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Designing a Sustainable Municipal Compost Facility

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The Southeastern Connecticut Regional Resources Recovery Authority's proposed compost facility reflects a well-thought-out strategy that leverages advanced composting technologies and engineering practices to create a sustainable and economically viable operation.

By David Aldridge and Greg McCarron

The amount of organic waste produced in North America pressures waste management systems and, when placed in landfills, creates excessive methane to control and uses up valuable landfill space or gets incinerated. In response, municipalities and private companies are diverting organic wastes from landfills and reusing them as feedstock to create high-quality compost. While theoretically simple, there is a logical series of processes and parameters, some specific to each site, to reach the goals communities and solid waste management organizations hope to achieve.

We cover them in this article using the Southeastern Connecticut Regional Resources Recovery Authority (SCRARRA) to highlight several elements of success. SCRARRA serves 12 municipalities with a population of 230,000, generates approximately 130,000 tons of MSW currently processed in a waste-to-energy facility, and handles 18,000 tons of mixed recycling annually.

SCRARRA is in the midst of constructing and operating a new compost facility to compost food scraps (targeted feedstock) and wood chips using aerated static pile (ASP) technology. This compost facility will be the first and only large-scale aerobic food waste composting facility in southeastern Connecticut, fulfilling an infrastructure need in a historically underserved region.



With this facility, SCRARRA will provide the infrastructure to create a sustainable, environmentally friendly system for diverting organics from the waste stream into a high-quality soil amendment for farmers and gardeners (see **Figure 1**).

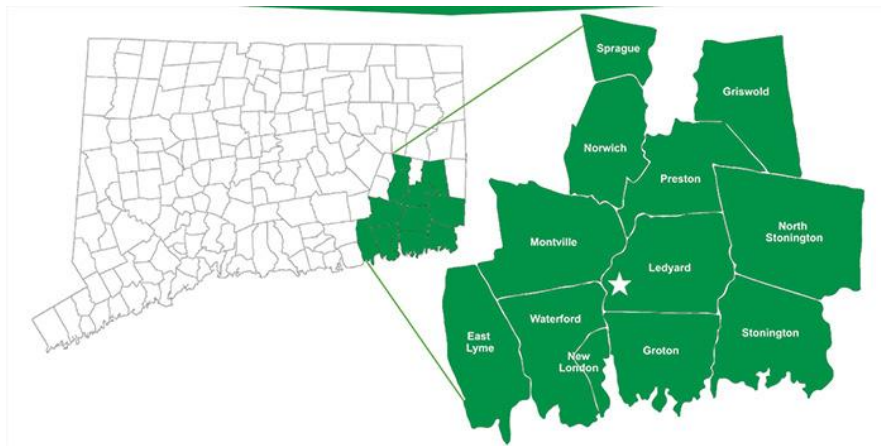


Figure 1: SCRARRA serves 12 municipalities with a population of 230,000..
Images courtesy of SCS Engineers.

Siting

After considering four different sites, SCRRRA selected a 33.67-acre site in Preston, CT, owned by SCRRRA. The Authority already leases a large portion of the lot to Covanta for a waste-to-energy facility. The proposed compost facility will occupy about 7.5 acres (**see Figure 2**).



Figure 2: The final 7.5-acre site is in Preston, CT, co-located with a Covanta WTE facility.

Sustainable Solutions Have Economic, Human, and Environmental Returns

Implementing SCRRRA's facility will save money for the member towns in the face of rising waste management costs. The overarching environmental and human goals are to provide the region with the large-scale infrastructure necessary to divert organics from the waste stream and process them into nutrient-rich compost for the local community. Still, the economic benefits are important in the long term. The SCRRRA facility aims to:

- Establish compost infrastructure that will facilitate the diversion of food waste from the waste stream
- Establish large-scale capacity for organics recycling
- Reduce greenhouse gas emissions created by incineration and trucking of ash out of the region and trucking of purchased soil

amendments into the region

- □Sequester carbon in the natural process of composting
- □Provide a local source of soil amendment/fertilizer alternatives, some of which will be provided free to environmental justice communities for their community gardens
- □Reduce the amount of waste sent to incinerators and landfills
- □Educate communities about organic recycling and composting




SCRARRA had SCS Engineers perform a financial pro forma based on the conceptual process design, initial feedstock, and expected annual growth using the hybrid approach. Included in costs were the capital and operating costs, site facility with equipment, utilities, maintenance, and labor. Revenue sources included a tipping fee for food and compost sales. The pro forma results showed six scenarios and possibilities for the necessary funding to move forward. The scenarios are useful to help build flexibility in the long term. A USDA grant from the Composting and Food Waste Reduction Program and SCRARRA reserve funds finance the facility. SCRARRA seeks additional funding from the EPA and the Connecticut Department of Energy & Environmental Protection, pending approval.

Perform a Pilot Program to Test Before Investing

Working with SCS Engineers, SCRARRA completed a successful Connecticut Department of Energy and Environmental Protection (CT DEEP) approved food waste composting pilot project that produced a high-grade soil amendment.

The large-scale food waste composting demonstration project was conducted in 2021 at the town of Stonington's transfer station. The project evaluated the receipt and composting of food scraps using the same ASP technology proposed for the full-scale facility.



SCRRRA composted two batches of feedstock material with differing mix ratios of food scraps to wood chips. The pilot project produced a high-grade soil amendment, corroborated by certified lab tests. These certified tests are essential to know that the product meets high-quality standards. Based on the success of the pilot test and after careful financial analysis, SCRRRA decided to develop a permanent, full-scale compost facility.

Compost Process Optimization is Critical

The SCRRRA compost facility will use a hybrid process, including aerated static piles followed by machine-turned windrows. Aerated Static Pile (ASP) composting is a controlled aerobic decomposition process, which entails placing organic materials in piles and maintaining high oxygen levels by continually blowing air through the piles.

To maximize the efficiency and quality of the composting process, the following key parameters for all facilities should be emphasized:

- **Proper Feedstock Mix:** Ensuring a balanced input of organic materials to optimize decomposition
- **C:N Ratio:** Maintaining a carbon-to-nitrogen ratio between 25:1 and 40:1 to balance the nutrients available for microbial activity
- **Bulk Density:** Keeping the bulk density within 700 to 1,000 lb./cy to ensure adequate porosity and aeration
- **Moisture Content:** Maintaining moisture levels between 50 to 60 percent is crucial for microbial activity and preventing water saturation that can impede aeration
- **Oxygen Levels:** Ensuring more than 10 percent oxygen is always present to support aerobic decomposition
- **Temperature Control:** Maintaining temperatures between 130° to 140°F, which is optimal for composting and helps in pathogen reduction and faster breakdown of materials

- **Forced Aeration and Heat Removal:** Using forced aeration to enhance oxygen supply and facilitate the removal of excess heat through the vaporization of water, thus preventing overheating
- **Moisture Depletion Caution:** Monitoring to avoid excessive moisture loss, which can slow down the composting process and reduce the quality of the finished product



Compost Facility Process

The SCRRRA compost facility includes the following key components, presented in the order of its composting process.

1-Scale and Scale House

Incoming organic materials are weighed upon arrival at the facility. Commercial trucks with food scraps are directed to the enclosed receiving and mixing building. SCRRRA trucks with wood chips are directed to the open-air wood chip stockpile area.

2-Receiving and Mixing Building

The receiving and mixing building is fully enclosed, with a concrete floor (**see Figure 3**). Food scraps are unloaded inside the building and immediately mixed with wood chips. Food scraps are not stockpiled and get incorporated into the composting process on the day of receipt. The organic materials (e.g., food scraps and wood chips) are mixed to create a mixture that meets the system's feedstock requirements.



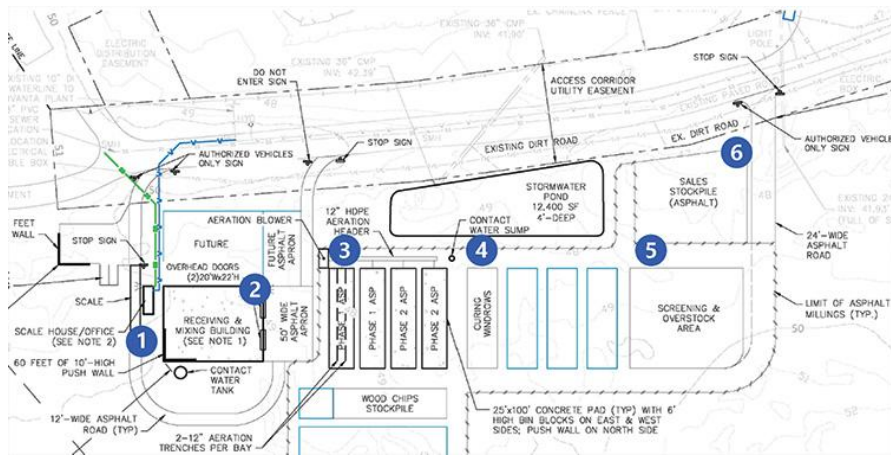


Figure 3: Stepping through the compost facility process.

3-ASP Bays

Mixed organic materials are initially placed in a Phase 1 ASP bay. Each of the two Phase 1 ASP bays is delineated by moveable concrete bin blocks with a height of 6 feet, a width of 24 feet, and a length of up to 80 feet. At the end of the Phase 1 process, organic materials are moved to a Phase 2 ASP bay. Each of the two Phase 2 ASP bays is delineated by moveable concrete bin blocks with a height of 6 feet, a width of 24 feet, and a length of up to 80 feet. All ASP bays include a concrete slab with cast-in-place aeration trenches.



4-Curing Windrows

At the end of the Phase 2 process, composted materials are moved to a curing windrow. Each of the four curing windrows is up to 15 feet in height, 30 feet in width, and 100 feet in length. The windrow area will include an asphalt millings surface.

5-Screening Area

At the end of the curing phase, the composted material will be screened to remove non-organic materials and large particles (e.g., sticks, rocks, wood chips) to create fine-grade compost for distribution or sale. The screening area will include an asphalt millings surface.

6-Storage Areas

Finished compost will be stored in the sales stockpiles, up to 15 feet in height, up to 60 feet in width, and variable in length. The sales stockpile will include an asphalt surface. Ground wood will be stored in stockpiles up to 15 feet in height, up to 30 feet in width, and variable in length. The ground wood stockpile will include an asphalt millings surface.



Results from the first batch run during pilot testing.

Design Considerations

The site will be compacted and graded to a 1.5 to 2.5 percent slope, preventing stormwater ponding. The site's grading, roughly from south to north, will generally match the existing grading and stormwater flow patterns. The drawings indicate the surfacing of the site for the various operational areas, which will include concrete, asphalt, or asphalt millings.



Stormwater will be directed into a new stormwater pond and reused in the process to the extent possible. Contact water from the ASP process will be contained and collected in a sump. Contact water will

then be pumped from the sump to a small above-ground tank and recycled into the process.

A 4- to 5-foot-high screening berm planted with grass will be installed on the south perimeter. Any other areas within the facility boundary not covered by concrete or asphalt will have grass. Physical barriers (perimeter fencing and locking gates), signage, and staff vigilance control customer access at the site entrances. The facility entrance signage will identify the name and address of the site, phone number, hours of operation, and accepted materials.

Feedstocks and Moving Toward Finished Compost

The feedstocks will be sourced locally from residential and commercial generators in the SCRARRA member towns (i.e., East Lyme, Griswold, Groton, Ledyard, Montville, New London, North Stonington, Norwich, Preston, Sprague, Stonington, and Waterford). SCRARRA's 12 municipal transfer stations have an abundance of yard trimmings and wood waste generated within each town, which SCRARRA will grind for use in the compost facility as a bulking agent and carbon source.

SCRARRA plans to collect clean, source-separated food scraps at each municipal transfer station and partner with experienced organics haulers to provide curbside pickup to the residents of the SCRARRA member towns. We expect local businesses, schools, hospitals, etc., will also use the facility. The specific quantity of food scraps from each type of generator is unknown.



Initially, SCRARRA does not intend to accept compostable plastics. SCRARRA will work with the member towns and the above-noted haulers to provide outreach and training to the food scrap generators, including a definition of acceptable materials.

SCRRRA expects food scrap quantities to increase over time, with the first-year quantity estimated at 1,000 to 2,000 tons (about 80 to 170 tons per month). The designed system can manage about 5,500 tons of food scraps (about 460 tons per month) and 8,500 tons of wood chips annually. Finished compost will range from 3,500 cubic yards in the first year to about 19,000 cubic yards when reaching higher input levels. Due to tourism, food scrap quantities may increase in the summer season. The facility will be open to commercial customers only. The general public can drop off or pick up materials at the existing municipal transfer stations.

SCRRRA plans to participate in the US Composting Council Seal of Testing Assurance (STA) Program. The samples are sent to a STA Compost-Certified lab for analysis of typical compost parameters, as recommended by USCC, including the degree of completion (e.g., stability, maturity). Finished compost will be ready for distribution when lab tests or field tests indicate that it is "stable" and "mature" based on carbon dioxide evolution tests and plant bioassay tests. Expected users of the finished compost include farmers and landscape companies. While generating compost year-round, we expect most compost sales to occur in the Spring and Fall.



The pilot project produced a high-grade soil amendment, corroborated by certified lab tests



Monitoring for more than 10 percent oxygen and temperatures between 130 to 140°F, optimal for composting and helps in pathogen reduction and faster breakdown of materials.



Environmental Controls for Noise, Water Conservation, and Odors

Noise from truck traffic will be minimal due to the limited number of trucks delivering materials. Further, food scrap trucks unload inside the receiving building, where mixing will occur to minimize noise. The

process relies on static piles with only occasional movement of the materials by a loader. As such, noise from loader operation can be kept to a minimum.

Likewise, indoor mixing helps minimize dust generation. During dry conditions, detention pond stormwater can be useful for dust control on the roads and the screening process, as noted in a daily log.

Concrete slopes in each ASP bay drain contact water to the aeration trench, which serves a dual purpose as a below-grade leachate drainage system. In this approach, contact water from each ASP bay drains by gravity is collected and pumped from the sump to a storage tank near the receiving building. Recycling contact water from the storage tank to increase the moisture content of the feedstocks is preferential over other water sources for conservation.

The compacted and graded site slope will be at a 1.5 to 2.5 percent angle, preventing stormwater ponding. The site's grading, roughly from south to north, will generally match the existing grading and stormwater flow patterns. Stormwater will be directed into a new stormwater pond and reused to the extent possible by directing excess stormwater to the existing site stormwater system (i.e., a large infiltration basin to the north).

Food scrap materials are received inside the receiving building and processed daily by mixing food scraps with wood chips on the same day of receipt and moving them into a Phase 1 ASP bay. If the food scrap materials cannot be mixed or moved within the same day due to an unforeseen condition, the materials can be covered with wood chips, four to six inches in depth, to act as a biofilter.

The ASP system will maintain conditions at optimal temperature and oxygen levels, thereby minimizing odor generation. The blower design is for high flow capacity, so oxygen levels in the ASP bays will remain high, and temperatures will remain in the optimal range for the microbes (i.e., 130° to 140° F). Most odor-causing compounds are generated and broken down in the first two weeks of the process. Placing a biocover over the ASP bays reduces emissions. This biocover will consist of unscreened, finished compost or ground wood waste. The wet biocover improves emissions reductions. Should offensive odors be detected, placing a thicker biocover over the ASP bays reduces them more.



Sharing and Leveraging Lessons Learned

Overall, SCRRRA's proposed compost facility reflects a well-thought-out strategy that leverages advanced composting technologies and engineering practices to create a sustainable and economically viable operation. The focus on hybrid systems and the incorporation of rigorous process controls indicates a forward-thinking approach to composting at scale. | WA

SCRRRA Executive Director David Aldridge and SCS Engineers Greg McCarron, PE, Certified Compost Professional, present this case study at multiple solid waste, composting, and sustainability events. They are currently planning a live session and on-demand recording to continue sharing helpful insights for these growing initiatives while maintaining environmentally sound processes and positive associations with the surrounding communities they serve. David can be reached at daldridge@scrrra.org. Greg can be reached at gmcarron@scsengineers.com.