Full-Scale Composting Financial Feasibility Study

THE UNIVERSITY OF UTAH
OFFICE OF SUSTAINABILITY

Composting Feasibility Study
Authored by: Cindy Morris, Intern, MBA Candidate 2012
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University of Utah

EXECUTIVE SUMMARY

In June 2005, the University's trash audit estimated **720 tons** of compostable food, which was 11% of the overall waste. This study investigated collection of this organic waste. The study focused on 3 areas, since 69% of the food waste came from these: the Heritage Center Cafeteria, the Student Union Building Food Court, and the University Hospital Food Services.

At the University of Utah, there are 2 options for composting food waste: **1.** Transport it to an off-site composting contractor or **2.** Establish a composting operation on-site. For option 1, the Salt Lake County Landfill is the only contractor that will be accepting post-consumer organic waste in the near future. For option 2, because of limited space, an in-vessel composting machine was chosen. It is fully automated with sensors to monitor temperature, oxygen and moisture and a biofilter to eliminate odors.

University solid waste data was collected for 2010, for comparison with 2005, and a waste audit was performed at the Heritage Center and the Union. 2010 green waste data was collected for the Grounds Department (which takes care of much of the University) and Red Butte Gardens, which totaled 448.9 tons. An estimated total of 400 tons of organic food waste from the three focus areas was calculated. Approximately **850 tons** of compostable material could be diverted annually, or **2.3 tons/per day**.

A Financial Life Cycle Analysis was completed for each option. The results are a Life Cycle Cost (LCC) of **$42,728.10** for **option 1** and a Life Cycle Savings for **option 2** of **$ 368,608.28**. This would suggest that **option 2** is the better financial choice.

In addition to financial impact, it should be noted that **option 2** lessens green house gas emissions by at least 1000 MTCO(2)E annually. This is a result of 850 tons of waste not being hauled to the landfill, a distance of 28 miles roundtrip. There would be additional GHG emission reductions from using the compost made instead of transporting it from vendors.

The ideal recommended set-up for capturing post-consumer organic waste at food venues is already in place at the University Hospital Food Services and the Heritage Center Cafeteria. At the Union Food Court, the customers would separate their own waste. This requires continuing education; however, much of the paper/packaging waste is already compostable, which helps to decrease contamination. It is recommended that a composting program be implemented to collect waste from these 3 major areas; collection could then be added from other areas after analysis of the cost and benefits.

Introduction

The US generates more than **34 million tons** of food waste each year, more than 14% of the total municipal solid waste stream. In 2009, less than 3% of this food waste was recovered and recycled. The rest —**33 million tons**— was thrown away. Paper is the only category which generates more waste, but more is recycled. **Food waste now represents the single largest component of MSW (Mixed Solid Waste) reaching landfills and incinerators.** When food is disposed in a landfill, it quickly rots and becomes a significant source of methane — a potent greenhouse gas with 21 times the global warming potential of carbon dioxide.[i]

This study investigates the feasibility of collecting food waste at the University and turning it into compost. A 2005 waste audit estimated that the University had 720 tons of food waste each year which is taken to the landfill as trash. 240 tons of compostable/soiled paper and 230 tons of prunings, leaves and grass were also part of the trash, which could be composted as well.

University-wide composting would substantially aide in the achievement of several of the goals listed in the University's 2010 Climate Action Plan. Some of these are:

- a zero-waste campus: Converting the estimated 960 tons per year of organics to compost, which could be used in landscaping would give zero waste from this material.
- 25% waste reduction in 5 years through reuse, diversion, and aggressive recycling: A composting program could eliminate 17% of the current waste stream.
- Compost 100% of garden waste: Garden waste would be the major component in the pre-consumer waste aspect of the proposed composting. Garden waste could be collected at many of the food venues on campus.
- Revise vendor contracts to implement stricter sustainability practices and delineate incentives for waste minimization: Once a composting program is chosen, food vendor contracts can be revised to include responsibility for reducing waste through organic waste collection and expanded use of compostable containers.

What is Composting?

Composting involves the decomposition of organic materials to produce a nutrient rich soil-like or mulch product. There are 5 primary variables that must be controlled during this decomposition, in order to derive the most benefit from this natural, but usually slow, process.

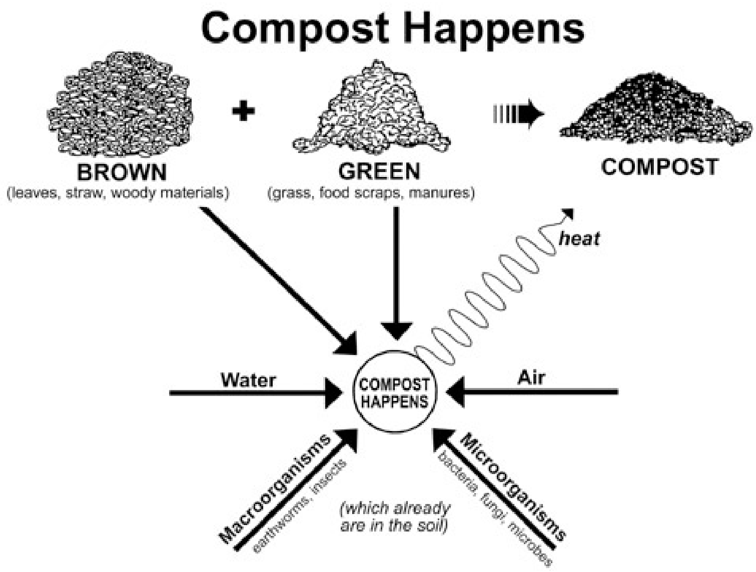
Carbon/Nitrogen balance. There should be a proper balance of "green" organic materials (e.g., grass clippings, food scraps, manure), which contain large amounts of nitrogen, and "brown" organic materials (e.g., dry leaves, wood chips, branches), which contain large amounts of carbon. In general, an initial ratio of 30:1 carbon:nitrogen is considered ideal. Higher ratios tend to retard the process of decomposition, while ratios below 25:1 may result in odor problems. Typically, carbon to nitrogen ratios for yard trimmings range from 20 to 80:1, wood chips 400 to700:1, and municipal solid wastes 40 to 100:1. As the composting process proceeds and carbon is lost to the atmosphere, this ratio narrows; finished compost should have ratios of 15 to 20:1.

Particle size. Grinding, chipping, and shredding materials increases the surface area on which the microorganism can feed. Smaller particles also produce a more homogeneous compost mixture and improve pile insulation to help maintain optimum temperatures. If the particles are too small, however, they might prevent air from flowing freely through the pile.

Moisture content. Water is the key element that helps transform substances within the compost pile and makes the nutrients in organic material accessible to the microbes. Organic material contains some moisture in varying amounts, but moisture also might come in the form of rainfall or intentional watering. A moisture content of 50 to 60 percent of total weight is considered ideal.

Oxygen flow. Turning the pile, placing the pile on a series of pipes, or including bulking agents such as wood chips and shredded newspaper all help aerate the pile. Aerating the pile allows decomposition to occur at a faster rate than anaerobic conditions. Care must be taken, however, not to provide too much oxygen, which can dry out the pile and impede the composting process.

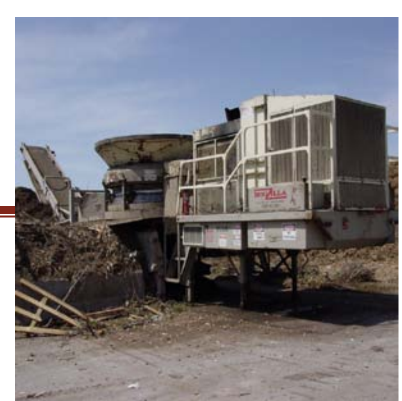
Temperature. For composting, the optimum temperature range is between 90 and 140° F, to promote rapid composting and destroy pathogens and weed seeds. Controlling the previous four factors can bring about the proper temperature. Cooling is a sign of reduced microbial activity, which can come from completing the composting process or a problem with one of the controlled factors. The compost should cool completely at the end, which is called curing.



Finished compost will no longer heat on its own, thus maintaining the ambient temperature, and there will be no weed seeds or pathogens. The pH will be near 7.0, and the moisture content will be between 35 and 50 percent. The organic matter volume will be reduced to between 40 and 65 percent of the original amount. It is important to protect the compost from windblown weed seeds until its point of use. It is very important not to apply unfinished or immature compost; it may have phytotoxins that can kill plants. An inexpensive way to test for mature compost is the watercress test. Watercress seeds will not germinate or grow in immature compost because they are very sensitive to pH and nutrition.[ii]

Full-Scale Composting Options at the University

Option 1 – Composting Contractor. Many universities have formed partnerships with community composting businesses. At present, existing composting businesses in this community only accept pre-consumer compostable materials.



The management at Eco-Scraps, a local composting company, is working towards setting up a pickup route with a local waste hauler for pre-consumer waste. There would be a charge for this service. They may consider accepting some post-consumer waste in the future, but the type of material accepted would be limited in order to keep the quality level of their compost.

The Salt Lake City government has instructed the Salt Lake City Landfill to prepare to expand the composting area to include post-consumer waste. Currently, the program only accepts the following waste: fruits and vegetables, coffee grounds, egg shells, sawdust, and yard waste. They hope to accept post-consumer waste within the year; this would include meat and bones (which they can grind up). They may accept biodegradable paper products, but they may need to be shredded or pulped.

GRINDER AT SL LANDFILL

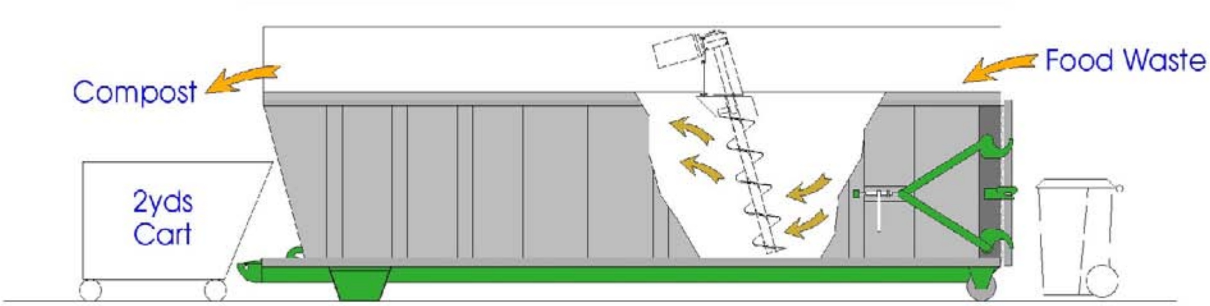
TROMMEL SCREEN AT SL LANDFILL

The Landfill's Composting Process: Green waste is collected and run through a grinder. It is then transported to the compost area where it composts in wind rows for 6 to 8 weeks, reaching a temperature of at least 120 degrees in order to kill any weed seed or bacteria. After the wind row process is complete, the compost is then run through a trommel screen in order to separate the fine and coarse material. After the material has been screened, the fine material is sold.[iii]

Option 2 – In-House Composting. Until a local business accepts post-consumer waste, this is the only way to divert post-consumer compostable waste. The University currently has a small-scale composting project diverting pre-consumer waste to the Edible Campus Gardens' composting bins. Because of limited space, possible smell or rodent problems, an In-Vessel Composting Unit would be the best way to accomplish large-scale composting at the University.[iv] It is possible that the University of Utah could turn this effort into a business, by collecting pre and post consumer waste from other businesses, helping to pay for the costs associated with running a composting facility. Several machine options have been investigated, focusing on those that other US Universities have successfully used. Information on 2 systems with the capacity to handle this project is listed in Appendix E. The Earth Flow Machine from Green Mountain Technologies, which was installed last year at the University of Colorado at Boulder, was chosen for the financial analysis, because its capital cost is 40% less than the other large machine.

With this system, food waste can be added daily to the loading end along with shredded green waste. The auger mixes the food waste into the hot compost, which rapidly breaks down as it moves toward the discharge end of the vessel. The typical process time for the waste to flow through the vessel is 14-21 days. The finished compost can be unloaded about once a week and can be used directly as mulch or can be cured (stand in a pile) for 30-60 days before being used as a soil amendment.

This option would require the purchase and set-up of 2 Earth Flow Machines with moisture addition systems here on campus. Each one's capacity would be 1-1.3 tons/day. An area by the Cardboard Recycling Building (near the high temperature water plant) has been chosen as a possible location for the purposes of this study only. The west part of the median, which currently has grass, would be of sufficient size. The machines would be placed side by side (lengthwise) on a concrete slab. The finished compost may need to be transported elsewhere to be allowed to cure in a pile before use.



MEDIAN: COMPOST MACHINE PROPOSED LOCATION

CARDBOARD RECYCLING BUILDING

Life-Cycle Analysis-20 years

Option 1: Organics Hauled to Salt Lake Landfill Composting

This involves picking up post consumer waste daily from 3 locations: the Union, Heritage Center, and the Hospital Cafeteria and hauling it to the Salt Lake Landfill for composting.

Cost Items	Base Date Cost	Year of Occurrence *(from base date)*	Discount Factor	Present Value
Cost Savings for tipping fees change from trash to composting at Landfill: $22.82/ton times 400 tons	($ 9,128)	annually	d=3	($135,801.60)
Extra Cost for Contractor to pickup organic waste daily at 3 locations	$ 12,000	annually	d=3	$178,529.7
Total LCC				**$ 42,728.10**

Option 2: Compost Machine

This involves the purchase and set-up of 2 Earth Flow Machines with moisture addition systems here on campus. Each one's capacity is 1-1.3 tons/day. It includes hiring an employee to handle the compost operation and to pick-up organic waste daily from the 3 locations.

Cost Items	Base Date Cost	Year of Occurrence *(from base date)*	Discount Factor	Present Value
Initial Investment Cost: -Machine Purchases (2) -Freight (2) -Set-up costs (concrete pad, run electricity, water, sewer) -Purchase containers/dolley -Wood Chipper	 $260,100 $ 4,000 $ 34,915 $ 625 $ 15,800	 Base Date Base Date Base Date Base Date Base Date	d=3	 $260,100 $ 4,000 $ 34,915 $ 625 $ 15,800
Composting Employee (20 hours/week)	$ 17,000	annual	d=3	$252,917
Electricity: 2,555 kWh @ $.06/kWh	$ 166	annual	d=3; e=6	$4,549.82
Water: 6,150 gal/year @ $ .01/gal	$ 62	annual	d=3	$ 922.40
Maintenance & Repairs	$ 7,803	annual	d=3	$116,088.9
Truck to pickup and transport materials (15 hrs/week)	$ 1,200	annual	d=3	$ 17,853
Compostable Trash Disposal: 400 tons @ $76.13/ton	$ 30,452	annually	d=3	($453,048.90)
Yard Waste Disposal Savings: 448.9 tons @ $53.31/ton	($ 23,930)	annual	d=3	($356,018)
Possible Compost Savings: -97 tons: Red Butte Garden @ $72.8/ton (includes hauling) -287 tons: Grounds @$38/ton	($ 7,061.60) ($ 10,906)	annual	d=3	($105,058.8) ($162,253.7)
Total LCC				**($368,608.28)**

Yellow highlighted items are costs that are mainly associated with transportation. Using a 3% discount rate is extremely conservative for these values. Transportation inflation was 12.6% from July 2010-June 2011[v]. Transportation costs have risen by 39% over the last 10 years.

Current Organic Waste Processes

Heritage Center. This is the major meal provider for on-campus housing, operated by Chartwell's, a food service contractor. During Fall/Winter Semesters, approximately 2300 students are served 3 meals a day here. Trays, plates, glasses, and silverware are washed and reused. Students use compostable napkins. Occasionally, paper plates are used for temporary demand increases, but they are made of compostable materials. Students place their waste on a system of rotating shelves, which are sent to employees, who dump the waste into a trough containing recycled water. This trough moves the waste to the pulper, and the pulped waste is poured into a trash container. This area usually produces from 2-3 partially full 45 gallon trash containers each day during Fall & Winter, which are very heavy because of the concentrated volume and the water. Most of this waste is organic, post-consumer food scraps. The design of this center is the same as used by many universities to capture post-consumer food waste with minimal contamination. There is also a salad bar, which produces pre-consumer fruit and vegetable waste that could be separated from the other waste. It is not currently being diverted from the regular trash. Coffee grounds (more easily captured here with the filters) could also be used in an organic composting program. All of this compostable waste is currently being put in the trash compactor and sent to the landfill. In 2010, about 200 tons of waste came from this compactor.

ROTATING SHELVES/TROUGH

PULPER

Student Union Food Court. This is the largest food court on campus, also run by Chartwell's. Currently, Chartwell's Sustainability Coordinator is running a program to capture the pre-consumer food wastes from these operations. The employees have been trained to separate out these food wastes; the coordinator checks the bags and removes contaminates. Coffee grounds are also collected and added to these materials. 4.2 tons of fruit/vegetable waste and 1 ton of coffee grounds were composted, from Aug 13, 2010 to the end of the year. This food waste is weighed and then transported by the Coordinator to the compost bins in the Pioneer gardens. The Pioneer gardens use this compost in growing vegetables that are sold in a Fall Event. In an effort to save water, trays are not used at this facility; there are paper plates, cups and many containers that are compostable. The utensils used were previously compostable, but currently are not. The change took place this past year to help prevent the spread of flu (this plastic ware, not being wrapped, was placed in bins for students to retrieve). There is also a minimal amount of plastic containers and plastic wrap used. Jamba Juice, a separate contractor, uses non-compostable cups, which becomes part of the trash in that area.

TRASH BIN: UNION

CHARTWELL'S SUSTAINABILITY COORDINATOR CONSOLIDATING PRE-CONSUMER ORGANICS

Customers currently dispose of all of their post-consumer waste themselves in trash receptacles. The major challenge for collection systems in which the customer separates the waste is contamination. Continuing education will be necessary; as much of the packaging/paper goods as possible should be compostable. In 2010, 227.86 tons of waste from the Union Center was taken to the Salt Lake Landfill. Chartwell's also manages several small food cafés throughout the main campus (a list is included in Appendix B). No organic collection programs currently exist at these facilities; however, food is prepared by Chartwell's at the Union, so there would be no pre-consumer garden waste to collect at these facilities.

University Hospital Cafeteria. This large operation has 3 managers. There are two major areas of food distribution: one for patient food and a retail area for the visitors/employees at the hospital. The facility currently has a pulper that is used to reduce the volume of its waste from both areas. 3 meals per day are served 7 days per week. Employees separate out the trash, recyclable items, and dishes. During the school year, these employees are honors students (who are not paid), while in the summer, temporary employees are hired. Patient services use china, silverware, glasses, warming trays, and cloth napkins, which are washed and re-used. Patient Services also prepares boxed lunches to send to outpatient areas.

RETAIL ROTATING SHELVES

PATIENT TRAYS

The retail area uses styrofoam containers, styrofoam cups, plastic bottles and aluminum cans (they have recycle bins for collecting the aluminum cans and plastic bottles), recycled napkins, and compostable silverware. The compostable plastic silverware is purchased for its durability as well as its compostability. The retail area has a system of rotating wire shelves similar to the Heritage Center: on one side the customer places their tray and it rotates the trays to the back area where the employees separate the trash. The preparation area uses mostly pre-prepared vegetables and fruit, so there is not much pre-consumer waste. It is possible that the cafeteria would begin preparing its own fruits and vegetables in the future. Before capturing post-consumer waste from patient rooms, careful consideration should be given to disease containment.

TROUGH & PULPER

Yard Waste. In many areas, grass clippings are left on the grass to breakdown. Much of the green waste is hauled to the Salt Lake Landfill composting program. The landfill charges the University less per ton for the green waste than for other waste, resulting in a cost savings for the University. From April 2010 to March 2011, **449.4 tons** of yard waste was transported to the landfill to be composted: from the Grounds Department (361.45 tons), Red Butte Gardens (87.45 tons), and University Student Apartments-USA (.5 tons).

The University Grounds Department handles landscaping for most areas of campus, except Red Butte gardens, USA, and some areas of Research Park. USA uses a wood chipper to mulch the tree branches; this mulch is used in their flower beds to help control the weeds. Leaves are shredded and transported to the Salt Lake Valley Landfill for composting; during 2010, this required only 1 trip in November.

The University Grounds Department purchases about 1500 cubic yards of mulch per growing season (April-Sept), at a cost of approximately $24-30k per year. Red Butte gardens purchases compost from the Salt Lake Landfill, about 97 tons in 2010, at a cost of $7,061.60 (includes hauling charges).

Various Other Collection Possibilities. There are many other small cafes and restaurants in the University area where pre and post consumer organic materials could be collected. Pre-consumer waste at the UMFA Café was collected starting in January 2011 for the composting project at the Sill Gardens. A list of the various food venues throughout campus, their contact information, and what they have that would be compostable is found in Appendix B. Just as in the Union, pre-consumer waste shouldn't be too difficult to collect, but post-consumer waste separated by the customer can be challenging with regards to contamination. Unlike the Union area, much of the packaging at these small food areas is not compostable; many managers cite cost as the prohibiting factor. If post-consumer waste collection is expanded to these areas, the containers and packaging will need to be addressed. Appendix C contains a list of companies who sell compostable containers.

Organic Waste Estimate

Cascadia Consulting Group completed a waste audit for the University of Utah in June 2005. This study didn't include waste from construction projects managed by contractors, from University Student Apartments (USA), or from Research Park. Following is a table summarizing their findings as it pertained to compostable materials in 2005:

Area	% of total U trash	% of This area's trash: Compostable	Food (tons)	Compostable / soiled paper (tons)	Prunings, leaves, grass (tons)
Libraries	2	28	17	14	0
Residence Halls	15	33	273	44	0
Classrooms	5	19	49	10	0
Research Buildings	5	21	8	8	48
Research Buildings/Classrooms	5	20	28	36	6
Admin Building	4	24	28	6	25
Hospitals/Clinics	45	5	73	25	55
Exterior Litter Cans	1	59.1	24	4	2
Union	4	64.3	152	19	0
Support Services (maint, transp)	10	20	32	12	90
Auxiliaries (Bookstore, theatre, museums, athletic facilities)	5	32	36	28	38
TOTALS	**101**	**18**	**720**	**206**	**264**

Unfortunately, there hasn't been a waste audit since 2005, so this is the best comprehensive data available. The Residence Halls, the Union, and the Hospitals/Clinics house the largest dining facilities on campus and had the largest amount of food in their trash containers (about 69% of all the food waste). Therefore, research into the collection of food waste was focused on these 3 dining facilities. An informal trash audit was performed, by the author, at both the Heritage Center (the Residence Halls' dining facility) and the Union, to estimate the current percentage of compostable materials in the trash at those facilities (see Appendix D for the data from these audits). Available data for the waste at these areas in 2010 was also gathered in the table below:

Area	2005 Total Trash (tons)	2010 Total Trash (tons)
Residence Halls	960.6	200
The Union	265.9	227.86
Hospitals/Clinics	3060	2104.5

As can be seen in the above chart, the only area that is comparable is the Union. The 2010 data for the Residence Halls included only the trash compactor for the Heritage Center, while the 2005 study amount included all of the trash containers in the HRE area. The 2010 data for the Hospital did not include the trash at the Huntsman Cancer Institute, Madsen Health Center, Moran Eye Center, and University Neuropsychiatric as the 2005 study did. Because of this problem, several methods were used to estimate the amount of compostable materials currently present.
In 2005, 11% of the overall trash (6,545 tons) was food waste, 720 tons. Total waste for 2010 was approximately 5,500 tons. Calculating 11% of total waste, an estimate of **605** tons of food waste could be expected in 2010. The University of Washington, which has been very successfully operating a food waste diversion program, estimates that it currently captures 60% of the total compostable food waste. If the University of Utah were able to obtain this diversion rate in the future, this would mean composting **363** tons of food waste per year.

Another way to estimate the amount of food waste would be to use a percentage at each area from 2005. Because the 2010 trash numbers do not include the same areas as that of 2005, this number is not reasonable for the Residence Halls or the Hospitals. 69% of the food waste in 2005 came from the 3 focus areas, which is **441.6 tons**, but using these percentages for 2010 results in 237.6 tons, only 37% (see chart below).

Area	2005 food waste %	2010 food waste (in tons) using 2005 %
Residence Halls	28.4	56.8
The Union	57.2	130.3
Hospitals/Clinics	2.4	50.5
Total	69 (**441.6** tons)	**237.6** (only 37%)

A third way to estimate the tonnage of compostable food at the Union and the Residence Halls is from the trash audit, which was recently done at these 2 facilities. Two trash audits were taken at the Union, one from the Chartwell's food court area and another one from the Jamba Juice area. Compostable food and paper goods were included; the audit showed that 73% of the trash in the Chartwell's area and 67% in the Jamba Juice area were compostable. The average of these 2 numbers is 70%, which translates to **159.5** tons for 2010 for the Union. 74% of the trash at the Heritage Center was compostable, or **148** tons.

Using this new information, new estimates were calculated for the Residence Halls and the Union.

Area	2005 food waste %	2010 food waste
Residence Halls	28.4	148
The Union	57.2	159.5
Hospitals/Clinics	2.4	50.5
Total	69 (**441.6** tons)	**358** (56%)

Summarizing these estimates: about 358-442 tons of compostable materials could be recovered from these 3 facilities. Green waste, which was separated and weighed for 2010, totaled 448.9 tons. A total of **806.9-890 tons** of waste could be collected, or **2.2-2.4 tons per day.** The composting process reduces the volume of the original material by 50-60%, so this amount of material could be expected to produce about **323-445 tons of compost** annually.

APPENDIX

A: Life Cycle Analysis Estimates, Assumptions, & Sources

Option 1:

--Cost of Trash 2010 (Hauling and tipping fees): Union Trash: $17,347.48/227.86 tons =$76.13/ton (*From invoice charged to Chartwell's for all trash charges for Union Building for 2010*)
--Cost of Yard Waste 2010 (Hauling and tipping fees: $23,930.82/448.9 tons = $53.31/ton (*Tipping Fees from Joshua James: $4,410.83 Grounds and $1,399.20 Red Butte Gardens; Invoice #11054360 from Cynthia Garcia for Assist Landscape and Maintenance on trees, shrubs, hauling & removal, which included 745.92 labor hours=$18,120.79)*
--Initial Cost savings for Diverting Organic Food Waste to the Composting Area: $76.13-$53.31= $22.82/ton times 400 tons = $9,128.00 annually

--Extra Price to pickup compost material at 3 locations daily and transport to Salt Lake Landfill (*Ace Disposal Price Quote: $1000/month*)

Option 2:

-- Earth Flow-40 Machine with moisture addition system: *(all info about machine from Green Mountains Technology sales representative Vance Calvez)*
Life Expectancy: 20 years
Initial Cost: $130,050

Electricity:	motor – 2000 w @ ½ hr/day = 1 kwh/day
	Fan & controls – 100 w @24 hrs/day = 2.5 kwh/day
	Total: 3.5 kwh/day (365 days/year) ($.065/kwh[1]) = $83.00/year
Water:	25 gal/day for summer months only
	Total: 25 gal/day (123 days) = (3,075 gal/year)($.01/gal)[2] = $30.75

Maintenance/Repair: estimate 3% of capital costs per year (includes material and labor)
Loading/Unloading Machines: 10-20 minutes per day (loading), 1 hour/week unloading

--Freight: 10,000 lbs; from 98110 to 84112; w: 8.5' l: 40' h:10.5' (*on-line quote from Express Global Systems*)

--Machine Set-up: (*Estimate obtained from Cottonwood Builders, Inc., Tom Neilson; See Pg 15)*

Bring electricity to machine from Cardboard Recycling Building: $7,803
Bring water to machine: $6,259
Concrete Pad: $15,088
Sewer Connect: $7,265
Total: $36,415

--Buckets: UBC uses the Yellow 45 Gallon Brute Rubbermaid containers for their composting program. (*current pricing found at http://www.wasserstrom.com/restaurant-supplies-equipment/Product_653202*); Mark Morrison, Heritage

[1] Myron Wilson, Office of Sustainability Director
[2] Commercial Rate, SLC Public Utilities Website

Center, said he fills 2 to 3 45-gallon buckets everyday with pulped waste. This price was calculated for 11 buckets (3 for each of the 3 pick-up areas, with 2 extra)
--container dolley (pricing found at *http://www.wasserstrom.com/restaurant-supplies-equipment/SearchCtrlCmd?storeId=10051&langId=-1&searchType=Basic&filter=&sort_results=relevance&narrowSearchTermFilterArray=&newSearch=true&stdPageSize=20&currPgNum=&searchFilter=&errorViewName=SearchResultsView&search_field=dolley*)

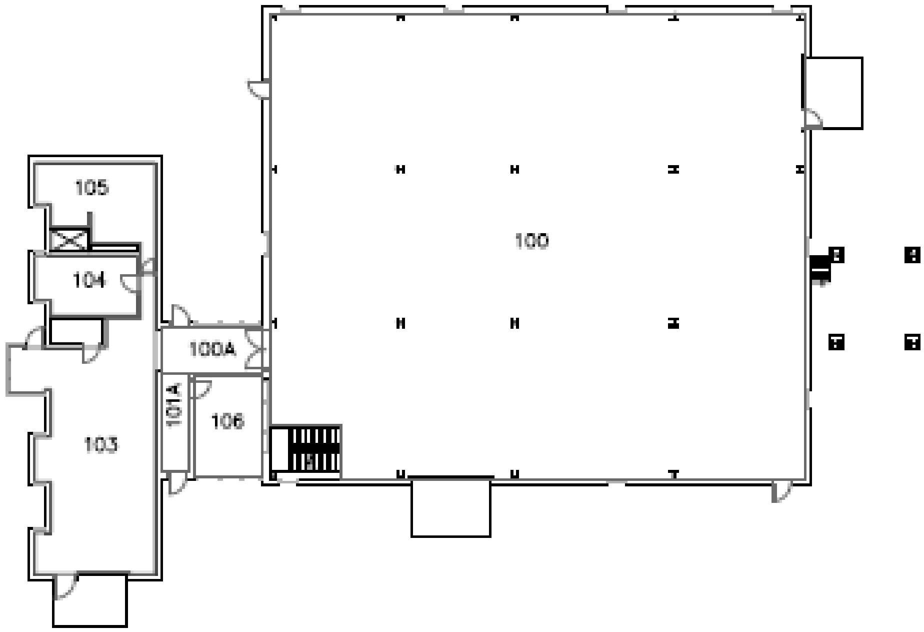
--Cost of Trash & Cost of Yard Waste: same as Option 1

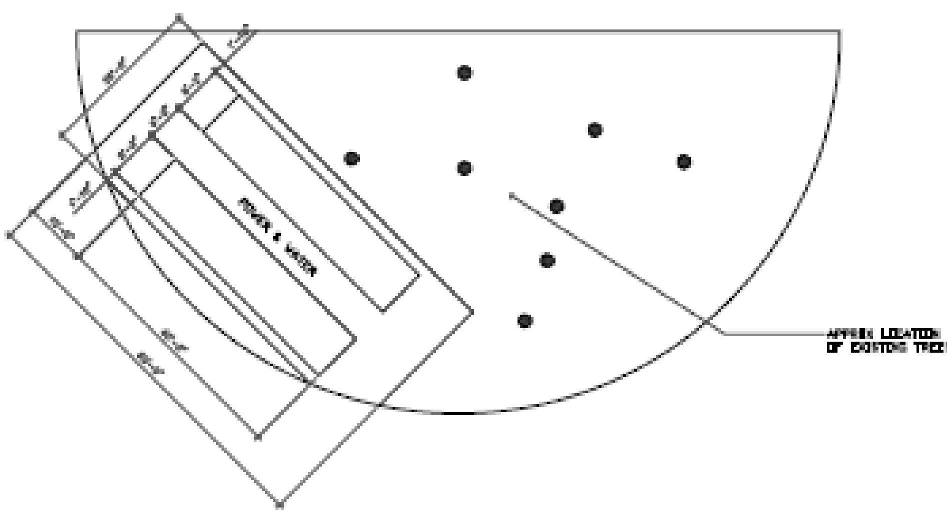
--Wood Chipper: estimate done for USA in November 2010; *See Page 16 (Vermeer Rocky Mountain Inc. http://www2.vermeer.com/vermeer/AP/en/N/equipment/brush_chippers/bc600xl)*

--Employee: route 2 hrs/day (*UNH says pick-up at 3 dining locations, and additional locations on some days, transporting to a farm to unload, washing and returning buckets takes 2 student employees 2 hours per day, http://www.ees.ufl.edu/homepp/townsend/UNH.pdf*);
14 hrs/week for route plus 2.5 hrs/week loading plus 1 hr/week unloading = 17.5 hrs/week
--Salary for 20 hrs/week employee: info from Joshua James, FM Recycling Coordinator

--Truck: 2 hours per day for route plus 1 hour once a week for unloading = 15 hours/week
Cost: $100 month (*Myron Wilson, Office of Sustainability Director estimated*)

--Compost Savings:
Machine will produce about 384 tons of compost annually (*see Organic Waste Estimate for details*).
Red Butte Gardens: purchased 97 tons of compost from the Salt Lake Landfill in 2010, at a cost of $1980. *(Info from Larry Hansen, CPA, Salt Lake Valley Solid Waste Facility*) Hauling costs for this compost were $5,085.37 (*from Cynthia Garcia, accounting, FM*) for a total cost of $7,065.37, or $72.80/ton.
The Grounds department purchases about 1500 cu yd per growing season = 750 tons at a cost of about $24-30k per year. (*info from Sue Pope, Grounds Department*)= abt $36/ton. The Grounds department could use additional compost to help keep the weeds down in the hospital parking lot; whether or not it could replace some of the amount purchased would depend on quality and curb appeal.





University of Utah: Building 303 Slab Plan

COTTONWOOD BUILDERS, INC.
GENERAL ENGINEERING CONTRACTOR
3804 South Highland Dr.
Salt Lake City, Utah 84106
(801) 278-9391 Fax(801)278-9396
cottonwoodbuildersinc@comcast.net

August 9, 2011

University of Utah

RE: University of Utah, Composting Study

We are pleased to give you the following proposal on the above referenced project. This quote is based on the information I have received from emails and the Green Mountain Technologies 3 page spec sheet.

Install the following in a half circle area on the South side of HTW Plant:

1- The installation of 60’ x 26’ concrete pad - 6.5 bag mix with fibermesh on 6” of 1” rock with 8” thickened edges. This includes excavation and removal of 4 pine trees.
$ 15,088.00

2- Connect 4” sewer line to manhole in corner of ½ circle, 18’ deep to flow line with 4” pipe extending 2’ above concrete slab.
$ 7,265.00

3- ¾” copper water line, hot tap on 6" culinary water, approximately 150 LF to the West in small parking lot off the Business Loop. Includes all asphalt, concrete, sod and irrigation repair. Install freeze-less facet.
$ 6,259.00

4- Install 2 conduits from cardboard house to the Earth Flow Machine as per the spec – 208 volt, 3 wire, 30 amp and 110 volt, 15 amps, pull wires and connect to machine. Repair concrete, asphalt and landscape.
$ 7,803.00

Total Price $ 36,415.00

Exclusions: Plans, permits, bonds, engineering.

If you have any questions, please feel free to give me a call. My cell number is 801-750-9701.

Sincerely,
Thomas P. Neilson

Vermeer Rocky Mountain Inc.

Kevin Toone
Branch Manager

Business: 801-975-1216
Fax: 801-975-7900
Toll Free: 866-816-6971
Cell: 801-599-0119
2075 S. Pioneer Road
Salt Lake City, UT 84104
ktoone@vermeermt.com
www.vermeerrockymountain.com

2075 Pioneer Rd.
Salt Lake City, UT 84104
Phone: 801-975-1216
Fax: 801-975-7900
www.vermeerrockymountain.com

Branch		
25 - Salt Lake City		
Date	Time	Page
11/19/2010	10:22:05 (O)	1
Account No.	Phone No.	Quote No.
UNIVE005	8015412326	01 001241
Ship Via	Purchase Order	
Kevin Toone	Salesperson KT	

Invoice to:
University of Utah
University Student Apartm
1945 Sunnyside Ave
Salt Lake City, UT 84108

EQUIPMENT QUOTE

DESCRIPTION ** Q U O T E ** Expiry Date: 12/19/2010 AMOUNT

New VR BC600XL BC600XL Value Pkg 6 inch capacity disk style brush chipper — 13290.00

27HP Kohler CH27 gas engine; low oil pressure automatic shutdown; 18.5 x 8.5 - 8 load range C tires; live hydraulics; variable speed horizontal feed roller; telescoping tongue; 2" ball coupler hitch; jack with caster wheel; backup marker flag holders; lockable tool/battery box; infeed table lower stop bar

****INCLUDING THE FOLLOWING OPTIONS****

BC600XL002 BC600XL WITH 27HP KOHLER GAS
BC600XL070 BC600XL AXLE W/O ELECTRIC BRAKES -
BC600XL798 BC600XL STANDARD LIGHTS
BC600XL050 BC600XL AUTOFEED (KOHLER)

MISCELLANEOUS CHARGES/CREDITS
==============================

NEW EQ TRANSPORT FEES QTY: 1 PRICE: 450.00 — 450.00

Subtotal: 13740.00
UTAH-SLC 6.85%: ~~910.37~~
Quote Total: 14650.37

Authorization: ______________________

MINUS TAX
Add 15%
15,800

Terms are due upon receipt unless otherwise specified. Customer shall be responsible for any and all costs associated with collection of any past due balance, which includes the payment of reasonable attorneys' fees incurred for such collection.	Signature	Date

B: Campus Food Venues

Name	Building	Manager	Phone Number	e-mail	Composting Possibilities
Brio	Law Library Architecture Building Turpin University Services	Quinn McDonough	(801) 673-7103	quinn@briocoffee.com	He would be interested in saving coffee grounds-has had past experience with this, and lots of problems with not having regular pick-up; they might be making own sandwiches sometime in the future for Turpin location
Caputo's	Carolyn Tanner Irish Humanities	Andy Evans	801-583-8801	handyandyevans@gmail.com	They would be happy to store pre-consumer waste; they have a fridge, so perhaps pickup once a week? Willing to try post-consumer waste-might be hard as most containers are not compostable (soup cups, fry box size container, cups)
f/Stop	UMFA-main floor	Johnny Peterson, Café Manager	Cell Phone: 801-618-5838 Cafe Phone: 801-585-5353	john.peterson@umfa.utah.edu	They are already participating in a pre-consumer waste capture for the Sill Gardens composting project, since Jan 2011. Would be interested in discussing post-consumer waste
		Kelsey Pudlock, previous OS intern-composting		kpudlock@gmail.com	
Jamba Juice	Student Union	Chris	(801) 575-6756	jamba1248@hotmail.com	No pre-consumer waste; have polystyrene foam cups-their waste gets thrown in the Union Trash for several venues
Template Café	CRCC-2nd floor	Adam Kaslikowski	(801)631-6659	adam@metarestaurant.com	Be happy to save pre-consumer veg, fruit and coffee grounds. Open M-Th, might need help with refrigerating between pick-ups; during school year, abt 4-8 gallons per day of veg/fruit
The Point	Huntsman Cancer Institute-6th floor		(801) 585-0616		
	Eccles Health Sciences Education-1st floor				
	Warnock Engineering Building-floor 1 or 0	closed for summer			
	383 Colorow				
	Williams Building	Brandon Howard	(801) 585-0618	Brandon.Howard@hci.utah.edu	His position was RIF'd Aug 2011, so need to find another contact.
Café Pierre	585 Komas				
University Hospital Cafeteria	University Hospital	Claudia Deines R.D. C.D., Manager Patient Care Services	801-581-2864	claudia.deines@hsc.utah.edu	
		Jay Oberst, Retail Manager		Jay.Oberst@hsc.utah.edu	
Starbucks	University Hospital-1st floor lobby	Jay Oberst, Retail Manager		Jay.Oberst@hsc.utah.edu	
Moran Eye Center Deli	Moran Eye Center-6th floor or 1st				

Chartwell's Locations:	Chartwell's	Reggie Conerly, Manager	801-581-5749	reggie.conerly@food.utah.edu
		Katie Hunt, Sustainability Director	704-654-0483	kphunt@gmail.com
Heritage Center	Heritage	Mark Morrison-Heritage Manager	801-870-4405	mark.morrison@food.utah.edu
Crimson Corner	c-store in heritage	Chartwell's		
Crimson view restaurant	Union-closed for summer-reopening in august	Chartwell's		
Union Outtakes	c-store	Chartwell's		
OSH Outtakes	Orson Spencer Hall	Chartwell's		
105 Café	Annex General Office-2nd Floor	Chartwell's		
SBSB Outtakes	Social Beh. Sci Bldg. Closed for Summer- Reopening in fall)	Chartwell's		
Union Foodcourt	Student Union Building	Chartwell's		
England Hub	Health Science Classroom Building	Chartwell's		
Mom's Café	Marriott Library	Chartwell's		
OSH Café	Orson Spencer Hall	Chartwell's		

C: Compostable Tableware/Packaging

Al-Pack Enterprises Ltd.

Asean Corporation

BIOgroup USA (BioBag)

Bioselect: www.BioSelect.com info@bioselect.com 800-521-8580 PO Box 221216 Charlotte, NC 28222 (Used by Ohio University in their composting program)

Biosphere Industries

Cortec Corporation

Earthcycle Packaging Ltd.

Eco Products

Fabri-Kal Corp.

FKuR Kunststoff GmbH

Genpak

Huhtamaki Americas

Innovia Films Inc.

InnoWare Plastic, Inc.

International Paper

National Checking Company

Nature Friendly Products

NatureWorks LLC

Northern Technologies – Natur-Tec

Penley Corporation

Simply Biodegradable LLC

Solo Cup Company

Telles

W. Ralston (Canada) Inc.

D: Trash Audits

Heritage Center Trash Audit: June 14, 2011

Pre-Consumer Waste:						
Sample:	**Pounds**	**Ounces**	**Bucket**	**Pounds (net)**	**Ounces(net)**	**Percent of Total**
1	5	3	1 clear	2	4.25	
2	21	1	1 clear	18	2.25	
TOTAL:				20	6.5	
						11.31
Post-Consumer Waste:						
3	18	0.75	1 grey	11	7.25	
4	2	8.75	1 white	1	8.25	
5	35	2	1 grey	28	8.5	
6	28	14.75	1 grey	22	5.25	
7	61	10	1 green	49	4.25	
TOTAL:				**113**	**1.5**	**62.67**
Trash:						
8	21	12	1 green	9	6.25	
9-12	84	48	4 green	37	9	
TOTAL:				**46**	**15.25**	**26.02**

Type of Container:	**Pounds**	**Ounces**
Green Trim Trax Bucket:	12	5.75
White Trim Trax Bucket:	1	0.5
Rectangular Grey Bucket:	6	9.5

PRE-CONSUMER FRUIT & VEGETABLE WASTE

POST-CONSUMER FOOD WASTE (PULPED)

TRASH

Union Trash Audit (Food Court Area): June 9, 2011

Recyclables in Trash:						
Sample:	**Pounds**	**Ounces**	**Bucket**	**Pounds (net)**	**Ounces(net)**	**Percent of Total Weight**
Plastic Bottles	0	2.5	none	0	2.5	
Glass Bottles	1	3	none	1	3	
TOTAL:				**1**	**5.5**	**7.88**
Post-Consumer Waste:						
3	6	14.75	1 white	5	14.25	
4	3	14.75	1 white	2	13.75	
5	3	9.5	1 white	2	9	
Pizza Boxes	1	2	none	1	2	
TOTAL:				**12**	**7**	**72.89**
Trash:						
7	2	1	1 white	1	0.5	
8	3	4.5	1 white	2	4	
TOTAL:				**3**	**4.5**	**19.23**

INITIAL TRASH

POST-CONSUMER COMPOSTABLE MATERIAL

WASTE

GLASS BOTTLES

PLASTICS 1 & 2

Union Trash Audit (Jamba Juice Area): July 1, 2011

Recyclables in Trash:						
Sample:	**Pounds**	**Ounces**	**Bucket**	**Pounds (net)**	**Ounces(net)**	**Percent of Total Weight**
Plastic Bo…	0	2.25	none	0	2.25	
TOTAL:				**0**	**2.25**	**3.72**
Post-Consumer Waste:						
3	3	9	1 white	3	9	
TOTAL:				**3**	**9**	**66.94**
Trash:						
7	2	2.25	1 white	2	2.25	
TOTAL:				**2**	**2.25**	**29.34**

Initial Trash

Post-Consumer Compostable Material

Waste

Plastics #1&2

E: In-Vessel Composting Machines

The Earth Flow™

Earth Flow with Roof and BioFilter

The Earth Flow™ is an in-vessel system that converts up to two tons of daily organic waste into compost. The unique design incorporates a fully enclosed vessel and odor control system with an inclined auger for mixing, shredding and discharging the organic waste. The compost process is automated by the control panel which turns on the mixing system, blower and sprayers based on settings from LCD interface.

Auger Mixing System

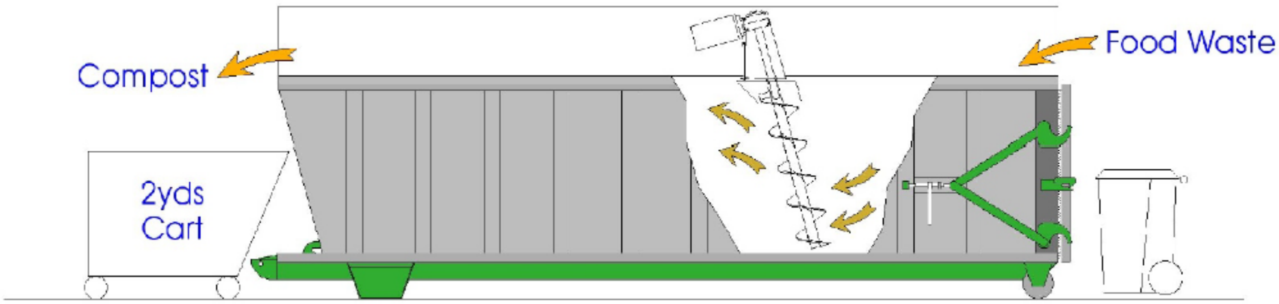
The stainless steel inclined auger is mounted on a carriage which moves side to side and fore and aft within the vessel. The auger churns and shredsthe compost in the vessel in less than ½ hour advancing it slowly toward the discharge end of the vessel.

Mixer Control Panel

The control panel operates the auger, odor control and moisture addition systems based on operator settings. The controller uses efficient variable frequency drives to regulate the mixer speed while minimizing the use of electricity.

Green Mountain Technologies www.compostingtechnology.com

THE EARTH FLOW PLUG FLOW DESIGN



Earth Flow Operations

Food waste can be added daily to the loading end of the Earth Flow along with shredded woody or green waste materials. The auger mixes the food waste into the hot compost which rapidly breaks down as it moves toward the discharge end of the vessel. The typical process time for the waste to flow through the vessel is 14 to 21 days. As the organic waste converts into compost, its volume is typically reduced by about 50-60% allowing compost can be unloaded about once or twice a week. To unload compost, open the discharge door and the auger will lift the compost up to 3 feet and push out several yards of compost into a bucket loader, cart or pick-up truck.

Equipment Specifications

Vessel Insulation	R-10 3” foam insulation (optional on CS)
Mixing Auger	13.5” 304 Stainless steel
Gear Motor	3hp 3 ph (208/230/460V – 50/60 Hz)
Gearbox	Helical bevel synthetic lube
Carriage and Rail Drives	VS ¼ hp motor
Control Panel	Programmable PLC in NEMA 4x panel
Power Requirements (Motors)	30A 220V single or 208V 3 phase
Power Requirements (Fan and Controls)	15A 110V

Vessel Specifications	EF-10-CS*	EF-10	EF-20	EF-30	EF-40
Compost Capacity (yd3)	10	10	20	30	40
Processing Capacity (lbs/day)	500-665	500-665	1000–1330	1500–1995	2000-2660
Processing Capacity (tons/day)	~0.25-0.33	~0.25-0.33	~0.5-0.67	~0.75-1.0	~1-1.3
Length – Overall	14’	12’	20’	30’	40’
Width – Overall	6’	7’-2”	8’-2”	8’-2”	8’-2”
Height – Overall (to roof peak)	9’	10’-2”	10’-3”	10’-3”	10’-3”
Approx System Weight (lbs)	3,000	3,000	6,500	8,800	10,000

* The EF-10-CS employs a coated, carbon steel vessel instead of a stainless steel vessel

Contact:
Phone: (802) 368-7291
Fax: (802) 368-7313

Green Mountain Technologies
www.compostingtechnology.com

Location:
5350 McDonald Ave
Bainbridge Island, Wa 98110

Green Mountain Technologies, Inc.
The Organic Recycling Company

Earth Flow™ 40 Price & Specifications

Effective July 1, 2011

EF-40 BASE PRICE **$128,850**

Vessel Specification

Earth Flow™ Key Features

- Exclusive Inclined Auger and Plug Flow Technology
- Stainless Steel Walls and Floor (14 gauge for walls, 11 gauge for floor)
- Stainless Steel Carriage and Travel Car
- Translucent Roof Enclosure for Passive Solar Gain

Total vessel capacity (cubic yards)	40 yd3
Processing capacity (lbs/tons per day)	2000-2660 lbs/day (~1.0-1.3 TPD)
Length overall (ft)	40'
Width overall (ft)	8'-2"
Height overall (ft)	10'-3" to peak of roof
Insulation	R-10

Mixing System

Mixing Auger	13.5" 304 Stainless steel
Gear Motor	5hp, 3 ph (208/230/460V – 50/60 Hz)
Gearbox	Helical bevel, synthetic lube
Carriage & Rail Drives	VS ¼ hp motors
Control Panel	Programmable PLC in NEMA 4x panel
Power Requirements (Motors)	30A 220V single or 208V 3 phase
Power Requirements (Fan and Controls)	15A 110V

OPTIONS AVAILABLE

Moisture Addition System	$1,200
Tote Loader with Hydraulic Package	$9,980
1500W In-Floor Heater	$2,850
Extended Parts Warranty*	$1,980/yr
On-Site Service Package**	$2,490/yr

* Standard warranty is a 1-year parts replacement warranty
** Please note: the On-Site Service Package would be for malfunctions and repairs and would not include preventative maintenance such as cleaning and lubrication.

Prices subject to change without notice.
Shipping FOB Origin, assembled

Headquarters
5350 McDonald Ave.
Bainbridge Island, WA 98110
Tel 206.842.5471

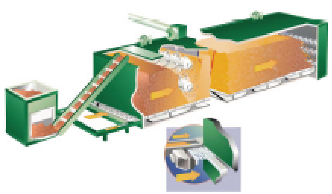
www.compostingtechnology.com

Wright Environmental Management Inc.

Organic Waste

Invessel Composting System for

THE UNIVERSITY OF UTAH



June 2011

Submitted by: Stephen Wright

1.0 Benefits of Implementing Wright Composting Technology

Wright Environmental Management Inc. has extensive experience working with Colleges/Universities facilities across the USA. This experience has contributed to the development and enhancement of a partnership model with significant benefits for both facilities and students. A summary of the critical points follows.

Financial

Implementing on-site composting allows institutions the ability to reduce waste collection and disposal fees, as well as limit exposure to environmental liabilities of shipping waste to landfill. Food waste, when released to a municipal wastewater treatment system, generates surcharges related to Biological Oxygen Demand ("B.O.D.") these surcharges can also be avoided. Institutions can also realize savings associated with avoiding the purchase of bedding soil for green house activities and topsoil for grounds maintenance. Surplus compost may also be sold generating revenue for the institution.

Training and Job Skill Development

Understanding the science of composting is a valuable skill in today's employment marketplace. As waste is increasingly diverted from disposal to composting, private companies and local governments require skilled and trained employees to operate their new composting facilities. Diploma courses in composting, available from many colleges, could be integrated with a training and job skill development program, and supported by practical experience operating the institution's on-site composting facility

Operations and Staffing

Wright composting tunnels require minimal maintenance and consume relatively small quantities of electricity and water. One or two operators per shift can staff Wright systems, depending on the system chosen. We recommend that a minimum of two operators and one supervisor be trained to operate and maintain the system, to ensure appropriate backup during illness or absenteeism.

Environmental Benefits

Wright composting tunnels contain moisture released from the composting materials, effectively controlling the release of leachate to surface and ground waters.

Each Wright composting tunnel includes a primary exhaust fan, which operates continuously to maintain the tunnel under negative pressure. All tunnel exhaust air is directed to a biofilter for treatment prior to release to the environment.

On-site Management of Putrescible Wastes

Wright technology is a proven processor of putrescible waste including **meat, fish, dairy products, fruits and vegetables, cooked foods, sewage biosolids, and paper wastes**.

The Wright composting tunnel can be loaded every day eliminating the need to store waste, minimizing vector attraction and odours. Wright tunnels can be left unattended for days in the event of illness or absenteeism.

2.0 Composting Tunnel Design Features

The Wright composting system uses fully enclosed flow through tunnels that can transform organic wastes into a soil-like material in a short time period. The patented and proven technology is ideally suited to compost putrescible/rotting organic waste in an economically and environmentally sound manner.

The in-vessel composting system, or tunnel, developed by Wright Environmental, is an innovative and unique approach to fully enclosed composting. Common problems associated with composting technologies have been specifically and systematically addressed.

Vector/rodent attraction and a higher potential for odours are problems associated with the putrescible portion of the waste stream that are managed by the Wright tunnel. Air supply, moisture levels and temperature are the critical factors throughout the composting process, and are controlled automatically in the tunnel to support microbial activity. Odours, which can be a significant problem associated with composting, are managed by maintaining the tunnel under negative pressure and filtering tunnel exhaust air through an effective biofilter. The tunnel air management system simultaneously ensures a microbial environment with more than 15% oxygen.

With a minimum of moving parts and the use of corrosion resistant stainless steel, the system can be maintained with low energy, labor and maintenance costs. Our systems are designed to meet the needs of the local authority and the community they will serve, and range in capacity from 2000 pounds of waste per day for on-site applications to hundreds of tons of waste per day for centralized locations. The in-vessel systems are modular and can be adapted to the requirements of the community, providing the ultimate flexibility for expansion of composting capacity.

System Operations

Composting material is moved in a plug flow fashion through the tunnel in the designated number of retention days. Material is supported on a series of stainless steel perforated trays that form the tunnel floor. The trays are pushed forward as a continuous unit by an external hydraulic ram.

When the ram is moving an empty tray into the tunnel, all trays within the tunnel are moving forward. As an empty tray is being inserted, compost from a single tray is being unloaded at the tunnel discharge end using a series of vertical breaker bars and a discharge auger. The auger discharges the compost from the unloading tray onto a conveyor and the empty tray emerges from the tunnel ready for inspection and re-use. Surges of waste quantities or changes in composition can be accommodated by inserting and filling more trays than the number required on a typical loading day.

The tunnel is controlled for air supply and temperature using dedicated control probes, supply and exhaust fans and an air circulation system with associated air plenums.

Composting material then moves through a set of spinners that act to invert, homogenise, agitate and stack the material into the next zone. Water is added during material cross-mixing to re-establish proper moisture levels. Material remains in the second zone for an additional number of days equivalent to retention time in Zone 1 (e.g. 7 days in Zone 1 and 7 days in Zone 2 equals 14 retention days) while significant stabilization occurs through control of air supply, water and temperature. The compost product is then removed from the tunnel.

Key design features include, in part:

- A proven technology with more than 40 installations
- Rapid composting, resulting in limited retention time
- Sequential tray loading operations
- Zero leachate discharge
- Containment and treatment of all composting tunnel exhaust air
- Automatic material and tray/floor advancement with few moving parts
- Internal mixing provided by patented spinners
- Automatic control of temperature levels within set degree ranges, airflow and moisture,
- Modular design allows for flexibility
- Minimal staffing requirements and low operating costs
- Interlocked equipment operation to protect workers from exposure to moving parts
- Contained composting environment to protect workers from air borne spores and gases associated with the composting process

Aeration and Odour Control

Composting of organic waste, by its very nature, entails management of putrescible materials that are prone to degradation. If conversion occurs without the presence of oxygen, anaerobic bacteria flourish producing a number of odourous compounds as by-products. Aerobic composting, if managed properly, does not produce unacceptable odours. Structural porosity and a sufficient supply of air and water ensure that aerobic microorganisms flourish.

Aerobic composting is supported utilizing a network of exhaust and supply fans. A primary exhaust fan operates continuously to maintain the tunnel under negative pressure and contributes to a highly oxygenated atmosphere within the tunnel. Upon demand, through temperature control, air under positive pressure from supply fans is supplied to the material via air plenums beneath the mass. These air plenums allow equal distribution of supply air below the perforated tray flooring forcing air to distribute evenly through the composting material.

Air exhausted from the tunnels is passed through a biofilter, where naturally occurring bacteria remove odours before the air is released to the environment. In this manner, odourous air generated within the tunnel is contained and treated.

The biofilter is a natural filtration system that cleanses the air stream of organic and inorganic odourous compounds. Wright biofilters are carefully designed to ensure effective removal through proper mass loading, balanced air distribution and long air residence time. The biofilter medium is specially blended to sustain physical and biological activity through ideal organic content, surface properties, porosity, pH and moisture content. The biofilter is approximately three feet in depth constructed with piping laid in a base of water-washed stones covered with a carefully selected mixture of organic materials.

Temperature Control

Each tunnel is equipped with a series of probes that monitor temperatures. These temperatures, in relation to control panel set points, are used to operate supply fans.

The optimum temperature range for composting organic waste is 50^0C to 65^0C. The temperature set point in the first composting zone is typically set between 58^0 C and 60^0 C for greater than 3 days to ensure pathogen reduction. A set point between 52^0C and 54^0C is used in the second zone to maximize conversion of putrescible materials.

Moisture Control

Water is often cited as the limiting factor in the composting process. Optimum conditions for composting of organic waste at between 55% and 65% moisture are met through feedstock blending and/or water addition during pre-processing and through the addition of water via a series of spray nozzles located at the tunnel spinners. As a tray is being advanced all material passing through the spinners is projected through a wall of fine mist created by the nozzles. In this manner, the composting material is thoroughly remoistened and brought back to optimum conditions.

Leachate Control

Any moisture that drains out of the composting material flows into the plenums that run along the base of the tunnel and from the plenums to sump boxes located at the sides of the tunnel. Leachate is pumped back onto the composting materials from the sump boxes through pipes located at each sump box. As the overall water balance is negative, no leachate is typically released to the environment or to the local sewage system.

Minimizing Vector Attraction

As Wright composting tunnels are fully enclosed and leachate is captured and recirculated, insects, vermin and birds are not attracted to the organic waste during the composting process.

Compost discharged from the tunnels is typically sufficiently converted so that no food value remains.
Processing equipment and tunnel loading systems are designed to facilitate good housekeeping procedures.

Compost Product

Compost produced after 14 days within a Wright composting tunnel will be very similar to soil in appearance, with a dark colour and similar texture. Material will be reduced in volume by approximately 30% and pathogen reduction will have occurred. Additional curing may be required depending on application.

Nutrient values vary depending on the composition and characteristics of the organic waste feedstock. For example, compost from sewage sludge, animal manures and food wastes will have higher levels of available nitrogen than compost made from yard wastes alone.

Levels of contaminants, such as heavy metals, plastics, glass etc., will be dependent on the levels of contaminants in feedstock materials.

Compost is recognised for its agricultural benefits, including improved soil structure and tilth, improved moisture retention capabilities, increased nutrient retention, improved plant growth rates, enhanced drought and erosion resistance, and as a result greater crop yield.

3.0 Composting Technology Track Record

Wright's composting tunnels are being used to compost a range of organic wastes, including source separated food and yard wastes, the organic portion of a processed mixed waste stream, and sewage sludge amended with wood wastes. Wright has commissioned tunnels ranging in size from 2,000 pounds per day to 75 tons per day (tpd), typically based on 14 days retention. For central composting facilities, installing multiple tunnels provides site capacity.

Approximately 40 on-site composting tunnels, ranging in capacity, are installed at educational institutions, hospitals, correctional facilities and military bases across North America to compost food wastes from cafeterias and food preparation from kitchens. Information on a number of these facilities follows.

Allegheny College, Meadville, Pennsylvania

Processing approximately 2,000 pounds of food waste and amendment per day, Allegheny College, with a student population of 1,850 has become the first college or University in Pennsylvania to install an on-campus composting facility. Commissioned in October 2001, the Wright composting tunnel processes food waste from the college's three on-campus cafeterias, producing compost that is used on the college gardens and grounds.

Ohio University, Athens Ohio

Delivered to Ohio University August 2008 and will be operational September 2008. This Wright tunnel processes approximately 4,000 pounds per day of food, wood and paper wastes from University grounds. University staff and students will operate the tunnel. It is situated in a partially enclosed building to allow for classroom instruction on composting and environment issues. Compost generated from the tunnel will be used on the grounds and gardens around the University. Avoiding the costs of waste transportation, disposal fees and B.O.D. charges provides effective cost recovery to Crawford County for this program.

Powhatan Correctional Facility, Commonwealth of Virginia

Operational in August 2000, this Wright composting tunnel processes approximately 4,000 pounds per day of food, paper and wood wastes from the institution and is scheduled to receive food waste from other correctional institutions in the immediate area. The inmate population operates the tunnel. Compost is used on farm properties surrounding Powhatan Correctional Facility.

University of British Columbia, BC Canada

Commissioned in 2004, this Wright composting tunnel has capacity for approximately 5-tons of food and wood waste per day. The project was demonstrated to be economically viable, considering avoided waste transportation, disposal fees and reduced B.O.D. surcharges along with reducing transportation emissions. University grounds staff and students operate the tunnel.

Wright also has a number of larger centralized composting facilities designed to process and compost organic wastes:

Lynnbottom Composting Facility, Isle of Wight, UK

A 60 tonne per day composting facility using three 20 tonne per day Wright composting tunnels is operated on the Isle of Wight, UK, by Island Waste Services Ltd. (IWSL), a privately financed initiative with Biffa Waste Services Ltd. and the Isle of Wight local authority. This facility composts food wastes collected from island residents and businesses, shredded green waste collected through the island's civic amenity sites and the fines residual from IWSL's refuse derived fuel plant.

Inverboyndie Treatment Plant, Banff, Aberdeenshire, Scotland

This mixed waste composting facility is operated in Banff, Scotland by Aberdeenshire Council. The facility receives and processes approximately 26,000 tonnes of mixed domestic and commercial waste, collected in wheeled bins, per annum. The organic portion of the mixed waste stream is directed to two 25 tonne per day composting tunnels while the non-organic materials is directed to disposal. Compost is being used to provide final cover for a series of closed landfills in Aberdeenshire.

Reedy Creek Improvement District, Orlando Florida, US

Reedy Creek Improvement District (RCID) is the local authority providing services to Walt Disney World in Orlando, Florida. RCID has implemented a composting facility to manage food wastes from their resorts and hotels. A total of 60 tons per day of food waste blended with wood waste is being collected seven days per week, and composted in 3 Wright tunnels. Compost is being used for landscaping within Walt Disney World and is sold to local citrus growers.

4.0 Wright Environmental Composting Systems

The Wright pre-engineered composting systems range in size from our WEMI model 2000 to our WEMI model 5-ton. Each composting tunnel is designed to process 65% food waste mixed with 35% carbon amendment, with a retention time of approximately 14-days.

Equipment Included with each system

Rooftop mixer or ground mixer, Bucket Lifter, 64 gallon Schaefer wheeled bins, Outfeed Conveyor, Biofilter and the Wright Composting tunnel pre-plumbed and pre-wired to the clients specifications. Power specifications to the composter are to be determined.

Budget Pricing

WEMI model 2000	$325,000.00 USD
WEMI model 3000	$375,000.00 USD
WEMI model 4000	$450,000.00 USD
WEMI model 3-ton	$600,000.00 USD
WEMI model 4-ton	$700,000.00 USD
WEMI model 5-ton	$850,000.00 USD

These systems include the composter tunnel and equipment, including supervision of off loading and siting of the composting tunnel, related equipment, commissioning and training procedures. **Note Transportation is extra.**

Our proposal includes 2 visits, the first for supervision of off-loading and siting on the concrete pad, hook-up and general testing. The second for commissioning and training, this may take place at the same time as the first visit. Additional support is available by phone, as well on-site visits can be arranged at a per day cost.

Purchaser is responsible for design and/or construction of any civil works and building, as well as the costs of crane rental and personnel for off-loading, positioning and connection of equipment.

4.2 Post In-Vessel Composting

Following 14 days within the tunnel, compost will be discharged onto a conveyor that will move the compost away from the tunnel.

Wright recommends that the discharged compost be cured for an additional four to six weeks, depending on the intended use of the compost product. Curing typically is carried out in windrows or static pile. In windrows turning as required based on temperatures and oxygen levels within the windrows. (In static pile methods, curing typically takes four months).

4.3 Biofilter

One biofilter will be provided with the composting tunnel. Wright Environmental recommend that be biofilter be positioned on the top of the vessel or on the ground at the side of the vessel depending upon the size of tunnel. Wright will provide the biofilter box, water washed stones, air distribution pipe within the stone and the biofilter media.

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[i] http://www.epa.gov

[ii] http://www.caes.uga.edu/Publications/pubDetail.cfm?pk_id=6288&pg=np&ct=composting&kt=&kid=&pid=

[iii] http://www.slvlandfill.slco.org/html/Compost.html

[iv] Epa.gov

[v] All inflation statistics on this page are based on the price and cost estimates as estimated by the Consumer Price Index for All Urban Consumers as published by the U.S. Department of Labor: Bureau of Labor Statistics