

Memorandum

To Paul Niedzwiecki, Executive Director
Patty Daley, Deputy Director
Kristy Senatori, Deputy Director
Erin Perry, Special Projects Coordinator

CC Betsy Shreve, AICP, AECOM Project Director
Jeffrey Reade, AECOM
Julianne Marrion, AECOM

Subject **Cape Cod Commission
208 Water Quality Management Plan Update
Task Order 12D
Technical Memorandum on Barnstable County Septage Analysis**

Project Number 60303168

From Thomas Parece, P.E., AECOM Project Manager

Date June 30, 2016 (Revised September 30, 2016)

1. Background

As part of an agreement dated June 26, 2013, between Barnstable County, acting through the Cape Cod Commission (the Commission) and AECOM Technical Services, Inc. (AECOM), AECOM has been issued various task orders to assist the Commission in assessing issues associated with water quality on Cape Cod. Task Order 12 consisted of the following sub-tasks:

- A. Watershed Updates and Hybrid Development, Technical Assistance for Implementation
- B. Eastham Salt Pond Phase 1 - Permeable Reactive Barrier (PRB) Initial Site Characterization;
- C. Nauset Estuary Watershed Nutrient Load Allocation Joint Evaluation of Existing and Expanded Water Quality Data;
- D. Septage Analysis; and
- E. Eastham Route 6 Drainage BMPs Salt Pond.

The purpose of this technical memorandum is to document the findings related to sub-task D. This task was intended to develop a County-wide assessment of current and potential future septage disposal needs; evaluate projected septage generation rates under several scenarios, to perform an analysis of septage treatment capacity at on-Cape facilities and proximate off-Cape facilities; and finally to assess the geographical impact on septage hauling/disposal costs.

2. Quantifying Septage, Grease, and Private WWTF Sludge Quantities

A. Current

Septage/O&G

The assessment of septage generation rates on Cape Cod has been performed a number of times over the past 10+ years. To update previous evaluations, AECOM attempted to obtain information from all facilities on Cape Cod, and within a 40-mile radius of the county line. Additionally, selective telephone polling of various health agents and septage haulers was conducted as well as a septage database obtained from the Commission.

The upper-Cape town Boards of Health, as well as Provincetown Board of Health, were contacted regarding the total septage generation in their respective towns. During the research phase of this project, it became evident that most of the Boards of Health do not maintain electronic records of pump outs, rather, they maintain hard copies of hauler's manifests. These receipts tend to be carbon copies. Some manifests are sent from the treatment facilities, but sometimes are sent to directly by the septage hauler. Exceptions to this include Yarmouth and Provincetown. Yarmouth has implemented an electronic system for tracking septage pumping records which contains current and historic information by Yarmouth property. The online system provides online information to residents and haulers of pumping information. Provincetown is in the process of implementing a new electronic filing system that will be used in the future, but there was no historical information available at this time.

The database provided by the Commission provided septage receiving quantities for all of the sewage/septage treatment facilities located on the Cape. In some cases, the information for the treatment facilities was broken down by the town in which the septage was generated, however for the Dennis-Yarmouth and Barnstable facilities, only total receipts were shown. . Proximate off-Cape facilities, which may receive septage from sources on Cape Cod but were not included in the Commission database, were also contacted. The following is a list of off-Cape facilities contacted and the results of this polling.

- Wareham: Wareham has an agreement to take septage from Bourne, and will accept grease from anywhere. They were able to provide receiving data on a town by town basis.
- Fall River: Fall River accepts from anywhere. They had no records available, but anecdotally reported not typically receiving septage/grease from any Cape towns.
- New Bedford: No contact was made with the New Bedford facility after repeated attempts.
- Taunton: While Taunton has a municipal sewage treatment plant, there's also a privately run septage receiving facility. The septage receiving facility reported receiving little to no septage from Cape towns.
- Kingston: The facility typically receives 15-20 thousand gallons per day, but indicated they do not receive from any Cape towns.
- Fairhaven: No contact was made with the Fairhaven facility after repeated attempts.
- Hanover: Hanover indicated that they do not receive septage.
- Plymouth: Telephone contact was made, but requests for specific information have been unanswered.
- Dartmouth: Dartmouth confirmed that they do not receive out-of-town septage.
- Marion: Marion confirmed that they do not receive septage.
- Marshfield: The facility indicates that it has some spare septage capacity, but currently does not receive any septage from Cape towns.

A summary of receiving volumes sourced from Cape towns on a facility by facility basis is as follows.

Table 2-1 - Septage Generated By Cape Towns, by Facility

Facility	Septage Received (gal/yr)	Grease Received (gal/yr)
Barnstable	13,097,000	1,012,200
Chatham	803,906	101,302
Falmouth ¹	8,275,340	0
Tri-Town	8,165,686	1,441,003
Dennis-Yarmouth	14,971,865	1,167,883
Wareham ²	650,768	238,349
Plymouth, New Bedford and other Facilities ³		
Total Cape Towns	45,964,565	3,960,737

Notes:

- Quantities for Falmouth include both septage and grease, as data was not available separately.
- Quantities received from Barnstable County towns only.
- Quantities received at Plymouth, New Bedford and other facilities outside of 40-mile radius undetermined at this time.

A 2005 report¹ prepared for the Town of Orleans estimated septage quantities in the order of 59 million gallons per year, however the 2005 estimate does not differentiate between septage and grease quantities. If current grease and septage quantities are added, the current quantities are 49.9 million gallons per year, which is 15 percent lower than the 2005 estimate. The difference between the two estimates is likely the result of a decline in population over the past decade, expanded sewerage in towns with WWTFs, some remaining gaps in information from those off-Cape WWTFs that have yet to respond to AECOM's request for information (e.g. New Bedford, Plymouth), and the possibility that some of the larger commercial haulers may be taking septage to locations outside of the 40-mile radius surveyed. In the absence of any additional data with which to fill these gaps in information, AECOM would estimate current septage and grease generation quantities based on the data available, with a 15 percent factor of safety added to account for data gaps.

Table 2-2 - Estimated Current Annual Generation of Septage and Grease on Cape Cod

Description	Volume (mil. gal.)
Septage Generation	52.8
Oil & Grease Generation	4.6
Total	57.4

Based on the information currently available and presented in Table 2-1 less than 1 percent of septage generated on Cape is treated at off Cape facilities, while 8 percent of grease is treated off-Cape. If the gap between the actual data available (Table 2-1) and the corrected estimate (Table 2-2) is all attributable to Cape generated septage being shipped to unaccounted for off-Cape treatment facilities, these percentages change to the 14 and 18 percent for septage and grease, respectively.

Private WWTFs

¹ "Tri-Town Septage Treatment Facility Evaluation", Wright-Pierce, 2005

According to MassDEP, there are a total of 55 private WWTFs holding Groundwater Discharge Permits on Cape Cod (laundromats and car washes not included). The total combined permitted flow of these facilities is 3.2 mgd. Based on AECOM's experience with these types of facilities on Cape Cod, we would expect annual average flows to be in the order of 33 percent of the permitted max day flow. In addition to flow, generation of sludges from these types of facilities is a function of wastewater strength. Again, based on our experience with these types of systems, a medium to higher strength wastewater was assumed. The basis of the private WWTF sludge estimate is as shown in Table 2-3 below.

Table 2-3 - Private WWTFs on Cape Cod

Description	Value
Quantity of Private GWDP Holders	55
Cumulative Permitted Max Day Flow	3.2 mgd
Assumed Average to Max Day Ratio	0.33
Assumed BOD Strength	250 mg/l
Assumed Sludge Yield	0.55 lbs sludge/lb BOD removed

Based on these assumptions, the annual average quantity of private WWTF sludges is 223 dry tons per year, which equates to 3.6 mil. gals per year at an assumed solids concentration of 1.5 percent.

B. Future Scenarios

- 1) An additional aspect of this task was to assess how generation rates would change if only 50 percent of the existing developed parcels remained on Title 5 systems, and how they would change assuming full build-out of all developable parcels on Cape Cod.

Based on information contained within the recently updated 208 plan, only 15 percent of existing residential and commercial wastewater flow goes to WWTFs, the balance of 85 percent goes to title 5 or non-compliant on-site systems. If the 85 percent of flow currently going to on-site (i.e. Title 5) systems were to be reduced to 50 percent, generation of septage would be expected to be reduced proportionally. The current estimate of septage generation would be expected to be reduced to 31.1 million gallon per year, as shown below.

$$52.8 \frac{\text{mil. gal.}}{\text{yr}} \times \frac{0.5}{0.85} = 31.1 \frac{\text{mil. gal.}}{\text{yr}}$$

There would however be a corresponding increase in sludge generation at WWTFs, both private and publicly owned. Current waste sludge quantities from the four publicly owned treatment works (POTWs) on Cape are presented in Table 2-4 below.

Table 2-4 - POTW Treatment Sludges (Dry tons/year)

Year	Location				Total
	Barnstable	Falmouth	Chatham	Provincetown	
2013	1,132	258	195	85	3,683
2014	1,015	286	250	79	3,645
2015	1,201	329	278	86	3,910
Average	1,116	291	241	83	3,746

If the quantity of wastewater served by POTWs increased from 15 percent to 50 percent, there would be a corresponding 3.33X increase in POTW sludges, or a total of 12,500 dry tons per year. Because oil and grease capture typically occurs before discharge to either a septic or sewage collection system, it is assumed that this scenario has no impact on grease quantities.

- 2) One other scenario involved assessing the increase in septage quantities in the event of a complete build-out of all developable parcels on Cape Cod. Table 2-5 is from a 2012 Commission report entitled “Cape Wide Buildout Analysis to Support Regional Wastewater Planning”.

Table 2-5 - Projected Current and Future Buildout Projections

	Existing dwellings (All Land Use Codes)	Additional Dwellings (All Land Use Codes)	% change	Existing Non-residential sf. (Land Use Codes 013, 031, 300-999)	Additional non-residential sf. (Land use Codes 013, 031, 300-999)	% change
Barnstable	25,167	4,296	17	19,442,037	4,577,937	24
Bourne	9,587	2,524	26	3,977,036	4,743,325	119
Brewster	7,440	1,661	22	1,092,877	1,184,883	108
Chatham	6,729	904	13	3,203,061	857,329	27
Dennis	14,816	1,185	8	3,021,445	3,313,741	110
Eastham	5,930	565	10	709,739	1,062,236	150
Falmouth	20,940	3,774	18	7,728,402	2,955,858	38
Harwich	10,038	2,063	21	1,993,037	1,062,282	53
Mashpee	9,687	1,559	16	2,406,349	3,922,966	163
Orleans	5,049	778	15	1,924,894	1,579,296	82
Provincetown	4,306	1,325	31	1,561,678	125,475	8
Sandwich	9,258	2,492	27	1,959,446	3,122,267	159
Truro	2,941	1,697	58	457,248	533,608	117
Wellfleet	3,958	1,463	37	583,288	794,772	136
Yarmouth	16,307	1,556	10	9,863,508	2,206,716	22
Total	152,153	27,842	18	59,924,044	32,042,693	53

Source: “Cape Wide Buildout Analysis to Support Regional Wastewater Planning” Cape Cod Commission, July 2012

Given that population and development on Cape has slowed significantly in recent years, it is reasonable for the purposes of this evaluation that the data shown in the 2012 report are still reasonably valid. The data from the table shows an 18 percent increase in dwellings, and a 53 percent increase in non-residential development. In order to extrapolate what this would mean in terms of wastewater/septage generation, a means of converting the two different metrics (dwellings vs non-residential floor space) into a common metric is required.

The Massachusetts Title 5 (Title 5) regulation has guidelines for the estimate of wastewater generation from both residential and commercial properties. Although it is AECOM's experience that these guidelines tend to overestimate actual wastewater generation, they are useful for the purposes of assessing percentage changes from existing baselines.

The Title 5 regulation apportions 110 gal/d per bedroom for residential dwellings. A typical assumption is that dwellings on Cape Cod consist of 3 bedrooms on average, for an equivalent Title 5 flow of 330 gal/d per dwelling. Although wastewater generation from non-residential space is strongly dependent on the property use, AECOM's recent work for the Town of Orleans suggests that 75 gals/1000 sf is a reasonable average for typical non-residential property use on Cape Cod. Table 2-6 shows the data presented in Table 2-5, presented in terms of equivalent Title 5 flow.

Table 2-6 - Projected Increase in Title 5 Equivalent Flow at Full Buildout

Description	Existing Dwellings	Full Build-out Dwellings
Quantity	152,153	179,995
Equiv. Title 5 Flow, gal/d	50,210,490	59,398,350

Description	Existing Non-residential Space	Full Build-out Non-residential Space
Area, sf	59,924,044	91,966,737
Equiv. Title 5 Flow, gal/d	4,494,303	6,897,505

Description	Existing	Full Build-out
Total Title 5 Flow, gal/d	54,704,793	66,295,855
	percent Increase	21 percent

As Table 2-6 indicates, full build-out of all developable parcels on Cape Cod would result in a roughly 20 percent increase in Title 5 equivalent flow. With the understanding that Title 5 tends to over predict actual flows, it is reasonable to assume that actual flows, and therefore septage generation, would increase by the same percentage, from 52.8 to 63.9 million gallons annually.

C. Current Receiving Policies

With the exception of Provincetown, all POTWs on Cape Cod as well as the Tri-town and Dennis-Yarmouth facilities receive septage. Policies on grease receiving, including which town(s) material is accepted from, vary from facility to facility. A summary of each facility and its current policy is described in Table 2-7.

Table 2-7 - Facility by Facility Receiving Policies

Facility	Septage Receiving Policy	Grease Receiving Policy
Barnstable WWTF	Barnstable, Sandwich, Mashpee, and any other town as long as the truck contains, even in part, septage from one of these identified towns	Barnstable, Sandwich, and Mashpee
Chatham WWTF	Chatham only	Chatham only
Falmouth WWTF	Falmouth only	Falmouth only
Provincetown WWTF	None	None
Tri-town STF ⁽¹⁾	All Cape towns	All Cape towns
Dennis-Yarmouth STF	All Cape towns	All Cape towns

Notes:

1. The Tri-town STF closed in May 2016 and therefore no longer has any septage or grease receiving capabilities.

3. Quantify Septage Processing Capability On-Cape and at Proximate Off-Cape Facilities

On-Cape and proximate Off-Cape septage facilities were contacted in order to determine the overall capacity of the systems. The septage and grease receiving capacities at each of the combine wastewater treatment facilities varies seasonally. Due to the lower influent wastewater flows in the winter months, the facilities cannot accept as much of the higher concentrated septage and grease wastes. The capacity can also fluctuate on a daily basis, based on the influent wastewater flows and whether the equipment is operating properly. Table 3-1 shows the current capacity for On-Cape and proximate Off-Cape facilities. The current capacity of on-Cape facilities is approximately 51.3 million gallons septage and 3.4 million gallons grease per year. The estimated septage capacity for proximate off-Cape facilities is at least 53.3 million gallons septage per year and 5.2 million gallons grease per year. It is important to note that the grease receiving capacities of several of the off-Cape facilities was not available. Additionally, there are several proximate off-Cape facilities that were contacted and did not provide a response but may have some capacity to receive septage from Cape towns.

Dennis-Yarmouth’s additional septage capacity, based on data through August 2016, appears to be sufficient to accommodate the 8.2 MG/year septage that was historically received at the Tri-Town STP. According to Yarmouth officials, the facility has not reached intake capacity for septage and grease in the 3 months after the closing² of the Tri-Town plant, which also coincided with what is historically the highest volume months of the year. Yarmouth officials report the facility has the ability to either dispose of thickened sludge (97% water) or sludge cake which allows for flexibility to continue to increase receiving capacity while maintaining discharges below the permitted 28 million gallons per year. The Dennis-Yarmouth facility has approximately 3 MG/yr excess grease capacity, which is sufficient to accept the 1.4 MG/yr that historically went to the Tri-Town facility. Yarmouth has also applied for a Brown Grease separator grant that would add additional intake capacity and would convert the brown grease component of the grease to a revenue source offsetting and potentially reducing the intake process for grease. There is an additional 0.3 MG/yr capacity available at Barnstable WWTF, but their current policy allows them to only accept grease from Barnstable, Mashpee, and Sandwich.

² The Tri-town Septage Treatment Facility ceased receiving septage and grease deliveries on May 31st, 2016.

Of the four on-Cape facilities, both Falmouth and Barnstable expressed plans for future upgrades. Falmouth is currently operating close to maximum capacity and is investigating upgrades to their sludge handling facility in order to increase sludge thickening capabilities. The Barnstable WWTF is planning to upgrade the septage building and potentially upgrade the treatment plant. Most of the off-Cape facilities did not express plans for future upgrades to their septage processing. Fall River WWTF does not currently have upgrades planned, but indicated that future upgrades within the next 10 years may include their septage receiving facility, which is an older system, and an addition of a dewatering system to allow for better sludge management.

Table 3-1 - Capacity and Current Receiving Quantities (through 2015)

Facility	Current Septage Received (MG/yr)	Current Estimated Septage Capacity (MG/yr)	Estimated Excess Septage Capacity (MG/yr)	Current Grease Received (MG/yr)	Current Estimated Grease Capacity (MG/yr)	Estimated Excess Grease Capacity (MG/yr) ⁽¹⁰⁾
On-Cape Facilities	46.1	53.3	7.2	3.7	5.7	2.0
Barnstable ^{1,2}	13.10	16.9	3.8	1.0	1.3	0.3
Chatham ³	0.44	0.44	0.0	0.10	0.10	0.0
Falmouth ³	7.96	7.96	0.0	N/A	N/A	N/A
Tri-Town ⁴	8.17	0	-8.2	1.4	0	-1.4
Dennis-Yarmouth ¹	15.0	28.0	13.0	1.2	4.3	3.1
Off-Cape Facilities ⁹	5.2	53.3	5.2	2.5	5.2	2.7
Wareham	2.6	5.2	2.6	2.5	5.2	2.7
Fall River ⁵	N/A	N/A	N/A	0	0	0
Raynham	N/A	N/A	N/A	N/A	N/A	N/A
Taunton ⁶	N/A	N/A	N/A	N/A	N/A	N/A
Kingston	N/A	3.9	N/A	0	0	0
New Bedford ⁷	N/A	39	N/A	N/A	N/A	N/A
Plymouth ⁸	N/A	N/A	N/A	N/A	N/A	N/A
Marshfield	2.6	5.2	2.6	N/A	N/A	N/A

Notes:

1. Barnstable and Dennis-Yarmouth grease receiving capacities are based on the system capacity multiplied by a ratio of the 2015 grease quantities/2015 total.
2. Barnstable currently only accepts three loads with grease per day.
3. Chatham and Falmouth capacities are based on actual septage received in 2015. Falmouth indicated that they are currently operating at their maximum capacity.
4. Tri-Town STP closed as of May 2016.
5. Fall River indicated that they have excess septage capacity.
6. Taunton facility capacity based on groundwater discharge permit.
7. New Bedford capacity is based on 2014 Stantec Report³.
8. Plymouth is currently operating near maximum capacity (Stantec 2014).
9. System capacities for Off-Cape facilities are based on the maximum daily rate at 5 days/week.
10. The excess grease capacity may be less due to the current policies at Barnstable, Chatham, and Falmouth, which all have restrictions on which town(s) they accept grease from.

³ Stantec. *Task 2.0: Septage and Food Waste Market Study Technical Memorandum 2.0*. Town of Orleans, MA. December 23, 2014.

4. Assess Economics of Standalone Septage Processing vs Septage Processing at a Conventional WWTF

This element included a number of components, as listed below.

- Determine capital and O&M costs for new combined facilities as identified for potential development;
- Determine O&M costs only for the existing septage only facility in Dennis-Yarmouth, as well as O&M costs for existing combined facilities;
- Determine capital and O&M costs for new treatments facilities that treat domestic wastewater but do not include septage handling;
- Determine the incremental additional cost for building and maintaining the addition of a septage handling capability to a wastewater treatment facility; and
- AECOM will develop a concept level design for each scenario: total project costs as well as O&M costs will be compared. Break-even tipping fees will be estimated.

Each of these items was evaluated as follows.

- a) Determine capital and O&M costs for new combined facilities as identified for potential development.

AECOM has had numerous discussions with a variety of parties associated with septage disposal on Cape Cod, which include the Commission, Mass DEP, existing treatment facility staff and septage haulers. The only facility recently in planning stages for receiving and processing biosolids to include sludge and food waste was a project slated at the Bourne Integrated Solid Waste Management (ISWM) facility. The intent was for a private developer (Harvest Power of Waltham, MA) to construct and operate a facility that would take biosolids, to include sludges, FOG, and food waste for digestion and conversion to methane, which would fuel an onsite combined heat and power (CHP) system. Based on Harvest Power's inability to secure a long-term contract with Eversource for sale of the electrical energy produced however, the planned project was scrapped in March 2016. Bourne, the County and Yarmouth continue to look for opportunities to put an Anaerobic Digester in place to reduce the regions sludge and food waste disposal costs. Bourne, the County and Yarmouth have developed estimates of the regions sludge and food waste to allow for conversations with potential partners. Ongoing discussions are continuing with three potential partners but will be expanded to include more with the waste estimates that have been developed. New legislation that sets aside net metering credits at retail prices make putting a Digester in or near the region more attractive.

- b) Determine O&M costs only for the existing septage only facility in Dennis-Yarmouth, as well as O&M costs for existing combined facilities.

As part of the data gathering effort associated with the recently updated 208 plan, AECOM developed a data base of O&M costs at a number of on-Cape and off-Cape facilities. A summary of these O&M costs is as follows.

**Table 4-1 -
Summary of O&M Costs for WWTFs Handling Septage and/or Septage and Sewage**

Location	Discharge Flow (gpd) ⁽¹⁾		O&M Cost (\$/yr)	Unit Cost (\$/yr/gpd)
	Design	Annual Average		
Tri-Town ²	45,000	26,300	\$1,000,000	\$38.0
Dennis-Yarmouth ^{2, 4}	76,700	53,600	\$1,216,000	\$22.7
Provincetown ³	750,000	150,000	\$840,000	\$5.6
Falmouth	1,200,000	400,000	\$1,224,000	\$3.1
Wareham	1,560,000	1,067,000	\$3,209,000	\$3.0
Chatham	2,300,000	1,300,000	\$2,046,000	\$1.6
Barnstable	4,200,000	1,800,000	\$2,439,000	\$1.4

Notes:

1. With the exception of the Dennis-Yarmouth facility, all plant surveyed are designed and permitted on a max daily flow basis. The Dennis-Yarmouth facility is permitted on an annual discharge basis of 28 million gallons per year, which when spread across 365 days/yr equates to 76,700 gpd.
2. Septage only
3. Sewage only
4. Flow and O&M costing for Dennis-Yarmouth current through FY16.

With most facilities, there is only a slight difference between wastewater received and wastewater discharged. The Dennis-Yarmouth facility's ability to dispose of liquid sludges, effectively acting as a transfer station, means that is not the case there. For the sake of computing annual average receiving quantities and unit costs, annual receiving quantities for FY 2016 were used, and spread on a 7-d/wk basis to be consistent with the convention chosen for design discharge capacity.

Yarmouth officials indicate a variety of aggressive cost saving measures are on-going at the Dennis-Yarmouth facility. This combined with the spreading of fixed and semi-fixed costs against the volume increase being realized by the Tri-town closure should result in a significant reduction in unit processing cost in the coming year. Yarmouth officials project a FY17 O&M expenses of \$1.57M, which if spread across the full capacity of the plant of 30 million gallons/yr, could potentially reduce unit costs to \$19.1/yr/gpd.

- c) Determine capital and O&M costs for new treatment facilities that treat domestic wastewater but do not include septage handling.

As part of the 208 Plan update, AECOM developed a tool for estimating the capital and O&M costs for treatment plants of different sizes (Figure 4-1 and Figure 4-2). The database includes both plants that receive and do not receive septage, however of those that do, most receive smaller quantities and do not have any special facilities for receiving/processing septage. For the purposes of this evaluation, it can be assumed that the data is representative of plants that did not expend any significant additional capital to accommodate septage receiving, and whose O&M costs are only marginally affected.

Using these tools and two hypothetical plants on the lower and higher capacity range of what might be expected on Cape Cod, the following estimates were arrived at.

Table 4-2 - Capital and O&M Costs

Description	“Small” WWTF	“Medium to Large” WWTF
Rated Capacity, gal/d	750,000	4,000,000
Annual Average Flow, gal/d	250,000	2,000,000
Capital Cost	\$16.0 million	\$45.0 million
Annual O&M Cost	\$0.85 million	\$2.79 million

Figure 4-1 - Capital Cost Estimation Tool
RESULTS OF PROJECT COST SURVEY

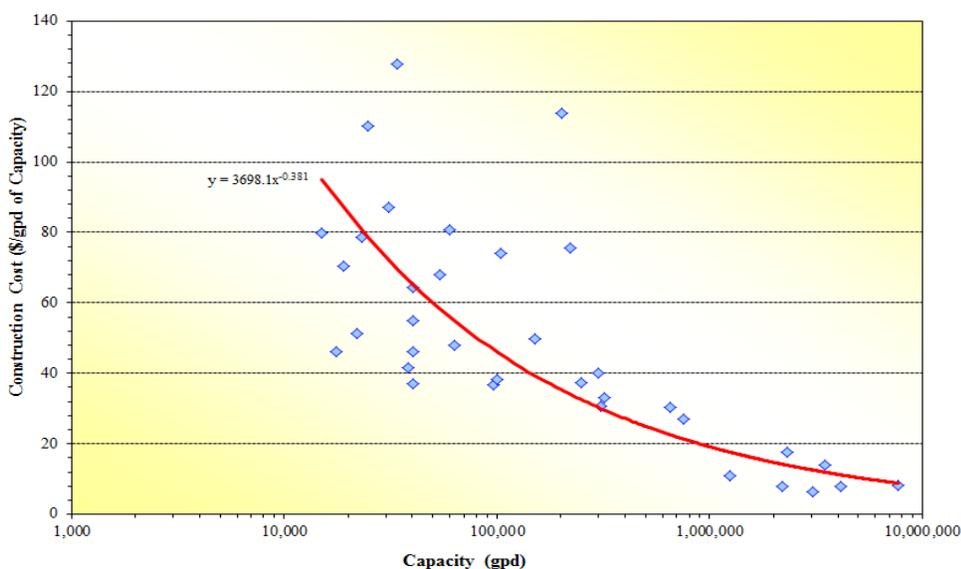
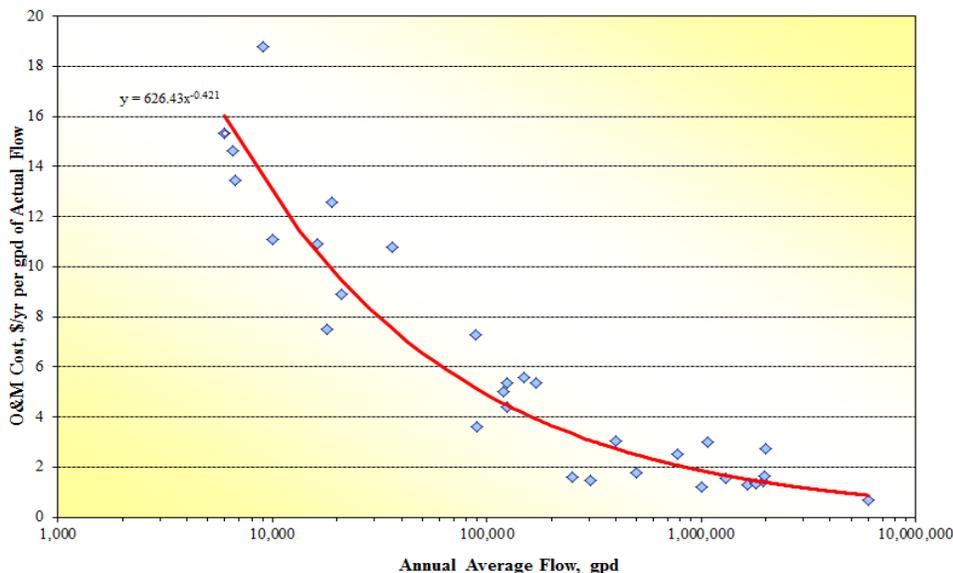


Figure 4-2 – O&M Cost Estimation Tool
RESULTS OF O&M COST SURVEY



- d) Determine the incremental additional cost for building and maintaining the addition of a septage handling capability to a wastewater treatment facility.

Using Falmouth as an example of a WWTF that receives both sewage and septage, the following are sewage/septage receiving rates as well as solids generation.

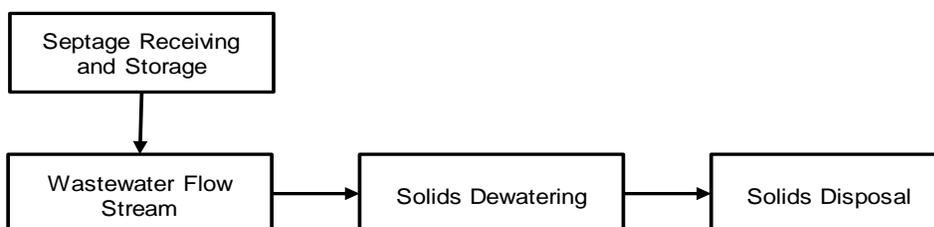
- Annual Average Flow, gpd: 450,000
- Annual Average Septage Receiving, gpd: 22,700
- Annual Average Sludge Generation, dry tons/yr: 290

Falmouth would be considered an extreme example in terms of septage vs. sewage received, because the sewage collection system covers only a small portion of what is a fairly large and in some areas densely populated community. Even so, septage represents less than 5 percent of the flow coming into the WWTF on a volume basis, and as such, would not be expected to have an appreciable impact on flow related capital or O&M costs.

Septage is however about 10 times more concentrated than sewage in terms of solids and organic content. So, in the case of Falmouth, although septage only accounts for less than 5 percent of the volumetric loading to the plant, it accounts for roughly a third of the organics/solids loading to the facility.

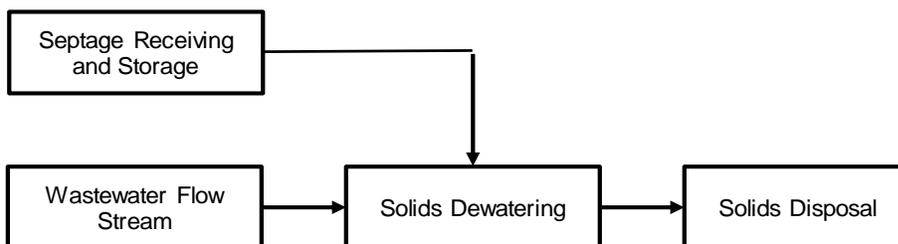
There are essentially two options for handling septage at a conventional WWTF. The first and simplest option is to mix it in with the sewage entering into the facility as shown in the schematic below.

- Alternative No. 1 - Accept, Degrit, Store, Blend Septage into Wastewater Stream, and Dewater Solids.



The second is to process it directly with the other biosolids produced from the WWTF.

- Alternative No. 2 - Accept, Degrit, Store, Thicken, Blend Liquid (filtrate) into Wastewater Stream, and Blend Solids into Solids Stream for Dewatering.



While AECOM would typically recommend Alternative No. 2 to reduce impacts to the biological process, we would recommend with either alternative that septage receiving include its own pre-treatment. Several manufacturers provide package septage receiving stations that include screening, washing/conveyance of screenings, and metering of received material, as shown in Figure 4-3. They are self-contained which reduces nuisance odors and housekeeping issues.

The uninstalled raw equipment price for such a system capable of handling up to 30,000 gal/d of septage is in the order of \$150K dollars. AECOM would estimate the fully installed cost to be in the order of \$500K to \$750K, depending on the degree of enclosure and odor control mitigation required. It is AECOM's experience that the amount of incremental solids processing required is well within the capacity of existing solids processing systems at a typical WWTF.

Figure 4-3 - Typical Package Septage Receiving Station
(Courtesy of Lakeside Equipment Corp.)



The incremental impact on O&M costs arises from the following factors:

- Additional solids processing costs (energy and chemicals);
- Additional dewatered solids disposal costs;
- Additional staffing and maintenance costs; and
- Additional power required both in the solids processing area and the biological process, which will receive additional filtrate.

AECOM estimates the total incremental cost for receiving up to 8 million gallons per year of septage over running a conventional sewage treatment facility to be \$250K/yr.

A summary of both capital and O&M costs for the two hypothetical plants outlined in Table 4-2, both with and without septage, is as follows.

Table 4-3 - Capital and O&M Costs With/without Septage Receiving (8 mil. gal./yr)

Description	"Small" WWTF		"Medium to Large" WWTF	
Rated Capacity, gal/d	750,000		4,000,000	
Septage Received, gal/yr	0	8,000,000	0	8,000,000
Annual Average Flow, gal/d	250,000	270,000	2,000,000	2,020,000
Capital Cost	\$16.0M	\$16.5M	\$45.0M	\$45.5M
Annual O&M Cost	\$0.85M	\$1.10M	\$2.79M	\$3.04M

As can be seen, the incremental capital cost was negligible in comparison to the total project cost in either case. As one might expect, the incremental O&M cost was more of a significant impact for the smaller plant (30 percent) that it was for the larger plant (10 percent).

- e) Develop a concept level design for each scenario: total project costs as well as O&M costs will be compared. Break-even tipping fees to be estimated.

Concept level capital and O&M costs have been developed for a conventional WWTF and a conventional WWTF receiving septage, for two plant sizes, as shown in Table 4-3 above. The estimate of costs for a facility treating septage can be developed as follows.

While the cost estimation tools developed for the 208 plan are useful for concept level pricing, they are flow based and derived of data from conventional WWTFs. As indicated previously, the 8 million gals/yr of septage that is the basis for this analysis translates to only 22,000 gal/d on average. However, due to its strength, it has the organic and solids equivalent of 220,000 gal/d of sewage. That means that the biological and solids processing portions of a 22,000 gpd septage plant, which comprise the bulk both capital and O&M costs would be comparable to a WWTF averaging 220,000 gpd, or having a peak rated capacity of 660,000 gpd. Other unit operations that are sized more based on flow, such as pumping, sedimentation, filtration, and disinfection systems would be sized considerably smaller. Based on our experience, AECOM would derate the overall capital costs derived from the capital cost estimation tool for a 220,000 gpd WWTF by 33 percent, to account for portions of a septage plant being sized for the smaller flow. However the O&M costs, which are largely driven by staff, the biological process, and solid processing would remain similar. Using Figure 4-1 and Figure 4-2 for a WWTF rated for 220,000 gpd average/660,000 gpd peak, and derating the capital estimate by 33 percent as discussed, an estimate for a Septage only facility is as shown Table 4-4.

Table 4-4 - Capital and O&M Costs for Septage Only Facility

Description	Septage Receiving Facility
Annual Average Flow, gal/d	22,000
Capital Cost	\$9.8 million
Annual O&M Cost	\$0.78 million

The breakeven tipping fee can be calculated by amortizing the capital cost over 20 years, adding the annual O&M costs, and spreading it out across the annual gallons received. For the case of the WWTF receiving septage, only the incremental costs directly attributable to septage processing are considered. For a septage only facility, all of the project costs are considered. With the simplifying assumption that the borrowing rate and inflation are roughly equivalent, this led to the estimate of break-even tipping fees shown in Table 4-5.

Table 4-5 - Break-even Tipping Fee for 8 million gallons/yr Septage Treatment Capacity

Description	Septage Treatment at WWTF	Septage Only Facility
Capital Cost	\$0.5 million	\$9.8 million
Annual O&M Cost	\$0.25 million	\$0.78 million
Break Even Tipping Fee	\$0.035/gal	\$0.159/gal

Schematics for a WWTF facility designed for septage receiving, and a septage only treatment facility are as shown in Figure 4-4 and Figure 4-5.

Figure 4-4 - Schematic of WWTF Configured for Septage Receiving

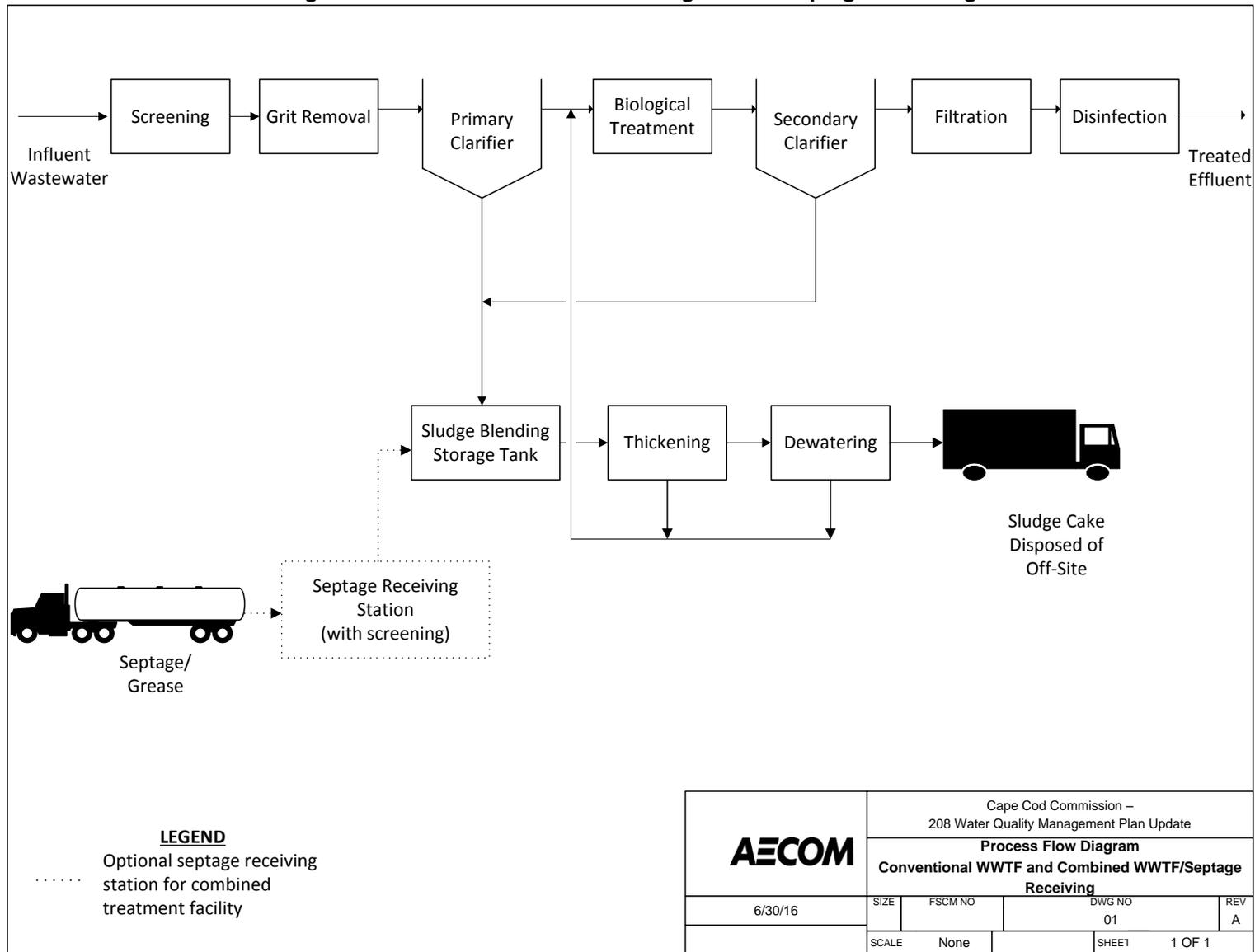
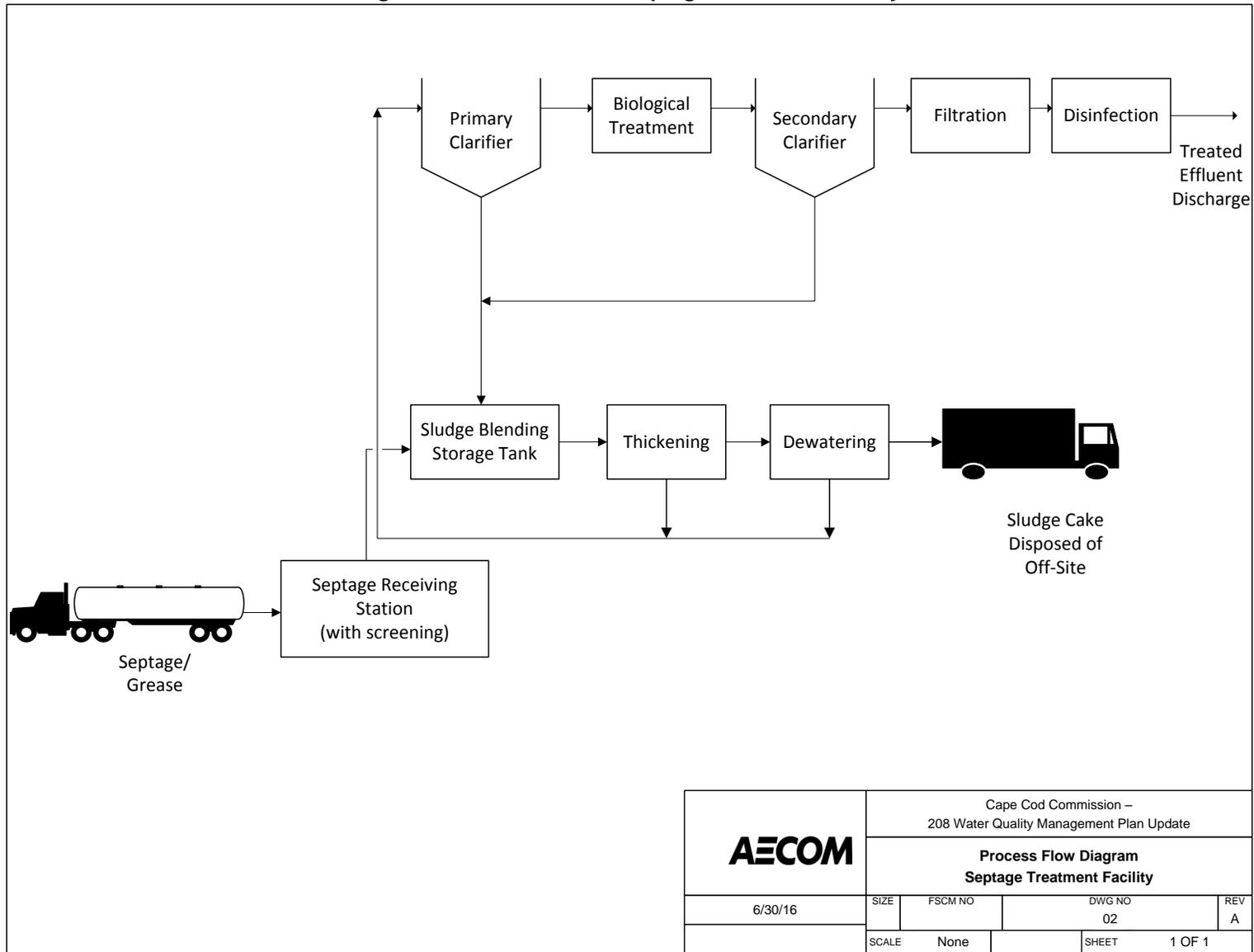


Figure 4-5 - Schematic of Septage Treatment Facility



AECOM	Cape Cod Commission – 208 Water Quality Management Plan Update			
	Process Flow Diagram Septage Treatment Facility			
6/30/16	SIZE	FSCM NO	DWG NO	REV
			02	A
	SCALE	None	SHEET	1 OF 1

5. **Sub – regional Needs**

Based on the data collected from the Cape facilities and Wareham WWTF, the septage generation rates on a sub-regional basis were determined. The data that was “not classified” was divided into various sub-regions based on known information. For example, the Tri-Town facility recorded data on a town basis for all towns in the outer and lower Cape, so it is known that the “other” septage was received from mid or upper Cape. The breakdown of septage generation by sub-region is shown in Table 5-1.

Table 5-1 - Assessment of Septage Generation on a Sub-regional Level

Sub-Region	Percentage of Total	Estimated Septage Generation Rates (MG/yr)
Outer/Lower ¹	24	12.5
Mid ²	40	21.4
Upper ³	36	18.9
Total	---	52.8

Notes:

1. Includes “not classified” septage received at Barnstable WWTF.
2. Includes “not classified” septage received at Tri-Town and all of Dennis-Yarmouth.
3. Includes “not classified” septage estimated to be disposed of off-Cape.

A limited phone survey of septage haulers from each sub-region was conducted in order to determine the primary factors that drive selection of disposal locations and the setting of pump out fees to homeowners. A response was only received from septage haulers located in upper and lower Cape, who expressed similar thoughts. Additionally, one septage hauler located off-Cape but covers a large portion of New England, including Cape Cod, was contacted during the survey.

The two septage haulers located on-Cape both noted that with the closing of the Tri-Town facility, there are now limited disposal options. Dennis-Yarmouth is now the only facility that will accept septage from all Cape towns without restrictions. All of the haulers who responded indicated that the primary factor that drives the disposal location is where the pump-out is and what the driver’s route for the day is.

The fees collected and the determination of fees varied by each hauler. One hauler indicated that their pump-out fees vary by town depending on how far away they are from their main facility, and not necessarily dependent on the ultimate disposal location. Another hauler indicated that their pump-out fees do not currently vary by town, but that they expect the prices may need to be adjusted to account for the additional labor and transportation costs due to the recent closing of the Tri-Town facility. This hauler also indicated that they already increased grease pump-out rates since Tri-Town STP closed, as the Tri-Town facility had a lower tipping fee than the Dennis-Yarmouth facility. A hauler located off-Cape provided pricing for the various sub-regions, as shown below in Table 5-2.

Table 5-2 - Estimated Pump-Out Rates on a Sub-regional Level

Sub-Region	Estimated Pump-Out Rate (per 1,500 gallon tank)
Upper Cape	\$380
Mid Cape	\$405
Outer Cape	\$435
Lower Cape	\$450

A previous report completed by Stantec for the Town of Orleans received feedback from more haulers and also found that the fees varied depending on the location of the pump-out. The range of pump-out fees were \$225 to \$370 for a 1,000 gallon tank and \$325 to \$350 for a 1,500 gallon tank⁴. This rates estimated in Table 5-2 are slightly elevated, which could be for a number of reasons, including potential increase in prices over the past two years and the difference in pricing for a local hauler versus larger, off-Cape hauler. The current tipping fees at the various On-Cape facilities, as well as nearby Wareham, are presented in Table 5-3. As indicated by one of the haulers, the Yarmouth grease tipping fee is higher than other on-Cape and off-Cape facilities, which may impact haulers' fees moving forward with the closing of the Tri-Town facility.

Table 5-3 - Tipping Fees by Facility

Facility	Septage Tipping Fee (\$/gal)	Grease Tipping Fee (\$/gal)
On-Cape Facilities		
Barnstable	\$0.105	\$0.105
Chatham	\$0.09	\$0.14
Falmouth	\$0.10	N/A
Yarmouth	\$0.10	\$0.19
Off-Cape Facilities		
Wareham	\$0.10	\$0.10

The average septage tipping fee is approximately \$0.10 per gallon, which accounts for 27 percent to 44 percent of the pump-out fees reported in the 2014 Stantec report. Assuming a hauler adds a 10 percent increase to the tipping fee, the remaining approximately 50 percent of the pump-out fee can be attributed to labor and transportation costs. The Yarmouth STP is located approximately 15 miles from the Tri-Town STP, about a 20 minute drive without traffic. This translates into approximately 40 minutes to an hour, roundtrip, of additional labor. This could impact prices in the outer and lower Cape. The impact of additional labor and transportation may not directly correspond to potential increases in pump-out fees for homeowners. While some haulers have up to 9,000 gallons of capacity, most septage pumping trucks haul 3,000 to 5,000 gallons, which equates to 2 to 3, 1,500 gallon septic tanks. Therefore, this additional hour of labor and transportation costs could be allocated to three homeowners, such that the increase per pump-out is 5 to 10 percent. Also, the increase could be further impacted by the driver's route and whether or not they were already scheduled to drive to the Yarmouth area for another pump-out. It is not anticipated that mid or upper Cape fees will be significantly impacted by the closing of the Tri-Town facility, as the closest disposal locations are still available.

One hauler indicated that they would be more likely to pay higher prices for disposal than to drive longer to a facility with a lower tipping fee, as this would increase both labor and transportation fuel costs. For example, a grease pump-out at a restaurant near Orleans may be disposed of at the closest facility, Yarmouth, and charged \$0.19/gal. Although Wareham WWTF will also accept this grease load, pending capacity, the additional 33 miles and 80 minute round-trip, is likely not worth the savings of \$0.09/gallon. Yarmouth is discussing with Wareham disposal at their brown grease separator if they have capacity. If Wareham does not have capacity, Yarmouth may install a brown grease separator similar to Wareham, enabling them to reduce costs related to grease intake and solids disposal.

⁴ Stantec. *Task 2.0: Septage and Food Waste Market Study Technical Memorandum 2.0*. Town of Orleans, MA. December 23, 2014.

6. Observations and Conclusions

Overall, this study found that Cape towns produce approximately 52.8 MG/yr septage and 4.6 MG/yr grease. The Cape has four facilities that treat septage and grease that can accommodate approximately 53.3 MG/yr septage and 5.7 MG/yr grease. Having only a slight excess in capacity has not been a problem to date due to most upper Cape septage being transported to off-Cape facilities. The Dennis-Yarmouth STP currently has enough excess septage treatment capacity to handle the approximately 8.2 MG/yr that historically was disposed of at the Tri-Town facility.

The Dennis-Yarmouth facility has approximately 3.1 MG/yr excess grease capacity, which is sufficient to accept the 1.4 MG/yr that historically went to the Tri-Town facility. There is an additional 0.3 MG/yr capacity available at Barnstable WWTF, but their current policy allows them to only accept grease from Barnstable, Mashpee, and Sandwich. Dennis-Yarmouth's current pricing may be causing haulers to use other options. Dennis-Yarmouth's implementation of a Brown Grease separator similar to Wareham, or, based on their discussions with Wareham to deliver it's grease cake to their Brown Grease separator may allow for a decrease in pricing to provide on-Cape disposal options for all the grease except for those towns close to Wareham. Grease disposal is in high demand and there is now only one facility on the Cape that accepts grease without restrictions. This observation resonated with several people who were contacted from various treatment facilities and septage hauling companies. The closing of the Tri-Town facility has already caused some grease pump-out fees to increase. A reduction in Dennis-Yarmouth's pricing through innovation may allow for their decreasing fees since they reportedly have excess capacity.

In terms of economics, the construction of septage/grease treatment capacity in conjunction with conventional sewage treatment is considerably more cost-effective than stand-alone septage/grease treatment, due to some economy of scale, and sharing of equipment/infrastructure at combined sewage and septage facilities.

In conclusion, in the near to intermediate term, there does not appear to be a capacity crises on Cape Cod as it pertains to septage treatment. While transportation costs will be impacted, primarily for outer-Cape users, they should be somewhat offset by tipping fees at Dennis-Yarmouth that are less than what outer-Cape users typically paid at Tri-Town. There appears to be adequate disposal capacity for grease however tipping fees at the Dennis-Yarmouth facility may cause haulers to go off-Cape for disposal. Yarmouth officials report that they are actively exploring options that should help reduce costs.