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A Waste Assessment of the UNLV Dormitories

A Thesis submitted in partial satisfaction
of the requirement for the degree of

Bachelor of Arts

In

Environmental Studies Program
University of Nevada, Las Vegas

By

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Abstract

The purpose of this thesis is to examine the waste stream of the UNLV dormitories to see if there is a significant amount of waste that can be diverted through a possible recycling program to lower disposal costs. Also with this data we can look at if the student monitored program in the Upper Classmen Complex dormitories is having any effect on the waste stream. This was done through a waste assessment which is where garbage is sorted and weighed by categories. This study found that 35% of the waste stream is recyclable. This data was compared to the national Municipal waste stream, where 55% of the waste was recoverable. It was also discovered that the recycling program in UCC had a noticeable effect on plastic, a nominal effect on aluminum and cardboard, and a negative effect on paper. This study is to only serve as a baseline and more research needs to be done to make any recommendations on waste disposal improvements.

Introduction

The purpose of this project is to conduct a waste assessment study of the UNLV dormitory waste stream and complete the first step in determining the feasibility of expanding the Rebel Recycling Program to include the UNLV on-campus Resident Halls. Currently, in the Upper Class Complex (UCC), there is a student monitored program that is a part of the Rebel Recycling Program that collects paper, cardboard, plastic, and aluminum and is picked up on a weekly basis. Ideally, this should be expanded to all the halls and taken over by the administration to provide a longer lasting involvement in the program.

Tara Pike, Rebel Recycling Coordinator and my current content advisor, conducted a senior thesis in 1994 that ended up creating the current recycling program for UNLV (Pike 1994). She did not include the Residence Halls in her analysis because she was not familiar with them at the time. However it has been noted that the Residence Halls have been trying to get a program started for sometime. Yet, in the eight years since that study, no formal recycling program has been established. Administrators and residents have come and gone, technology has advanced and people in general are more aware of the environment than ever. In 2001 the south wing of the Tonopah Hall was completed, adding an additional 422 residents (Campus Housing 2002). According to Campus Housing (Cox 2003) the total cost for Resident Hall waste disposal a year is \$41,479.92. And with the ground breaking ceremony for a new dorm building a year away, this is a good time to seriously evaluate the potential (or possibility) of starting a university run recycling program in the UNLV Residence Halls to help cut down on waste disposal costs.

It is important to know how much total waste is generated and how much of it can be diverted. Unfortunately, Republic Services, the company that picks up the university's trash, charges per pick up rather than by weight, so it is difficult to find the total amount of waste generated in the Residence Halls. There are 11 three cubic yard dumpsters available for use by dorm residents. There are exactly 1,500 residents in all of the halls, and that the EPA estimates that on average, people discard 4.5 pounds of waste per person per day (3.2 if recycling is considered) (EPA 1998). Based on the EPA estimate, there could be as much as 47,250 pounds of waste generated a week (1500 residents X 4.5 avg per person X 7 days a week). Garbage is picked up 6 days a week, however pickups are frequently missed. Considering that residents don't stay in their room all the time and dispose all of their waste into the Resident Hall dumpsters, this number would not be very accurate. If Republic Services weighed all the material they collected prior to land filling it, then understanding the amount of total waste would be easy. Without accurate garbage generation statistics, the second data set, which this study plans to collect, is important. Since it is not possible to physically show that a recycling program will reduce the number of dumpsters needed, thus saving money in waste disposal costs, it needs to be shown that a recycling program would be capable of diverting a certain amount of recyclables from the waste stream. In theory, a dumpster could be removed because there will be a certain percentage less waste disposed of at the Resident Halls. This thesis deals with conducting a waste stream assessment on the dormitories waste stream and the ultimate realization of this thesis is whether there is enough recyclable material that can be diverted from the waste stream so that implementing a recycling program would be feasible. To be feasible, the program would need to support itself. The

problem is that no recycling program can support itself by selling the recyclable material to generate enough revenue to cover the costs of collecting and processing the material. (Pike 2003) In that case; if possible, the benefits from the program should outweigh the costs. If there is a loss, it should be small. Benefits would include, but not exclusive to, value to residents (physical and psychological), and money saved on waste disposal costs. Losses cover money to maintain program and hassle to residents (program may cause aesthetic problems on the floor, recycle bins maybe used as trash bin that causes odor problems on the floor, etc). This essentially asks the question if there is enough recyclable material, and if enough can be diverted to achieve this goal. Because start-up costs for recycling programs are normally high and participation and education will be low. It is highly unlikely that the necessary prerequisites will occur. Yet, if there is a significant amount of recyclables in the waste stream, a program would still be possible. Funds-raising or writing grant proposals could provide the needed start-up costs. A program can also be successful based on the value given to it by residents.

The focus of this study is the Residence Halls at UNLV. Located on the South East side of campus, they are split into three sections. The South Complex (William, Rodman, and Boyd Halls) three buildings connected to each other and are designated for freshmen. The Upper Classman Complex (Buildings B, C, D, and the Hughes Hall) is a set of four separate buildings that houses upper classmen. Finally, the Tonopah complex is a six-story building with a north and south wing. There are approximately 1,500 residents living in these halls, 600 in both South and Tonopah complex, and 100 residents per building in the UCC (Campus Housing 2002). The UCC recycling program is a student monitored program started by resident assistants a year and a half ago. It is in

conjunction with the Rebel Recycling Program, who loans the bins and does pick-up once a week free of charge. There is a station on every floor of UCC. The program collects paper, plastic, aluminum and cardboard. Figure 1 is an example of the program.

Figure 1: UCC Recycling station



Recyclable materials include plastic, paper, cardboard, aluminum, and steel. Plastics include PETE (Polyethylene Terephthalate #1) and HDPE (High Density Polyethylene #2) which include such things as soft drink bottles, gallon milk and juice containers, and laundry detergent bottles (Hegberg 1992). Plastics numbered three through seven will be considered trash. Paper will include white and colored paper, newspapers, magazines and glossy paper, computer print-outs, paperboard and envelopes. Cardboard will include corrugated types. Paperboard will be considered as paper. Aluminum includes soda and juice cans, but could also include scrap pieces. Steel will mostly be made up of tin cans. Trash will encompass everything else, such as glass, used paper towels and tissues, food containers and wrappers, clothes, bathroom supplies and so forth. The EPA defines a waste stream assessment as “a study that will help determine

waste stream composition by identifying waste volumes, existing waste management practices, and associated costs. It will help identify which portions of the waste stream could be recycled, reduced, or eliminated all together” (EPA, 2000).

This project focuses on the finding of the composition of the waste in the Residence Halls and it is very narrow in focus. The ultimate intention of this study is to create a recycling program in the dorms, this study is only a part of the whole and will not be able to address the problem thoroughly. Resident participation will not be conducted and noted under future studies. This project will not be submitted to Housing administration for consideration. This is strictly a baseline study that must be built upon to provide a solid argument for a university run program in the UNLV Residence Halls. The results of this analysis will hopefully encourage other people to continue the study and pursue implementation of a recycling program in the Residence Halls.

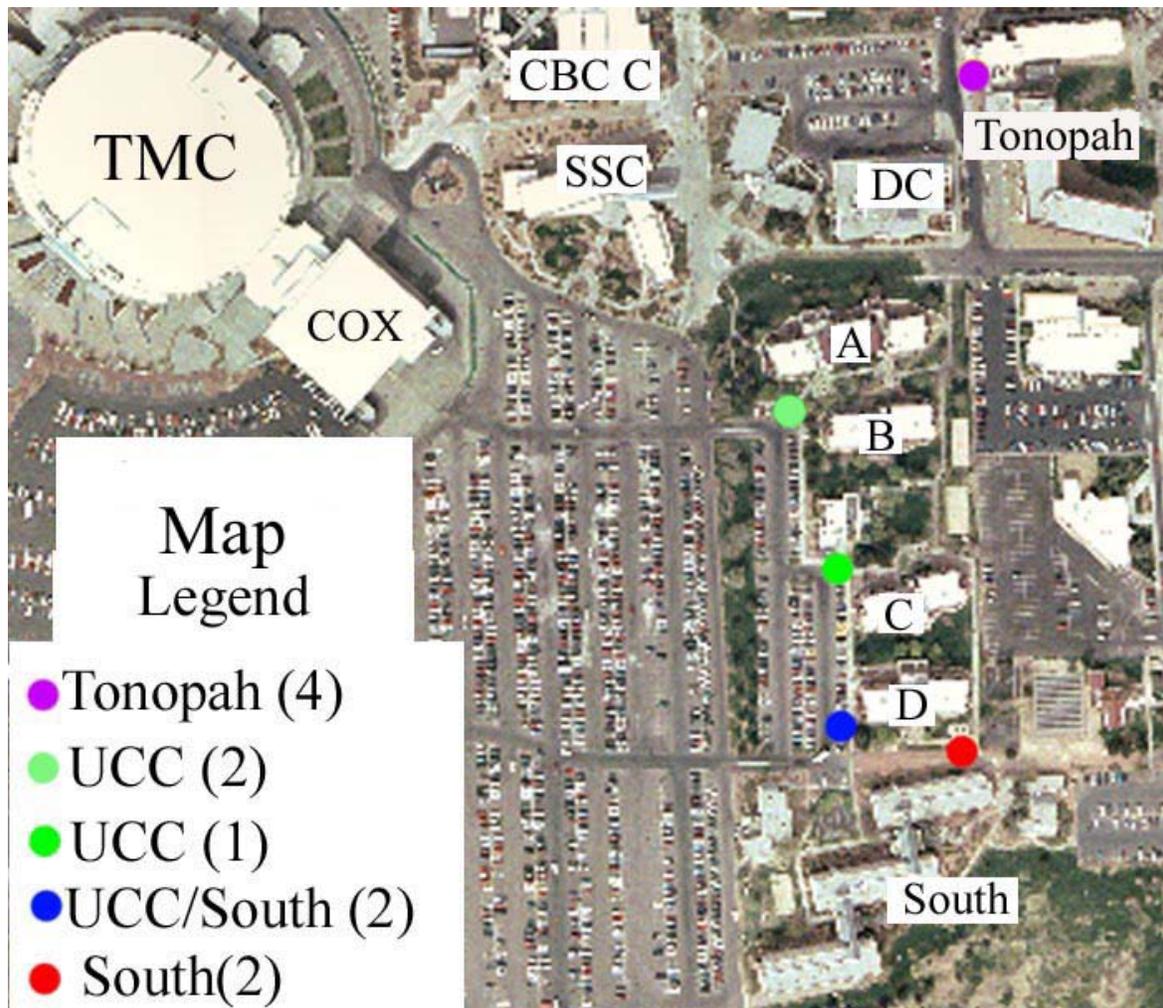
Hypothesis

There are two hypotheses in this study. The first concerns the composition of the waste stream. It will be assumed that the UNLV Residence Hall waste stream composition will be similar to that of the national stream. By using data from the Environmental Protection Agencies (EPA’s) Municipal Solid Waste in the US: 2000 Facts and Figures, which is a national study on the municipal solid waste stream, it will be possible to compare the two waste streams. The second hypothesis is that the student monitored recycling program currently in UCC will show some noticeable effect on the waste stream. The 4 materials collected by the Rebel Recycling Program should make up a significantly lower percent of the waste stream in the UCC designated dumpster than that of the other Residence Halls without the program.

Methods/Procedures

A full waste stream assessment involves actually sorting and weighing every piece of trash discarded into the Residence Halls designated dumpsters. Because this is such a large task, a scaled down waste stream assessment will be accomplished. There are 11 dumpsters in all, four exclusive to Tonopah, three exclusive to UCC, and two are exclusive to South. The other two could contain trash from the UCC, South, or both. Figure 2 is a map that shows where these dumpsters are located in conjunction to the dormitories.

Figure 2: Map showing Residents Hall's and Dumpster Location



Rather than look at individual dumpsters, I will group them in these categories, since residents have a tendency to use some bins more than others. Trash pick-up is done six times a week (not on Sundays) around 4 A.M. The weighings were conducted every Saturday morning at the recycling center for 8 weeks, from February 8th to April 12th with two exclusion weeks. The assessment took place on Saturday between 8 A.M. and 12 P.M. Earlier on Saturday, around 1-3 AM; Bags were picked up from each dumpster and marked with the dumpster's number it came out of so it would be distinguishable during sorting. The number series is as follows; 1-4 were from Tonopah Dumpsters, 5-7 were from UCC, 8-9 were from UCC/South, and 10-11 were from South.

Since there is no set time that the dumpsters are emptied by Republic Services, early collection is mandatory to prevent possible loss of sample. Because it was not feasible to record every piece of trash in the dumpster, a fair generalization can be obtained by weighing one large bag (13 gal or more) or 2 small bags (10gal or smaller, grocery bags) per dumpster, once a week, for 8 weeks (with the exclusion of the Spring Break weekend). After retrieving the bags from each dumpster, the sorting and weighing procedure was conducted at the recycling center. Each bag was broken open and sorted by category. The categories are as follows; paper, cardboard, aluminum, steel, plastic #1 and #2, and everything else (trash) (Pike, 1994). Due to difficulties in handling and selling, glass will be in the trash section. Once sorted into categories, the materials were weighed using a Pelouze® digital scale (Model PE10, cap 10lbs x 0.2oz (Figure 3)).

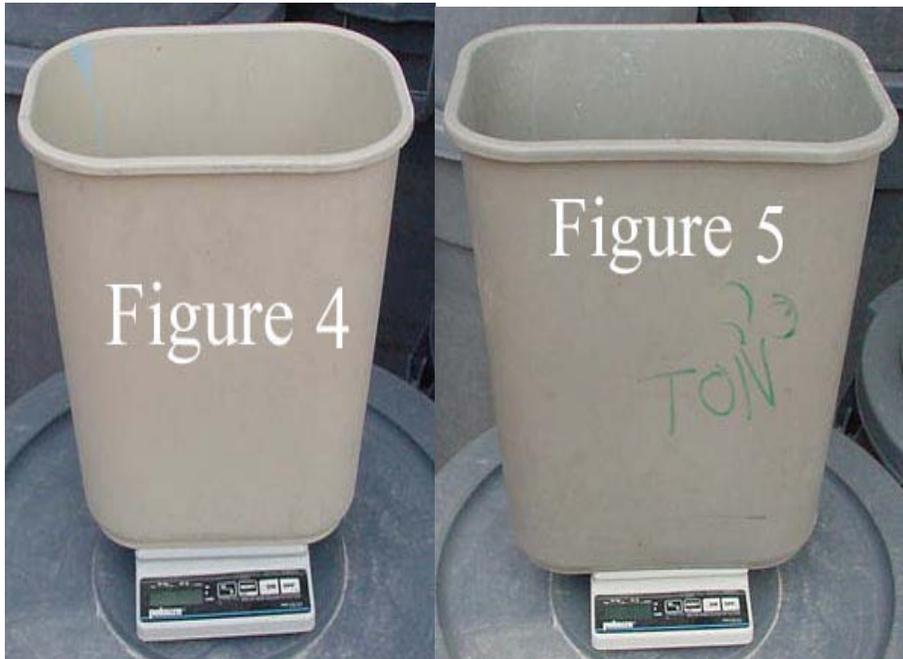
Figure 3: Digital Scale used for weighing materials



A 7 quart trash container was used for weighing recyclables and a 13 quart container was used for the trash as seen in Figure 4 and 5. By placing the bin on the scale and pressing the “reset” button so the scale would be tared, or would read zero. Then the recyclables were put in and weighed. Weighing was conducted in a covered area to prevent wind error.

Figure 4: Container used to weigh recyclables

Figure 5: Container used to weigh trash



The recyclables collected were integrated into the campus program recyclables and the waste was re-deposited into a dumpster near the Lied Athletic Complex (LAC).

Results

Due to technical difficulties, there was no data collection during the weekend of March 1st. Data collection was also not conducted during the weekend of March 22nd due to Spring Break. The lack of residents led to a lack of sample, thus there was insufficient sample to conduct a collection. As shown in Figure 1, there are 4 groups that each of the 11 dumpsters belong to, Tonopah, UCC, UCC/South, and South. Table 1 shows the total amount of waste taken from each of the 11 dumpsters (in ounces).

Table 1. Trash taken from each dumpster by overall weight in ounces

| Buildings | Total trash |
|-----------|-------------|
| Tonopah | 1117.2 |
| UCC | 744.9 |
| UCC/South | 794.6 |
| South | 666.2 |
| Total | 5138.1 |

* In Ounces

Overall, 101 lbs were collected from the Tonopah dumpsters, 90 lbs from the UCC dumpsters, 71 lbs from the UCC/South dumpsters, and 58 lbs from the South Complex. Approximately 321 total pounds of trash was collected and sorted. Because Tonopah has four dumpsters, this building had the most material by weight. UCC has 3, UCC/South has 2 and the South Complex has 2 dumpsters, which helps explain the fluctuating weight numbers. The bags also varied in weight. Shopping bags may have contained more material than a 30 gallon trash bag, and visa versa. Table 2 shows the results broken down by specific materials. The table outlines one day of data collection. The full data collection is shown in Appendix A. All weights are in ounces. It should be noted that for the first week, a different scale was used that weighted in increments of half a pound. Because it was inefficient, the current scale was used from weeks two through eight.

Table 2. Composition of bins in ounces for 1 week data collection

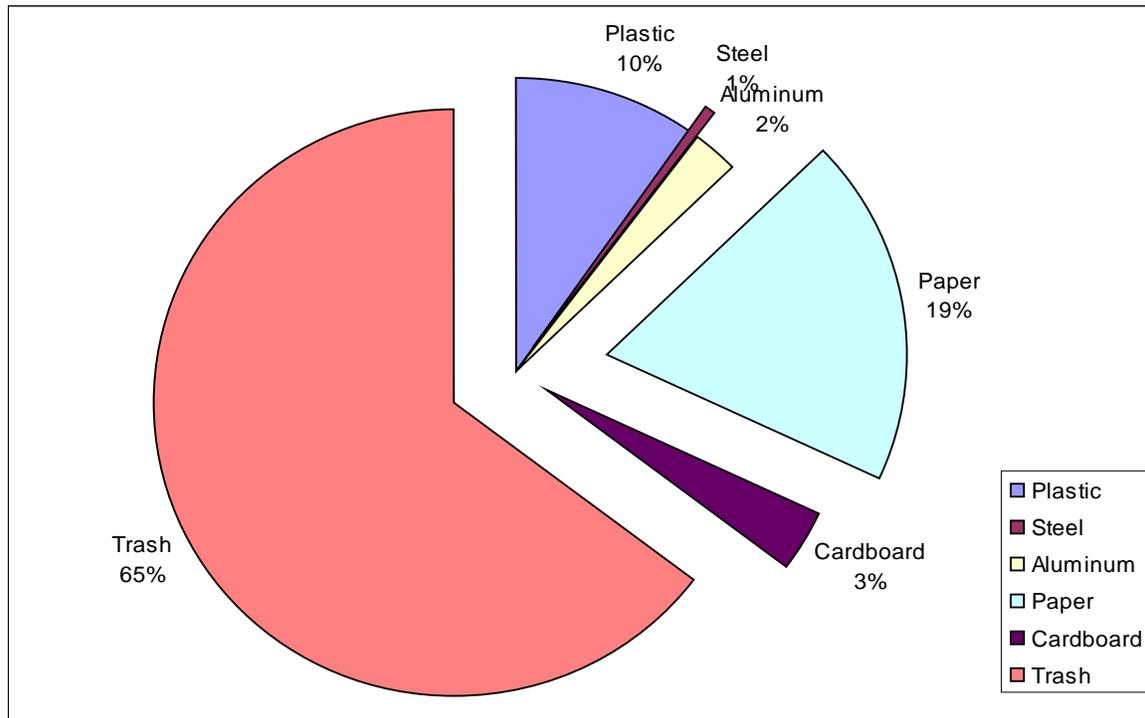
| 2/15/2003 | * Weight in Ounces | | | | | | | |
|-----------|--------------------|------|-----|-----|---|-----|------|-------|
| Tonopah | #1 | 6.4 | 0 | 3 | # | 0 | 16 | 41 |
| Tonopah | #2 | 4 | 0 | 2.6 | 0 | 0 | 16 | 22.6 |
| Tonopah | #3 | 8.6 | 0 | 0.6 | 7 | 0 | 41.6 | 57.8 |
| Tonopah | #4 | 10.5 | 0 | 0.6 | 5 | 0 | 24 | 39.9 |
| UCC | #5 | 3.8 | 0 | 0 | # | 0 | 11.6 | 25.6 |
| UCC | #6 | 6.8 | 0 | 0.6 | 5 | 5.4 | 33.6 | 51.6 |
| UCC | #7 | 0 | 0 | 0 | # | 0 | 20.8 | 52.8 |
| UCC/South | #8 | 2.4 | 0.2 | 0.6 | # | 0 | 73.6 | 115.8 |
| UCC/South | #9 | 4.8 | 0 | 0 | # | 0 | 35.2 | 57.4 |
| South | #10 | 0 | 0 | 0 | 0 | 0 | 19.2 | 19.2 |
| South | #11 | 8.4 | 0 | 16 | # | 0 | 30.4 | 72.9 |
| | | 55.7 | 0.2 | 24 | # | 5.4 | 322 | 556.6 |

Plastic and paper were the most prevalent recyclable material. Cardboard, steel and aluminum were the smallest percentages of the waste stream. This appears true for all data sets. Finally, Table 3 shows the total results from the full 8 week data collection process sorted by items and given in ounces. Moisture was not taken into consideration and will be discussed in the limitations section. Figure 6 is a pie graph of those results.

Table 3. Total collection results by items

| Plastic | Steel | Aluminum | Paper | Cardboard | Trash |
|--------------------|-------|----------|-------|-----------|--------|
| 497.2 | 32.3 | 120.8 | 990.1 | 174.8 | 3322.9 |
| * Weight in Ounces | | | | | |

Figure 6. Total collection results by item (graph)



A total of 321.13 lbs of trash was collected. Of all the materials collected, trash composed of 65% of the total weight, while paper was 19%, and plastic was 10%. The other items constituted less than 10% of the total weight. Some reusable items were collected in the eight week study period and consisted of 2 folders, 1 sign and a mini stapler, which weight a total of 4.1 ounces. This data has not been integrated into the table above because it is insignificant toward the object of this project.

Table 5 breaks down the information to show where the majority of each recyclable came from. The purpose is to see if the student monitored program in UCC is having an affect on the contents of the waste stream. A complete breakdown by item and by week is in Appendix B.

Table 5. Percent of Recyclables per building

| Plastic | Total material | Total Trash | % comp | Paper | Total material | Total Trash | % comp |
|--------------------|----------------|-------------|--------|-----------|----------------|-------------|--------|
| Tonopah | 204 | 1626.3 | 13% | Tonopah | 200.7 | 1626.3 | 12% |
| Ucc | 130.5 | 1440.8 | 9% | Ucc | 488.9 | 1440.8 | 34% |
| Ucc/South | 56.1 | 1133.7 | 5% | Ucc/South | 220.8 | 1133.7 | 19% |
| South | 106.6 | 937.3 | 11% | South | 79.7 | 937.3 | 9% |
| | | | | | | | |
| Aluminum | Total material | Total Trash | % comp | Cardboard | Total material | Total Trash | % comp |
| Tonopah | 38 | 1626.3 | 2% | Tonopah | 55.6 | 1626.3 | 3% |
| Ucc | 27.8 | 1440.8 | 2% | Ucc | 42.8 | 1440.8 | 3% |
| Ucc/South | 21.2 | 1133.7 | 2% | Ucc/South | 32 | 1133.7 | 3% |
| South | 33.8 | 937.3 | 4% | South | 44.4 | 937.3 | 5% |
| * Weight in Ounces | | | | | | | |

Looking at plastics, it seems the program is having a significant effect. The waste stream in Tonopah was 13 percent plastic. In South, the plastic composed of 11 percent of the waste stream. In UCC and UCC/South, which the program affects, the waste streams had a nine and five percent plastic composition respectively. Aluminum, which is collected in the same bin as plastic had no significant change, with Tonopah, UCC, and UCC/South having two percent and South having four percent. The trend is completely reversed with paper. Tonopah and South have a low 12 and nine percent respectively, while UCC has an incredible 34 percent and UCC/South has 19 percent. Something is clearly wrong in this area. Cardboard is collected in the same bin as paper and has seemingly not been influenced by the program. Tonopah, UCC, and UCC/South have three percent while South has five percent.

Limitations

Waste assessments are traditionally done by sorting the entire bin, rather than just randomly pick one bag out of the dumpster. However, traditional waste assessments are

done by groups of people. As an individual, it would be difficult to accomplish such a demanding feat. Therefore the sample size for this study is small compared to other waste assessment studies.

Another problem was the inability to collect some recyclables normally categorized in traditional waste assessments. Glass, which was one of the heavier materials in the waste stream, could not be recycled and was counted as trash. Glass cannot be recycled by the Rebel Recycling Center because of the dangers of handling and because the costs of transporting it to a market sharply outweigh the gains. If glass could be recycled, more waste could have been diverted.

Perhaps the most important thing that was overlooked in this experiment was water. Wet paper/cardboard could not be collected for the purpose of this experiment. This means that paper/cardboard that could have been collected and diverted from the waste stream actually ended up in the waste stream. This would not only decrease the overall paper/cardboard composition but increase the trash composition. This also directly affects the trash waste stream percentages as well. Wet trash was not dried out before being weighed, so that additional water was also weighed as trash, further increasing the total trash weight. All these factors should be considered when looking at the data.

Discussion/Results comparison

My first hypothesis is that the UNLV dormitory waste stream would look similar to the national waste stream. The EPA's report on Municipal Solid waste in the United States, 2000 edition reported details the MSW stream in the United States, prior to and after recycling. The original table includes residential and commercial waste, but states

that 65% of the total is residential (EPA 2002). So taking that into consideration, Figure 7 is a modified graph of the nation's waste stream. The results from the report also had a more specific categorization scheme, having items such as food waste and wood in their own categories. If it was broken down into the items this experiment looked at, it would look something like Figure 8.

Figure 7. Recalculated table for residential waste only.

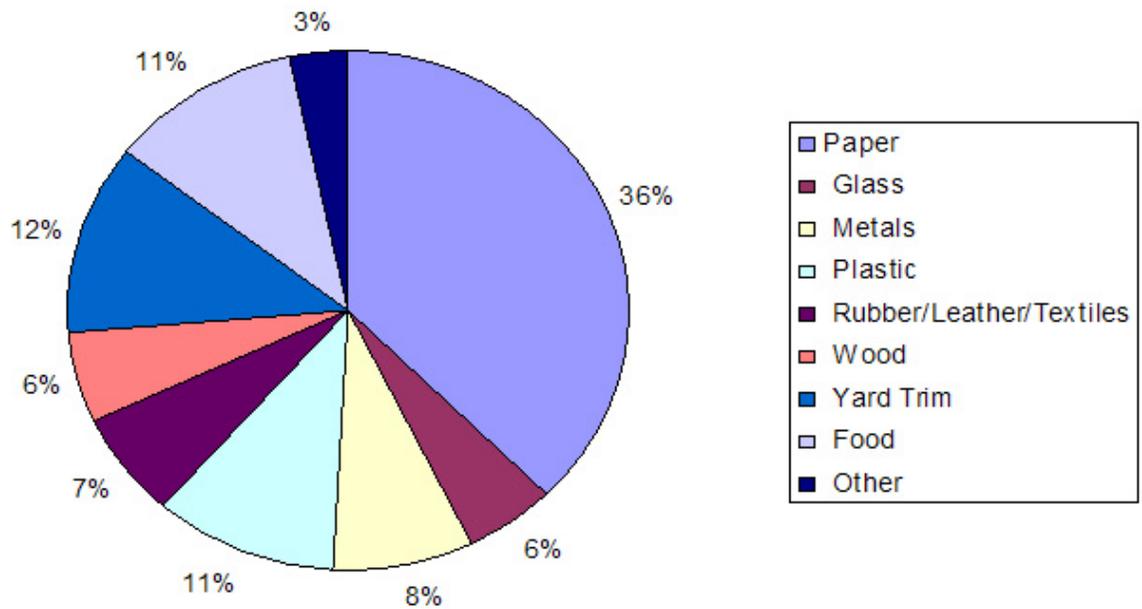
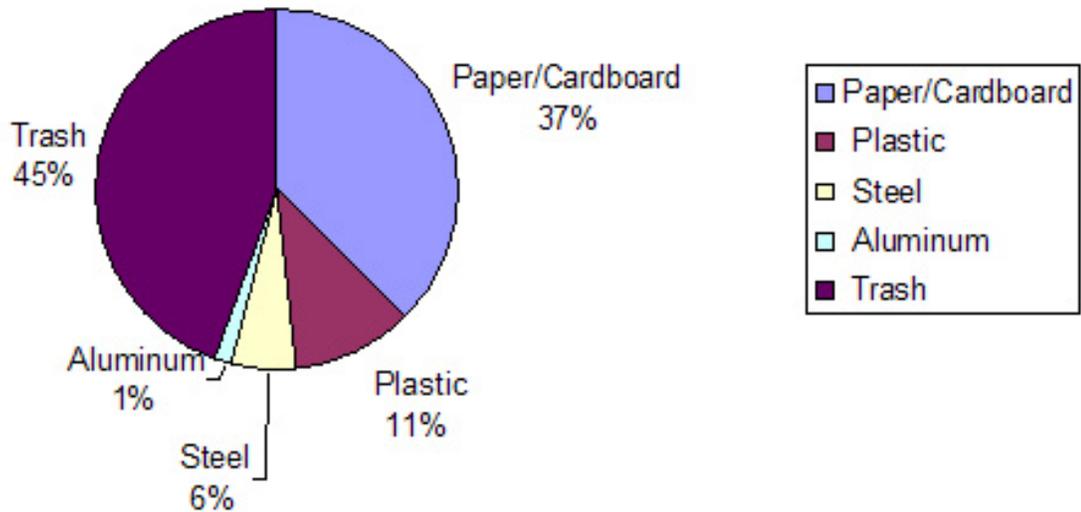


Figure 8: Recalculated National Waste stream broken into tested categories



As for proportions, the table is somewhat similar to the experiment results. Waste is most prevalent followed by paper, then plastic. Paper was collected with cardboard in the national study, so the two materials are combined. In the national stream, there is a large amount of steel compared to these experiments results. This can be explained by the fact that there are no cooking facilities allowed or located in the Residence Halls. The majority of steel weight comes from canned goods and pet food (pets are also not allowed in the Residence Halls), which is why the Residence Halls produce such a small amount.

Turning to statistical analysis, we can use a paired T- test to see if the results are significantly different or not. A paired T-test is a test used to see if two paired sets differ in a significant way (Sheskin 1997). Using the Microsoft Excel program, the 10 data point were put into a T-test formula ($TTEST=(\text{Nat. \%s}),(\text{Experiment \%s}), 2$ (two tails, because the differences could be positive or negative), 1 (To indicate a paired test is being done)). Figure 9 shows the results given by the program.

Figure 9: Results of Excel run paired T-Test

| t-Test: Paired Two Sample for Means | | |
|-------------------------------------|------------|------------|
| | Variable 1 | Variable 2 |
| Mean | 20 | 20 |
| Variance | 388 | 703.5 |
| Observations | 5 | 5 |
| Pearson Correlation | 0.888595 | |
| Hypothesized Mean Diffe | 0 | |
| df | 4 | |
| t Stat | 0 | |
| P(T<=t) one-tail | 0.5 | |
| t Critical one-tail | 2.131846 | |
| P(T<=t) two-tail | 1 | |
| t Critical two-tail | 2.776451 | |

The thing to note on this data is the P(T<=t) two tail number. This is the probability of the numbers being significantly similar or different. According to the data, there is a 100% certainty that these two data sets are significantly similar, supporting the first hypothesis. However, the sample size is so small, (5) that it detracts from the overall certainty of the equation. This would suggest that while it does support the hypothesis, it is not concrete evidence and would require more sampling to prove inconclusively.

The EPA report itself acknowledges that the numbers given in the report are only to be used as ballpark estimates for local and state entities. Because of regional variations, it requires a community to examine its own waste management needs, and perform their own waste assessment study. In order to start a recycling program, it is important to know how much recyclable material can be recovered. That is why the results of this study are being compared to the national study. The resources used in this study are inadequate to estimate these materials, this is why national data is being used as

a comparison. The results are similar enough to show that the level of recycling, or rather the lack of, is not because there is not enough for a program to be feasible, rather it is the lack of education and convenience, which is what a program will hope to provide.

My second hypothesis was semi-supported. According to the data, the program has a noticeable effect on plastic in the waste stream. It had no effect on cardboard and aluminum compared to the Tonopah building but had a slight effect compared to the South Complex. Unfortunately, the percent of paper products recovered from the trash dumpster in UCC compared to the other buildings was as much as 3 times greater. While there is a container to recycle paper in UCC and not in the other buildings, UCC still has a significantly higher percent of paper in the waste stream. While moist paper could have played a role in reducing collected paper in the other buildings, there is no reason to believe this cannot also be applied to UCC. As shown by the waste assessment, paper is the second most abundant material, and most abundant recyclable material, so it is not like there is a shortage of it for recycling purposes. This indicates that there is a problem with this portion of the program that must be remedied. This will need to be looked at in a further study of the program.

Further Study

This study is just the first step and there is a long road ahead before the ultimate goal of this thesis can be realized. The results achieved, are not enough to convince housing administration that a recycling program is needed. The results of this study show that there is potential for one, but not enough evidence to back it. A survey needs to be administered to get the Resident Hall students opinion. A survey could be done to determine the resident's attitudes and perceptions toward recycling. If results are

favorable, it could influence the administration to start a recycling program similar to other universities.

Because pick-up of the dormitories garbage is erratic at best, a traditional waste assessment may not be possible. What could be done is to convince both Republic Services and Housing Administration to let one or two dumpsters stand as sample dumpsters. In other words, those bins will not be picked up at all. Then a group of people could go through them and dump all the garbage found into other dumpsters that are being picked up. This will allow a greater sample size to see if the generalization from this paper is true. Also all dumpsters are 3 cubic yards, and have a mark for each yard (Pike 2003). As seen in figure 10, there are marks in the dumpsters that show 1/3 fullness and 2/3 fullness. By measuring the dumpster before each pick-up, a ballpark figure of the volume of waste that is coming from the Residence Halls could be generated.

Figure 10: Dumpster measurements



Assuming the student monitored program starts up again next fall, it leaves potential for it to be analyzed. This would require weighing all the recyclables that came from each building individually. One could also see if programs/posters encourage recycling. A few weeks into the semester, one building could be used as a control and the recycling program would be allowed to run the way it currently does. An education program could be implemented in another building and signage could be improved in a third building. The fourth building could have an education program and signage. This experiment along with the survey would reveal the effects on education on the amount of recyclables collected. This combined with the waste assessment would be significant evidence that a recycling program could help reduce waste disposal costs.

Conclusion

The purpose of this thesis was to see if there was enough recyclables in the waste stream of the UNLV Residence Halls to warrant extending the campus wide recycling collection program to include the entire UNLV Residence Halls. A waste stream assessment where the total waste is sorted into recyclable and non-recyclable categories was conducted. The results revealed that 35% of the waste stream was composed of recyclable materials. The percent of the four recyclables currently collected by the student monitored program in the UCC is similar to other Residents Hall buildings. This shows that while plastic recycling is effective in UCC, the other three materials were not significantly being diverted, and could use some attention. There were several drawbacks in this experiment that may have altered the results. These problems include the inability to recycle glass, moist paper/cardboard and the small sample sizes. Because of inadequate measuring techniques, national data on MSW composition had to be utilized and used to

compare with these experiments results. Some similarities were found. In order for the Rebel Recycling to extend their pick-up services to all the Residence Halls, further studies must be done to show that a program would indeed be a service to the Residence Halls rather than a hindrance.

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