New York State
Pollution Prevention Institute

# New York State Pollution Prevention Institute

RIT Golisano Institute for Sustainability

*Feasibility Study for:*

## *Village of Rhinebeck*

***Rhinebeck, NY***

## Composting Alternatives Assessment and Feasibility Study

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## Executive Summary

The Village of Rhinebeck (the Village) in the Town of Rhinebeck (the Town) is located in Duchess County, in the Hudson Valley region of New York State. The Village has done a significant amount of work to reduce its environmental footprint, including achieving bronze level certification through the Climate Smart Communities (CSC) program. The Village has been interested in implementing a composting program for a number of years and, while the Village has been involved and even led past efforts to implement a composting program, a program has not yet been implemented. This is in part because some critical pieces of information were still missing to be able to adequately weigh the various composting options and make a decision that would meet the needs of the Village.

To address this information gap, the New York State Pollution Prevention Institute (NYSP2I) at Rochester Institute of Technology (RIT) worked with the Village of Rhinebeck to conduct a composting feasibility study over the course of several months in 2021. The objective of this work was to define and compare several composting options so that the Village could make an informed decision regarding which option to implement.

In collaboration with the Village, NYSP2I helped to define a goal statement for the Village composting program, estimate food waste volumes and available composting feedstocks for a composting pilot, conduct an assessment of alternatives, engage with stakeholders, and benchmark the financial structures of existing composting programs.

Based on a target of 100 households and approximately 5 businesses to be early adopters of a composting pilot program, it was determined that the Village should expect approximately 1.7 tons per week of food scraps as part of a pilot program. It was also determined that, if the material is stockpiled, the existing yard waste mulching program should be able to provide the necessary bulking agent or carbon source for composting the expected pilot food waste volume.

Five composting options were considered as part of the feasibility study: municipal in-vessel composting, municipal windrow composting, municipal 3-bay composting, municipal aerated static pile (ASP) composting and third-party composting. The assessment considered several factors when comparing these five options in terms of their feasibility for meeting the needs of the Village, including their cost, their greenhouse gas (GHG) impact, whether or not they were

appropriately sized, what the level of access to finished compost would be, and what types of food scraps each alternative could reliably accept. The alternatives ranged in average cost, with ASP being the least expensive on average and in-vessel being the most expensive options on average. However, with many variables to consider, there is opportunity to control costs associated with any of the options to bring them into comparable range with the others. While each of the options could accept all types of food scraps at their optimal operational size, ASP, in-vessel, and 3rd party composting would be able to do so at the size expected for the Village pilot program. Of these, ASP and third-party would be the easiest to scale when and if the pilot expands to include more households or businesses.

Financial structures of existing programs were also researched and summarized as part of this effort. The most common program types were focused on supporting residents, and were formed with public-private partnerships which provided more options for structuring based on community needs and private service offerings. While all options have their pros and cons, what seems to be the most viable is a municipal run drop off program or a public-private drop off program. Curbside collection, without the addition of grant funds and a high confidence in participation rates, can be a challenging first step. Municipal programs that support commercial businesses were also identified. There are fewer examples to note, mostly from larger communities. However, some of the key aspects may be scalable to fit into the Village's program strategy.

In summary, the study determined that there are several feasible options for implementing a composting program within the Village of Rhinebeck. While some options meet more of the requirements than others, each of the options has benefits and draw backs associated with it. Now that the comparative information has been summarized through this effort, next steps should include internal discussions among decision makers to determine which factors (e.g., cost, convenience, timeline to implement) have the most weight and therefore which option should be implemented in the Village of Rhinebeck.

## Introduction

The Village of Rhinebeck (the Village) in the Town of Rhinebeck (the Town) is located in Duchess County, in the Hudson Valley region of New York State. The Village has done a significant amount of work to reduce its environmental footprint, including achieving bronze level certification through

the Climate Smart Communities (CSC) program. Several pertinent groups have been established to tackle environmental issues, including the joint Town and Village Environmental Committee, a collaborative effort between the Town and Village, and the CSC Task Force, which includes a Food Waste/Composting subcommittee. The Village has also gained the support of the mayor for their efforts to keep food waste out of landfill. The Village has determined that the next step in reducing their environmental footprint is to implement a food waste composting program.

The New York State Pollution Prevention Institute (NYSP2I) was contracted to support the CSC Task Force by collaborating on a feasibility study for establishing a food waste composting program. NYSP2I, sponsored by the Department of Environmental Conservation (NYSDEC) through the Environmental Protection Fund, offers businesses, municipalities, and community organizations resources and solutions for pollution prevention, including identifying practical, cost-effective solutions for diverting, preventing, and managing food waste.

The objective of this feasibility study is to assess the key attributes of implementing a composting program in the Village. Study elements include:

- a baseline state of food waste efforts and knowledge in the Village
- a summary of stakeholder engagement
- an assessment of alternative program options
- a summary of financial models

## Background

### *Program Goal*

Establishing a program goal enables the Village to have a statement that is agreed upon by the program leadership, which can ground all actions moving forward. It sets the intention that the team will build on for planning and strategy development. It is also a concise statement to use when communicating with stakeholders so they understand the program direction.

Leveraging a template provided by NYSP2I from its Toolkit for Building a Municipal Food Waste Strategy[1], the project team brainstormed ideas for the larger strategic initiative, target populations, region, food waste tactics (e.g., community composting), and desired outcomes for the food waste

composting program. A series of goals were drafted and refined before the following was solidified and approved.

The following goal statement was finalized by Rhinebeck and signed off on by Village of Rhinebeck Mayor Gary Basset:

> As part of its climate smart efforts, the Village of Rhinebeck will develop an engaging and effective public food scrap diversion program that reduces greenhouse gases at landfills and builds healthy soil—ultimately becoming a model for others in our region.

## *Program Baseline*

Before assessing the feasibility of food scrap diversion options to help Rhinebeck accomplish its goal, information about the local and regional context was gathered, including reviewing prior local efforts to implement a food scrap diversion program. Past local efforts include work conducted by Dutchess County in 2017 through an organics recycling study, prepared by Cornell Cooperative Extension of Dutchess County[2] with help from a steering committee, as well as a joint environmental task force between the Village and Town of Rhinebeck, Village and Town of Red Hook and Village of Tivoli in 2018.[3] The Village Mayor was engaged as one of the committee members. The Village also conducted a food waste reduction education campaign through the Climate Smart Communities program.[3] A survey of residents was also conducted as part of the past efforts. While the survey encompassed feedback from Red Hook, Tivoli, and Rhinebeck, there was a significant (39%) response rate from Rhinebeck residents. One of the key takeaways from the survey was that residents were interested in food waste collection, but are sensitive to price. The majority would prefer to forego the convenience of a paid curbside pickup program and use the low to no cost drop off program. One thing to note is that the survey was voluntary and as such may have been skewed toward residents who already care about food waste prevention and diversion.

Through the baselining activity, it became evident that the Village's feasibility study is not the first venture into assessing opportunities for food scraps recycling. Although there is demonstrated interest in a program from municipal leadership, businesses and residents, past efforts have not led to implementation. There may be a variety of reasons for this. Based on the information readily

available, it appears that gaps in infrastructure (food scraps collection as well as recycling outlets), anticipated costs for consumers or businesses, and inconsistent project leadership to carry momentum forward may have been some leading causes. Additionally, there may have been a lack of expertise to translate the community compost concepts into an operational program.

Contextual awareness about past efforts towards establishing a food scraps diversion program for Rhinebeck and the surrounding areas was valuable. Since some baseline research and stakeholder engagement had already been performed, the project team was able to move more quickly into the practical aspects of the project and focus on some of the gaps identified in the earlier work.

## Stakeholders and Participants

### *Stakeholder Engagement Process*

There are three main groups of stakeholders involved in any given project or initiative, which NYSP2I refers to as 'core', 'connected', and 'external' stakeholders. Core stakeholders play a fundamental role in designing and realizing a plan. They are typically influential decision-makers within a community, including legislators and community leaders. Core stakeholders are typically engaged first as their buy-in is critical to a program's success. Connected stakeholders are not only affected by a given plan, they are also involved in carrying it out. Connected stakeholders can and should provide valuable insight into the executability and other nuances related to implementing a program. For example, connected stakeholders may be participants in a pilot. External stakeholders are likely to be people, groups, or other organizations within the community who will be affected by the food waste plan, but won't be active participants.

As part of conducing this assessment effort, NYSP2I facilitated engagement with core and connected stakeholders, building upon past efforts already completed by the Village. Through past efforts, including outreach and surveys, the Village had previously engaged some core and connected stakeholders, including Mayor Basset, as well as many residents. This stakeholder engagement process sought to build upon that past work to identify and engage additional core and connected stakeholders. Because previous work had focused on outreach to Village residents, new stakeholder engagement focused on engaging remaining core stakeholders and

businesses that were identified as possible early participants in a composting pilot. Working closely with compost subcommittee members, a list of over 40 stakeholders was compiled and organized to identify which should be contacted as possible core and connected stakeholders. Table 1 shows the stakeholders that were engaged as part of the assessment. As the highway department staff would be involved in operating a municipally-run program, a meeting was held to discuss the composting options being considered, what their potential role would be, what equipment and assets would be available for use in a compost program, and to understand what their questions and concerns were. Staff from the wastewater treatment plant also attended, as there has been interest in a biosolids composting program in the past as well. Several local businesses were identified by the composting subcommittee as possible early adopters or participants in a composting pilot program, and outreach was done to these businesses to gauge initial interest and, if initial interest was shown, to discuss pilot participation in more detail and to understand their questions and concerns. An informational letter was written and sent to businesses first to share information on the request and then subsequent discussions were held over the phone or on Zoom.

*Table 1: Summary of stakeholders contacted who showed support for a Village composting program.*

| Stakeholder | Stakeholder Type | Role |
|---|---|---|
| Mayor Basset | Core | Public supporter |
| Highway Department | Core | Possible compost site operator |
| Wastewater Treatment Plant | Core | Possible future partner, should bio solids be included |
| The OZone | Core | Possible partner for 3rd party composting |
| Terrapin | Connected | Possible early adopter |
| Sunflower Market | Connected | Possible early adopter |
| Business 1 | Connected | Possible early adopter |
| Business 2 | Connected | Possible early adopter |
| Business 3 | Connected | Possible early adopter |
| Business 4 | Connected | Possible early adopter |

## *Stakeholder Feedback*

The following two subsections summarize the key takeaways from the stakeholder engagement from the core and connected stakeholders.

### *Core Stakeholder Feedback - Highway Department and Wastewater Treatment Plant*

General feedback from highway department and wastewater treatment plant staff regarding the possibility of a municipally-run program was positive. There was lively discussion regarding the possibility of composting both food scraps and biosolids if a municipally run program was operated. Key takeaways from this discussion included:

- Highway department staff were generally open to the possibility of operating a composting site at the highway department land.
- Wastewater treatment plant staff were very interested in implementing a composting process to manage biosolids onsite. This would eliminate current disposal cost for biosolids, and provide an available resource (compost) to the Village.
- There is a significant amount (approximately 250 cubic yards annually) of yard waste currently collected as part of the yard waste mulching program that could be used as a feedstock in a composting program.
- If biosolids and food scraps are to be composted, then this should be done on site at the wastewater treatment plant, to eliminate the need for moving biosolids offsite.
- There are two possible composting sites available – one each at the highway garage and the wastewater treatment plant. The highway department land is more easily accessible in the near term.
- The highway department has several pieces of equipment that could be used for compost site operation, including a bobcat, and two front loaders
- Ease of operation and odor control were identified as two priorities

### *Connected Stakeholder Feedback - Food Service Businesses*

General feedback from the businesses that were contacted as part of the stakeholder engagement process was largely positive. An effort was made to identify businesses that may be willing to be early adopters of a pilot program, including providing feedback and working with municipal staff to provide feedback and adjust behavior as the pilot program gets off the ground.

Separate conversations were held with the six businesses listed in Table 1. The following summarizes the overlapping themes and key takeaways:

- Most restaurants said that it would be important to be able to compost all food scraps (including meats and dairy).
- Businesses liked the idea of having some sort of public display of their participation, and would welcome the opportunity to share their participation with their client base and other businesses.
- Having rolling bins with well-sealed lids was an important requirement for storing food scraps on site.
- Most businesses said they would like to see food scraps being collected on at least a weekly schedule.
- Generally businesses accepted the idea of paying to participate in the composting program, but said that costs would need to be comparable to their current trash hauling rates.
- Landlords would need to be engaged and on board in many cases for businesses to be able to participate.

## *Stakeholder Data Collection: Waste Estimates*

To be able to assess composting options for the Village of Rhinebeck, an estimate of the amount of food scraps that would be included in a pilot program had to be developed. Food waste generation was estimated by first defining and quantifying the target population for a future composting program, and then applying multiple established estimation factors to determine a range of food waste generation that could be expected. Rhinebeck defined their target population as residents and businesses in the Village of Rhinebeck. Using the United States Census Bureau website, the population of the Village of Rhinebeck was determined to be 2,570, and the number of households was 1,269. Next, estimation factors were identified and applied to the population and household data for Rhinebeck. NYSP2I estimated that the residents of Rhinebeck generate between 4.2 – 5.9 tons of food waste each week, based on the following three food waste generation factors:

- 8.7 lbs/household/week[4]
- 238 lbs/person/year [5]
- 4.2 tons/week[6]

Utilizing the sources gathered in the initial baseline activity, an estimate of participation rates was developed based on pilot programs of neighboring municipalities operating at the same scale as Rhinebeck. The anticipated rate of participation was 10% of households, approximately 100 households, being mindful that it is a conservative estimate and there will be opportunity to increase participation after implementation of a successful pilot program.

A subset of businesses was also identified as possible pilot participants, as described in a previous section and summarized in Table 1. NYSP2I calculated the approximate food waste generated from businesses that Rhinebeck identified. Food waste estimates for local businesses were generated from information available directly through NYSP2I's Organic Resource Locator tool, information from the websites of the businesses, and use of D&B Hoovers database. NYSP2I applied well-researched and widely recognized conversion factors listed on its website for these calculations.

A bulking agent, or carbon source is another integral part of the composting process. Because the Village of Rhinebeck currently operates a yard waste mulching program, information from this program was used to estimate the amount of bulking agent that would be available for use in a compost program. Based on data collected in the 2017-2018 fiscal year, approximately 650 cubic yards of mulch were produced from the yard waste program. Table 2 summarizes the expected amounts of food scraps and finished mulch in terms of mass (tons) and volume (cubic yards).

*Table 2: Estimated mass and volume of possible feed stocks for Village of Rhinebeck composting pilot*

| Description | ton/week | yd3/week | ton/yr | yd3/yr |
|---|---|---|---|---|
| Residential food scraps | 0.4 | 1 | 21 | 52 |
| Commercial food scraps | 1.3 | 3 | 68 | 156 |

| Description | ton/week | yd3/week | ton/yr | yd3/yr |
|---|---|---|---|---|
| Mulch | 3.8 | 13 | 195 | 650 |
| **Total** | **8.9** | **17** | **284** | **858** |

Biosolids were also discussed as a possible feedstock for a future composting program. While biosolids are mentioned in the alternatives assessment discussion where applicable, they were not a core component of the assessment. Biosolids composting is something that the municipal staff were interested in pursuing and it should be considered in the future. It was understood that biosolids composting would not be implemented as soon as food scrap composting. It is important to note that wastewater treatment plant (WWTP) staff estimated approximately 40 cubic yards of biosolids are produced every two weeks, which would translate to approximately 520 cubic yards of biosolids produced on an annual basis. This volume potenially will change if the biosolids dewatering process is adjusted to remove more moisture.

## Alternatives Assessment

### *Assessment Process*

An assessment of five possible composting program options for the Village of Rhinebeck was completed, and is summarized in the following sections. The objective of this assessment was to provide the necessary information on composting options to the Village of Rhinebeck so that they can make an educated decision about which option to choose.

To define an appropriate scope of the assessment, NYSP2I met with the Village's composting subcommittee to determine 1) the specific composting options that should be included in the assessment 2) the deciding factors that would be used to determine the best alternative for Rhinebeck and 3) a list of other considerations to include, information that would be informative but not necessarily be factors in the final decision. The deciding factors comprise the bulk of the information collected and summarized for each option. The other considerations are discussed in the narrative as applicable. The lists of composting options, deciding factors, and other considerations suggested by NYSP2I and finalized in collaboration with the Village are as follows:

*Table 3: Assessment considerations*

| Composting Options | Deciding Factors | Other Considerations |
|---|---|---|
| • In-vessel composting<br>• Windrow composting<br>• Aerated static pile (ASP) composting<br>• Three-bay composting<br>• Third party composting | • Cost to municipality<br>• GHG impact*<br>• Appropriate size<br>• Level of access to finished compost<br>• Possibility of community participation<br>• Acceptable types of food scraps | • Ease of use by participants<br>• Access to program<br>• Logistical complexity<br>• Level of opportunity for engagement and education<br>• Need for volunteers or other labor<br>• Timeline to implement<br>• Ability to expand the program |

*Note: differences in GHG impact of the options considered were negligible at the level of analysis done. See GHG impact section for more information.

## *Greenhouse Gas Impact*

Rhinebeck was interested in understanding the relative greenhouse gas impacts of the different composting options being assessed. As the options differ in terms of operational energy usage and transportation requirements, it was important to Rhinebeck to ensure that the greenhouse gas impact reductions of composting food waste were not outweighed by impacts of transporting food waste or operating composting equipment. The US EPA Waste Reduction Model (WARM) was used to evaluate this. The WARM tool allows users to compare the relative GHG impacts of alternative material management pathways. In this case, the tool was used to estimate the GHG impacts of landfilling food scraps with that of composting food scraps. The comparison was done based on 88 tons per year of food waste, which was based on the projected pilot food waste collection rate of 1.7 tons per week (Table 2). Transportation distances of 255 miles for landfilling

and 14 miles for composting were included in the model. The average transportation distance to landfill from the Organics Recycling Study for Dutchess County (Figure 1) was used. The transportation distance to compost was the average distance from the Village to three third party compost sites: Greig Farm, Ulster County Resource Recovery Agency (UCRRA), and McEnroe Organic Farm. Within the WARM tool, both scenarios (landfilling and composting) include and exclude various aspects to generate a net emissions factor used for the GHG emissions estimate. A summary follows of the key aspects included for landfilling and composting:

The WARM landfilling net emissions factor includes:

- Transportation to landfill
- Landfill methane
- Avoided CO2 from energy recovery
- Landfill carbon sequestration

The WARM composting net emissions factor includes:

- Transportation and turning of compost
- Fugitive emissions
- Fertilizer offset
- Soil carbon storage

The WARM tool estimated that landfilling 88 tons of food scraps per year generates approximately 47.2 MT CO2e, while composting the same sequesters approximately 10.3 MT CO2e. Therefore, the overall greenhouse gas reduction associated with composting 88 tons of food scraps annually is approximately 57 MT CO2e each year. An important finding to note for the Village is that transportation comprises a relatively small (<10%) percentage of the overall impacts of landfilling food waste, even if that food waste is shipped over 200 miles for disposal. Conversely, the transportation impacts associated with composting the food scraps locally are nearly negligible, as can be seen in Figure 2. This analysis provided the assurance that, should the Village choose to use a local third party composter, the GHG emissions associated with transportation to that third party will not outweigh the GHG emissions reduction inherent to composting those food scraps.

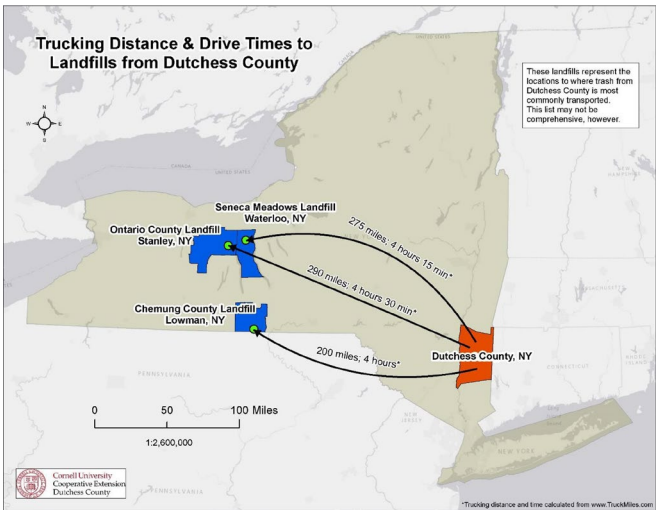


*Figure 1: Transportation distances from Dutchess County to 3 area landfills*

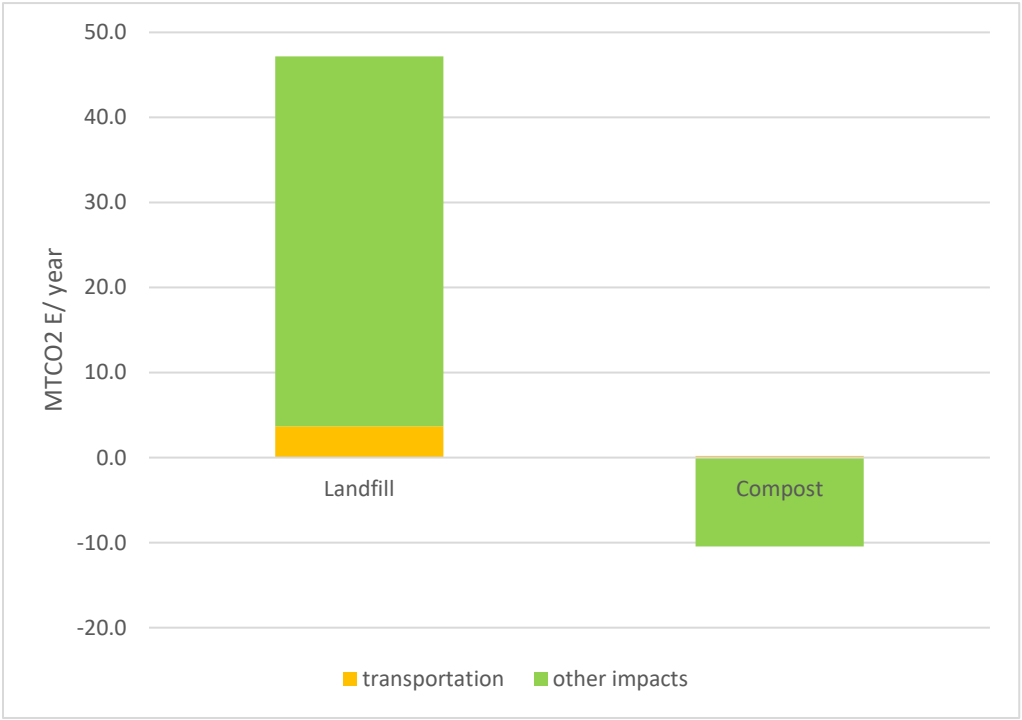


*Figure 2: Greenhouse gas impacts of landfilling and composting 88 tons of food waste*

## *In-vessel Composting*

### *Description and Requirements*

In-vessel composters are pieces of equipment that compost organic material inside a container or "vessel". Because of their design, in vessel systems tend to require a smaller footprint than most of the other composting options. However, they typically require more site specifications, often including electrical hook up (e.g., 220V, 3P) or plumbed drainage or both. In-vessel composters also tend to provide some level of operational automation as compared to other composting options. Depending on the specific equipment, in-vessel composters can include very low levels of automation or be almost entirely automated. The costs of the equipment roughly correlate to the level of automation, with more automated units being more expensive. Labor requirements are generally for loading and unloading the machine, with very little labor needed to manage the material once inside the vessel. Staff would be responsible for loading the proper amount of food scraps and carbon source into the machine, as well as moving output material to a curing pile as needed. Most in-vessel systems tend to work best when used in a 'continuous feed' manner, so it should be expected that staff would be needed for approximately a half hour daily to put new material into the vessel. This differs from other composting methods that usually operate more as 'batch systems' with a new pile being built every few days to every week.

### *Scalability and Acceptable Materials*

Due to the contained nature of in-vessel systems, they can be difficult or expensive to scale or both. Scaling beyond the capacity of the initial piece of equipment requires either replacement of the equipment with a larger model or purchase of an additional unit to be used in conjunction with the first. In-vessel systems are therefore often used for lower volume programs, the needs of which can be met with one or two units, and that don't expect to undergo rapid expansion.

Because the composting process happens within a vessel, in-vessel systems are typically able to reach and maintain high temperatures that would otherwise require a larger amount of material to reach. Because of this, in-vessel systems generally are able to accept meat and dairy products regardless of the volume of material being composted. As with any compost system, a supply of a bulking agent (i.e., carbon source or "browns") must be available and incorporated into the system. The ratio depends on the unit used and the nature of the food scraps, but many require

at least a 1:1 ratio of food scraps to bulking agent by volume. Yard waste from the Rhinebeck yard waste mulching program would be an acceptable carbon source for most of the in-vessel units, but would need to be chipped before being suitable to incorporate, as larger pieces of branches etc. could cause the equipment to jam.

*Figure 3: Examples of in-vessel compost systems [7,8]*

*Table 4: Pros and cons of in-vessel composting*

| Pros | Cons |
|---|---|
| • High amount of control over process and the output material<br>• Semi – fully automated<br>• Insulated<br>• Odor containment<br>• Faster processing time<br>• Can accept all types of food scraps<br>• Relatively small footprint | • High capital expense<br>• Ongoing maintenance<br>• More of an ongoing staffing need<br>• More difficult and expensive to scale<br>• May or may not use available yard waste (depends on machine)<br>• May require more site preparation (e.g., electrical and plumbing) |

*Table 5: projected costs of in-vessel composting of 1.7 tons per week food scraps*

*Capital costs are amortized over 10 years at 3.5% interest rate unless otherwise noted.

| Description | Cost | Units | Number/ Year | Annual Cost * | Notes |
|---|---|---|---|---|---|
| Capital costs | $62,000-$183,000 | ea. | 1 | $613-$1,809 | Includes all capital costs shown in italics in the following rows |
| *In vessel composter* | *$62,000-$180,000* | *ea.* | *1* | *N/A* | *Varies depending on capacity, and level of automation and self- monitoring included.* |
| *Shelter* | *$1,000-$3,000* | *ea.* | *1* | *N/A* | *Optional, but nice to have in winter months especially. Shelter can range from just a roof to a partially or fully enclosed space.* |
| Wood chips / shavings | $4.50- $6.50 | yd. | 0-100 | $0-$650 | Yard waste may need to be supplemented during some parts of the year. |

| Description | Cost | Units | Number/ Year | Annual Cost * | Notes |
|---|---|---|---|---|---|
| Operation and maintenance | $20-$30 | hr. | 130 | $2,600 - $3,900 | Most systems require at least 0.5 hr. a day to load and unload the machine. Assumes 5 day work week year round. |
| Electricity use | $0.14 | kWh | 0 - 17,000 | $0 - $2,380 | Energy usage varies by machine. Energy usage taken from spec sheets for appropriately sized units for 1-2 tons/week food scraps. Electricity cost is NYS average at time of report. |
| Food scrap collection | $20-$30 | hr. | 52 | $1,040- $1,560 | Assumes 1X weekly pick up of food scraps, 1 hr. per pick up. |
| **Total Annual Cost - Y1-10** | | | | **$4,253 - $10,949** | |
| **Total Annual Cost - Y10+** | | | | **$3,940 - $9,140** | |
| **Total Cost – 30 Yr.** | | | | **$121,330- $292,290** | |

## *Three-Bay System*

### *Description and Requirements*

A three-bay (or three-bin) compost system is a method of composting in which material is moved through different bays as it reaches different stages of the composting process. Moving material to the next bay serves to mix and oxygenate the pile, which is a necessary component of the composting process. The first bay serves as the starting bay, where food scraps are combined with a carbon source (e.g., wood chips) and where the initial composting phase occurs. Once internal temperatures start to rise, material is turned into the second bay for the main decomposition phase. Last, the material is turned into the third bay, where it starts the cooling process. It may stay in this bay or be stored in a separate pile as it finishes the curing process.

These systems do not require any electrical hook-up or plumbed drainage. However, a flat surface with appropriate drainage for compost leachate is needed. A concrete pad, while not necessary, is often used. Labor requirements would include operating a skid steer or other front loader equipment once every couple weeks when the compost needs to be turned into the next bay. Ongoing maintenance would be related to maintaining the turning equipment (e.g., skid steer) and any repairs to bay walls.

### *Scalability and Acceptable Materials*

Three-bay systems are best suited for a small- to mid-range volumes of food scraps. The expected volume for the Village of Rhinebeck pilot (1 to 2 tons per week) is at the higher end of the range appropriate for a three bay system. Thus scaling the system beyond the initial capacity would entail either adding bays (rather than making larger bays), or transitioning to a composting system that is better suited for larger volumes (e.g., ASP or windrows).

The bay walls would provide some protection from the elements, which would help to maintain pile temperatures. If there are no large fluctuations in the food scraps volume that is expected, it is possible to compost meats and dairy in a three-bay system. However, if volume fluctuates or the pile is not monitored and turned properly, the pile may not reach and maintain temperatures needed to compost all types of food scraps safely. In addition, controlling odor depends in part on proper aeration (i.e., turning) of the compost pile. While biosolids could technically be composted

using a three-bay system, the additional volume of the biosolids would put the total volume outside the range of what is appropriate for a three-bay system.

*Figure 4: Three-bay composting system*

*Table 6: Pros and cons of 3-bay composting*

| Pros | Cons |
|---|---|
| • High level of control over process and output material<br>• Inexpensive initial cost<br>• Semi-controlled footprint<br>• Would make use of existing yard waste | • Manual turning required<br>• More difficult to scale<br>• Possible limited feed stocks (at expected pilot volume)<br>• Proper management crucial for odor containment |

*Table 7: Projected costs of 3-bay composting of 1.7 tons per week food scraps*

*Capital costs are amortized over 10 years at 3.5% interest rate unless otherwise noted.

| Description | Cost | Units | No./Yr | Annual Cost* | Notes |
|---|---|---|---|---|---|
| Capital costs | $919-$2,191 | ea. | 1 | $98-$232 | Amortized over 1 yr. includes material costs shown in italics in the following rows |
| *Concrete blocks* | *$1.87* | *ea.* | *325-400* | *N/A* | *Based on a building 3 bays, each approximately 10ftx10ftx4ft* |
| *Mortar* | *$7.62* | *bag* | *28-32* | *N/A* | |
| *Temperature sensor* | *$100-$1,200* | *ea.* | *1* | *N/A* | *Options range based on durability and auto monitoring.* |
| *Construction labor* | *$20-30* | *hr.* | *12-18* | *N/A* | *May be able to be done by municipal staff, otherwise would need to be contracted out.* |
| Wood chips and shavings | $4.50-$6.50 | yd. | 0-100 | $0-$650 | Existing wood chips may need to be supplemented at times. |
| Operation and maintenance | $20-$30 | hr. | 104-156 | $1,040-$4,680 | Would need staff to turn and build piles approximately 1 time each week. Assumes 2-3 hours per turn or build. |

| Description | Cost | Units | No./Yr | Annual Cost* | Notes |
|---|---|---|---|---|---|
| Food scrap collection | $20-$30 | hr. | 52 | $1,040- $1,560 | Assumes 1 time weekly pick up of food scraps, 1 hour per pick up. |
| **Total Annual Cost – Year 1** | | | | **$2,178 - $7,122** | |
| **Total Annual Cost – Year 2+** | | | | **$2,080 - $6,890** | |
| **Total Cost – 30 Yr.** | | | | **$62,498- $206,932** | |

## *Windrow Composting*

### *Description and Requirements*

Windrow composting is a process of layering organic waste (e.g., food scraps and wood chips) into long piles (windrows). As in a three-bay system, compost is turned periodically, but instead of being stored in bays, it is formed into another windrow each time it is turned. The size and number of windrows depends on the frequency of food scrap collection, but there would be multiple windrows at various stages of the composting process at any given time. It is necessary to incorporate space in between the windrows to allow the use of turning equipment (e.g., skid steer). Thus windrows require more space than other composting options.

The windrows are often turned and moved using a skid steer or front loader, and labor would be required to operate this equipment both to build windrows (i.e., layer carbon source with food scraps), and to turn the piles and monitor them (e.g., measure internal temperature). A windrow turner can also be used to aerate the piles, although these are usually only cost effective on very large windrow operations and would not be appropriate for the Village's pilot scale.

### *Scalability and Acceptable Materials*

As windrows are not contained within a structure, they are one of the easiest composting methods to scale. This can be done by simply making a longer windrow or creating additional ones. While some smaller windrow operations are inside, windrow systems typically stand out in the elements,

usually uncovered, which means they rely on their own volume to maintain internal heat during the composting process. Therefore, while windrows can be used for composting at any scale, they are only able to process meats and dairy when they have adequate enough volume to maintain temperatures. Because of this, windrows would not be well suited for Rhinebeck's pilot scale composting program. If biosolids were included in the program, the overall volume of material would be more appropriately matched to windrow composting.


*Figure 5: Examples of windrow composting systems* [9,10]

*Table 8: Pros and Cons of windrow composting*

| Pros | Cons |
|---|---|
| • High level of control over the process and output material<br>• Easy to scale<br>• Lower capital expense<br>• Would make use of existing yard waste<br>• Customizable and flexible<br>• Low tech, fewer items to maintain | • Manual turning required<br>• Best suited for larger amounts of material<br>• Longer processing time<br>• Requires largest amount of space<br>• More difficult to fully or partially cover<br>• Limited feedstocks (at expected pilot volume)<br>• Proper management crucial for odor control |

*Table 9: Projected costs of windrow composting of 1.7 tons per week food scraps*

*Capital costs are amortized over 10 years at 3.5% interest rate unless otherwise noted

| Description | Cost | Units | Number/Year | Annual Cost* | Notes |
|---|---|---|---|---|---|
| Operation and maintenance | $20-$30 | hr. | 104-156 | $1,040-$4,680 | Would need staff to turn and build piles approximately 1 time each week. Assumes 2 to 3 hours per turn or build. |

| Description | Cost | Units | Number/Year | Annual Cost* | Notes |
|---|---|---|---|---|---|
| Temperature sensor | $100-$1,200 | ea. | N/A | N/A | Options range based on durability and auto monitoring. Not included in annual cost. |
| Food scrap collection | $20-$30 | hr. | 52 | $1,040-$1,560 | Assumes 1 time weekly pick up of food scraps, 1 hour per pick up. |
| **Total Annual Cost – Y1+** | | | | **$2,080-$6,240** | |
| **Total Cost – 30 Yr** | | | | **$62,400 - $187,200** | |

## *Aerated Static Pile (ASP)*

### *Description and Requirements*

Aerated static pile (ASP) composting is a method of composting that uses forced air to aerate the compost pile, rather than manual turning. Food scraps and other organics are layered on top of a single or a set of perforated pipes connected to a blower which either pushes or pulls air through the compost pile. ASP can be done at a variety of scales (i.e., approximately 2 cubic yards and up). The smaller systems are often semi-contained within a built bay or box (similar to a three-bay system), while larger systems look more like windrows with long piles out in the open. An electrical hookup is required for the blowers, but no plumbing is needed. As for any of the on-site options, proper site leveling and drainage would be needed to account for leachate. ASP composting consists of building a pile atop a system of perforated pipes, and then, after several weeks when the pile has finished composting, moving the finished compost into a curing pile

where it stays for several more weeks or months to finish curing. Because the aeration process happens via forced air and not manual turning, ASP composting requires significantly less labor than windrow and three-bay composting, and significantly less space than windrow composting.

*Scalability and Acceptable Materials*

The ASP method of composting lends itself well to scalability. For incremental increases in volume, piles can be extended and additional perforated pipe length added. For more significant increases in volume, additional blowers and pipe may need to be added to accommodate another pile. Because ASP systems do not rely on monitoring and manual turning to aerate the compost pile throughout its stages, it can provide a simpler option for ensuring the right temperatures are reached and maintained. This means that all food scraps could be accepted (i.e., meat, dairy, and vegetable), and that potential odor due to anaerobic conditions would be less likely to be a problem.

*Figure 6: Examples of ASP composting systems[11,12]*

*Table 10: Pros and cons of ASP composting*

| Pros | Cons |
|---|---|
| • High level of control over the process and output material<br>• Easy to scale | • Additional equipment (air pump) has to be maintained.<br>• Some capital expense required |

| Pros | Cons |
|---|---|
| • Relatively low capital expense<br>• Would make use of existing yard waste<br>• Customizable and flexible<br>• Limited turning required , low staffing need | • Logistical challenges of laying and removing pipes<br>• Pipe network needs to be updated as program grows |

*Table 11: Projected costs of ASP composting of 1.7 tons per week food scraps*

*Capital costs are amortized over 10 years at 3.5% interest rate unless otherwise noted

| Description | Cost | Units | No. /Year | Annual Cost* | Notes |
|---|---|---|---|---|---|
| Capital Expenses | $12,995-$19,995 | ea. | 1 | $128-$198 | Includes one-time costs shown in italics in the following rows. |
| *Training* | *$2,995-$4,995* | *ea.* | *1* | *N/A* | *Based on systems available through O2 Compost (commonly used ASP method)* |
| *Construction materials* | *$10,000-$15,000* | *ea.* | *1* | *N/A* | *Depends on whether a shelter is built or pipes are buried into ground or sit on top, or both.* |
| Operation and maintenance | $20-$30 | hr. | 52-104 | $1,040-$3,120 | Would need staff to build new pile approximately 1 1 time each week. Assumes 1 to 2 hours per build. |

| Description | Cost | Units | No. /Year | Annual Cost* | Notes |
|---|---|---|---|---|---|
| Food scrap collection | $20-$30 | hr. | 52 | $1,040-$1,560 | Assumes 1 time weekly pick up of food scraps, 1 hour per pick up. |
| **Total Annual Cost - Y1-10** | | | | **$2,208 – $4,878** | |
| **Total Annual Cost – Y11+** | | | | **$2,080 - $4,680** | |
| **Total Cost – 30 Yr.** | | | | **$63,680 - $142,380** | |

## *Third Party Composting*

### *Description and Requirements*

Third party composting is an option whereby food scraps are collected and brought to an existing compost or other food scrap recycling facility for recycling. The municipality would not be involved in operating the compost site, but would help to coordinate the collection of the food scraps and interface with the contracted company for payment etc. This option would require the least cost upfront and the least amount of municipal labor to operate. If Rhinebeck decided to consolidate food scrap collection, there might be a small space requirement for storing full bins of food scraps for pick up or before they are hauled to the recycling site.

### *Scalability and Acceptable Materials*

As this option depends on an existing food scraps recycling site to recycle the material, the scalability of the program as well as the material that can be accepted depends on the specific site that is contracted to recycle the food scraps. Two of the three area compost sites that were contacted would accept all types of food scraps (including meats and dairy), whereas one said they would limit the amount of meats and dairy accepted.

*Figure 7: Examples of Third party composting sites [13],[14]*

*Table 12: Pros and cons of third-party composting*

| Pros | Cons |
|---|---|
| • Lowest upfront cost<br>• Few or no additional resources needed<br>• Easier start up<br>• Feedstock flexibility<br>• Seasonal issues less likely | • Less visible to community members<br>• Less control over future costs<br>• No use for existing yard waste<br>• Higher ongoing costs<br>• More direct cost increase with food waste increase |

*Table 13: Projected costs of third party composting of 1.5 to 2 tons per week food scraps*

| Model | Description | Cost | Units | Number./ Year | Annual Cost | Notes |
|---|---|---|---|---|---|---|
| Self-haul | Tip fee | $20 | ton | 88- 104 | $1,760-$2,080 | If self-hauling, the cost that would be charged by the recycling company (i.e., "tip fee"). Based on one area tip fee quote. Second quote excluded due to being double the cost and distance. |
| Self-haul | Food scrap collection | $20-$30 | hr. | 104-156 | $2,080-$4,680 | Assumes 1 time weekly pick up of food scraps, 2-3 hours per pick up. Includes variations in transportation time. |
| Self-haul | Sub-total | | | | $3,840 - $6,760 | Varies widely depending on the cost of municipal hauling. |

| Model | Description | Cost | Units | Number./ Year | Annual Cost | Notes |
|---|---|---|---|---|---|---|
| Commercial hauler | Collection fee | $260-$310 | month | 12 | $3,120 – $3,720 | Commercial hauler fees include the 'tip fee' at the recycling site. Based on one local company quote. Variation due to possible fluctuations in food scrap amounts. |

### *General Equipment*

There are some equipment and costs that are common across all or most of the composting options described. Some of these costs are summarized here. Whether or not these costs are incurred depends on whether the Village chooses to operate the collection.

*Table 14: Common equipment and costs across composting options*

| Description | Cost | Unit | Notes |
|---|---|---|---|
| Bin tipper | $1,100- $2,000 | ea. | Useful if large bins will be used that cannot be tipped by hand. |
| Pressure washer | $250-$1,250 | ea. | Would be needed for bin washing. Varies depending on whether it is purchased used or new, and the durability of the washer. |

| Description | Cost | Unit | Notes |
|---|---|---|---|
| 32 gallon totes | $50-80 | ea. | Commonly used for commercial scale food scrap collection. Larger bins could be used, but are likely oversized based on the businesses that may participate in the pilot. |
| 4 gallon buckets | $5-10 | ea. | Commonly used for residential food scrap collection. |

### *Other considerations*

The previous sections summarized the findings related to the information the Village deemed to be deciding factors, and some of the other considerations as applicable (e.g., ability to expand, logistical complexity). In addition to these factors, there were other considerations that were important for the Village to understand. The opportunity for engagement and education through the composting program was one. With any of the alternatives assessed, there is opportunity for engaging and educating the community concerning composting and food waste reduction. The municipally run alternatives (i.e., in-vessel, 3-bay, ASP, windrow) would all provide relatively easy-to-access opportunities for members of the community to come and see the composting process in person. This type of in-person learning would be more difficult, but not impossible to achieve with a third party compost program. For example, many existing composting sites offer public tours. The Village could help to organize regular trips to a third party composter to provide the same type of in-person engagement. Another opportunity for community engagement and education is related to collection of food scraps. The two main models for collection are curbside collection and drop-off stations. Again, both provide some point of contact with the community and could become part of a learning opportunity in different ways. For example, if drop-off stations are staffed, staff could collect in-person feedback from participants when they come to drop off their food scraps, and participants could ask questions and discuss the program with staff. An educational booth could also be set up to operate in conjunction with the drop-off location. If drop-

off stations are not staffed, or a curbside collection model is implemented instead, the engagement opportunities may be more passive. For example, educational flyers could be distributed with clean bins, or educational posters could be posted at un-staffed drop-off locations. In summary, while the methods may vary, there are ample opportunities for education and engagement through any of the composting alternatives assessed.

### *Summary of Alternatives*

The alternatives assessment confirmed that there are multiple feasible options for implementing a composting program in the Village of Rhinebeck. Four municipally-run programs were considered as well as using a third party composting option. While the costs can vary widely depending on the specifics of each option (Figure 7), ASP composting may provide the lowest cost on average of the options, would be able to handle all types of food scraps at the Village's pilot volume, and is relatively simple to operate as compared to the other municipally-run options considered (i.e., in-vessel, windrow, 3-bay). Due to higher operational costs because of manual turning requirements, windrow and 3-bay composting are slightly more expensive than ASP composting on average but similar to one another in terms of average cost. However, they differ in other aspects. While a well-maintained 3-bay system may be able to handle all types of food scraps, it is likely that uncovered windrows may not be able to reach and maintain temperatures required for accepting all types of food scraps year round. Third party composting would provide the easiest scenario to implement as no municipal labor would be required to operate a compost site, and would be able to accommodate all types of food scraps. Depending on the third party option chosen, this option could be in the low-mid range of cost among the options assessed. In-vessel composting would entail the greatest amount of automation, but is also likely to be the most expensive option, and would require staff to input material on a continuous basis (every 1 to 2 days) rather than building piles more in-frequently (every 1 to 2 weeks). While the average costs are a useful way of comparing alternative composting options, it is important to note that the costs of each option can range significantly and do overlap with one another, as can be seen in Figure 7. For example, while in-vessel composting is the most expensive option on average, if the less expensive in-vessel unit were chosen, it is possible to operate an in-vessel system that is comparable in cost to any of the other options chosen. So, it will be important for the Village to refine the estimated costs provided in this study to determine true final costs based on the option chosen.

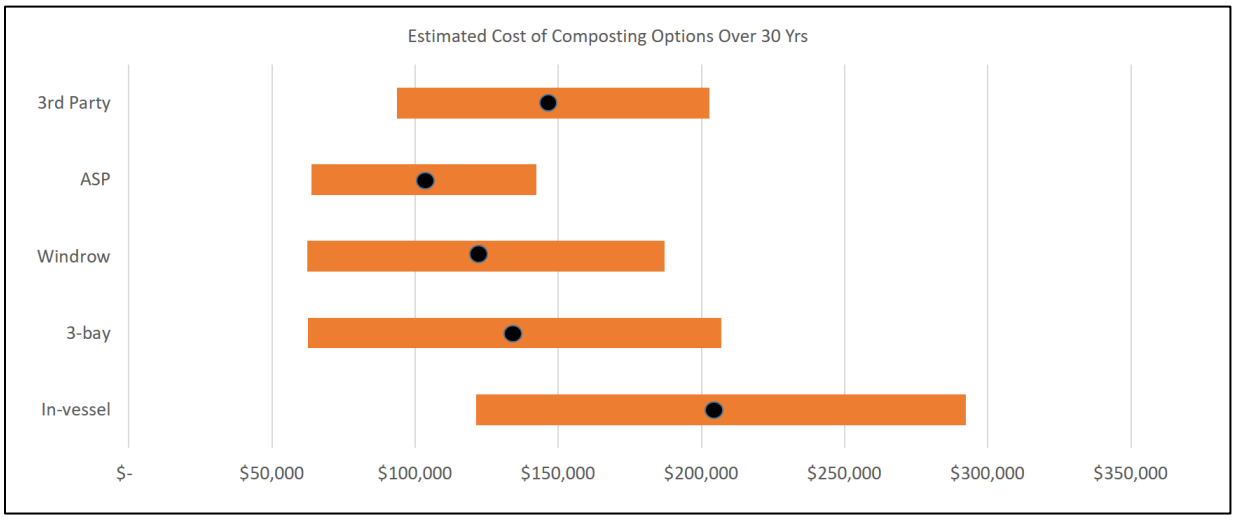


*Figure 8: Estimated 30 year cost of five composting alternatives assessed for the Village of Rhinebeck. Costs are based on composting 1.7 tons per week of food scraps.*

*Table 15: Summary of composting options by deciding factors. Ratings are given on a relative basis.*

| Deciding Factors | In-Vessel Composter | Windrow Composting | Static Aerated Pile | 3 Bay System | 3rd Party Composting | Notes |
|---|---|---|---|---|---|---|
| Cost | high | med | low | med | med | |
| GHG Impact* | med | low | med | low | med | Differences in GHG impact among the options are negligible in comparison to the GHG impact reduced by not landfilling the material. |
| Well suited for pilot size | yes | no | yes | maybe | yes | Determinations were made considering the pilot scale (1-2 tons/week) of food waste. Three-bay provides marginally more protection than windrow. |
| Level of Access to Finished Compost | high | high | high | high | low | Any municipally run program would have similar access to the finished compost. |
| Possibility of community participation | high | high | high | high | low | Any municipally run program would have similar access to the finished compost. |
| Able to handle all f types of food scraps | yes | maybe | yes | maybe | yes | Determination for windrow and three-bay would change if volume increased significantly. Pilot size is just on the cusp of large enough to accept all food scraps. |

## *Evaluation Process*

In parallel with assessing alternative mechanisms for managing Rhinebeck's food scraps, the project team researched the various means of financially structuring the program based on model programs identified. There are many residential programs across the U.S.[15] but not all are representative examples of how Rhinebeck may operate its program. Rhinebeck is a small municipality that does not manage, either through direct operation or third-party contract, its curbside trash collection. This is sometimes referred to as open hauling.

A large number of programs, including those in New York State, are either operated at the county level or have county-level support or incentives to facilitate the programs at the village or town level, e.g., Ulster County's composting facility provides area communities with a local outlet for their food scraps at a lower rate than landfill. Some communities also operate or have some type of control over residential trash pick-up which can be used as a financial incentive for residential participation in organics collection as well as help communities see a return on investment through lower trash tip fees.[16]

Although there are a large number of municipally-focused programs in operation across the U.S., a concerted effort was made to identify feasibility studies or municipal program descriptions that have similar community characteristics to Rhinebeck, i.e., small municipalities that do not manage, either through direct operation or third-party contract, curbside trash collection.

For each program identified, the following was documented:

- Community name
- Community type
- Background information, e.g., population and location
- Program description
- Costs passed on to participants
- Financial information
- Grant funding received as a part of starting, expanding, or operating the program

After a number of programs were documented, they were categorized by the type of partnership and funding attributes. These elements along with pros and cons were summarized in the table provided in Appendix A. A case study for each model type was also noted. The major findings from this table are summarized the next section.

## *Benchmarking*

### *Residential Participant Programs*

Residential facing food scraps recycling programs typically fall into one of two major categories, curbside collection or drop off spots. Programs of each type can be managed exclusively by local governments, privately, or by some combination of the two. Within each type, there are variations in the program attributes, which are described in more detail below.

The following program descriptions include the use case, description, description of municipal costs, and an example community program. Additional detail, including the pros and cons is provided in Appendix A. Not all community examples listed are perfectly parallel to Rhinebeck's program attributes (e.g., open hauling and community size) but the model type appears to be or has demonstrated to be a model that can be used in communities with characteristics similar to Rhinebeck.

Under either curbside or drop off programs, costs (including materials and labor) will be impacted by the handling and ownership of collection bins. There are two main options. One method is a bin swap where residents' bins are collected and replaced with a clean bin, typically emptied and washed at an offsite location. The alternative is to have the food scraps emptied and returned at the point of drop off or collection; residents are expected to reuse and maintain cleanliness of their bins. Some communities have bins for sale which they are able to offer at a discounted rate after buying from a distributer in bulk. Some programs require use of a particular bin (either available for purchase or rent) while others are allow use of any bin that meets the needs of each individual household.

Marketing is also a programmatic cost that is case-dependent, i.e., promoting a strictly privately operated drop-off program as opposed to actively recruiting participants in a curbside collection pilot run by the municipality. Marketing and promotions can include, but are not limited to, write-

ups in community newsletters, instructional videos, demonstrations, informational meetings, mailed flyers, window decals, yard signs and informational tables at community events.

Common food types accepted by each program type are highly dependent on the scale and equipment used and therefore could not be listed under program type descriptions. This information is covered in the alternatives assessment section.

*Publicly Operated Programs*

Publicly operated programs have into two main use cases applicable to Rhinebeck, drop off and curbside collection, shown in Table 16 that follows. In either situation, as indicated in the name, the municipality operates all aspects of the program, e.g., marketing, logistics, compost site management, etc. There were fewer examples of these types of programs identified. Sole management of a program introduces complexities but also has benefits including ability to design a program that best meets the community's needs, access to finished compost, and ability to host demonstrations and educational events.

In the curbside collection example, food scraps are collected with yard waste in a ride-along program. Communities do have programs where food scraps are not collected with yard waste, however, in this more specific case, costs incurred by the municipality are minimized because they are taking advantage of existing infrastructure and behaviors to add food scraps collection as a service.

*Table 16: Summary of publicly operated program models*

| Use Case | Description | Municipal Costs | Example(s) |
|---|---|---|---|
| Drop off | Residential drop off location at municipally operated composting site, use volunteers or staff to manage compost pile | - Marketing the program<br>- Depending on the structure of the program costs may include staff or volunteers to manage drop off locations, larger collection bins, infrastructure set up costs (e.g., signs, shroud for the bins.)<br>- Compost facility operational costs | Town of New Lebanon (Town) [17]<br>- Very small - bin system, unable to accept a wide variety of materials<br>- Free for residents<br>- Composting site at the local community garden |

| Use Case | Description | Municipal Costs | Example(s) |
|---|---|---|---|
| Curbside collection | Use existing equipment, labor and routing to collect food scraps along with yard waste | - Municipal resources to haul organics<br>- Truck modifications to collect food scraps<br>- Marketing the program | Kaneville Township, IL (Township)[18]<br>- Opt-in program operated by hauler<br>- $220 per season<br>Village of Mt Prospect, IL[19]<br>- No charge to residents if the household provides its own bin<br>- Operated seasonally |

*Public-Private Programs*

For communities similar to Rhinebeck, public-private partnerships appear to be more common than public or private only services. Roles and responsibilities between the municipality and the private companies involved likely differ some for each community. Table 17 that follows shows four examples of programs, two drop-off and two curbside collection programs, which vary in cost structures. With public-private programs, a community is paying for convenience, expertise, logistical support or hauling or recycling infrastructure that private companies are able to provide that municipality's specific needs.

There are two different styles of drop off programs listed in Table 17. In both program models, the drop off locations are set up in public places. What differentiates the two is that the second option listed situates the drop-off spot at the community's transfer station rather than in a more open space such as a farmers market. The transfer station example makes the compost drop-off program free for residents and non-residents who have already paid the annual permit fee for the transfer station but are required to pay additional fees per drop off for trash disposal at the site. The Town has open hauling for curbside collection of trash. Residents and non-residents can also purchase a permit specifically for the compost drop off. An organics hauler is then paid by the community to cart the food scraps to a local composting site.

For either drop-off location model, residents and non-residents can be required to pay an annual fee for participation in the program, if desired. However, with the transfer station model, the municipality can use some existing infrastructure and resources to support addition of food scraps collection, whereas other locations would require those systems to be built from scratch.

For the curbside options, one model is to temporarily set up financial incentives for local haulers to collect food scraps from residents. In the example provided, the community does have open hauling for residential trash collection. The other model listed is a pilot program where residents are encouraged to participate through greatly reduced fees for the first year. In both these examples, communities received grant funds to help launch the program

*Table 17: Summary of public-private program models*

| Use Case | Description | Municipal Costs | Example(s) |
|---|---|---|---|
| Drop off | - Residential drop off<br>- Roles and responsibilities between the private hauler and the community may vary program to program<br>- Typically, the private hauler manages most of the physical logistics (i.e., collection and hauling)<br>- Municipality responsibilities may include program marketing, drop off staffing and resident education | - Marketing the program<br>- Depending on the structure of the program costs may include staff or volunteers to manage drop-off locations, larger collection bins, infrastructure set up costs (e.g., signs, shroud, bins, etc.)<br>- There may be some costs passed on to participants | City of Kingston, NY (City)[20]<br>- $12per month to participate in the weekly service<br>- Compost drop off at Kingston Farmers Market<br>- Partnership with Community Compost Co.<br>- Marketing materials are co-branded<br>City of Buffalo, NY (City)[21]<br>- Compost drop offs at multiple locations<br>- Material is picked up by Natural Upcycling<br>- Free for residents |
| Drop off | - Residential drop off at existing transfer station, may include a tip fee or annual cost for residents<br>- Food scraps consolidated and hauled to an off-site compost facility, typically using a private hauler | - Transfer station operation, including staffing the drop off<br>- Marketing of the program<br>- Private hauling fees | Town of Saugerties, NY (Town)[22]<br>- Annual transfer station fees are $35 for residents, $55 for nearby communities, food scrap permit on its own is $20 for residents and non-residents<br>- Food waste carted away by Community Compost Co.<br>- Town pays about $300 per month for the service |
| Curbside collection | - Municipality pays organics haulers a "reward" for every new residential customer they sign up<br>- Amount provided to haulers helps offset their costs of collection and provides incentives for all parties to participate | - Fees paid to haulers<br>- Program marketing | Minnetonka, Minnesota (City)[23]<br>- Community received a grant from the county to pay haulers $25 for each new customer<br>- Residents have the ability to adjust their garbage pick up to help offset their own costs.<br>- The county reduced the $/ton tip fee for organics as compared to municipal solid waste at the county transfer station |
| Curbside collection | - Residential curbside collection by a private hauler under contract with local municipality<br>- Municipalities have applied for grants to lower the collection cost for residents for a limited time | - Incentives for residential participation<br>- Marketing of the program<br>- Private hauling services | Town of Bedford, NY (Town)[24]<br>- First-year participants receive 50% off their contract price with the hauler using funds from the grant<br>- Pilot participants must pay the one-time cost for a tote<br>- Services provided by a private carter[25]<br>- Received a grant through Climate Smart Communities[26] |

*Privately Operated Programs*

The following table provides a summary of programs run exclusively by private companies. These programs exist in a variety of community types, including those with open hauling for residential trash. There are examples of both drop off models as well as curbside collection. As listed in the examples, some communities promote these services as available to residents on their website even if they are not actively involved with the program's operation.

*Table 18: Summary of the privately operated program model*

| Use Case | Description | Municipal Costs | Example(s) |
|---|---|---|---|
| Drop off or curbside collection | - Municipality may encourage participation and enable easy access to services but not be actively involved in executing the program<br>- Private haulers do their own marketing and operations with drop-off locations or curbside collection | - Negligible cost to municipalities<br>- Minor marketing costs (optional) | - Many examples of private programs in operation<br>- See NYSAR3's NYS Food Scrap Drop-Off & Collection Programs Map[27]<br>Greater Rochester NY<br>- Impact Earth operates curbside collection and drop-off programs around greater Rochester[28]<br>- Private collection services listed on the website of Monroe County (where Rochester is located) with resources about backyard composting[29]<br>-Within greater Rochester, Town of Henrietta, NY (Town), private services not listed on the town website; town has open hauling for trash collection.<br>Saratoga Springs, NY (City)[30]<br>- Promotes composting by listing available private haulers in the area, drop off for free at the farmers market, and information about how to compost at home |

*Commercial Participant Programs*

Examples of community supported composting programs that provide services to businesses were difficult to locate at the village scale. Some programmatic aspects from larger municipal programs that include businesses may help inform some of Rhinebeck's future efforts. The three main program types (with some sort of municipal involvement) identified are summarized below.

- Communities contract with a private hauler to offer food scraps collection as a service to community area businesses and residents for those interested. The City of Evanston, Illinois has this arrangement with its local hauler.[31]

- Communities with large scale municipally-operated compost facilities through resource recovery agencies or solid waste authorities can also be observed to accept food scraps

with a tip fee from food businesses and not just area residents. Examples include Ulster County Resource Recovery Agency, Onondaga County Resource Recovery Agency and Oneida-Herkimer Solid Waste Authority compost facilities.

- Some communities will focus on education, technical assistance and occasionally on incentives for encouraging business participation even if hauling is managed exclusively by private companies without a government partnership. Tompkins County uses funding it receives through an annual solid waste fee and other income sources to provide technical assistance, window decals, promotion on the county website, bins and signage and a reduced hauling rate to companies that sign up for their ReBusiness Partners Program.[32] The City of Fort Collins, Colorado has a similar program to the Tompkins County program.[33] In addition, for a short period of time, they offered a rebate program of up to 50% of the additional cost for using a compost services, up to $500 if companies signed up for at least six months with a local hauler.[34]

## Conclusions and Next Steps

Though this alternatives assessment, five options for implementing a composting program for the Village of Rhinebeck were assessed; municipal in-vessel composting, municipal windrow composting, municipal 3-bay composting, municipal aerated static pile (ASP) composting and Third party composting. The assessment considered several factors when comparing these five options in terms of their feasibility for meeting the needs of the Village, including their cost, their GHG impact, whether or not they were appropriately sized, what the level of access to finished compost would be, and what types of food scraps each alternative could reliably accept. ASP composting would provide a relatively easy-to-operate municipal composting option, which would allow all types of food scraps to be composted at the lowest average cost of the options assessed. three-bay and windrow composting would provide many of the same benefits of ASP in terms of municipal control over the process, but would require more operational labor and expense overall as compared to ASP, and may be limited to only vegetable scraps depending on the consistency of food scrap volumes composted, and proper manual aeration of the piles. An in-vessel system could accept any type of food scraps, has a small footprint, and provides higher levels of automation and odor control as compared to other municipally-run composting options. However, an in-vessel system requires more frequent attention from staff and, while lower cost in-vessel

options could be competitive with other options, the in-vessel option is on average the most expensive option considered. Using a third party compost site was also considered, and showed to be cost-competitive with other municipally run options depending on the third party that is contracted. This option would provide the benefit of fast and relatively easy program startup as compared to the municipally run composting site options, but would also have the potential drawback of less control over future costs as well as lower level of access to finished compost. The greenhouse gas impacts of transporting food scraps to a third party composting site were also assessed, and determined to be negligible in comparison to the benefit of diverting the food scraps from a landfill.

Financial structures of existing programs were also researched and summarized as part of this effort. This information will be useful for determining whether the Village will contract with a third party for food scrap collection (either at drop-off sites or curbside), or manage the collection and transportation of the food scraps with municipal resources. Because the Village uses open hauling' for trash currently, it may be more difficult to create incentives for participation in a composting program than if the Village had more direct control over the trash hauling costs. However, there are a variety of examples of successful programs operating within these same constraints in other areas of the state and country. While all options have their pros and cons, what seems to be the most viable is a municipally run drop-off program or a public-private drop-off program. Curbside collection, without the addition of grant funds and a high confidence in participation rates, can be a challenging first step. Municipal programs that support commercial businesses were also identified. There are fewer examples to note, mostly from larger communities. However, some of the key aspects may be scalable to fit into the Village's program strategy.

In summary, there are several feasible options for implementing a composting program within the Village of Rhinebeck. While some options meet more requirements than others, each of the options has benefits and drawbacks. Next steps should include internal discussions among decision makers to determine which factors (e.g., cost, convenience, timeline to implement) hold the most weight and therefore which option should be implemented in the Village of Rhinebeck.

## Appendices

Appendix A – Financial Analysis Table

## References

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[5] ReFED - A Roadmap to Reduce U.S. Food Waste by 20 Percent

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[27] https://www.nysar3.org/page/nys-food-scraps-drop-off--collection-programs-178.html

[28] https://www.impactearthroc.com/composting

[29] https://www.monroecounty.gov/des-environmentalrecycling

[30] https://sustainablesaratoga.org/composting-opportunities/

[31] https://www.cityofevanston.org/government/departments/public-works/services/trash-recycling-and-yard-waste-services/commercial-and-business-services

[32] https://recycletompkins.org/other-programs-and-services/rebusiness-partners/

[33] https://www.fcgov.com/recycling/wrap.php

[34] https://www.fcgov.com/recycling/pdf/business-compost-service-rebate-pre-application.pdf?1323293012

Appendix A: Financial Analysis Table

| Type | Use Case | Description | Municipal Costs | Pros | Cons | Example(s)* | References |
|---|---|---|---|---|---|---|---|
| Municipal | Drop off | Residential drop off location at municipally operated compost facility, use volunteers or existing resources to manage compost pile | - Marketing the program<br>- Depending on the structure of the program costs may include staff or volunteers to manage drop off locations, larger collection bins, infrastructure set up costs (e.g. signs, shroud for the bins, etc.) at the drop off location<br>- Compost facility operational costs | - No hauling fees<br>- Municipal controlled program<br>- Ability to educate residents more easily<br>- Access to finished compost<br>- May be a free program for residents<br>- Ability to use existing staff to monitor drop off sites | - May have limited abilities to scale up the program<br>- Requires residents to transport their food scraps | [1] Town of New Lebanon (Town)<br>- Population 2,200<br>- Unclear if residents have access to the finish compost<br>- Very small 3 bin system, unable to accept a wide variety of materials<br>- Free for residents<br>- Compost site at the local community garden<br>- Program is marketed at the local farmers market<br>- Developed posters and an educational video | [1] https://climatesmart.ny.gov/?type=1336777441&tx_sjcert_certification%5bcertification%5d%5b__identity%5d=93 |
| Municipal | Curbside collection | Leverage existing equipment, labor and routing to collect food scraps along with yard waste | - Municipal resources to haul organics<br>- Truck modifications to collect food scraps<br>- Marketing the program<br>- Bins and bin washing equipment | - Ease of use for residents<br>- Leverage existing infrastructure<br>- Municipal controlled program<br>- Ability to educate residents more easily<br>- Access to finished compost | - May not be a year round program due to the tie with yard waste collection<br>- Requires specific equipment and/or vehicle modifications to support the program | [2] Kaneville Township, IL (Township)<br>- Population 1,300<br>- Opt-in program operated by local hauler<br>- $220 per season (not a year-round service)<br>[3] Village of Mt Prospect, IL<br>- Population 55,000<br>- No charge to residents if the HH provides its own rigid container<br>- HH may rent a container for a small fee<br>- Collection is once per week<br>- Operated seasonally April to December | [2] https://www.lrsrecycles.com/kanevilletownship/<br>[3] https://www.mountprospect.org/departments/public-works/solid-waste/organics-yard-waste |
| Public/ private | Drop off | - Residential drop off (or bin swap) that is through a public/private partnership<br>- Roles and responsibilities between the private hauler and the community may vary program to program<br>- Typically, the private hauler manages most of the physical logistics (i.e., collection and hauling of food scraps)<br>- Municipality responsibilities may include program marketing, drop off staffing and resident education<br>- Some programs are co-branded between the hauler and municipality, others are exclusively municipality branded | - Marketing the program<br>- Depending on the structure of the program costs may include staff or volunteers to manage drop off locations, larger collection bins, infrastructure set up costs (e.g. signs, shroud for the bins, etc.) at the drop off location<br>- There may be some costs passed on to residents participating the program | - May have access to finished compost<br>- No municipal labor required to operate the compost pile | - Requires residents to transport their food scraps<br>- Less municipal control of all aspects of the program<br>- May have a fee for residents to participate | [4] City of Kingston, NY (City)<br>- Population 23,000<br>- $12/mo. to participate in the weekly service<br>- Compost drop off at Kingston Farmers Market<br>- Partnership with Community Compost Co.<br>- Compost is available for sale through Community Compost Co.'s sister company Hudson Soil Co.<br>- Fees incurred by the municipality to support this partnership have not been found<br>- Marketing materials are co-branded<br>- Bins are not provided<br>[5] City of Buffalo, NY (City)<br>- Population 256,000<br>- Compost drop offs at multiple locations<br>- Material is picked up by Natural Upcycling<br>- Free for residents<br>- Marketing materials are exclusively branded by the City<br>- Bins are not provided | [4] https://kingstonfarmersmarket.org/news-programs/compost-at-the-market/<br>[5] https://buffalorecycles.org/wp-content/uploads/2021/07/COB-34More-FoodWaste-Info.pdf |
| Public/ private | Drop off | - Residential drop off at existing transfer station, may include a tip fee or annual cost for residents<br>- Food scraps consolidated and hauled to an off-site compost facility (typically using a private hauler) | - Transfer station operation, including overseeing and/or staffing the drop off spot<br>- Marketing of the program<br>- Private carter hauling fees | - Ability to educate residents<br>- Some municipal control of the program aspects<br>- Existing infrastructure/labor to manage drop off site | - Requires residents to transport their food scraps<br>- Limited/no access to finished compost<br>- Fees to haul organics (may be passed on to residents) | [6] Town of Saugerties, NY (Town)<br>- Population 19,000<br>- annual transfer station fees are $35 for residents, $55 for nearby communities, food scrap permit on its own is $20 for residents and non-residents<br>- Food waste carted away by Community Compost Co.<br>- Partnership between the town and Community Compost Co. has the town paying about $300 per month for the service<br>- Bins are not provided<br>- Town also sees a benefit because they pay a tip fee at UCRRA for trash hauling that is dropped off by Town residents to the transfer station.<br>- [7] UCRRA solid waste disposal fee is $105/ton and SSO (for commercial haulers) is $20/ton | [6] https://hudsonvalleyone.com/2018/10/15/saugerties-adopts-new-composting-system/<br>[7] https://ucrra.org/about-us/fee-schedule/ |

## Appendix A: Financial Analysis Table

| Type | Use Case | Description | Municipal Costs | Pros | Cons | Example(s)* | References |
|---|---|---|---|---|---|---|---|
| Public/ private | Curbside collection | - Municipality pays organics haulers a "reward" for every new residential customer they sign up<br>- Amount provided to haulers helps offset their costs of collection and incentivizes all parties to participate | - Fees paid to haulers<br>- Program marketing | - Facilitating curbside collection<br>- Minimal effort/ involvement from municipality<br>- Incentivizes haulers to sign up more customers | - Requires funding/budget available to pay haulers<br>- Less control over the program aspects (including education and finished compost)<br>- May require other levers to incentivize HH to participate (e.g. reduced trash bills) | [8] Minnetonka, Minnesota (City)<br>- Population 53,000<br>- Community had has a grant from the county to pay haulers $25/new customer sign up<br>- Residents have the ability to adjust their garbage pick up to help offset their own costs.<br>- The county reduced the $/ton tip fee for organics as compared to MSW at the county transfer station to encourage municipal programs ($15/ton as compared to $45/ton)<br>- Food scraps appear to be managed at the county level. No indication of access to finished compost for residents. | [8] https://www.biocycle.net/tapping-organics-to-reach-recycling-goal/ |
| Public/ private | Curbside collection | - Residential curbside collection by a private hauler under contract with local municipality<br>- Municipalities have applied for grants to lower the collection cost for residents for a limited time (there are examples of county, state and federal grants) | - Funding/budget to incentivize residential participation<br>- Marketing of the program<br>- Funding/budget to pay for private hauling services | - Ability to educate residents<br>- Some municipal control of the program aspects<br>- Ease of use for residents | - Likely need a minimum amount of participation to make worthwhile<br>- Need a plan for long term financial sustainability<br>- No access to finished compost | [9] Town of Bedford, NY (Town)<br>- Population 17,000<br>- First year participants receive 50% off their contract price with the hauler using funds from the grant (no more than $15/mo. via reimbursement from the Town)<br>- Pilot participants must pay the one-time cost for a tote to use from the Town ($15)<br>- [10] Services provided by a provided by a private carter (Curbside Compost based out of Connecticut)<br>- The town also operates drop off locations<br>- For residents interested in curbside collection are not eligible for the subsidized rate but do receive a free compost bin and compostable bags<br>- [11] Received a $37,422 grant through Climate Smart Communities to start a food waste curbside pickup program in 2019 for 225 households | [9] https://bedfordny.gov/wp-content/uploads/2020/05/Curbside-picke-up-print-out-form.pdf<br>[10] https://bedford2030.org/curbside-compost-2/<br>[11] https://www.dec.ny.gov/docs/administration_pdf/19cscawards(2).pdf |
| Private program | Drop off or curbside collection | - Municipality may encourage participation and enable easy access to services but not actively involved in executing the program<br>- Private carters do their own marketing and operations with drop off locations or curbside collection | - Negligible cost to municipalities<br>- Minor marketing costs (optional) | Little cost or effort required by the municipality | - No control over program aspects<br>- May have low participation without proper incentives/interventions | - Many examples of private programs in operation<br>- [12] See NYSAR3's NYS Food Scrap Drop-Off & Collection Programs Map Greater Rochester NY<br>- [13] Impact Earth operates curbside collection and drop-off programs around greater Rochester<br>- [14] Private collection services listed on the Monroe County (where Rochester is located) website and resources about backyard composting<br>- within greater Rochester, Town of Henrietta, NY (Town) with population 44,000, private services not listed on the town website, town has open hauling for trash collection.<br>[15] Saratoga Springs, NY (City)<br>- Population 28,000<br>- promotes composting via listing available private haulers in the area, drop off for free at the farmers market as well as information about how to compost at home | [12] https://www.nysar3.org/page/nys-food-scraps-drop-off--collection-programs-178.html<br>[13] https://www.impactearthroc.com/composting<br>[14] https://www.monroecounty.gov/des-environmentalrecycling<br>[15] https://sustainablesaratoga.org/composting-opportunities/ |

*Note: not all examples are exactly indicative of Rhinebeck's program attributes (e.g., open hauling) but the model type appears to be or has demonstrated to be actionable model for communities like Rhinebeck