Food Waste Diversion at Southern Oregon University

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Introduction

The EPA has identified that food scraps and yard waste currently make up 40% of 'trash' which is sent to landfills. Improper waste management has created vast amounts of unnecessary and harmful waste. A solution to minimizing this large impact is composting. A practical definition of the process as identified by The Practical Handbook of Compost Engineering states "Composting is the biological decomposition and stabilization of organic substrates, under conditions that allow development of thermophilic temperatures as a result of biological produced heat, to produce a final product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land. Thus, composting is a form of waste stabilization, but one that requires special conditions or moisture and aeration to produce thermophilic temperatures" (Haug 1993). More simply defined by the United States Environmental Protection Agency (EPA), compost is organic material that can be added to soil to help plants grow.

Southern Oregon University is committed to sustainable practices, environmental stewardship, and research that advances our understanding of local, regional, and global environmental issues. Sustainability at Southern Oregon University prides itself on sustainable student resources, environment, and campus operations. Sustainable campus operations include the recycling program by a previous capstone project in 2011. The recycling center sorts an average of over 6000 pounds of recycling each month, and has diverted 62% of the campus waste from the landfill. The Southern Oregon University Climate Action Plan identifies a goal of being climate neutral by 2050. A campus is declared climate neutral if the campus has no net climate impact resulting from carbon or other greenhouse gasses. The phrases "reducing waste stream" and "composting all compostable materials" are found multiple times throughout the climate action plan in efforts to reduce greenhouse gasses and meet climate goals. In 2017 Southern Oregon University earned a silver rating from the Sustainable Tracking, Assessment & Rating System (STARS). Of the institutional characteristics which have been rated, several waste related characteristics have been rated, with room for improvement.

STARS Characteristic/ Sub Characteristic	Score
Waste	4.71/10.00
---Waste Minimization & Diversion	3.35/8.00
Food & Dining	2.30/8.00
Air & Climate	5.37/10.00
---Greenhouse Gas Emissions	4.37/10.00

Southern Oregon University currently has no post-consumer composting system in place, and the current collection of pre-consumer food waste from the Hawk is not being utilized in a sustainable mater. Without any composting measures, vast amounts of 'waste' are being sent to landfills which we could be utilizing. Major sources of food waste include the Hawk dining commons and Student Union dining commons. A capstone project aimed towards

institutionalizing composting on campus will lead to a decrease in waste sent to the landfill, reduce harmful emissions, save money on tipping fees, and create a structure at the SOU farm for composting, research, and community involvement with students.

Southern Oregon University claims to have goals of becoming climate neutral, reducing greenhouse gas emissions, reducing waste all waste with a focus on food waste, maintaining or improving STARS rating, and composting all compostable material. The university has a commitment to sustainability which includes research which advances our knowledge of environmental issues, and a mission statement which states "Southern Oregon University is an inclusive campus community dedicated to student success, intellectual growth, and responsible global citizenship. SOU would prove its goals, commitments, and mission by institutionalizing composting on campus.

While different methods of composting exist, the ideal method for this institution is vermicomposting. This composting process uses various species of worms to turn organic waste into high quality compost. Although this method is typically performed in a small garden setting, it can easily be applied in a large scale capacity. In a favorable environment, worms will eat more than their body weight in food waste per day, the worm will then digest the waste, collect nutrients for itself, and produce castings which obtain a large amount of nutrient rich mater. *Eisenia fetidas* or Red Wigglers are a species of worms which adapted to decaying organic materials. Red worms are hermaphrodites, meaning they have both male and female reproductive organs, but still require 2 worms to reproduce. Both worms reproduce, creating cocoons with at least 3 baby worms. In 2 to 3 weeks, the eggs hatch from the cocoons and can reproduce themselves once they age to 2 to 3 months.

Project Goals

The main goal of this project is to reduce the amount of waste that Southern Oregon University sends to the landfill. After researching different methods of diverting food waste, we have found that composting the food waste produced on campus will greatly reduce the amount of food waste that goes to the landfill, diverting it instead to the Bulk Materials Yard on campus to be made into a usable product. With the decision to focus this project on using composting to divert the university's food waste, another key goal for this project is to institutionalize a system of composting on SOU's campus. With the implementation of a composting system on campus, we also hope to lower the university's costs by reducing the mass of waste that must be transported to the landfill and therefore reducing tipping and transportation fees.

To implement and sustain a successful composting system on campus, we will establish connections between groups and entities across campus that will both streamline the process of implementation and improve the project's chance of success and survival. Some of these groups include SOU's Grounds and Landscaping teams; Roxane Beigel-Coryell and the Sustainability Council; Marcus Welch and A'viands (SOU's Food Service Provider); and and the SOU Farm. This project could also provide an opportunity for chemistry students on campus to conduct tests on the compost that is produced, looking at how it chemically develops over time and how it differs with changes in the input to the compost. We also hope to form a relationship with Rogue Valley Farm to School, furthering their educational visits to the farm by developing a composting system that can help the students learn about responsible and sustainable food management. There may also be the opportunity for a partnership between SOU and Recology as

they could help us with some of the issues that arise within the collection process and may be interested in supporting the program.

Along with the implementation of the physical composting system on campus, we would also like to form a "Compost Committee" of interested parties across campus that would meet quarterly to examine the physical system, identify any issues or areas for improvement, and work to implement any necessary changes. We hope to establish this group as one that will be able to both help with the initial implementation and monitoring of this project and help keep the project alive and growing in future years.

An important aspect of establishing this project and setting it up for a successful future will be creating a master plan that will explain in detail how we will implement and develop the project over time and how the project will be managed in the future. The master plan will also highlight key stakeholders in this project and how they will play a role in its development and maintenance. Whether or not this project is fully implemented by the end of this year, when all five of the current capstone group members are working on it, the master plan should illustrate the implementation plan to the point that another group or organization could follow it and use it to establish a composting system on campus when the opportunity arises.

Research Questions

To help highlight key aspects of this project, we have come up with some research questions that will emphasize the project's direction and focus. One of the main questions we hope to be able to answer is "How much food waste can we divert from the landfill?". To answer this, we will be using data from past and future waste audits and attempting to gather digital data from a new system of waste categorization at the Hawk to determine how much of the total waste could be diverted. Knowing this will help us analyze the costs and benefits of implementing the system, and will allow us to develop the project's scale based on the results.

Another key unknown that will be answered through this project is how much implementing a campus-wide composting system will cost, and how much money it will save the university through tipping, transportation, and other fees. These questions are some of the most basic aspects of the cost-benefit analysis if they are looked at in strictly monetary terms, without considering environmental and other costs and benefits. Although these other aspects will be looked at, these initial questions serve as a platform for developing support for the project and establishing how much financial aid we will need to acquire in order to accomplish our goals.

Although this is not a very specific task, we are also focusing on answering the question of how we can successfully manage a composting system on SOU's campus. While our other research questions involve analyzing the project before its implementation, this question is focused more on how the actual system will be developed on campus and the methods that must be employed to maintain the project's success over time. Answering this will involve developing a clear and all-inclusive master plan, identifying key stakeholders and obtaining their support for the project, and planning for future changes that may arise.

Literature Review

Composting at the university level is starting to become the mainstream across the nation. Universities like Harvard, Iowa State University, and many more have paved the way to reduce food waste on university campuses. For example, Harvard University started a project in 2008

called The Harvard Yard Soils Restoration Project. This project was established to restore the soils and plants on the harvard campus without the use of chemicals or synthetic fertilizers. They implemented a five step process that would set up baseline and testable data for soil health. After the study, the results clearly showed significant improvement in the natural nutrient cycling system of the soil through improved root growth, nitrogen levels, and reduced need for irrigation. The deeper root growth improved moisture retention which led to a lesser need for irrigation required. Available nitrogen had increased to a healthy range between 100 and 150 pounds per acre. Irrigation in the test plot was reduced by over 30% due to the improved moisture retention capacity from the deeper root structures. Not only were soils improved, but the projects' other objectives were accomplished as well. In addition, The Facilities Maintenance Operations landscape manager showed students their maintenance machinery and how compost tea is produced and used. Harvard research scientists used soil samples from the plots for further scientific studies, which led to greater academic research performed on the soil samples (Harvard Facilities Operations Maintenance 2009).

Iowa State University also built their composting facility in 2008 in order to reduce the food waste from their dining facilities and animal waste from their dairy farm that being sent to the landfill. Their compost is also used on campus for research projects for students in various departments. In addition, ISU implements composted soils across the campus to reduce soil erosion and the overuse of chemicals/fertilizers in agriculture. By making their own compost, the university is able to mix food waste with nitrogen- rich manure, carbon-rich corn stover and yard waste to create a very rich compost soil, while also greatly reducing the waste that would rather be sent to a landfill.

Farm Services operates Cornell's compost facility which creates high-quality compost from up to 8,000 tons of organic waste each year. According to this composting facility which collects from over 60 waste streams, they have collected annually about 4,000 tons of animal bedding and manure from research and teaching facilities, 300 tons of plant debris from campus projects including greenhouses, orchards, and farms, 800 tons of food scraps and organic kitchen waste from dining halls and smaller on-campus dining stations, and additional waste products as well (Jonas 2018b). Composting on campus reduces overall generated waste, and saves money on transporting the waste. Cornell's composting facility is located just one mile from campus, allowing for larger savings on transportation costs. By 2009, Cornell had drastically reduced its waste stream and the compost facility won the EPAs Environmental Quality Award (Schwarz & Bonhotal 2009). Using the Cornell Soil Health Test it has been observed the impacts of a soil remediation strategy on plant growth and soil quality. Results showed both long term and short term improvements in soil quality. These improvements include but are not limited to increased potentially mineralizable nitrogen, available water holding capacity, total organic matter, aggregate stability, active carbon, and a reduction in bulk density (Sax et al. 2017).

Arizona State University has become a leader in waste reduction, especially at their sporting events. One methodology that they follow is the Environmental Protection Agency's (EPA) Waste Reduction Model (WARM). This is an environmental model that assesses greenhouse gas (GHG) emissions and the projections of GHG emissions that different waste management strategies produce (West Coast Climate Forum; Information not currently available on official EPA website; Hottle, 2015). "WARM was developed to help waste planners model impacts by selecting material inputs and providing model parameters which include

transportation distances and landfill conditions (e.g. methane capture efficiency and landfill moisture content). WARM enables scenario development to create comparisons between differing approaches to waste treatment and the subsequent impacts" (Hottle, 2015). This methodology was used in the study *Toward Zero Waste: Composting and Recycling for Sustainable Venue Based Events* during four baseball games at Arizona State University. In this study, students did waste audits for the four-game series to collect raw data, they extrapolated the data for a sum total within the year, and then they used the WARM model to analyze 7 different scenarios. In addition, the games were used to observe how guests reacted when public figures or people in the crowd properly disposed of their waste in the proper landfill and recycling bins. They observed this reaction by "staffing" bins with people who sorted the waste responsibly. The results of this study found that the contamination rate for the first game, which is the control of the study, was 34%. In the second game, the contamination rate went down to 11% because of the "staffed" bins. At the last game of the series, Hottle et al. left the bins unstaffed to see the effect of "staffing". They found that the contamination rate was 23% in the landfill and recycling bins (Hottle, 2015).

At Penn State University, their composting system started as a project for the collection of pre-consumer food waste, went through different levels of implementation with various changes, and concluded with the implementation of a complete composting site that takes in pre-and post consumer food, manure, and yard trimmings (Goldstein, 2003). This program collects food waste and soiled napkins from most of the food service facilities on campus, which totaled about 2.25 tons a day which can be extrapolated to five days of the academic week (Goldstein, 2003). While this project was initially successful enough to warrant continuation, it did not follow the same structure throughout its existence. Like any project to be developed, the Penn State composting program developed over time and implemented techniques to better the system. Two of the main improvements at Penn State that could be implemented from the beginning of a new composting system were larger collection bins and mechanized lifting systems to put the compostable material into the trucks to be hauled away (Goldstein, 2003).

At the University of Oregon, they composted almost 340 tons of food waste in the 2016-2017 academic year and they received a STARS rating of 2.49/5.00 for Waste Minimization which has a relative percentage compared to ours. In 2014, the U of O Zero Waste Program introduced composting in 5 buildings that feature central zero waste stations. These stations capture are intended to capture the entire waste stream including: paper, glass, metal, plastics, cartons, compost, and landfill materials. In 2014-15 the recovery rate rose to 59.12% due to these efforts. According to their Environmental Resource and Recycling Manager, the zero waste system is now a campus standard and is being implemented through campus construction standards. For example, Each campus food service area (catering, housing food service and campus cafes) utilizes compostable ware and careful capture of these items. Furthermore, all of the food service areas compost pre-consumer, post-consumer food waste, and other compostable items. All of the food that has not been cooked or served is donated to one of the local food banks. In order to compile extensive records of data on the program, U of O carefully measures and tracks food collection and the actual tonnage from their hauler/processors, all of which we can access for our project.

Methodology

Project Design

At first glance the idea of implementing a composting program on campus seems straightforward. Everyone at a place of higher education seems to be on board with the idea of waste diversion and the soil remediation that composting would provide, yet the fact that there is not one currently instated on campus speaks volumes to the challenges that play into institutional change. That's where the heart of this challenge begins, arbitration between all the entities on a college campus to sacrifice a little time and energy to create a synergistic and lasting result. Composting has always looked to be a great step toward furthering the sustainability of Southern Oregon University's campus but getting everyone on board is the hardest first step. That's where we began our project.

Creating connections and getting all groups on campus involved will yield a greater chance for this program to have lasting power. For the source of the waste, we are in contact with managers Marcus Welsh and Josh Lanier at SOU Dining/Aviands to finalize plans to divert the food waste for the project. Janitorial assistance is beneficial to hold and handle the waste. From here, Zack Williams at SOU Landscaping has agreed to establish a collection schedule in which grounds/facilities would transfer the food waste from the SU and Hawk to the composting facility for its final step in the chain. This is where the food waste will be cared for and transformed into compost with the help of the grounds manager and staff. This process requires a complete overhaul in our current waste management on campus and due to this, will inevitably face resistance due to change in day to day tasks. Though everyone is on board when asked, when the rubber meets the road, we truly need accountability and a plan of action at each level to ensure an effective and streamlined process, which will benefit even those with no direct involvement.

The second largest obstacle besides the human factor is money. The university, in general, is always struggling financially, so projects with no obvious monetary involvement are disregarded entirely. Though future funding may not come from the university itself, we have obtained full funding through the Green Fund at SOU to purchase the necessary materials for this system and construct the hay housing for the worms. As a backup for future expansion and development, we have also applied for several grants and reached out to alumni with a vested interest in the future of SOU. Our main goal is to get a large enough spread of support so that we have greater access to funds and resources to create a lasting impression on campus for years to come.

When the money is in place, as well as the chain of operations, the school will be diverting a significant amount of its total waste away from landfills. We will be a more sustainable school with grounds providing a steady stream of compost for themselves as well as more money being saved in long-term reduced tipping fees. The compost created will also play part in creating more opportunities for volunteer work or even providing curriculum for kids and advanced education. Whether it is through Rogue Valley Farm to School or another organization, connecting young children with the food cycle will help produce future stewards of the environment. Not only will this result in research opportunities in the future simply due to its existence, this research will also ensure stability and consistency in the compost created.

Methods

Food waste will be diverted from the Hawk by trained employees and be placed in designated bins, which will be purchased specifically for this project, then wait to be transferred by ground employees. They will haul the food waste to their debris lot as this site will house the composting epicenter. Once here, the food will be combined with already existing yard waste and wood chips as well as hay and red wiggler worms. In this vermicomposting system, the worms will then act as the driving force behind decomposition as they break down the waste into usable soil amendment. This process of composting will take from 3-6 months from waste to usable material and will be under strict scrutiny of senior ES students as well as grounds employees who are familiar with the process. This means of composting is much easier to manage with post-consumer waste as long as the one can make sure the worms are continuing to break the matter down.

Figure 1, shown below, illustrates the general composting process that will take place at the Bulk Materials Yard. This process begins with setting up the rectangular structure of hay bales as indicated in part 1 of Figure 1, then adding green and brown waste such as grass clippings and other organic matter from SOU Landscaping's existing projects and work around campus. This initial bedding will largely come from waste that has already been sitting at the Bulk Materials Yard. After allowing this material to settle and decompose for a short amount of time, worms can be added into the mixture. When the worms have begun to spread themselves throughout the structure, food waste will be added gradually, and a wooden sheet will be placed over the hay bale structure to better maintain the temperature of the mixture, protect the worms from harsh weather conditions and other hazards, and prevent pests from getting into the composting material.

This cell of hay bales will be constructed with the help of Zack Williams at SOU Landscaping and the rest of his team, along with our group members if necessary. In the coming weeks, we are set to use our Green Fund grant money to purchase all of the necessary items for this project as they are laid out in the budget. After purchasing these items, we will begin building the structure, incorporating the bins into SOU Dining facilities, and training employees at these facilities to recognize the different waste streams and how to separate what can and cannot be composted in this system.

The current plan for implementation of the vermicomposting system includes setting up vermicomposting infrastructure in the Bulk Materials Yard, which is highlighted in Figure 2 below. This location is ideal because it is less than a quarter mile away from the Hawk, SOU's primary dining hall and the source of the vast majority of the university's food waste. This nearby location means that the food waste will not have to be transferred far before it can be composted, which saves time and energy and reduces transportation costs. Although the Bulk Materials yard is not particularly large, there is room for possible future expansion to the east of the garden if this becomes necessary as the project develops.

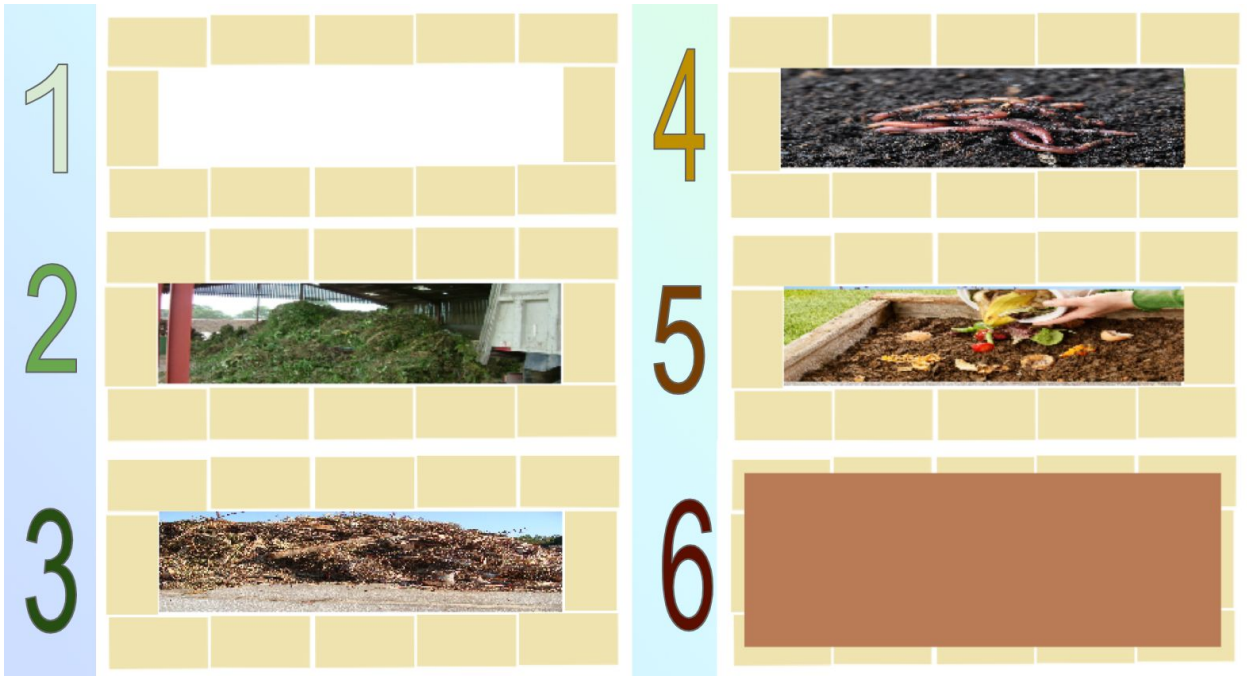

Figure 1: Simplified diagram of the vermicomposting process to be implemented in the Bulk Materials Yard at Southern Oregon University.

Figure 2: Location of the Bulk Materials Yard on Southern Oregon University's campus. This yard is located above SOU's stadium, northwest of the turf field and track.

Results and Discussion

Southern Oregon University strives to be an eco-friendly campus but currently sends large amounts of useful food waste into landfills with no plans in action for change. Our capstone group has been working endlessly to find the best ways to reduce the food waste on campus and lower our input into the landfill. By the end of this capstone project we will have changed how SOU deals with food waste and reduce the campus's input into the landfill. Soon we will have implemented a composting system at the SOU wood waste yard, that will be receiving food waste from SOU's main dining areas that include the Hawk and Elmo's Grill in the Stevenson Union. The food waste will be added to a vermicomposting structure made up of rows of 4-5 ft straw bales, covered with a sheet of wood. Through the development of this project, we will also have built a strong relationship with different groups on campus and worked toward the goals of sustainability and being a green campus. A detailed master plan will also be provided with the completion of our project, explaining the process that led to the development of our project as well as describing the maintenance of this for the future. Once our project is complete and running, we will have hoped to open up a platform for research and educational opportunities with local youth and potential SOU science classes.

A substantial portion of this project involved coordinating with different stakeholders on campus to figure out the best method of composting SOU's food waste and to decide how this method could be implemented. In the initial research and discussion phases of this project, we discovered a wide variety of universities and other institutions that had implemented different types of composting systems, each of which had its own benefits. After speaking with one of the key stakeholders in the beginning of this project, Dean Williamson, who was the Director of the SOU Farm at the time, we determined that a viable method of composting here would be creating large concrete cells on the SOU Farm where food waste would be delivered and converted into usable compost. This process would involve Dean turning the waste with his tractor, combining it with green and brown waste, and rotating it through the cells as it developed. While this idea seemed to make perfect sense at the time, it began to fall apart after Dean stepped down from his position at the farm.

Although this was a disappointing and unexpected loss for us, Dean's departure highlighted some of the flaws of this initial concrete cell idea: the waste would have to be transported a long distance from the dining halls to the farm, the concrete would be expensive, and the cells would be relatively permanent and not flexible to new project developments. After Dean's departure, we continued to research different composting methods and, with the help of Zack Williams, the coordinator of SOU Landscaping, we arrived at the conclusion that vermicomposting with hay bails would be one of the best ways to compost our food waste without adding an unachievable amount of work to the SOU landscaping team. By using hay bales and wood panels to create the cells for vermicomposting, we would not only reduce the cost of the project, but also bring in less environmentally harmful products and create infrastructure that could be adjusted and expanded over time as the system develops. We also determined that the Bulk Materials Yard, where landscaping stored their yard waste, would be a better location to implement the vermicomposting structure because it is closer to the school and would require less transportation of the food waste, reducing costs and emissions related to transportation.

An important conclusion to be drawn from this process is that working closely with the key stakeholders of any project is essential, but relying too heavily on one person or one group's experiences and opinions can also limit a project's potential. Some of the flaws of our initial project plan seem apparent when looking back at it, but at the time, we accepted the plan largely as a result of Dean's recommendations based on his experience and expertise with composting. It is still entirely possible that SOU could have successfully implemented this initial plan for composting, but it would have been a more intensive and challenging process and may have limited future project development. By stepping back and looking at the project from a new perspective after Dean left, we were forced to think more about what type of system would best complement the needs and abilities of the different parties at SOU. Having an intelligent and experienced leader to run a project can be very helpful, but combining this with a group of other focused individuals who bring their own ideas and perspectives to the project is essential.

Conclusion

The implementation of this new composting system will have a long term effect on how our campus deals with pre and post consumer food waste and will be beneficial to our goal of being a sustainable campus. After our team is done with the development of this project, we will rely on SOU's Landscaping and Dining teams, along with the cohort of future capstone students who will take over our project, to carry on the management of the composting system. This project will require substantial initial investments of $3,600, but in the long-term it will have a positive environmental and financial impact on our campus.

Appendices

Contacts

Name	Phone Number	Email	Position/Title
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Linda			
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Budget

Item	Cost per Item	Quantity	Total Item Cost
Vermicomposting			
32 Gallon Bins	$60	15	$900
Scale	$40	1	$40
Worms	$40/lb	50	$2,000
Straw Bale Structure	120	3	$360
Rows 6-8ft x 16ft= 12 bales/structure	$10/bale	120	-
Plywood Cover (4 per structure)	$30/board	8	$240
2x4's	$3	8	$24
Unexpected Expenses	3%	-	$107
Total			**$3,671**

Timeline

	Winter	Spring
Perform waste audit at SU	Apply for funding with Environmental Affairs Committee	Receive Funding from Green Fund
Perform waste audit at Hawk	Present to Sustainability Council	Build Structure
Reach out to organizations about funding/grants	Research new composting method (vermicomposting)	Finalize Master Plan
Create outline for compost committee	Begin to collect needed materials (worms)	Employee training initiation
Submit research proposal		Find “Champions”

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