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UW Garbology Project
Final Report: McMahon Hall
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Abstract

This report details results from the research study of the waste patterns of selected McMahon Hall residents during winter quarter of 2014. The waste from two floors, 4th Floor North Tower (freshman floor) and 11th Floor South Tower (mixed cohort, primarily upperclassmen floor) was sorted over a seven week period. Data suggests there is no difference in waste behavior between students of different academic seniority. Students are not utilizing compost bins and the majority of the waste on both floors is recycling. In addition to these findings the waste diversion rate in McMahon dormitory is 30% less than all other regions of the University of Washington's campus. We argue this implies a significant issue with McMahon Hall's waste stream which can be addressed directly by increasing building residents' access to compost bins.

Background

For nearly two years the UW Garbology Project (UWGP) has researched the University of Washington's (UW) waste efficiency. Correctly disposing of compostable items has proven to be the primary problem in all of our previous waste-sorting analyses. Over this time we have found that there is persistent confusion about where waste goes, especially compost. In some cases¹, the contamination rate of the average trash bin was as high as 81%, with the majority of this contamination comprised of compostable materials. On the other hand, in our research study of Denny Hall², where waste was analyzed pre and post compost bin introduction, the access to compost bins allowed for an increase in waste diversion, but the increase was only about 10%. Further, even in instances when individuals have access to all waste bins (i.e., trash, compost, and recycling) the contamination rate is still high, suggesting that user confusion may be a primary cause of inefficiencies in our waste stream.

Despite these previous research projects and our focus on educational outreach, the overarching problem(s) causing the confusion has yet to be identified. To help identify this problem, UWGP chose to focus its 2014 efforts on an examination of between outcomes of waste practices (i.e. patterns in discarded materials) and the perceptions of individuals producing the waste itself (i.e. the decision-making of the people doing the discarding). UW dormitories thus became the natural focus of this study, for two reasons. First, as a relatively private setting on campus, they allowed us to sample waste which could be directly attributed to a specific set of individuals, thereby enabling the aforementioned comparison. Second, UW residents are a major constituency within the UW community as a whole, and the direct study of their waste behaviors is therefore of significant value in and of itself.

¹ Johnson, Jack. "Our Work: Summer 2012 Final Report." *The UW Garbology Project*. The UW Garbology Project, 21 Aug. 2012. Web. 21 June 2014. <<http://uwgarbology.weebly.com/our-work.html>>.

² Johnson, Jack. "Our Work: Denny Project Final Report." *The UW Garbology Project*. The UW Garbology Project, 30 June 2013. Web. 21 June 2014. <<http://uwgarbology.weebly.com/our-work.html>>.

Project Overview

To facilitate this analysis, we narrowed our larger questions down to two primary avenues of inquiry. Each is discussed in detail here.

The first portion of the study examined differences between actual and perceived waste behaviors. Here our hypothesis was that an individual's actual waste behavior and their perceived waste behavior are not the same. To test this hypothesis, we attempted to independently measure each side of the equation. Individuals' perceived waste behaviors were ascertained through an online questionnaire targeted at assessing individuals' abilities to properly sort waste into compost, recyclables, or trash, their thoughts on the current waste system, and their thoughts about their peers' waste behaviors as well as their own. Actual waste behaviors were ascertained by means of sorting and analysis of the waste produced within the study area, enabling a direct comparison between what UW students think and what they actually do when it comes to waste disposal.

The second portion of the study examined whether an increased tenancy within the campus student community produces a measureable improvement in either perceptions or actual behaviors. In other words, it examined whether UW dorm residents appear to be learning UW's waste system over time, and whether this produces increases in waste efficiency. Here our hypothesis was that upperclassmen have a superior familiarity with and knowledge of UW's waste system, and will therefore (in aggregate) correctly allocate their waste into appropriate disposal bins more frequently than would a freshman student. To test this hypothesis, we diversified the aforementioned waste analyses to include questionnaire data and waste collected from two floors: 4th Floor North Tower (the freshman floor) and 11th Floor South Tower (a floor with a higher number of upperclassmen) in McMahan residence hall.

Ultimately, we hope that with these analyses we will be able to expand outreach by applying the information obtained from this study to areas that are identified as most problematic by student opinion and behavior. Overall, this will help us to address the issues of contamination and confusion with waste practices, which in turn allows us to create a better method for educating students about how to properly dispose of their waste. The result will help decrease the overall waste that goes to the landfill along with the amount of money the UW spends on waste disposal.

Methods

In order to quantify actual waste behaviors, waste sorts were performed for seven consecutive weeks from January 16 through February 27, 2014. McMahan staff emptied the primary waste bins for trash and recycling every Wednesday morning at 8 AM and collected the waste for our analysis on Thursday morning at 8 AM, allowing for a 24-hour accumulation period.

After accumulation and collection, the waste was then transported by UW Recycling staff from McMahan Hall to the UW Recycling Center for sorting. Waste sorts were held at UW Recycling Center every Thursday afternoon. Each type of collected waste bin (i.e., trash, recycling, and compost) was individually sorted by volunteers (comprised of UWGP members, UW EcoReps members, and students enrolled in UW Archaeology 205) and reallocated to the "correct" waste category as defined by current UW waste disposal standards. To help document problem

categories within collected waste, sorting volunteers were asked to communicate their observations on commonly-misplaced items. After sorting, each category was weighed in grams and this data was recorded.

In McMahan Hall, composting is voluntary, and collection of samples from compost bins was therefore a special case which merits further discussion. The resident staff has set up an incentive program to encourage individuals to compost. Students in a “cluster,” who share living space such as bathrooms, must compost four times during a quarter. McMahan’s system operates by assigning compost dates and times each quarter. For winter quarter, the assigned days were Monday and Thursday from 5-6 PM. During this time all students in McMahan who wanted to participate in composting had to bring their compost to the Resident Advisor’s (RA) Office. The RA would then ask individuals which floor and tower they lived in. Compost from individuals living on the 4th Floor North Tower or 11th Floor South Tower was placed in separately-labeled bins. The compost was allowed to accumulate for a whole weekly cycle (i.e., Monday and Thursday).

On the first week of the collections, compost was not collected on Monday, January 13, 2014 due to change in collection days. Prior to the start of the quarter compost was originally set to be collected on Wednesdays and Thursdays and the change in collection days was not communicated to the researchers until *after* the project had started. Compost was not collected on January 20 and February 17 because RA offices were closed in observance of President’s Day and Martin Luther King Jr. Day. Results of analysis of compost bins are therefore problematic, since they are incomplete at best and largely plagued with sampling issues which remained outside the control of UWGP staff.

Statistical analysis was performed after all sorting data was collected. Averages, standard deviations, total collection, and contamination rates for each floor and waste type were calculated. A Student’s t-test or Welch’s t-test analysis was performed (as appropriate depending on the results of f-testing) to see if the waste patterns on 4th Floor North Tower and 11th Floor South Tower were significantly different at 95% confidence.

The questionnaire asked individuals to correctly allocate specific waste items (common waste items and often-miscategorized items were the primary focus), to rate themselves and their peers in efficiency and correctness when disposing of waste items, and to express any concerns they may have with the waste system. The survey was distributed electronically by McMahan Hall residence staff. The survey was optional and anonymous. Approval to study human subjects was obtained from UW’s Internal Review Board for this portion of the research study.

Results

The t-test results for the waste sort analysis show that there was no significant difference (at 95% statistical confidence, 2-tailed) between the waste patterns of the two floors examined. The raw data used to obtain these results can be seen in the unsorted data (**Table 1**), the sorted data (**Table 2**) and the mean percentage composition and contamination (**Table 3**). Since there is no difference, this means that freshman, juniors, and seniors correctly/incorrectly dispose of their waste with the same frequency. In other words, there is no evidence to suggest that UW upperclassmen correctly dispose of waste at a higher rate than freshmen. **Figure 1** shows how students disposed of their waste in aggregate. Students from 4th Floor North and 11th Floor South placed the majority of their waste in the trash, 72.6% and 71.3% respectively. Less than 2% of the waste is allocated to compost on both floors.

In **Figure 2**, the average trash bin composition shows that the majority of the (landfilled) waste on both floors is actually compost: 52.2% on the 4th Floor North and 56.2% on 11th Floor South. Trash is actually the smallest category, with the composition of the average trash bin at 17.3% on the 4th Floor North and 15.6% on the 11th Floor South. For the average recycling bin, recyclables were the major component in each bin with the 4th Floor North having 86.9% recyclable materials in the recycling bin and the 11th Floor South having 88.8% recyclables (**Figure 3**). Individuals living on the 4th Floor North or 11th Floor South rarely composted, as each floor had only one compost contribution over the entire seven weeks. Due to the small data pool for compost, one sample from each floor, no statistical analysis was performed on this data.

Figure 4 shows that after all the waste from all bin types (i.e., trash, recycling, and compost) was correctly reallocated, the majority of the waste was actually recycling with the 4th Floor North at 45.8% and 11th Floor South at 44.6%. The second largest majority of waste after reallocation was compost with 40.9% on the 4th Floor North and 42.9% on 11th Floor South.

Unfortunately, the results for the questionnaire portion have not been calculated because the response to the questionnaire was so small (i.e., 2 responses) that any analysis would be misleading at present. To bolster the number of respondents, we will re-distribute the questionnaire in fall of 2014, as is discussed below. For the present, however, we are unable to fully address our first hypothesis, and the primary goal of this work remains temporarily out of reach.

Discussion

As previously mentioned, there were no statistical differences between the upperclassmen's (e.g. juniors and seniors) behavior and the freshmen's. In other words, the two floors were the same in waste-disposal patterns. Overall, students were allocating the majority of their waste to the trash bin and compost bins received the least amount of waste (**Figure 1**). Yet the average trash can on both floors was comprised of greater than 50% compost (**Figure 2**). Compost bins were underutilized by all students and this may have been due to lack of accessibility to the bins.

Students must provide their own containers and collect the waste in their rooms. After collecting the compost a student must carry the compost to the RA's office during one of the two times during the week the office is open, Monday and Thursday from 5-6 PM. If the students living in a "cluster" compost four times in a quarter they receive a free frozen yogurt coupon. This is a large investment of time and energy for a student with little to possibly no reward. In addition students often live in small dorm rooms, meaning an additional waste bin for compost further confines their available living space. In order to encourage individuals to compost the process must be made easier, be more accessible to all students, and be less of a time investment.

The average recycling bin was far less contaminated than the trash (**Figure 3**) with both floors correctly allocating over 85% of the materials within recycling bins. The contamination of the recycling was equally split between compost and trash and is minimal in comparison to the study from the fall of 2012³ which showed that the average recycling bin was contaminated by 39% , with the majority (36% of bin mass) being compost. In total the majority of the waste examined in this study was recyclable (**Figure 4**) and it was most often correctly allocated. This stands in contrast to previous research, in which compost^{4,5,6} was the largest waste category overall. This difference could be driven by several possibilities: differences in product consumption, less overall food waste, more packaging, or a combination of all three. It makes sense that individuals living in dormitories would have more recyclable waste items from all the personal products and food they would buy for their residence (e.g. soap, shampoos, cans of soup, etc.) than individuals who are merely walking around campus. The decrease in overall food waste could be because individuals living in dormitories have a place to store their food (i.e., a refrigerator) until it can be consumed. Previous testing locations were outside on UW campus and individuals may have not had access to a refrigerator or may not have wanted to carry the food with them. In the recyclables large amount of packaging (i.e., boxes) from products and various mail packages were observed. There were other recyclable materials as well, but most weeks there was a considerable number of boxes and recyclable packaging. Any or all of these scenarios could be contributing to the difference in the amount of overall compost and recycling levels.

The total waste diversion rate for both floors in McMahon Hall is 27%, which is quite poor when compared to previous UWGP studies from Fall 2012 (66.9%)³, the Denny Hall Project (52.5%)⁵,

³ Johnson, Jack. "Our Work: Fall 2012 Final Report." *The UW Garbology Project*. The UW Garbology Project, 12 Dec. 2012. Web. 21 June 2014. <<http://uwgarbology.weebly.com/our-work.html>>.

⁴ Johnson, Jack. "Our Work: Summer 2012 Final Report." *The UW Garbology Project*. The UW Garbology Project, 21 Aug. 2012. Web. 21 June 2014. <<http://uwgarbology.weebly.com/our-work.html>>.

⁵ Johnson, Jack. "Our Work: Denny Project Final Report." *The UW Garbology Project*. The UW Garbology Project, 30 June 2013. Web. 21 June 2014. <<http://uwgarbology.weebly.com/our-work.html>>.

⁶ Johnson, Jack. "Our Work: Fall 2012 Final Report." *The UW Garbology Project*. The UW Garbology Project, 12 Dec. 2012. Web. 21 June 2014. <<http://uwgarbology.weebly.com/our-work.html>>.

and the overall UW campus diversion rate for 2013 (58%)⁷. In fact, it is over 30% lower than these previous research studies, and needs to be improved.

Conclusion

Low overall diversion rates for McMahan Hall likely represents a substantial issue for the UW waste stream, especially since dormitories produce a significant amount of the UW's total waste. The best first step in improving diversion rates in McMahan Hall, compost bins need to be made more readily-accessible to residents. Placing a compost bin on each floor of the dormitory would allow students to access bins on their own time and bins would be in a closer proximity than the RA's office, which for some individuals is several floors away.

In addition to making compost bins more accessible, further behavioral studies must be conducted. The questionnaire administered to individuals living on the 4th Floor North and 11th Floor South had an underwhelming amount of responses (n=2). The UW Garbology Project intends to re-administer the survey to a larger number of individuals, all individuals living in dormitories on UW campus during the fall of 2014. Surveying a larger number of individuals increases the number of possible responses and will allow us to follow through on our original research design by conducting an analysis on a population similar to the individuals living in McMahan during winter 2014. Though the population from fall of 2014 is not comprised of the same individuals who lived in McMahan during winter quarter of 2014, it is expected to be similar in aggregate and will allow us to understand how individuals believe they dispose of waste. This perceived behavior (during fall 2014) can then be compared to actual behavior (from winter 2014 waste sort results) as a means identifying the sources of confusion that students confront when allocating their waste.

Acknowledgments

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⁷ "Home | UW Recycling: 2013 Annual Report." *Home | UW Recycling*. University of Washington, n.d. Web. 22 June 2014. <washington.edu/facilities/building/recyclingandsolidwaste/>.

Appendix

Table 1: Unsorted Waste Raw Data (in grams)

Unsorted Waste	Week	1/16	1/23	1/30	2/6	2/13	2/20	2/27
4th Floor North Tower	Trash	22344	9024	25099	18126	18594	24738	22624
	Recycling	9990	7048	5474	9545	5646	5204	6156
	Compost	0	0	0	0	2352	0	0
11th Floor South Tower	Trash	14214	12522	18420	17152	17230	15644	20407
	Recycling	6726	0	11668	11336	8022	0	7162
	Compost	0	0	1708	0	0	0	0

Table 2: Sorted Waste Raw Data (in grams)

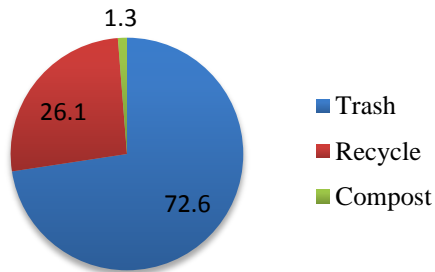
Sorted Weights	16-Jan			23-Jan			30-Jan			6-Feb		
Waste Type: 4th Floor	Trash	Recycling	Compost	Trash	Recycling	Compost	Trash	Recycling	Compost	Trash	Recycling	Compost
Trash	3168	4294	10588	2530	1852	4642	2746	7538	14815	3256	6324	8546
Recycling	342	8986	662	842	5456	750	264	5024	186	594	7999	952
Compost	0	0	0	0	0	0	0	0	0	0	0	0
Waste Type: 11th Floor												
Trash	3642	5244	5328	1866	2710	7946	2488	6738	9194	2082	3260	11810
Recycling	516	6114	96	0	0	0	472	10304	892	660	10002	674
Compost	0	0	0	0	0	0	0	98	1610	0	0	0
Sorted Weights	13-Feb			20-Feb			27-Feb			Overall Mean		
Waste Type: 4th Floor	Trash	Recycling	Compost	Trash	Recycling	Compost	Trash	Recycling	Compost	Trash	Recycling	Compost
Trash	3378	5942	9274	3268	10630	10840	3396	6728	12500	3106	6187	10172
Recycling	560	4896	190	390	4536	278	234	5610	312	461	6072	476
Compost	6	46	2300	0	0	0	0	0	0	6	46	2300
Waste Type: 11th Floor												
Trash	2518	4748	9964	2502	4986	8156	2588	4784	13035	2527	4639	9348
Recycling	618	6820	584	0	0	0	326	6540	296	370	5683	363
Compost	0	0	0	0	0	0	0	0	0	0	14	230

Table 3: Mean, Standard Deviation, & Contamination Rates

Waste Category	4th Floor North Tower						11th Floor South Tower				
	Subtype	Mean %	SD	n	% Cont.	SD %	Mean %	SD	n	% Cont.	SD %
Trash	Trash	17.27	5.46	7	82.73	5.46	15.64	4.60	7	84.36	4.60
	Recycling	30.56	7.33	7			28.14	7.19	7		
	Compost	52.17	5.76	7			56.22	10.65	7		
Recycling	Trash	6.80	3.20	7	13.15	5.01	5.96	1.71	5	11.25	2.53
	Recycling	86.85	5.01	7			88.75	2.53	5		
	Compost	6.35	2.94	7			5.29	2.56	5		

Figure 1: These totals show how students allocated their waste prior to our sorting it and reallocating the waste into the correct categories. Both the 4th Floor North (right) and the 11th Floor South throw most of their waste in the trash.

Total Composition Prior to Reallocation: 4th Floor North



Total Composition Prior to Reallocation: 11th Floor South

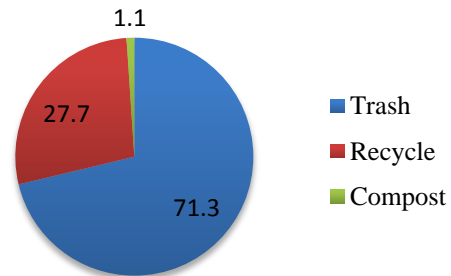
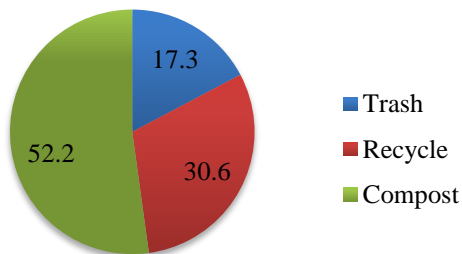


Figure 2: The average trash composition of the both floors, 4th Floor North Tower (left) and 11th Floor South Tower (right), shows that the highest contaminant is compost.

Average Trash Composition: 4th Floor North



Average Trash Composition: 11th Floor South

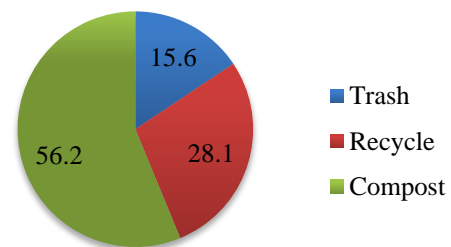
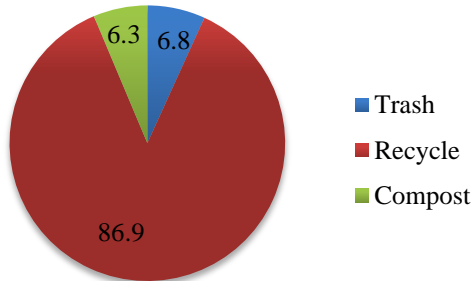


Figure 3: The average recycling bin on both floors was mainly comprised of recyclable materials. The highest contaminant was trash on the 4th Floor North Tower (left) and the 11th Floor South Tower (right).

**Average Recycling Composition:
4th Floor North**



**Average Recycling Composition:
11th Floor South**

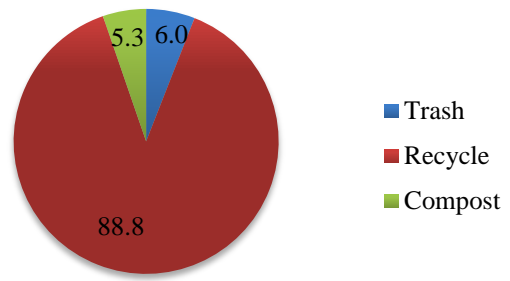
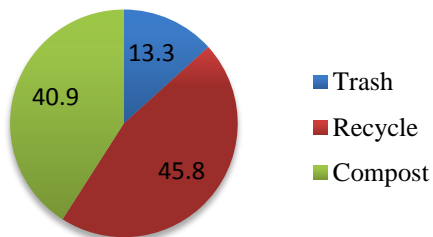


Figure 4: Shows the total waste on both floors after all waste has been correctly reallocated. The 4th Floor North Tower (left) shows the majority of the waste disposed was recyclable and 11th Floor South (right) showed the same result.

**Total Composition After
Reallocation: 4th Floor North**



**Total Composition After
Reallocation: 11th Floor South**

