Appendix H

Technical Memo – Management of Future Downtown Wastewater Flows and Biosolids

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Memorandum

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Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 1 – Facilities Engineering** **Deliverable 1.c.8 – Final Technical Memorandum on Management of Future Downtown Wastewater Flows and Biosolids**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	05/26/16 (06/22/16)

1. Background

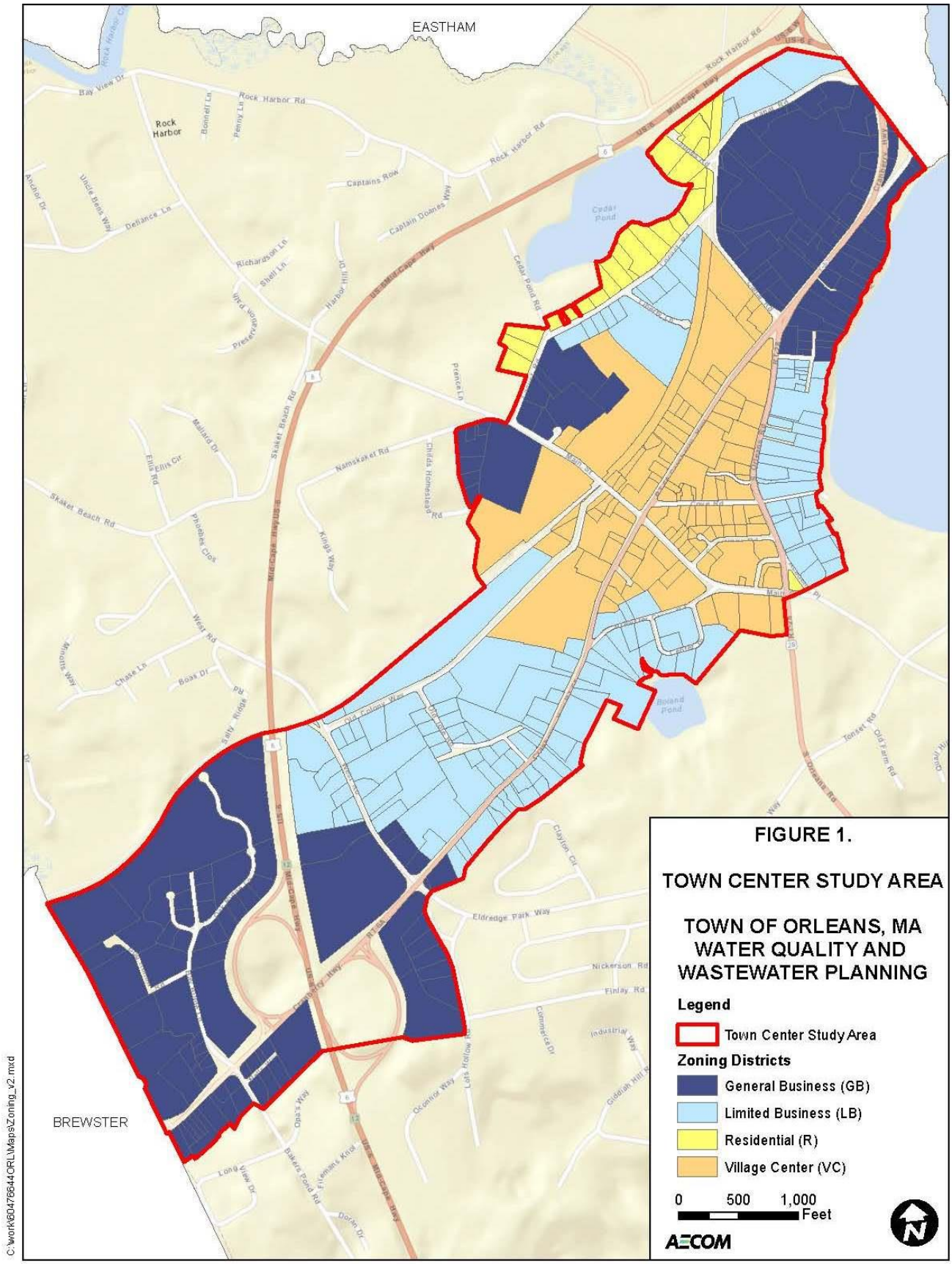
This Technical Memorandum presents the proposed management of wastewater flows and biosolids associated with the future preferred build-out scenario for the Town Center Study Area.

2. Introduction

The goal of the Downtown Planning task of the Town of Orleans Water Quality and Wastewater Planning project is to conduct planning and engineering services for development of a Town Center plan that will support water quality and wastewater planning on a sub-watershed basis. The area addressed in this task is the Town Center Study Area, which includes the business districts along the Route 6A corridor as well as some residential use (see Figure 1).

This Technical Memorandum presents the proposed methods to manage future downtown wastewater flows associated with the preferred build-out scenario (i.e. Scenario Option 3b – Modified Growth Rate with Consideration of Vision, Market Conditions, and Provision of Sewer) and allocate sewer capacity, as well as management of future downtown wastewater biosolids. Please refer to:

- *Water Quality and Wastewater Planning Task Number 1.b – Downtown Planning Technical Memorandum on Downtown Future Growth Scenarios;*
- *Strategies to Limit Growth, Draft Regulations to Obtain Zero Interest Financing, and Implications for Wastewater Loading Impacts; and*
- *Other Community Impacts in the Downtown dated* May 4, 2016 (*Downtown Planning Buildout Technical Memorandum*) for detail on the preferred build-out scenario.


EASTHAM
BREWSTER
Rock Harbor
Rock Harbor Rd
Bay View Dr
Bonnell Ln
Penny Ln
Captains Row
Captain Doanes Way
Anchor Dr
Uncle Bens Way
Defiance Ln
Richardson Ln
Shell Ln
Harbor Hill Dr
Cedar Pond
Cedar Pond Rd
Mid Cape Hwy
US Rt 6
Skaket Beach Rd
Namskaket Rd
Childs Homestead Rd
Mallard Dr
Ellis Cir
Ellis Rd
Phoebes Close
Knight Way
West Rd
Chase Ln
Boas Dr
Wilcotts Way
Selly Ridge Rd
Old Colony Way
Orchard Rd
Roland Pond
Tonset Rd
Old Farm Rd
Claylon Cir
Eldredge Park Way
Nickerson Rd
Finlay Rd
Commerce Dr
Industrial Way
Giddiah Hill Rd
Lots Hollow Rd
Okonnis Way
Ops's Way
Bakers Pond Rd
Fivemens Knoll
Long View Dr
Dorian Dr
FIGURE 1.
TOWN CENTER STUDY AREA
TOWN OF ORLEANS, MA
WATER QUALITY AND
WASTEWATER PLANNING
Legend
Town Center Study Area
Zoning Districts
General Business (GB)
Limited Business (LB)
Residential (R)
Village Center (VC)
0 500 1,000
Feet
AECOM
C:\work\60476644\ORL\Maps\Zoning_v2.mxd

3. Management of Future Downtown Wastewater Flows

A. The wastewater flows for each future build-out scenario were developed and reported in *Downtown Planning Buildout Technical Memorandum* and are summarized in Table 1.

Table 1. Orleans Town Center Study Area Future Wastewater Flows and Loads

Parameter	Scenario 1[1]	Scenario 2[1]	Scenario 3[1]	
			Option 3a[1]	Option 3b[1]
Wastewater Flow (gpd)	337,013	233,730	183,150	190,815
Septage Flow (gpd)	16,000	16,000	16,000	16,000
I/I Flow (gpd)	22,501	22,501	22,501	22,501
Total Flow (gpd)	375,514	275,231	221,651	229,316
BOD Loading (lbs/d)	1,002	727	592	612
TSS Loading (lbs/d)	940	681	555	574
TN Loading (lbs/d)	188	136	111	115
Effluent BOD Load (lbs/d)	94	68	55	57
Effluent TSS Load (lbs/d)	94	68	55	57
Effluent TN Load (lbs/d)	31	23	18	19

Notes:
1. Scenario descriptions:
   - Scenario 1: Full Build-out Under Current Zoning without Wastewater Limitation
   - Scenario 2: Growth Scenario to Reflect Vision to Increase Residential Density in the Town Center
   - Scenario 3: 2050 Planning Horizon
     - Option 3a: Historical Growth Rate
     - Option 3b: Modified Growth Rate with Consideration of Vision, Market Conditions, and Provision of Sewer

B. An analysis of liquid treatment options for each service area was conducted. The evaluation was reported in *Water Quality and Wastewater Planning Task Number 1.c.10 – Final Technical Memorandum on Wastewater Treatment, Residuals, Septage Management, Effluent Transmission and Pumping Components of the WWTF*.

The existing Tri-Town Septage Treatment Facility is located on a 26-acre parcel to the northwest of the Exit 12 cloverleaf. It is recommended that the proposed Overland Way WWTF be constructed at this site. Because of the planned decommissioning of the facility, and the proximity of this location to the Downtown Area, it is a logical choice for siting a proposed Overland Way WWTF to receive flow from the Downtown Area.

The Meetinghouse Pond (MHP) Area however is a fair distance from this location, and would require a force main several miles long to bring flow from the eastern edges of town to either the proposed Overland Way WWTF site or the proposed Downtown Area collection area. For the purpose of this evaluation, it was assumed that a proposed smaller, satellite WWTF would be dedicated to the MHP service area, located on the Town owned property at 223 Beach Road. The higher degree of neighborhood sensitivity associated with the Beach Road site requires as small and unobtrusive a facility as possible. This combined with the economy of scale of providing biosolids/septage processing capacity at one location led to the decision that the Beach Road site would not receive septage, and that any WWTF residuals generated would be trucked to the proposed larger Overland Way WWTF located at the existing Tri-Town Septage Treatment Facility site. It is estimated that on average, proposed MHP WWTF residuals would need to be hauled to the Tri-town site approximately once per week. With these factors built into the basis of design, an analysis of treatment options for each location was performed as follows.

With the site selected and flow/loadings to the facility defined, AECOM used its experience with similar projects to define a list of applicable technology options for the proposed Overland Way WWTF and proposed Meetinghouse Pond WWTF. Five technologies were selected for evaluation as follows:

- Conventional Activated Sludge (“CAS”);
- Sequencing Batch Reactor (“SBR”);
- Integrated Fixed Film Activated Sludge (“IFAS”);
- Membrane Bioreactor (“MBR”); and
- Rotating Biological Contactor (“RBC”).

The liquid train technology recommended for both sites is the membrane bioreactor (MBR). This technology is recommended because of its expansion capability, ability to achieve potentially lower TN limits in the future, its small footprint, and it’s ease of operation. This technology is available in discrete modules, which facilitates the phasing in of capacity as needed to coincide with the development of the collection system.

AECOM estimates that if some of the existing tankage (ie. septage holding tanks, septage receiving tanks, etc.) is utilized to mitigate hourly fluctuations in flow, four modular MBR treatment trains would be needed to satisfy initial design conditions. A fifth treatment train would be needed to accommodate future build-out conditions. Although AECOM would recommend the installation of only four treatment trains for now, the concrete pad, piping and connections should be designed to accommodate the fifth future train should the full build-out condition materialize. The overall concrete pad dimensions required for the five module build-out condition are 54 feet by 78 feet. The proposed location for the MBR system would be in the vicinity of where the existing primary clarifiers and RBCs are currently located.

C. Phasing of the proposed Overland Way WWTF and Downton Area collection system is a key component of the overall Project Plan. Phasing considerations consist of the following:

- Size and complexity of the Project;
- Local Authorizations;
- Cost Impact to Property Owners;

- Revenue Sources and Availability - Real Estate Taxes; Betterments and/or Special Assessments; Connection Fees; User Charges; Septage Revenue; Septic Management Fee; Water Infrastructure Fund; Local Option Taxes; District Improvement Financing; Local Infrastructure Development Program; Water Mil Charges; and Stormwater Fees. USDA Grants; US Economic Development Administration (EDA) Grants; HUD Community Development Block Grants; EPA Nonpoint Source Section 319 Grant Program; EPA STAR Grants; MassWorks Grants; 604(b) Water Quality Planning Grants; Planning or Technical Assistance Grants;

- Financing Sources and Availability - Conventional Financing; SRF Financing; USDA Financing; Renewal and Replacement Reserve Fund; and Debt Service Reserve Fund;

- Implementation Method(s) - Design-bid-build; design-build; design-build-operate;

- Public-Private Partnership Arrangements/Agreement(s); and

- Regulatory approvals.

It is proposed that the Overland Way WWTF and Downton Area collection system be constructed in at least two phases with the first phase occurring within the next five years and the second phase occurring within the next ten years. In addition to the phasing considerations noted above, this recommendation is based upon the following:

- Develop a plan which has manageable components with regards to availability of federal, state and local funding and the ability to generate revenues at a level acceptable to the Town;

- Develop a plan that does not restrict the construction activities to only larger construction firms. This also allows for construction firms located on the Cape the ability to submit bids on the projects;

- Develop a plan that allows incorporation on Public-Private Partnerships as soon as possible thereby reducing the cost to the Town;

- Develop a plan that allows for the evaluation of the costs-effectiveness of the Non-traditional technologies demonstration projects which may impact the overall size of the collection area as well as the size of the proposed WWTF;

- Develop a plan that incorporates the use of modular treatment units; and

- Provide wastewater service to the core downtown area serving properties located near the intersection of Main Street and Route 6A as soon as possible and followed by expansion into the remaining Downtown Area.

4. Management of Future Downtown Wastewater Biosolids

The wastewater biosolids loads for each future build-out scenario are summarized in Table 1. As important as flow projections, an estimate of pollutant concentrations is required to properly size WWTFs. Because there is no existing sewage collection or treatment system in place, there is no data from which to project sewage pollutant concentrations. Normal textbook[1] ranges for the key parameters of BOD, TKN and TSS are as shown in Table 2 below. To reflect the fact that this will be a new collection system where inflow/infiltration will be low, the concentrations were assumed to be on the medium to higher end of the range.

[1] "Wastewater Engineering, Treatment and Reuse", Metcalf & Eddy, 4th ed.

Table 2. Assumed Sewage Pollutant Concentrations

Constituent	Typical Ranges			Value Assumed
	Low	Medium	High	
BOD, mg/l	110	190	350	270
TKN, mg/l	20	40	70	55
TSS, mg/l	120	210	400	310

To address what impact septage receiving would have, actual annual average data from the existing Tri-Town Septage Treatment Facility was used. It was assumed that septage would be received only at the proposed Overland Way WWTF servicing the Downtown Area. Additionally, it is assumed that it will be processed with biosolids from the facility, so that only septage filtrate would be mixed with raw sewage influent to reduce solids loadings on the biological process. The resulted blended influent, as well as the influent characterization for the proposed Meetinghouse Pond WWTF, is as shown in Table 3.

Table 3. Assumed WWTF Influent Pollutant Concentrations

Constituent	Downtown Area	Meetinghouse Pond Area
BOD, mg/l	340	270
TKN, mg/l	60	55
TSS, mg/l	300	310

The values for BOD and TKN for the proposed Meetinghouse Pond WWTF reflect a homogeneous residential area as compared to the higher values used for the Downtown Area as well as reflecting a new collection system with limited I/I to dilute the wastewater flow. The value for TSS for the proposed Meetinghouse Pond WWTF reflect a homogeneous residential area as compared to the slightly lower value used for the Downtown Area since the water usage will be higher in the Downtown Area as well as reflecting a new collection system with limited I/I to dilute the wastewater flow.

With the flows and concentrations defined, an analysis of biosolids treatment options for each service area was evaluated. The evaluation was reported in Water Quality and Wastewater Planning Task Number 1.c.10 – Final Technical Memorandum on Wastewater Treatment, Residuals, Septage Management, Effluent Transmission and Pumping Components of the WWTF. Based on the evaluation the following was recommended:

- For reasons of economy of scale, impact to neighbors, and site constraints, it is anticipated that all treatment facility residuals from the proposed Meetinghouse Pond WWTF be trucked to the proposed Overland Way WWTF site and co-processed with residuals there.

- Septage receiving/processing will occur only at the proposed Overland Way WWTF.

- Septage will be received and be blended with Waste Activated Sludge (WAS) and co-dewatered so that it reduces the solids loading to the biological process that would result if it was introduced directly to the liquid train. It is anticipated that a blend of septage/WAS will have better dewatering characteristics..

An estimate of average solids generation from each source is summarized in Table 4.

Table 4. Estimate of Average Solids Production from WWTF and Septage Receiving

Item / Constituent	Meetinghouse Pond WWTF Residuals	Overland Way WWTF Residuals	Septage Receiving at Overland Way WWTF	Combined Totals
Gal/d	1,157	2,625	16,000	19,782
TSS, %	1.80	1.80	0.36	0.64
TSS, lbs./d	174	394	480	1,048

With the projected residuals/septage quantities defined, AECOM used its experience with similar projects to define a list of applicable technology options. While dewatering is usually a two-step process requiring thickening first, there are a few technologies available that allow dewatering to acceptable solids levels with one device. Two thickening technologies, two dewatering technologies, and two combined thickening/dewatering technologies were selected as follows:

- Gravity Belt Thickener (GBT);
- Rotary Drum Thickener (RDT);
- Belt Filter Press (BFP);
- Rotary Press;
- Belt Filter Press w/pre-Thickening Zone; and
- Screw Press.

The screw press achieved the highest weighted score by a fairly large margin. A key differentiator in this analysis was the fact that the screw press did not require a separate thickening step, which reduced the overall capital cost and footprint required for solids processing. Another category that set it apart was that because it is an enclosed system, control of odors and housekeeping are significantly less of an issue than with belt types of processes where the product is open to the ambient environment.

5. Next Steps

The proposed plan accounts for the current wastewater flow generation as well as the anticipated demand from the future Buildout of the Downtown Area in a way that considers project costs (funding and revenue generation) as well as modular treatment units to accommodate anticipated wastewater flows and loadings.

This Technical Memorandum represents the final deliverable for the Downtown Planning task. The project team will continue with the Facilities Preliminary Design Task and completion of the amended Comprehensive Wastewater Management Plan.