FINAL REPORT – JUNE 26, 2014

BUILDING CONSUMPTION AND WASTE ANALYSIS

COMMISSIONED BY:

University of Michigan, Office of Campus Sustainability

OFFICE OF CAMPUS SUSTAINABILITY
UNIVERSITY OF MICHIGAN

planet blue
UNIVERSITY OF MICHIGAN

PREPARED BY:

RRS

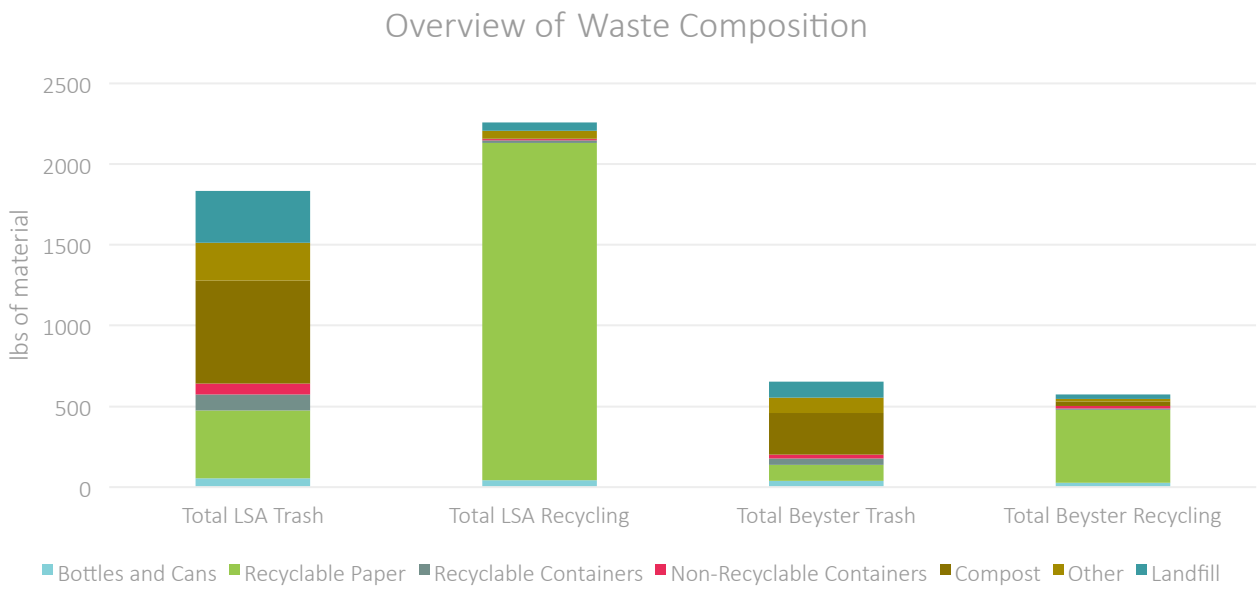
416 LONGSHORE DRIVE
ANN ARBOR, MI 48105
734.996.1361
RECYCLE.COM

EXECUTIVE SUMMARY

Resource Recycling Systems (RRS) evaluated supply chain inflow and waste output from two campus buildings over a three-month period. This analysis is meant to be representative of administrative and academic/engineering buildings and does not include residential halls or the health system which generates 52% by weight of total institution waste.

After three sorts were completed it was found that:

- 50% of the waste stream was correctly diverted from trash to the recycling system
- 22% of the material was placed incorrectly, either landfill material contaminating the recycling or recyclable material found in the trash
  - The recycling streams had overall 7% contamination
- 37% of the current trash stream (17% of all waste) is suitable for composting
  - If all currently recyclable items were diverted, then 60% of the landfill stream would be suitable for composting



RRS recommends that the University of Michigan take steps to in the following areas.

EDUCATION AND OUTREACH

- The most prevalent recyclables found in the trash stream were common recyclables such as paper, bottles and cans. U-M should focus on increasing signage and labeling at all containers and discouraging disposal of recyclables in trash containers.
- Signage and labeling was found to be insufficient or outdated in the Beyster building. This is consistent with lower rates of recycling and higher rates of contamination in this building's waste stream. It is likely that other buildings across campus also have insufficient or outdated signage and labeling. Current generation signage designs are excellent, but need to be better distributed.
- Changes in printing practices could reduce unnecessary printing, such as banner sheets and non-double-sided print jobs. Additional education could continue to reduce this unnecessary use of paper across campus.
- Continued education to staff and faculty on availability of source-separated programs for items such as E-waste, scrap metal and polystyrene foam for atypical item recycling. Also education on availability of extra recycling containers for office clean-outs and document purges could reduce disposal of large quantities of paper.

CAMPUS-WIDE FOOD WASTE COMPOSTING

- 17% of the total waste stream (recycled and landfilled) of the two buildings is suitable for diversion into a compost program. This percentage will be higher for buildings on campus with food service operations.
- RRS estimates the costs for collecting a compost stream across campus will be approximately $137,000 per year including amortized capital and avoided costs.

IMPROVING PROCUREMENT PRACTICES

- Institute policies and practices to incentivize the purchase of reusable products or products with company take-back programs. These can vary from disposable coffee cups to vacuum filters.
- The mMarketsite procurement portal for office supplies does not leverage negotiated prices for items made with recycled content. Staff responsible for purchasing supplies are presented first with products made with virgin materials rather than recycled content. There is currently a "Featured Items" window that could be repurposed to this end for minimal cost.

Contents

BUILDING CONSUMPTION AND WASTE ANALYSIS 1
Executive Summary 1
Education and Outreach 2
Campus-wide Food Waste Composting 2
Improving Procurement Practices 2
Background and Purpose 4
Project Details 6
Definitions 6
Methodology 7
Results and Discussion 9
Program Recommendations 20
Appendices 23
Appendix A: Photographic Documentation
Appendix B: Proposed Green Purchasing Guidelines
Appendix C: Raw Data
Appendix D: Hypothetical Future Potential

Figure 1: Percentage Composition by Weight 9
Figure 2: Compatibility with Current Programs (Compostable material currently is landfilled) 11
Figure 3: Beyster Trash and Recycling by Sort 12
Figure 4: LSA Trash and Recycling by Sort 12
Figure 5: Current and Potential Diversion 13
Figure 6: Best Potential Diversion 15
Figure 7: Future Diversion Potential ..... D

BACKGROUND AND PURPOSE

In 2013, the University of Michigan (U-M) Ann Arbor Campus (including the hospital) generated 19,050 tons of waste. Recycling makes up 25% of that total, composting 4%, and the remaining 71% is disposed of in the landfill or other waste disposal facilities (unless suitable for donation to local charity).

One of U-M's six sustainability goals for 2025 is to reduce the amount of waste sent to disposal facilities by 40% over 2006 levels. U-M Waste Management Services has worked extensively to increase the percentage of waste diverted to recycling, composting and donations during both daily operations and special events, such as Student Move-Out and football games. The Office of Campus Sustainability and Waste Management Services continue to strive for maximum diversion and initiated this assessment to identify potential for additional diversion in administrative and classroom buildings.

In February 2014, RRS was engaged by the University of Michigan and the Office of Campus Sustainability (OCS) to conduct a thorough waste audit of two multi-use administrative buildings, Literature, Science, and the Arts (LSA) on central campus and the Bob and Betty Beyster (Beyster) Building (formerly Computer Science Engineering - CSE) on north campus, in order to assist U-M in furthering their diversion goals. In addition to conducting three waste and recycling sorts from each building, RRS engaged with stakeholders with procurement and administration responsibilities to better understand material flow through the target buildings. RRS reviewed staff activities related to recycling and routine purchasing practices, and analyzed both occupancy and purchasing data to better inform the team of material intensity.

This project is intended to validate a waste diversion baseline so that decision makers are best prepared to adjust, design, and implement waste diversion programs, including, where possible, avoiding waste generation in the first place. Engaging the populace of a large research and medical university presents a set of challenges very different from a standard business office building, These include navigating multiple channels of leadership, procurement, and distribution, as well as educating both the transient student body and the more permanent administration, faculty, and staff.

As U-M's technical partner for this project, RRS has completed a consumption and waste analysis of two buildings on the Ann Arbor Campus. This consumption and waste analysis included:

- Gathering data related to solid waste, recycling, packaging waste, office supplies and product procurement processes.
- Conducting three sorts of trash and recycling streams from the LSA and Beyster Buildings (one each in March, April and May 2014).
- Developing a preliminary baseline and metrics for organics, recycling and packaging waste streams generated.
- Reviewing ordering procedures, practices and products for waste reduction and recyclability.

This report includes the results of the assessment and waste audits including data on waste stream composition, potential diversion from the landfill and reduction in carbon footprint. RRS also estimated the relative costs of different diversion options and prepared program recommendations including actions with the highest impact and a prioritized list of next steps.

This report also includes:

- Strategy on how to roll out a compostables collection program within the buildings including education, signage and labeling, and bins.
- A set of decision-making tools to purchase products for recyclability, waste reduction and energy efficiency.

PROJECT DETAILS

DEFINITIONS

DEFINITIONS OF ACRONYMS COMMONLY USED:

The following acronyms describe the various materials that make up the packaging that is most commonly discarded. Much of it is challenging to recycle and some of it is quite valuable.

PET: Polyethylene terephthalate (#1 Plastic)
PETE: another abbreviation for PET
PET-G: Polyethylene terephthalate glycol-modified (#7 Plastic)
*often mistakenly labeled #1 Plastic
HDPE: High Density Polyethylene (#2 Plastic)
LDPE: Low Density Polyethylene (#4 Plastic)
OCC: Old Corrugated Containers
ONP: Old Newspaper
PP: Polypropylene (#5 Plastic)

TOOLS USED IN THE WASTE SORTS:

The following equipment was employed to conduct the waste sorts:

Sorting Table: This is a large table constructed with an embedded mesh screen to allow for the filtering of small items (aka fines)
Bins: 14-gallon recycling bins used to place material into sort categories
Buckets: 32-gallon garbage cans used for larger volume sort categories
Scale: 300-lb max scale with accuracy to 0.1 lb

BUILDING STATISTICS:

Literature, Science, and the Arts

- 824 workstations
- 67,408 square feet
- 7 classrooms, labs, or study areas
- 187 offices
- 1 lounge
- 18 conference rooms

Bob and Betty Beyster Building

- 902 workstations
- 144,535 square feet
- 21 classrooms, labs, or study areas
- 129 offices
- 4 lounges
- 7 conference rooms

METHODOLOGY

INITIAL DATA GATHERING AND BUILDING TOURS

RRS commenced the waste assessment by meeting with primary stakeholders (OCS, Waste Management Services, Building Services, and Procurement) to review project goals, waste sort methodology, current operations, waste reduction and recycling practices and procurement processes.

RRS provided U-M with an information and data request document covering baseline data (volumes and costs) for solid waste and recycling, procurement policy and any written procedures, especially around office supplies, food, foodservice ware, "green" or Environmentally Preferable Purchasing (EPP) policies, other procurement processes, purchasing records for office supplies, food, foodservice ware and other items (see Appendix B).

RRS met with Facility Managers for a walk-through of LSA and Beyster to review the accessibility and utilization of the loading docks and dumpsters, shipping and receiving locations, the in-building waste and recycling generation/bin locations and their relevant signage and labeling, and supply room areas to observe operational procedures and supply and equipment packaging. A simple visual inspection for contamination at the bin level was also done.

RRS documented the walk-throughs with photos (see Appendix A).

INTERVIEWS WITH PROCUREMENT STAKEHOLDERS

After reviewing the 2013 purchasing records for office supplies, food, foodservice ware and other items, RRS met with the administrative staff with procurement responsibilities at each building to gather information and evaluate how the product selection and ordering process may or may not contribute to increased packaging and over-ordering. RRS assessed whether there is currently or may be opportunity for a greater prioritization around the procurement of sustainable products, specifically as it relates to reducing the amount ordered and used, as well as how recyclable the products are at the end of their useful life.

WASTE SORTS

RRS and the U-M Project Management team agreed on a sort location (North Campus Transfer Facility), optimal sorting times to minimally impact U-M operations (between 7:00 am and 1:00 pm when the trucks were out), methodology and protocol. Trash and recycling dumpsters from each building were sorted each month over a period of time (March when winter session classes are still in full swing, April just prior to the end of the winter session, and May after move-out and during spring session). This schedule was intended to capture common phases of waste generation throughout the year, as well as look for expected spikes in waste generation at the end of the semester.

The initial 57 sort categories were determined before the sorts with expectations to expand into some extra categories. During the sort, materials were first sorted into main categories (Bottles and Cans, Other Containers, Drink Cup, Source Separated, Fiber Products, Compost, and Other).

Next these materials were sub-sorted into secondary categories or their final categories depending on the amount found in each. For the data in the report, the categories were restructured to more directly fit into current U-M recycling programs. All sort categories and their final categorization are included in Appendix C.

During the first and second sorts, the weight of food wrappers, chip bags and packaging was documented to determine if amounts generated would justify collection and recycling programs of these waste streams. These materials cannot be sorted by the single-stream facility that processes the city recyclables, but can be collected separately and shipped to reprocessors. The sorting team paid attention to the fraction of the trash stream that is made of actual packaging and packaging materials and could either be diverted through recycling, or avoided through change in purchasing behaviors.

During the third sort, the team also monitored the number of disposable silverware and cups (by unit) to determine if what was purchased ended up in the trash and what alternative products could be used to divert these products to recycling or composting. The team also observed paper utilization and whether or not printing was double-sided, and if there was excessive printing by one office or another.

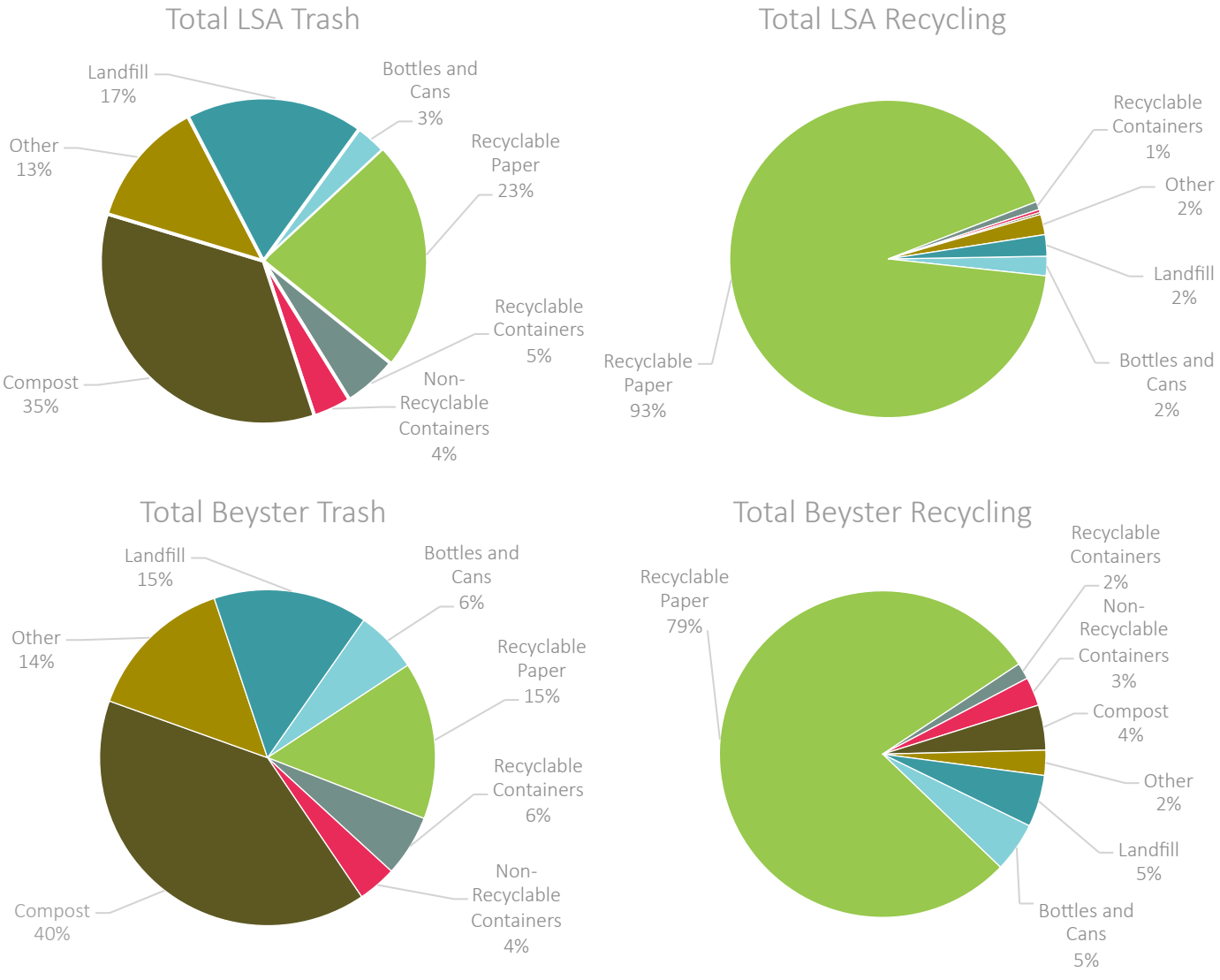
RRS documented the waste sorts with photos (see Appendix A).

RESULTS AND DISCUSSION

WASTE STREAM COMPOSITION

The following charts illustrate the percentage composition by weight of the sorted trash and recycling streams across all three sorts. Total material sorted for LSA and Beyster was 4,092 pounds and 1,225 pounds respectively. Pre-sort, 55% percent of the material from LSA was pulled from the recycling dumpster and 45% from the trash, while Beyster was 47% from recycling and 53% from trash.

Figure 1: Percentage Composition by Weight



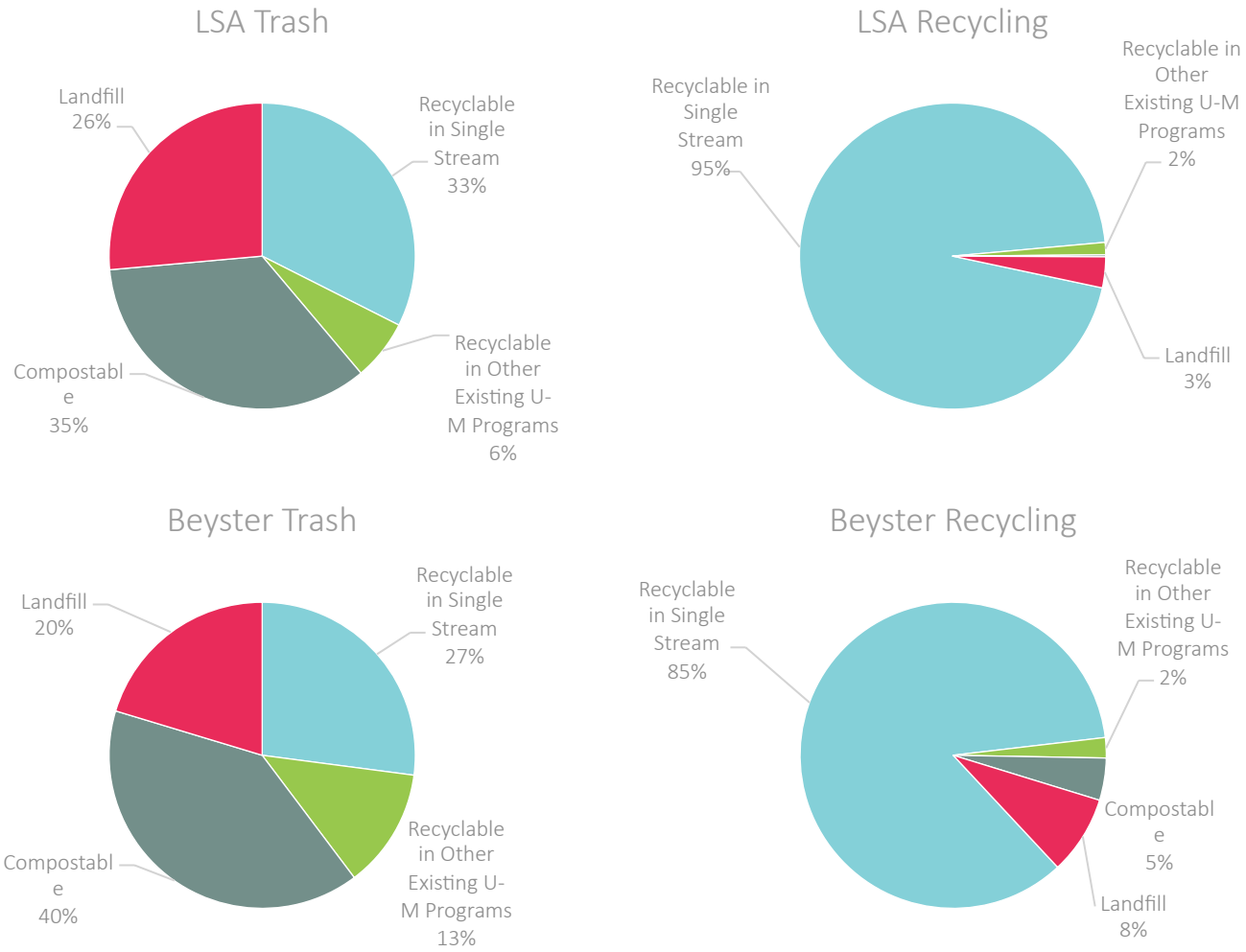
MAJOR SORT CATEGORIES

- ***Bottles and Cans*** – Includes drink bottles and cans made from plastics (mainly PET and HDPE), aluminum and steel that are suitable for collection in the current single-stream program.
- ***Paper*** – Includes all standard paper including office paper, cardboard, newspaper and other recyclable paper that is suitable for collection in the current single-stream program.
- ***Other Recyclable Containers*** – Includes plastic drink cups and to-go containers made from PET, HDPE and PP, milk cartons and juice boxes, and other metal containers that are suitable for collection in the current single-stream program.
- ***Other Non-Recyclable Containers*** – Includes polycoated paper cups and to-go containers, polystyrene foam and crystal cups and to-go containers, multi-material cups and compostable plastics that are currently not accepted in the single-stream program or the City's composting facility.
- ***Compost*** – Includes food waste, soiled paper, bathroom paper waste (uncontaminated), and compostable paper such as paper plates and to-go containers that would be suitable for processing at the City's composting facility.
- ***Other*** – Includes e-waste, universal waste, toner/ink, packing foam, plastic film, scrap metal, bulky plastics, K-cups, waxed paper, chip bags, and other unique items. Most of these items are targets for recycling either through source-separated U-M programs (i.e. packaging polystyrene, TerraCycle pen collection program) or through future targeted recovery programs (i.e. TerraCycle snack/chip bag collection program, TerraCycle binder collection program).
- ***Landfill*** – All non-recyclable or non-compostable materials that are likely not targets for recovery; includes some multi-material packaging and durable goods.

Each of the categories contains a number of subcategories. Raw data by weight of these subcategories can be found in Appendix C.

The charts in Figure 2 summarize the data in a slightly different way looking at the material's compatibility with the current single-stream program and other U-M source-separated programs. Compostable materials that are compatible with the City's current program are also highlighted, however, all of that material currently is landfilled.

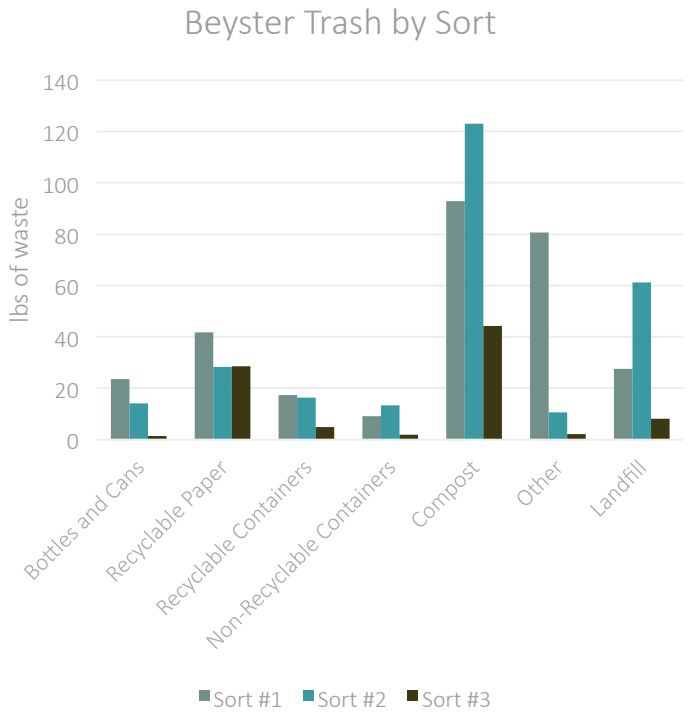
Figure 2: Compatibility with Current Programs (Compostable material currently is landfilled)



Data from each of the three sorts is summarized in Figures 3 and 4. Overall, the waste streams were fairly consistent from sort to sort with the following noted exceptions. Each can be seen as a spike in Figure 3 or Figure 4.

- In the third sort of trash from the LSA building, there were nearly 300 pounds of mixed and office paper, primarily in the form of catalogs and unemptied binders, as well as a large amount of rigid plastic office file organizers.
- Similarly, the second sort of recycling from LSA contained a large file purge of 60+-year-old documents from the Registrar's office.
- The third Beyster sort had two anomalies. There was a large amount of cardboard boxes in the recycling sort, and the trash sort contained what appeared to be a year-end clean-out of a refrigerator – resulting in an unusually large mass of organic waste.
- In general the trash output of the Beyster building declined from sort to sort, which is to be expected given the higher proportion of student use in comparison to LSA and the fewer number of students using the building in May.

Figure 3: Beyster Trash and Recycling by Sort



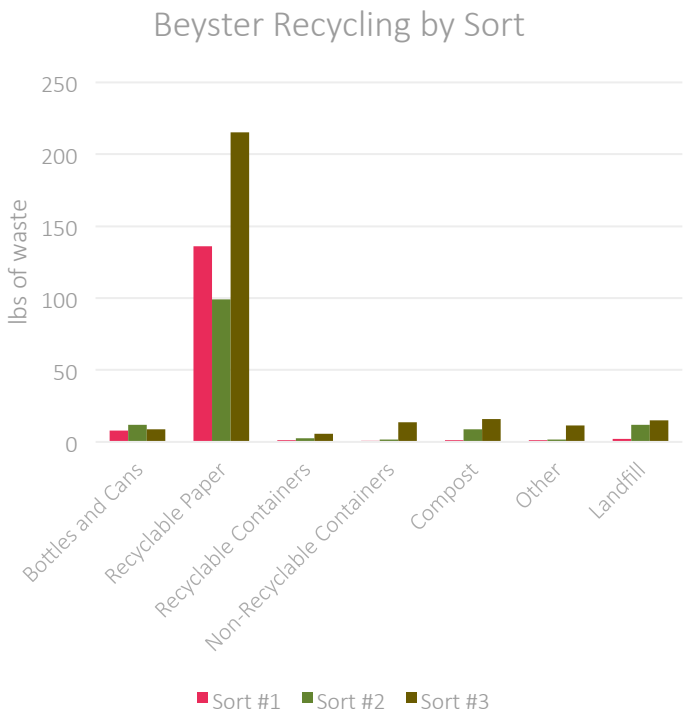
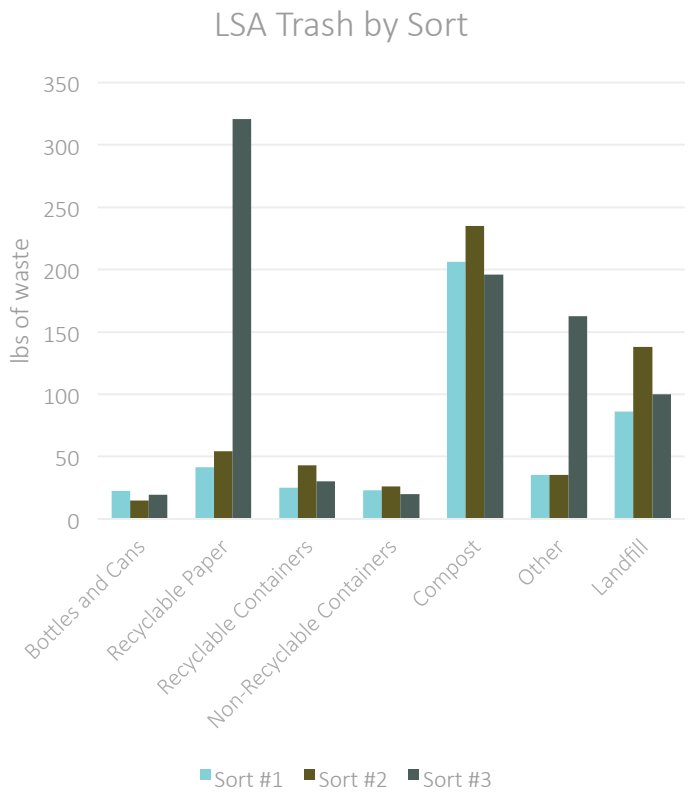
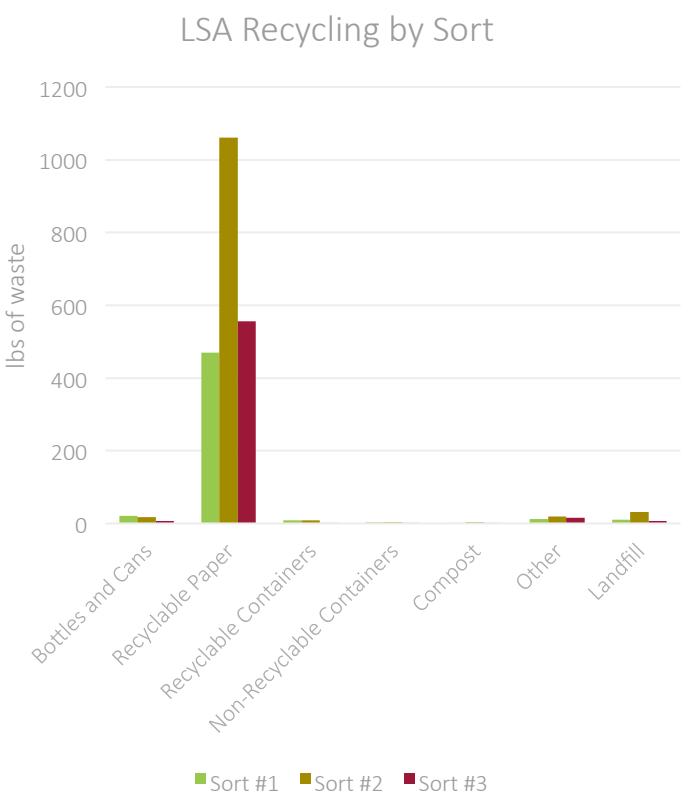


Figure 4: LSA Trash and Recycling by Sort

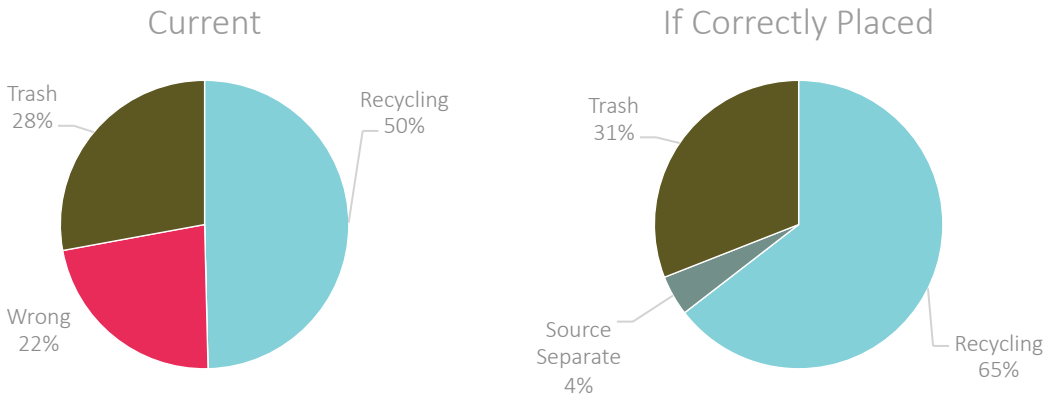




POTENTIAL DIVERSION FROM THE WASTE STREAM

The total amount of recyclable material found in the waste stream (when contamination is removed) was 50%. If all items were placed in the correct bin, the theoretical diversion rate for these buildings is 69%. This is primarily a matter of education and human behavior. It was noted by the Project Team during our site visits that the educational signage and labeling was much more up to date and prolific in LSA than in Beyster, and the data shows that while LSA had 22% of material incorrectly placed, Beyster misplaced 28% of material. Even more critical to the current programs, Beyster had 15% contamination in the recycling stream, compared to LSA at 5%. Fifteen percent contamination is quite high and is difficult for MRFs to handle. In both buildings, 30% of the trash was composed of materials that could be included in the current single-stream recycling program. This suggests that signage and labeling clearly indicating what can go in the recycling bin can have an effect on behavior.

Figure 5: Current and Potential Diversion



Overall, in both buildings, 57% of the bottles and cans found were still in the trash stream. Similarly, only 17% of paper was found in the trash, but due to the overall generation and weight of the material it made up 67% of the recyclables found in the trash. Of the recyclables that are compatible with the current single-stream program and that were found in the trash, 82% of them are common recyclables (bottles, cans and paper). This would imply that consistent signage and, whenever possible, siting recyclable containers where there is a trash container could significantly increase the diversion of materials. This is discussed further in the Program Recommendations section.

Drink cups and other containers made up most of the remainder of the single-stream recyclables in the trash (about 18%). These are mostly to-go containers for food and beverages from restaurants. As noted during the sorts, the majority of these containers were from offsite restaurants. In the current U-M program, these are recyclable containers but do create some difficulty in diverting. During the waste sort, the sort staff removed food from to-go containers and placed the food in the organics bin and the containers in their proper category. This is not always practical or possible for a student or staff member to do. In general, a to-go container that is empty of food but has some food residual in it is fine to include in the recyclable stream. Similar issues are apparent with drink cups. While the plastic cups are accepted in the program, the tops

and straws are generally considered contamination. Often cups with significant amounts of liquid are disposed of, which if placed in the recyclables bin could ruin the paper. It is rarely feasible to have a sink available to dump liquids or ice into, except in break rooms. This type of behavior could be encouraged in those specific areas.

During the third sort, specific counts of plastic and paper cups and utensils were done to see if these materials were being correctly diverted (Table 1). As is shown below, there is considerable confusion in Beyster with these materials, whereas LSA was much more consistent. The plastic cups counted here should be recyclable, with issues as noted previously, but LSA does not recycle many of them. The paper cups and utensils are not recyclable and should be in the trash, however, Beyster places them quite often in recycling, representative of the higher contamination of the recycling stream.

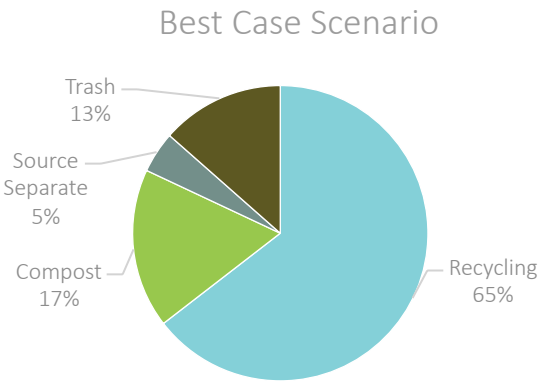
Table 1 - Counts of targeted materials during the 3rd sort

Third Sort Special Counts			
	Plastic Cups	Paper Cups	Utensils
LSA Trash	342	574	413
LSA Recycling	34	31	-
Beyster Trash	17	58	100
Beyster Recycling	38	66	25
Total Found	***431***	***729***	***538***

Blue liner bags are used in many U-M buildings to identify and assist in handling recyclable waste. During the sorts, the number of blue bags found in the trash and recycling streams was counted. While Beyster more consistently used the blue bags for recycling (88% of the time), a high percentage of the blue bags were found in the trash (9%). LSA utilized the blue bags 68% of the time, but only 1% of the blue bags were found in the trash. The high percentage of blue bags in the trash is concerning, in that custodial staff may be incorrectly disposing of separated recyclable materials. It was observed, in at least some of the cases, that the blue bags found in the trash contained a majority of landfill material in them. This would mean that either the bag was used in a trash receptacle or that the custodian noticed a highly contaminated recycling bag and placed it in the trash. Continuing education and auditing of custodial staff is recommended to ensure full understanding and compliance of the recycling programs.

Seventeen percent of the waste stream could be diverted if a composting program were implemented, collecting food waste and compostable paper waste. The stream of compostable material referenced here is post-consumer food waste and soiled paper products.

Figure 6: Best Potential Diversion



It is important to understand that these potential diversion rates are academic in nature, and assume perfect compliance 100% of the time. Obviously, this is not the case in practice. There will always be a "wrong" slice of the pie chart, as individuals will, either through ignorance, unwillingness or unfeasibility, incorrectly dispose of waste regardless of availability of receptacles or the presence of well-designed educational materials. This analysis is intended to illustrate how little of the waste stream is actually waste, and how there are higher and better uses for much of the material currently being sent to a landfill. Actual recovery rates will be understandably lower than the idealistic upper bound of 90%, however, given that such a large proportion of the trash stream is compostable, U-M could expect to see at minimum a 10% increase in diversion from the landfill. This number will likely increase dramatically for food service buildings where post-consumer compostable waste makes up an even larger slice of the trash stream.

COSTS OF DIVERSION STRATEGIES

EDUCATIONAL SIGNAGE AND LABELING

The cost of creating and distributing additional educational materials is highly variable, ranging from the simple production of educational materials that are already designed to an organized campaign requiring significant staff time and potentially the design of new art assets. Ultimately it is likely that a very cost-effective educational campaign can be very effective in the Beyster building and other buildings across campus with outdated or limited signage and labeling.

Each bin should have a sign with a reminder of the materials that are included. These signs should be protected to ensure that they look nice over time and preferably are consistent across campus. Additionally, trash containers can be labeled with a "No Recyclables" sign to remind people to place their materials in the recycling bin.

An extremely effective measure is to pair recycling and trash receptacles; anywhere there is a trash repository in a common area, there should be a recycling container as well. This capital outlay can be significant depending on the style of the containers, but can drive recovery dramatically as individuals may not make the effort to search out a recycling container when looking to quickly dispose of a sheet of paper, bottle, or can, and only a trash bin is nearby.

ORGANICS MANAGEMENT

The development, implementation and management of a comprehensive campus-wide organics management program is described in a feasibility study prepared by RRS for U-M in 2011. This

study looked at a number of options, ranging from utilizing the existing City of Ann Arbor organics composting program to the development and operation of an onsite in-vessel composting system. One of the major hurdles identified was the reluctance of the program to accept post-consumer food waste, such as meat and dairy products. However, since then the transfer of operations to WeCare Organics (WeCare) has taken place, and a curbside post-consumer compost collection has become available. This changes the business calculus for designing a system for U-M relative to the findings of the previous study.

If it is possible to utilize WeCare as a composting partner, U-M would only need to focus on collection costs and educating the campus community about keeping the compostable stream as food waste and soiled paper waste only. U-M would need to negotiate with WeCare to determine if compostable plastics including compostable plastic bags, cups, utensils and containers could be acceptable. Compostable bags would be essential for collection of the material in the buildings and transportation to the outdoor roll-carts. Cups and other PLA products would not be essential but can help in increasing the diversion of food waste and to-go containers, reducing many of the issues with recycling these containers, as described previously.

Costs from the previous study for rolling out a campus-wide composting program are detailed in Table 2. The 2011 study estimated 1,143 tons of compostable food waste could be collected each year when the program is fully deployed. Operational costs from trash collection and landfill tip fees will be reduced, in addition to reduced costs for cleaning grease traps outside of food service facilities. In aggregate, a fully implemented, comprehensive composting program is expected to have a yearly cost of $137,276, including amortized capital costs and savings from avoided costs. This program would need to be developed with input from WeCare, to finalize the list of materials accepted and other contractual details. RRS recommends further investigation into such a partnership to solidify these cost projections.

Table 2 - Cost of Campus-wide Organics Program (RRS 2011)

Description of Cost	Cost
Cart Purchases	$15,000
Second Collection Truck	$200,000
Total Capital	**$215,000**
Labor	$142,009/yr
Amortized Capital	$18,503/yr
O&M	$14,019/yr
Compost Tip Fee	$45,709/yr
Total Cost	**$220,240/yr**
Estimated Savings	($82,944)/yr
Estimated Incremental Cost	**$137,296/yr**

Recyclable foodservice packaging was prevalent in the trash stream. However, as mentioned previously, it only composed roughly 18% of the recyclable material found in the trash stream. In reviewing purchasing behavior, it was apparent that the majority of the to-go containers were brought in by students and staff and not part of university purchasing. RRS does not recommend a particular strategy for increasing the recovery of foodservice materials, but does encourage U-M to consider it as program changes are made either with the composting program or other waste diversion efforts.

General industry trends have focused on either city-driven initiatives or zero-waste programs in stadium environments. Locally, a broader community-wide initiative would allow for consistency around messaging and increase the likelihood of successful recovery of the material. Through Washtenaw Food Policy Council advocacy, Washtenaw County is considering an updated EPP (Environmental Preferable Purchasing) Policy to require reusable, compostable or recyclable food service products within their purchasing, operations and special events, and sample ordinance language is drafted for municipalities to adopt similar policies for establishments within their jurisdictions. U-M could collaborate with Washtenaw County and Ann Arbor to establish standards for food vendors' to-go containers. The other trend focuses on stadiums going to zero-waste programs. Typically they utilize all compostable containers for all vendors within the stadium. This is possible through complete control of the purchasing and limitations on what attendees are allowed to bring in.

Short of a community-wide initiative, U-M has two other alternatives for approaching the foodservice materials. The first is to work with WeCare to allow the acceptance of a diverse set of compostable plastics and then work with all on-campus vendors to utilize compostable cups and to-go containers. This would mimic the program at the Ross School of Business that currently hauls material to Tuthill Farms for composting. This could be done in conjunction with a campus-wide rollout of a composting program and would significantly increase the ease with which students and staff could divert foodwaste. However, U-M is not a closed system like a stadium; accordingly, the risk of contamination of the composting stream with non-compostable plastics is much higher.

The second alternative is to create a voluntary program to encourage catered meals or food ordered by U-M to utilize materials currently acceptable in the single-stream program. Two major steps would need to be taken to implement this option. First, a detailed specification of what is recyclable would need to be developed and conveyed to nearby restaurants. Second, an extensive education program would need to be implemented, not only to instruct staff on which restaurants utilize the correct materials, but also how to handle the diverse set of materials including utensils, small portion cups and other confusing materials. This type of program could be used to create awareness and begin to educate staff and faculty who are interested in reducing the waste in their catered meals.

Overall, the current signage and labeling that U-M utilizes[1] is accurate and conveys the right messages. Based on the results of this study that the vast majority of the recyclables found in the waste are currently directly listed, RRS does not recommend any changes to the current signage and labeling. The one potential change would be to specifically call out plastic cups and plastic to-go containers (on the line that currently says plastic tubs). A note about them being generally free of food, water and ice would need to be added.

RECOVERY OPTIONS FOR THE 'OTHER' CATEGORY

The category "other" includes e-waste, other universal waste, toner/ink cartridges, packing foam, plastic film, scrap metal, non-recyclable bulky plastics, K-cups, snack/chip bags, and other unique items. Most of these items are targets for recycling either through source-separated U-M programs or through future targeted recovery programs.

E-waste, universal waste, packing foam and scrap metal are all recyclable in current U-M programs. For each, the materials can be placed at the loading dock for collection. However, a significant quantity of scrap metal was found in the trash in one of the sorts for each building. In both cases, the material was not suitable for single-stream recovery due to the size and shape however, the material would likely have a high value. Continual education of staff on the availability of the source-separated programs is key to their widespread adoption. Minor amounts of E-waste and universal wastes were found.

The TerraCycle pen program is a current U-M Waste Management and Recycling sponsored program available to all buildings on campus. The collected pens are boxed meeting a certain weight minimum, a shipping label is printed from the TerraCycle website (free of charge to U-M), and the package is mailed to TerraCycle in Trenton, New Jersey. Other writing utensils can be added to the pen collection program. Different TerraCycle programs are available for materials that we sorted and categorized as "other" including binders and snack/chip bags, as well as other materials such as drink pouches and foil-lined granola/energy bar wrappers. TerraCycle re-purposes these materials into new products for sale and pays U-M per item shipped to them.

Foam cups are not currently recyclable through the single-stream collection program, but can be collected and delievered to the Drop-Off Station for recycling and potentially included in the current U-M polystyrene foam collection program. In terms of recoverability, there are no ideal options for hot cups. Polycoated paper cups are an alternative, but are also not currently recyclable locally. Based on industry trends, they are likely to become recyclable in the next three to five years, so the switch to paper cups is a good step. Foam wrapped paper cups will be very difficult to recycle due to their complex multi-material structure. Polylactic acid (PLA) coated paper compostable cups are another alternative, but they are not currently accepted by the City of Ann Arbor's composting program.

[1] Available at http://www.recycle.umich.edu/grounds/recycle/posters_signs.php

A few materials identified during the sorts have potential to be recycled in the near future through source-separated programs including plastic film for packaging and the coffee "K-cups" used in Keurig and other single-serve coffee machines. As an example, Keurig programs are currently available for sending the K-cups back to the manufacturer for beneficial reuse. Likewise, at U-M the plastic film is not currently recyclable, but there are vendors who collect it in larger volumes for recycling.

For each of these materials which can be collected, bins can be placed in areas where there is high generation. They can then be either consolidated in a central location or shipped directly to their end location. U-M is already targeting all high volume recyclable materials in their source-separated programs accounting for over 60% of the “other” category. The take-back programs described here are mostly for students and staff who are interested in pushing the boundaries of recovery toward zero waste.

While these diversion strategies will help to reduce waste, reducing the waste coming to campus in the first place is both the environmentally preferrable choice and the more cost-saving option. U-M should establish a green purchasing program to prioritize vendors that take back or consider end of life in their products. The program can require food and drink vendors to provide recyclable alternatives to the current non-recyclable packaging (i.e. K-cups, coffee bags). The green vendor program could become part of a larger Environmentally Preferrable Purchasing (EPP) guideline and could apply to facilities and custodial products such as air filters, vacuum filters and other semi-durable items (see Appendix B for example). Purchasing behaviors and related best practices are addressed in the following section.

PURCHASING OBSERVATIONS

During material sorts, significant amounts of printed paper were sorted, both from the waste and recycling streams. There are numerous strategies that have been employed by companies to reduce the amount of paper printed by staff. At a basic level, setting printers to automatically print double sided and removing the banner sheet identifying the user, along with education, can go far in reducing the amount of printed paper. Another level of monitoring and tracking can be put in place to find average usage of printers among different staff and faculty. These results could be used to set quotas on printer usage. Some companies have even posted at the printer a weekly update of who has printed the most that year to allow competition and peer pressure to drive reductions in printing. These strategies can be further explored to see what is feasible in the current information technology systems.

U-M Procurement Services has negotiated the prices of materials with recycled content to be competitive with materials comprised entirely of virgin content. However, the Project Team noticed both in building walk-throughs and waste sorts that most office paper used was Boise X-9 with no recycled content, despite the fact that OfficeMax paper with 30% recycled content is less expensive. During interviews with staff it became clear that navigating the 219 options for copy paper in the purchasing portal was often secondary to more pressing work, and they would simply purchase the first, least expensive option they found, which is the Boise X-9. Modifying the purchasing portal to feature items that have low environmental footprint would likely increase

the purchase of these items. Purchasing recycled content materials helps support the recycling markets that many of U-M's current waste products are being sold into. Higher demand for these materials will help to drive up revenue for these recyclables. Supporting the recycling economy helps reduce the environmental footprint of the region and increases jobs.

PROGRAM RECOMMENDATIONS

Recommendation	Cost Impact	Impact on Goals	Explanation
1. Consistent signage and labeling	Low	Medium	The building with more comprehensive and up-to-date signage and labeling had higher levels of recycling with less contamination.
2. Education for staff	Low	Medium+	Encouraging staff to avoid disposable items in favor of reusable drinkware, plates, pens, etc. Education of staff, including custodial, for proper placement and handling of materials.
3. Food waste composting	High	High	Adoption of a robust food scrap composting program could reduce the trash in these buildings by up to 18%, and would have the most significant impact toward reaching the U-M waste reduction goal.
4. Adjust purchasing portal	Medium	Medium	Replace products in the default "Featured Items" category with equivalent products with higher recycled content. Prioritize vendors which take back or consider end of life in their products.
5. Minimize unneeded printing	Low	Medium	Many "banner sheets" were found in the recycling. These can be turned off by default along with setting printers to default to duplex printing.
6. Increase recovery of foodservice materials	Medium	Medium	Explore opportunities to work with the community to reduce waste from to-go containers from restaurants.

Based on the findings of this study, the priority recommendations of RRS to maximize diversion from the landfill are: (1) expanded campus-wide education of what is and is not recyclable; and (2) the implementation of a campus-wide organics management program. In addition, adjustments should be make to the mMarketsite supply purchasing portal to ensure that material, especially office paper, with a high percentage post-consumer recycled content is highly visible to those charged with ordering and managing of business consumables.

CONSISTENT SIGNAGE AND LABELING / EDUCATION

Based on the results of this study, RRS recommends a two-fold education and outreach program. The first step is an audit of any low performing buildings for updated signage and labeling to ensure that all utilize the single-stream directions and avoid old labeling that is confusing for

students and staff. For example, in Beyster many recycling bins were labeled “Paper Only” or had little to no indication of what was acceptable in the bins. In areas where trash containers far outweigh recycling containers, increasing the availability of recycling containers can significantly increase diversion. Although often high in initial cost, a standard hallway recycling container can divert half a ton of material a year if filled on a weekly basis during the school year. For each bin deployed, this recovery would save U-M $5 per year in avoided landfill costs and increase recycling revenue by approximately $10 per year. These savings can help to offset the capital cost of adding new containers.

The second part of the outreach program is to further educate individuals at all levels of the recycling system including new students, staff and faculty, and custodial staff. Based on the significant portion of common recyclables found in the trash, new students and all faculty should be educated on the importance of their contributions to U-M’s sustainability goals and the benefits to the environment. Additional education to staff on the availability of either source-separated programs or recycling bins for office clean-outs can help them divert more during times of large waste generation. This could reduce the significant quantities of paper, scrap metal and other valuable materials disposed of in the trash. Based on the count of bags during the sorts, up to 9% of the blue bags were found in the trash. This indicates that custodial staff are incorrectly disposing of a potentially significant amount of recyclables that have been separated by students and staff. A program to educate and audit the custodial staff could go far to ensure compliance and find potential areas for program improvements that address any of their issues. Additionally, working with custodial and other staff to identify frequently disposed-of products could lead to switching to a reusable alternative, or possibly source-separated recovery through a take-back program.

FOOD WASTE COMPOSTING

An organized and universal organics collection system is the single greatest opportunity to reduce waste going to the landfill. In order to meet and exceed diversion goals it is strongly recommended that U-M seriously consider investing in such a program. As seen in Figure 6, it would account for 17% of the total waste stream diversion for the two buildings studied. It is assumed the percentage would be significantly higher in buildings with foodservice facilities. Across campus, based on the 2011 study prepared by RRS, it would account for over 1,100 tons per year diverted from local landfills. The university can look for ways to work with the community to increase the recovery of foodservice materials, either through expansion of the food waste composting program or working with the community to prioritize recoverable materials over disposable ones.

MINIMIZING WASTE PRODUCED

Another aspect of outreach revolves around reducing the amount of material being generated in the first place. Policies to reduce or eliminate the purchase of disposable products when reusables are an option can reduce waste generation. Encouraging the use of reusable cups and mugs instead of disposable cups for both hot and cold beverages is another option. Protocols designed to minimize printing, such as a dialog box asking the user whether they really need a hard copy, or presetting printer options not to print banner sheets and default to double-sided

printing, can go a long way in reducing the amount of paper going into the recycling stream. This requires a comprehensive pattern of engaging individual staff and offices to participate in these initiatives.

The current set of policies and procedures for ordering supplies with a minimal environmental footprint are insufficient. While U-M Procurement Services has negotiated the prices of materials with recycled content to be competitive with materials comprised entirely of virgin content, the purchasing portal does not assist the consumer in easily finding and taking advantage of this valuable work. Currently the results of a search for office supplies are sorted by "Featured Items." RRS recommends working with OfficeMax to "feature" items, especially copy paper, with a minimum of 30% recycled content. This program can be expanded to preferentially feature companies that are actively considering end of life of their products and packaging to reduce the impact U-M is having on the environment.

APPENDICES

APPENDIX A: PHOTOGRAPHIC DOCUMENTATION

Waste Sort 1

Beyster Trash Sort #1

Picture 1: Trash pile- before sort

Picture 2: Trash pile – cups, food waste, wrappers

Picture 3: Trash pile- napkins, wrappers, chip bags, paper

Picture 4: Trash pile- Aluminum

Picture 5: Trash pile- lost and found

Picture 6: Trash pile- bathroom paper towel and toilet paper rolls

Picture 7: Trash pile- coffee grounds and foil bags

Picture 8: Trash pile- recyclable bottles and cans

Picture 9: Trash pile- office paper, mixed paper, recycling bags, cardboard

Picture 10: Trash pile- boxed lunch

Beyster Recycling Sort #1

Picture 11: Recycling pile- before sort

Picture 12: Recycling pile- foam, paper

LSA Trash Sort #1

Picture 13: Trash pile- before sort

Picture 14: Trash pile- coffee and foil bags

Picture 15: Trash pile- snack bags

Picture 16: Trash pile- cups

Picture 17: Trash pile- sandwich wrappers

LSA Recycling Sort #1

Picture 18: Recycling pile- before sort

Picture 19: Recycling pile- mixed plastics

Picture 20: Recycling pile- take-out waste: cups and wrappers

Picture 21: Recycling pile- Styrofoam

Picture 22: Trash pile- recycling bins

Waste Sort #2

Beyster Trash Sort #2

Picture 23: Trash pile- food wrappers, organics, and bathroom waste

Picture 24: Trash pile- mixed plastics, organics, styrofoam peanuts

Beyster Recycling Sort #2

Picture 25: Recycling pile- pizza boxes

Picture 26: Recycling pile- building accessories

LSA Trash Sort #2

Picture 27: Trash pile before sort- very dirty

Picture 28: trash pile- bathroom waste

Picture 29: Trash pile- mixed paper

Picture 30: Trash pile- cups

Waste Sort #3

Beyster Trash Sort #3

Picture 31: Trash pile- before sort

Picture 32: Trash pile- bag of unused toilet paper rolls

Beyster Recycling Sort #3

Picture 33: Recycling pile- before sort

Picture 34: Recycling pile- empty recycling bags in pile

Picture 35: Recycling pile- phone packaging

Picture 36: Recycling pile- mixed paper

Picture 37: Recycling pile- styrofoam packaging

Picture 38: Recycling pile- sub sorting

LSA Trash Sort #3

Picture 39: Trash sort

Picture 40: Trash sort- media

Picture 41: Trash sort- unopened medical tape

Picture 42: Trash pile- toilet paper rolls

Picture 43: Trash pile- office paper in recycling bag

Picture 44: Trash pile- organics bin

LSA Recycling Sort #3

Picture 45: Recycling pile- bagged recycling

Picture 46: Recycling pile- mixed paper

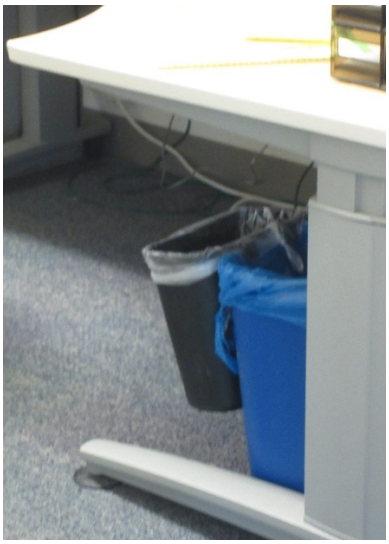
Picture 47: Recycling pile- cardboard, unused UPS boxes

Picture 48: Recycling pile- rubber strips

Pre-Sort Building Walk Through

Beyster Building

Picture 1: Trash box in building atrium



Picture 2: Trash & recycling desk bins

Picture 3: Office recycling bin

Picture 4: Kitchen trash bin

Picture 5: Hallway trash and recycling bins- no signage visible

LSA Building

Picture 2: Supply/Printing room recycling collection

Picture 7: Supply/Printing room- pen collection

Picture 8: Duplex printer

Picture 9: Signage to cut down on printing

Picture 10: Supply room- binders, paper, and pens

Picture 3: Supply room- printer cartridges, toner, and paper

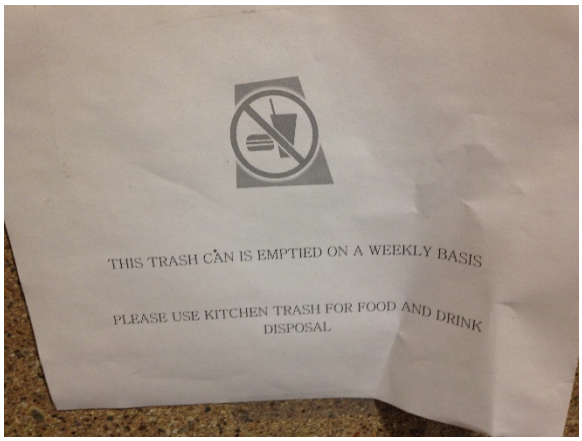
Picture 4: Computer lab- cardboard recycling

Picture 63: Hallway trash and recycling bins- labeled

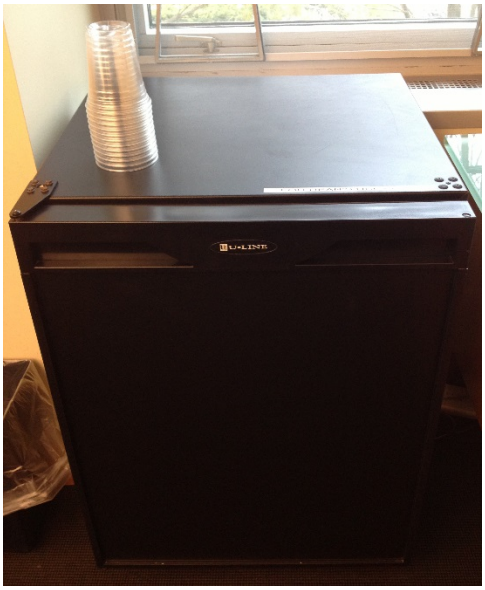
Picture 54: Conference Room trash and recycling bins

Picture 15: Desk trash can- recyclable bottles

Picture 16: Hallway trash with signage



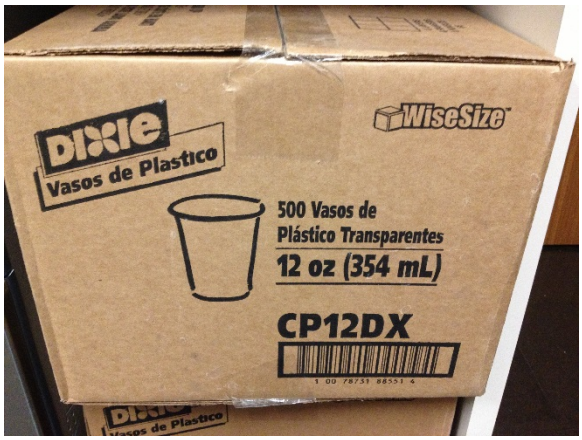
Picture 7: Trash bin signage (to left)



Picture 8: Conference room refrigerator

Picture 19: Conference room- reusable and paper cups

Picture 20: Kitchen signage



Picture 101: Kitchen paper cup supply

Picture 92: Kitchen trash

Picture 113: Bathroom paper towels

APPENDIX B: PROPOSED GREEN PURCHASING GUIDELINES

The University of Michigan (U-M) is committed to the stewardship of the environment and to reducing U-M's dependence on non-renewable energy. These Green Purchasing Policies and Procedures support U-M's commitment to sustainability.

The goal of this policy is to reduce the adverse environmental impact of our purchasing decisions by buying goods and services from manufacturers and vendors who share our commitment to the environment. Green purchasing is the method wherein environmental and social considerations are taken with equal weight to the price, availability and performance criteria that colleges and universities use to make purchasing decisions.

Green Purchasing minimizes negative environmental and social effects through the use of environmentally friendly products. Green Purchasing attempts to identify and reduce environmental impact and to maximize resource efficiency.

When placing orders for an office or department, we encourage those making purchasing decisions to consider the environmental factors by patronizing manufacturers who:

- conserve energy and water during production, transportation, and use
- minimize generation of waste and the releases of pollutants
- use recycled materials
- have a "take-back" recovery program
- produce products that can be reused or recycled
- manufactured with energy derived from renewable resources such as bio-based fuels, solar and wind power
- use alternate fuel vehicles

Honoring this commitment gives preference to products and services that have a lesser public health and environment impact.

Energy

- All desktop computers, notebooks and monitors purchased meet, at a minimum, all Electronic Product Environmental Assessment Tool (EPEAT) environmental criteria designated as "required" or higher as contained in the U.S. Environmental Protection Agency (EPA) and Institute for Electrical and Electronics Engineers (IEEE) 1680 Standard for the Environmental Assessment of Personal Computer Products, whenever possible. Apple, Dell, Gateway, HP and Lenova are manufactured to this standard.
- Copiers and printers purchased shall be compatible with the use of recycled content and remanufactured products.
- Remanufactured toner cartridges should be used in all copiers and printers whenever possible.
- All future electrical products purchased by U-M shall meet the EPA Energy Star certification when available and practicable.
- Where applicable, energy-efficient equipment shall be purchased with the most up-to-date energy efficiency functions. This includes, but is not limited to, high efficiency space heating systems and high efficiency space cooling equipment.
- When possible, suppliers of electronic equipment, including but not limited to computers, monitors, printers and copiers shall be required to take back equipment for reuse or environmentally safe recycling.
- U-M shall replace inefficient interior lighting with energy efficient equipment.

Toxins and Pollutants

- Cleaning solvents shall be biodegradable, phosphate free and citrus based where their use will not comprise quality of service.

- Industrial and institutional cleaning products meet Green Seal certification standards or environmental preference and performance shall be purchased and/or be required to be supplied by janitorial contractors.

Recycling and Recycled Materials

- 30% post-consumer waste recycled paper shall be the standard for all applications where quality of service or the health and safety of employees is not compromised.
- Products that are durable, long lasting, reusable or refillable are preferred whenever feasible.
- All documents (by University and Suppliers) shall be printed and copied on both sides to reduce the use and purchase of paper.
- Recycle unwanted supplies within your department.

Packaging

- Packaging that is reusable, recyclable or compostable shall be specified when available and suitable for use. Packaging should be eliminated or minimized to the greatest extent possible.

APPENDIX C: RAW DATA

See attached Excel workbook for the complete dataset.

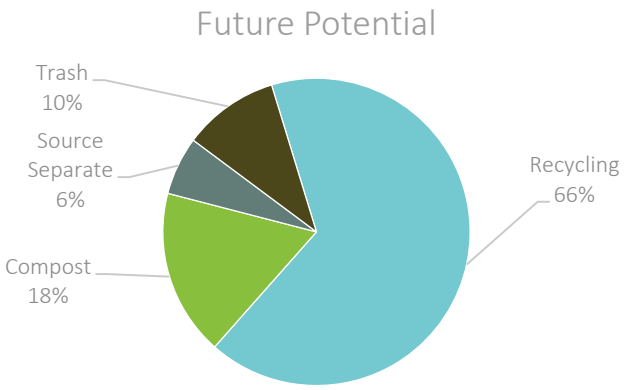
Detailed Sort Categories

1) Bottles and Cans
   a) Plastics
      i) PET (#1) & HDPE (#2)
      ii) PP, PS, Other (#3-7) - NO PVC
      iii) Other Plastics
   b) Deposit
      i) PET (#1) & HDPE (#2)
      ii) Aluminum Cans
      iii) Glass
   c) Non-deposit Aluminum Cans
   d) Metal Cans
   e) Non-deposit Glass
2) Other Recyclable Containers
   a) PET (#1) & HDPE (#2)
   b) PP, PS, Other (#3-7) - NO PVC
   c) Plastic Cups (PET, PP, PS)
   d) Aluminum
   e) Metal
   f) Cartons
3) Other Non-Recyclable Containers
   a) Polycoated Drink Cup
   b) PLA/Compostable Containers
   c) PLA/Compostable Bottles
   d) PLA/Compostable Drink Cups
   e) Other Plastics
   f) Foodservice PS Foam
   g) Foam Wrapped Paper Cups
   h) Poly-coated Containers
4) Paper/Cardboard
   a) Mixed Paper
   b) Cardboard
      i) Clean (Recyclable)
      ii) Food (Compostable)
   c) Newspaper
   d) White Office Paper
   e) Shredded Paper
5) Compost
   a) Food Waste
   b) Compostable Paper
7) Other
   a) E-waste
   b) Other Universal Waste
   c) Toner/Ink
   d) Scrap Metal
   e) Plastic Seals
   f) PLA Utensils
   g) Plastic Utensils
   h) Other PS Foam
   i) Non-PS Foam
   j) Film
   k) Waxed Paper
   l) Wrapper/Chip Bags
   m) K-cups
   n) Pens
   o) Mini Trash Cans
   p) Media/CDs
   q) Trash Can Top
   r) Bulky Plastics (non-recyclable)
   s) Plumbing
   t) Textiles
   u) Binders
   v) Air Filters
   w) Battery
   x) Clips
   y) Lost and Found

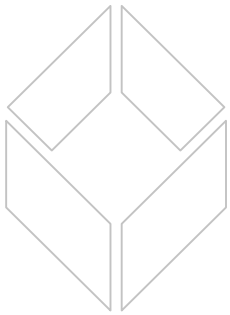
APPENDIX D: HYPOTHETICAL FUTURE POTENTIAL

In the future it is likely that the single-stream recycling program will be able to sort additional materials, such as coated paper drink cups. The City of Ann Arbor's municipal composting program is also expanding and may have the future potential to add support for PLA (compostable plastic) cups[2]. If, in addition to these trends in material recovery, the campus were to institute an organized source-separate composting program and expand more aggressive source-separate program for hard-to-recycle materials (such as Keurig coffee pods, markers, or binders), it is theoretically possible to drive the aggregate diversion rate for these buildings to 90%. Again, this sample is representative of administrative and classroom buildings – buildings with foodservice facilities could see significantly higher diversion of post-consumer food waste.

Figure 7: Future Diversion Potential



[2] It should be noted that compostable plastics made up less than two pounds of all material sorted in the entire project.



MANAGING CHANGE IN A RESOURCE-CONSTRAINED WORLD

RRS is a consultancy with a vision. We see a world where resources are managed to maximize economic and social benefit while minimizing environmental impact. A world where abundance keeps pace with societal needs.

We have assembled a unique team of strategists, engineers, economists and communications specialists with core strengths in materials and recovery, coupled with expertise in life cycle management and applied sustainable design. These experts operate confidently across the supply chain, identifying the most leveraged opportunities to affect change, and developing pathways to long-term value.

RRS has been working toward this vision since 1986. Our clients are leaders in materials management, and in partnership we have achieved outstanding results. We remain nimble and responsive, providing informed, innovative, actionable solutions to the sustainability challenges of our time.

RRS

APPENDIX B: PROPOSED GREEN PURCHASING GUIDELINES

The University of Michigan (U-M) is committed to the stewardship of the environment and to reducing U-M's dependence on non-renewable energy. These Green Purchasing Policies and Procedures support U-M's commitment to sustainability.

The goal of this policy is to reduce the adverse environmental impact of our purchasing decisions by buying goods and services from manufacturers and vendors who share our commitment to the environment. Green purchasing is the method wherein environmental and social considerations are taken with equal weight to the price, availability and performance criteria that colleges and universities use to make purchasing decisions.

Green Purchasing minimizes negative environmental and social effects through the use of environmentally friendly products. Green Purchasing attempts to identify and reduce environmental impact and to maximize resource efficiency.

When placing orders for an office or department, we encourage those making purchasing decisions to consider the environmental factors by patronizing manufacturers who:

- conserve energy and water during production, transportation, and use
- minimize generation of waste and the releases of pollutants
- use recycled materials
- have a "take-back" recovery program
- produce products that can be reused or recycled
- manufactured with energy derived from renewable resources such as bio-based fuels, solar and wind power
- use alternate fuel vehicles

Honoring this commitment gives preference to products and services that have a lesser public health and environment impact.

Energy

- All desktop computers, notebooks and monitors purchased meet, at a minimum, all Electronic Product Environmental Assessment Tool (EPEAT) environmental criteria designated as "required" or higher as contained in the U.S. Environmental Protection Agency (EPA) and Institute for Electrical and Electronics Engineers (IEEE) 1680 Standard for the Environmental Assessment of Personal Computer Products, whenever possible. Apple, Dell, Gateway, HP and Lenova are manufactured to this standard.
- Copiers and printers purchased shall be compatible with the use of recycled content and remanufactured products.
- Remanufactured toner cartridges should be used in all copiers and printers whenever possible.
- All future electrical products purchased by U-M shall meet the EPA Energy Star certification when available and practicable.
- Where applicable, energy-efficient equipment shall be purchased with the most up-to-date energy efficiency functions. This includes, but is not limited to, high efficiency space heating systems and high efficiency space cooling equipment.
- When possible, suppliers of electronic equipment, including but not limited to computers, monitors, printers and copiers shall be required to take back equipment for reuse or environmentally safe recycling.
- U-M shall replace inefficient interior lighting with energy efficient equipment.

Toxins and Pollutants

- Cleaning solvents shall be biodegradable, phosphate free and citrus based where their use will not comprise quality of service.
- Industrial and institutional cleaning products meet Green Seal certification standards or environmental preference and performance shall be purchased and/or be required to be supplied by janitorial contractors.

Recycling and Recycled Materials

- 30% post-consumer waste recycled paper shall be the standard for all applications where quality of service or the health and safety of employees is not compromised.
- Products that are durable, long lasting, reusable or refillable are preferred whenever feasible.
- All documents (by University and Suppliers) shall be printed and copied on both sides to reduce the use and purchase of paper.
- Recycle unwanted supplies within your department.

Packaging

- Packaging that is reusable, recyclable or compostable shall be specified when available and suitable for use. Packaging should be eliminated or minimized to the greatest extent possible.

APPENDIX C: RAW DATA

See attached Excel workbook for the complete dataset.

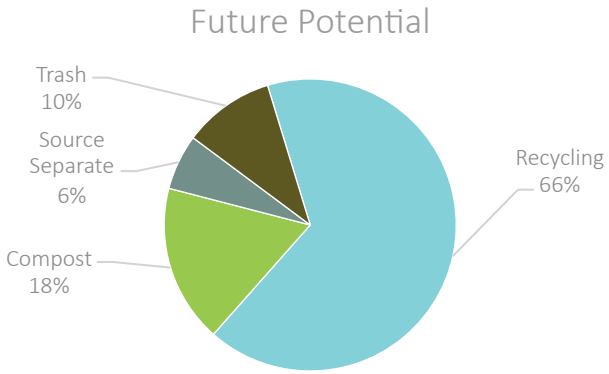
Detailed Sort Categories

1) Bottles and Cans
   a) Plastics
      i) PET (#1) & HDPE (#2)
      ii) PP, PS, Other (#3-7) - NO PVC
      iii) Other Plastics
   b) Deposit
      i) PET (#1) & HDPE (#2)
      ii) Aluminum Cans
      iii) Glass
   c) Non-deposit Aluminum Cans
   d) Metal Cans
   e) Non-deposit Glass
2) Other Recyclable Containers
   a) PET (#1) & HDPE (#2)
   b) PP, PS, Other (#3-7) - NO PVC
   c) Plastic Cups (PET, PP, PS)
   d) Aluminum
   e) Metal
   f) Cartons
3) Other Non-Recyclable Containers
   a) Polycoated Drink Cup
   b) PLA/Compostable Containers
   c) PLA/Compostable Bottles
   d) PLA/Compostable Drink Cups
   e) Other Plastics
   f) Foodservice PS Foam
   g) Foam Wrapped Paper Cups
   h) Poly-coated Containers
4) Paper/Cardboard
   a) Mixed Paper
   b) Cardboard
      i) Clean (Recyclable)
      ii) Food (Compostable)
   c) Newspaper
   d) White Office Paper
   e) Shredded Paper
5) Compost
   a) Food Waste
   b) Compostable Paper
7) Other
   a) E-waste
   b) Other Universal Waste
   c) Toner/Ink
   d) Scrap Metal
   e) Plastic Seals
   f) PLA Utensils
   g) Plastic Utensils
   h) Other PS Foam
   i) Non-PS Foam
   j) Film
   k) Waxed Paper
   l) Wrapper/Chip Bags
   m) K-cups
   n) Pens
   o) Mini Trash Cans
   p) Media/CDs
   q) Trash Can Top
   r) Bulky Plastics (non-recyclable)
   s) Plumbing
   t) Textiles
   u) Binders
   v) Air Filters
   w) Battery
   x) Clips
   y) Lost and Found

APPENDIX D: HYPOTHETICAL FUTURE POTENTIAL

In the future it is likely that the single-stream recycling program will be able to sort additional materials, such as coated paper drink cups. The City of Ann Arbor's municipal composting program is also expanding and may have the future potential to add support for PLA (compostable plastic) cups[2]. If, in addition to these trends in material recovery, the campus were to institute an organized source-separate composting program and expand more aggressive source-separate program for hard-to-recycle materials (such as Keurig coffee pods, markers, or binders), it is theoretically possible to drive the aggregate diversion rate for these buildings to 90%. Again, this sample is representative of administrative and classroom buildings – buildings with foodservice facilities could see significantly higher diversion of post-consumer food waste.

Figure 7: Future Diversion Potential



[2] It should be noted that compostable plastics made up less than two pounds of all material sorted in the entire project.

MANAGING CHANGE IN A RESOURCE-CONSTRAINED WORLD

RRS is a consultancy with a vision. We see a world where resources are managed to maximize economic and social benefit while minimizing environmental impact. A world where abundance keeps pace with societal needs.

We have assembled a unique team of strategists, engineers, economists and communications specialists with core strengths in materials and recovery, coupled with expertise in life cycle management and applied sustainable design. These experts operate confidently across the supply chain, identifying the most leveraged opportunities to affect change, and developing pathways to long-term value.

RRS has been working toward this vision since 1986. Our clients are leaders in materials management, and in partnership we have achieved outstanding results. We remain nimble and responsive, providing informed, innovative, actionable solutions to the sustainability challenges of our time.

RRS