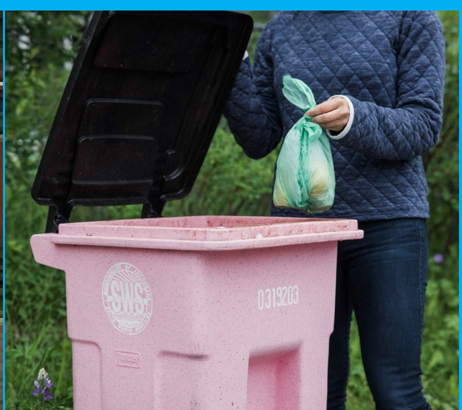
Organics Management Feasibility Report

Organics Collection and Processing within The Municipality of Anchorage



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TETRA TECH

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Organics Collection and Processing within The Municipality of Anchorage

DECEMBER 1, 2021

PROJECT NUMBER: 208-190461

PRESENTED TO

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EXECUTIVE SUMMARY

As the Solid Waste Services (SWS) works through the engineering and development plans for the larger landfill and multi-complex Resource Recovery Center, the idea of incorporating an organics management facility has been introduced and under consideration.

A feasibility study performed by Tetra Tech under the USDA Community Compost and Food Waste Reduction (CCFWR) Grant included evaluation of the SWS existing organics management system and high-level analysis for SWS to consider the feasibility of a full-scale organics management operation within the Municipality of Anchorage (MOA).

The objective of the Feasibility report is to provide an evaluation of organics collection and processing options to allow MOA to quantitatively determine the most suitable organics management strategy, accommodating the existing feedstock in the short-term with considerations for future scalability and improved organics diversion.

The report focuses primarily on composting technologies, due to the overall familiarity and generally lower capital cost but also includes a review of alternative technologies to determine if another option is more appropriate for MOA's management program and unique climate. It only presents options at this time to enable SWS to consider the concept of an organics management facility within the Municipality of Anchorage on an SWS facility property. The study presents a phase-in approach to support SWS's longer-term future planning for solid waste management.

1. **Short-Term** is the feasibility report to present Solid Waste Services (SWS) with a high-level analysis of potential organics management technology options and site locations for consideration of potentially siting organics management operations within the Municipality of Anchorage.

2. **Mid-Term** is a pilot-scale composting project based upon award of the second round of the USDA Community Compost and Food Waste Reduction (CCFWR) Grant. *(USDA-NRCS-NHQ-CCFWR-21-NOFO0001112)* for funding the pilot-scale composting project. SWS submitted the grant application in July 2021, and award announcement is expected in October 2021.

   The pilot-scale composting project would ideally commence in 2023, allowing for planning, design and implementation of the pilot composting project that could coincide with site work for the new multi-complex Resource Recovery Center if the pilot project is sited at the CTS.

3. **Longer-Term Future Planning** toward a hypothetical full-scale composting facility to produce local compost (soil amendment) for residential and agriculture use. Also included is an alternative option for dry anaerobic digestion for green renewable energy production, biogas and electricity. The longer-term future planning is for siting organics management at the Anchorage Regional Landfill (ARL).

For the pilot composting project Tetra Tech assisted SWS in writing the grant narrative, which described SWS's existing organics (yard debris and food scraps) program of a limited resident curbside collection and drop-off sites at the Anchorage Regional Landfill (ARL) and the Central Transfer Station (CTS). The collected organic material is transported approximately 50 miles to a composting facility. This opportunity for a pilot project would further develop SWS' current organics program and organics diversion strategic planning efforts. By introducing a composting operation within the municipality, SWS could

- Eliminate transportation of organics 50 miles to Palmer and the subsequent return 50 miles to bring finished compost back to Anchorage.

- Provide locally produced compost for residents to use, closing the loop on organics recycling within Anchorage.
- Increase diversion and reduce the amount of waste material disposal in the landfill.

Pilot aligns with the USDA grant program objectives.

- Produce a consistent high-quality compost product for local food production.
- Support local food system resilience; generate composted materials for use on home vegetable gardens and local farms.
- Improve soil quality; reduce reliance on fertilizers by using local compost.
- Train SWS staff on how to compost. Foundational composting skills are needed and could create jobs. The pilot-scale project would be designed as a training endeavor for SWS to gain the necessary hands-on experience in preparation for a potential municipal-scale composting operation at the ARL.
- Engage with the local community; public outreach and education

Pilot aligns with the SWS Integrated Solid Waste Master Plan and MOA Climate Action Plan (2019) goals.

- There is community demand to improve organics recycling participation rates and increase diversion from the landfill. Organics recycling should be convenient and accessible for residents and businesses.
- SWS seeks to reduce the transportation of organic feedstocks and finished compost by managing these materials locally. To build community resiliency and circular economy with an organics management facility.

Funding for this pilot composting project will utilize one of the composting technologies identified in the feasibility report, in a limited fashion, as part of the CCFWR round two, and would allow SWS to accomplish several goals. First to cover equipment lease cost for the pilot-scale composting technology identified in the feasibility report, a membrane covered composting operation known as the GORE system.

The pilot would support further research for SWS to increase source separated organics (SSO) diversion and collection, public outreach and education. The pilot could include test marketing use of certified compostable bags for collection, and compostable food service ware items in schools and with other institutional entities to demonstrate success with these materials or partnering with sustainable packaging contacts to expand compatibility (*e.g. Green Alaska Solutions, LLC, Alaska Food Policy Council, and other entities*).

Another important objective about the pilot is it provides a development scenario for SWS, with hands on experience to understand various and seasonal flow of feedstocks, challenges and overall learning curve for managing a composting operation, get enough hands-on experience toward implementing full-scale organics operation.

Potential Sites

This report identified two potential sites for the pilot composting project. The pilot could be located at the existing CTS as a temporary site, or the pilot could be sited at the ARL with the intention to scale up the pilot composting project to a full-scale organics management facility. The ARL provides the possible opportunity to start with a pilot operation and expand to a commercial organics operation as part of the SWS facility.

Organics Collection

The collection of source separated organics can also be phased-in overtime allowing all stakeholders including public outreach and education, establishing efficient collection routes. This public outreach effort would further develop SWS's existing organics management program as part of the short-term steps, and establish some commercial organics collection.

Paradigm shifts in solid waste management have occurred over time. More recently landfilling and waste-to-energy have been long-term, cost-effective, and environmentally compliant solutions for the management of waste. While we continue to have these waste solutions, the paradigm for materials management continues to evolve as markets shift and new technologies become available allowing us to realize a larger fraction of value from resources that are discarded bringing us to a more circular infrastructure and economy.

As municipalities look for ways to reduce carbon emissions, there is a growing interest in organics recycling and composting operations to help with carbon sequestration. For states and municipalities looking to implement zero waste strategies, organics is one of the primary materials to divert from the solid waste stream. High recycling goals cannot be reached without managing the considerable organics fraction that is at least 30 percent of the municipal solid waste stream. Even for locations that have addressed recycling or made other progress, this organics is often a largely untapped area.

SWS is the most logical entity to advance longer term, comprehensive leadership for increasing waste diversion and implement sustainable materials management efforts to mitigate climate change.

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
ICI	Industrial, Commercial and Institutional
SSO	Source Separated Organics
PFAS	Per- and polyfluoroalkyl substances
BPI	Biodegradable Products Institute
USCC	United States Composting Council
EN	European Union standardized testing standard
STA	Seal of Testing Approval, compost certification program offered by USCC

1.0 INTRODUCTION

In order to effectively utilize the new SWS Central Transfer Station (CTS) Project and accomplish the associated material recycling and diversion goals, SWS is seeking long term planning to optimize organics management and diversion. At the request of the Municipality of Anchorage Solid Waste Services (SWS), the Tetra Tech Project Team conducted an initial review of four (4) alternative options for organics collection and processing within the Municipality of Anchorage.

The objective of the Feasibility Study is to provide an evaluation of organics collection and processing options to allow Municipality of Anchorage to quantitatively determine the most suitable organics management strategy, accommodating the existing feedstock in the short-term with considerations for future scalability and improved organics diversion. The Feasibility Study focuses primarily on composting technologies, due to the overall familiarity and generally lower capital cost but also includes a review of alternative technologies to determine if another option is more appropriate for Municipality of Anchorage's management program and unique climate.

The analysis provides the potential sites identified by SWS to be the most feasible, including potential alternative sites for a composting operation closer to Anchorage. Included are the type of organics management technology and equipment for material handling and processing best suited for the given alternative.

1.1 OBJECTIVES

The Project Team conducted a high-level feasibility review of four options, including technology and locations for siting for organics collection and processing within Municipality of Anchorage. The analysis will also discuss the type of organics management technology and equipment for material handling and processing best suited for the given alternative.

The objective of the study is to provide an evaluation of organics collection and processing options to allow MOA to quantitatively determine the most suitable organics management strategy, accommodating the existing feedstock in the short-term with considerations for future scalability and improved organics diversion.

The study focus is primarily on composting technologies, due to the overall familiarity and generally lower capital cost but will also include a review of alternative technologies including anaerobic digestion to determine if another option is more appropriate for MOA's management program and unique climate.

2.0 BACKGROUND: SCOPE OF WORK

The Project Scope of Work (SOW) included two tasks. **Task 1** was evaluation of SWS's existing organics management system from residential curbside collection and drop-off locations, through transportation to the existing composting Moffit Farms site in Palmer and finished product use. The evaluation of the existing organics management system can be found in **Section 9.0** of this report.

Task Two is the feasibility report for evaluation of four (4) alternative options for organics collection and processing within MOA. This report provides a high-level analysis of options previously identified by SWS to be the most feasible, including potential alternative sites for a composting operation closer to Anchorage. The analysis also discusses organics management technologies and equipment for material handling and processing best suited for the given potential site as presented in **Table 2-1**.

Table 2-1: Potential Location Sites and Technology

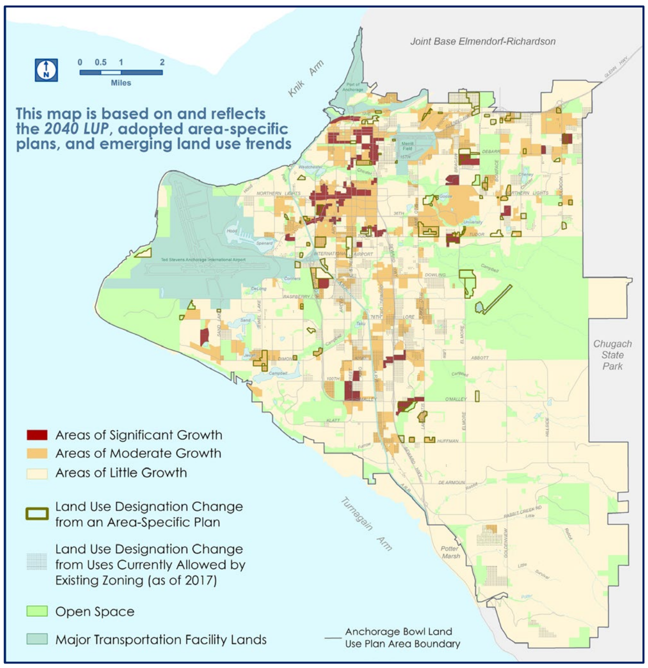
	Potential Location Site	Technology
Option 1	Anchorage Regional Landfill	Composting operation
Option 2	Anchorage Regional Landfill	Alternative Technology including Anaerobic Digestion. As part of this Task, we reviewed the specifications and condition of the existing dormant in-vessel composting system at Alaska Waste to evaluate potential use.
Option 3	Alternative Locations: Central Transfer Station and Asplund Wastewater Treatment Plan	This option will require input from SWS and other MOA departments to identify feasible locations and opportunities for third-party partnerships
Option 4	Central Transfer Station	Organics collection. A review of the feasibility to incorporate organics receipt and management at the existing CTS property. Any utilization of the existing CTS will have to be integrated with the ongoing progression of the proposed Resource Recovery Center development concept plans (*Phases 1A & Phase 2*), currently being performed by the Tetra Tech team.

For Options 1 through 3 listed above, analysis includes identification of location, organics management process, collection and transportation implications, potential feedstock, pre-processing needs, proximity to generators, compatibility with certified compostable packaging and food service ware items, and compost end-use and marketing to the local community. In order to compare the financial implications of the above options, the evaluation will provide a conceptual screening or feasibility-level cost estimate.

2.1 DEMOGRAPHICS

Based on scale data from SWS and Alaska Waste, households generate an estimated 35% of the trash collected in Municipality of Anchorage. The Anchorage 2040 Land Use Plan1 (2040 LUP) identifies four major housing types: large-lot single family, single-family, compact housing, and multi-family/other. The 2040 LUP anticipates growing demand for more compact and multi-family housing as single family lots become scarce. Infill type development is also expected to densify in the Municipality of Anchorage in coming decades. Population is expected to increase by 47,000 people and 21,000 households over the next 20-25 years. This represents the Anchorage Bowl's share of the metropolitan region's projected growth through 2040. **Figure 1** shows the areas of significant population growth.

Figure 2-1: 2040 LUP Significant Population Growth



The 2040 LUP indicates the need for investment in water, sewer, roadway, air, and rail services. It also identifies Anchor institutions as "large organizations that have an established presence by sheer size, permanence, and stabilizing social ties and services to the surrounding community. It should be noted that SWS was not listed as an Anchor institution even though SWS "serves the needs of the city's residents".

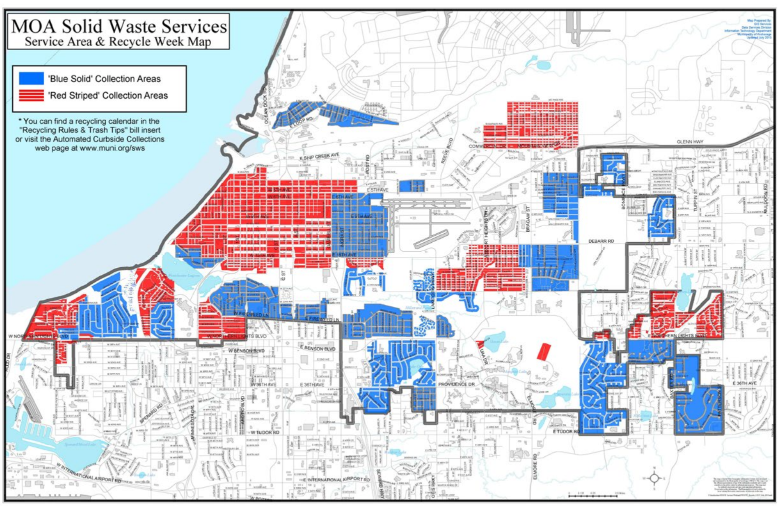
Solid waste collection in the Municipality of Anchorage is provided through both public and private sector services. By Municipal Code, SWS provides service to a Refuse Collection area (SWS Service Area) comprising approximately 20% of Anchorage including the original downtown area, which is the commercial core. The service area holds much of the high-density residential population, but this residential sector is not located in the downtown area.

In the SWS Service Area, trash is collected from single family, duplex and triplex housing units using roll carts. Single stream recycling is provided to these customers at no additional charge. Commercial and multi-family residential (4 units or larger) customers are serviced by dumpsters in varying sizes, from 3 to 8 cubic yards, and in frequency, either daily or weekly service. As of April 2021, SWS provides trash service to 3,796 multi-family properties and 8,638 single family residences, a total of 12,434 residential customers.

Figure 2.2 shows the Municipality of Anchorage- Solid Waste Services service area. The Integrated Solid Waste Master Plan (ISWMP) reported that Municipality of Anchorage disposed of 330,000 tons of municipal solid waste (MSW) at the Anchorage Regional Landfill (ARL) in 2016. In 2017, a waste composition study was conducted at the ARL. A random sample of 2,000 pounds of municipal solid waste (MSW) was selected from the active face of the landfill. No waste collection streams were considered for the waste composition study.

Figure 2.3 shows waste composition results from the 2017 ARL study. Consolidating all the organics fractions including food scraps, wood and yard waste and other compostable materials including food-soiled papers together was a total of 39.2% of the MSW composition. The single largest component of the organics fraction was food scraps at 18% which is equivalent to 59,400 tons of food waste per year that was disposed in the landfill. Wood and yard waste were 17% which is equivalent to 56,100 tons of wood/yard waste per year that was disposed in the landfill. Other compostable materials including food-soiled paper was 4% which is equivalent to 13,200 tons of compostable materials per year that was disposed in the landfill. In 2017, 128,700 tons of compostable organic material (food scraps, wood and yard waste, and compostable papers including food-soiled napkins and paper towels) per year was disposed in the landfill.

Figure 2-2: Municipality of Anchorage - SWS Service Area Map



2.2 ALASKA SOLID WASTE REGULATIONS

Facilities used to store materials for transfer, reuse, recycling, or resource recovery are not required to obtain a facility permit under Title 18 of the Alaska Administrative Code (18 AAC), in particular under the Solid Waste Regulations in Title 18 AAC 60, unless such facility is causing or contributing to a nuisance or poses a risk to public health and the environment. If this occurs, the facility operator would be required to submit a facility design and operating plan. Proposed improvements, expansion, or new pre-processing and recycling facilities including transfer stations, MRF, construction and demolition recycling, and composting facilities (including in-vessel digestion) which are not located or occurring in a permitted facility such as the ARL would not be required to obtain a solid waste facility permit under Title 18 AAC 60.

2.2.1 Solid Waste Treatment

The State of Alaska does not have a composting regulation, however composting operations are regulated by Title 18 AAC 60.010(i) for solid waste “treatment” instead of using the term “composting”. A composting facility that meets the requirements would need to obtain a Treatment Facility permit.

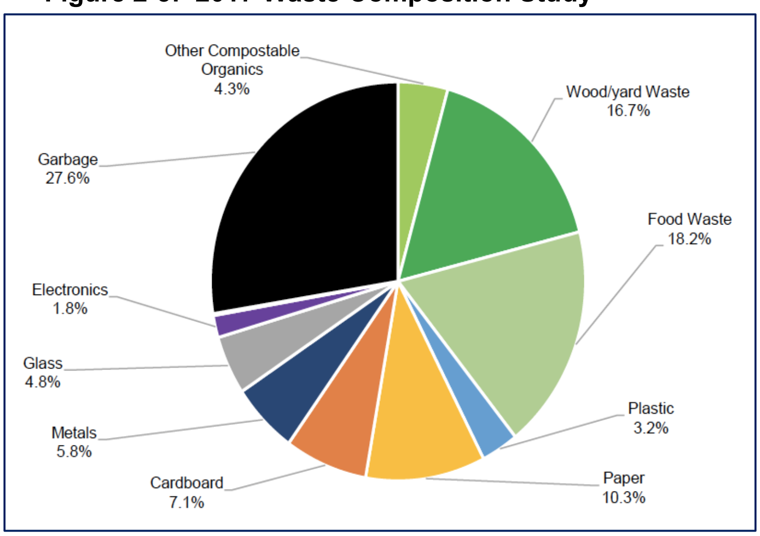
2.2.2 Municipality of Anchorage Municipal Code

The Municipality of Anchorage Code (AMC) provides regulation pertaining to solid waste pre-processing and recycling facilities in Title 21 Chapter 21.05.060 and Chapter 26.70. Title 21, Chapter 21.05.060(E), Subsections (1.) Composting facility (2) Hazardous waste treatment facility (3) Incinerator or thermal desorption unit (4.) Junkyard and salvage yard (6) Landfill (7) Recycling drop-off (9) Solid waste and/or recycling include use-specific standards for solid waste and/or recycling transfer facilities including use-specific minimum size requirements, setback requirements, outdoor storage limitations, noise, dust and litter control, and fencing requirements.

The MOA Code of Ordinances provides solid waste regulations for the purpose of regulating the storage, collection, processing and recovery, and disposal of solid waste in order to protect public safety, health and welfare and to enhance the environment. Key sections under Chapters 26.70 and 26.80 include the following:

26.70.030 - Use of municipal collection service required. – Requires that residents and business owners within the SWS area (former City of Anchorage) use the waste management system provided by the municipality.

Figure 2-3: 2017 Waste Composition Study



26.80.055 – Solid Waste Disposal Fee Reduction. – A business or organization involved in recycling of paper, plastic, glass, steel, aluminum, copper and brass will be granted a 50% reduction in disposal fees for residual waste resulting from their recycling operations. Such business or organization must meet established conditions for recycling operations that recover post-consumer solid waste materials.

26.80.070 – Surcharges to Support Community Recycling Initiatives. – Requires the Solid Waste Disposal Utility (SWDU) to implement community-wide initiatives to support reduction, recycling, and reuse of waste products otherwise disposed at the landfill. These initiatives are financed and implemented through a surcharge collected by the SWDU on all wastes delivered to solid waste transfer or disposal facilities.

2.2.3 Air Permit

Composting operations typically generates particulate matter (PM) during the material receiving and mixing processes. Also, during the turning windrows or moving of the finished compost. These activities are not a major source of air emissions [AS 46.14, 18 AAC 50, and 42 U.S.C. 7661(2)]. Dust emissions from composting operations typically results from the delivery and unloading of materials, mixing, and grinding, and screening of dry material. Wet SSO feedstocks generally do not generate dust. The material receiving area will be maintained clean and scraped as soon as the feedstock material is mixed and moved to the composting pad. Facility records will be maintained as part of good process management. There is the potential opportunity for managing feedstocks and finished compost under a covered area that would control dust and particulate matter.

3.0 ORGANICS MANAGEMENT TECHNOLOGIES

This section introduces industry organic diversion technologies that may be suitable to Anchorage’s unique requirements, including climate and seasonal availability of feedstocks, to further increase organics diversion, subsequently reducing GHG emissions.

3.1 COMPOSTING METHODS

3.1.1 Passive Aerobic Composting

Passive systems typically encompass the simplest forms of composting. At a fundamental level, they involve stacking organic materials into piles and then waiting for decomposition to take its course. Generally, materials would either be formed into a circular or oblong shape (static pile), or long thin piles (windrows). Once formed, passive systems rely on natural convection of air through the pile to provide oxygen to the decomposition process. These systems typically have the highest residency times of up to two years, depending on the material composting and climate.

Table 3-1: Passive Composting

Benefits	Considerations
▪ Simplicity – minimal skills required by operator. ▪ Low capital cost and operating cost. ▪ Applicable to small volumes of leaf and yard waste.	▪ Pathogen reduction temperatures not achieved. ▪ Extended time to produce compost product. ▪ Not suited to food waste or biosolids composting. ▪ Exposure to rain, wind, and cold can be problematic unless in a covered environment.

Figure 3-1: Static Pile

Figure 3-2: Windrow

3.1.2 Windrow (Aerated Turned)

Turned composting consists of placing the mixture of organic materials into piles, or windrows, which are turned on a regular basis. Turned windrows is the most common method of composting in North America. Typically, windrows are formed for this application, that are up to 6 feet high for dense or tightly packed materials such as manures, and 10 to 12 feet high for porous or less dense materials such as yard waste (leaves and branches). In colder climates, windrows can be taller and wider to reduce heat loss. The equipment used for turning these windrows determines the size, shape, and spacing of the windrows. Front-end bucket loaders or telescopic handlers with a long reach can build higher and wider windrows. Windrows formed with turning machines are sized based on the equipment design. Small pull-type turners form smaller windrows, while large self-propelled machines form 10- or 12-feet piles with a base width of 20 feet or more.

Windrows aerate primarily by natural or passive air movement (convection and gaseous diffusion). The rate of air exchange depends on the porosity of the windrow. Turning the rows mixes the materials, rebuilds the porosity of the windrow, and releases trapped heat, water vapor and gases. This type of compost technology is best suited to composting yard and garden waste. Windrow systems have been used for composting food waste if it is incorporated and covered with non-food substrates as it is received. Composting times can be expected to be six months or longer depending on feedstocks and climate.

Figure 3-3: Self-Powered Windrow Turner

Figure 3-4: Second Windrow Turner Example

Figure 3-5: Pulled Windrow Turner

Table 3-2: Windrow Composting Benefits and Considerations[1]

Benefits	Considerations
▪ Can handle feedstocks with lower Carbon to Nitrogen (C: N) ratios. ▪ Relatively low capital costs and low technology requirements (windrow turners, front-end loaders, or farm equipment will suffice). ▪ Can achieve pathogen reduction temperatures with careful management and monitoring of the pile. ▪ Relatively low operating costs. ▪ No electric power needed. ▪ Large amount of industry practical experience.	▪ Large land area required. ▪ More labor intensive that aerated static pile, particularly for feedstock with low C:N ratio or porosity. ▪ Can be odorous, which may require larger buffer area between operation and neighbors. ▪ More challenges to overcome if food waste or biosolids are included due to increased odors and attraction of food waste to pests and wildlife. ▪ Exposure to rain, wind, and cold can be problematic unless in a covered environment.

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.3 Aerated Static Pile (ASP)

3.1.3.1 Passive Aeration System

A method of augmenting a passive composting system is by introducing aeration systems at the base of the compost pile. Perforated pipes are laid on the ground, as shown on Figure 3-6, where air flows into the pipe and then percolates upwards through the compost by convection. This aids in achieving aerobic conditions in the pile, as it reduces the likelihood of anaerobic pockets of material occurring throughout the pile. Passive aerated piles can still benefit from turning the piles to re-build porosity. However, these systems can still require significant composting periods (up to two years) and are not well-suited to process feedstocks with food waste or low C:N ratios.

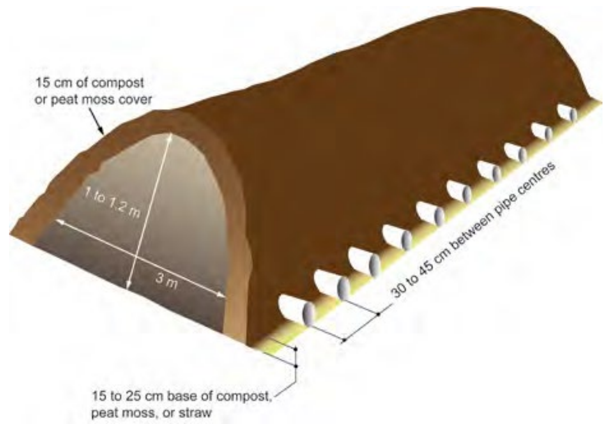


Figure 3-6: Example of Passive Aeration

Table 3-3: Passive Aeration Systems Benefits and Considerations

Benefits	Considerations
▪ Low capital and operating costs. ▪ Well-suited to small quantities of material. ▪ No electric power needed. ▪ Large amount of industry practical experience.	▪ Not suitable for food waste. ▪ Odors can be problematic. ▪ Pathogen reduction temperatures may not be well controlled. ▪ Not suitable for large quantities of material. ▪ Constructing piles overtop aeration systems can be complex. ▪ Exposure to rain, wind, and cold can be problematic unless under cover.

3.1.3.2 Active Aeration System

Active aeration differs from the above-described technologies in that air is forced through the composting pile using fans or blowers. This composting approach should have the composting area built on an impermeable surface such as a concrete or asphalt pad with a 2% grade to allow for leachate collection. Each pile can be equipped with a concrete floor with imbedded aeration channels or piping, or perforated pipe is placed on the compost pad and compost piles are built over top. The aeration pipes are connected to a blower equipped with a control system to moderate temperature and oxygen content in the pile. The control system tracks operating conditions to determine aeration rates, usually based on temperature feedback. Condensate and leachate are collected in the trench with drainage to a sump. Odor is managed by maintaining aerobic conditions in the pile and placing a cover of finished compost over the pile surface with positive air systems. With negative aeration systems, exhaust air is treated through a biofilter consisting of a wood chip and compost based medium (for negative air systems). The composting time for this type of system is typically three months with a curing stage of 3 to 6 months, depending on feedstocks and climate.

Figure 3-7: Aerated Static Pile Inside Bunker Walls

Table 3-4: Aerated Static Pile Composting Benefits and Considerations[1]

Benefits	Considerations
▪ Can be suitable for composting food waste and biosolids. ▪ Forced aeration reduces land requirements and mixing. ▪ Can result in more rapid stabilization in the high-rate compost stage. ▪ Use of negative aeration with a biofilter can help control odors. ▪ Smaller surface area relative to windrows. ▪ Can have lower operating equipment requirements with less mixing/turning. ▪ Can achieve pathogen reduction temperatures.	▪ Slightly higher capital cost for forced aeration equipment. ▪ Moisture addition may be required if piles dry from over aeration. ▪ Feedstock pre-processing requires a higher degree of care; feedstocks must be well mixed and properly sized and moistened. ▪ More operator skill required to manage aeration systems. ▪ Aeration systems generally require three phase electrical supply. ▪ Exposure to rain can be problematic if pile becomes over saturated unless it is under cover.

[1] *Source*: http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.3.3 Membrane Covered Aeration System

The covered aerated static pile composting area is typically constructed on an impermeable surface such as concrete or asphalt with a 2% grade to allow for leachate collection. The aeration system design uses an aeration channel built into the impermeable compost pad. Leachate collection in the aeration channel and drains to a sump. Surface leachate is drained over the pad to a leachate pond or sump. The system shown in Table 3-5: Membrane Covered Aerated Static Pile Composting Benefits and Considerations1is the GORE Cover System that operates using positive aeration. The cover is made of a microporous membrane (PTFE) sandwiched between a bottom and top fabric. The cover is placed over the pile and secured to the ground or to support walls on the side of the pile. As air is injected into the pile, the breathable membrane expands like a balloon to create an in-vessel like environment. The sealed edges create a fully enclosed system. This membrane allows for the management and retention of moisture, temperature, and odor. Odors are reduced with efficient aeration, and with odor molecules being absorbed into the moisture film forming inside the cover. The control system monitors oxygen content and pile temperature. The control system uses oxygen feedback to activate the blowers to maintain oxygen levels. The composting process consists of the main active phase (4 weeks under GORE cover), second active phase (2 weeks under GORE cover) and curing phase (2 weeks without GORE cover). The residence time for this type of system is approximately 56 days. Further curing of the compost can be expected with a market ready compost produced in 6 to 9 months, depending on feedstocks and climate.

Recent systems are being constructed inside a sheltered structure for the first stage. This enhances odor controls in sensitive areas.

Figure 3-8: Membrane Covered Aerated Static Pile

Table 3-5: Membrane Covered Aerated Static Pile Composting Benefits and Considerations[1]

Benefits	Considerations
▪ System uses low volume blowers and has reduced energy consumption over other static pile systems. ▪ Lower space requirements than windrow systems. ▪ Contained system reduces potential for odor emissions and contaminated stormwater. ▪ Pathogen reduction temperatures are exceeded. ▪ Moisture loss due to aeration is minimal compared to uncovered aerated piles.	▪ Potential steam or dust issues inside if inside a building enclosure. ▪ Indoor air must be managed in odor control system prior to release (possibly biofilter). ▪ Requires advanced operating skills. ▪ Moderate to high capital and operating costs.

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.4 Mass Bed

There are several iterations of mass bed systems that vary from passive to in-vessel in design. The commonality is that they are all designed to process large quantities of material (15,000 to 150,000 tons). These systems are typically appropriate for a wide range of feedstocks and involve an active composting period of two weeks to twelve months depending on variables, such as active aeration, turning, or enclosed systems. Feedstocks are generally placed in large piles and turned or agitated on a regular basis to ensure appropriate mixing. Active aeration may be built into the ground or a surrounding building to augment the composting process, as well as manage odors. For more complex systems, automated equipment may be used to manage processing parameters, turn/agitate material, and move material through the building. Due to increased complexity, these systems need to process significant quantities of material in order to justify the high capital and operating costs.

Figure 3-9: Agitated Mass Bed

Figure 3-10: Turned Mass Bed

Table 3-6: Mass Bed Benefits and Considerations

Benefits	Considerations
▪ Able to process large quantities of material in short timeframes depending on process setup ▪ Reduced footprint compared to turned windrows ▪ Suitable for high levels of automation to reduce labor costs and increase consistency ▪ Can increase moisture retention due to low surface area to volume ratio	▪ Can be high capital costs due to complexity of system and equipment involved ▪ Specialized equipment is required ▪ Frequent maintenance that may require significant expertise depending on the system design ▪ Proper preparation and mixing of feedstocks are critical to smooth operation ▪ Difficult to add moisture in outdoor operations ▪ Convection of oxygen through pile is limited and can result in anaerobic (odorous) conditions.

3.1.5 In-Vessel Systems

3.1.5.1 Static or Agitated Container

More temporary or modular in-vessel facilities may involve sealed metal containers similar to 40 yd^3 roll-off bins (static container) or a smaller version of the agitated mass bed (agitated container). These containers offer modularity and flexibility compared to a fixed concrete structure, as more containers can be added if feedstocks increase, and site layout can be readily modified to changing conditions.

Static containers often involve modular metal bins that can be filled with material, sealed from the front or side, moved around site, and connected to an active aeration system. These systems are typically batch systems with low quantities of material per container (up to 1,000 tons per year) but can easily be scaled with acquisition of more containers. The active composting period of materials is typically quite short (2 to 3 weeks), which results in higher odor content of material entering the curing and maturing phase, than in systems with longer composting periods.

Agitated containers differ in processing flow, as material continuously flows through the system. Input organics undergo active composting while slowly travelling through the system. Compost exiting the system after the 2- to 4-week processing time still requires curing and maturing. Agitated containers are generally used for smaller quantities of material (660 lbs to 11 tons per day), but are highly modular, as they can be run in parallel. These systems also typically involve more sophisticated control systems that automatically adjust temperature, water input, and other control parameters.

Figure 3-11: Static Container System

Figure 3-12: Agitated Container System (Wright Digestor)

Figure 3-13: Hot Rot Compost System

Table 3-7: Static and Agitated Container Benefits and Considerations

Benefits	Considerations
▪ High degree of odor control except for when material is removed. ▪ Lower space requirements, static and agitated containers are relatively mobile, so site layouts can be modified. ▪ May allow for modular expansion if feedstocks grow or are larger than expected. ▪ Agitated containers are highly automated.	▪ Operating and maintenance expertise required to manage more complex aeration and control systems. ▪ Higher capital and operating costs (vary with technologies). ▪ May require skilled maintenance staff. ▪ Some vendors claim shorter residence time (one to four weeks) and are used in combination with another composting method/technology.

3.1.5.2 Rotating Drum

Rotating drum composters are similar to rotating dryers or cement kiln drums. Organics are process in a continuous flow through the drum. Rotating drum compost equipment vary in size and capacity from 10s of tons per day to 100s of tons per day. The drums are slightly sloped from the feed end to the discharge end. Materials slowly travel through the drum as the drums rotate. Drums may be aerated using a complex piping fixture with exhaust air capture for treatment in a biofilter. Active composting can range between one and seven days. Rotating Drums are normally paired with other composting technologies to fully stabilize and cure the compost.

Figure 3-14: Rotating Drum System

Table 3-8: Rotating Drum Benefits and Considerations

Benefits	Considerations
▪ Effectively mixes feedstocks and amendments ▪ Effective for initial decomposition of organic feedstocks ▪ Can be used for a variety of feedstocks and feedstock blends including yard waste, food waste, biosolids and other sources. ▪ Drums can be located outside or inside buildings, depending on drum size ▪ Aeration of drums reduces anaerobic conditions	▪ Results in an unstable compost that requires further processing to produce a finished marketable product ▪ highly mechanical and can require specialized maintenance staff (e.g. millwright) ▪ Drum wear and corrosion may occur depending on drum design and maintenance of the drum interior ▪ Complex loading and unloading ▪ Non-aerated drums results in anaerobic conditions

3.2 ANAEROBIC DIGESTION

Anaerobic digestion (AD) is a biological process that uses bacteria to decompose biodegradable organic materials (such as food waste, yard waste, and non-recyclable paper) in the absence of oxygen. The process results in production of biogas consisting primarily of methane and carbon dioxide. The biogas can be used to generate electricity, or it can be upgraded to pipeline-quality natural gas or other types of fuel (such as CNG). The remaining solid material that is not converted to biogas is called digestate. The digestate can be marketed as a fertilizer or soil amendment, typically after composting and curing. Currently the market for digestate is limited. It can be gasified to extract the remaining energy value or be landfilled. Anaerobic digestion can result in residue requiring landfill disposal, both from pre-processing of the feedstock and post-processing of the digestate. Factors that affect viability of an individual anaerobic digestion project include the following:

- Regulatory requirements to divert organic waste from disposal or reduce GHG emissions
- Quantity and characteristics of organic feedstock
- Carbon credit
- Tipping fees to process organics
- Long-term fuel or power purchase agreements (PPAs)
- Strength and stability of the market for beneficial use of digestate
- Avoided cost of disposal

Anaerobic digestion facilities are highly suitable for processing source-separated food waste or source separated food and yard waste. When yard waste is processed, the woody components may be removed and used as a bulking agent in a post-digestion composting process, rather than being used as feedstock to the digester, since these materials are slow to digest and yield lower levels of biogas. Management of source-separated organic waste requires infrastructure to collect this waste separately from other municipal waste. Anaerobic digestion facilities can also process mixed waste but would usually be paired with a mixed waste processing facility (integrated or as part of a separate operation) to recover recyclables, remove non-biodegradable materials, and digest an organic-rich fraction separated from the mixed waste. Without such pre-processing, the digesters would need to be substantially oversized to handle waste constituents with little or no biogas generation potential, and the resulting digestate would have significantly reduced potential for beneficial use.

3.2.1 Dry Anaerobic Digestion (High Solids)

Dry anaerobic digestion (AD) technologies (dry AD) or high solids AD is commonly used for source separated organics (SSO) that contain woody materials such as yard and garden waste. Dry AD has a similar biological process to wet AD, however, for wet AD the substrate is a slurry (<15% total solids by mass) and for dry AD the substrate is 40% to 50% total solids. This falls well within the range of available high solid or stackable substrates such as MSW, food waste, yard waste, and other organic substrates. The higher solids content equates to higher transport efficiencies in comparison to wet systems where 90% or more of the feedstock transported is simply water. Numerous proprietary technologies have been developed to commercially execute dry AD. Most notable amongst these technologies are garage style digesters and assisted plug flow digesters.

In garage style dry digesters, biomass is placed inside a sealed garage-like container with or without the use of material separation. Once the container is full, the environment is sealed, oxygen is removed, the temperature is increased to approximately 98˚F, and the substrate is irrigated with microbially enhanced liquids for a period of 25 to 30 days (which varies based upon substrate and technology purveyor). Liquid percolate (leachate) infiltrates the biomass and is collected through floor drains.

The methane rich biogas is continuously collected from the container. The biogas can be used to generate heat, electricity or both as in a traditional wet AD system. After the reaction period, the remaining waste is removed (either to landfilling or composting), and a new batch is inserted. This method has few mechanical parts and thus offers the advantage of needing limited material separation prior to digestion. This process has feedstock flexibility that comes at the cost of gas production efficiency.

The lack of stirring during the process means that not all materials are exposed to the methanogenic microbes vital to AD reactions, and the gas production suffers as a result. Depending on the pre-processing, dry AD can achieve a portion of the efficiencies (as low as 50% to 60%) in comparison to production rates achieved by wet AD technologies. Specifically, garage style digesters convert available total solids to biogas with roughly half the efficiency of wet AD systems. However, there is more flexibility as wet and dry materials that can be processed.

An advantage of dry AD systems is that they can handle larger amounts of contaminants (i.e., metal, glass, plastics, woody material, etc.). This is also a disadvantage at the back end of the process as the end product needs additional handling and processing and the contaminants affect the marketability of the end product.

Figure 3-15: Example of Garage Style Dry Anaerobic Digestion[1]

3.2.2 Wet Anaerobic Digestion (Low Solids)

Wet AD systems basically follow the processes listed above but have a feedstock input that is less than 15% total solids. Figure 3-16 is a flow diagram that illustrates the various stages in a wet AD process.

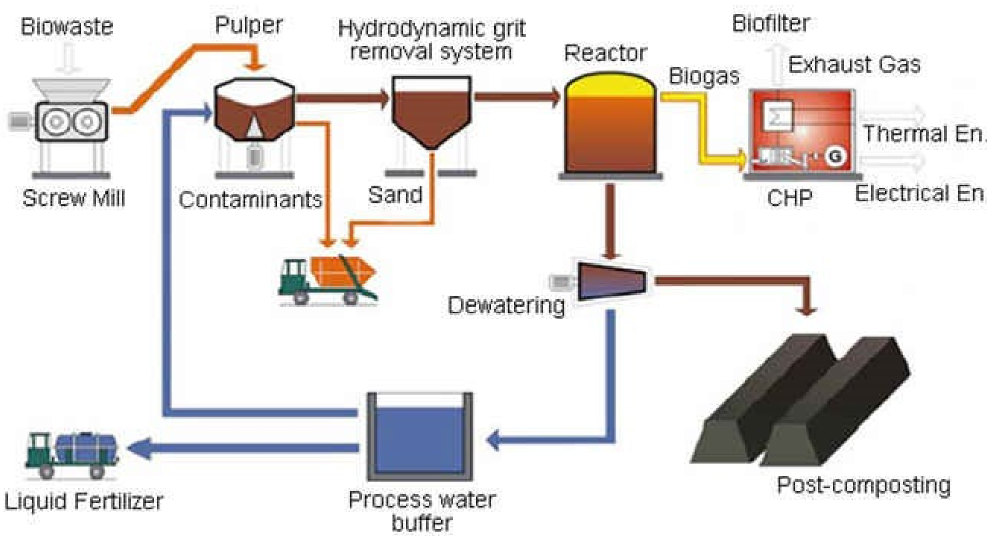


Figure 3-16: Flow Diagram of a Typical Single Stage Wet AD Process

[1] Source: *BioFerm Energy Systems* http://biofermenergy.com/

Co-digesting wastewater treatment residuals (biosolids) with source separated organics (SSO) from a MSW stream is being tested and considered in many wastewater treatment plants. Sanitary wastewater treatment plants that have anaerobic digesters have similar back-end processes for managing solids from the wastewater treatment plant. Co-digestion would require SSO to be processed into a slurry before it is fed into an anaerobic digestion unit. The source separated organic and biosolids would then be blended and mixed and fed into the co-digestion unit (i.e., anaerobic digestion reactor).

The digesters are typically pancake style digesters with fixed covers and insulation to conserve heat and minimize energy consumption for maintaining process temperatures. As with other anaerobic digestion alternatives, a hot water boiler and heat exchangers would be used to heat the feedstock and maintain process temperatures within the digesters. Mixing would be provided by submersible mixing equipment configured with tank roof access for maintenance and repairs while the tank remains in service.

As with the other technologies, biogas generated with co-digestion is recovered, cleaned, compressed, stored and used to produce electrical power or upgraded for injection into a natural gas distribution system. Recovered heat would supplement natural gas consumed in maintaining digestion process temperatures. Benefits to co-digestion compared to other AD approaches for the organic fraction of MSW are as follows:

- Utilize available digester capacity at wastewater treatment plants;
- Increase biogas quality and quantity that could be sold and/or used to supplement energy use at the plant; and
- Increase reaction time in the reactor.

3.3 COMMERCIAL FOOD WASTE DEPACKAGING

As states and municipalities aim to implement zero waste strategies, organics is one of the primary materials to divert from the waste stream. Even for locations that have addressed recycling or made other progress, organics often a largely untapped area.

As an example, Northeast states have promulgated food waste regulations focused on diverting organics from landfill aimed at commercial food waste generators, except for Vermont that has a universal recycling ban that includes residential food waste. With the problem of decreasing waste disposal capacity and increasing costs, both the public and private sectors are looking for ways to divert organics and be compliant with these emerging commercial organics bans. To be compliant commercial generators must source separate food waste from their solid waste stream, so the need for collection and food waste depackaging systems are evolving.

Depackaging technologies are responding to this need and are designed to remove the outer packaging and remove the food from its primary packaging with a focus on reuse of the food and the packaging materials. For solid waste facilities looking to get involved with organics recycling, depackaging can be integrated into existing material management streams at MRFs and Transfer facilities or can be a stand-alone operation.

Depackaging is a preprocessing step. It eliminates the need for manual labor and helps eliminate waste. It's difficult for generators to source separate food for many reasons: employee turn-over and training, lack of space, and time consuming to open packages, the yuck factor, to name just a few.

It keeps contaminants out of the feedstocks aimed for wet anaerobic digestion systems where food waste slurries can be pumped into the wet AD system. Depackaging can also preprocess feedstocks aimed for composting operations where the food waste particle size can be reduced for mixing with other feedstocks. It minimizes contaminants entering organics recycling facilities that take in commingled source separated food wastes from the commercial sector as well as residential organics programs. Depackagers can average around 90 – 99% recovery rate, depending on how much food remains adhered to the packaging after separation.

The process itself needs to be designed for the right application. There are two streams of materials that need to be managed: food waste and the packaging waste that is typically cardboard, plastics and metal. Depackaging can be optimized to target organics for wet AD and composting with minimal contamination and do as little damage to the packaging material for recycling purposes

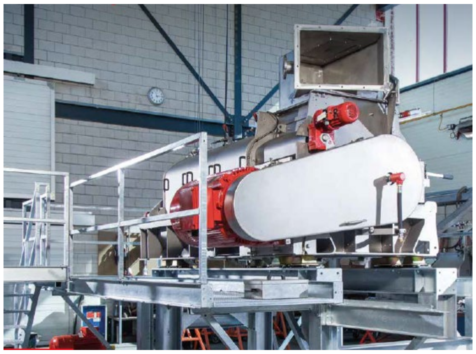


Figure 3-17: Depackager
Photo courtesy: **[Van Dyk Recycling Solutions]**

Figure 3-18: Bio-slurry
Photo courtesy: **[Scott Equipment]**

How Depackaging Works

Figure 3-19 shows an overview of the main components of a depackaging operation.

- A is the infeed conveyor with the Blue arrows showing the direction of the flow of the incoming packaged food.
- B is the infeed screws that enable the metered flow of the materials entering the C the Separator.
- D and E show the paths of the Packaging Waste and Organics discharges.

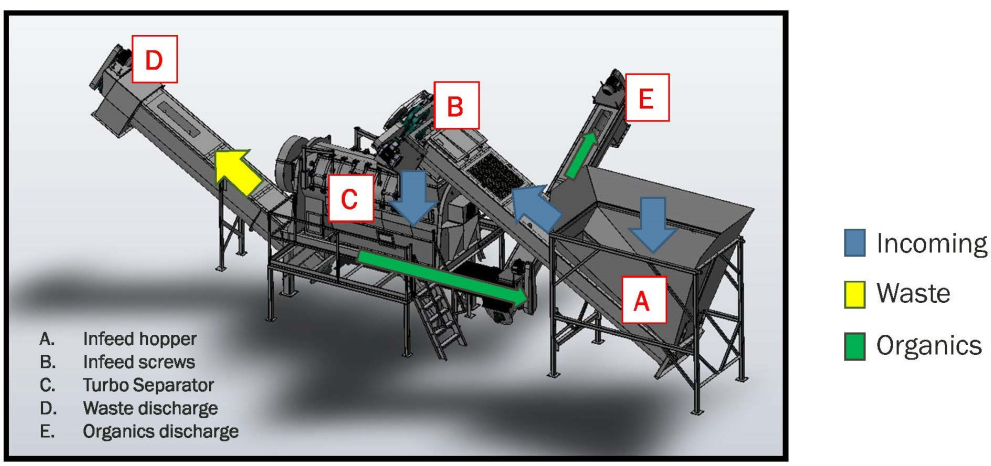


Figure 3-19: Flow Diagram of a Typical Depackaging System

4.0 DEVELOPMENT SCENARIO FOR SWS

SWS seeks to implement a pilot-scale composting facility at ARL or potential other location including the CTS. The pilot project will be designed as a training endeavor for SWS to gain hands-on experience in preparation for a potential municipal-scale composting operation at the ARL. The pilot-scale composting facility would operate to service the Community Compost food scrap drop-off program, in parallel with SWS' expansion of residential curbside organics to increase participation rate and development of a commercial organics collection program.

The existing organics program includes Curbside Organics Collection and Community Compost food scrap drop-off sites at both the Anchorage Regional Landfill (ARL) and the existing Central Transfer Station (CTS). The organics collected from both organics collection programs are transported approximately 50 miles to a composting facility. This pilot project supports Community Compost to operate as an extension to SWS' current organics management program and strategic plan for diverting organics from the landfill by introducing a pilot-scale composting operation.

4.1 SHORT-TERM: PILOT COMPOSTING FACILITY

The Project Team assisted SWS on the USDA Grant Application for Community Compost and Food Waste Reduction (CCFWR) Grant round two. The grant round two application narrative was based on evaluation of SWS's existing organics management system, and a high-level analysis for SWS to consider the feasibility of building organics management operations within the Municipality of Anchorage, which in part was funded by the CCFWR Grant round one.

The continuation of USDA funding for the pilot composting project will utilize one of the composting technologies identified in this report, in a limited fashion, as part of the CCFWR round two.

This pilot project, along with further research, will support Solid Waste Solutions' (SWS) organics management program goals to:

- Increase source separated organics (SSO) diversion and collection.
- Develop public outreach and ongoing education.
- Future planning on potential use of certified compostable food service ware items where applicable.

The USDA (CCFWR) Grant round two funding award would enable SWS to initiate site planning and development work in 2022, and implementation of the pilot-scale composting project in early 2023.

Pilot Project Objectives Align with the USDA Grant Program

- Produce local compost; to produce a consistent high-quality compost product for local food production.
- Generate composted materials for use on home vegetable gardens and local farms, support local food system resilience.
- Reduce reliance on fertilizers by using local compost to improve soil quality.
- Train volunteers and SWS staff on how to compost. Foundational composting skills are needed and could create jobs.

This pilot project also supports the goals in the SWS Integrated Solid Waste Master Plan and Municipality of Anchorage Climate Action Plan (2019).

- Make organics recycling convenient and accessible for residents and businesses. There is community demand to improve organics recycling participation rates and increase diversion from the landfill.
- Increase diversion through food waste reduction, organics collection/drop-off programs, expanded compost facility capacity and end market development, public sector recycling, community outreach and education programs.
- Expand the Community Compost Program by incorporating a composting operation within the Municipality of Anchorage too manage food waste and produce compost for local use. This would eliminate truck emissions due to transporting the organic material to more distant processing operations.
- From a GHG perspective, it is important to recognize methane emissions from landfill is several times higher than emissions from transportation. A contributor to climate change is methane emissions generated from the decomposition of organic (i.e. food, wood and yard) waste in the landfill.

4.1.1 Pilot Composting Pilot at Anchorage Regional Landfill (ARL)

A goal of the pilot-scale composting operation is to locate the pilot composting operation at the ARL. This pilot project is designed to prepare SWS to build up the composting operation at the ARL to support SWS' vision for new practices and programs that reduce waste generation, encourage reuse of materials, and increase recovery and recycling of materials to realize prolonged life at the ARL. The pilot composting operation would be managed by a professionally trained compost operator who would train volunteers to work at the site. Partnering with Anchor Garden would enable a volunteer community effort and outreach through their network of volunteer gardener coaches across each of Anchorage's 37 community council. This partnership would identify and educate environmental leaders within Anchorage communities to educate constituents, connecting neighborhoods, and potentially develop a Master Recycler/Composter program.

The composting pad area should be solid ground, either concreate or asphalt, with a minimum space of 60 ft. x 200 ft. Onsite power and a small building for housing the WIFI, controls and electronics is needed. The ARL already has these structures and services onsite therefore co-locating a composting operation at ARL makes sense economically and logistically. The pilot project would utilize existing Community Compost food waste collection site at the CTS and transport system to the ARL. As the composting facility grows over time to accept more food scraps (nitrogen source), the woody materials (carbon sources) are already collected onsite at ARL.

As the pilot project could potentially operate year-round, recommend utilizing a storage building or high tunnel structure to enclose the composting operation for managing the composting process and feedstocks during the severe cold months. Wind is an issue in Anchorage. Use of an existing structure or high tunnel can also help mitigate the challenges associated with wind. Also consider a building for receiving of inbound organic materials. This is especially important if the pilot project is located near an airport.

4.1.2 Odor Management

When considering a location for a composting operation, it is most prudent to select sites that prevail downwind and are removed from "receptors" as there is possibility for fugitive odors or other vectors. The GORE cover system technology is designed to reduce odor. However, odor discharges still may occur during the receiving and mixing of materials. During the composting process, fugitive odors may occur when uncovering the pile to turn and when synthesizing a new pile.

Tetra Tech can assist with odor monitoring and prepare an air model based on yearly data from the airport should SWS request this additional support.

4.1.3 Recommendation: Membrane Cover Composting System

Sustainable Generation Pilot Scale System

The Sustainable Generation (SG) GORE cover system is flexible in design and is simple and low cost to operate. The system is expandable to scale up as needed. The SG Mobile™ System is recommended for this pilot project. SG can have the Mobile System delivered, installed, and train the SWS operations team within 12-16 weeks after the agreement is signed. The SG Mobile System controls operate using standard 110/240/480-volt power. A small building is required for housing the electrical and WIFI equipment. System controls are managed through the SG's server for SWS site operator to connect either through cell phone, IPAD, or PC to log on and get real time temperature, blower times, and aeration. SG Mobile System main components are listed below.

- One SG Mobile System GORE cover
- One SG Mobile Blower
- One 6-inch HDPE pipe for aeration; can be above or in ground
- Connection to power and WIFI
- 100 tons per batch; process cycle time is up to 8 weeks

SG provides training for SWS site operator on all equipment, feedstock recipe and mix. SG personnel is onsite for set up and provides continued support for the duration of the 2-year pilot.

SWS Staff and Equipment Requirements

A dedicated SWS staff is required to assist with initial set up and commissioning of the Sustainable Generation Mobile System. The amount of time for preparation is 2 to 3 days for the initial set up and pile build. SWS staff is required to assist the SG personnel with the aeration system that requires welding and drilling of HDPE pipes, and guide the first pile mix and to build the compost pile.

- Extendable arm loader with forklift attachment to move and store pilot equipment prior to installation, and for unloading equipment
- Grinder/shredder or mixer for mixing feedstocks
- Front-end loader for building piles
- Screener for screening finished compost to remove overs and contamination, provides consistent end-use product.

After installation is completed and the composting operation is underway, SWS staff will confirm to SG that equipment is operating correctly. SG personnel will conduct a follow up site visit after 4 weeks of operation. **Table 4-1** shows the required SWS responsibilities and site requirements for implementation of the SG Mobile System (GORE Covered System).

Table 4-1: SWS Responsibilities and Site Requirements for the SG Mobile System

Item	Description
Site Pad Location	Minimum of 60 ft x 200 ft solid ground. *(concreate or asphalt)*
Equipment Acceptance	Receive SG Mobile System pilot equipment and store prior to installation.
Forklift	Extendable arm loader *(can also be large enough to reach 15 ft. high)* for unloading SG pilot equipment - Unloading SG Mobile System pallets upon arrival to site - Loading SG Mobile System pallets upon completion of the project
Dedicated Static IP Address	Internet connection for operating control systems. *(Must be dedicated static IP address.)*
Permitting	Permits and approvals per State and Local regulations authorities.
Insurance	Proof of insurance as required *(minimum $120,000 for the SG Mobile System equipment)*
Feedstocks for Mix Recipes	Feedstock and bulking agenda for 6 batches total *(using an 8-week treatment process.)* - Each batch should be approximately 100 tons (@ 925 lbs. /cu yd) - 1:1 by weight or 3:1 by volume - C:N ratio of 25-30:1 *(Carbon to Nitrogen ratio)* - 55-65% Moisture Content - Minimum 35% porosity
Equipment for Pre-treatment	Tub grinder, shredder, or mixer for mixing feedstocks. For receiving and mixing feedstocks into recipe in preparation for the composting process.
Material Handling	Front-end loader for building compost pile 10 ft. high.
SWS Staff for Assistance	For Installation and start-up assistance. Assist SG technician in the startup checklist and system testing to ensure proper functioning of equipment.
SWS Lead Operator	Designated single point of contact who will be responsible for all on-site activities and the operation of the control system and system reporting.
Pile Construction	Building of the first pile. GORE® cover placement, weighting system placement, flipping of heap for Phases 1-3.
Post-Treatment	Screener for final compost product
Laboratory Testing	Sample, ship, and lab testing per SG protocol. - SWS responsible for lab testing fee. - Lab results to be shared with SG and GORE.

4.1.3.1 Feedstocks and Finished Compost

The organics collection from the current Community Compost drop-off sites (ARL and CTS) is the feedstock for the pilot project. During the 2020 season (May-October) there was a total 20.31 tons of food waste collected from both locations. The per week average was a total 2.75 tons of food waste in 2020. SWS indicated there could be 10 tons per week of comingled food waste and yard waste to start up the pilot composting operation. It would be beneficial to source additional feedstocks to increase throughput.

Tetra Tech can assist SWS on sourcing additional feedstocks and increase residential participation. Potentially include institutional/commercial food waste, agricultural or landscape green waste. Tetra Tech can also assist SWS with the storage of the feedstocks in preparation for the composting operation. After the active composting process is complete, the compost requires additional time to cure and stabilize. The finished compost product would be available for residents at the pilot composting location after the first year of the pilot.

4.1.3.2 Estimate Costs for Pilot-Scale Composting Project

Funding would allow SWS to hire an industry consultant to assist with the pilot-scale project, lease equipment for a pilot composting operation, and train local staff. The funding is required for a two-year equipment lease of a Sustainable Generation (SG) GORE Covered composting system to manage source separated organics (all food and yard waste). In 2021 SWS spent $88,650 for a vendor to manage the two organic waste drop-off sites. The services included organics collection containers at both drop-off sites, transportation of the collected organics 50 miles to a farm for composting and transportation of finished compost back to the two sites for residents to use. This budget could be utilized to support the pilot project and serve as a partial matching fund.

Tetra Tech

Tetra Tech's budget for consulting services to support SWS's pilot compost project is $21,000. Tetra Tech will be involved throughout the process and assist SWS on the preparation for the pilot, site preparation, feedstocks, and lead time required for Sustainable Generation/GORE personnel. Recommend weekly 1-hour calls or bi-weekly 2-hour calls to check on the status of the project.

Sustainable Generation

The SG Mobile System is a lease for a 2-year pilot period. The lease price for 24 months is $99,700. This includes shipping equipment to and from the SWS location. Also includes SG personnel on-site during all major steps in the process including:

- To mobilize the system, commissioning, training and supervise the initial building of the pile
- Supervise the turning of the piles between phases
- Inspection of the final compost product produced at the end of the process
- To de-mobilize the system for shipment.

4.1.3.3 Project Examples of Pilot-Scale Sustainable Generation/GORE

Cold Climate

Tetra Tech has consulted on several GORE systems in Canada including the City of Edmonton, and a more recent GORE system near the City of Saskatoon in Saskatchewan, Canada. Tetra Tech also assisted Metro Vancouver on a composting pilot project located at the **Northwest Langley Wastewater Treatment Plant in Vancouver, British Columbia, Canada**. **Figure 4-1** shows how the feedstocks are mixed in the tub grinder and the piles are built using a front-loader. **Figure 4-1 and Figure 4-2** shows the cover in place and the surrounding area clean. Sustainable Generation has other relevant experience with cold climate installations. This information is attached as a separate PDF.

Figure 4-1: Feedstock Preparation

Figure 4-2: Active Composting

Community Composting

Sustainable Generation worked with Earth Matter New York, a hands-on community education resource that seeks to divert organics from the waste within the New York City borough of Manhattan. For the majority of their organics processing, the Sustainable Generation (SG) system is used which consists of the Gore Technology

Breathable cover that retains moisture in the pile and mitigates odors. **Figure 4-3** shows the SG Mobile System with solar to power the computer sensors, controls, and blower timers. Earth Matters processed 600 tons of organics in 2020. Each pile consists of about 80 tons of organics. A new pile is built every 4-6 weeks using skid steers to manage the piles. The Gore system is scalable and allows Earth Matter to increase volumes processed. They have recently established venues to distribute locally produced compost more widely, which frees up processing space.

Figure 4-3: Earth Matter New York

5.0 LONGER-TERM: FULL SCALE ORGANICS MANAGEMENT

Tetra Tech conducted a high-level analysis of up to four alternative options for organics management, collection, and processing within the Municipality of Anchorage.

5.1.1 Membrane Covered Aeration System

The Project Team conducted a high-level analysis for the feasibility of a covered aerated composting system for managing organic waste from a variety of source separated organics (SSO), including yard debris and all food materials. The organic waste stream can include residential yard debris and kitchen waste, municipal and commercial green waste, and commercial food materials.

The Sustainable Generation/GORE cover system is flexible in design and is simple and low cost to operate. The system is expandable to scale up as needed over time.

The system is highly efficient for emission and odor controls, stormwater, contact water and leachate management, and is effective in all climates – especially in cold climate environments.

As described in **Sections 3.1.3.3 and 4.1.5.1** the system controls are managed through the Sustainable Generation (SG) server for SWS site operator to connect either through cell phone, IPAD, or PC to log on and get real time temperature, blower times, and aeration.

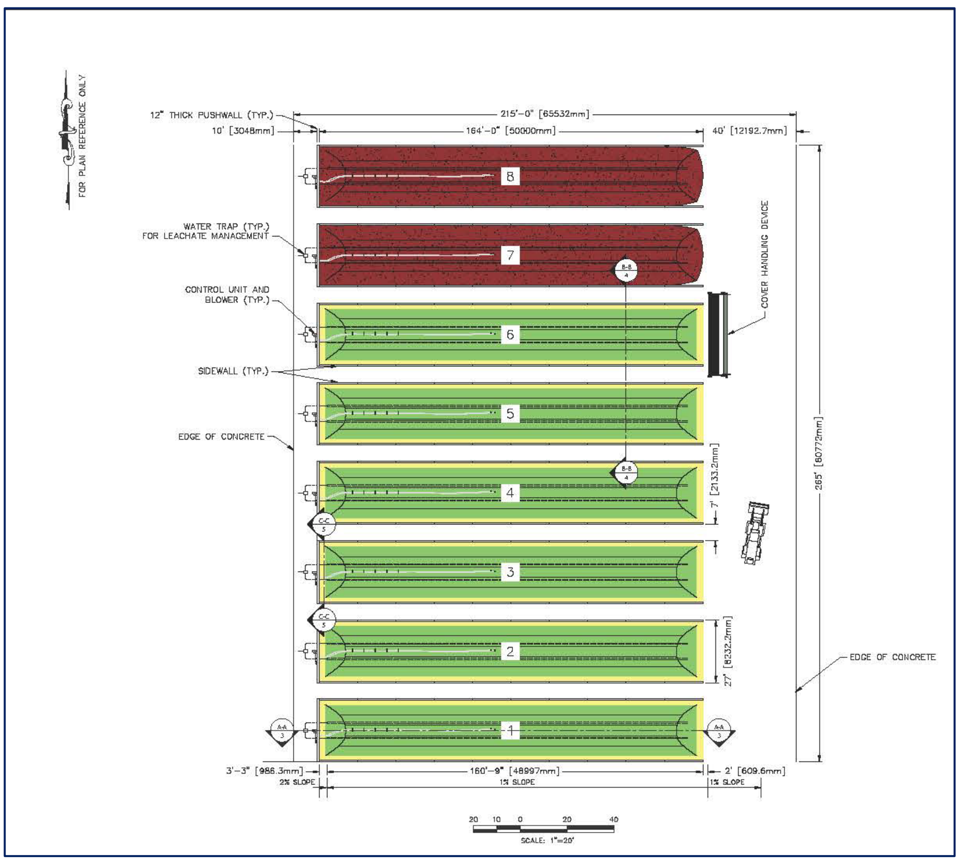


Figure 5-1: SG GORE 6 Bunker

5.1.2 Dry Anaerobic Digestion (High Solids)

The Project Team conducted a high-level analysis for the feasibility of a dry anaerobic digester for managing organic waste from a variety of source separated organics (SSO), including yard debris and all food materials.

The organic waste stream can include residential kitchen waste, municipal and commercial green waste. These waste mixtures typically contain high proportions of solids and foreign matter, and this is where the advantages of dry anaerobic digestion bring value for managing organics.

Hitachi Zosen INOVA (HZI)/Kompogas Dry Anaerobic Digestion technology is proven in cold climate environments in Europe. The first North American HZI/Kompogas system is located in San Luis Obispo, California and started operations in 2018.

Figure 5-2: HZI San Luis Obispo, CA

It is designed to process up to 36,500 tons per year of SSO, green waste and fats, oils, grease (FOG) from the county-wide residential collection program. The system is designed as a continuous dry (thermophilic temperature) anaerobic digestion for organic waste management and converts the material into renewable products. **Table 5-1** shows the general AD process and output. **Table 5-2** shows the potential end-products and markets.

Table 5-1: Dry Anaerobic Digestion Process, Activity and Output

Anaerobic Digestion Process: Basic Steps	Activity and Output
Pre-treatment	Organic waste is shredded and cleaned of metals before being fed into the plug-flow digester
Material fed into the plug-flow digester	Thermophilic AD process ensures complete sanitation of the organic matter while its gas potential is fully exploited.
Biogas generation and collection	Biogas is utilized in an on-site combined heat and power (CHP) unit to produce renewable energy in the form of electricity, can be exported to the utility power grid.
Digestate (discharge) collection both solid and liquid fractions	Solid digestate is aerated in indoor composting area and marketed as nutrient- rich compost and fertilizer to local the agriculture market and residents Liquid digestate marketed as nutrient- rich compost and fertilizer to local the agriculture market.

Table 5-2: Dry Anaerobic Digestion End-Products and Uses

Potential End-Products	Uses
Biogas	• Electricity feed into LFGTE (Doyon) • Can be cleaned/upgraded for use as RNG fuel
Compost	• Soil amendment for residential and local farms
Biochar	• Mixed with compost for soil amendment • Fuel
Hydrogen gas collection	• Renewable energy and fuel

The HZI/Kompogas AD system in San Luis Obispo cost approximately $25M. This results in a capital cost factor of $685 per annual ton processed.

Cost benefit analysis should be conducted to assess the feasibility of a dry anaerobic digestion system. This analysis would be based on several factors including the potential end-product and markets as shown in **Table 5-2.**

Tetra Tech has completed over 100 AD projects (wet and dry systems), and can provide SWS with complete bioenergy services, including feasibility and cost benefit analysis, design, development design, construction management, and engineering services.

5.1.3 Existing In-Vessel Equipment at Alaska Waste

As part of this task, the Project Team conducted a desktop review of the specifications and condition of the existing dormant in-vessel composting system located at the Alaska Waste facility to evaluate the potential use. The system is currently housed inside the metal fabrication area with eight worker bays. Due to keeping the equipment indoors and complaints of odor, the ventilation system needed to be retrofitted and expanded to the outside of the building. A greenhouse fan was installed to pull moisture and smell to the outdoors.

Rotary Drum System

Alaska Waste purchased an XACT BioReactor rotary drum system. The system is a 10-foot diameter by 30-foot-long vessel installed at Alaska Waste 2009 and began operation in 2010. The rotating drum system is designed to process 45 cubic yards per week for a 7-day continuous process. Alaska Waste processed about 15 cubic yards per week.

Figure 5-3: Rotary Drum at Alaska Waste

The in-vessel composting system is comprised of the BioReactor, four conveyors, and a mixer. Processing started with commercial food waste being loaded into a four-auger mixer truck to sit overnight. This allowed for the excess liquid to drain off. In the morning, the mixer was started, and manures and wood chips were added to create a feedstock recipe. The mixing process was about 20 minutes, and the contents were discharged onto a conveyor that sent the material to the in-feed of the BioReactor. **Figure 5-2** shows the in-vessel system housed inside the Alaska Waste metal fabrication building.

Commercial Food Waste Challenges

Alaska Waste collected commercial food waste, specifically unpackaged produce (fruits and vegetables) from local supermarkets. There were challenges with the waste collection process due to the high volume of moisture from produce waste and compounded by the cold climate. *(Moisture content of fruit and vegetables is between 75-95%.)* Problems occurred when pre-consumer vegetables and fruit waste (thousands of pounds per day) were placed in the dumpster, and free liquid generated from the produce would run out of the dumpster and from the collection trucks. To manage the issue with moisture, Alaska Waste provided all of its grocery store customers with 64-gallon tipper carts.

Another challenge was the timing of the rotating drum. To find the right timing to balance the rotation sequence to prevent the material from going anaerobic. A third challenge was developing the right mix of inbound feedstocks including wood chips, wet food waste and horse manure. A part of this operation involved training staff to understand materials (carbon and nitrogen sources) to find the right mix of feedstock for the feedstock recipe.

Alaska Waste partnered with tree services to stockpile a massive supply of woodchips to get through the winter, so they stockpiled this carbon source from May through September. They found it useful to utilize a grinder/auger truck to reduce particle size and mix the feedstock to create a homogeneous feedstock for the composting process.

Alaska Waste stopped using the equipment in 2016 due to staffing issues. This year (2021) Moffitt Farms agreed to purchase the equipment.

6.0 DEVELOPMENT SCENARIOS FOR ORGANICS FACILITIES

One of the goals of this feasibility study is to identify two (2) locations near the Anchorage population center for development of an organics management facility.

6.1 POTENTIAL SITES

Tetra Tech conducted a high-level analysis of five potential sites. Two of these sites are located at the Alaska Regional Landfill (ARL), two locations at existing Central Transfer Station (CTS), and the Asplund Wastewater Treatment Plant.

Table 6-1: Potential SWS Sites for Organics Management

Solid Waste Facility Location	Purpose	Proposed Technology
Alaska Regional Landfill (ARL): LFGTE site North and West Additions	Pilot-scale composting project; Full-scale organics management facility	Membrane covered composting for Pilot-scale composting project and scale up to full capacity composting operation. Dry Anaerobic Digestion with biofilter for odor management.
Central Transfer Station (CTS): Triple A Property CTS building	Pilot-scale composting project; Organics receiving	Membrane covered composting for pilot-scale composting project. Temporary location for composting. Organics receipt at the CTS/Resource Recovery Complex
Asplund Wastewater Treatment Plant	Pilot-scale composting project	Membrane covered composting for pilot-scale composting project. Temporary location for composting.

6.2 ALASKA REGIONAL LANDFILL (ARL)

For siting a full-scale organics facility that could be designed as membrane covered composting operation, or as a dry anaerobic digestion facility with a composting operation.

Two potential locations at the ARL were identified. One potential site is the property adjacent to the existing landfill gas to energy (LFGTE) facility. A second potential site is the area called North Addition / West Addition.

6.2.1 Existing Landfill Gas To Energy (LFGTE) Facility

The existing landfill gas to energy facility located at the Doyon Utilities is the location identified with the best potential for siting a full-scale composting facility and a dry anaerobic digestion operation.

This is due to the general site footprint requirements and minimum dimension/aspect ratios. For the purpose of this feasibility study, the requirements of the AD with composting operation can be placed into the form as the site plan dictates.

Figure 6-1 shows the hypothetical layout for the organics management facility.

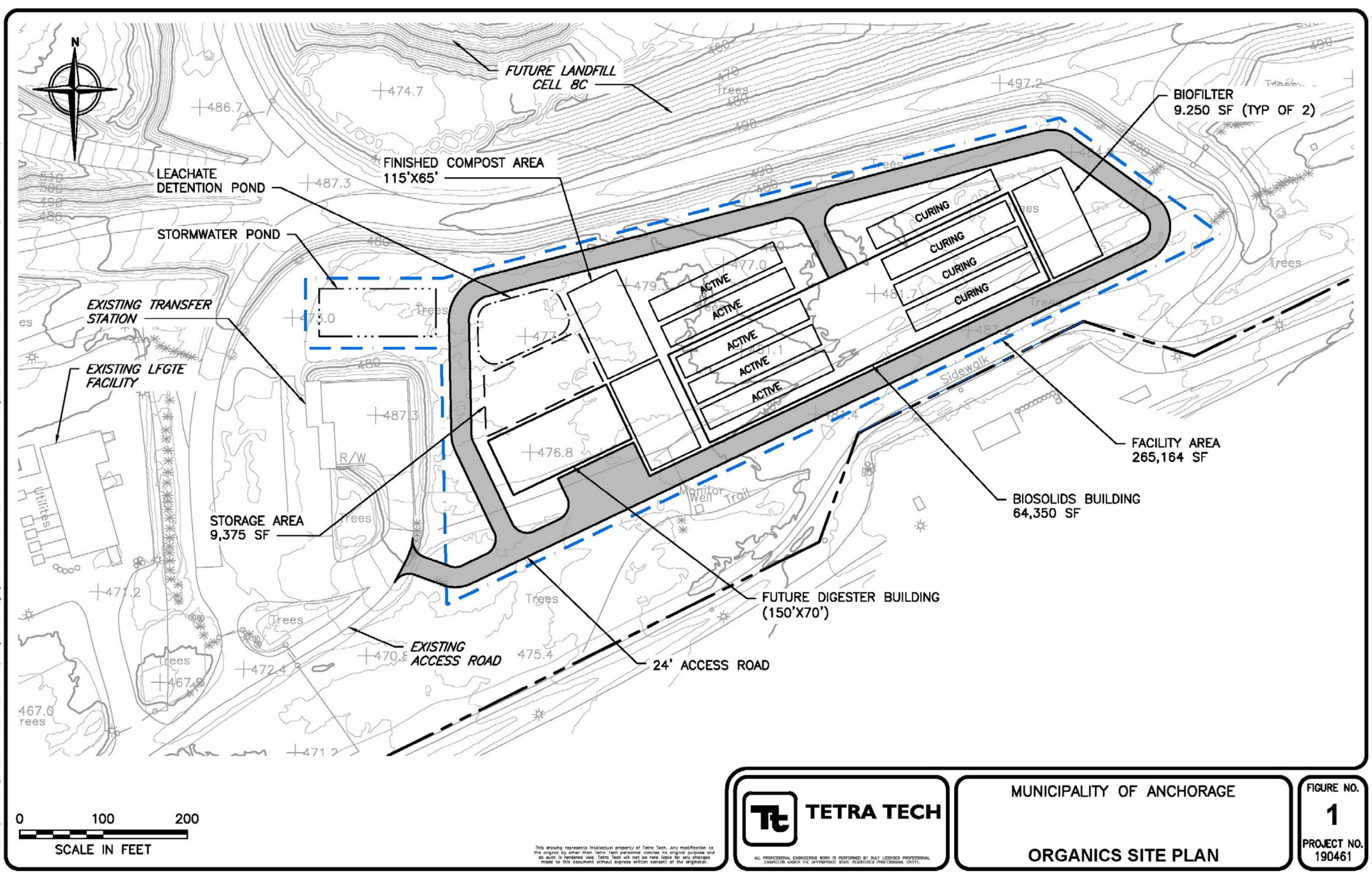


Figure 6-1: LGFTE at ARL

6.2.2 North and West Additions at ARL

For the purpose of this feasibility study, the requirements of the AD with composting operation can be placed into the form as the site plan dictates.

Figure 6-2 shows the potential locations where the organics management facility could be located relative to the landfill. The same hypothetical layout for the organics management facility as shown in **Figure 6-1** can be utilized. This again is due to the general site footprint requirements and minimum dimension/aspect ratios

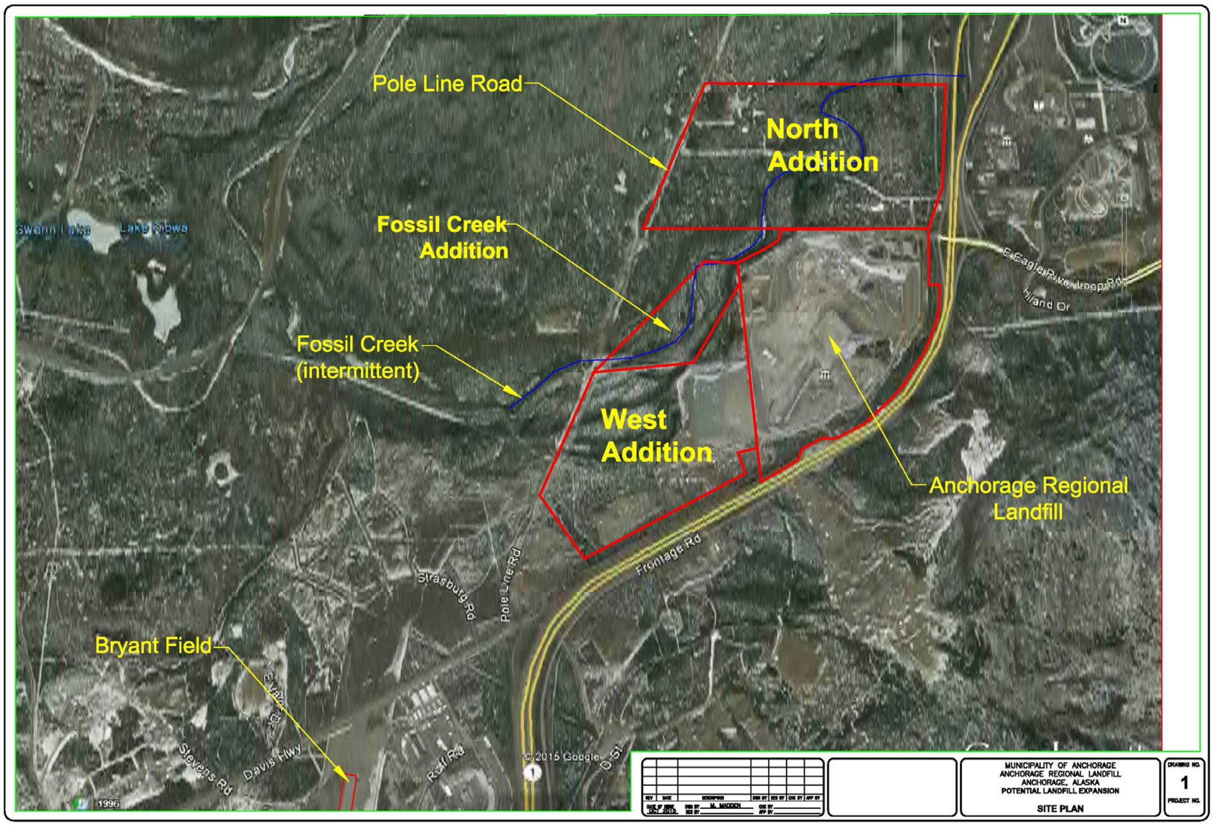


Figure 6-2: North and West Additions at ARL

6.3 CENTRAL TRANSFER STATION (CTS)

It is the project team's understanding that the Triple A Property area outlined in **Figure 6.3** would be cleared and technically not developed during 2023. If we consider this area for the potential opportunity to site the pilot-scale composting operation into the Resource Recovery Campus at the current Central Transfer Station, ideally it would line-up with USDA grant for commencing the project in 2023.

As a pilot project, it could provide the community an opportunity to learn about organics recycling and composting best practices.

6.3.1 Triple A Property

Potential location for a pilot composting project at the Triple A property in 2023, timing might work with SWS plans for clearing this area for the next phase of development. The pilot project would be a temporary structure until a final location could be determined and approved, ideally at the ARL. **Figure 6.3** shows the potential L-shaped area that could be utilized for the pilot-scale composting project.

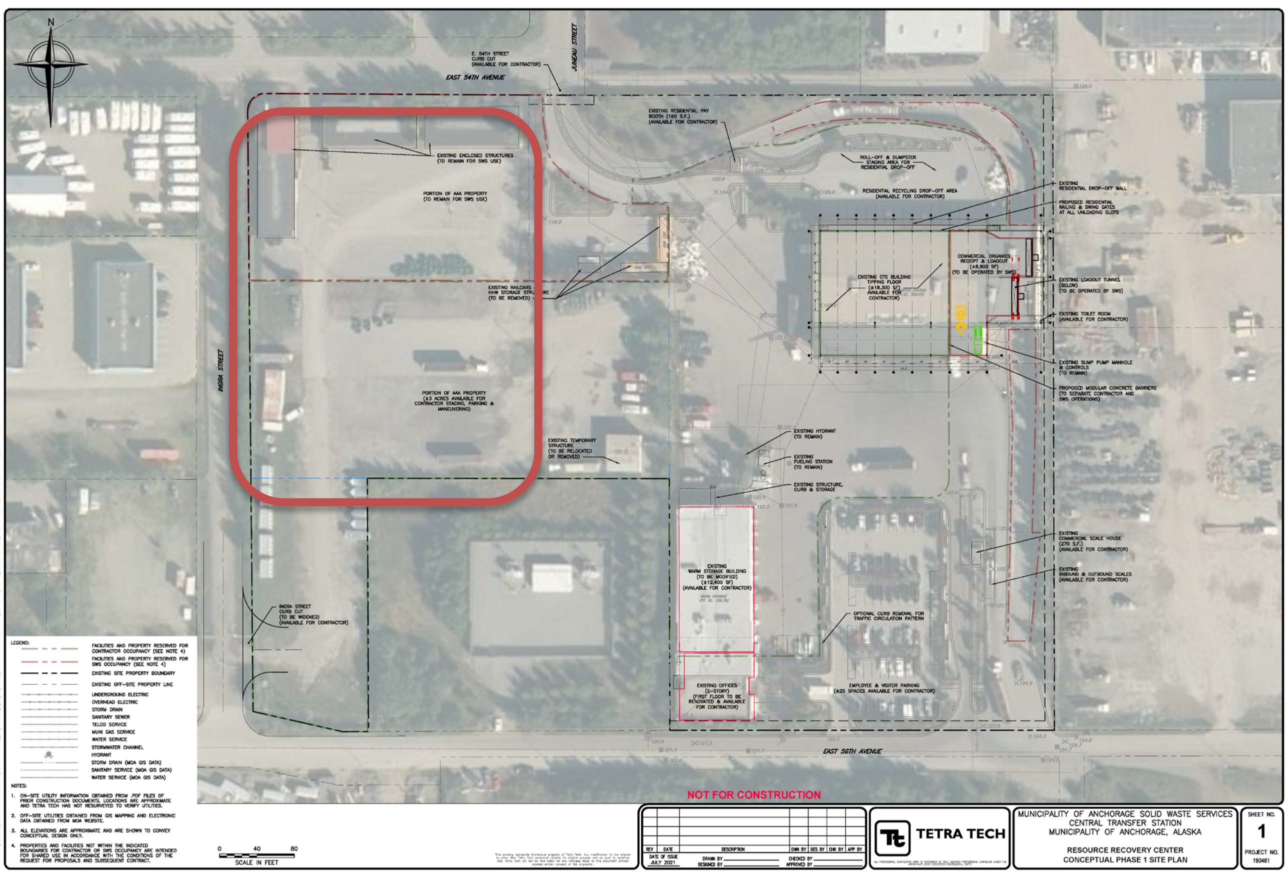


Figure 6-3: Triple A Property at CTS

6.3.1.1 Organics Receiving at the Proposed Recycling Center

Tetra Tech conducted an initial review to incorporate organics receipt (residential and potentially commercial) and management at the existing CTS. Any utilization of the existing CTS will have to be integrated with the ongoing progression of the proposed Resource Recovery Center development concept plans (Phases 1A and Phase 2), currently being performed by the Tetra Tech team.

Tetra Tech is working on the RFP for a third party to manage the existing Central Transfer Station (CTS) for receiving recyclable materials. One third of the building is reserved for organics receiving by SWS. Two bays and the loading area estimate 20 feet wide by 150 feet long. The bays will be used primarily for the collection of yard waste from both commercial trucks and residential drop-off.

Figure 6.4 shows the current draft of the proposed site plan for the proposed recycling and SSO acceptance facility. The areas outlined in red is the space designated for SWS activities for organics receiving and collection.

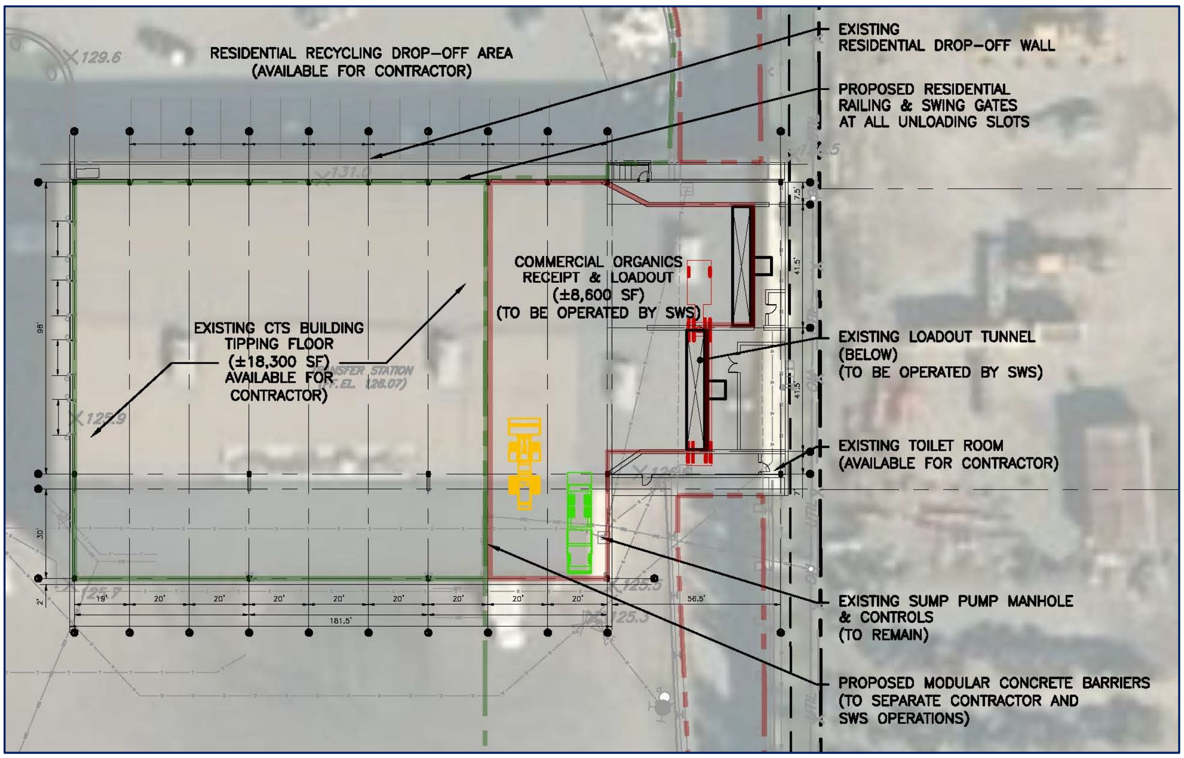


Figure 6-4: Organics Collection at the Proposed Recycling Center (Existing CTS)

6.4 JOHN M. ASPLUND WASTEWATER TREATMENT PLANT

Anchorage Water and Wastewater Utility (AWWU)'s Asplund facility (AWWTF) could be a potential site for the pilot-scale composting project. However, it is located near the Ted Stevens Anchorage International Airport. **Figure 6.5** shows the AWWTF facility located near the airport. Although there appears to be potentially some areas for the pilot-scale composting project, there is always a potential risk for an organics facility to attract birds. Therefore, it is not recommended to site a composting facility near an airport for this reason.

Figure 6-5: John M. Asplund Wastewater Treatment Plant

Co-digestion of biosolids and the organic fraction of the MSW (source separated organics) is not recommended for producing a compost product as a soil amendment. As one example, the recent experience at the Golden Heart Utilities with PFAS detection in their biosolids compost stopped their sale of compost for residential use. Of course, the biosolids digestate can be disposed of in the landfill, but this is not the purpose of SWS' potential organics management facility.

As a potential opportunity for AWWTF to manage biosolids, AWWU might consider composting biosolids mixed with wood chips as bulking agent. The most appropriate type of composting technology would be an agitated mass bed composting operation as described in **Section 3.1.4.**

6.5 POTENTIAL ORGANICS TONNAGE

Organic feedstocks generated in Anchorage were identified in order to determine the size of a potential organics processing facility. These estimates were based on the 2016 MSW disposal rate (~330,000 tons) and waste composition statistics from a comparable northern municipal region.

Waste Composition

An example of a comparable municipal region in the Peace River Regional District (PRRD) located in the North-Eastern corner of British Columbia was selected to provide an estimate for organic materials disposed at a landfill. A four-season waste composition study was performed for the PRRD that comprised of over 150 samples (200 lbs. per sample) across four sectors of residential curbside collection, generator drop-off at a transfer station, and industrial, commercial, and institutional (ICI) sectors.

Results from the PRRD study indicate that the largest components of the solid waste stream are compostable organics (food waste, compostable papers, and yard debris), followed by mixed paper, plastics, and building materials. The waste composition results would enable SWS to develop a baseline set of data for the various sectors. These data would then allow SWS to benchmark future organic diversion programs. **Table 6.2** shows the compostable organics percentages of each stream.

Table 6-2: Percentage of Compostable Organics in a Comparable Municipal Region

Sectors	Percentage of Compostable Organics
Residential Curbside Collection	51.5%
Generator Drop-Off	28.3%
Industrial, Commercial and Institutional (ICI)	31.2%
Weighted Average	**35.2%**

Predicted Organic Waste Feedstocks

The predicted future organic waste feedstocks estimated for each waste stream sectors (residential curbside collection, residential drop-off, and ICI) tends to experience different levels of organic diversion in a fully developed source separated organics (SSO) program. It is estimated that residential curbside collection could achieve 50% diversion of compostable organics, generator drop-off could have about 30% organics diversion, and the commercial (ICI) sector could achieve 50% organics diversion rate.

Based on estimated MSW tonnages, the percentage of compostable organics and organic diversion parameters, **Table 6-3** shows the organic waste quantity estimation that are available for a hypothetical organic processing facility. **Table 6-3.1** shows the potential sources of organic waste.

Based on Tetra Tech's analysis and current MSW characteristics, it is estimated that there is about 130,000 tons of organics in the waste stream and based on potential diversion capture rates, a compost facility within the Municipality of Anchorage would need to be sized for at least 62,000 tons of organic waste per year.

Table 6-3: Organic Waste Quantity Estimations

Sector	Estimated Amount of Waste Disposed (Tons)	Estimated Amount of Organics Disposed (Tons)	Predicted Organics Capture from Collection
Residential Curbside Collection (SWS and Private Hauler Service)	132,572 tons	68,255 tons	34,127[1] tons
Generator Drop-off	41,475 tons	11,756 tons	3,527[2] tons
Industrial, Commercial and Institutional (ICI)	155,953 tons	48,628 tons	24,314[3] tons
Total	**330,000 tons**	**128,639 tons**	**61,968 tons**

1) Assumes 50% of organics stream is collected from residential curbside collection programs
2) Assumes 30% of organics can be diverted from self hauled generators
3) Assumes 50% of organics from commercial sector can be diverted

Table 6-3.1: Potential Sources of Organic Waste

Sources	Type of Materials	Availability
Residential: Food and yard debris; curbside collection (SWS and Private Hauler Service), and Generator drop-off	All food scraps including meats, bones and dairy, food-soiled compostable papers (napkins, paper towels, greasy pizza boxes)	Year round
	Grass clippings Leaves Brush Christmas trees	June-September September-October May January
Industrial/Commercial: Grocers, restaurants, coffee shops, bakeries, breweries, hotels, fish processors	Food scraps from meal prep and food waste, coffee grounds with filters, brewer spent grain; certified compostable food service items	Year round
Institutional: District Nutrition Services, Alaska School District	Food scraps from meal prep and food waste; certified compostable food service items	School year
Aramark, US Foods, Sysco Joint Base Elmendorf-Richardson Ted Stevens International Airport	Food scraps from meal prep and food waste; certified compostable food service items	Year round
Other	Trees, logs, wood debris; wood chips; wood pallets; clean wood from C&D; horse manure/bedding	Year round

Commercial Organics Collection

The Industrial, Commercial, and Institutional (ICI) sector *(i.e. large grocers/supermarkets, full-service restaurants, schools, etc.)* represents 47% of waste disposed in Anchorage, an estimate of 155,953 tons of commercial waste per year.

Assuming the organics fraction is 30% of that commercial waste stream, this would equate to 48,628 tons per year of commercial organics disposed at the ARL. It is predicted that half of the commercial organics could be captured. This is an estimate of 24,314 tons of commercial organics that could be collected for organics recycling through composting or anaerobic digestion. **Figure 6-6** shows the potential large commercial generators *(large grocers and restaurants)* in Anchorage. Large commercial generators include Carrs, Fred Meyer, Costco, Target, and Wal-Mart stores.

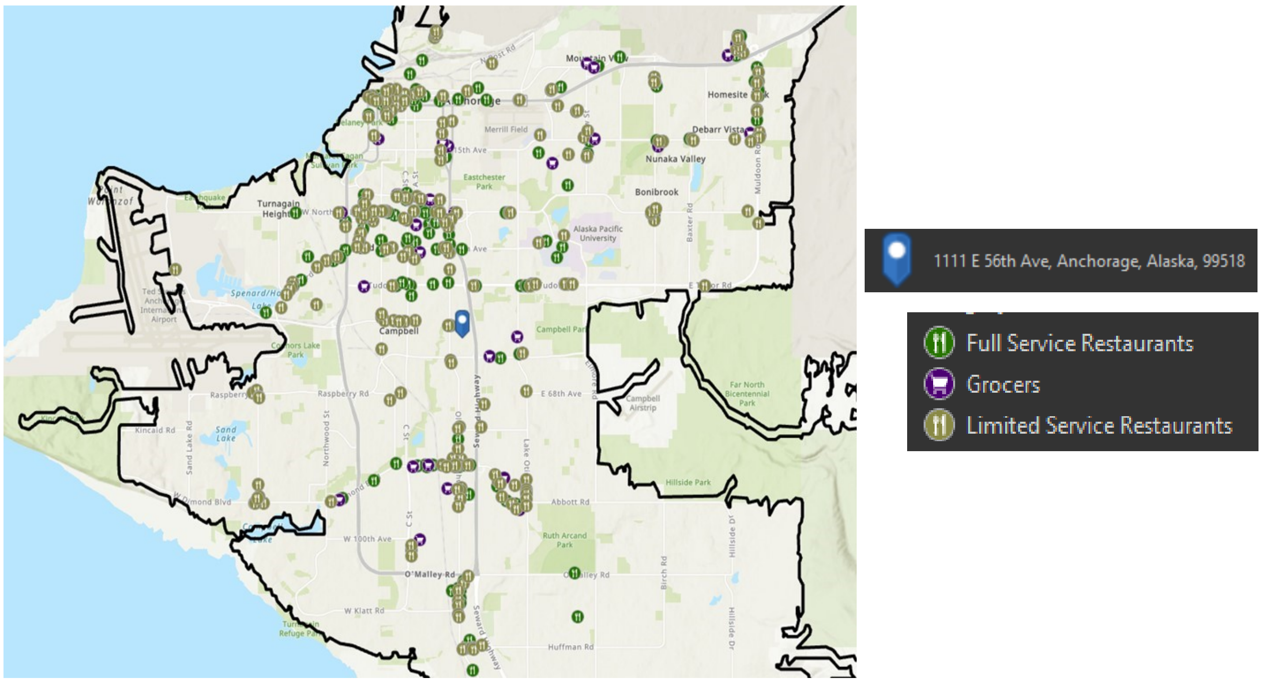


Figure: 6-6: Industrial, Commercial, and Institutional (ICI) Food Waste Generators

6.6 POTENTIAL COSTS FOR AN ORGANICS MANAGEMENT FACILITY

Based on Tetra Tech's analysis and current MSW characteristics, it is estimated that there is about 130,000 tons of organics in the waste stream.

Based on potential diversion capture rates, a compost facility within the Municipality of Anchorage would need to be sized for at least 62,000 tons of organic waste per year. A full-scale composting operation to manage this amount of annual organics tonnage is estimated between $15 M to $30 M.

Based on the HZI/Kompogas example described in **Section 5.1.2,** an estimated project cost to process 36,500 tons per year is between $25 M to $35 M. A dry AD system designed to manage at least 62,000 tons of organic waste per year is estimated between $50 M to $70 M.

Additionally, there is the likelihood for the combination of the dry AD system with the membrane covered composting system to manage digestate. The costs for these two technologies combined could be an estimate $40 M to $100 M, depending on the size of the dry AD system. These estimated costs are based on an initial high-level analysis. There are some cost efficiencies that could be addressed with planning, design, and engineering services.

Table 6.4 Overview of Estimate Cost: Organics Management System

Type of Organics Management System	Estimate Cost Range	Benefits
Composting Facility	$15 M to $30 M	Locally produced compost. System is scalable over time
Dry Anaerobic Digestion	$25 M to $70 M	Locally produced biogas, electricity, and compost from the digestate. System is potentially scalable, requires preplanning.
Dry Anaerobic Digestion with membrane-covered composting system	$40 M to $100 M	Locally produced biogas, electricity, and compost from the digestate. Design cost efficiencies and systems are potentially scalable, requires preplanning.

7.0 COMPOST PRODUCT QUALITY

7.1.1 Contamination

Both the composting operation and dry anaerobic digester can accept wood debris, yard trimmings, all food waste including meat and bones, and certified compostable food service ware products. These technologies will not accept packaged food or liquids unless it has been de-packaged. Should SWS consider receipt of packaged food from commercial entities, then the potential organics recycling facility would need to include a depackaging operation.

Recommend no recyclables will be accepted at the potential composting facility. Any material delivered in conventional plastics bags should not be accepted. Contamination is typically plastics. Items NOT accepted, but are not limited to:

- Treated or painted wood
- Pet waste
- Personal hygiene products including diapers
- Non-biodegradable plastic films
- Metal, glass, plastic, concrete, textiles
- Animal mortalities

7.1.2 Available Feedstock and Recipe

Knowing what materials are available and the seasonal volumes are some factors to consider for developing a feedstock recipe for the composting process. For example, bakery wastes are drier than produce and fruit from a grocery store. SWS will gain experience during the pilot-scale project, to get familiar with the materials available to calculate a mixture resulting in an initial C:N ratio of 30:1 and moisture content of approximately 55-60%. Preparing a recipe and referring to compost basics will enable a composting facility to avoid odor, pathogens and vectors.

7.1.3 Testing and Certification

Composting system operators will establish quality limits, observe, monitor, sample and analyze at different points throughout composting process. Compost is ready to use after temperatures within the curing compost mass are near ambient levels and the oxygen levels are near 5% for several days. Maturity testing can be done with the Solvita® test to check for carbon dioxide and ammonia emissions.

The compost system operator should establish a relationship with a good lab for regular testing to meet regulatory compliance. This includes good test sampling methods necessary for environmental health and safety (pathogens, metals and inert), to determine the degree of completion (stability and maturity), and the characteristics for end market use (physical characteristics and chemical composition).

Typically, a composting facility will initially focus on manufacturing one high quality compost product for general purpose. The initial product can be a compost product for residential, municipal, landscaping, and DOT projects.

Compost certification is the US Composting Council's Seal of Testing Assurance Program (STA). STA is a compost testing, labeling and information disclosure program designed to give the compost manufacturer the information needed to market the product and benefit from the sale and use of the compost it manufactures.

7.1.4 PFAS

In our modern life, fluorinated chemicals are used across many industries including textiles, plastics manufacturing, and fire fighting foams. Per- and Polyfluoroalkyl substances (PFAS, PFOs and PFOAs) are man-made fluorinated compounds that are used in consumer products since the 1940s because of their stain- and grease-repelling properties. Most commonly as an effective FDA-approved ‘grease-proofing’ barrier on food packaging specifically paper and molded-fiber pulp.

It is likely that most composting facilities have a detectable level of PFAS in their finished compost. There are multiple pathways to a composting facility including yard waste, food materials and food packaging, rainwater, etc. However, compost is not the only place where PFAS have an impact, also in wastewater, landfills (i.e., leachate), and groundwater.

Compostable Food Service Ware Items

The Biodegradable Products Institute (BPI), a North American organization that provides certification to ASTM D6400 industry standard test methods for the biodegradability of compostable materials in commercial composting facilities. In 2019, BPI restricted and will eventually eliminate fluorinated chemicals from the BPI certification of compostable products including fiber and compostable plastics. BPI adopted the European industry standard EN 13432 limit of 100 ppm total fluorine in 2019, and “no intentionally added fluorinated chemicals” are allowed for BPI certification.

Currently there is no comprehensive lab test to determine the amounts of PFAs in compost. Although recently the EPA released a September 2, 2021 press release about its first draft laboratory analytical method to test for 40 per- and polyfluoroalkyl substances (PFAS) in eight different environmental media, including wastewater, surface water and soils, a long-awaited action that will allow the agency and states to set wastewater and stormwater discharge limits for the chemicals.

Organics recycling and solid waste facilities should continue to promote the benefits of re-use and recycling through composting and compost use. The value of finished compost outweighs the risks from trace levels of PFAS. It is important for the solid waste and organics industry to be alert to potential sources and look upstream for industries that use these chemicals.

7.1.5 Compost Use and Food Systems

There is a direct relationship between organics recycling and the local food system. This relationship is demonstrated through the practice of recycling food waste through composting and compost use on local gardens, public spaces, and Department of Transportation projects, closing the loop on organics recycling.

Alaska soil is young and in need of nutrients. The residential home garden market and new housing developments have the greatest potential and need for compost and soil amendment products. The end-user will need to add organic material to their soil to establish healthy gardens, lawns, shrubs, etc. In addition, local garden associations including Anchor Gardens, a network of volunteer gardener coaches across each of Anchorage’s 37 community council areas, can help close the organics recycling loop, to encourage use of nutrient-rich local compost to grow local food.

8.0 SWS EXISTING ORGANICS MANAGEMENT PROGRAM

The Organics Management Program generally operates from May 1 to October 30. Organics collection is available to Municipality of Anchorage residents through curbside collection by SWS staff and private sector waste hauler Alaska Waste, and Community Compost for residents to drop-off food scraps at the Central Transfer Station (CTS) or Anchorage Regional Landfill (ARL). SWS partners with the transportation company Central Recycling Services (CRS) to service and haul the collected organics to the Moffitt Farm composting operation in Palmer. CTS then backhauls the finished compost to Anchorage, distributed between the CTS and ARL sites for residents to pick up the finished compost at no charge for their home use. The SWS Organics Management Program has four (4) organics collection streams. These collection streams are presented in **Table 8-1**.

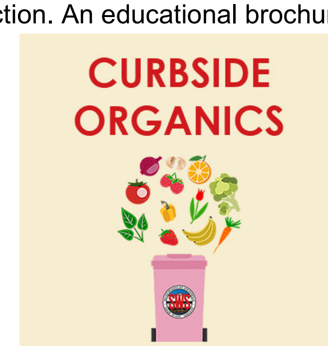
Table 8-1: Collection Streams

SWS Organics Collection Streams
SWS Curbside Organics Collection
SWS Community Compost, drop off locations at CTS and ARL
Alaska Waste Curbside Organics Collection
Alaska School District Food Scraps Collection

8.1 SWS CURBSIDE ORGANICS COLLECTION

Curbside Organics is offered by SWS to residents for the collection of yard debris in 96-gallon roll carts, and food scraps placed in a paper or certified compostable plastic bag for weekly curbside collection service for 26 weeks. In 2019, a total of 236.34 tons of curbside organics were collected from 779 households by SWS and delivered to the ARL. In 2020, a total 320.93 tons of curbside organics from 1100 households were collected by SWS and delivered to ARL.

- In 2018 residents signed up for the curbside organics program and received a 96-gallon roll cart (pink) for yard waste and 5-gallon bucket with 24 compostable bags for food scraps collection. An educational brochure was included with distribution of the carts.



- In 2019, SWS no longer provided a 5-gallon bucket as an option but residents were offered a choice between a 32-gallon or 96-gallon roll carts for both yard debris and food scraps. Yard debris materials were placed directly in the carts without bags. Food scraps could be collected in either paper or compostable bags and placed in the cart for the scheduled organics curbside collection day.
- SWS waste truck (automated side load) collected the curbside organics and delivered the organics to the ARL. The trucks unload into a 40-foot roll off container that is staged to accept the organic materials.
- For the 2021 program, SWS runs one dedicated waste truck for curbside organics collection 4 days per week. The SWS truck hauls an estimated 2.5 ton of organics per day to ARL. That is a total of 10 tons of curbside organics per week delivered to the ARL.

- The 40-foot roll off container is serviced by Central Recycling Services (CRS) and hauled twice a week to Moffitt Farms in Palmer, where collected organics (comingled yard debris and food scraps) are processed into a finished compost product. The Moffitt Farm composting operation is approximately 50 miles from the ARL.

Accepted Materials

The Curbside Organics Program accepts most backyard home compostable foods scraps including fruit, vegetables, beans, eggshells, and coffee grounds/tea bags (including paper coffee filters). Not accepted are meat, bones and any proteins including cheese and fish. Yard debris includes grass, leaves, garden debris, twigs. Large woody materials, branches and stumps are not accepted in the curbside organics program.

In 2019, 779 households participated in the curbside organics program. A total of 236.34 tons of organics were collected. In 2020 the third year of the Curbside Organics Program, 1100 households participated in the curbside organics program for weekly collection. A total of 320.93 tons of organics (*yard debris and food scraps)* were collected by SWS.

Program Costs

SWS provided customers with weekly curbside organics collection for a monthly service fee. All infrastructure components related to collection including pink roll carts and outreach education materials for a monthly service fee was based on the cart size. **Table 8-2** shows the per household monthly cost based on cart size.

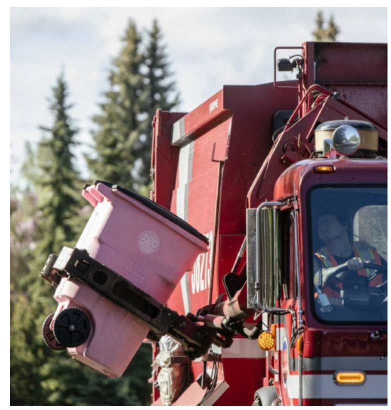


Table 8-2: SWS Curbside Cart Cost for Weekly Service Per Month

Cart Size	Cost for Weekly Service Per Month
32-gallon cart	$5 per month
96-gallon cart	$10 per month

In 2018, the costs involved for operating the Curbside Organics program costs were $6,704. That amount included SWS trucks and drivers for the curbside organics collection, stickers or tags for the roll carts, and compostable bags. SWS had a supply of 96-gallon carts and 5-gallon buckets available for the Curbside Organics program that were purchased for a previous program.

Starting in 2021, SWS will charge a tip fee to all waste haulers that participate in the Curbside Organics program for organics delivery to the ARL. The tip fee is $33.87 per ton of organics delivered. The current per ton rate for trash disposal at the ARL is $67.73. The charge does not apply to the public. SWS would consider charging residents a fee for participation in the Community Compost program at the ARL and CTS. The fee to participate includes the drop off household food scraps and the pick-up of free compost limited to 10-gallons of compost per resident.

In October 2020, MUNICIPALITY OF ANCHORAGE amended the Municipal Codes to allow increase rates for SWS disposal utility *(AO No. 2020-92; Anchorage Municipal Code Sections 26.80.050 and 26.80.070)*. In 2021 SWS charges $33.87 tip fee for organics (yard debris and food scraps) at ARL for waste haulers that participate in the Curbside Organics Program. Yard debris or food scraps delivered to ARL in quantities greater than a cubic yard for composting or alternative uses are subject to a fee equal to one-half (1/2) the per ton rate at the solid waste disposal facility that is $67.73 per ton for MSW. The Municipal Code also requires that loads must be free of contaminants to qualify as compostable and must be segregated from other waste streams. This fee does not apply to wood lot deliveries.

8.2 COMMUNITY COMPOST COLLECTION

Community Compost is a no-cost residential drop-off program with two collection sites, one at the CTS and one at ARL. **Table 8-3** presents the Community Compost drop-off areas for organics collection.

Table 8-3: Organics Drop-Off Locations

Community Compost Collection Sites	Address
Central Transfer Station (CTS)	1111 E. 56th Avenue in Anchorage
Anchorage Regional Landfill (ARL)	15500 E. Eagle River Loop Road in Eagle River

Community Compost operates during the same season as the Curbside Organics program that is from May to October. Residents can bring their source separated kitchen food scraps for collection including fruit, vegetables, beans, eggshells, and coffee grounds/tea bags (including paper coffee filters). Not accepted are meat, bones and any proteins including cheese and fish. Starting in 2020, residents were not allowed to bring yard debris to the drop-off sites. This was due to the large amount of yard debris that residents were bringing into the sites specifically to the CTS.

The CTS has two rolls-off for food scraps collection and there is one roll-off at the ARL. Each location is serviced by CRS. CRS hauls the material directly to the Moffitt Farm composting operation in Palmer. Since the CTS has a higher volume of residents using this organics drop-off site, CTS is serviced weekly (26 times). The organics drop-off site at ARL is serviced bi-weekly (13 times). During 2020, CRS did 11 pickup/hauls (2 from ARL and 9 CTS) for a total 20.31 tons of organics collected from the Community Compost Program.

CRS backhauls finished compost to both sites. The compost is available for residents to pick up at no charge at the beginning of the season on an honor system. However, the compost supply typically runs out by late July. To help mitigate this issue, starting in 2021 SWS will offer the free compost to residents on a monthly basis limited to two 5-gallon buckets (10-gallons per resident).

In 2018, the costs involved for operating the Community Compost program was a total $18,110. That amount included Central Recycling Services (CRS) for the transportation of the collected organics to Moffitt Farm in Palmer, and the backhaul of finished compost to the two collections sites in MUNICIPALITY OF ANCHORAGE. SWS developed public educational materials including signage and magnet boards to educate residents on acceptable food scraps.

8.3 ALASKA WASTE CURBSIDE ORGANICS COLLECTION

In 2019 Alaska Waste started their curbside organics collection offered to specific Anchorage neighborhoods including Bayshore and Oceanview for route efficiency. The targeted neighborhoods are described as high-end communities with grass lawns and potential higher volumes of yard debris. Households registered for the program by responding to an email campaign. During the first year of the curbside organics program, 100 customers registered for curbside organics collection from June 6 through October 31.

Alaska Waste operates their organics collection route with one dedicated truck (rear load) to haul the collected organics to the ARL and unloads the material into the 40-yard container. Use of the rear load truck for the organics collection route does not impact their regular trash service that uses automated side-loader trucks.

Alaska Waste charged residents $12 per month for weekly curbside organics collection including a 96-gallon roll carts for collection of comingled yard debris and food scraps. For program consistency and to minimize contamination, Alaska Waste utilized the same residential education materials and list of accepted yard debris and food scraps established by SWS.

During 2020, 100 households registered for the Alaska Waste curbside organics program. A total of 55.77 tons of organics per year were collected. For 2021, Alaska Waste estimates between 70 and 120 households will participate and the number of households be could increase to 150 households. Based on SWS curbside organics collection data, Alaska Waste collected an estimate of 32.8 tons of organics in 2019, *(21 weeks of curbside organics collection x 1.56 tons per week = 32.8 tons per year).* In 2020, Alaska Waste collected a total of 55.77 tons of organics per year.

Organics Material Characterization

- Alaska Waste reported that a high percentage of the organics collected at the curb was yard debris. Of the yard debris, 75% to 80% was grass clippings, 10-15% leaves and some branches.
- There is very little contamination, which indicates residents that participate in the curbside organics program are educated and committed to organics diversion and recycling.
- Alaska Waste conducted surveys with residents that participated in the curbside organics program for feedback on the frequency of curbside collection and container size. Alaska Waste received no complaints about the curbside program.

Commercial Organics Collection

Alaska Waste provided organics collection services to several of their commercial customers specifically supermarkets and grocery stores. Food scraps were collected from the grocers' back of house operations that is typically fruits, vegetables, and some bakery items. The amount of food scraps collected was about 25 tons per week. This commercial food waste was transported directly to Moffitt Farms for use as animal feed for the farm's livestock. Alaska Waste also services the Kaladi Brothers Coffee Shops. An average of 6 tons of coffee grounds per week are collected and delivered to a composter located in Talkeetna.

No packaged food is accepted in the commercial organics collection service. Alaska Waste indicated they would require an education outreach program to commercial food waste generators to collect packaged food. They also indicated the collection of commercial packaged food would require a separate depackaging route. The packaged food requires a depackaging facility to remove the food from packaging. There are no organics recycling facilities for depackaging commercial food in Municipality of Anchorage.

8.4 ALASKA SCHOOL DISTRICT FOOD SCRAPS COLLECTION

In 2019, the Alaska School District (ASD) working with SWS, Central Recycling Services (CRS) and Moffitt Farms, implemented a 4-month food scrap collection and composting pilot program. The goals of the pilot were to estimate the amount food scraps disposed of during the school year to determine the feasibility of instituting a district-wide food scrap diversion program, and potentially identify waste reduction options for the district meal service. There are 85 schools in the Anchorage school district.

During the school year of 2019, 10 elementary schools participated in the first year of the food scrap collection pilot program. In 2020, 11 elementary schools participated in the food scrap collection program. Most of the schools selected to participate in the food scraps programs had trash compactors. Compactors were weighed for the amount trash disposed in the compactors, so it was relatively easy to determine the amount of food waste diverted from each school. Liquids were an issue with the compactors during winter and resulted in more costs due to equipment problems.

How the ASD Food Scraps Collection Program Works

During the lunch period with help from the school staff, students separated their food scraps into 3 separate bins. Food scraps were collected in a yellow bin, trash in a grey bin, and liquids were collected separately. **Table 8-4** shows the food waste separate collection bins.

Table 8-4: ASD Collection Bins

Material	Bin Color
All Food Scraps[1]	Yellow container
Trash for Landfill	Grey container
Liquids	Collected separately

1) Moffitt Farm composting operation accepts all food scraps including bones from the ASD food scrap collection program.

All food scraps were collected in a 20-gallon yellow bin on wheeled dollies and lined with a certified compostable bag. This made it easier for the school staff responsible for removing the food scrap containers from the lunchroom. The food waste-filled compostable bags were removed from the yellow bin and transferred to a 96-gallon cart, which was rolled out to the curb once per week for pickup.

SWS collected the 96-gallon containers and transported the ASD food scraps to the ARL and transferred the bagged food scraps into the 40-yard roll-off container. The school district's food scraps were consolidated with SWS organics at the ARL. Central Recycling Services (CRS) serviced the 40-yard container twice per week and hauled the organics to Moffitt Farm in Palmer.

In 2019, during the first year of the ASD food scrap collection program, a total of 14.2 tons of food scraps were collected from the 10 schools. In 2020, a total of 6.2 tons of food waste were collected from 11 schools and included most of the previous elementary schools, one high school and one middle school. In 2020 the food scraps program stopped in 2020 due to COVID, and therefore data for the year is incomplete.

8.5 SWS TOTAL ORGANICS COLLECTED PER PROGRAM

In 2019 a total of 263.34 tons of Organics (food scraps and yard debris) were collected from both the Community Compost and SWS Curbside Organics Collection programs. **Table 8-5** shows the total tonnages of SWS food scraps and yard waste collected per year from 2016 to 2020. In 2021, SWS estimates a total of 575 tons of organics collection for the year. The estimated total tons include:

- 500 tons residential curbside (SWS and Alaska Waste customers combined)
- 50 tons from commercial collection
- 25 tons from the two Community Compost sites

Table 8-5: SWS Organics Collection Program Locations and Tons Collected

Year	Program	Participation	Food Scraps (Tons)	Yard Debris (Tons)	Organics[1]	Notes
2016	Community Compost at ARL	500 Participants	7 Tons	--	--	
2017	Community Compost at ARL	1200 Participants	22 Tons	--	--	Compost pick-up was only offered at ARL, not at CTS due to watershed concerns.
	SWS Curbside Organics Collection	122 Households	--	22 Tons	--	Yard debris collection from the neighborhoods of Rogers Park and College Village; organics taken to the Wood Lot at ARL
2018	Community Compost (ARL & CTS)	--	--	--	48.87 tons	Community Compost June 4-October 31. Stopped distribution of 5-gallon buckets. Residents were encouraged to drop off (2) 5-gallon buckets of food scraps at one time. Open to all residents, no registration required.
	SWS Curbside Organics Collection	292 Households	--	--	56.25 Tons	2 trucks for weekly collection on Wednesdays/17 weeks of service; Residents received 96-gallon cart and 5-gallon bucket/24 compostable bags
2019	Community Compost (ARL & CTS)		30.04 Tons	--	--	CRS did 21 hauls (7 from ARL/14 CTS) to Moffitt Farm. Average 1.22 tons per haul
	SWS Curbside Organics Collection	779 Households	--	--	236.34 Tons	34 weeks of collection from May to October 209.65 tons of food scraps were collected. From November to December 26.69 tons of food scraps were collected.

	Alaska Waste Curbside Organics	109 Households			32.8 Tons	Curbside collection from June to October 31 (21 weeks of collection x 1.56 tons per week = 32.8 tons per year)
	ASD Food Scraps Collection	10 Schools	14.2 Tons	--	--	SWS collects food scraps/brings to ARL.
2020	Community Compost (ARL & CTS)		20.31 Tons	--	--	CRS did 11 hauls (2 from ARL/9 CTS) to Moffitt Farm. ARL was serviced twice per week.
	SWS Curbside Organics Collection	1100 Households	--	--	320.93 Tons	
	Alaska Waste Curbside Organics	100 Households	--	--	55.77 Tons	
	ASD Food Scraps Collection	11 Schools	6.2 Tons	--	--	

1) *Organics refers to co-mingled yard debris and food scraps.*

8.6 CENTRAL RECYCLING SERVICES

Central Recycling Services (CRS) is a private business that provides dump trucks, roll-off and walking floor trailer services. CRS does not provide residential waste collection services. CRS is operational year-round and operates a transfer station with rail line. CRS manages the recycling of metals, comingled construction, and demolition materials (C&D) and aggregates and repurposes the clean wood from C&D. CRS provides dumpsters and trailers for hauling and collection throughout the Anchorage bowl, the Mat-Su Valley, Kenai, and remote areas of Alaska. The CRS facility is located at 2400 Railroad Avenue in Anchorage, that is only a few miles from SWS.

Consolidation and Transfer of Organics

The SWS Organics Management Program is the only organics collection program that CRS services. CRS provides and services the organics collection containers at both the CTS and ARL locations, the walking trailer at the ARL, and transportation of the collected organics directly to the Moffitt Farm Composting Operation in Palmer. CRS also backhauls the finished compost to the CTS and the ARL and will continue to backhaul compost on a scheduled monthly basis starting in 2021.

Scope of Services Include:

- Haul the collected organics (backyard home compostable foods scraps and yard debris) from the two SWS Community Compost locations and the SWS Curbside Organics Program and transport the material to the Moffitt Farm for composting.

- Provide and service one organics container for Community Compost collection at both the CTS and the ARL locations from May 1 to October. Community Compost locations service schedule: CTS is serviced weekly for 26 weeks and ARL is serviced bi-weekly for 13 weeks. Organics are hauled to Moffitt Farm.
- Provide and service a walking floor trailer for the Curbside Organics Collection at the ARL with service 3 times per week to haul the organic material to Moffitt Farm.

- Supply and deliver finished compost from Moffit Farm to Anchorage. A total of 120-yards of finished compost delivered in 10-cubic yard increments each month to the CTS and the ARL from May 1 to September 30.

In 2021, SWS contract for services with CRS was a total of $88,650. **Table 8-6** shows the itemized services of the contract.

Table 8-6: Central Recycling Services Costs for Organics Program Service

Service	Cost
Community Compost	
1 Organics Container at ARL	$2,475
1 Organics Container at CTS	$6,925
Supply/Deliver Finished Compost: May to September[1]	
ARL 10 cubic yards per month	$4,750
CTS 10 cubic yards per month	$4,750
Supply/Service Trailer at ARL for organics collection and haul to Moffit Farm	$69,750
Total Cost	**$88,650 per year**

1) *Total of 120-yards of compost in 10 cubic yards per month*

8.7 MOFFIT FARM COMPOSTING OPERATION

Moffitt Farm is a bifurcated family business. One side of the business is a 500-acre farm with a composting operation situated on less than 5 acres of the property. The other side of the business is Central Recycling Services (CRS) that operates a state-of-the-art C&D Recycling operation and transfer station facility located on 7.5 acres near downtown Anchorage. CRS services the Municipality of Anchorage, and the Joint Base Elmendorf/Richardson (JBER). The Moffitt Farm composting operation is part of the farm operations that includes 280 cows,180 pigs and several horses. The farm's animal manures are composted onsite, although the manures are kept separate from the municipal organics that includes SWS organics and other private waste haulers with organics collection routes.

Windrow Composting Process

All inbound municipal feedstock materials are unloaded onto a receiving area and mixed directly on a dirt pad. The inbound feedstocks are typically the municipal comingled yard debris and food waste. However, mixing the municipal organics with wood chips as a bulking agent is required to make a homogenous feedstock. The mixing is conducted on the dirt pad receiving area. Then material is transferred to the windrows. There are three sites for windrows. No information was provided about specific length, width, or height of the windrows. Equipment used for the composting operations includes:

- Front-end loader for making the windrows and building piles
- Turner pulled from behind a tracker to turn windrows
- Screener for screening out oversized particles from the finished compost for a consistent final compost

The windrow operations are maintained only during the summer months. Winter and high wind are issues for the composting operation. As the windrows do not retain heat all year, the organics material is moved from windrows and built into large piles to build up and maintain heat that is needed to finish composting process. The composting process takes one full year to produce a finished compost. At the end of the composting process, about one-third of the original mass of material is finished compost.

Feedstocks for the Composting Operation

In addition to the inbound municipal organics, Moffitt Farm has a variety of available feedstocks on the farm including animal manures and some agricultural waste.

- Several private sector waste haulers deliver organics material to Moffitt Farm. These private waste haulers include Ramsey and Alaska Waste, and several wood chip companies. Moffit Farm does not charge tip fees for commercial produce that is used on farm as animal feed. However, the farm will charge a fee for commercial organic loads with contamination from plastic bags and other packaging.
- Alaska Waste delivers produce only commercial organics (vegetables and fruits) from supermarkets including Fred Meyers, Carrs and Charlies that is used for animal feed. Moffitt Farm estimates 1500 tons of commercial organics per year is received from the Anchorage/Valley area. It is unclear if any amount of the commercial organics is mixed with the SWS collected organics for the composting operation.
- Spent grain from the 49 State Brewery Company and other breweries is also used as animal feed. This is due to the high protein value in the spent grain. However, if the grain is bad, then it is utilized in the composting operation.
- Carbon sources are needed to mix in with the comingled food scraps and yard debris. The carbon sources are woodchips from tree companies, wood chips processed from clean wood sorted from C&D, and chipped wood pallets. A magnet is used to remove nails and fasteners.

Finished Compost, End-Markets and Gaps

Moffitt Farm has systems in place for commercial compost sales and has developed a high demand for their finished product in the Valley. The farm produces different compost products for different end use markets. As an example, the farm produces 6,000-7,000 yards of cow manure compost per year that sells for $75 per cubic yard to local farmers, home gardeners, and landscapers. No further information was provided about compost use and end-markets. The finished compost that is delivered to SWS for residential use is the compost made from the cow manure.

Demand for locally produced compost is doubling for home gardening (due to COVID), and the demand is starting early in the growing season (May). Some of the challenges with producing compost involves less transportation and sourcing feedstocks for composting with less potential pesticides and weed seeds. On a regular basis, Moffitt Farm sends samples of their finished compost for lab testing to ensure they produce consistent and high-quality compost products. The lab reports are available.

Potential to Expand Composting Operation

Moffitt Farm is considering to potentially expand their composting operation including a new pad design to replace the dirt area for receiving and mixing inbound materials. The Farm also expressed interest in the in-vessel composting equipment located at Alaska Waste. The discussions with Alaska Waste were stopped during COVID in 2020. Moffitt Farm was interested in the composting equipment but then COVID hit, and this halted further discussions. Moffitt Farms agreed to purchase the in-vessel composting equipment from Alaska Waste in 2021.

8.8 MUNICIPALITIES FOR COMPARISON

The evaluation included a benchmark study against 2-3 municipalities with a similar population (±300,000 population) and climate. The comparison Includes a high-level summary of the available organics management programs, with a focus on comparing the program cost structure. The municipalities for comparison are listed below.

1. Metro Vancouver, British Columbia, Canada
2. Whitehorse, Yukon Territory, Canada
3. Seattle, Washington
4. Minneapolis, Minnesota

Metro Vancouver, British Columbia, Canada

Vancouver operates under a mandatory food waste program, with an action plan of zero waste by 2040 in addition to becoming a carbon neutral city. Food waste is picked up weekly at residential curbs by multiple private sector and public sector haulers. Both environmental education and "kitchen catchers" are provided to residents of the community. Contamination issues in food waste include plastic such as discarded ketchup packets, but contamination is found in less than 5% of food waste. Final compost is sold at $30-40/ton or $20/cy, which is created using ASP and GORE technology.

Whitehorse, Yukon Territory, Canada

Whitehorse's mandatory food waste diversion program utilizes ASP technology to create compost that is sold at $5/20L bag of compost. A wealth of information is provided on the city's website, including a pickup calendar and documentation on the city's goals and awards, including achieving zero waste by 2040. Food waste contamination is less than 5% and is mostly made up of discarded plastics. Residential pickup of food waste by public and private sector haulers occurs on a biweekly basis.

The landscape in Canada for the collection of organics includes both the residential and commercial sectors. For the residential sector, the municipality typically contracts that out the organics collection service to the private sector to collect organics on behalf of the municipality. For the commercial sector, it is an open market so businesses will contract out with the private sector haulers directly. To get the commercial sector to divert organics, there is an organics disposal ban at the disposal sites and transfer stations. The haulers are charged a 50% surcharge for the entire load for high levels of organics in the garbage.

Seattle, Washington

Seattle Washington (753,000 population, 2019 US Census). Food scraps diversion has been mandatory in Seattle since 2009, though Seattle started its original program with yard waste in 1998. Pickup by Waste

Management and Recology is offered on a weekly basis, taking the waste from food waste carts and kitchen food scrap containers provided to the residents by the city. Seattle's goal is to reduce food waste by 2030 but the city has challenges including underreporting of waste materials and poorly located collection containers for public space recycling.

Minneapolis, Minnesota

The City of Minneapolis, Minnesota (429,000 population, 2019 US Census) Solid Waste & Recycling Division (SWRD) services 107,000 customers. The type of housing includes all single-family homes and housing with less than with 4 units, including some townhomes. SWRD services several larger buildings, the city parks, and commercial and municipal properties. All residents are required to have garbage collection, recycling is not mandated although the city offers recycling services at no charge.

Organics (food scraps) recycling is collected weekly. Residents are provided a cart and a welcome kit upon registering for the organics program. Food scraps must be contained in a certified compostable plastic or paper bag. Accepted materials include all food, non-recyclable paper, certified compostable plastics, and other compostable items. SRWD operates 7 residential organics drop-off sites located throughout the city, and neighborhood groups sponsor 3 additional organics drop-off sites. Yard waste is not accepted in the food scraps recycling program.

Yard waste collection is seasonal, collected at the curb between April through November. The city does not provide a cart. Residents can use their own bin or set out paper or certified compostable plastic yard waste bags. Conventional plastic bags for yard waste are prohibited *[Minnesota State law Statute 115A.931(c)].* Minneapolis has yet to implement mandatory food waste diversion legislation, and the participation rate in the program holds steady at 47.6%. All food scraps are picked up weekly and brought to a composting operation. The final compost product is offered at low cost or no cost to qualifying community gardens. Educational campaigns focused on waste reduction have been introduced by the city in an effort to reach the city's zero-waste goal.

Table 8-7 shows the cities' organics collection program compost technology used, fees and end-markets. **Table 8-8** shows the types of accepted organics materials, participation/diversion rates, and contamination issues**.** **Table 8-9** shows the state legislation, and cities' goals and key challenges.

Table 8-7: Organics Collection Programs: Technology, Fees and End-Markets

	Metro-Vancouver, British Columbia Canada	Whitehorse, Yukon, Canada	Seattle, Washington	Minneapolis, Minnesota
Tipping Fee	$120-$150 per ton	$50 per ton	Residential food and yard waste are $68 ton Commercial food waste is $98 ton. Land clearing debris is $56 ton	$77.36 per ton
Composting Technology	2 Aerated Static Piles (ASP) 2 GORE cover 1 in-vessel	Aerated Static Pile (ASP) located at the landfill	Gore Cover System at Cedar Grove	Aerated Static Pile (ASP)

	1 Anaerobic Digester (dry)		Aerated Static Pile (ASP) at Lenz Enterprises	
End Markets	Soil amendment. Turf farm, retail sale, nurseries, agricultural land application	Soil amendment. Retail sale $5 per 20 Liter bag. Bulk for $45/CY	Compost is sold in bulk at the compost facilities. - Cedar Grove $32/ CY - Lenz $36/Ton	Compost offered through Community Garden Compost Program.

Table 8-8: Accepted Organics Materials, Participation/Diversion Rates and Contamination

	Metro Vancouver, British Columbia Canada	Whitehorse, Yukon, Canada	Seattle, Washington	Minneapolis, Minnesota
Accepted Materials	Food and yard waste Commercial food waste Packaged food & industrial food waste processing Fats, Oils/Grease (FOG) Agricultural waste Some certified compostable bags & food service items[1]	Food and yard waste Food soiled papers Certified compostable food service items Sawdust and wood shavings	Food and yard waste	Food waste Certified compostable food service items (BPI[2]) Other compostable household items
Participation Rate	> 90%	> 90%		47.60%
Diversion Rate	63% (Regional)	33% (City)		2.43% organics 17.63% yard waste[3]
Contamination Rate	< 5% by weight Plastic films, condiment packages/ketchup packs	< 5% by weight Plastic films, condiment/ketchup packs		0.68% Plastic-lined paper products (coffee cups), yogurt cups, aluminum cans, plastic films, condiment/ketchup or soy sauce packs, straws

1) *Depends on the Organics Recycling Facility acceptance of certified compostable items.*
2) *The Biodegradable Products Institute (BPI) is one of the North American certifiers of composable food service items that meet the ASTM D 6400 industry standard for plastics and paper coated plastics intended to be compostable in an industrial (commercial) composting facility.*
3) *Yard Waste is a separate curbside collection stream.*

Table 8-9: Organics Collection Programs: Legislation, Goals and Challenges

	Metro-Vancouver British Columbia Canada	Whitehorse Yukon, Canada	Seattle Washington	Minneapolis Minnesota
Legislation	Mandatory	Mandatory	Mandatory (2009)	Voluntary, mandatory (2022) at the county level
Goals	Zero Waste by 2040 Green City 2020 Action Plan. Reduce solid waste disposal 50% from 2008 levels.	Zero Waste by 2040. 50% waste diversion from landfill.	50% reduction in food waste by 2030. Signed commitment by large grocers	Zero Waste Plan. Identify strategies to collaborate with different sectors within the city to meet zero waste goals.
Challenges	• Source pollution prevention (single-use plastics production and use • Reduction of clothing/textiles	• Identify strategies to collaborate with different sectors within the city to meet the city's zero waste goals.	• Under-reporting, double counting of materials. • Access to organics recycling bins in public spaces • Lack of space for containers in multi-family housing	• Ongoing costs. • Data gaps, difficult to understand which city department is responsible for which waste reduction programs. • Funding for education/outreach • How to achieve SSO

9.0 OTHER COMPOSTING OPERATIONS IN ALASKA

9.1.1.1 City of Gustavus Disposal and Recycling Center (DRC)

Gustavus is a small city with a population of 500. The Disposal and Recycling Center (DRC) started food waste composting program in 1996 as way to improve their waste handling facilities. Food waste is wet and presented challenges for the DRC's manual compression baler to reduce the volume of waste for landfilling. The objectives for composting food waste included to:

- Conserve limited landfill space
- Improve work environmental for waste baling operation
- Reduce bear and bird scavenging of food waste
- Produce local compost as low-cost soil amendment to residents.
- Promote recycling

The composting area is a 6,600 square foot. The composting operation is on a sloped concrete pad with an electrified fenced around the entire composting area and is located adjacent to the city's landfill. Residents bring their food waste to a collection hopper. When the hopper is full, it is emptied onto a mixing pad where food waste is mixed with wood chip. A Bobcat is used for mixing and transporting the food waste mixed pile to a Quonset shed for composting. The composting process is a passive aerated static pile located inside a Quonset shed with space for three static piles (windrows). The dimensions of static piles are 7 to 9 feet wide at the base, 20 feet long and 3 to 5 feet high.

Photo courtesy: Paul Berry, Gustavus Disposal and Recycling Center (DRC)

Figure 9-1: Gustavus Disposal and Recycling Center (DRC) Composting Site

Food scraps are collected from residents and from the single commercial generator, the Glacier Bay National Park (GBNP) and Glacier Bay Lodge. Operational costs for the food waste composting program are funded through user fees (19 cents per pounds of food waste at the drop-off site), sale of finished compost, and from the city's General Fund.

Table 9-1: Amount of Food Waste Composted Per Year (in tons) at DRC

	Residential Food Waste Generation Total in tons	Glacier Bay National Park Food Waste Generation Total in tons	Total Amount of Food Waste Generated in Tons Per Year
2018	20.5 tons	11.7 tons	32.2 tons
2019	21.15 tons	13.85 tons	35 tons

Table 9-2: Yards of Compost Sold Per Year at DRC

	Amount of Compost Produced and Sold Per Year	Revenue Generated
2018	10 yards	$1,250. ($125 per yard
2019	20 yards	$2400. ($120 per yard)

Table 9-3: Challenges and Solutions at DRC

Challenge	Solutions
Excess Moisture (rain and snow)	The composting process is under a cover using a Quonset shed.
Freezing Temperatures	Less food waste is processed during the winter; therefore, food waste is stored in the dumping hopper until the temperatures are above freezing.
Birds	Minimize mixing activity time, covering food waste with wood chips to prevent birds from scavenging.
Bears	Installation of electrified fencing, with proper signage and gate. No bear issues since 2001.
Organic material particle size	Shredder (DRC currently does not have this equipment)
Contamination from plastics	Manual sorting, and public outreach and education. Certified compostable plastic bags are allowed for residents' convenience.
PFAS/PFOA	DRC is just beginning to understand this issue and has not yet developed a policy.

9.1.1.2 Yakutat Tlingit Tribe

Tlingit is a federally recognized tribe to preserve and protect the culture and land of Yakutat Tlingit People, a private tribal government service in the Tongass National Forest.

The Yakutat Tlingit Tribe Environmental Department conducted a household waste stream assessment to determine the amount of food waste and material categories. From this analysis the Environment Department determined that food waste is 45% of the waste stream. With a population of 650 Population and 250 households, it was determined that average household produces 5 to 25 pounds of food waste per week including meat and bones (primarily from subsistence hunting). Residential and commercial food waste generation is a total of 1.25 tons per week. Other research included tours of composting facilities in Washington state, and to learn about potential challenges with compostable bags.

The Environmental Department decided on a rotary drum in-vessel composting system, the Big Hannah 120" (Sweden) as the most suitable given the contamination factors due to the weather and animals (bears and rodents).

The in-vessel technology uses an auger/drum system can process 0.5 tons of organic material per week as a continuous feed. It takes two-months for the discharge process to make an immature compost that must site in a curing pile to mature and stabilize for an additional two months.

Table 9-4: Collection Process and Costs - Yakutat Tlingit Tribe Environmental Department

Food Waste Collection Process Materials	Household Costs and Activity
Public Outreach	$30 per household for collection buckets and inoculant
Pick-up using a double bucket system, one bucket with holes to drain into the second bucket.	Spent grain (bagasi flakes) as an inoculant to ferment the food waste (anaerobic composting) to manage odors. Can also use saw dust. Residents use a handful of the inoculant on top of the food waste and add carbon/newspaper to push down the food waste and place the lid to close the bucket for collection.

Table 9-5: Compost Pricing and Need - Yakutat Tlingit Tribe Environmental Department

Finished Compost Pricing	Compost need
One bucket load is $5 each 1/3 cubic yard for $25 1 full cubic yard for $44	Yakutat Tribe is food sovereignty *(the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods)*
	Building soil health is important

9.1.1.3 Susitna Organics

Susitna Organics in Wasilla Alaska is a compost manufacturer that uses primarily manures and agriculture waste as feedstocks. Sells compost and topsoil in bag and bulk. Creates a humified compost using an inoculation process (ACS inoculate) for their windrow operations. Ken’s Garden Center in Wasilla offers Susitna Organics Compost, selling it by the cubic yard (3'x3'x3') and by the 5-gallon bucket. The Project Team conducted an online search for further information about Susitna Organics, however the Susitna Organics website no longer exists as of September 27, 2021.

9.1.1.1 Golden Heart, Utility Service of Alaska

In June 2019 the Golden Heart composting operation suspended all sales of its wastewater biosolids compost sold to local farmers and gardeners due to PFAS contaminants in the compost stockpiles.

9.1.1.2 University of Alaska Fairbanks

The Georgeson Botanical Garden is located at the Fairbanks Experiment Farm and is part of the School of Natural Resources and Extension at the University of Alaska Fairbanks.

9.1.1.1 Fairbanks Compost

Family farm operation producing organic compost sourced from native Alaskan grasses grown on farm and composted for three years. No information about compost products for sale was available.

9.1.1.2 Good Earth Garden School in Palmer

Provides educational glasses and workshops on composting and organic farming practices, including master composter training for certification.

10.0 CONCLUSION AND RECOMMENDATIONS

There is growing interest in developing organics infrastructure as part of a circular economy to reduce greenhouse gas emissions and mitigate climate change. Public and private entities need to collaborate to pivot public thinking toward a circular economy and a sustainable flow of materials. This involves changes in public behavior in terms of consumption and disposal, where food waste is recycled back into the market with high-value use through composting and anaerobic digestion.

There are many considerations in the planning, development, and operations of organics management facilities. These include siting, state and municipal regulations, permitting, available feedstocks, and population density and commercial demographics of surrounding neighborhoods and businesses. All these factors provide meaningful data in determining what type of an organics project is needed to service the area. Most projects are scalable if properly designed.

As the Solid Waste Services (SWS) works through the engineering and development plans for the larger landfill and multi-complex Resource Recovery Center, the idea of incorporating an organics management facility has been introduced and under consideration.

A feasibility study performed by Tetra Tech under the USDA Community Compost and Food Waste Reduction (CCFWR) Grant included evaluation of the SWS existing organics management system and high-level analysis for SWS to consider the feasibility of a full-scale organics management operation within the Municipality of Anchorage (MOA).

The report provides a high-level evaluation of organics collection and processing options to allow MOA to quantitatively determine the most suitable organics management strategy, accommodating the existing feedstock in the short-term with considerations for future planning toward scalability and improved organics diversion.

The report focuses primarily on composting technologies, due to the overall familiarity and generally lower capital cost but also includes a review of alternative technologies to determine if another option is more appropriate for MOA's management program and unique climate. It only presents options at this time to enable SWS to consider the concept of an organics management facility within the Municipality of Anchorage on an SWS facility property. The study presents a phase-in approach to support SWS's longer-term future planning for solid waste management.

1. **Short-Term** is the feasibility report to present Solid Waste Services (SWS) with a high-level analysis of potential organics management technology options and site locations for consideration of potentially siting organics management operations within the Municipality of Anchorage.

2. **Mid-Term** is a pilot-scale composting project based upon award of the second round of the USDA Community Compost and Food Waste Reduction (CCFWR) Grant. *(USDA-NRCS-NHQ-CCFWR-21-NOFO0001112)* for funding the pilot-scale composting project. SWS submitted the grant application in July 2021. The grant was not awarded in 2021.

   Tetra Tech recommends a phase-in approach to organics management. For a pilot scale composting, recommend the Sustainable Generation (SG) GORE cover system that is flexible in design and simple and low cost to operate. The system is expandable to scale up as needed. The SG Mobile™ System is recommended for the pilot-scale project. SG can have the Mobile System delivered, installed, and train the SWS operations team within 12-16 weeks after the agreement is signed. This system will provide SWS staff the needed training and basic composting operation skills. The pilot-scale composting project would ideally commence in 2023, allowing for planning, design and implementation of the pilot composting project that could coincide with site work for the new multi-complex Resource Recovery Center if the pilot project is sited at the CTS.

3. **Longer-Term Future Planning** is for siting an organics management facility at the Anchorage Regional Landfill (ARL). This is a hypothetical approach to consider a full-scale composting facility at the ARL to produce local compost (soil amendment) for residential and agriculture use.

   Two potential locations have been identified at the ARL. One potential site is the property adjacent to the existing landfill gas to energy (LFGTE) facility. A second potential site is the area called North Addition / West Addition.

   The existing landfill gas to energy facility located at the Doyon Utilities is the location identified with the best potential for siting a full-scale composting facility and a dry anaerobic digestion (dry AD) operation. This is due to the general site footprint requirements and minimum dimension/aspect ratios. For the purpose of this feasibility report, the requirements of the AD with composting operation can be fit into the form as the site plan dictates.

   Based on Tetra Tech's analysis and current MSW characteristics, it is estimated that there is about 130,000 tons of organics in the waste stream and based on potential diversion capture rates, a compost facility within the Municipality of Anchorage would need to be sized for at least 62,000 tons of organic waste per year.

   The full-scale organics facility could be designed as a membrane covered composting operation, scaling up the technology from the pilot-scale composting project. As an alternative option, SWS might also consider a dry anaerobic digestion (dry AD) facility with composting operations. Dry AD could support the current LFGTE operations, through managing organics for renewable energy production, including biogas and electricity, and digestate would be composted for a finished soil amendment product.

Growing Support for Organics Management Facility

There is ongoing support from state agencies including the USDA Natural Resources Conservation Services and Alaska Department of Natural Resources Division of Agriculture for developing organics recycling infrastructure and connecting compost use with local agriculture.

The Alaska School District (ASD) food scraps program could be expanded to all schools. As the largest meal preparer in the Municipality of Anchorage, the ASD Central Kitchen should participate in the source separation of their food scraps from preparing meals. Moreover, certified compostable food service items could be implemented to replace single use plastics for student meals.

Results from earlier surveys conducted by SWS indicate that residents like the organics collection program and residents would continue to participate in the program. This could present an opportunity to expand the SWS organics management program through mandating source separated organics (SSO) and provide curbside organics collection to all residents. This can reduce the per household program costs for collection if all residents pay for this service.

Organics processing is likely a higher cost per ton than the landfill tipping fee. As an example, the SWS landfill tip fee is $50-$60 per ton, most likely the cost for organics processing is about $70 per ton. There are federal grant opportunities that support the capital costs for organics management facilities, and could offset the cost for organics processing. This can bring the down cost for organics processing to below the landfill tip fee, which makes it economically feasible for communities to implement organics management facilities. Many municipalities seek these federal grants that are focused on greenhouse gas emissions reduction through organics recycling to improve their environmental profile on a local and regional level.

There are opportunities to expand organics collection through private waste haulers. MOA has several private sector waste haulers that service the municipality. Alaska Waste currently participates in SWS curbside organics collection program and would consider expanding their organics service to both residential and commercial customers. Blue Arctic is enthusiastic about the SWS organics collection program and expressed interest in training and marketing support to learn more about organics collection and composting process.

11.0 REFERENCES

1. Solid Waste Services Integrated Solid Waste Master Plan, November 2019
2. Municipality of Anchorage Materials Recovery Facility Feasibility Study, September 2019
3. Alaska School District Pilot Food Scraps Collection and Composting Summary 2019
4. Alaska School District Pilot Food Scraps Collection and Composting Summary 2020
5. Municipality of Anchorage Contract Service with Central Recycling Services 2021
6. Anchorage Land Use Plan 2040
7. Anchorage Municipal Codes Chapter 26.80 Solid Waste Disposal
8. Composting Feasibility Study Fairbanks North Star Borough Alaska, November 25, 2015
9. Composting in Rural Alaska, BioCycle Magazine, July 18, 2011
10. City of Gustavus Disposal and Recycling Center (DRC) Food Waste Composting Operating Plan
11. Composting Feasibility Study Fairbanks North Store Borough, Alaska November 25, 2015
12. US EPA Announces First Validated Laboratory Method to Test for PFAS in Wastewater, Surface Water, Groundwater, Soils September 2, 2021 press release
13. AWWU AWWTF Biosolids Management Business Case Evaluation, March 26, 2018.

12.0 LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone Environmental Group, LLC shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

APPENDIX A

STAKEHOLDER INTERVIEWS

Stakeholder interviews were conducted to obtain feedback from select local environmental leaders on the collection and recycling of organics to identify opportunities for developing end-markets and programs for SWS. Interviews were conducted as virtual meetings and through email communications as needed.

The general feedback from the stakeholder conversations is that the stakeholders agree to continue to build out an organics management program for Anchorage. To divert organics from the landfill for beneficial use as a locally produced compost. Collaboration and communications are important components to a successful program. Call notes from these interviews are included in the Appendix.

The Stakeholder interviews include private waste haulers, school district, composting operation, a brewery, state government leaders and local Tribal representatives. **Table 12-1** shows the names of stakeholder interviews.

Table 12-1: Interviews Name and Affiliation

Interviews: Name	Affiliation
Scott Crockett, State Resource Conservationist Tracy Robillard, Public Affairs Specialist	USDA Natural Resources Conservation Service (NRCS) Alaska State Office
Glenda Grave, Natural Resource Manager Erik Johnson, Natural Resource Specialist II	Alaska Department of Natural Resources, Division of Agriculture (DNR)
Jodie Anderson, Director	Matanuska Experiment Farm and Extension Center, University of Alaska Fairbanks
Donna Mears, Environmental Engineer	Central Recycling Services (CRS)
Matthew Moffitt, Owner/Composter	Moffit Farm
Robbie West, Laurel Andrews, and Mike Shrewsbury	Alaska Waste
Maggie Bardauska, Recycling Coordinator	Alaska School District
Andy Merger, Director	Alaska School District Student Nutrition
Sassan and Kristy Mossanen, Owners	Denali Brewing Company
Jonathan Rubbo, Environment/Waste Management	Yakutat Tlingit Tribe
Jason McDonald and Brian Vanderwood	Blue Arctic Waste Solutions
Paul Berry, Manager, Disposal and Recycling Center	City of Gustavus

Key Feedback From Interviews

Curbside Organics Collection and ARL

- **The collection routes are not efficient.** SWS collects organics 4 days per week using a single dedicated collection truck (rear load). Based on the organics program stats, the SWS collection is from less than 400 homes per week. Most curbside collection trucks can collect from 500-900 homes per day.

- Alaska Waste brings the collected curbside organics to the ARL. Their truck drivers are familiar with the unloading process at the ARL that is backing onto the ramp to unload organics in to the 40-yard roll-off. **Alaska Waste indicated that the 40-yard roll-off is often full on the days their trucks bring in material.**
- The Curbside Organics Program accepts most backyard home compostable foods scraps including fruit, vegetables, beans, eggshells, and coffee grounds/tea bags (including paper coffee filters). Not accepted are meat, bones and any proteins including cheese and fish. **The Curbside Organics Program is not really a full organics program. Meats, bones, and compostable papers could also be collected to support a full organics program.**

Access to Free Compost

- Alaska Waste customers complain that the free compost is not available to them when they go to the pickup at the CTS. **There is not enough compost for all curbside organics participants.** This is due to the first come first service access and unmonitored distribution at the compost pick-up site.
- ARL is 15 minutes out of town, and residents feel the drive to ARL is inconvenient. The CTS has long lines to wait for the free compost. Pickup of compost on weekends. Saturday is the one day that the facility is open and there is already too much traffic
- Provision of compost. SWS will need to move the compost pick up from CTS to another location that is easy for residents to access the compost. Residents want to use compost and would prefer locally produced compost. Purchasing compost from the big box stores is expensive.
- **Earlier composting operations in MUNICIPALITY OF ANCHORAGE over the last decade presented issues including the production of inconsistent and contaminated compost products. Having a good compost operator is important, as is developing the expertise needed.**

Alaska School District

- For the 2021 school year, ASD decided that Food Scraps Collection will not be offered during this school year due to COVID. The decision to cancel the food scraps collection program was based on how the lunch would be served and where students might be eating their meals either in the classroom or in the lunchroom.
- **School resources are limited. There is not enough staff to support and expand the food scrap collection program; there is only one custodian per school**. Each school tends to have Recycling Champions that are teachers and Custodians. Recycling Champions is a term for a teacher who is passionate and willing to take on extra responsibilities to help their school recycle without additional pay.

- ASD has a unique food service with Central Kitchen for the entire school district. ASD school meals are prepared inhouse at the Central Kitchen where it is put into packaging for distribution to each school. The food is prepared like a TV dinner or an airline meal that involves a lot of plastic film and packaging. As an example, a cooked hot dog is served in a black plastic tray. Then the food package goes through a plastic wrap machine. If students eat meals in the classroom, all food scraps and plastic waste would be disposed of in the trash stream.

- **ASD Central Kitchen (Student Nutrition) does not divert the food scraps from preparing meals.** Student Nutrition is the largest meal preparer in MUNICIPALITY OF ANCHORAGE. They are the largest single meal producer in the community and donate food to local food banks.

TABLES

FIGURES