2015
Apply for DEP Groundwater Discharge Permit for new facilities	Sept 2014
DEP approval of Phase 1 plans and specifications	Nov 2014 to Jan 2015
Phase 1 Construction - Contractor Prequalification and Bidding	Nov 2014 to Apr 2015
Obtain DEP Groundwater Discharge Permit and Site Assignment	Apr 2015
Annual Town Meeting appropriation for Phase 1 Construction	May 2015
Tri-Town Intermunicipal Agreement termination	May 2015
Phase 1 Construction	Jul 2015 to Jun 2017
Administrative Items	
File SRF Project Evaluation Form	Aug 2011
Develop specific plans and measureable goals for non-structural program	Dec 2011
Obtain commitments for regional facilities	Dec 2011
Complete financing plan	Oct 2012
Establish scope of annual TMDL Compliance Report	Jan 2015
Adopt Sewer Use Rules and Regulations	Jan 2016
Adopt User Charge system	Jan 2016
Hire staff for wastewater facilities	Jul 2016 to Jun 2017
Complete O&M Manual	Jan 2017

11.13.2 Capital Costs

The capital costs of a public infrastructure project include both the costs of construction and the ancillary expenses for land, design, construction oversight, start-up and other essential items needed to create a self-sustaining system. Table 11-7 presents the current preliminary estimate of capital costs. Of the approximate $100 million construction cost, about three quarters is associated with the collection system and the rest with treatment and disposal and with septage handling. When costs for land, contingencies, engineering and legal expenses are included, a total capital cost of approximately $150 million is indicated. The land costs that are shown in Table 11-7 include $0.9 million for pump station sites, $0.8 million for easements, and $2.5 million for cluster treatment/disposal sites.

These cost estimates do not reflect any potential cost savings associated with non-structural measures or, regional solutions, and as such include a significant implicit contingency if these items can be successfully implemented. These cost estimates also do not address the potential future need to address removal of phosphorus or contaminants of emerging concern.

The costs presented in Table 11-7 are expressed in mid 2008 dollars, and suitable inflationary factors must be considered to project those costs into the future. For simplicity, these estimates do not yet include the added costs of constructing the project in phases. A preliminary estimate of capital costs for Phase 1 is $50 to $60 million, including the costs related to the establishment of a functional wastewater department or entity (i.e., administrative structure, sewer maintenance equipment, plant maintenance equipment, vehicles, etc.). The normal course of project development will include a preliminary design phase and a final design phase, both of which allow the opportunity to update costs estimates based on increasingly more detailed information

The costs presented in Table 11-7 pertain only to the Core Program. Should the Town later decide that the Extended Program is needed or desired, approximately $96 million (2008 dollars) would be added to the capital cost.

TABLE 11-7
PRELIMINARY ESTIMATE OF CAPITAL COSTS FOR CORE PROGRAM

Component	Cost, $ million
Collection System	73.2
Central Treatment System	19.3
Effluent Disposal Facilities	5.5
Septage Handling	2.2
Local Treatment/Disposal Systems	2.2
Construction Subtotal:	**102.4**
Site Investigations (soils, archaeology)	0.6
Land	4.2
Evaluation of non-structural elements	0.3
Engineering, Legal and Administrative	15.4
Contingencies	25.6
Total:	**148.5**

Notes: All costs expressed in mid 2008 dollars.
No premium included for phased construction.

11.13.3 Operation and Maintenance Costs

Once the structural aspects of the recommended plan are in place, the Town will incur significant on-going costs for operation and maintenance (O&M). Table 11-8 presents a preliminary estimate of those costs, which total approximately $1.4 million per year. Labor, energy and sludge disposal are the most significant items and account for nearly 75 percent of the total. The engineering line item in Table 11-6 is related to program-related tasks such as annual TMDL compliance reports, continued freshwater pond evaluations, and coordination with the stormwater management program. No credit has been included for revenues from septage haulers, nor have the costs of the Extended Program been included.

As with the capital costs, the preliminary and final design work will provide opportunities for updating these preliminary figures.

TABLE 11-8
PRELIMINARY ESTIMATE OF
OPERATION AND MAINTENANCE COSTS FOR CORE PROGRAM

Component	Cost, $ per year
Labor	580,000
Chemicals	50,000
Electricity	184,000
Fuel	50,000
Sludge Disposal	204,000
Maintenance	109,000
Equipment Replacement	83,000
Laboratory and Monitoring	40,000
Administrative	40,000
Engineering	30,000
Total:	**1,370,000**

Notes: All costs expressed in mid 2008 dollars.
Total includes $220,000 allocated to local treatment systems.

11.13.4 Application for SRF Loans

The Town should view the State Revolving Fund (SRF) as a primary financing mechanism for the capital costs of this project. This program typically provides favorable interest rates for eligible costs and a 20-year repayment schedule. Eligible costs include most collection, treatment and disposal facilities, but do not include design costs or land purchase. The Massachusetts DEP administers this program. The Town should submit a Project Evaluation Form in August 2011 to provide DEP with an outline of the project and current cost estimates. DEP applies a series of priority rankings to determine which projects receive funding in given year, and places the selected projects on its Intended Use Plan annually. Factors that contribute to higher priority ratings include: the severity of the problem to be corrected by the project, regionalization, and the existence of any state or federal enforcement actions.

The SRF program has been revised to include a new more favorable financing mechanism provided under the 2008 Environmental Bond Bill. Orleans should be a prime candidate for that

favorable financing for projects which focus on nutrient management. The bill sets forth five criteria:

- The project must have a nutrient management focus,
- The applicant must be free from enforcement orders related to nutrient control,
- The project must stem from a DEP-approved CWMP,
- The CWMP must be consistent with any applicable regional water resources management plans, and
- The approved plan must be "growth neutral"; that is, it should not allow any more wastewater flow than would have occurred anyway under current zoning and wastewater requirements.

This CWMP has been developed to comply with all of these criteria. The financing under this new program will include the equivalent of zero percent loans, and the term of the loan is 30 years. The legislation that establishes this financing program also extends the maximum allowable term for betterment assessments to 50 years.

11.13.5 Potential for Grants

The project costs for the Recommended Plan described herein are very large and will have a significant impact on the local community. Every effort should be made to obtain grants to reduce the local share of the capital plan. The most applicable grant program for Orleans is administered through the Rural Development branch of the US Department of Agriculture. These grant funds are available for the planning, design, and construction of municipal wastewater infrastructure projects. Grant amounts and loan interest rates vary depending on the availability of funds and the median household income of the municipality. The main eligibility criterion is median household income (MHI). Specifically, if the municipality's MHI is below the state average, then it qualifies for up to 45% grant funding; however, if the municipality's MHI is below 80% of the state average, then it qualifies for up to 75% grant funding. The state average MHI was $50,502 based on the 2000 census.

Based on the 2000 Census results, the Town's overall MHI was $42,594 and the Census Designated Place (CDP) MHI was $30,238. Accordingly, it is anticipated that the Town could qualify for up to 75% grant funding and a 30-year loan at an interest rate between of 2.75% (poverty rate) and 4.75% (market rate). It is important to note that the Rural Development has historically had significantly less funding available than the combined needs of eligible projects. Accordingly, other grant sources should be aggressively pursued.

The total annual costs associated with the Recommended Plan are about $9.7 million for the full Core Program, based on 30-year financing at 3.75%. Without any state and/or federal grant assistance, this results in wastewater-related costs of approximately 5% of MHI for the town overall and approximately 8% of MHI for the Orleans CDP. Based on EPA guidance, these affordability measures indicate that this project is prohibitively expensive without state and/or federal grant assistance. Grant contributions of over 50% of the capital cost are required in order to reduce the local wastewater-related costs to about 2% of MHI, the standard affordability threshold.

As the project evolves, grant funding should be pursued aggressively, including demonstration grants for evaluation of some of the non-structural plan components. The Town should partner with the County to make an aggressive push for significant grant funding to Cape Cod.

11.13.6 Financing Policy with Respect to Betterments and Taxes

The Town must establish a detailed plan that allows these very large capital and operating expenditures to be funded in a way that maintains the Town's sound financial standing. While that plan will evolve during the design phase of the project, certain policies need to be established to allow the public to understand the impacts on individual property owners. Those policies include:

- Recovery of annual operation and maintenance costs from users proportional to their wastewater flow; and

- Balancing betterment assessments and property tax increases to reflect the mix of benefits that accrue only to users and those benefits that accrue to all taxpayers.

On August 27, 2008, the Orleans Board of Selectmen addressed the latter issue, by establishing the goal of equalizing the annual costs paid by users and non-users. Based on preliminary cost information available at that time, the Board set forth a policy of recovering 80% of the project debt service through property taxation (paid by users and non-users) and 20% through betterment assessments (paid only by users). The Board of Selectmen's policy is contained in Appendix L.

11.13.7 Costs to Typical Users and Non-Users

Table 11-9 presents current estimates of the equivalent annual costs to typical sewered users and those who continue with private on-site septic systems. The basis for these cost estimates is presented in the notes of the table. Based on the August 27, 2008 Selectmen's policy, recovering 80% of the project costs through the property tax results in a rough equivalency between sewered and unsewered users, for the stated assumptions. While there may be property owners who are faced with different costs than the "typical" owner, this interim policy should eliminate any significant incentive for most residents to either seek or avoid sewer service.

For the owner of a $700,000 home (the 2008 average assessed value), the equivalent annual cost for the Core Program without any grant contributions is about $2,600, given the assumptions listed in Table 11-9. For the owner of a $300,000 condominium in the 15% federal tax bracket, the equivalent annual cost would be approximately $2,100, other factors being equal. The equivalent cost would be approximately $3,400 per year for the owner of a $1,500,000 home in the 35% tax bracket. For purposes of comparison, equivalent annual costs for the Core Program with an assumed 50% grant contribution are also shown in Table 11-9.

Based on a total estimated capital cost of $60M for Phase 1, the equivalent annual cost for a sewer user at that time would be $1,520 per year without grants and $1,240 per year with 50% grants (based on 1,550 equivalent users).

TABLE 11-9
EQUIVALENT ANNUAL COSTS FOR TYPICAL RESIDENTS - CORE PROGRAM

	Equivalent Annual Cost, $/year Without Grants		Equivalent Annual Cost, $/year With 50% Grant (assumed)	
Cost Item	**Typical Sewered Home**	**Typical Unsewered Home**	**Typical Sewered Home**	**Typical Unsewered Home**
Betterment Assessment	623	0	302	0
Property Tax Increase	1,231	1,231	597	597
Sewer Connection	648	0	648	0
Septic System Replacement	0	1,570	0	1,570
Septage Pumping	0	88	0	88
User Fee	435	0	435	0
Income Tax Reduction	-345	-345	-290	-290
Total:	**2,592**	**2,544**	**1,692**	**1,965**

Basis: 20% of municipal debt service recovered from betterment assessments
80% of municipal debt service recovered from property taxes
$5,000 sewer connection cost financed at 5% over 10 years
$18,000 septic system replacement cost financed at 6% over 20 years
Typical home assessed at $700,000
Increased property tax deductible from federal income tax (28% bracket)
O&M costs of wastewater system recovered from 3,100 equivalent users
Debt service based on capital cost financed at 2% for 20 years (without grant)
Debt service based on capital cost financed at 3.75% for 30 years (with 50% grant)

Note: Alternate allocation of debt service from better assessments and property taxes may be applicable for scenarios which involve significant grants and should be evaluated.