Prepared for:

CAPE COD COMMISSION
3225 Main Street
Barnstable, Massachusetts 02630

Final Task 4 Report: Cost/Benefit Comparison of Options and Final Recommendations Municipal Solid Waste Out-Of-State Disposal Cost/Benefit Analysis

Prepared by:

Geosyntec Consultants
289 Great Road, Suite 202
Acton, Massachusetts 01720

Geosyntec Project Number: ME1979

November 2021

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

ABBREVIATIONS AND ACRONYMS

Formal names for offices, agencies, institutions, companies, products, and programs are capitalized; technical terms are in lower case.

AD	anaerobic digestion; anaerobic digestor
C&D	construction and demolition
CASP	covered aerated static pile
CCC	Cape Cod Commission
CY	cubic yards
GHG	greenhouse gas
ISWM	Integrated Solid Waste Management (Facility operated by the Town of Bourne)
LFG	landfill gas
LFGTE	landfill gas to energy
MassDEP	Massachusetts Department of Environmental Protection
MRF	materials recovery facility
MSW	municipal solid waste
NPV	net present value
PAYT	pay as you throw
PPP	public-private partnership
ROI	return of investment
RFP	request for proposal
SEMASS	Southeast Massachusetts Waste-to-Energy Facility (Covanta)
SSO	source-separated organics
TPD	tons per day
TPY	tons per year
UCRTS	Upper Cape Regional Transfer Station
U.S. EPA	U.S. Environmental Protection Agency
WARM	Waste Reduction Model (U.S. EPA)
WTE	waste to energy
YTS	Yarmouth Transfer Station

1. INTRODUCTION

1.1 Purpose and Terms of Reference

This Task 4 Report (Report) was prepared by Geosyntec Consultants, Inc. (Geosyntec) for Barnstable County consistent with the scope of work submitted to the Cape Cod Commission (CCC) and Barnstable County, as approved under Contract No. 500-21-7914A on 12 November 2020 for the project titled "MSW Out-of-State Disposal Cost/Benefit Analysis" (hereafter "Project"). The scope of work for the Project was outlined in the Request for Proposal (RFP) No. 7914 issued by the County on 20 August 2020, as described in Geosyntec's proposal dated 1 October 2020 and further clarified in our letter to CCC dated 20 October 2020. Geosyntec has prepared this Report to present findings from Task 4 (i.e., Cost/Benefit Comparison, Recommendations, Presentations, and Presentation Materials) of the Project, with the primary goal of providing a cost/benefit comparison of future options for management of municipal solid waste (MSW) generated in towns in the Cape Cod and Islands Region (hereafter "Cape and Islands"). For the purposes of this evaluation, Cape and Island towns include:

1. 15 towns in Barnstable County (Barnstable, Bourne, Brewster, Chatham, Dennis, Eastham, Falmouth, Harwich, Mashpee, Orleans, Provincetown, Sandwich, Truro, Wellfleet, and Yarmouth),
2. Six towns on Martha's Vineyard in Dukes County (Aquinnah, Chilmark, Edgartown, Oak Bluffs, Tisbury, and West Tisbury), and
3. Nantucket in Nantucket County.

The Massachusetts Department of Environmental Protection (MassDEP) has determined that in-state MSW disposal capacity will be increasingly limited in the near-medium term. This Project is thus intended to support Cape and Island towns by:

1. Securing medium to long term access to reliable out-of-state MSW disposal infrastructure,
2. Reviewing viable options for reducing the quantity of MSW for disposal through development of on-Cape processing capacity,
3. Providing the necessary transfer systems to support on-Cape processing and out-of-state MSW disposal, and
4. Reducing overall MSW management costs to towns and residents while minimizing environmental impacts.

Data and information used in the Project were assembled in collaboration with CCC and Barnstable County following a Request for Information issued by Geosyntec on 7 December 2020, supplemented where necessary with additional publicly available sources of information as well as conversations with private companies. It is noted that the Project only concerns disposed MSW (i.e., materials that currently end up in a landfill or incinerator) and does not extend to materials that are currently diverted for recycling, reuse, or other non-disposal disposition.

1.2 Project Background and Objectives

The Cape and Islands are at risk of rising MSW disposal costs, primarily due to diminishing waste disposal capacity across New England as MSW landfills close and aging waste-to-energy (WTE) incinerators are operating at capacity. Additionally, the state has a moratorium on permitting new WTE facilities and the likelihood of permitting a new landfill is considered extremely low due to local opposition and other factors. At the same time, the draft MassDEP 2030 Solid Waste Master Plan outlines ambitious goals for waste reduction and diversion. However, recycling commodity prices, which were already depressed due to steep declines in exports to Chinese and other Asian markets following imposition of stringent rules on contamination levels since 2018, are under increasing pressure due to budgetary constraints affecting collection and operation of recycling systems. These factors drive recycling operators to recover their increased costs through renegotiation of materials recovery facility (MRF) processing agreements with local governments.

The lack of disposal capacity and available markets to process recyclable materials along with increasing transportation costs are negatively impacting MSW disposal budgets for municipalities across Massachusetts, including on the Cape and Islands. To address these issues and provide towns with information that can be used to plan for future MSW management, Barnstable County is working through the CCC and the Cape Cod Cooperative Extension on a companion project to this Project to assess waste reduction and diversion measures to reduce the volume of waste that requires disposal. Nonetheless, significant disposal needs remain, for which options for out-of-state waste transportation via rail to landfill disposal facilities offers the most realistic and cost-effective solution.

1.2.1 Project Approach

The primary objective of this Project is to support the Cape and Island towns that are participating in this effort with their MSW management obligations, with a focus on reducing overall costs to towns and residents. This Project also seeks to leverage potential opportunities to utilize existing infrastructure on the Cape and Islands, specifically the Upper Cape Regional Transfer Station (UCRTS) and the Yarmouth Transfer Station (YTS).

The Project includes four main tasks:

1. Task 1 – Quantify and Characterize Cape and Islands MSW

2. Task 2 – Analysis of Disposal Options
3. Task 3 – Analysis of Processing, Tipping, and Transportation Options
4. Task 4 – Cost-Benefit Comparison and Recommendations

1.2.2 Summary of Findings from Task 1

In Task 1, Geosyntec reviewed the existing solid waste management and recycling system and prepared a technical memorandum (memo) to describe findings from a desk study evaluation of the quantity and characteristics of MSW generated on the Cape and Islands as well as the current cost for MSW disposal incurred, the current MSW hauler, and the current disposal facility serving each town. Based on this, projections of future waste disposal needs were developed. Geosyntec also reviewed the potential tonnage of food scraps and other organics that could be recovered from MSW for on-Cape processing. Geosyntec's final Task 1 Memo was submitted to CCC on 11 March 2021. Findings from Task 1 serve as the baseline for defining future MSW disposal system requirements in Tasks 2 and 3.

<u>Waste Quantities and Composition</u>

Primary findings from analysis of the existing system on the Cape and Islands were as follows:

1. The Cape and Island towns served 112,602 households in 2020 (about 2,500 more than in 2019) and handled a total of 84,465 tons of MSW for disposal (about 1,600 tons more than in 2019). Data for 2020 represented service to approximately 68% of the reported 164,899 households on the Cape and Islands. Overall, a conservative value of 85,000 tons per year (TPY) is assumed to represent the current MSW quantity handled by Cape and Island towns.
2. Population dynamics and historical waste generation reported over the last ten years suggest that population trends will be flat or slightly declining with future waste generation lower than current rates. However, given the significant seasonal variation in populations of many towns and the need for this Project to provide conservative estimates of future waste management challenges, a zero rather than declining growth rate is assumed for all waste streams.
3. Only four towns offer curbside collection services. Residents not served by curbside collection must bring MSW to their town's drop-off center or contract with a private commercial hauler. MSW collected curbside or at drop-off centers is either direct hauled to a disposal facility or is consolidated at a small town-owned transfer facility or the YTS prior to hauling. The UCRTS is not currently used for MSW transfer but serves as a privately operated construction and demolition (C&D) waste facility.

4. Only Bourne, Falmouth, and Nantucket dispose of MSW in on-Cape facilities. All other towns send their MSW off-Cape to either Covanta's Southeast Massachusetts (SEMASS) WTE Facility in Rochester, Plymouth County or the Crapo Hill Landfill in New Bedford, Bristol County. The Middleboro Landfill and other off-Cape landfills are also used depending on hauler routing and schedules.
5. Based on regional waste composition data, about 30,000 TPY of food waste and other organics may be recoverable from the MSW disposal stream. An additional 3,000 TPY of cardboard may also be recoverable along with some C&D waste components and textiles. In the interests of conservatism, however, only the potential for increased food waste and organics diversion is further explored as a mechanism to reduce the total quantity of MSW requiring out-of-state transfer and disposal.

It is noted that the only two operating landfills within the limits of the Cape and Islands are the Bourne ISWM Facility and the small landfill on Nantucket. The Bourne ISWM serves the MSW disposal needs of Bourne and Falmouth under a long-term contract and also accepts WTE incinerator ash from SEMASS under contract. Currently, the majority (about 85%) of the facility's disposal capacity is consumed by WTE incineration ash. Although Bourne is about to file for a major expansion to provide capacity well into the 2030s, it is Geosyntec's understanding that the ISWM Facility does not represent a viable on-Cape disposal option to serve the long-term needs of all Cape and Island towns. Nantucket also plans to continue use of its on-island landfill, but only for disposal of post-processing residues from its co-composting facility. Overall, however, the volumes of MSW that are sent to on-Cape landfills are quite small and do not significantly impact the assumption that the total annual tonnage for disposal is 85,000 TPY.

Review of In-State and Regional Disposal Options

MassDEP has predicted that in-state MSW disposal capacity at WTE facilities and landfills will be increasingly limited in the near-medium term; therefore, it was assumed that in-state disposal options would not be a reliable medium- to long-term option.

On a regional scale, Geosyntec considered options for trucking MSW from Cape Cod to WTE facilities or landfills in New England. In our experience, the maximum practical one-way distance for truck-based hauling of MSW is approximately 150 miles. Options for truck-based hauling to landfills in New York, New Jersey, Pennsylvania, or Canada were thus not explored as these would be cost prohibitive. The 150-mile distance was used to screen for potentially available regional WTE and landfill disposal options:

- Regional WTE capacity: The Massachusetts Materials Management Capacity Study conducted in February 2019 indicated that WTE facilities in Connecticut and Maine are running at capacity and accept only small amounts of MSW from Massachusetts. Due to the lack of available WTE capacity, no further consideration was given to WTE options in New England.

- Regional landfill capacity: Based on a review of operating landfills within 150 miles of Cape Cod, none are available that are willing to both accept out-of-state waste and have more than 10 years of remaining permitted disposal capacity. Therefore, further analysis of landfill options in New England was not considered.

Based on these findings, this Project assumes that no regional disposal options exist; therefore, long-haul rail transportation to out-of-state landfills will be the only reliable method available for MSW disposal over the medium to long term.

1.2.3 Summary of Findings from Tasks 2 and 3

Building on the waste characterization study in Task 1, Task 2 involved identification and analysis of out-of-state landfill disposal options. Subsequent analysis in Task 3 identified existing methods and alternative options for transporting MSW to the landfill facilities identified in Task 2, including processing, short-haul trucking, tipping, and long-haul rail transfer. Due to their broadly overlapping scope, Tasks 2 and 3 were conducted simultaneously. Geosyntec's final Task 2 and 3 Report was submitted to CCC on 11 June 2021.

For economies of scale to function effectively to secure a long-term disposal contract that reduces overall MSW management costs to towns and residents, it is assumed that all 22 towns listed in Section 1.1 will participate jointly in any option for out-of-state rail transfer via a contract mechanism administered by the County, or another special purpose entity. It is recognized that a relatively small quantity of waste may continue to be sent to on-Cape landfills. In addition, an increasing quantity of food waste and other organics may be separated for local processing using composting or anaerobic digestion (AD) systems, further reducing the total assumed quantity of MSW that requires out-of-state disposal. However, in the interests of conservatism it is assumed that the quantity of MSW for out-of-state disposal will remain consistent at 85,000 TPY. This allows for potential temporary or permanent disruptions to local processing or disposal.

<u>Out-of-State Disposal Options</u>

Rail infrastructure on Cape Cod is owned and operated by CSX; therefore, review of waste-by-rail transfer options focused on disposal facilities served by CSX. Geosyntec's analysis indicated that using rail to transport MSW from the Cape and Islands to out-of-state landfills represents a viable long-term disposal solution with six waste-by-rail landfills identified that have direct CSX rail access or access via a short-line transfer. As shown on Figure 1-1, these sites are operated by four different companies in Virginia, Ohio, South Carolina, and Georgia. Each candidate landfill offers at least ten years of remaining permitted capacity, can readily accept an additional 85,000

TPY of incoming waste, and can manage the transportation logistics associated with transporting waste from Cape Cod by rail.

No.	Landfill	State	Operator	Distance (miles)
1	King George	Virginia	Waste Management	560
2	Atlantic Waste Disposal	Virginia	Waste Management	660
3	Sunny Farms	Ohio	Waste Innovations	800
4	Tunnel Hill Reclamation	Ohio	Waste Innovations	800
5	Lee County	South Carolina	Republic Services	920
6	Taylor County	Georgia	GFL Environmental	1,200

Note. Distances shown are approximated and have not been verified as actual CSX rail haul distances.

Figure 1-1: Active Waste-by-Rail Landfills Served by CSX

Geosyntec interviewed the private waste companies that operate these landfills to confirm information about their companies, the serviceability of CSX rail links to the landfills, and expected turn times for railcars. Overall, we are confident that these six landfills are realistic candidates for reliable and stable out-of-state MSW disposal. Therefore, should the County pursue out-of-state rail transfer and disposal contracts, it is likely that there will be several firms competing to take the waste.

On-Cape Processing Options

Changes in technology and/or waste disposal regulations, as well as mandates for diversion and recycling over the expected lifecycle of an out-of-state disposal contract may have significant impacts to MSW disposed in the long-term. However, with the exception of composting and AD of segregated food waste and other organics, it is Geosyntec's opinion that other emerging technologies for processing of certain components of MSW such as pyrolysis, gasification, or cellulosic fermentation are not sufficiently well established on a commercial scale to be considered further in this Project. Similarly, the poor performance of U.S. based projects that have attempted to process materials recovered from mixed waste processing facilities (often referred to as advanced materials recovery facilities or "dirty MRFs") rules out consideration of commercially available mixed waste processing options. Therefore, the only non-landfill options considered were small-scale composting or AD of source-separated food waste and other organics.

Based on the logistical difficulties of delivering organics from the islands for processing in Barnstable County, it is assumed that organics generated on Martha's Vineyard and Nantucket will remain on those islands for processing (Nantucket already operates a co-composting facility). This Project thus focused on potential development of organics processing capacity in Barnstable County. Geosyntec's preliminary analysis indicated that processing of residential organics under a decentralized program could eliminate up to 24,000 TPY from out-of-state disposal, helping alleviate some long-term disposal challenges faced by Cape and Island towns as well as improve overall waste diversion and recycling rates.

In accordance with the assumptions outlined above, beyond backyard or community-scale composting (which Geosyntec recommends should be actively encouraged), the only options considered are small-scale composting or AD facilities that process source-separated organics (SSO), that is organics that are removed from the mixed waste stream by households and either collected curbside or delivered separately to drop-off centers. Some options to consider for increasing participation rates include implementing pay-as-you-throw (PAYT) programs to either provide a financial incentive for greater recycling and participation in SSO collection or a penalty for not doing so.

Covered aerated static pile (CASP) composting technology offers a reliable solution for organics processing; therefore, CASP technology was used to estimate facility sizes and costs. However, other composting and AD technologies are available that would likely also be suitable. It is noted that several issues will need to be overcome as part of implementing a successful organics processing system, not least the challenge of having households embrace the additional step of having to separate their organics for curbside collection or delivery to drop-off centers. Pushback against the higher costs for separate organics handling and processing should also be expected.

On-Cape Tipping and Transportation Options

There are currently two rail-capable transfer stations on Cape Cod: YTS and UCRTS. As part of the scope for Task 3, the rail transfer capacity required to manage an annual amount of 85,000 tons of MSW is was assessed based on these existing transfer stations' capabilities for managing tipping and loading of MSW into rail cars for long-haul transportation. Main considerations were as follows:

1. If MSW was generated at a steady state throughout the year, 85,000 TPY would represent approximately 300 TPD assuming a six-day working week. However, due to the high seasonality of waste generation on Cape Cod, waste generation is estimated to peak at approximately 600 TPD during July and August. Therefore, the transfer facilities must be able to manage the number of railcars required for this peak throughput.
2. Typical railcars can transport between 100 and 110 tons of MSW. Therefore, 85,000 TPY represents approximately 800 railcar loads that must be transported each year. During the peak season, six railcars will have to be loaded each working day.
3. Due to the need to minimize the duration for which MSW is stored once a railcar is filled, waste is typically transported by unit trains; that is, a discrete number of cars that are shipped on a regular schedule without being split up or stored. Assuming a 60-car unit train, two unit trains would need to operate, with one train arriving every 12 days to return a set of empty cars and leave with a set of loaded cars. To provide two days of excess capacity of railcars in case of a delay in the arrival of the unit train, the transfer station in Cape Cod would have to provide storage for up to 66 railcars.

Based on the above, for a single transfer station to manage all MSW generated by participating households in Cape Cod, the facility must be able to load up to 600 TPD of MSW into railcars as well as have capacity to store up to 66 rail cars on site.

Geosyntec's site reconnaissance of the YTS and UCRTS facilities and review of their operating conditions and on-site storage capacity for railcars suggests that both facilities are viable options and could meet the requirements for out-of-state transfer of 85,000 TPY at a peak rate of 600 TPD. Both facilities are currently operational as rail transfer facilities with operating permits. However, YTS will likely require a permit modification for higher operating throughput and operating UCRTS at a peak rate of 600 TPD without making upgrades and adding equipment and personnel could potentially put transfer operations at risk of slowdown or disruption. Thus, although developing UCRTS remains a viable standalone option for out-of-state MSW transfer, developing YTS appears to offer a more robust option.

In terms of providing redundancy, the option of developing both transfer stations may be preferred. In this case, waste transfer under a dual primary and secondary operating system may be warranted, with the secondary facility used to transfer steady but limited quantities of MSW throughout the year but with its main role being to help to smooth seasonal peaks and provide backup capacity to the primary facility in the event of a service outage.

Should an out-of-state transfer and disposal operation be pursued, coordination will be required with the current operators of both transfer stations regarding the end of their lease agreements on the facilities.

Environmental Performance

Environmental performance of the current system and the options discussed were estimated and analyzed using U.S. EPA's Waste Reduction Model (WARM). The WARM model calculates annual greenhouse gas (GHG) emissions, expressed in metric tons of CO2 equivalent (MTCO2e), associated with the operations and transportation activities for a different waste processing and disposal options. Annual estimated GHG emissions associated with each waste disposal option considered herein are summarized in Table 1-1 overleaf. A detailed discussion of the WARM methodology input assumptions and results is provided in Section 5 of the Task 2-3 Report. Note that positive and negative emissions indicated in Table 1-1 can be considered as emissions above or below an internal baseline within WARM. In interpreting negative emissions, therefore, it is the magnitude of differences between options that is important. For example, the expected GHG emissions from disposal/processing associated with decentralized composting (-6,080 MTCO2e) are 11,438 MTCO2e less than the existing system (+5,358 MTCO2e).

In summary, GHG emissions associated with disposal/processing are relatively low (and negative in some cases) for all options. Without separation of organics for on-Cape processing, all three rail transfer options are roughly equal in terms of their environmental performance. Higher GHG emissions are associated with longer rail haul distances. Total GHG emissions for rail haul options are slightly lower than the existing system: if a closer landfill is selected, total GHG emissions would be about 2,500 MTCO2e/year, roughly 3,100 MTCO2e/year less than the baseline, whereas if a farther landfill is selected total GHG emissions would be about 3,800 MTCO2e/year, roughly 1,800 MTCO2e/year less than the baseline.

Including separation of organics would result in significantly improved environmental performance relative to the existing system and proposed waste-by-rail options. Total GHG emissions are estimated at about -5,200 to -4,200 MTCO2e/year, a reduction of 10,800 to 9,800

MTCO2e/year relative to the baseline. This could represent a nearly threefold reduction in total GHG emissions associated with MSW management.

Table 1-1: Summary of Annual GHG Emissions from Different Options

Option	GHG from Transportation (MTCO2e/year)	GHG from Disposal/Processing (MTCO2e/year)	Total GHG Emissions (MTCO2e/year)	Reduction in GHG from Baseline (MTCO2e/year)
Existing System (Baseline)	294	5,358	5,652	N/A
Rail Transfer[1]				
YTS Only	1,299 – 2,588	1,197	2,496 – 3,785	1,867 – 3,156
UCRTS Only	1,315 – 2,604	1,197	2,512 – 3,801	1,851 – 3,140
YTS + UCRTS	1,248 – 2,537	1,197	2,445 – 3,734	1,918 – 3,207
On-Cape Organics Processing with Rail Transfer of Inorganics[2]				
Backyard/Community	901 – 1,829	-6,080	-5,179 – -4,251	9,903 – 10,831
Decentralized	952 – 1,880	-6,080	-5,128 – -4,200	9,852 – 10,780

Notes: (1). Ranges given for transportation reflect the different rail haul distances to candidate landfills, which varies from 560 to 1,200 miles as shown in Figure 2-1. (2). As GHG emissions from transportation and disposal are similar for all three waste-by-rail options, the effects of adding backyard/community composting or a decentralized composting program are assessed assuming transfer of residual inorganics using YTS + UCRTS.

Overall, waste-by-rail represents a slight improvement to the existing system in terms of GHG emissions, particularly if a closer landfill is utilized. However, the quality of LFG management and the existence of a well-run LFGTE system to utilize captured methane are significantly more important criteria for selecting a waste-by-rail site than distance from the Cape. Implementing on-Cape organics composting is recommended as a meaningful measure to reduce the towns' GHG footprint for MSW management.

2. COST/BENEFIT ANALYSIS

2.1 Overview and Criteria for Assessment

2.1.1 Scope of Work for Task 4

Task 4 involves a wholistic cost/benefit comparison of options identified in Tasks 2 and 3 to make final recommendations to the County. Specifically, this task includes:

- Identification of the overall costs and benefits of recommended processing, tipping, transportation, and disposal options.
- Calculation of average disposal cost avoidance for the towns resulting from successful food waste diversion.
- A cost/benefit and return on investment (ROI) analysis of options for processing, tipping, transportation, and disposal of MSW, including an overview of potential ownership and operations options. The ROI analysis covers a 15-year period from 2021 through 2036 in five-year increments.
- An overview of public-public, public-military, and public-private partnerships that could serve to accomplish the goals of each option.
- Providing a draft outline of the scope of work for County Procurement's use in pursuing identified options through issuance of an RFP.

2.1.2 Assumptions and Limitations

The cost/benefit analysis was set up according to the following main assumptions and limitations:

1. Individual assumptions associated with developing the cost analyses are provided for the existing system (baseline) and each proposed option as described in the remaining subsections in Section 2 of this Report. These assumptions mostly concern upfront costs and capital expenditures (CAPEX). The cost analyses primarily look at the per unit operating cost (OPEX) of each option.
2. Upfront costs and CAPEX assumptions are included in the ROI to provide a more complete analysis of the relative total costs of each option. The ROI analysis method utilized is a net present value (NPV) analysis.
3. The most recent year for which actual data were available is 2020 as reported in the Task 1 Memo and Task 2-3 Report. Therefore, all calculations are based on projecting forward from 2020.

4. Pricing assumptions used in the analysis are based on published figures, market surveys, and discussions with vendors and did not include firm quotes. Actual pricing will vary depending on the project timing and specific market conditions.
5. Transportation costs associated with organics diversion to an on-Cape composting facility will vary by town based on whether it is implemented as a curbside or drop off program. A simplifying assumption has been made that the transportation cost associated with collection or transport of organic waste to compost facility is offset by a reduction in the transportation cost for the collection and transport to a landfill since the tonnages and volumes are the same.

2.2 Existing System (Baseline)

The overall costs of the existing system include collection, transfer, and disposal program expenses for each of the 22 towns. However, the scope of this Report and the overall project is to assess out-of-state disposal; therefore, for this Report the baseline for existing system costs used is total current disposal cost. Utilizing the data provided in the Task 1 Memo, Geosyntec calculated a weighted average disposal rate for the towns of $90.03 per ton. Applying this rate to the total MSW quantity handled by the 22 towns (85,000 TPY) results in a total baseline disposal cost of $7.7 million per year.

Diminishing waste disposal capacity along with annual research and analysis of MSW landfill tipping fees by the Environmental Research and Education Foundation indicates a trend leading to a 20% or greater increase in disposal costs by 2030 in the northeast. This would result in the weighted average disposal cost of $90.03 rising to about $108 per ton. However, regional towns reported paying approximately $100 per ton and were expecting a 20% increase, which would result in a $120 per ton disposal rate. Assuming disposal rates in the range of $108 to $120 per ton in 2030, the resulting projected baseline disposal cost in 2030 would increase to $8.5 to $10.2 million per year, respectively. This correlates to an annual increase of 2.1% to 3.3%.

Using these rates, Geosyntec projected an “expected” and “high” disposal baseline cost for a 15-year period from 2021 through 2036 and summed the totals in five-year increments. Results are summarized in Table 2-1 overleaf, with all values stated in millions of dollars. The projected total baseline disposal cost for this 15-year period is $132.8 to $145.0 million. Calculation details are provided in the MS Excel spreadsheet included as Appendix 1 to this Report.

Table 2-1: Projected Long-Term Baseline Disposal Costs, 2021-2036 ($ millions)

Increment	Period	Projected Cost (Expected)	Projected Cost (High)
Years 1-5	2021-2025	$39.9	$40.8
Years 6-10	2026-2030	$44.1	$47.9
Years 11-15	2031-2036	$48.8	$56.2
Total	2021-2036	$132.8	$145.0

2.3 Out-of-State Disposal Options

2.3.1 Input Assumptions and Parameters

Geosyntec developed a long-term out-of-state disposal cost model based on the Task-2-3 Report results as summarized in Section 1.2.3. In developing the model, assumptions included the annual number of tons and per ton cost for transfer into railcars, rail transport, and landfill disposal. Other assumptions included rail car lease costs and annual inflation. The per-ton costs assumptions are stated as a range, representing "expected" and "high" estimates. Assumptions were developed based on findings from Tasks 1 through 3 and include the following:

- MSW disposal: 85,000 TPY
- Potential maximum diversion: 24,000 tons of organics
- YTS and/or UCRTS operating cost: $3.50 to $6.00 per ton which includes the cost of an equipment operator and equipment to move material from the transfer floor into a rail car.
- Rail transport to landfill: $30.00 to $33.00 per ton
- Landfill Disposal: $22.00 to $35.00 per ton
- Rail Car Lease: $8 to $10 per ton
- Inflation: 2.00% for transfer and disposal costs, 1.50% for rail car leases, and 4.0% for rail transportation

Based on the assumptions provided, the assumed total cost per ton was $63.50 to $84.00 per ton, which favorably compares to the average $90.03 per ton cost reported for 2020.

2.3.2 Expected Costs

Geosyntec developed a 15-year cost projection utilizing the long-term out-of-state disposal cost model. Using the projected cost for the first year of $63.50 to $84.00 per ton, annual management costs for MSW are $5.4 to $7.1 million assuming 85,000 TPY disposed. These figures do not include upfront CAPEX, which are discussed in Section 2.5.2. Assuming diversion of the full 24,000 TPY of organics, the projected disposal cost for the first year would be $3.9 to $5.1 million, a reduction of $1.5 to $2.0 million in disposal expense. It is important to note that this does not represent an absolute decrease in the expected total system cost because there are costs associated with managing the organics, which are further discussed in Section 2.4.3.

Geosyntec projected the long-term out-of-state disposal cost for a 15-year period and summed the totals for five-year increments. The projected results are shown in Table 2-2. Note that all figures are stated in millions of dollars. The projected total out-of-state disposal cost for the 15-year period is $98.9 to $129.4 million. Calculation details are provided in the MS Excel spreadsheet included as Appendix 1 to this Report.

Table 2-2: Projected Long-Term Out-of-State Disposal Costs, 2021-2036 ($ millions)

Increment	Period	Projected Cost (Expected)	Projected Cost (High)
Years 1-5	2021-2025	$28.5	$37.6
Years 6-10	2026-2030	$32.7	$42.8
Years 11-15	2031-2036	$37.6	$48.9
Total	2021-2036	$98.9	$129.4

2.4 On-Cape Processing Options for Food Waste and Other Organics

2.4.1 Options Evaluated

Based on the findings in Task 2-3 Report, the two most viable On-Cape processing approaches identified were backyard/community scale composting and decentralized small scale composting of source separated organics (SSO).

Backyard/community scale composting can include a flexible range of options, including subsidizing individual residential backyard composting units and establishing small community composting facilities within neighborhoods. In either case, this approach has upfront program costs, requires annual education costs, and may require changes to local ordinances. In the remainder of this Report, only costs for backyard composting (and not community scale composting) are assessed. It is assumed that community scale facilities would have roughly equivalent costs on a per-household basis (i.e., establishing a single community facility serving 50 houses that is, for example, hosted in a small neighborhood park and run by volunteers would cost about the same as establishing 50 individual backyard composting units in these same houses).

In the Task 2-3 Report, Geosyntec assumed a decentralized SSO composting system would utilize three on-Cape covered aerated static pile (CASP) facilities. Collection of the food waste for delivery to these facilities can be accomplished by providing curbside residential collection, one or more municipal drop-off locations, or a combination best suited to each individual town. This option requires upfront CAPEX to establish the CASP facilities, upfront composting education costs, and annual OPEX which can be partially offset by the sale of compost.

Upfront cost considerations for each composting option are summarized in Table 2-3 below.

Table 2-3: Potential Costs Considerations for Organics Composting Options

Option	Upfront Cost or CAPEX	Annual OPEX
Backyard/Community Scale Composting	Advertising and education Subsidies for backyard units Plot provision for community facility Permitting and regulatory approvals	Education Program management
Decentralized Small-Scale Composting System	Advertising and education Curbside or drop-off collection program Land acquisition Facility design and construction Permitting and regulatory approvals	Education Facility operation Regulatory reporting

As described in the Task 2-3 Report, rather than constructing a single, large SSO processing facility to serve all of Barnstable County, a decentralized approach is recommended in which three small facilities are developed. The main advantage of a decentralized approach is redundancy. If there is a problem with one facility, SSO feedstock could be relatively easily transferred to the other facilities. Decentralized systems are thus more robust to climate change impacts such as flooding or storms. Another advantage of decentralization is that it allows processing capacity to better match demand and requires less upfront capital risk. Total processing capacity can be scaled up over time to match demand (i.e., one facility can be developed as a "proof-of-concept" pilot before additional facilities are developed). Based on a decentralized approach, Geosyntec looked at developing three small-scale facilities across Barnstable County by grouping the 15 towns into three sub-regions (i.e., Outer/Lower Cape, Mid-Cape, and Upper Cape). A breakdown of participating households in each sub-region indicated approximately equal SSO generation of 25 to 30 TPD per sub-region.

2.4.2 Input Assumptions and Parameters

Geosyntec collected or developed representative cost data for the two organics diversion alternatives. The inputs, costs, and benefits for each are listed below.

Backyard Composting

- Maximum potential organics diversion = 24,000 TPY
- Expected participation rates of 100% and 30% were modeled
- Upfront education cost of $3 per household
- Upfront subsidy of $25 per household to offset all or a portion of the cost associated with purchasing a backyard composting unit
- Ongoing annual education of $1 per household base case and an alternative assumption of an additional $2 per home for additional program support for community

A qualitative assessment of the cost considerations and benefits of backyard composting is provided in Table 2-4 overleaf.

Decentralized Small Scale Composting System

- Maximum potential organics diversion = 24,000 TPY
- An assumed participation rates of 100% was modeled
- Upfront Education cost of $3 per household
- Ongoing annual education funding of $1 per household
- Up to three CASP facilities each with an 8,000 TPY capacity
- A single pilot project facility as first phase
- Each facility will require $1.5 million upfront capital
- Four total full-time employees running each facility
- Total operation cost is $85 to $90 per ton or a net of $50 to $70 per ton after sale of compost
- Output of 6,600 cubic yards of compost per facility per year
- Sale of compost at $30 per cubic yard, although we recognize it may be possible to sell compost in a range $60 or more.

A qualitative assessment of the cost considerations and benefits of a decentralized small-scale composting system is provided in Table 2-4 overleaf.

Table 2-4: Cost/Benefit Assessment for Composting Options

Option	Cost Considerations	Benefits
Backyard/Community Scale Composting	Requires upfront costs and ongoing education and outreach Requires subsidy for backyard units May require provision of land plot for community-based system Needs to comply with local codes and regulations Difficult to measure success	Helps meet organics diversion goals Tonnages that does not enter the MSW system lowers total disposal costs Increases availability of compost Enhances local community/school gardens Provides community educational opportunities
Decentralized Small-Scale Composting System	Additional collection via curbside or drop-off centers Requires upfront costs and ongoing education and outreach Requires upfront capital Annual operational cost	More control over meeting organics diversion goals Tonnages that does not enter the MSW system lowers total disposal costs Provides capacity for potential use by large private generators, generating revenue Revenue from sale of compost Potential for public-private partnership

2.4.3 Expected Processing Costs

Geosyntec used the inputs and assumptions in the previous section to model the capital and operating costs for each composting option, which are discussed below on a total cost and unit cost basis. Calculation details are provided in the MS Excel spreadsheet included as Appendix 1 to this Report.

<u>Backyard Composting</u>

The expected costs for backyard composting include an upfront cost and annual funding for educations and programs. The upfront expenses include educational campaign in year 1 to educate citizens on composting best practices and a $25 per household subsidy of the cost of composting kits. Assuming 100% participation of households, the total upfront cost would be $3.2 million, including education costs of about $338,000 and capital subsidy of $2.8 million.

Geosyntec projected the costs of supporting backyard composting over a 15-year period and summed the totals for five-year increments. The projected results are shown in Table 2-5 overleaf. Note that all figures are stated in millions of dollars. The projected total backyard composting cost for the 15-year period is $1.95 to $5.84 million.

Table 2-5: Projected Long-Term Backyard Composting Costs, 2021-2036 ($ millions)

Increment	Period	Projected Cost (Expected)	Projected Cost (High)
Years 1-5	2021-2025	$0.6	$1.8
Years 6-10	2026-2030	$0.7	$1.9
Years 11-15	2031-2036	$0.7	$2.1
Total	2021-2036	$2.0	$5.8

Decentralized Small Scale Composting System

The expected costs for one fully operational SSO composting facility include approximately $1.5 million in upfront capital and, with sale of compost at $30 per cubic yard, a net cost of $50 to $70/ton. These estimates are based on a facility designed to handle 10,000 TPY but with an expectation that maximum annual throughput would be approximately 8,000 TPY. Three facilities would be needed to manage the maximum 24,000 TPY of organics diversion.

Geosyntec projected the costs of a decentralized composting system over a 15-year period and summed the totals for five-year increments. The projected results are shown in Table 2-6 below, with all figures stated in millions of dollars. The projected total backyard composting cost for the 15-year period is $2.0 to $5.8 million.

Table 2-6: Projected Long-Term Costs for Decentralized Composting, 2021-2036 ($ millions)

Increment	Period	Projected Cost (Expected)	Projected Cost (High)
Years 1-5	2021-2025	$8.3	$9.6
Years 6-10	2026-2030	$9.2	$10.5
Years 11-15	2031-2036	$10.1	$11.6
Total	2021-2036	$27.6	$31.7

2.4.4 Expected Transportation and Disposal Cost Avoidance

In order to simplify the analysis, it was assumed that the transportation cost associated with collection or transport of organic waste to the compost facility is offset by an equal reduction in the transportation cost for the collection and transport to a landfill since the tonnages and volumes are the same.

Geosyntec calculated the disposal cost avoidance by comparing the projected out-of-state disposal cost over a 15-year period under an assumed 85,000 TPY as shown in Table 2-2 in Section 2.3.2 with the projected cost of disposal assuming diversion. Assuming the diversion of 100% percent of the organics or 24,000 TPY, the disposal cost avoidance is $27.9 to $36.5 million over the projected 15-year period. Calculation details are provided in the MS Excel spreadsheet included as Appendix 1 to this Report.

2.5 Tipping and Transportation Options

2.5.1 Options Evaluated

The following options were identified in Tasks 2 and 3 for financial modeling of out-of-state transfer of MSW by rail:

1. Option 1: Develop only YTS,
2. Option 2: Develop only UCRTS, or
3. Option 3: Develop both YTS and UCRTS

2.5.2 Input Assumptions and Parameters

As described in the Task 2-3 report and earlier in Section 2.3, the projected range for total out-of-state disposal cost was reported as $63.50 to $84.00 per ton, which includes transportation, transfer, rail equipment and disposal costs. The transfer cost component assumption is $3.50 to $6.50 per ton regardless of which transfer station is utilized.

2.5.3 Expected Costs

Both transfer stations would require some facility upgrades and a permit modification to be capable of handling the total tonnage generated by Cape and Island residents during the peak season. Geosyntec estimated an upfront capital cost of $500,000 to $1 million for equipment, rail, and facility upgrades and permit modifications for each transfer station.

2.6 Return on Investment

To analyze the expected costs of the out-of-state disposal option Geosyntec projected 15-year costs and analyzed the results in five-year increments as previously shown in Table 2-1 for the existing system (baseline) and Table 2-2 for the long-term out-of-state disposal option. Based on the total projected cost over 15 years, the ROI was calculated for both the baseline and out-of-state option using NPV analysis and a discount rate of 3%. This discount rate reflects the assumed long-term risk-adjusted borrowing or reinvestment rate for a municipality. NPV analysis enables fair comparison of total annual costs, all upfront costs, and timing differences for future options against the baseline. Calculation details are provided in the MS Excel spreadsheet included as Appendix 1 to this Report.

As indicated in Table 2-7 below, the NPV of expected disposal costs under baseline conditions is $104.5 million over the ensuing 15-year period through 2036. However, as previously discussed disposal costs could increase faster than modeled due to decreased airspace availability in the region. In this case, the NPV of projected disposal costs could rise as high as $113.4 million over the next 15 years.

Table 2-7: 15-Year Projected Baseline Disposal Cost and NPV ($ millions)

Item	Period	Projected Cost (Expected)	Projected Cost (High)
Total Cost	2021-2036	$132.8	$145.0
NPV	-	$104.5	$113.4

The out-of-state disposal option shown in Table 2-8 below has an expected NPV cost of $78.5 million over the ensuing 15-year period, although this value could be as high as $103.5 million. The NPV analysis for the out-of-state option factors in the upfront capital costs for YTS and UCRTS. The out-of-state disposal option is projected to result in lower disposal costs than the baseline in NPV terms, with savings of $26.0 million (assuming expected costs) to $9.9 million (assuming high costs). It is important to note that these savings do not account for additional organics diversion costs as discussed below.

Table 2-8: 15-Year Projected Out-of-State Disposal Costs and NPV ($ millions)

Item	Period	Projected Cost (Expected)	Projected Cost (High)
Total Cost	2021-2036	$98.9	$129.4
NPV	-	$78.5	$103.5

To analyze the expected costs of organics diversion options, Geosyntec projected 15-year costs and analyzed the results in five-year increments as previously shown in Table 2-5 for backyard composting and Table 2-6 for the decentralized composting option. Based on the total projected cost over 15 years, the ROI was calculated for both the baseline and out-of-state option using NPV analysis and a discount rate of 3%.

The backyard composting approach generated a $4.7 to $7.8 million NPV over a 15-year period as shown in Table 2-9 overleaf. This assumes that a 100% participation rate can be attained.

Table 2-9: 15-Year Projected Backyard Composting Cost and NPV ($ millions)

Item	Period	Projected Cost (Expected)	Projected Cost (High)
Total Cost	2021-2036	$1.95	$5.84
NPV	-	$4.70	$7.80

The decentralized composting option generated a $21.7 to $25.0 million NPV over a 15-year period as shown in Table 2-10 below. Again, this assumes that a 100% participation rate can be attained. Small scale composting operating costs are offset by the $30 per cubic yard revenue assumed to be generated from the sale of compost.

Table 2-10: 15-Year Projected Decentralized Composting Cost and NPV ($ millions)

Item	Period	Projected Cost (Expected)	Projected Cost (High)
Total Cost	2021-2036	$27.6	$31.7
NPV	-	$21.7	$25.0

3. REVIEW OF POTENTIAL CONTRACTING MECHANISMS

3.1 Overview

Based on the analyses in this Report and the Task 2-3 Report, it is recommended that management of MSW from the Cape and Islands towns takes place using the existing YTS and/or UCTS coupled with a contract with a third-party service provider for rail transport and disposal. Typical contract and RFP provisions are described below.

3.2 Rail Transportation and Landfill Disposal Contract Options

The most common contracting mechanism for out-of-state MSW disposal by rail is to contract with a single service provider who is responsible for both rail transport and disposal. The County may also consider incorporating the rail transfer station operation at YTS and/or UCRTS into the contract depending on its desire to self-perform these services.

Contract terms are likely to be similar regardless of the service provider. Each rail services firm contacted by Geosyntec as part of this project indicated that interim and long-term contracts would be available to the County and that it is unlikely that they would require a "put or pay" arrangement based on the County's waste volume. Long-term contracts can provide additional favorable outcomes as a point of negotiation surrounding other terms and conditions. For example, a longer-term contract may provide cost concessions as it provides the receiving landfill a guaranteed volume over a longer period, which allows for equipment costs to be fully depreciated over the term of the contract. Five, ten, and 20-year contracts are typical in the solid waste industry. Geosyntec would recommend a longer-term contract for the County as it provides price and service stability.

Additional terms and conditions will be needed to address the scope of transportations services, contractor responsibilities at the receiving facility, duties related to the condition and repair of leased rail cars, rail car inventory, County responsibilities, coordination, price adjustments through the contract period, renegotiation of transportation with CSX (typically every two years), forecasted waste tonnages, liability for damages, and control of the rail backhaul. The contract should include a description of how the work will commence with a phasing plan for the ramp up of MSW volumes along with an operational and communications plan. The contract should also detail ancillary provisions such as assignment, rights, legal venues, notices, and access or audit requirements. The contract terms the County should expect will likely be grouped into the following major categories: general provisions, containers, landfill services, transportation services, payment, waste specifications, liability/damages, and ancillary provisions.

The rail transportation and service provider will need to renegotiate rail transport rates roughly every two years with CSX and therefore the contract with the County will likely allow for price escalators resulting from increased rail transportation costs. In the past, Class I railroads have experienced financial losses from long-term contracts and, as a result, they no longer execute contracts with durations in excess of two years. Note that pricing changes are based on rail economics, not the consumer price or other common indices.

3.3 Composting Contract Options

Based on additional research conducted for Task 4, multiple small composting contract options were identified including a public private partnership (PPP) for development and operation of the new facilities, commercial processing contracts, and/or commercial collecting and processing contracts. To help understand the regional landscape for municipal composting, Geosyntec interviewed Black Earth Compost, who have provided municipal contracted and individual homeowner subscription services in Eastern Massachusetts for ten plus years and have more recently expanded to offer services on the Lower Cape.

The range of options include:

1. Site management of municipal owned composting facility (such as in Groton)
2. Long-term (i.e., 20-year plus) lease agreement to site and operate a private composting facility on municipal property (e.g., recent RFP in Manchester-by-the-Sea)
3. Siting a private regionally facility and offering processing capacity at a per ton basis or subscription to individual households
4. Contracting for collection via drop-off centers and/or curbside and processing under a municipal contract, including education and pilot programs

Pricing will vary depending on the contracting approach. The cost for processing should fall on the higher side of the net per ton range for an owned facility. Black Earth indicated that municipal contracts that include curbside collection, processing, and education normally fall in the range of $1.50 to $3.80 per household for weekly or bi-weekly services, depending on density. They also stated that drop-off center collection, as an alternative to curbside, could likely be offered at $15 per 60-gallon container.

4. SUMMARY AND RECOMMENDATIONS

Based on review of information discussed in this Report, the following major findings and recommendations are identified for Task 4 of the Project.

1. Out-of-state disposal by rail should be pursued utilizing one or both of YTS and/or UCTS (depending on operational preferences for the Cape and Island towns). When compared the existing system as a baseline, this option results in a lower total disposal cost over a projected 15-year period from 2021 through 2036, a higher ROI (as measured by NPV analysis), and superior environmental impact based on modeled GHG emissions using the U.S. EPA's WARM Model.
2. Organics diversion using backyard composting will improve financial results (NPV and ROI) even further as compared to out-of-state disposal by rail with no organics diversion. However, while backyard composting represents the most financially favorable option, it has a lower probability of achieving maximum diversion as compared to the more formal option of implementing a decentralized system for organics collection and processing at small-scale composting facilities.
3. Out-of-state disposal of MSW by rail combined with organics diversion via the decentralized composting option is financially superior to the projected cost of the baseline system but has lower financial savings than simply disposing of all materials by rail. However, this option will likely provide the highest environmental performance since it is the most likely this system will maximize GHG emission reductions associated with organics diversion.
4. Although more expensive than backyard composting, a decentralized composting system for managing organics has a greater potential for verifiable and scalable maximum organics diversion. Geosyntec's analysis assumes that three 10,000 TPY composting facilities (CASP systems) will be constructed around the County to handle the maximum expected 24,000 TPY of diverted organics. However, it is recommended that a single 10,000 TPY CASP facility be designed and permitted as a pilot project prior to expanding to three facilities.
5. PPPs for development and operation of organics collection and composting systems are available and should be explored.
6. Federal and State Grants are available to governments to implement organics diversion. The USDA is currently accepting grant proposals from local governments to host Community Compost and Food Waste Reduction (CCFWR) pilot projects, with up to $2 million in funding available. For 2021, the USDA's Office of Urban Agriculture and Innovative Production is accepting applications on Grants.gov through 16 July.

7. The Massachusetts Department of Environmental Protection a offers municipalities composting grants through its Sustainable Materials Recovery Program to help pay for compost bins and program implementation.
8. Although beyond the scope of this Project, the County should conduct additional analyses on utilizing the two existing transfer stations (YTS and UCRTS). Creating contract mechanisms that enable both transfer stations to be used rather than just one is expected to provide multiple benefits with little expected cost increase.

5. REFERENCES

Request for Proposals of Reuse of Transfer Station Property, Upper Cape Regional Transfer Station, generals Boulevard, Sandwich, MA, dated January 25, 2017.

Joint Base Cape Cod 2013 Joint Land Use Study Update and Community – Military Partnerships Study Final Report, Cape Cod Commission, dated October 30, 2013.

Cape Cod 2020 Regional Transportation Plan, 2020-2040, Cape Cod Commission, dated July 15, 2019.

Final Report, Massachusetts Materials Management Capacity Study, prepared by MSW Consultants, dated February 11, 2019.

Final Report, Evaluation of Future Disposal Alternatives for Municipal Solid Waste, prepared by CDM, dated April 2010.

Massachusetts State Rail Plan May 2018, Massachusetts Department of Transportation.

Task 1 – Quantify and Characterize Cape Cod MSW, MSW Out-Of-State Disposal Cost/Benefit Analysis, Final Rev. 1 Memorandum prepared by Geosyntec Consultants dated 26 May 2021.

Task 2 and 3 Report – Options for Disposal, Processing, Tipping, and Transportation, MSW Out-Of-State Disposal Cost/Benefit Analysis, Final Report prepared by Geosyntec Consultants dated 10 June 2021.

U.S. Environmental Protection Agency, Waste Reduction Model (WARM), www.epa.gov/warm.

APPENDIX 1 –
COST CALCULATIONS
(see attachment)