

# Engineering Review of Orleans CWMP

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This report, completed on behalf of the Town of Orleans, presents the comments, conclusions and recommendations of CH2M HILL related to its engineering review of the Comprehensive Wastewater Management Plan (CWMP), dated April 2009, developed by Wright-Pierce for the Town. The scope of the review is in accordance with the Scope of Services, dated July 24, 2010, (Attachment A) issued by the Wastewater Protection Collaborative in support of the Orleans CWMP development process.

Specific recommendations for implementation are included under the particular items to which they pertain.

## **1. Needs Assessment**

The outline of existing conditions and assessment of wastewater management needs covers all of the important water resource areas of concern. The existing and future wastewater flows are appropriately estimated and reasonable. Evaluation of sanitary, water supply protection, economic growth and convenience/aesthetic needs are well developed. Future wastewater flows for commercial and residential development may be slower to develop than anticipated, but are appropriate, with changes readily accommodated by the phasing of the program. The plan appropriately focuses on nitrogen in the Orleans estuaries and embayments that are affected by Eastham, Brewster, Chatham and, to a lesser degree, Harwich. Several comments are warranted:

- 1.1 The CWMP, including the *Evaluation of Freshwater Ponds* (Appendix A), conducted by a sub-consultant, indicates that, although not of the level of importance of nitrogen enrichment of embayments, nutrient loading to the freshwater ponds (primarily phosphorus, but possibly also nitrogen loading in the late Summer in certain ponds) is causing significant impairment of a number of the Orleans ponds. Both the CWMP and the pond subconsultant's report outline the insufficiency of information for other ponds, the associated necessary assumptions and the resulting uncertainty with respect processes governing eutrophication and water quality, and consequently the wastewater, stormwater and other management controls necessary to restore and protect the ponds. Given the importance of the human and aquatic uses of the freshwater ponds in Orleans, this is a significant gap in the needs assessment.

Because of the characteristics of phosphorus transport through groundwater and the potential for additional growth and/or more year-round usage of homes in the watersheds of certain ponds, continued and possibly increasing enrichment and degradation of the water quality can be expected. The CWMP recommendations to sewer tributary areas to Bolands Pond and Crystal and Pilgrim Lakes will provide some degree of protection in these cases. The CWMP recommends that the town continue to monitor and evaluate ponds conditions to determine what other controls are needed to supplement the nutrient reduction benefits of the Core Program. However, there are no line items for such activities in the Schedule for Implementation (Table 11-4) and no cost allocated their implementation in the Preliminary Cost Estimate of Operation and Maintenance Costs for the Core Program (Table 11-6).

- 1.2 It is unclear how the question of nutrient impacts to Eastham and Brewster freshwater ponds, if any, are being addressed. If this question will be addressed by the CWMP's being done by Eastham and Brewster, it may be helpful to mention so in the Orleans CWMP and clarify that there may be greater or lesser regional project costs pending the results of the Brewster and Eastham plans.
- 1.3 While the CWMP is appropriately focused on wastewater management needs of Orleans, stormwater is a significant contributor (nitrogen, phosphorus, bacteria) to the major water quality issues facing the town's estuaries, lakes and ponds and stormwater management is a significant need or requirement going forward. Although the scope of the CWMP does not include development of a stormwater management plan, reference to the existing work of the town, as well as forthcoming EPA and state regulatory requirements for more intensive stormwater management programs, and how those activities should integrate with the wastewater program, would be helpful.
- 1.4 Consideration should be given to the appropriate mention in the needs assessment chapter of emerging contaminants as a factor to be tracked and evaluated. It should then be referenced in the Alternatives Evaluation chapter as a risk factor in consideration of continued use of Title 5 or enhanced on-site systems vis a vis centralized facilities.
- 1.5 Section 2.2.3 of the CWMP references the TMDLs prepared (or being prepared) by the Massachusetts Estuaries Program (MEP). The section mentions the purposes of these studies, the data bases being used and the use of the resulting TMDLs for regulatory use in wastewater management. However, the CWMP does not explain or document the actual water quality, habitat, aesthetic effects of excessive nitrogen enrichment in the specific estuaries and embayments of Orleans, assuming that the reader has read, understands and is convinced by the MEP reports. Although the impacts of excessive nitrogen enrichment are well

documented and commonly accepted, given that most of the remainder of the CWMP is based almost exclusively on remediation of these nitrogen impacts, at least a short summary of the nitrogen cycle and examples or statistics, possible summarized from the MEP documents, would be appropriate.

- 1.6 It is not clear whether the benefit with respect to nitrogen reduction in Pleasant Bay (Ryders Cove) of the decision by Chatham to sewer the entire town has been included in the percent reduction required by Orleans and Brewster.
- 1.7 The fact that the existing Tri-Town septage facility is reaching the end of its useful life and will require substantial investment in capital repair and replacement costs is documented in various reports and correspondence of the town. This need should be highlighted in the Existing Conditions, Future Needs and Wastewater Management Needs chapters of the CWMP. The need is appropriately dealt with in subsequent sections of the plan.

## **2. Alternatives Evaluation**

The development of technology options and the configuration of wastewater collection and treatment and effluent disposal options are very clear and sound from an engineering perspective. The range of technologies considered is comprehensive and the requirements and expected performance of each technology is reasonable.

The following comments are offered:

- 2.1 The expected effluent quality of Title 5 systems with enhanced treatment (15-19 mg/l, Table 5-3) is reasonable looking backward in time and is consistent with currently documented experience. However, the focus on nitrogen removal in coastal environments with a predominance of on-site systems has led to a substantial level of investment in research and development of innovative, small scale systems in recent years. While individual on-site systems are impractical for numerous reasons for densely developed downtown areas, it is reasonable to project that advanced technologies will be fully approved and acceptable for less densely developed areas and could provide a more cost-effective option than conventional sewerage, pumping and centralized treatment in post-Phase 1 stages of the program. Currently the CWMP includes no significant provisions for evaluation of advanced on-site systems in future phases of the program.

For the reasons outlined above, it is suggested that the CWMP consider:

- a. The potential impacts of lower effluent nitrogen concentrations for enhanced on-site systems on project requirements. Between five and ten milligrams per litre (mg/l) would seem reasonable, along with

testing the sensitivity of the cost of the plan to the potential range of concentrations. Similar technological improvements may benefit performance of cluster systems and should be evaluated also.

- b. Implementation of a pilot program to select, install, maintain, monitor and evaluate advanced on-site systems in a small area or areas of Orleans. Consideration to the implementation of such a pilot in Brewster or Eastham, potentially providing more saving with respect to collection and transport costs, could be considered. A key goal of this pilot program would to provide experience, should such technologies prove effective for wider application, with the requirements entailed in maintaining, monitoring and overall management of a network of these systems to demonstrate compliance with the TMDL load reductions.
- c. A plan for adapting future phases of the CWMP to include such systems should they prove feasible with respect to cost, operational, performance and regulatory criteria.

Consideration to piloting the use of an in-situ, permeable reactive barrier technology should also be considered, possibly in lieu of the remote cluster systems beings recommended for near-term nitrogen reduction.

The possibility of state and/or federal financial support of such pilot projects should be actively sought.

- 2.2 While non-structural, non-traditional control measures (stormwater management, fertilizer control, natural attenuation and flushing enhancements) will not in themselves replace structural controls in the denser residential and commercial areas of town, the high cost of the program dictates that these technologies be aggressively developed for potential application at the extensions of the sewerred areas where transport costs are a substantial component of cost. At present they are somewhat loosely included in the three composite plans in Section 6.

### **3. Composite Management Plans**

The process used for identification and screening of the nine town-wide plans was reasonable and fair. The three composite plans selected for detailed evaluation were synthesized from the nine plans using the best features of each plan and integrating regionalization options into each plan. The following comments are made:

- 3.1 There is no documentation of consideration of an “enhanced on-site systems” component to any of the nine options. While, as stated above, it is understood that enhanced on-site systems cannot satisfy all nitrogen removal requirements,

it is reasonable to assume that advances in the technology will render such systems feasible from performance and operational perspective within the next few years and that such systems could be a viable, cost-effective option to sewer extensions.

It may be that such options were considered and eliminated for various reasons such as:

- Difficulties and costs involved in demonstrating TMDL compliance in light of a large number of such systems
- Issues related to possible future regulatory requirements for emerging pollutants
- Concerns about reliability or long-term performance of such systems

These are valid issues to consider. However, the document does not record such consideration.

### 3.2 Several comments regarding capital cost estimates:

3.2.1 Based on the description of the methodology stated in Section 7.6 of the report, it appears that the construction cost estimates for the wastewater treatment components of the plans were based on unit costs in terms of dollars per gallon for comparably sized plants in New England. The data base of recent capital and O&M costs for wastewater facilities developed by Wright-Pierce is very likely the most comprehensive and relevant source in New England for comparable costs of the facilities being proposed in Orleans. Such estimates are useful for alternative comparison purposes, but may not reflect actual process requirements and site-specific conditions for the Orleans facilities. For the purposes of estimating total project costs in order to provide the best estimates possible to determine financial burden to future users, cost estimates based on cost curves generally warrant the use of a higher percent contingency. In this case, it appears that 40% was added to construction costs to cover both the engineering, legal, administrative and construction cost contingency. Considering that permitting, legal services, preliminary and final design and engineering services during construction could approach or exceed 20% of the construction cost, a remaining contingency of 20% for construction contingency appears light at this stage of the project.

- 3.2.2 A cost item does not appear to be included for the Baker's Pond cluster system. Possibly it is included in other line items.
- 3.2.3 It seems reasonable that the requirements and uncertainties related to the more complex Plans 1 and 3 would warrant a higher contingency than Plan 2.
- 3.2.4 The capital cost estimate for evaluation of the non-structural elements of the plan appear reasonable. An annual allowance for implementation of non-structural components of the plan appears to be missing from the O&M Estimate (Table 11-6)?

#### **4. Site Selection Process**

The site selection process was appropriate for the comprehensive planning stage of a project. The availability of the Tri-Town site, which already has a site assignment by the state and is being used for wastewater treatment, is an unusual and fortuitous situation for a town planning a new wastewater system. The technical and public issues related to finding an acceptable site for a wastewater treatment facility are typically the most difficult issues to resolve. For this reason alone the Plan 2 has an overwhelming advantage over Plans 1 and 3. In fact, it is questionable whether Plan 1 is really feasible.

In the opinion of the reviewer, finding 11 technically suitable sites for wastewater treatment and disposal and gaining local acceptance, ownership and regulatory permitting approval to use those sites would be a very unrealistic goal to set at this point in the planning process and is arguably a fatal flaw for Plan 1. Failure to obtain any one of the sites during the lengthy process of acquiring all 11 (a likely occurrence) would, by necessity, modify the requirements of one or more other sites and "reopen" the siting process at those locations, probably at some point requiring the use of the Tri-Town site in any case. The uncertainty inherent in this complex siting process would be a significant, on-going risk to the overall project during implementation, with the possible outcome being a situation in which the town is forced into a position in which a much less effective and more costly plan must be accepted. It is suggested that the CWMP explain the inherent problems with Plan 1 in more detail.

The location of the Tri-Town site with respect to Phase 1 of the Orleans plan, as well as its proximity to potential future connections from Brewster and Eastham, make it a very attractive site as well.

## 5. Environmental Assessment

Overall, the environmental assessment and answers to the MEPA comments is complete and responsive and adequately addresses the key environmental issues. The following comments are made:

- 5.1 On MEPA Comment 1005, it does not appear that the town has yet responded to the request that the CWMP consider effluent concentrations of 5 ppm for cluster systems. [It is assumed that they mean "...effluent removal rates to 5 ppm", not "...effluent removal rates of 5 ppm"]. The use of 5 ppm is probably overly optimistic, but could be considered as part of a sensitivity analyses for a range of potentially reliable effluent concentrations. Also, consideration of cluster systems for Bakers and Cedar Ponds and sewerage of the Cedar Pond watershed appears to be unanswered at present.
- 5.2 Could a pilot program of permeable reactive barriers in one or more subwatersheds be a less expensive, short term alternative than cluster systems for expediting nitrogen reduction in the period that the sewer system and wastewater plant are being constructed?

## 6. Public Involvement

The public consultation program supporting the development of the plan was comprehensive, transparent, well documented and effective in developing not only public consensus in support of the plan, but also in developing the plan itself. Regular meetings of the Wastewater Management Steering Committee (WMSC) were open to the public and televised. The development and presentation to the public of the interim reports provided a productive venue for gleaning preferences, concerns and ideas from residents of the town. The televising of progress reports to the Board of Selectmen, weekly workshops in neighborhoods and the availability of the members of the WMSC to meet with and listen to the public at any time resulted, in the opinion of this reviewer, in more understanding and involvement of the public in the Orleans CWMP process than any other planning process in recent experience. A key element of the process was the availability and technical expertise and knowledge of the consultant during the process.

It is important, in the opinion of the reviewer, that this public awareness and involvement be maintained and continued during the period of state review of the plan and during other interim activities during which public involvement may tend to wane. Item 7.6 addresses this point also.

## 7. CWMP Recommended Plan

The plan adopted in the CWMP takes advantage of existing wastewater plant site, substantial saving relative to other plans, adaptive approach that allows adjustment of the plan within Orleans, as well as continued development of regional options, phasing that places priority on early nitrogen reduction benefits and most critical areas of town needing service. Several comments are offered:

- 7.1 A cost allowance for the potential need to add phosphorus removal systems or additional sewers up-gradient of freshwater ponds that have not yet been evaluated should be considered.
- 7.2 Integration of non-structural elements of the plan in the operating budgets and timelines of the implementation plan could be more robust. Specific goals for nitrogen reduction should be set that could either lower costs for Phases 2-6, eliminate one or more of those phases or, at least, provide a factor of safety against future modifications of the TMDL load reductions, less-than-optimal nitrogen reduction experience in other parts of the plan or other uncertainties. *[For example, according to the HW Fertilizer management study, the MEP model does not include municipal or commercial nitrogen loads. While this may be a small increment, the accumulation of several factors such as this may require higher percent N reductions in the future.]*
- 7.3 A preliminary review of the operations and maintenance cost estimates for the Core Program (Table 11-6) indicate that the costs are high compared to experience with contract operations in other towns in New England. However, this may be reasonable considering that in most wastewater programs operations and maintenance budgets are established under conditions in which a fully operating wastewater management department incorporating sewer and plant maintenance equipment, vehicles, administrative infrastructure (hardware, software, etc.), spare parts inventory and a host of other management requirements already exist. This is obviously not the case in Orleans.

The cost for initial establishment of such capability will be significant. It can be considered as a fixed, up-front capital cost or as an operating cost, the latter-under the assumption that the wastewater system, when put in service, will be operated under contract to a private entity. In this case, it appears that the cost may be carried as a premium in the O&M budgets. In any case, it may be beneficial to add a brief discussion of this factor in the CWMP.



- 7.4 Regarding the overall cost of the project, the estimate of approximately \$2,600 per year (2008 dollars) for the typical residential customer is very high compared to other towns in the state. For example, the annual costs in Massachusetts municipalities for wastewater services, as reported in the Tighe & Bond 2009 Massachusetts Sewer Rate Survey, ranged from \$170 (Town of Dalton) to \$1,632 (Town of Ashburnham). The total annual cost of wastewater services in communities served by the MWRA ranged from \$304 to \$1,062, with an average of \$737 per year.

The high cost of the Orleans plan is due, of course, to the fact that the sewer systems of many other cities and towns were built between 30 and 100 years ago. Wastewater treatment plants of many communities were built or upgraded over 30 years ago, many with 85% grant funding under the construction grants program of the Clean Water Act. Regardless of the reason, the impact to Orleans residents and businesses will be substantial. The project Orleans is now considering must be viewed as an investment in future generations, as were those projects completed by other towns decades ago.

The high annual cost estimated at this stage of planning needs to be mitigated through a variety of initiatives, including:

- Fair allocation of the Orleans costs across the full range of businesses and residents who contribute nitrogen to the groundwater systems and who will benefit from protection and restoration of Orleans' water resources.
- Aggressive efforts to obtain state and federal grant and loan funding to offset capital costs.
- Working with state and county entities to identify new and reasonable use-based revenue sources to supplement local rates and taxes.
- Working diligently with Eastham and Brewster to resolve issues related to a regional approach to wastewater management both with respect to capital investment and on-going O&M costs. (See below)
- Monitoring and promoting innovative technologies and watershed management tools to maximize cost-effective non-structural elements of the plan.

7.5 With regard to regionalization options going forward, the *Wastewater Regionalization Study: Orleans – Brewster – Eastham* outlines potential options for joint arrangements between the three towns, some of the key issues related to capital and operating cost sharing, a preliminary estimate of potential savings due to various regional options and potential cost allocation formulas. The report identifies a number of the major issues that must be resolved by the three towns. Given the advanced stage of planning of Orleans in comparison to Brewster and Eastham, Orleans' plan to proceed with Phase 1 of its Core Plan is prudent. The phasing strategy outlined in the plan, along with the adaptive approach to management of future phases, provides a good context for further regionalization planning.

It is suggested that more emphasis be given to the cost savings of regionalization (both identifiable and unknown costs at this time) with respect to management and administrative costs associated with setting up and operating a new wastewater department "from scratch" in three separate towns (above and beyond traditional operating and maintenance budgets). Given the total population, limited areal extent of the towns and relative simplicity of the planned wastewater infrastructure, a single management entity would be most reasonable and save the considerable fixed costs of operating multiple wastewater departments.

7.6 The reviewer strongly agrees with the recommendations in Section 11.6 of the CWMP related to an annual report to DEP regarding the status of CWMP implementation. All of the items included in the list are important. Additional items to consider could include an update on regionalization plans and issues and an update on the status and results of pilot projects for innovative technologies. The town should consider means to maintain the involvement of key public constituencies as the implementation of the project goes forward.

7.7 In summary, while some of the above comments and recommendations, along with the comments of MEPA and others, may alter some aspects of the plan, particularly in its latter phases, it is the conclusion of the reviewer that the substantive recommendations and main elements of Phase 1 of the plan are sound, based on good engineering and scientific bases and should be implemented expeditiously. The plan provides a clear and necessary direction with cost-effective Phase I components and a series of latter phases that are reasonable, but adaptable as additional progress is made on regionalization options and as more detailed engineering and cost studies are completed.

## **Acknowledgements**

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# Attachment A

## Scope of Services

### Engineering Review of Orleans CWMP

The following questions will be addressed by the Technical Consultant in the review of the Town of Orleans' Comprehensive Wastewater Management Plan, dated April 2009:

1. **Needs Assessment** - Did the Wastewater Management Needs Assessment adequately define existing and future conditions and identify all important requirements and issues?
2. **Alternatives Evaluation** - Did the CWMP identify, appropriately evaluate and screen a full range of structural and non-structural alternatives for satisfying wastewater needs?
3. **Composite Management Plans** - Were feasible wastewater management alternatives appropriately combined into composite plans that satisfy wastewater needs within the planning horizon? Were the development, evaluation and screening of management alternatives, the nine composite plans and the final three alternative composite plans based on adequate information properly used in a decision-making framework to reach reasonable conclusions?
4. **Site Selection Process** - Was the process of site selection based on adequate evaluation of alternatives; sufficient technical, economic and environmental information; and fair consideration of public input and priorities?
5. **Environmental Assessment** - Were the environmental impact assessments of the three final plans based on adequate information; did they appropriately identify, evaluate and address a complete range of alternatives to the project; and were conclusions reasonable and justified based on the analyses and public input?
6. **Public Involvement** - Was the public involvement program comprehensive, open and transparent, and was public input requested, received, fairly evaluated and appropriately incorporated into development of the recommended plan?
7. **CWMP Recommended Plan** - Is the final Recommended Plan based on an adequately robust decision-making process that properly integrated and weighed the results of the engineering, economic and environmental analyses completed and public input received during the planning process? Are cost estimates reasonable at both the individual project level and the overall plan level? Will implementation of the Recommended Plan meet the wastewater management needs of the town and satisfy regulatory and nitrogen reduction requirements within the planning period?
8. **Recommendations** - Based on review of the CWMP process and its conclusions, what recommendations are made by the Technical Consultant that could resolve deficiencies in the plan, attain consensus on its recommendations, facilitate implementation or otherwise benefit the Town in meetings its wastewater management needs and environmental goals?

# Town of Orleans CWMP Review

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