Biosolids Composting Feasibility Study

Feasibility study for a town and regional biosolids composting facility

February 14, 2022

Prepared for:

Town of Montague

Prepared by:

Stantec

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Executive Summary

The Town of Montague operates a wastewater treatment plant (WWTP) on Greenfield Rd. The facility treats approximately one million gallons per day of sewage from the villages of Turners Falls, Montague Center, Montague City and Lake Pleasant.

Generally, the solids generated at the Montague WWTP have been dewatered and taken by a third party for either reuse or disposal. For several years the WWTP ran a pilot sized composting operation using the aerated static pile composting method. The WWTP maintains a composting registration with the Massachusetts Department of Environmental Protection (MA DEP). The pilot program was discontinued and the aeration system and cover structure for the composting piles was dismantled. However, a trailer type portable mixer of approximately five to seven yards capacity remains at the site.

The Town purchased new dewatering equipment and sized the equipment to handle the solids generated from the Montague WWTP and the solids from wastewater plants from several surrounding communities in Franklin County. This report looks at the feasibility of the Town operating a composting facility that would process either biosolids from the Montague WWTP only (4 dry tons per week) or biosolids from the WWTP and from several surrounding communities in Franklin County (10 dry tons per week).

[This feasibility study ultimately found that the WWTP site is an inadequate selection for a composting facility, whereas the Sandy Lane site is a highly feasible location, for either 4 or 10 dry tons per day.]

This report looked at the following as part of the feasibility review:

- The regulatory framework especially with regards to potential PFAS and PFOA regulations pertaining to biosolids compost.
- Costs and availability of third-party biosolids disposal or process as is the Town’s current practice.
- Technology, size and operational description of a composting facility.
- Methods and third-party firms that could market compost from the proposed facility.
- A comparison of siting the facility at the existing WWTP (on Greenfield Rd) or at the end of Sandy Lane adjacent to the Town transfer station.
- Control strategies for managing odors and preventing odor nuisances to the surrounding community, and their likely success.
- The capital and O&M costs for both a 4 and 10 dry ton per week facility.

PFAS and PFOA are environmentally persistent chemicals that can have adverse health impacts. These chemicals have been widely used in common consumer products and are ubiquitous in the environment. Massachusetts has set a limit of 20 ppb in drinking water for these chemicals, and the Commonwealth is beginning the process of establishing limits in soil and biosolids. Maine has done this and set the limit at 2.5 ppb for PFAS and 5 ppb for PFOA. Massachusetts has not yet determined what limits they may propose. **Section 2.2** of this report discusses this issue in detail.

A survey of third-party firms that either process or dispose of biosolids was done to understand the short and long term sludge disposal options available in the region. The predominant feedback was the following:

- Disposal options are getting scarce.
- None of the companies surveyed thought they would have a long term (20 year) availability.
- Tipping fees ranged from $100 to $150 per wet ton ($500 to $750 per dry ton) excluding transportation.
- Small and inconsistent supply of biosolids is at a disadvantage and pays the highest tip fee.

Total cost including tipping fee and an allowance for third-party transportation is estimated to range from $168 to $221 per wet ton ($839 to $1,076 per dry ton), $174,525 to $229,938 per year. These figures assumed all the facilities would take the material and did not include rental for dumpsters or transportation. The actual cost is likely to be higher than these estimates. See **Section 3** of this report for the details of the survey.

The study examined operating the composting facility as an aerated static pile (ASP) facility. This is the same technology previously piloted at the Montague WWTP. Below are the main parts of an ASP composting facility:

- Mixing building where the biosolids are received and mixed with a bulking agent (ground up wood) to form the compost mixture.
- The active composting building where the compost mixture is aerated at high rate and the time and temperature regulatory set points are met. This active stage of the composting lasts 21 days.
- The screening and curing building where the material coming from the active composting stage is screened to recover remaining bulking agent. The screened compost then goes to the low aeration rate final stage of curing.
- Product storage area.
- Odor control biofilter.

Two alternative types of ASP were examined for this project. The first alternative has mixing and receiving in a fully enclosed building, active composting in a roof only structure and aeration of the active compost pulled down through the compost on a continuous basis (negative aeration). The air from the enclosed mixing building and the aeration air pulled down through the active compost piles is sent to a biofilter for odor treatment.

The material then goes to screening to recover the remaining bulking agent and then goes into low-rate aeration for stabilization known as curing. By the time the material reaches these operations it smells like soil and does not require odor control. During the curing stage the compost is aerated by pushing the air up through the pile (positive aeration). This allows for better control of the moisture content of the material. After curing the material goes to storageThe second alternative is the same as the first with the exception that the active composting stage is fully enclosed in a building and all the air from the building goes to odor control treatment. In this alternative the active compost is aerated by pushing air up through the piles (positive aeration).

Section 4 of this report provides detailed descriptions of the ASP technology as well as the site and components of the operation.

Appendix A Figures 1 and 2 show the Site Plan view of a 4 dry ton per week facility at the Montague WWTP and a 10 dry ton per week facility at the Sandy Lane site respectively. The Montague WWTP has room enough for only a 4 dry ton per week facility while the Sandy Lane site can easily accommodate either size. A facility at the WWTP must be split with the mixing, biosolids and bulking agent storage and the screening at the west end of the WWTP and the active composting and curing at the east end. There is not enough room for odor control at the west end of the facility so the biosolids storage would be under a roof only without odor control. This makes the Sandy Lane site far more attractive than the WWTP for a composting operation.

The Massachusetts Department of Environmental Protection (MA DEP) has an unofficial odor limit of 5 dilutions to threshold (D/T) at and beyond the boundary of a biosolids composting facility. D/T is also known as odor unit per cubic meter (ou/m^3). This is an odor quantification method that can be tested in a laboratory. It is important to note that the odor limit of 5 D/T was selected by the MA DEP because it will not be perceived or be a nuisance to the general public. Using standard sampling and laboratory test methods it is mostly undetectable.

A computer odor dispersion model screening model was run for the following facility configurations:

- Site 1 (Sandy Lane) Alternative 1, Air pulled down through the piles (negative aeration) of active composting in a roof only building – 10 dry tons per week capacity
- Site 1 Alternative 2, aeration pushed up through the piles (positive aeration) of active composting in an enclosed building
- Site 2 (WWTP) Alternative 1 configuration for a 4 dry ton per week facility
- Site 2 (WWTP) Alternative 2 configuration for a 4 dry ton per week facility

The dispersion model predicts the odor concentration (ou/m^3) based on all possible wind speeds and in all directions. **Tables ES-1** through **ES-4** show the results of the modeling at various distances away from the odor sources.

Table ES- 1 : Model results for Sandy Lane Site with 10 DTPD facility with roof only building for active composting

Distance from odor source (m)	Odors from biofilter (ou/m^3)	Odors from curing piles (ou/m^3)	Odors from active composting (ou/m^3)	Combined odors from all sources (ou/m^3)
30	100.7	1.5	1.1	103.3
50	66.3	1.5	1.1	69.0
100	42.8	0.9	0.9	44.6
200	22.6	0.4	0.5	23.6
500	6.2	0.1	0.1	6.5
600	4.7	0.1	0.1	4.9
1,000	2.1	0.0	0.0	2.2

Table ES- 2: Model results for Sandy Lane Site with fully enclosed active composting

Distance from odor source (m)	Odors from biofilter (ou/m^3)	Odors from curing piles (ou/m^3)	Combined odors from all sources (ou/m^3)
30	102.6	1.0	103.6
50	67.5	1.1	68.6
100	43.7	0.8	44.5
200	23.2	0.4	23.6
500	6.4	0.1	6.6
600	4.8	0.1	4.9
1,000	2.2	0.0	2.2

Table ES- 3: Model results for WWTP Site with active composting in a roof only building

Distance from odor source (m)	Odors from biofilter (ou/m^3)	Odors from curing piles (ou/m^3)	Odors from active composting (ou/m^3)	Odors from biosolids storage (ou/m^3)	Combined odors from all sources (ou/m^3)
30	50.5	1.0	1.3	10.0	62.8
50	32.0	1.0	1.3	5.6	39.8
100	18.0	0.6	0.8	2.5	21.9
200	8.0	0.3	0.4	0.9	9.6
350	3.5	0.1	0.2	0.4	4.2
500	2.0	0.1	0.1	0.2	2.4
1,000	0.7	0.0	0.0	0.1	0.8

Table ES- 4: Model results for WWTP Site with active composting in a fully enclosed building

Distance from odor source (m)	Odors from biofilter (ou/m^3)	Odors from curing piles (ou/m^3)	Odors from biosolids storage (ou/m^3)	Combined odors from all sources (ou/m^3)
30	50.5	0.6	10.0	61.1
50	32.0	0.6	5.6	38.2
100	18.0	0.4	2.5	20.9
200	8.0	0.2	0.9	9.1
300	4.4	0.1	0.5	5.0
500	2.0	0.0	0.2	2.2
1,000	0.7	0.0	0.1	0.7

In reviewing the results in **Tables ES-1** through **ES-4** the following observations are important to note:

The overall odor offsite for a roof only active composting building (negative aeration) and a fully enclosed active composting building (positive aeration) are essentially the same. Since the roof only (negatively aerated) active composting building (negatively aerated) is less expensive to construct and maintain, it is the recommended ASP technology and was carried forward into the economic analysis.

The biofilter was the largest contributor to offsite odors. Even though the character of these emissions is mulch-like, it is important to get all offsite emission below the 5 odor units per cubic meter (ou/m^3) to meet the MA DEP unofficial odor limit. Although the model showed odors higher than the 5 ou/m^3 limit the facility can be constructed to achieve the DEP limit.

There are two items that lead to the conclusion that the odor limit off site can be achieved. One, the SCREEN3 model used to generate the ou/m^3 values in the tables is generally conservative and overstates the actual results. During the preliminary design stage of the project the more accurate US EPA model AERMOD should be used. This model uses five years of actual hourly meteorological data for the area as well as detailed topographic information. Secondly, minor changes to the design will reduce offsite odors. These include enclosing the biofilter in a prefabricated metal building with two up blast ventilation fans in the roof. This will provide substantial dispersion of the biofilter emissions. This approach is successfully employed at several composting facilities including two in Massachusetts, at Nantucket and Marlborough. In addition, the active composting operation should have a metal skin on three sides of the building and two upblast ventilation fans in the roof. The three sides will block emissions from the direction of the nearest neighbors and the up-blast fans will provide additional dispersion. These low-cost additions to the design will further reduce the offsite odor concentration. Odor impacts and management are discussed in detail in Section 7 of this report.

The WWTP is a poor selection for the facility whereas the Sandy Lane site is a very good location. Odors at the WWTP are more likely to be an issue than at the Sandy Lane site. There are homes to the west of the WWTP that are already complaining about odors from wastewater operations. The untreated biosolids storage and mixing required at the WWTP will make that situation worse. Also, there is very limited space available at the WWTP and this is why the biosolids storage emission are untreated. Odors, poor operational layout, size limitations and the need to demonstrate the site has to be used over other sites under the Rivers Protection Act, makes the Montague WWTP site a poor choice for locating a facility. The Sandy Lane site is far more attractive regardless of the size of the facility, 4 or 10 dry tons per week.

Section 8 of this report includes the engineer's opinion of probable construction costs for a composting facility located at the Sandy Lane site. Costs were calculated for a 4 dry ton per week and a 10 dry ton per week facility. In the 10 dry ton per week facility, a tip fee for the biosolids from other communities of $150 per wet ton was assumed. **Tables ES-5** and **ES-6** summarize the capital, O&M, and annualized costs as well as net present value for 4 and 10 dry ton facilities respectively. Construction costs for the 10 dry ton per week facility are approximately $1.8 million higher than for the 4 dry ton per week facility. Detailed breakdown of all cost and revenue items can be found in **Section 8** of this report.

Table ES- 5: Annual costs and Net Present Value for a 4 dry ton per week facility at Sandy Lane

	Capital		O&M		Total	
	Construction	Mobile Equipment	With Revenue	Without Revenue	With Revenue	Without Revenue
Cost	$ 3,132,000[1]	$ 615,000	$ 220,000[2]	$ 230,000		
Interest Discount Rate	2.5%	3.0%	2.5%	2.5%		
Term (years)	20	10	20	20		
Annualized cost	$ 201,000	$ 73,000	$ 220,000	$ 230,000	***$ 494,000***	***$ 504,000***
NPV	$ 3,132,000	$ 615,000	$ 3,430,000	$ 3,586,000	***$ 7,177,000***	***$ 7,333,000***

Table ES- 6: Annual costs and Net Present Value for a 10 dry ton per week facility at Sandy Lane

	Capital		O&M		Total	
	Construction	Mobile Equipment	With Revenue	Without Revenue	With Revenue	Without Revenue
Cost	$ 4,965,000[1]	$ 615,000	$ 194,000[2]	$ 452,000		
Interest Discount Rate	2.5%	3.0%	2.5%	2.5%		
Term (years)	20	10	20	20		
Annualized cost	$ 319,000	$ 73,000	$ 194,000	$ 452,000	***$ 585,000***	***$ 844,000***
NPV	$ 4,965,000	$ 615,000	$ 3,025,000	$7,047,000	***$8,605,000***	***$ 12,627,000***

Notes:
1. Construction cost assumes utilities available at the site
2. Revenue for 4 dry ton facility is from compost sales, for 10 dry ton it includes both compost sales and tip fee for 6 dry tons from other facilities

1.0 INTRODUCTION

The Town of Montague operates a wastewater treatment plant (WWTP) on Greenfield Rd. The facility treats approximately one million gallons per day of sewage from villages of Turners Falls, Millers Falls, Montage City and Lake Pleasant.

Generally, the solids generated at the WWTP have been dewatered and taken by a third party for either reuse or disposal. For several years the WWTP ran a pilot sized composting operation using the aerated static pile composting method. The WWTP maintains a composting registration with the Massachusetts Department of Environmental Protection (MA DEP). The pilot programed was discontinued and the aeration system and cover structure for the composting piles was dismantled. However, a trailer type portable mixer of approximately five to seven yards capacity remains at the site.

The Town has purchased new dewatering equipment and has sized the equipment to handle not only the solids they generate but also for solids from wastewater plants from several surrounding communities in Franklin County. The Town is looking to restart a composting operation. The desire to process biosolids locally stems from the high cost and long distance shipping currently involved in the third party handling of the solids.

The Town is considering two composting facility sizes; the first to handle only the biosolids generated at their own WWTP, 4 dry tons per week. The second is for a regional facility that would process the Towns solids as well as solids from the following communities:

- Ashfield
- Old Deerfield
- South Deerfield
- Erving
- Hadley
- Hatfield
- Northfield
- Orange
- Sunderland

According to data provided by the Solid Waste Management District (FCSWMD) the communities generate approximately six dry tons of biosolid per week for a combined 10 dry tons per week for a regional facility.

There are two potential sites for the composting facility; the first is at the Montague WWTP on Greenfield Road. The second is on a portion of town owned land at the end of Sandy Lane as part of the existing transfer station.

This report looks at the feasibility of constructing and operating a compost facility processing either four or 10 dry tons per week at either the WWTP or the Sandy Lane property. The report examines the regulatory framework in Massachusetts for biosolids ruse, the options for third party disposal or processing in the region, third parties in the region that market compost and other biosolids products, the ability of either of the sites to be the location of a facility of either size and the potential for odor impacts and the costs to construct and operate such a facility.

2.0 REGULATORY FRAMEWORK

The US EPA regulates the reuse and disposal of biosolids and biosolids products through 40 CFR Part 503 "Standards for the Use or Disposal of Sewage Biosolids" (Part 503). These US EPA standards for use or disposal of sewage biosolids, are applicable to reuse methods as well as incineration. Part 503 regulation provides limits on heavy metals and pathogen concentrations allowed in biosolids to be reused. Part 503 also lists acceptable processes to attain both pathogen limits and limit vector attraction. All States are required to meet these regulations as a minimum level of performance. States can request exemption from the US EPA for lesser limits. Some States have additional limits.

2.1 BIOSOLIDS QUALITY STANDARDS

The Part 503 rules as well as those of the New England states follow the 503 rules with some slight variations. For biosolids to be reused they must meet metals concentration limits. **Table 2-1** lists these limits from the EPA 503 regulations.

Table 2-1: Part 503 Maximum Metals Concentrations

Metal	Concentration Limit (mg/kg dry weight)		
	Exceptional Quality (eq) (Class A)	All Land Applied (Class B)	SRWTF 2018 Quarterly Avg.
Arsenic	41	75	No Detection
Cadmium	39	85	1.59
Copper	1,500	4,300	290
Lead	300	840	27.67
Mercury	17	57	0.16
Nickel	420	420	24
Selenium	100	100	No Detection
Zinc	2,800	7,500	273.33

Below are the states in the region and how their regulations compare to the Part 503 regulations:

- Connecticut – Has no regulation allowing reuse and therefore can only dispose of biosolids through incineration or disposal out of state.
- Maine – Regulated by Rule 06-096 Chapters 418 and 419 420 – Follow Part 503 but include 75 mg/kg limit on Molybdenum. Also regulates volatiles in Chapter 418 Appendix A
- Massachusetts – Regulated by 310 CMR 32 – Generally follow Part 503 but have a different contaminant list (See **Table 2-2**). The designations for the types differ from the 503. Massachusetts Type I and Type II are similar to the 503 Class A and B respectively.
- New Hampshire – Regulations are found in Env-Wq 800 - For biosolids generated outside of New Hampshire contaminant levels are lower than Part 503. (See **Table 2-3** for limits). In New Hampshire the Low Metals Quality Certification and Quality Certification are similar to the 503 Class A and B respectively.

- New York – Regulated by 6 NYCRR Part 360 – Utilize US EPA CFR 40 Part 503 limits.
- Rhode Island – Regulated by 250-RICR-150-10-3 - Class A must meet Part 503 EQ standard and Class B must meet Part 503 standard for all land applied biosolids.
- Vermont – Regulated by the US EPA 40 CFR Part 503.

Table 2-2: Massachusetts Biosolids Contaminant Limits

Metal	Concentration Limit (ppm dry weight)		
	Type I (503 Class A Equivalent)	Type II (503 Class B Equivalent)	SRWTF 2018 Quarterly Avg.
Boron (water soluble)	300	300	Not tested for
Cadmium	14	25	1.59
Chromium	1,000	1,000	43
Copper	1,000	1,000	290
Lead	300	1,000	27.67
Mercury	10	10	0.16
Molybdenum	40	40	No Detection
Nickel	200	200	24
Zinc	2,500	2,500	273.33
PCB (commercial fertilizer)	2	10	Not tested for
PCD (soil Conditioner)	1	10	Not tested for

Table 2-3: New Hampshire Biosolids Contaminant Limits

Metal	Concentration Limit (mg/kg dry weight)		
	Low Metals Quality Certification (503 Class A Equivalent)	Quality Certification (503 Class B Equivalent)	SRWTF 2018 Quarterly Avg.
Arsenic	10	32	No Detection
Cadmium	10	14	1.59
Chromium	160	1,000	43
Copper	1,000	1,500	290
Lead	270	300	27.67
Mercury	7	10	0.16
Molybdenum	18	35	No Detection
Nickel	98	200	24
Selenium	18	28	No Detection
Zinc	1,780	2,500	273.33
PCB	1	1	Not tested for
Dibenzodioxins and Dibenzofurans	27 ng/kg	27 ng/kg	Not tested for

In addition, the biosolids must be treated be a process to limit pathogens and vector attraction. These are generally referred to as Process to Reduce Pathogens which creates a Class B biosolids or a Process to Further Reduce Pathogen which creates a Class A product. Class B biosolids are generally used for agricultural land application and have restrictions on their use as well as require registration of each site where the biosolids are used. Class A biosolids can be used without restrictions and often used in both agricultural and horticultural uses such as landscaping and soil blending.

Montague is considering only a composting operation which generates a Class A biosolid that can be widely used by the general public without restriction. For composting to achieve Class A the compost material must achieve a temperature of 55°C for three days to kill pathogens and maintain an average temperature of 45°C without falling below 40°C for14 days to reduce vector attraction. These targets are readily achieved with aerated static pile (ASP) composting.

MA DEP will require that daily records of temperatures of composting piles be maintained and metals testing quarterly to ensure Class A targets are being met.

2.2 FUTURE TRENDS

There has been ongoing concern about contaminants of emerging concern (CEC). These are compounds from pharmaceuticals and personal care products that are being detected at low levels in surface waters. Among these CEC are endocrine disruptors which have the capacity to alter hormones. The US EPA continues to monitor levels of these compounds in biosolids and address the issue in their Biennial Reviews. In recent reviews the EPA identified 35 new chemicals to add to the list of CEC and stated that "no new human health toxicity data was identified for either the new 35 chemicals or for chemicals identified in previous biennial reviews."

In addition, US EPA provided guidance on perfluoroalkyl (PFAS and PFOA) compounds. Many of these compounds are no longer in commercial use in the United States but they are ubiquitous in the environment from past large-scale use. The EPA has recommended a limit of 70 parts per trillion (ppt) in drinking water for these compounds. In addition, the EPA is working to have PFAS designated as a hazardous substance (HR 535, PFAS Action Act).

In New England, Massachusetts has limited a combined limit of six PFAS compounds in drinking water to 20 ppt. Vermont and Maine have also adopted a drinking water limit of 20 ppt. New Hampshire limits concentration of any four PFAS compounds in drinking water to 15 ppt.

Maine has instituted soil screening limits to be applied to biosolids of 2.5 ppt for PFAS and 5.2 ppt for PFOA. Massachusetts has been requiring biosolids producers to test and record PFAS and PFOA concentrations quarterly and has begun the process of developing regulatory soil screening limits to be applied to biosolids. To date there has been only one stakeholder meeting in this process and the schedule and any details of the plan is not known.

Current MA DEP guidance for PFAS and PFOA testing methods and acceptable laboratories can be found at the MA DEP website.

https://www.mass.gov/info-details/testing-of-pfas-in-wastewater-and-residuals#testing-of-pfas-in-residuals-

3.0 THIRD PARTY DISPOSAL AND PROCESSING ALTERNATIVES

Stantec reached out to landfills. Incinerators and biosolids processors through the northeast to determine which facilities were still accepting biosolids, how long they might continue to do so, and the current tip fee.

A survey of available processing and disposal facilities in New England and Eastern New York was undertaken. A total of 20 facilities were identified and contacted. Of these, only one landfill had current and future capacity, four incinerators had current capacity but may not have future capacity and some had restrictions on the quality of the biosolids they would accept, and no processing facilities could guarantee acceptance of current or future biosolids. A major factor in reduced landfill capacity is that Casella is moving away from landfilling, and they manage a large number of landfills that have previously accepted biosolids. This has significantly reduced any long-term capacity for biosolids. Some of the responders to the survey did indicate they may accept biosolids if the price is high enough.

Tables 3-1, 3-2 and **3-3** lists the incinerators, landfills and processors contacted and notes on their capacity and conditions for accepting biosolids.

Table 3-1:Incinerators contacted

Facility	Owner	Travel Distance (miles)	Notes
Cranston, RI	Veolia	118	Limited capacity but may accept depending on biosolids and economics
Woonsocket, RI	Synagro	102	Will only accept biosolids 20% solids or greater, loading and quality must be consistent.
Upper Blackstone WWTF	Upper Blackstone Water Pollution Abatement District	75	Currently beginning a study on teaming with other utilities on regional facility.
Hartford, CT	Harford MDC	66	Currently beginning a study on teaming with other utilities on regional facility. Cannot guarantee future acceptance
New Haven, CT	Synagro	104	Liquid only limited capacity no long term guarantee
Waterbury, CT	Synagro	94	Liquid only limited capacity no long-term guarantee
Naugatuck, CT	Veolia	104	Limited capacity cannot guarantee acceptance of new biosolids
Mattabassett CT	Mattabassett District	79	Cannot accept out of state biosolids

Table 3-2: Landfills contacted

Facility	Owner	Distance from SRWTF (miles)	Notes
Seneca Meadows, Waterloo, NY	Seneca Meadows, Inc.	267	Limiting new biosolids customers
RI Central Landfill, RI	RI Resource Recovery Corp		
Crossroads Norridgewock Landfill, Norridgwock, ME	Waste Management	259	Cannot accept of state biosolids
Coventry, VT	Casella Organics	210	Currently being used to deposit SRWTF biosolids
Juniper Ridge Landfill Old Towne, ME	Casella Organics	249	No information provided by facility
Ontario Landfill Stanley, NY	Casella Organics	308	Not accepting biosolids landfill nearing end of use
Highland Landfill, NY	Casella Organics	165	No longer accepting biosolids
Bethlehem Landfill, NH	Casella Organics		Not accepting new biosolids customers

Table 3-3: Reuse Processing Facilities contacted

Facility	Owner	Distance from SRWTF (miles)	Notes
Hawk Ridge Composting Facility Unity, ME	Casella Organics	259	Composting facility Not accepting new biosolids customers
Grasslands Chateaugay, NY	Casella Organics	263	Chemical stabilization not accepting new biosolids customers
Soil Preparations Plymouth, ME	WeCare Environmental	278	Currently not accepting biosolids
Merrimack Composting Facility, NH	Town of Merrimack, NH	94	No new biosolids customers

Of all the facilities contacted, only one, Seneca Meadows Landfill, has the capacity to take Montagues biosolids for a long term.

3.1 PROCESSING/DISPOSAL COSTS

Based on the responses, costs were developed for disposal or processing fee facilities that might take Montague's biosolids but cannot guarantee long-term acceptance. Tipping fees based on the replies to the survey and transportation costs based on the following assumptions were used to determine the cost:

- Hourly truck operation cost of $175/hour
- A ½ hour allowance for loading and another for unloading
- An allowance of 1.5 times the distance traveled to account for lack of back haul but some efficiency for third party hauling
- Truck load of 20 tons per load
- No cost for roll off container rental is provided and I tis assumed Montague would own containers

Costs in the table are for Montague's biosolids only and not other communities in Franklin County that might contribute biosolids to a composting facility.

Table 3-4: Estimated Yearly Biosolids Handling Costs

Facility	Disposal Method	Distance from SRWTF (Miles)	Tipping Fee (Per Wet Ton)	Transportation Cost (Per Trip)	Cost Per Wet Ton	Cost Per Dry Ton	Estimated Yearly Disposal Total Cost
Seneca Meadows, NY	Landfill	131	$ 100	$ 1,356	$168	$ 839	$ 174,525
Woonsocket, RI	Incinerator	102	$ 150	$ 726	$ 186	$ 932	$ 193,765
Cranston, RI	Incinerator	118	$ 150	$ 658	$ 182	$ 912	$ 189,670
Hartford MDC	Incinerator	66	$ 150	$ 490	$ 175	$ 873	$ 206,050
New Haven, CT	Incinerator	104	$ 150	$ 648	$ 182	$ 912	$ 229,938
New England Waste Services, Newport, VT	Landfill	185	$ 150	$ 963	$ 198	$ 991	$ 200,590
Ontario Landfill Stanley, NY	Landfill	308	$ 150	$ 1,422	$ 221	$ 1,076	$ 229,938
Highland, NY	Landfill	185	$ 150	$ 858	$ 193	$ 964	$ 200,590
Hawk Ridge Composting Unity, ME	Composting	259	$ 150	$1,304	$ 215	$ 1.076	$ 223,795
Grasslands Chateauguay, NY	Chemical Stabilization	263	$ 150	$ 1,304	$ 215	$ 1,076	$ 223,795

3.2 CONCLUSION

The cost presented in Table 3-4 are likely lower than Montague will have to pay overtime. One message that was heard is that disposal and processing facilities are in high demand and that prices for service are increasing rapidly.

There has been a long-term trend in New England of diminishing alternatives for biosolids disposal and or processing. The information from the survey confirms this trend. High transportation costs and changing business models are causing higher costs especially for smaller communities with low volumes and long distances to contend with.

4.0 COMPOSTING FACILITY DESCRIPTION

4.1 MASS BALANCE

The Town is examining two composting facility sizes; one would process only the biosolids produced by the Montague WWTP, approximately four dry tons per week. The second would process material from Montague as well as from several other communities in Franklin County. The other facilities would send liquid biosolids to Montague to be dewatered and then composted for a facility capacity of 10 dry tons per week. In both cases the solids content is projected to be 20% with the introduction of new dewatering equipment at the Montague WWTP.

The Town is interested in employing the aerated static pile (ASP) composting method. This is the best choice for the following reasons:

- The Town has previously operated an ASP composting operation for their biosolids and thus have experience and are permitted for this technology.
- For the two facility sizes being considered it requires the least space, greatest process control.
- It is the most economical process with the best ability to capture and control odors. The only lower cost alternative is outdoor turned windrow. This requires significantly more space and does not have the same level of odor capture and control as ASP.

Below is a list of the stages and sequence of operation in an ASP composting operation:

- Mixing of biosolids with new and recycled bulking agent,
- Active or high-rate composting during which the majority of the composting activity occurs, regulatory time and temperature targets are met and measured, and the most odorous emission occur. Active composting lasts for 21 days,
- Screening of the compost to remove remaining bulking agent (BA) for reuse as recycled BA.
- Curing or low-rate composting. At this stage final stabilization occurs at a low oxygen demand. Tat this stage the odor of the material is low and has the character of soil rather than decomposing biosolids as occurs in the High-rate stage.
- Storage of the end product. At this point the compost is complete and can be easily stockpiles without concern for runoff control or odors.

Tables 4-1 and **4-2** lists the weekly weights and volumes of material at each stage of the ASP process for the four and 10 dry ton per facilities being considered:

Table 4-1: Mass balance for four dry ton per week ASP facility

Material	*Volume*	*Total Weight*	*Dry Weight*	*Volatile Solids*	*Bulk Density*	*Solids Content*
	(CY)	*(TONS)*	*(TONS)*	*(TONS)*	*(LBS/CY)*	*(%)*
Mixing Stage						
Biosolids	25.0	20.0	4.0	3.2	1,600	20.0%
Yard Waste (Processed) (Green Waste)	42.4	12.7	7.0	4.9	600	55.0%
Screened Recycled Bulking Agent	39.8	13.8	7.6	7.1	695	55.0%
Unscreened Recycle	0.0	0.0	0.0	0.0	780	55.0%
Active Composting Stage						
Mixture	101.8	46.5	18.6	15.2	914	40.0%
Composting Losses		32.7	1.5	1.5		
Screening Stage						
Screen Feed	79.6	31.1	17.1	13.7	780	55.0%
Recycled Bulking agent	39.8	13.8	7.6	7.1	695	55.0%
Curing Stage						
Curing	38.3	17.2	9.5	6.6	900	55.0%
Curing Losses		0.6	0.4	0.4		
Finished Compost Storage						
Compost to Storage	36.8	16.6	9.1	6.2	900	55.0%

In both mass balances it was assumed that the solids content of the biosolids going to composting is 20%. This is based on the intent to replace the existing dewatering equipment. In addition, it was assumed that only green waste would be used for the BA. Because the amount of BA is driven by the need to achieve a solids content of 40% in the compost mix green waste will result in the maximum sizing.

Table 4-2: Mass balance for 10 dry ton per week ASP facility

Material	***Volume***	***Total Weight***	***Dry Weight***	***Volatile Solids***	***Bulk Density***	***Solids Content***
	(CY)	***(TONS)***	***(TONS)***	***(TONS)***	***(LBS/CY)***	***(%)***
Mixing Stage						
Biosolids	62.5	50.0	10.0	8.0	1,600	20.0%
Yard Waste (Processed) (Green Waste)	106.1	31.8	17.5	12.3	600	55.0%
Screened Recycled Bulking Agent	99.4	34.5	19.0	17.7	695	55.0%
Active Composting Stage						
Mixture	254.6	116.4	46.5	37.9	914	40.0%
Composting Losses		81.8	3.8	3.8		
Screening Stage						
Screen Feed	199.1	77.7	42.7	34.1	780	55.0%
Recycled Bulking agent	99.6	34.6	19.0	17.7	695	55.0%
Curing Stage						
Curing	95.7	43.1	23.7	16.4	900	55.0%
Curing Losses		1.6	0.9	0.9		
Final Compost Storage						
Compost to Storage	92.1	41.4	22.8	15.5	900	55.0%

4.2 ASP TECHNOLOGY OPTIONS

ASP refers to the basic configuration of the composting process. How the process is housed and the manner in which the air is moved through the pile can have significant cost implications. In general, two configurations were examined in this study as they represent the most economical configurations to construct; The first is active compost piles with positive aeration, air is pushed up through the piles. In positive aeration it is essential to fully enclose the active composting piles. The active composting stage is the most odorous part of composting because the majority of the decomposition of organic matter occurs in this stage. Full enclosure of the active stage is needed to capture and control these odors.

The second configuration uses negative aeration in which the air is drawn down through the piles. Under negative aeration, the majority of the odor from the piles is collected directly from the piles and sent to odor control. A small percentage of odor is emitted from the pile surface, but this is low depending on whether the piles are continuously or intermittently aerated. The major benefit of negative aeration is that the active composting phase does not need to be fully enclosed. Only a roof is needed.

In both configurations a roof is required over the active composting stage to prevent rain and snow from adding significant amounts of moisture to the piles. Added moisture interferes with the heat generation in the piles and the airflow through them. Self-heating and proper air distribution through the piles are essential to successful composting and meeting Class Regulatory time and temperature targets.

If negative aeration is used the fan must be controlled by a variable speed drive and the fan must also be run continuously to maintain the odor capture. With a continuously running fan odor capture of 90% has been documented by Jacobs Engineering in tests on facilities in Kern County in California and Spotsylvania, VA. If intermittent aeration is used Stantec has measured 70% odor reduction in Columbus, OH and Longmont, CO. With continuous aeration it is possible to avoid full enclosure of the active composting phase. This will be further discussed in the Odor Management portion of the report.

One disadvantage of using negative aeration is that it is harder to dry the active composting piles near the end of the 21 days of this stage. This is important for the screening stage. Screening is most effective with material that is 55% or higher solids. When using negative aeration, the air moving through the fan is warm and moist, It tends to be less dense than cooler air and thus the volume of air is lower so a slightly larger fan is needed.

Positive aeration provides more air for the same energy use as negative aeration thus making it easier to dry the compost prior to screening. In addition, the use of intermittent aeration is possible because the air is captured in the fully enclosed structure.

The screening and curing operations are under a roof only. This is to prevent the moisture from rain and snow from lowering the solids content of the compost and making the screening difficult. Regardless of the aeration scheme for the active phase, positive aeration is used in the curing phase. At this stage the material smalls like soil and does not require odor control. Positive aeration further facilitates drying the material. The target solids content for the finished compost is 60% to 65%.

The selection of the active composting stage aeration scheme will be discussed and concluded in the Odor Management section of this report.

4.3 FACILITY DESCRIPTION

As noted earlier in this report the Composting operation is divided into the following stages:

- Mixing
- Active composting
- Screening
- Curing

- Odor control
- Compost storage
- Office

Figure A-1 in **Appendix A** is the layout at the WWTP. **Figure A-2** in **Appendix A** is a facility layout for the Sandy Lane site.

4.3.1 Mixing

The mixing operations consists of a fully enclosed structure that houses three storage bunkers: one for one week's storage of biosolids, one with one week's storage of recycled BA and the third with one week's storage of new BA. The space in front of the storage bunkers must be large enough to allow trucks delivering the materials to be fully enclosed in the building when tipping the material into the bunkers. Therefore, the building must also be tall enough to allow the trucks to empty their contents into the proper bunker.

In addition to the three bunkers for storage a mixing machine is needed to blend the compost mixture. The Montague WWTP has a trailer mounted mixer of about five cubic yards capacity. It is assumed this machine can be salvaged and used as the facility mixer. The mixer has a small side discharge conveyor. This will discharge the mixture onto another conveyor that will drop the blended compost mixture outside of the mixing building into a bunker. At the WWTP the mixing and bunkers are split up to fit into the available space.

4.3.2 Active Composting

Regardless of the aeration scheme the active composting stage will have the following characteristics: there will be space for four bays, with each bay holding one weeks' worth of compost mix. Three bays will be in active composting, and one will be available to be emptied and reloaded over the course of a week. Each bay will have an air distribution system in the floor consisting of trenches with perforated PVC pipe to move the air to or from the compost piles. The trenches will be covered with a cast iron or stainless-steel grates to protect the pipe in the trench. **Figure A-3** in **Appendix A** is a cross-section view of the active composting building.

There will be a separate blower gallery that will hose the aeration blowers, one for each bay, and the associated ductwork. The ducts will connect to the PVC pipe in the floor trenches and each pipe will have a clean out in the blower gallery. The floor of the bays and the blower gallery will be poured in place concrete.

The compost bays and the lower gallery will be separated by a 10-foot-high concrete wall made from precast concrete blocks. This will act as the push wall for stacking and removing the compost. There will be a similar concrete block wall at the outer edge of the first and forth bay. There will be a roof over both the bays and blower gallery with a minimum clearance over the bays of 21 feet to allow a front-end loader to lift its' bucket to full height.

If the active composting Is in positive aeration the bays and blower gallery will be fully enclosed. There will be a large stainless steel rollup door for each bay. If the aeration is negative, there will be only a roof over the bays and blower gallery.

4.3.3 Screening

At the Sandy Lane site the screening and curing operations will be in the same structure with only a roof. At the WWTP the screening will be at the west end of the WWTP and will have only a roof over it. The floor will be poured in place concrete and there will be pre-cast concrete blocks used as push walls at the discharge points for the screened compost and the recovered BA. The roof will cover the screen and enough space to cover the piles discharging from the screen. At the WWTP the screening and curing buildings are separate due to space constraints. The screening building is located at the west end of the facility and the curing building is located at the east end.

4.3.4 Curing

The curing building will be a roof only structure with five bays each holding one weeks' worth of material. Four of the bays will be actively curing while the fifth bay will be available to be emptied and reloaded over the course of a week. The bays will have positive aeration delivered through poured concrete floors with trenches, perforated PVC pipe and grates cove the trenches. There will be a blower gallery behind the bays and separated from the bays by a 10-foot-high push wall of precast concrete blocks. Each PVC pipe going into the floor trenches will have a clean out in the blower gallery. There will be a precast concrete block wall at the far edge of the first and fifth curing bays. There will be a roof over both the bays and blower gallery with a minimum clearance over the bays of 21 feet to allow a front-end loader to lift its' bucket to full height. **Figure A-4** in **Appendix A** is a cross section view of curing building.

4.3.5 Compost Storage

At the completion of curing the compost is a fully stabilized compost ready for unrestricted use. However, like all soil products compost is a seasonal product. Therefore, storage for at least six months' worth of material is recommended. As a Class A product there are no special requirements for storage. In addition, the compost is hydrophobic, so a cover is not needed as the water mostly runs off the piles.

The ground where the compost is to be stored needs only to be graded to allow stormwater to be moved away from the piles and either be absorbed into the ground or go to a stormwater basin.

4.3.6 Odor Control

Biofiltration was selected for odor control. Biofilters are the most common form of odor control for composting because they are highly effective, and easy to operate and maintain. Biofilters are filter beds with media that supports microorganisms. The odorous air passes through the filter bed media and the odorous compounds are absorbed into a moisture film on the media. Microorganisms in the moisture film oxidize the compounds removing the odor.

Biofilters can have either organic or inorganic media. Organic media (ground wood) is the most common for composting facilities because the material is readily available on site. The media is low cost but must be replaced every three years because it decomposes over time. The air is distributed to the biofilter media by perforated baseplates designed specifically for biofilters. These can be driven over by a front-end loader and thus makes media replacement quick and simple. **Figure A-5** in **Appendix A** is the cross-section of the biofilter. A surface irrigation system is required to maintain the moisture film on the media in warm weather. In winter the moisture in the air from active composting condenses in the filter providing the required moisture.

For a negatively aerated active compost option, air will be collected from the active compost aeration and the fully enclosed mixing building. This air will be sent to a biofilter for odor control. For positively aerated active composting the air will be collected from the enclosed active composting building and the mixing building and sent to a biofilter for odor control. At the WWTP site there will not be odor control for the biosolids storage pile due to the lack of available space.

The enclosed mixing building will be ventilated to odor control at a rate of six air changes per hour in accordance with guidance from the National Fire Protection Agency (NFPA). This also provides enough air to remove diesel exhaust from trucks tipping loads in the building. For fully enclose building rollup doors will be high speed doors to minimize fugitive emissions from the doorways. The effectiveness of these odor control strategies is further examined in the **Odor Management** section of this report.

4.3.7 Site Civil

MA DEP regulations for composting facilities requires that all water that comes into contact with the biosolids or the in-process compost must be collected and treated as wastewater. This means that all the surfaces over which biosolids or in process compost travels, such as in front of the mixing, active compost, screening and curing structures must be paved and sloped to catch basins that will collect the wastewater. At the Sandy Lane site a pump station will be needed to lift the wastewater up to the sanitary sewer in Sandy Lane. At the WWTP a pump station will be needed at the east end of the plant to move wastewater to the WWTP headworks.

The facility will need an office to maintain regulatory compliance records. In addition, the Sandy Lane site will require sanitary facilities for the operations staff. Many composting facilities have a truck scale to weigh

4.3.8 Office

Temperature records must be kept on each batch of compost to demonstrate compliance with regulatory targets. In addition, sanitary facilities are required for the staff. At the Sandy Lane facility this will be a 30-foot-long office trailer. At the WWTP space will have to be provided in the existing administration building.

4.4 FACILITY SIZING

Two facility sizes are examined in this report; the first to process four dry tons per week of biosolids from the Montague WWTP only and the second to process 10 dry tons per week from Montague and several communities in Franklin County. **Table 4-3** lists the sizes of the major components of each facility:

Table 4-3: Facility component sizing

Facility component	Component Description	Four dry ton per week facility	10 dry ton per week facility
Mixing receiving (Sandy Lane)	Fully Enclosed with for overhead doors	51' x 99' x 25' clearance[1]	51' x 99' x 25' clearance[1]
Mixing receiving WWTP	Roof Only (no room for odor control)	23' x 46' x 25' clearance	Not Applicable
Active composting	4 bays and blower gallery	43.5' x 67.5' x 21' clearance[1]	60' x 86' x 21' clearance[1]
Screening	Roof only	25' x 60' x 21' clearance[1]	45.5' x 60 x 21' clearance[1]
Curing	5 bays with blower gallery	33' x 63' x 21' clearance[1]	45.5' x 63' x 21' clearance[1]
Odor control	Biofilter	35' x 35' x 6' deep	60' x 60' x 6' deep
Office	Records and sanitary facilities	Use existing office	8'x 8' x 30' trailer

Notes:

1. Clearance is the free clearance height from the floor to the under ide of the roof. This is important to avoid FEL bucket from hitting the roof at full extension.

Figure A-1 in Appendix A is a site layout for the four dry ton facility at the WWTP. The larger 10 dry ton facility will not fit at the WWTP. **Figures A-2** in **Appendix A** is the site layout for the 10 dry ton per week facility at the Sandy Lane site. At the sandy Lane site, the four dry ton per week facility is the same configuration but slightly smaller.

The WWTP has challenges for space. The biosolids storage and mixing will be a roof only structure at the west end of the facility at the discharge to the dewatering operation. There is insufficient space to include odor control for the biosolids storage at this location. BA storage and screening will also be housed in a roof only building located south of the biosolids storage where the previous pilot scale composting screening area was located. This area will need to be enlarged. The active composting, curing and odor control will be located at the east end of the facility . This will require significant earthwork to build into slope on the north edge of the site.

At the Sandy Lane site the facility will be located to the southwest of the transfer facility and west of future proposed development. This area is lower than the surrounding land to the north and east. The site is arranged with mixing and receiving, and the active composting located in-line and the screening and curing also in-line but facing the active composting. The odor control is at the west end of the facility. All of these areas are connected by a paved surface with runoff collection as required by MA DEP regulations.

4.5 OPERATION DESCRIPTION

ASP is a batch process. This allows tracking of batches to ensure time and temperature targets are met. Material most move as a bath from the various processes, mixing/receiving, active composting, screening, curing and storage.

4.5.1 Mixing and Receiving

Each batch of compost will be made from one weeks' biosolids production. At the Sandy Lane site biosolids will be delivered in trucks and tipped inside the mixing building in a dedicated bunker. There is no truck scale because all dewatered biosolids will be produced at the Montague WWTP and biosolids from other facilities will arrive at the Montague WWTP as liquid to be dewatered.

Mixing will be completed by the existing trailer mounted mixer. A front-end loader (FEL) will place biosolids, recycled BA and new BA into the mixer proportional to meet the mix with the proper solids content of 40%. This should be periodically checked by checking the solids content of the individual components and the mix ratios adjusted if the solids contents change. The mixer will blend the BA and biosolids in about 10 to 15 minutes. The mixer has a small side conveyor that will discharge the mix onto another conveyor that will discharge the mix outside of the mix building in a bunker. The FEL will move the mix into an active composting bay. It is recommended that the mixing and active composting pile construction take place all in one day.

4.5.2 Active Composting

Any material in the active composting bays must remain aerated. This will be either continual or intermittent aeration. If continuous, a VFD will be used to adjust the aeration rate to control the pile temperature. Piles are self-heating and a maximum of 70^{o}C is desired. If aeration is intermittent, it should be run by a cycle timer but at no time should the aeration be off for more than 15 minutes. An active compost pile will deplete all the available oxygen in a pile in about 15 minutes. It is undesirable to have anaerobic conditions develop in the pile.

During the last few days of active composting, it is desirable to aerate the compost to the maximum extent to promote drying of the material to 55% to 60% solids prior to screening.

Each day during the active compost phase the temperature must be measured and recorded in each pile. It I s best to perform this in two or three locations but is only required by regulation one location the pile. The temperature reading must be recorded and saved in filles for each batch to demonstrate achieving time and temperature targets.

After 21 days the compost is removed from the active composting stage and taken to screening to recover the remaining BA. At this point the compost has achieved pathogen kill targets. It is vital that the bucket of the FEL be cleaned before tearing down an active composting pile or a separate bucket used. This must be done to prevent inoculating the compost with pathogens from the raw biosolids. A separate bucket is recommended as it takes less time than cleaning and is a more reliable method of preventing reinoculation.

After each pile is torn down and before constructing a new pile the aeration trenches should be cleaned using a mobile air compressor and air wand. This will prevent compost material from building up in the aeration trenches.

4.5.3 Screening

Screening can occur prior to curing because the aeration demand of the curing process I slow, the material is friable enough to allow air to move through it provided the material is aerated in the positive mode, air pushed up through the pile. The screen will short into two fractions; the larger fraction is BA which will be returned to the Mixing building in the recycle BA bunker. The small fraction is the compost. The screen mesh will be between ¼ and ½ inch. The smaller size is generally the most desirable in the market place. However, screening to the smaller size can take longer and is more susceptible to blinding of the screen. The large size screens more readily but may be less desirable and harder to market. Depending on the type of screening equipment used the screen mash can be changed.

4.5.4 Curing

The FEL using the same bucket used to tear down the active compost pile will build the curing pile. It is important in both the curing and active composting phase not to drive over the material being stacked in the pile. Driving on the material compacts it prevents air movement through the material.

Since the regulatory time and temperature targets should have been met during the active composting stage there is no monitoring required of the compost. Aeration should remain on continuously during this process. The curing stage lasts for 28 days (four weeks). At the end of curing the pile is torn down using the FEL and it is either loaded into a truck for transport to market or most likely moved to storage.

After each pile is torn down and before constructing a new pile the aeration trenches should be cleaned using a mobile air compressor and air wand. This will prevent compost material from building up in the aertion trenches.

4.5.5 Storage

The compost is now a Class A biosolids product and can be stored and used without restriction. Because compost is a seasonal use product the Town should plan on a minimum of six months of compost storage. The compost can be stockpiles in a continuous pile or individual piles. As with the active composting an curing stage the FEL should avoid driving over and compacting the material. The piles tend to shed water, so the material does not need to be covered. The pile scan be stored on a dirt surface since there are no restriction to its' use. However, the land should be graded to avoid puddles. A gravel or rock base should be avoided as the rocks and gravel inevitably find their way into the compost being loaded for a user. The rocks are undesirable in the end product.

Although not required, it is recommended that a sample of compost be tested by a soil lab for its' nutrient content, Phosphorous, potassium and nitrogen (PKN). This is valuable information for end users and adds value to the end product.

5.0 COMPOST MARKET OPTIONS

There are several methods compost facilities have used to move their finished compost into the marketplace. Some facilities simply give the material away to local users. The disadvantages of this are there are often many small users who come to the facility to pick up the material. This can create conflict with equipment movement on site, can distract facility personnel, does not provide revenue to help offset the operating cost and requires staff to take time to know and contact local users local users of dates for material availability. However, in areas where the value of the compost is understood, giving away the material can be very successful at moving the material offsite especially if specific dates for the pickup are clearly identified and made public.

Some facilities have been very successful at self-marketing their compost. This is generally at larger facilities where there can be a dedicated person at least half time available to run the marketing operation. This requires someone willing to spend time getting to know the local end users, contacting them and developing marketing material or the compost including nutrient content and a brand name. This is generally not economically viable for small facilities such as envisioned at Montague.

The most common method of compost marketing and distribution, especially for smaller producers is to use a third-party firm that specializes in soil and biosolids products. The advantage of using a third party is they have the marketing expertise, and they have access to a greater number of markets that may not be local. In addition, they may have their own soil blending operations that further increases the markets for the compost. The disadvantages of using a third party are the much lower price the facility receives for their compost and under most contracts the facility must store the compost long term until the marketing firm has an outlet for the material. This can sometimes be more than a year. Below is a list of some of the third-party compost marketing firms in New England:

Agresource – markets a variety of organics products including compost, soil, mulch and biofilter media.
110 Boxford Rd, Rowley, MA 01969
978-432-1234
Info@agresourceinc.com

Casella Organics – produces and markets a variety of organics products including biosolids compost and soil blends.
110 Main St, Suite 1308, Saco, ME04004
207-464-0230

Resource Management Inc. (RMI) – Blends soils, transports and utilizes compost on agricultural, and land reclamation projects
1171 NH Route 175, Holderness, NH 03245
603-536-8900
rmi@rmirecycles.com

WeCare Denali
232 Colt Highway, Farmington, CT 06032
888-325-1522
wecareproducts@denaliwater.com

6.0 SITE REVIEW

6.1 WWTP SITE

The WWTP site has an existing composting permit for the pilot scale operation. If a new facility is to be constructed the permit would need to be revised. In addition, the site is on the banks of the Connecticut River. Under the Massachusetts regulation 310 CMR 10.58 the river front area is defined as 200 feet from the mean high-water mark if the river's edge. The Massachusetts Rivers Protection Act The entire Montague WWTP is within the river front area. Work in the river front is not prohibited but the proponent must demonstrate that their project has no practicable alternative and that the work will have no significant adverse impacts. Given that the site is an existing WWTP, and all work would have to be within the existing facility boundary at the top of the river bank it is likely the facility could argue it would have not significant adverse impacts.

Based on the layout provided in **Figure A-1** in **Appendix A** the maximum size facility that could fit on the site would be the four dry tons per week processing only the Town of Montagues biosolids. With this arrangement the facility would be split between the east and west ends of the site. This presents logistical issues for transporting mix from the west end mixing area to the east end composting area. Also, the compost would need to be transported from the west end to the east end for screening and back again to the east end for curing. There is no space available for any finished compost storage so another site would be required for product storage. A separate storage site would not require a permit since the finished compost would be allowed unrestricted use.

6.2 SANDY LANE SITE

The parcel of land at the end of sandy Lane is approximately 5.8 acres in two parcels (4 and 8). There are wetlands to the west of both parcels, but both are outside of the 100-foot protection area of the wetland.

The site adjoins the Town Transfer Station. However, the land directly to the north of the site is planned to be developed into a regional bus transportation depot. The land to the east and southeast is planned for industrial or office use. The site is lower than the property to the north and east.

As can be seen in **Figure A-2** in **Appendix A** there is ample room for the 10 dry ton per week facility as well as room to expand in the future should it be needed. In addition, there is ample room for storage of the finished compost.

The site will need to be permitted as a compost facility with the MA DEP. Since the adjoining property is a waste transfer station it is not likely any further special permits with the Town will be needed. A discussion of odor potential and mitigation measures appears in the Odor Management section of this report.

7.0 ODOR MANAGEMENT

Composting is an inherently odorous process during the mixing and active compost stages. While there are a wide variety of compounds that contribute to the odor the most significant is dimethyl disulfide which is generated in aerobic decomposition. The nature of the odors emitted in the different stages changes as the composting process progresses. For an odor to become an odorous emission there are three contributing factors: first there must be something odorous, second the something odorous must have a surface from which to be emitted, and third there must be a force moving the odors from the surface into the surrounding atmosphere. Almost everything around us has an odor. The character of these odors however, differ. Some are pleasant some are definitely not. In composting there is this range of odor character. The biosolids and active stage compost are unpleasant, the curing and finished compost have a soil like odor that is generally not considered unpleasant. Even emissions from a biofilter that is often use for odor control in composting has a mulch-like odor.

Table 7-1 lists the odor sources and whether or not the air will be collected and treated and the treatment method:

Table 7-1: Odor sources and treatment

Odor Source	Sandy Lane Site	WWTP	Treatment Method
Biosolids storage	Treated	Not treated	Biofilter
Active composting	Treated	Treated	Biofilter
Screening	Not treated	Not treated	N/A
Curing	Not treated	Not treated	N/A
Compost storage	Not treated	Not treated	N/A

In Section 4.2 of this report the use of positive and negative aeration for active composting was discussed. If positive aeration is used the active composting operation must be fully enclosed to capture the odors from the piles. If continuous negative aeration is used, the aeration pulls 90% of the odors from the pile to be sent to odor control. The remaining 10% is allowed to vent to the atmosphere. With continuous negative aeration the active composting operation may not need to be fully enclosed.

7.1 ODOR MODELING

Odors can be measured and quantified in a laboratory using the forced choice olfactometry method. There are ASTM (ASTM E-679) and European Union (EN-13725) standards for this type of odor analysis. The Forced Choice Olfactometry method utilizes a panel of individuals that have been prescreened by the laboratory to represent a cross section of the general population with respect to odor sensitivity. The panelists are presented three ports to sniff from. Two of the ports present filtered fresh air and the third contain a blend of the odorous air sample and filtered fresh air. The panelist must select which port contains the sample blended with filtered air. When half the panel selects the correct port, the ratio of the sample to the filtered air is designated as the dilution to threshold (D/T). The D/T is the odor concentration (ou/m^3) of the air. Massachusetts has an unofficial odor limit is five (5) ou/m^3 at and beyond a composting facility boundary. This is very strict limit that is essentially undetectable by the Forced Choice Olfactometry Method.

To determine if the proposed facility can be operated within this limit and to determine if a fully enclosed positive aerated facility or an open negative aeration facility is best a computer dispersion model was used to estimate the impact of odor emissions from a facility on the surrounding community. To this end dispersion models were run for the following:

Site 1 Alternative 1

- Sandy Lane site
- 10 dry ton per week facility operated with negative aeration for the active composting
- Roof only for the active composting
- Fully enclosed mixing building
- Positive aeration for curing
- Roof only for curing building
- Biofilter for odor control of active composting process exhaust and the air from the mixing building

Site 1 Alternative 2

- Sandy Lane site
- 10 dry ton per week facility operated with positive aeration for the active composting
- Fully enclosed active composting
- Fully enclosed mixing building
- Positive aeration for curing
- Roof only for curing building
- Biofilter for odor control of air from active and the air from the mixing building

Site 2 Alternative 1

- WWTP site
- four dry ton per week facility operated with negative aeration for the active composting
- Roof only for the active composting
- Biosolids storage under a roof only due to lack of space for odor control
- Positive aeration for curing
- Roof only for curing building
- Biofilter for odor control of active composting process exhaust

Site 2 Alternative 2

- WWTP site
- four dry ton per week facility operated with positive aeration for the active composting
- Fully enclosed active composting

- Biosolids storage under a roof only due to lack of space for odor control
- Positive aeration for curing
- Roof only for curing building
- Biofilter for odor control of air from active composting

The model used was the SCREEN3 model. SCREEN3 is a screening model tool from the US EPA. It models only one odor source at a time and provides maximum ground-level concentrations at set intervals away from the odor source. Multiple sources are accounted for by summing the results for each source.

SCREEN3 is a preliminary screening model that account for a full range of atmospheric mixing conditions and wind speed from every direction. It does not use site specific meteorological data. The results of the SCREEN3 model is considered more conservative than for models using site specific meteorological data.

Tables 7-2 through 7-5 list the emissions modeled for each of the site and alternatives listed on the previous page:

Table 7-2: Site 1 Alternative 1 emissions

Odor Source	Odor Concentration (ou/m^3)	Odor emission Rate (ou/sec)
Active compost piles	350	74
Curing piles	300	56
Biofilter	300	3,211

Table 7-3: Site 1 Alternative 2 emissions

Odor Source	Odor Concentration (ou/m^3)	Odor emission Rate (ou/sec)
Curing piles	300	56
Biofilter	300	3,313

Table 7-4: Site 2 Alternative 1 emissions

Odor Source	Odor Concentration (ou/m^3)	Odor emission Rate (ou/sec)
Active compost piles	350	52
Curing piles	300	36
Biosolids storage	10,000	101
Biofilter	300	981

Table 7-5: Site 2 Alternative 2 emissions

Odor Source	Odor Concentration (ou/m³)	Odor emission Rate (ou/sec)
Curing piles	300	36
Biosolids storage	10,000	101
Biofilter	300	981

Although the odor concertation for the biofilter and compost piles in negative aeration is very similar the character is quite different. However, when modeling for the MA DEP for a compost permit, all sources are included and the odor limit of five (5) ou/m³ applies to all sources.

Tables 7-6 through 7-9 list the estimated odor concentration at various distances from the source:

Table 7-6: Model results for Site 1 Alternative 1

Distance from odor source (m)	Odors from biofilter (ou/m³)	Odors from curing piles (ou/m³)	Odors from active composting (ou/m³)	Combined odors from all sources (ou/m³)
30	100.7	1.5	1.1	103.3
50	66.3	1.5	1.1	69.0
100	42.8	0.9	0.9	44.6
200	22.6	0.4	0.5	23.6
500	6.2	0.1	0.1	6.5
600	4.7	0.1	0.1	4.9
1,000	2.1	0.0	0.0	2.2

Table 7-7: Model results for Site1 Alternative 2

Distance from odor source (m)	Odors from biofilter (ou/m³)	Odors from curing piles (ou/m³)	Combined odors from all sources (ou/m³)
30	102.6	1.0	103.6
50	67.5	1.1	68.6
100	43.7	0.8	44.5
200	23.2	0.4	23.6
500	6.4	0.1	6.6
600	4.8	0.1	4.9
1,000	2.2	0.0	2.2

Table 7-8: Model results for Site 2 Alternative 1

Distance from odor source (m)	Odors from biofilter (ou/m^3)	Odors from curing piles (ou/m^3)	Odors from active composting (ou/m^3)	Odors from biosolids storage (ou/m^3)	Combined odors from all sources (ou/m^3)
30	50.5	1.0	1.3	10.0	62.8
50	32.0	1.0	1.3	5.6	39.8
100	18.0	0.6	0.8	2.5	21.9
200	8.0	0.3	0.4	0.9	9.6
350	3.5	0.1	0.2	0.4	4.2
500	2.0	0.1	0.1	0.2	2.4
1,000	0.7	0.0	0.0	0.1	0.8

In Alternative 1 the highest odor concentration at the home immediately to the east of the WWTP was 21.8. The biofilter remission would be responsible for this. The highest odor concertation at the homes to the west of the WWTP was 6.3. This would be from the biosolids storage.

Table 7-9: Model results for Site 2 Alternative 2

Distance from odor source (m)	Odors from biofilter (ou/m^3)	Odors from curing piles (ou/m^3)	Odors from biosolids storage (ou/m^3)	Combined odors from all sources (ou/m^3)
30	50.5	0.6	10.0	61.1
50	32.0	0.6	5.6	38.2
100	18.0	0.4	2.5	20.9
200	8.0	0.2	0.9	9.1
300	4.4	0.1	0.5	5.0
500	2.0	0.0	0.2	2.2
1,000	0.7	0.0	0.1	0.7

In Alternative 2 the highest odor concentration at the home immediately to the east of the WWTP was 20.6. The biofilter remission would be responsible for this. The highest odor concertation at the homes to the west of the WWTP was 6.0. This would be from the biosolids storage.

7.2 CONCLUSIONS

In reviewing the results in Tables 7-6 through 7-9 the following observations are important to note:

The overall odor offsite for negative aeration and positive aeration are essentially the same. Since negatively aerated active composting is less expensive to construct and maintain, it is the recommended AP technology and will be carried forward into the economic analysis.

The biofilter was the largest contributor to offsite odors. Even though the character of these emissions is mulch-like, it is important to get all offsite emission below the five (5) ou/m^3 to meet the MA DEP unofficial odor limit. Two items give us confidence that this can be achieved; first the SCREEN3 model is generally conservative. During the preliminary design stage of the project the more accurate US EPA model AERMOD should be used. This model uses five years of actual hourly meteorological data for the area as well as detailed topographic information. Secondly, we recommend that the biofilter be enclosed in a prefabricated metal building with two up blast ventilation fans in the roof. This provided substantial dispersion of the emissions. This approach has been successfully employed at several composting facilities including two in Massachusetts, Nantucket and Marlborough. In addition, we recommend that the active composting operation have a metal skin on three sides of the building and two upblast ventilation fans in the roof. The three sides will block emissions from the direction of the nearest receptors and the up blast fan will provide additional dispersion. The model does not seem to require these steps, but they are low-cost additions that are likely to further reduce the offsite odor concentration.

One important result was the offsite odors caused a by the untreated emissions from the biosolids storage at the west end of the WWTP. The homes to the west already experience odor impacts from wastewater operations. There is very limited space available at the WWTP and this is why the biosolids storage emission are untreated. Odors, poor operational layout, size limitations and the need to demonstrate the site has to be used over other sites under the Rivers Protection Act, makes the site less than ideal. The Sandy Lane site is far more attractive regardless of the size of the facility, four or ten dry tons per week.

8.0 ECONOMIC ANALYSIS

Engineers' opinions of probable cost for construction and O&M of a compost facility were developed for both a four dry ton per week and 10 dry ton per week facility. The following assumptions were used in developing these costs:

The facilities are to be constructed at the Sandy Lane site (Site 1). This was selected because it is the better site, and the WWTP will require a second site for compost storage. The sandy Lane site provides complete operations at one location. The WWTP O&M cost is anticipated to be much larger than for the Sandy Lane site due to the greater amount of material movement around the site and the need to truck compost and yard waste to the site. At Sandy Lane the Towns yard waste drop off is at the transfer facility adjacent to the proposed facility.

The preferred technology of negatively aerated active compost piles with a roof and three sides to the building was used in the analysis. In addition, the biofilter is fully enclosed and roof up blast fans used on the biofilter, and active composting roofs as recommended in the odor management section of this report.

Operationally it was assumed that ground yard waste would be used for half the annual BA required. The remaining half would have to purchased wood chips. The following costs were assumed:

- Electricity - $0.10 per KWH
- Revenue from sale of compost - $5.00 per cubic yard
- Operator cost - $30 per hour
- The existing batch mixer would be repaired and used at the new facility
- All other mobile equipment would be purchased new. Used equipment can likely be obtained for about half the cost of new equipment
- The Town would transport the biosolids themselves from the WWTP to the Sandy Lane site
- No cost or tip fee is included for the dewatering operation
- A tip fee of $150 per wet ton assuming 20% solids ($750 per dry ton) is included as revenue for the biosolids from other communities. This does not include a fee for dewatering services and is in line with tip fees from the third-party disposal and processing survey in section 3.1 of this report. This applies only to the 10 dry ton per week facility.

Tables 8-1 and 8-2 show the Capital cost breakdown for a four and 10 dry ton per week facility at the Sandy Lane site respectively:

Table 8-1: Cost breakdown for four dry ton per week facility

ITEM	PERCENT	ESTIMATED COST	SUBTOTALS & TOTALS
Sitework		$ 184,000	
Compost building		$ 357,000	
Curing building		$ 451,000	
Biofilter structure		$ 69,000	
Compost & Curing Mechanical		$ 220,000	
Office trailer		$ 50,000	
Biofilter		$ 192,000	
Electrical		$ 50,000	
Composting control system		$ 50,000	
Construction Subtotal			*$ 1,823,000*
General Conditions			
Mobilization	0.5%	$ 10,000	
Contingency	25.0%	$ 456,000	
Contractor overhead & profit	20.0%	$ 458,000	
Performance bond	2.0%	$ 55,000	
Engineering	12.0%	$ 330,000	
Subtotal			*$ 1,309,000*
Construction total			***$ 3,123,000***
Mobile Equipment			
Front-end loaders		$ 275,000	
Batch mixer		$ 25,000	
Screen		$ 170,000	
Mobile air compressor		$ 5,000	
Dump Truck		$ 140,000	
Subtotal			*$ 615,000*
Project total			***$ 3,747,000***

Table 8-2: Cost breakdown for ten dry ton per week facility

ITEM	PERCENT	ESTIMATED COST	SUBTOTALS & TOTALS
Sitework		$ 206,000	
Compost Building		$ 684,000	
Curing building		$ 591,000	
Biofilter structure		$ 679,000	
Compost & Curing Mechanical		$ 231,000	
Office trailer		$ 50,000	
Biofilter		$ 349,000	
Electrical		$ 50,000	
Composting control system		$ 50,000	
Construction Subtotal			*$ 2,890,000*
General conditions			
Mobilization	0.5%	$ 15,000	
Contingency	25.0%	$ 723,000	
Contractor overhead & profit	20.0%	$ 726,000	
Performance bond	2.0%	$ 88,000	
Engineering	12.0%	$ 523,000	
Subtotal			*$ 2,075,000*
Construction total			***$ 4,965,000***
Mobile Equipment			
Front-end loaders		$ 275,000	
Batch mixer		$ 25,000	
Screen		$ 170,000	
Mobile air compressor		$ 5,000	
Dump Truck		$ 140,000	
Subtotal			*$ 615,000*
Project total			***$ 5,580,000***

Tables 8-3 and 8-4 show the annual O&M and projected revenue costs for the 4 and 10 dry ton facilities at Sandy Ln. respectively. **Tables 8-5 and 8-6** show the annualized costs for the 4 and 10 dry ton facilities at Sandy Ln. respectively.

Table 8-2: O&M costs for 4 dry ton per week facility at Sandy Ln.

Item	Unit Cost	Unit	Annual Units	Cost
Operations & Maintenance				
Labor Operator	$ 30.00	hour	1,664	$ 49,920
Labor Mechanic	$ 30.00	hour	62	$ 1,854
Front-end loader	$ 50.00	hour	832	$ 41,600
Screen	$ 50.00	hour	208	$ 10,400
Dump Truck	$ 50.00	hour	312	$ 15,600
Mixer	$ 25.00	hour	312	$ 7,800
Compost fans	$ 0.10	kwhr	98,024	$ 9,802
Biofilter fans	$ 0.10	kwhr	196,049	$ 19,605
Roof Fans	$ 0.10	kwhr	130,699	$ 13,070
Site Lighting	$ 0.10	kwhr	130,699	$ 13,070
Bulking agent	$ 35.00	yd^3	1,075	$ 37,625
Biofilter media	replace media every 3 years			$ 3,441
Admin & Lab	$ 6,000	Annual	1	$ 6,000
Subtotal				**$ 230,000**
Revenue				
Compost sales	$ 5.00	yd^3	1,924	$ (9,620)
Subtotal				$ (9,620)
Total annual cost				**$ 220,000**

Table 8-4: O&M costs for a 10 dry ton per week facility at Sandy Ln.

Item	Unit Cost	Unit	Annual Units	Cost
Operations & Maintenance				
Labor Operator	$ 30.00	hour	3,328	$ 99,840
Labor Mechanic	$ 30.00	hour	62	$ 1,854
Front-end loader	$ 50.00	hour	1,664	$ 83,200
Screen	$ 50.00	hour	416	$ 20,800
Dump Truck	$ 50.00	hour	416	$ 20,800
Mixer	$ 25.00	hour	832	$ 20,800
Compost fans	$ 0.10	kwhr	196,049	$ 19,605
Biofilter fans	$ 0.10	kwhr	490,122	$ 49,012
Roof Fans	$ 0.10	kwhr	130,699	$ 13,070
Site Lighting	$ 0.10	kwhr	130,699	$ 13,070
Bulking agent	$ 35.00	yd^3	2,650	$ 92,750
Biofilter media	replace media every 3 years			$ 10,929
Admin & Lab	$ 6,000	Annual	1	$ 6,000
Subtotal				$ 452,000
Revenue				
Compost sales	$ 5.00	yd^3	4,784	$ (23,920)
Biosolids tip fee	$ 750	dry ton	312	$ (234,000)
Subtotal				$ (258,000)
Total annual cost				$ 194,000

Table 8-5: Annual costs and Net Present Value for a four dry ton per week facility at Sandy Lane

	Capital		O&M		Total	
	Construction	**Mobile Equipment**	**With Revenue**	**Without Revenue**	**With Revenue**	**Without Revenue**
Cost	$ 3,132,000	$ 615,000	$ 220,000	$ 230,000		
Interest Discount Rate	2.5%	3.0%	2.5%	2.5%		
Term (years)	20	10	20	20		
Annualized cost	$ 201,000	$ 73,000	$ 220,000	$ 230,000	***$ 494,000***	***$ 504,000***
NPV	$ 3,132,000	$ 615,000	$ 3,430,000	$ 3,586,000	***$ 7,177,000***	***$ 7,333,000***

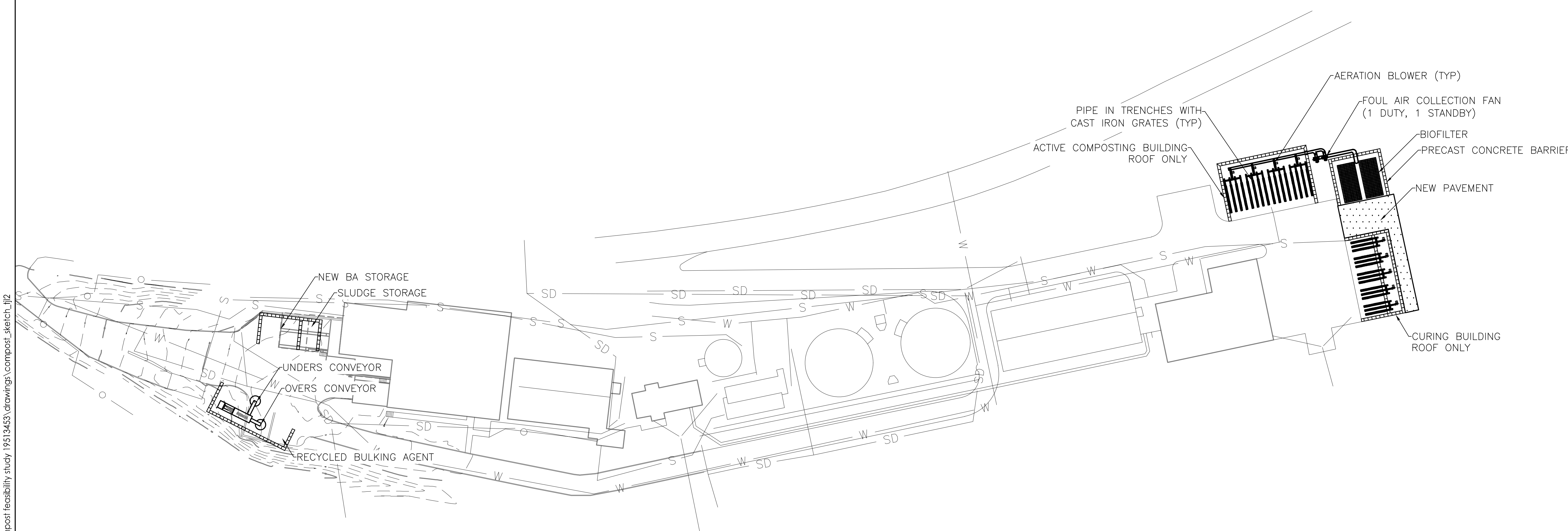
Table 8-6: Annual costs and Net Present Value for a 10 dry ton per week facility at Sandy Lane

	Capital		O&M		Total	
	Construction	Mobile Equipment	With Revenue	Without Revenue	With Revenue	Without Revenue
Cost	$ 4,965,000	$ 615,000	$ 194,000	$ 452,000		
Interest Discount Rate	2.5%	3.0%	2.5%	2.5%		
Term (years)	20	10	20	20		
Annualized cost	$ 319,000	$ 73,000	$ 194,000	$ 452,000	***$ 585,000***	***$ 844,000***
NPV	$ 4,965,000	$ 615,000	$ 3,025,000	$7,047,000	***$8,605,000***	***$ 12,627,000***

Appendices to follow:

A.1 Figure 1: Site Layout at WWTP
A.2 Figure 2: Site Layout at Sandy Lane
A.3 Figure 3: Cross Section of Active Composting Building
A.4 Figure 4: Cross Section of Curing Building
A.5 Figure 5: Cross Section of Biofilter

APPENDIX A



MONTAGUE WWTP COMPOSTING - SITE PLAN

SCALE : 1" = 75'

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Client/Project
Town of Montague

BIOSOIDS COMPOSTING

Project No.
195113453

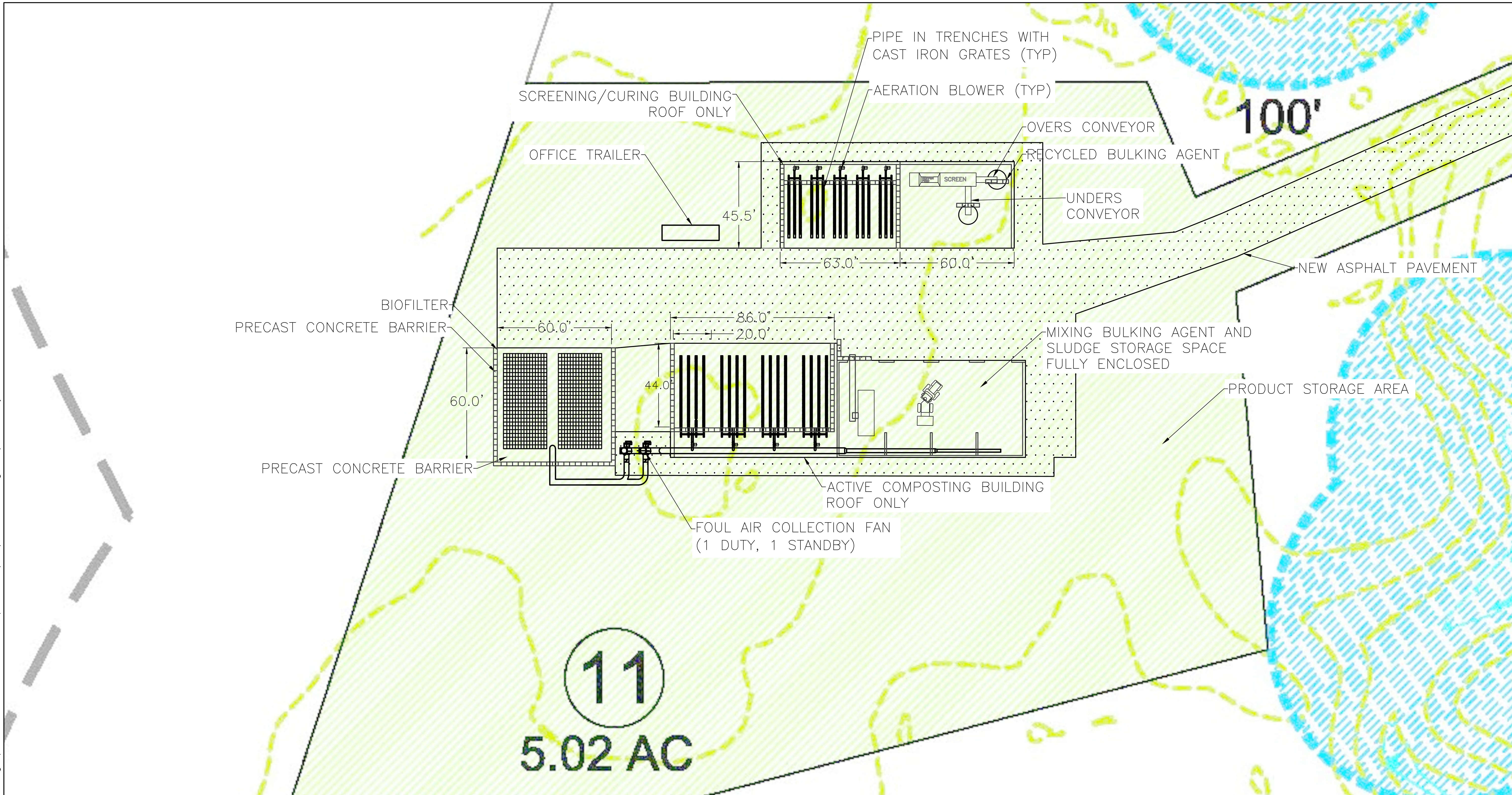
Title
MONTAGUE TREATMENT PLANT SITE
MONTAGUE WASTE

Revision

Date
12.2021

Reference Sheet

Figure No.
A-1



SANDY LANE COMPOSTING - SITE PLAN
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Project No.
195113453

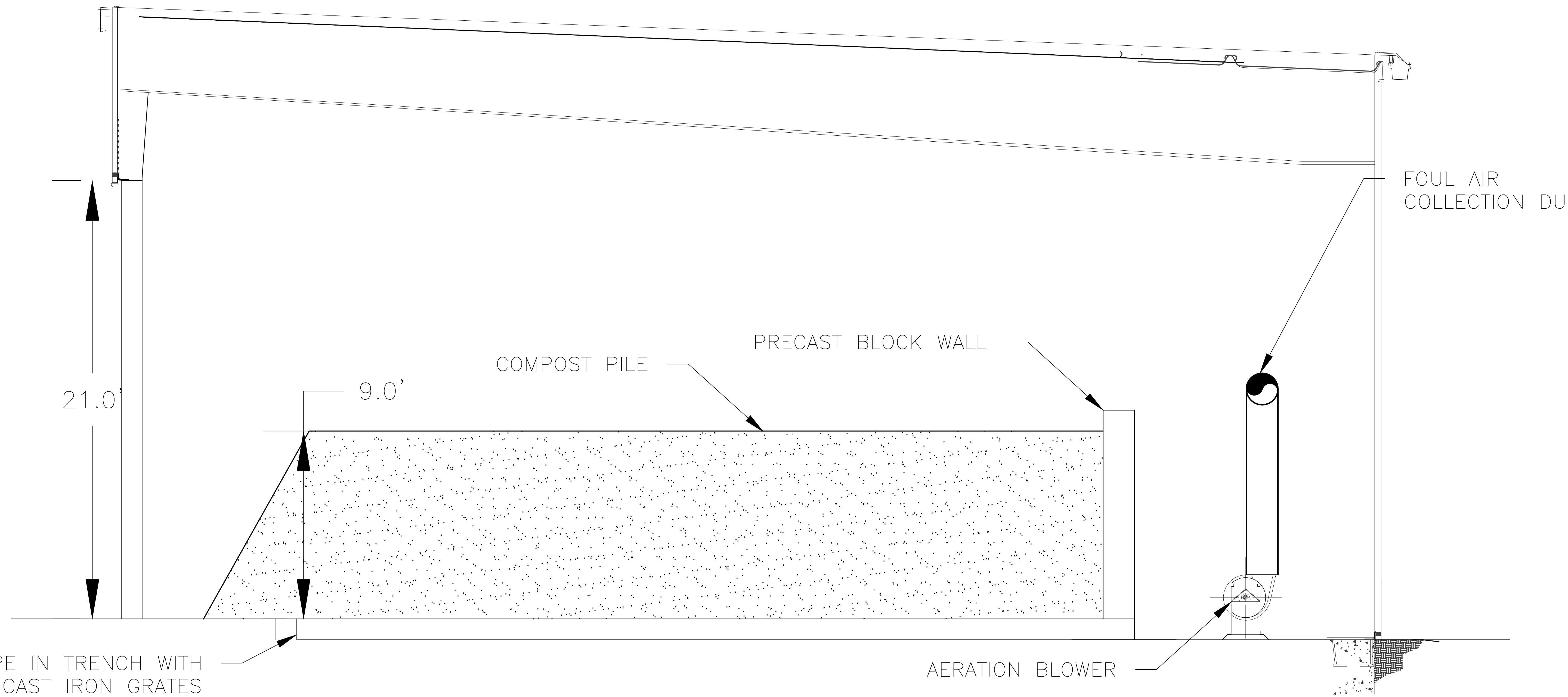
Title
SANDY LANE SITE
MONTAGUE AND FRANKLIN COUNTY WASTE

Revision

Date
12.2021

Reference Sheet

Figure No.
A-2



SANDY LANE COMPOSTING BUILDING - SECTION VIEW
SCALE : 1" = 5'

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SANDY LANE SITE
BIOSOIDS COMPOSTING

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Title
COMPOSTING BUILDING
SECTION

Revision

Date
12.2021

Reference Sheet

Figure No.
A-3

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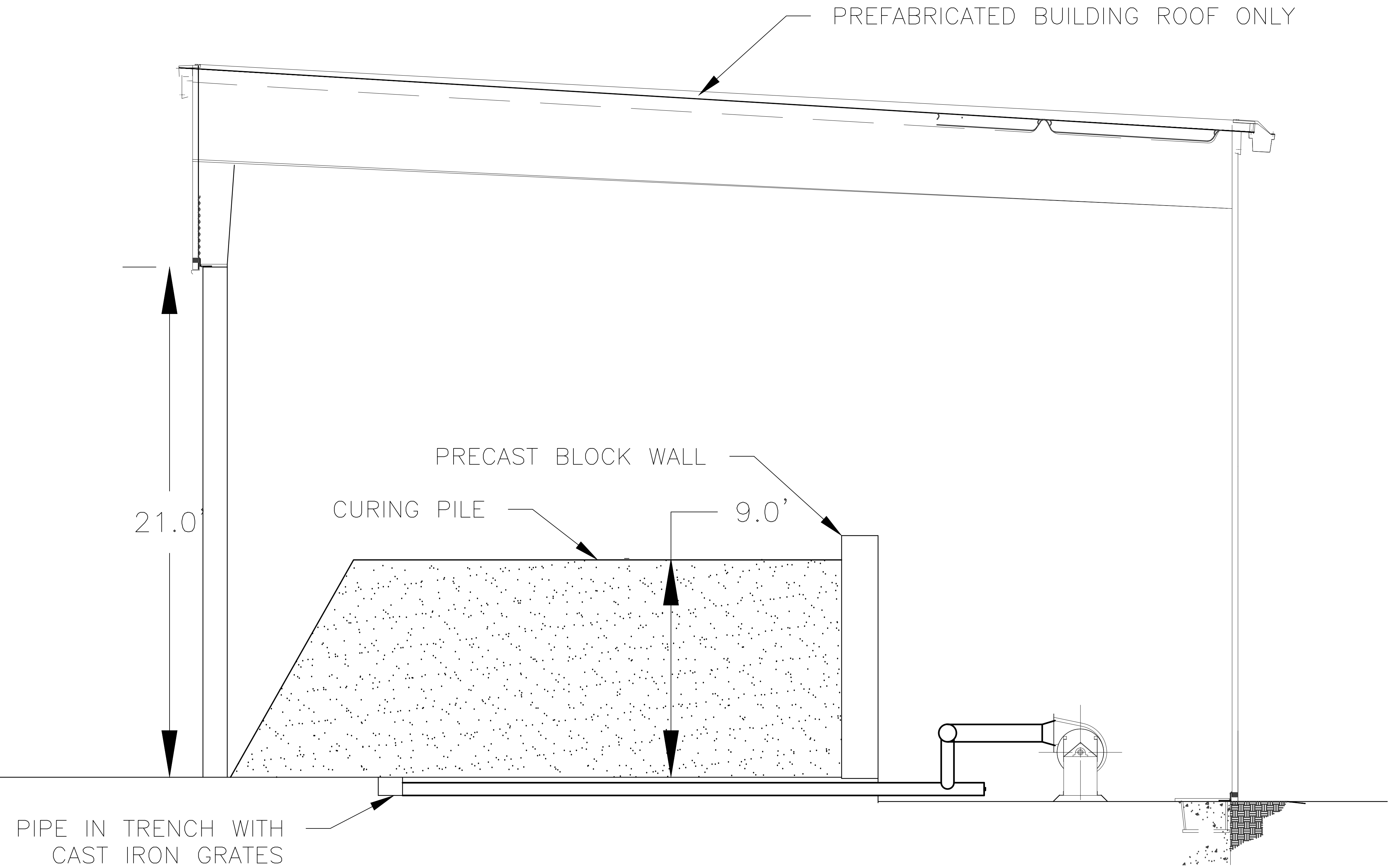

SANDY LANE CURING BUILDING - SECTION VIEW
SCALE : 1" = 5'

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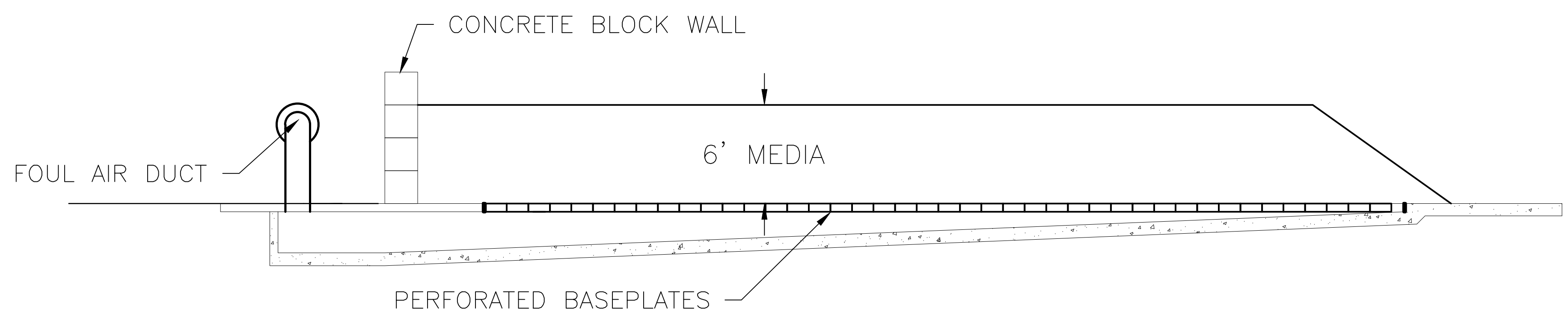
Title
CURING BUILDING SECTION

Revision

Date
12.2021

Reference Sheet

Figure No.
A-4



SANDY LANE COMPOSTING SITE - BIOFILTER SECTION
SCALE : 1" = 10'

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Title
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Revision

Date
12.2021

Reference Sheet

Figure No.
A-5