THE PENNSYLVANIA STATE UNIVERSITY

WASTE STREAM TASK FORCE REPORT

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PennState

Task Force Members

Omid Ansary, Senior Associate Dean for Academic Affairs, Penn State Harrisburg
Richard Brazier*, Senior Associate Dean for Faculty and Research, Commonwealth Campuses
Cory Chapman, Associate Athletic Director for Facility and Event Operations
Duane Elmore*, Director of Procurement Services, Auxiliary and Business Services
Meghan Hoskins, Director of Operations and Partnerships, Sustainability Institute
Brian Macafee, Assistant Manager of Farm and Operations Services, College of Agricultural Sciences
Ryan McCaughey, Manager of Grounds, Equipment, and Solid Waste, Office of Physical Plant
Phillip Melnick (co-chair), Senior Director of Buildings and Grounds, Office of Physical Plant
Judd Michael*, Professor of Agricultural and Biological Engineering, College of Agricultural Sciences
Nicole Rella, Student, Environmental Resource Management, University Park
Jim Richard*, Senior Director of Enterprise Services, Housing and Food Services
Tom Richard* (co-chair), Director of Institutes of Energy and the Environment
Bob Segura*, Assistant Director of Environmental Health and Safety, Office of Physical Plant
Haley Stauffer, Student, Biorenewable Systems, University Park
Lydia Vandenbergh*, Associate Director of Employee Engagement and Education, Sustainability Institute
Karen Winterich*, Professor of Marketing, Smeal College of Business

*indicates subcommittee lead

Ad hoc members
John Bechtel, Assistant Director of Design and Construction, Office of Physical Plant
Erik Cagle, Manager of Custodial Operations, Office of Physical Plant
Conal Carr, Director of Housing and Ancillary Services, Auxiliary and Business Services
David Cullmer, Sustainable Operations Analyst, Sustainability Institute
Nadine Davitt, Supervisor of Solid Waste and Labor Operations, Office of Physical Plant
Mary Easterling, Associate Director of Analysis and Assessment, Sustainability Institute
Nathan Elser, Graduate Student, Biorenewable Systems, University Park
Glenn Feagley, Manager, Lion Surplus
Doug Goodstein, Associate Director for Student Engagement, Sustainability Institute
Victoria Indivero, Writer/Editor, Institutes of Energy and the Environment
Maryam Shahri, Graduate Student, Biorenewable Systems, University Park

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Introduction

Penn State has been at the forefront of sustainable waste stream management for decades. Our food waste composting system has been a national model since the 1990s, generating some of the first high-quality public information about cost and performance and serving as a living laboratory for at least half a dozen research papers. For 15 years we have hosted the Pennsylvania Recycling Markets Center at the Penn State Harrisburg campus, which provides statewide leadership for market development and innovation. Our "Trash to Treasures" end of year move-out recovery program has served as a model for higher education across the Big Ten and beyond. And in 2014 Penn State was recognized by the National Recycling Coalition, earning the "Best of the Best" Outstanding Higher Education Award for our composting, recycling, and waste diversion strategies.

This is a proud legacy, but one that requires constant effort to maintain and improve. In the world of solid waste change is continuous, and in recent years that change has been swift and disruptive. This report represents Penn State's effort to adapt to some of the rapid change already underway, but also to put in place processes and procedures for continuous improvement, so that we will be a leader in sustainable waste stream management for many years to come.

The Penn State Waste Stream

Penn State's University Park campus generates close to 20,000 tons of solid waste each year. Of that total 62% was recovered through various recycling programs in 2017. In 2018, while the total waste stream dropped by 1,460 tons (a tribute to waste reduction), the amount disposed in landfills increased by 154 tons, reducing our overall recovery rate to 58%. Data for these two years is summarized in Table 1. Components of the waste stream that are not recovered for reuse at University Park (primarily through composting) are delivered to the Centre County Recycling and Refuse Authority, which markets the recyclables and serves as a transfer station for non-recyclables destined for landfill. Tipping fees vary from $20/ton for source-separated recyclables to $70/ton for municipal waste, with a penalty for contaminated recyclables ranging from $100/ton for contamination greater than 3% to $250/ton for contamination greater than 20%.

In 2018 Penn State contracted with Kessler Consulting for a waste audit at University Park, with 12 campus buildings audited from April 16-27, 2018, and 10 additional buildings audited November 5-16, 2018. Several of the tables and figures from that report are reproduced in this summary (Kessler Consulting Inc, 2019). The audit included four academic buildings, four administrative buildings, five dormitories, three dining halls, two athletic buildings, the student union (with administrative areas audited in the fall and dining areas in the spring), as well as a University apartment building and a library. The report focused on quantities, composition, and contamination. The full Kessler Consulting report is available in Appendix I: 2018 Kessler Waste Audit Report.

Table 1. Penn State Waste Stream Annual Tonnages

Material	Destination	2017	2018
Materials Addressed in this Assessment			
Recycled			
OCC	CCRRA - Recycling	759	783
Mixed Paper	CCRRA - Recycling	832	687
Plastics	CCRRA - Recycling	158	94
Glass	CCRRA - Recycling	83	67
Metal Cans	CCRRA - Recycling	126	83
Food Waste	OMPEC	1,584	1,539
Disposed			
Refuse	CCRRA - Disposal	5,795	6,160
Other Materials			
Recycled			
Scrap Metal	CCRRA - Recycling	122	32
Tires	CCRRA - Recycling	16	18
Wood Waste**	CCRRA - Recycling	3,226	214
Wood Waste**	OMPEC		1,443
Waste Soil	OMPEC	593	556
Yard & Leaf Waste	OMPEC	1,255	2,042
Grass-cycling	n/a	1,200	1,200
C&D and Asphalt	Various	849	273
Textiles	Trash to Treasure	40	44
Scrap Metal	Lion Surplus, Service Garage	219	266
Hazardous & E-waste	Various	664	618
Salvage	Lion Surplus	750	900
Disposed			
Residue*	CCRRA - Disposal	19	66
C&D Debris - Disposed	CCRRA - Disposal	1,774	1,516
Total Generated		**20,064**	**18,601**
Total Recovered		**12,476**	**10,859**
Recovery Rate		**62%**	**58%**

*Residue represents recyclable materials rejected by the Centre County Refuse and Recycling Authority due to contamination.
**Wood waste destinations were not differentiated in 2017.

The Kessler report extrapolated from the audited buildings based on the area of similar building types at University Park to produce Table 2 and Figures 1 and 2.

Table 2. Estimated University Park Campus-Level Generation for Audited Building Types

Building	Refuse	Paper	Plastic Bottles &Film	Misc. Plastics	Metal	Glass	Compost	OCC	Total Generated	Total Recovered	% of Total Campus Recovery	Recycling Rate
Academic	548	158.8	73.3	43.4	13.9	26.8	70.2	30.4	965	417	16%	43%
Admin	108	51.0	17.0	11.0	4.4	2.9	27.4	4.0	225	118	4%	52%
Apt	156	7.6	20.1	0.0	0.0	6.0	0.0	8.6	198	42	2%	21%
Athletic	52	4.4	4.8	1.0	3.0	0.1	1.3	4.6	71	19	1%	27%
Dining	432	8.6	52.4	0.0	33.5	5.6	1,216.7	325.8	2,075	1,643	61%	79%
Dorm	1,404	14.9	76.2	0.0	5.0	11.5	44.8	92.8	1,649	245	9%	15%
Library	45	12.2	5.5	5.6	1.1	1.4	6.3	0.2	78	32	1%	42%
Stud. Un.	213	6.4	25.3	1.0	5.0	2.4	94.1	28.1	375	162	6%	43%
Total	**2,958**	**264.0**	**274.6**	**61.9**	**65.8**	**56.8**	**1,460.8**	**494.5**	**5,637**	**2,678**	**100%**	**48%**

Note: All units are in tons/year or percent by weight.

The different building types had significantly different recycling rates and purity for each waste stream component, as illustrated in Figures 1 and 2 below.

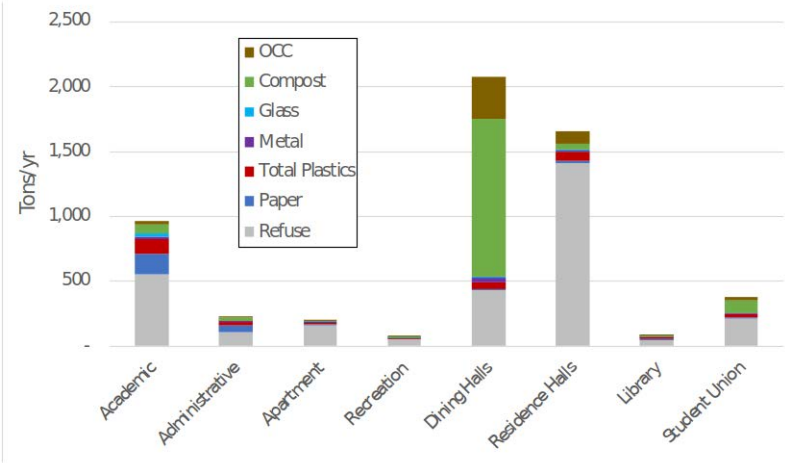

Figure 1. Estimated University Park Campus-Level Generation for Audited Building Types

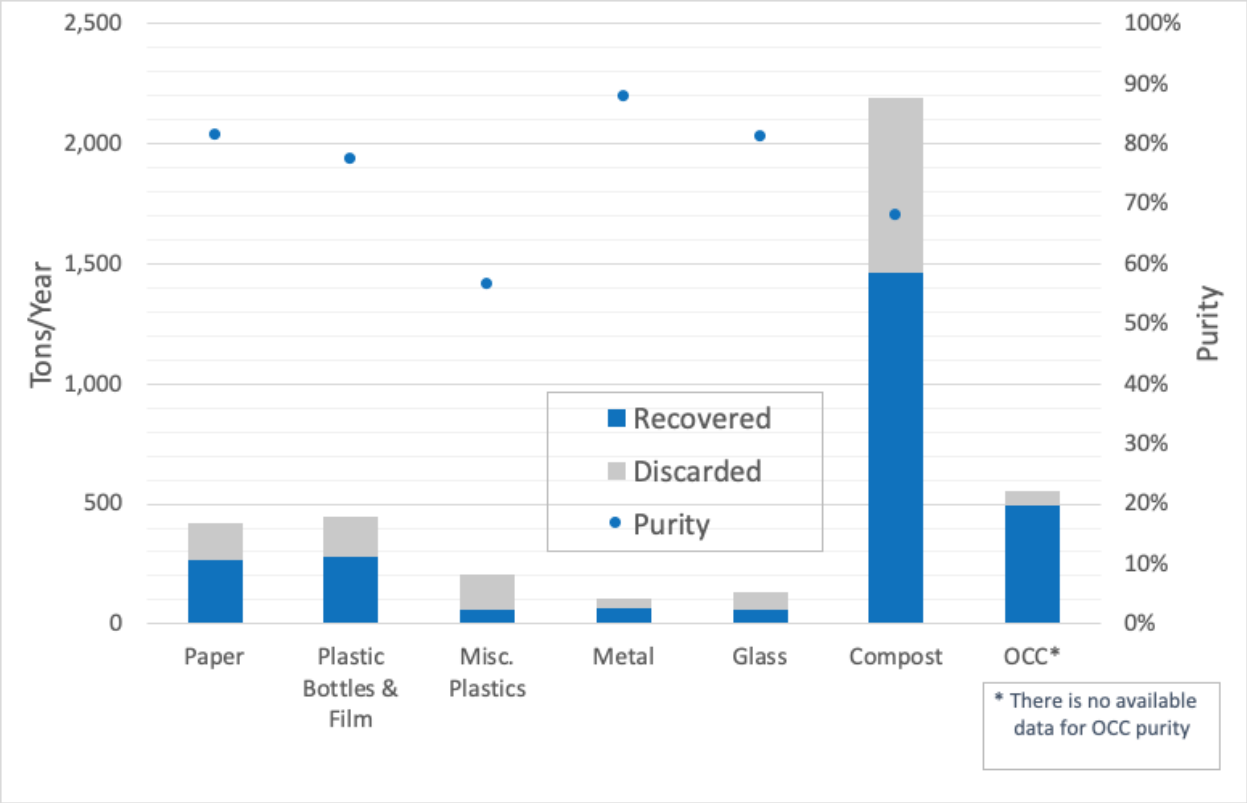

Figure 2. University Park Waste Stream Components, Quantities and Purity.

Table 2 and Figures 1 and 2 illustrate several important points. First, the dining halls are not only the largest waste stream generators, but also have the highest recycling rate (nearly 80%) and quantity (over 1,600 tons/year). Most of this recoverable material is compostable, then cardboard is next. Academic and administrative buildings including the library and student union have intermediate recycling rates, ranging from 42% to 52%. Dorms, apartments, and athletic buildings have lower recycling rates, ranging from 15% to 27%, with nearly half of the total University Park refuse generated in the dorms. Dorms also were estimated to have the highest percentage and quantity (tons/year) of non-recycled paper, old corrugated cardboard (OCC), plastics, metal, glass, and food waste (Kessler Consulting, 2019). Importantly, these low recycling rates appear to be correlated with low levels of contamination, indicating that while many in these buildings are not recycling, those that are pay close attention. Purity rates are among the highest for dorms, dining halls, and athletic buildings across all waste stream components.

Values and Principles

Penn State's solid waste management system is at the same time very visible, with bins in nearly every hallway on campus, and invisible, because the sources and sinks of most of the materials flow "beyond the bin" are generally hidden from view. One of the goals of sustainability in general, and this Task Force in particular, is to make the invisible visible, and therefore to encourage better decisions. For solid waste, those decisions are not just about recycling and disposal, but about the purchases and processes that occur much earlier in the material cycle.

There are several values and principles that guided the Solid Waste Task Force in its deliberations and informed the recommendations in this report.

- Values that guide sustainable material decisions:
  - *"Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people."* Pennsylvania Constitution, Article 1, Section 27
  - Penn State has an obligation to recycle under state law, section 1509 of Act 101. Our goal is not only complying with these requirements at all locations but exceeding our legal obligation.
  - "Climate change is recognized worldwide as one of the most important issues of our time, and Penn State will be a leader in addressing and solving this challenge." (Penn State Strategic Plan, 2016 – 2025)
  - To protect both our campus community and those exposed to our waste and recyclables, materials toxicity and risks to human health should be reduced or eliminated.
  - Penn State's waste stream will be managed in ways that protect water quality and environmental health.
  - "We recognize that the Earth's resources are finite, and it is our ethical responsibility to use renewable resources that can be sustained in perpetuity, using life cycle assessments and other science-based evidence to guide our decisions." (Materials Management in Oregon, 2050 Vision and Framework for Action. p. 3)
  - Penn State's materials management systems support the University's primary missions of education, research, and outreach. Engaging students and faculty in planning, evaluation, and demonstration of the effectiveness and efficiency of systems offers an opportunity to enhance education and research, to leverage our University as a living laboratory, and through outreach and extension to serve important needs across the Commonwealth of Pennsylvania.

- Principles behind recommendations
  - Selected waste management strategies must significantly reduce waste, be practical to implement, and be cost effective. The decision process must balance a wide range of objectives, including the values described above and the affordability and quality of a college education.
  - Penn State will provide our community with information and services to guide responsible material use.
  - This Task Force Report is a response to the current situation, but waste stream options are dynamic and in constant flux. Ongoing institutional processes are needed for sustainable materials management decision making across all sectors, from initial purchasing decisions to end-of-life.

General Challenges

- *Funding Investments and Cost Analysis*
  - Some recommendations have a significant one-time or ongoing cost associated with them. Savings are difficult to predict, and while external costs are documented internal labor and equipment costs are widely dispersed and not currently assessed.
- *Collaborative Effort Required Across University Units*
  - Success depends on all employees and students thinking and acting in a sustainable manner. Operational priorities and competing interests often are not compatible with actions required to successfully achieve waste management goals.
- *Frequently Changing Atmosphere for Recycling Locally and Globally*
  - Ever-changing markets and requirements will challenge our ability to implement sustainable changes and adjust to future externalities.
- *Population Transiency*
  - As a university, the population that has access to our facilities is constantly changing -- from new students arriving every semester to visitors attending public performances and athletic events. This is a challenge to be considered particularly while determining the new branding and messaging for recycling and sorting stations across campus.
- *Sustained Focus Year to Year*
  - Perpetual focus on waste management is required. There needs to be an ongoing effort to maintain awareness and participation and to adapt to future changes.
- *Awareness of and Compliance with Proposed Sustainable Procurement Policy*
  - Many people make purchasing decisions at the University and sustainability isn't always a primary consideration. Motivating and managing these decentralized decisionmakers will be challenging.
- *Overall Approach to Change*
  - In keeping with Penn State's historic approach, the recommended strategy is primarily to foster cooperation through "informed willingness" as opposed to "mandated compliance."

Most Significant Recommendations

- *Hire a Waste Reduction and Recycling Programs Manager*
  - We recommend a position be created and funded that will lead the effort to increase Penn State's recycling rate. Penn State's recycling rate has decreased in the past 3 years since this position was eliminated. This report contains recommendations that, if implemented, will require attention that is best achieved by hiring an individual to focus on these tasks. This position request is supported by the Spring 2019 survey results, which show a consistent request for more (and clearer, consistent) information and education on correct recycling (76% of 975 Penn State constituents responded 'Yes' when asked if they would like more information on the appropriate sorting of waste).
- *Hire a Sustainable Procurement Program Coordinator*
  - Managing material at the front-end of the process as it enters the University system is the most effective way to reduce waste and increase diversion. Creating this position will advance this effort that currently is not an area of focus in our procurement and waste management practices.
- *Design and Implement a Reimagined Integrated Organics Recycling System*
  - Organics are the largest component of current recycling but have high levels of contamination and remain the largest component of discards. This is our #1 opportunity.
- *Reemphasize Existing or Implement New Waste Reduction Strategies*
  - Specific recommendations are included in the Traditional Recycling section.
- *Redesign and Launch a New Recycling Program Brand*
  - The current Mobius brand is not consistently applied and is not strongly associated with recycling. Changes to the existing program provide a rebranding opportunity.
- *Leverage Materials Management as a Living Laboratory*
  - Create opportunities for students and faculty to engage and advance the business as well as the science of waste management and recycling.
- *Empower a Network of Advocates Across the University*
  - Include OPP's facilities coordinators, unit sustainability leaders, and Green Teams to be responsible for recycling and waste reduction in their units.
  - Currently, the University relies on all students and employees to Reduce, Reuse, and Recycle as part of how they live and work. The Task Force recommends that an individual or small group is tasked with assisting and promoting these efforts in each college and department.
- *Implement and Improve Educational and Awareness Programming*
  - Continuous education is necessary for the transient population of the University and as program requirements change over time.
- *Biannually Review and Update Waste Stream Management Plan*
  - Review practices biannually each March and October under the auspices of the Sustainable Operations Council so that changes can be considered and implemented before the start of the next fall semester.
- *Review and Revise University Policy AD34*
  - The University Recycling Program policy should reflect those recommendations of the Waste Stream Task Force that are implemented.

These general recommendations were developed by the Waste Stream Task Force subcommittees and reviewed and recommended by the Task Force membership. The following sections summarize the specific findings, goals, and recommendations of each subcommittee.

As the university considers investment in the waste management system, the following items are priority opportunities for investment.

- Procurement – Sustainable procurement is one of the most effective ways to reduce waste and increase recycling.
- Organic Material Capture – Reusing or recycling organics represents the single greatest opportunity for increased diversion from the landfill.
- Traditional Recycling – Though we are close to maximizing potential in capture of traditional recyclables, it is the face of recycling at Penn State and as such it demands investment.
- Education and Awareness – Ongoing education of an ever-changing campus population is necessary for the investments made in any other aspects of the waste management system to succeed.
- Innovation and Improvement – Material and waste management systems are not static. Continuous study, innovation is necessary. Funding research opportunities will facilitate future improvements and ensure the viability and relevance of our practices.

Additionally, several of the recommendations are interdependent. Pursuit of one recommendation affects, or even may eliminate, pursuit of another. First, developing an on-campus Materials Recovery Facility (MRF) as recommended below will negate the benefits of collecting recyclables from offices. Only one of these options should be pursued. Also, constructing a MRF or enhancing our relationship with the Centre County Recycling and Refuse Authority (CCRRA) are interdependent and affect the redesign of the recycling collection infrastructure and how recyclables will need to be sorted. Short-term changes to collection processes are needed and we recommend those be implemented because constructing a MRF or enhancing our relationship with CCRRA are long-term projects that will take years to study, construct, or implement. However, deciding to construct a MRF in the future will require additional changes to our collection process and educational programming.

Organics recycling is another area of interdependence. While Penn State has been a leader in pre-consumer food waste composting for decades, recent expansion to post-consumer collection led to problems with contamination. While retrenchment is an option, expansion offers the potential to increase overall solid waste recovery by more than 10%. An integrated system would require innovation in procurement and contracting, so that all food service items are either fully biodegradable or obviously not and continue with thorough simplified sorting and more robust processing, which could include energy recovery through anaerobic digestion. This would require partnerships with Dining, Athletics, Housing, Physical Plant, and all food vendors that operate on campus, and would likely require significant facilities investments. Designing and implementing such a system is an immediate opportunity for Living Laboratory research and education. Success would return us to national leadership and would set a model for future innovation in procurement as well as materials recovery.

Summary of Overall Recommendations

The report contains many additional recommendations. A summary of all recommendations is provided below.

Procurement

- Implement sustainable purchasing policy
- Develop measures of success
- Garner senior leadership and customer support
- Develop change management strategies
- Create, fund, and hire a Sustainable Procurement Program Coordinator (see description in Appendix IV: Proposed Sustainable Procurement Program Coordinator Position Draft)
- Fund Life Cycle Analysis grad student to address evolving materials recycling challenges and opportunities

Cost/Benefit

Sustainable Procurement Program Coordinator	$80,000 plus benefits
Life Cycle Analysis grad student position (annual)	$75,000

Traditional Recycling Streams

- Hire a Waste Reduction and Recycling Program Manager (see job description in Appendix V: Proposed Waste Reduction and Recycling Program Manager Position Draft).
- Redesign recycling program brand (currently *Mobius*).
- Update the sorting stations by reducing the number of streams from seven to six, removing miscellaneous plastics, and changing the standard infrastructure to stand-alone stations (as opposed to built-in), with signage affixed to bins, not the wall.
- Encourage waste reduction across campus via reusable mugs, beverage cups, and other reusable food containers; also reduce single-use plastic bags.
- Design and implement integrated organics recycling system. Evaluate procurement and vendor contracts for biodegradable food service items. Simplify sorting to reduce contamination. Improve organics management capabilities by investing in the Organics Material Processing and Education Center (OMPEC), potentially installing an in-vessel composting system or upgrading an existing anaerobic digester to contain and decompose biodegradable food service items as well as screen residual contaminants.
- Review Penn State Policy AD34.
- Conduct feasibility study to construct and operate an on-campus materials recovery facility.
- Consider enhanced partnership with CCRRA to simplify and improve collection of traditional recyclable materials.

Cost/Benefit

Waste Reduction and Recycling Program Manager	$80,000 plus benefits
Changing bins and/or signage across campus	$1,250,000
Reinstitute collection of materials from offices	$465,000 first cost
	$216,000 - 362,000 net annual cost
In-vessel Composting System or Digester Upgrade	$500,000
On-campus MRF Feasibility Study	$150,000

<u>Housing</u>

- Revise procurement standard operating procedure, which reduces onboarding of waste
- Immediate adoption of the University's recycling program brand redesign and roll-out of collection/separation areas
- Develop a timeline/tactical plan for implementation of support activities

Cost/Benefit

New signage for existing collection areas	$2,700
New lids for existing collection systems	$52,650
Upgrade of collection areas	$120,000
Eco-reps ongoing cost (annual)	$150,000
Re-introduction of compost collection (annual)	$113,250

<u>Food & Beverage/Special Events/Hotel/Dining/Sports Venues</u>

- Collect back-of-house food items for composting at venues and events
- Align event and venue recycling collection with overall campus program.
- Create/revise system for staff to collect recyclable containers (e.g., plastic bottles) after all sports and special events.
- Develop and implement standard for compostable food service items to maximize recovery as part of integrated organics recycling system.
- Increase purchase of compostable food service items
- Require all catered events to be "zero-waste."
- Sustainability improvements should be a priority when renovating Beaver Stadium.
- Consistent principles should be developed and applied to the purchase of food and foodservice items sold at Athletics and special events
- Rewrite contracts with branded retail dining establishments so that their operations are more aligned with Penn State sustainability goals
- Consider options for all special events, such as Special Olympics or THON, to reduce waste footprint. This could range from mandates for compostable foodservice items to the Office of Physical Plant (OPP) providing materials collections systems at any event.
- Work with Athletics Concessions to ensure future purchases dovetail with overall waste management goals.

Cost/Benefit

Compostable food service items (annual estimate)	$1,000,000
Waste Reduction and Recycling Program Manager	(previously listed)
New bins and signage	(previously listed)

Specialty Waste Streams

- Minimize purchased quantities and maximize recycled/reused disposal amount without compromising regulatory compliance.
- Ensure a sustainable best business practice is in place for the process to ensure future quantities of each unique waste stream are managed efficiently.
- Develop purchasing specifications that ban products containing certain hazardous or regulated materials.
- Enhance requirements and reporting for recycling of Construction and Demolition (C&D) waste.
- Design, construct, and operationalize a chemical tissue digester to replace the University's aging incinerator for improved management of animal mortalities.
- Establish a new design standard that eliminates new installation of fluorescent lights and replaces existing ones with LEDs as renovations are completed.
- Create purchasing incentive/ban to minimize office furnishings made from particle board, and other products whose non-recyclability translate to large waste management challenges at end-of-life.
- Identify/quantify greenhouse, farm, and other agricultural wastes that are generated on or off campus, which could be captured to augment current organic recycling practices.
- Commission a study of Lion Surplus to look for opportunities to expand the business model and increase its impact on material reuse across the University. Michigan State's surplus program generates more than $2 million of net income annually, paying back the facility loan and subsidizing other recycling efforts.

Cost/Benefit

Chemical tissue digester	$800,000 to $3,500,000
Lion Surplus business study (MBA APEX students?)	$20,000
Sustainable Procurement Program Coordinator	(previously listed)

Commonwealth Campuses

- Determine the impact, if any, of changes in University Park waste management processes on Commonwealth Campuses
- Asses the feasibility and potential value of adapting recommendations from the overall task force to the Commonwealth Campuses
- Distribute the Education committee's plan and materials to the campuses, as they have similar behavioral challenges as at University Park
- In fall 2019, two pilot studies will be conducted on Green 2 Go containers at two Commonwealth Campuses, collaborating with classes to perform the research on barriers and program improvement.

- Provide educational and financial resources to allow flexibility for Commonwealth Campuses to implement waste-reduction initiatives that best fit their needs.
- Provide guidance and training opportunities to support the waste-reduction initiatives being pursued at the Commonwealth Campuses.
- Explore the feasibility of establishing a voluntary group purchasing organization to support procurement of waste-hauling services for multiple campuses.

Cost/Benefit

Funding for campus initiatives	$ to be determined

<u>Education and Awareness*</u>

- Hire Waste Reduction and Recycling Programs Manager (see Traditional Recycling)
- New branding campaign
- Motivate behavior change (via behavioral science grad student position)
- App development (either Mobile App OR Web App)

Cost/Benefit

New branding campaign	$25,000
Behavioral science grad student position (annual)	$75,000
Mobile app	$250,000 plus annual fees
Web app	$50,000

*The investment in Education and Awareness recommendations will only be beneficial if other recommendations regarding structural changes are implemented simultaneously and coordinated among all units. It is critical to note that no amount of communication will be effective at changing behavior if the infrastructure is not conducive to behavior change.

Metrics

The introduction to this Task Force Report summarizes much of the data currently available about the Penn State waste stream at University Park. Collecting this data required considerable effort, both by campus staff and external consultants, and represents a careful and comprehensive analysis in terms of material quantities, the effectiveness of current collection systems, and the purity and disposition (recycled versus landfilled) of the different streams. From a practical and cost basis, these are critical metrics. Waste stream program design and implementation needs to leverage this information in evaluating tradeoffs and making evidence-based decisions. Additional metrics are also needed to assure these decisions fully reflect institutional values, and are affordable, efficient, and effective.

One of the available metrics that is particularly important is contamination. Presently, Penn State University Park is paying fees for every contaminated bag, and in 2018 sixty-six tons of material collected as recyclables was redirected to landfill because of this issue. To put this in context, across all recyclable streams other than cardboard (OCC), the contamination rates measured in the audit ranged from 12 percent to 43 percent (Figure 2). The worst offenders were the plastics categories (plastic bottles and film/miscellaneous plastics) and compost, and the least contaminated bins were metal and paper. Furthermore, the audit of Housing buildings told an interesting story. Contamination rates were significantly lower than other buildings on campus, ranging from 10 to 20 percent, but recovery rates were very low. This correlation helps to shed light on considering potential infrastructure changes and behavior modification as discussed in the Traditional Recycling section recommendations. [1]

Another measure of success would be to increase the capture of acceptable recyclables, sending less as refuse to the landfill. There is the potential to increase overall recovery rates 10 to 28 percent by collecting more recyclable material from the refuse stream. According to the 2018 audit, one-third of the waste in the refuse stream cannot be recovered, largely due to contamination by food and beverages. However, roughly 60 to 70 percent of the refuse stream includes materials that can either be recycled or composted. The Task Force recommendations include several strategies to reduce these losses of recyclable and compostable material to the refuse stream, and if these are effective the total quantity of refuse should drop over time. However, to fully measure the success of these strategies will require additional audits. As is often said in the management consulting world, “you cannot manage what you do not measure.”

There are several other metrics that are not adequately measured at present, which will be important to understand for future waste stream decisions. Foremost among these is the lack of data at the Commonwealth Campuses comparable to the data available at University Park. Penn State’s campuses have a diversity of recycling and refuse contractual arrangements, either with local communities or the private sector. A top priority should be getting information about quantities, purity, and “leakage” of recyclables into the refuse stream. Only with that data can locally relevant strategies be developed.

[1]Fall 2018 Waste Audit Results; Draft Technical Memorandum. Kessler Consulting, Inc.

In addition to basic information about waste stream flows and contamination levels, there are many other metrics that reflect Penn State values as previously described but are either not available for our specific waste systems or are only available at a general level. These include greenhouse gas emissions, nutrient pollution, recovery efficiency, human and ecosystem toxicity, and resource scarcity. Quantifying these impacts is complex, but tools do exist from the field of industrial ecology and life cycle analysis. Prior research indicates that the outcomes of these metrics vary widely among recycling pathways, even for the same material, and for both recycling and refuse also vary widely based on transportation distance and local processing options. Because Penn State does not market its own recyclables, it is difficult to know what recycling pathways are most relevant for a life cycle analysis, and these will shift over time as regional and international recycling markets evolve and adjust. While documenting and evaluating these pathways will take considerable effort, such analysis should be part of the ongoing assessment of success.

This report represents an important milestone as Penn State advances its leadership in sustainable operations to steward our planet's resources. To fully realize and maintain that leadership will require dedicated operational staff and academic support. Data and analysis will be central to that process, and in that context, we envision four key roles needed to design, implement, and maintain improvements the solid waste system. Two of these roles would be full-time staff positions, one in procurement and one as a recycling coordinator. These staff would be supported by two graduate students, one focused on human behavior and one focused on life cycle analysis. The first three positions are discussed in other sections in this report, while this metrics section provides the primary justification of the life cycle analysis graduate student. Modeled after the extremely successful partnership between academic researchers and operations staff that for decades has documented the safety and improved operations of the Living Filter, this graduate student would be dedicated to analysis of both internal and external metrics. The goal would be to inform evidence-based decisions about future system enhancements and investments in our solid waste system, as the circular economy of materials continues to rapidly evolve.

Recommended goals and principles to impact Penn State's waste stream using metrics:
Short term

- Fund and hire a graduate student to focus on Life Cycle Analysis, supervised jointly by a faculty member with LCA expertise as well as Recycling and Procurement staff.
- Build a team that formalizes metrics and coordinates ongoing data collection and analysis
- Report semi-annually to the Sustainable Operations Council

Long term

- Integrate metrics into policy development and justification
- Provide data to support sustainability scorecards
- Reassess and revise metrics as necessary

Procurement

Procurement is perhaps the most critical link in a sustainable materials management system. Purchasing decisions impact not just the materials flow into the University, including the embedded environmental impacts from the resource extraction, manufacturing and transport of the products, the durability of those products and how frequently they need to be replaced, and the potential to repurpose, compost, or recycle products at the end of their useful life.

A central recommendation of the Procurement subcommittee is to **develop Penn State's first-ever sustainable purchasing policy** (see Appendix II: Proposed Sustainable Purchasing Policy). This policy will be the guiding foundation for how the University can promote sustainable stewardship by controlling the Penn State waste stream at the onset, when goods or services are purchased or brought into the University. Developing and implementing this policy is paramount, but only the beginning of a successful program. Annual reviews will be needed to assess compliance with the procurement policy, leverage evolving opportunities for waste diversion, and developing innovative measures and benchmarks for a procurement first approach, where some of the greatest achievements may be invisible: products never purchased in the first place. For all these reasons, sustainable purchasing must become an enduring function of the university.

The procurement analysis focused on several specific topics: documenting the in-flow of products and services to our campuses; increasing opportunities for reduction, reuse, recycle, and upcycle of inbound products; meeting the food service target of the "20 by 20" goal to purchase 20% of food locally by 2020, improving waste stream control and diversion, including the packaging of products; and developing a sustainable purchasing policy. All of these topics can contribute to sound policies and procedures for how products and services are brought in, used, maintained, and eventually leave the University.

Recommended goals and principles to impact Penn State's waste stream through procurement:
Short term

- Implement sustainable purchasing policy
- Develop measures of success
- Garner senior leadership and customer support
- Develop change management strategies
- Create, fund, and hire a Sustainable Procurement Program Coordinator (see description in Appendix IV: Proposed Sustainable Procurement Program Coordinator Position Draft)

Long term

- Policy enforcement
- Policy scorecards
- Policy reassessment and revision as necessary

In short, success will be measured by observation. Decreased waste, increased diversion of waste, cost mitigation, and waste reduction per capita, including students and employees, will individually and together indicate success for improving the sustainability of Penn State's waste stream.

Implementation

This is a University-wide task force; therefore, it is important that there are partners across Penn State who will support and implement these recommendations. To help implement we will need to enlist senior leaders, all Purchasing functions, and department/unit heads through coaching, mentoring, education, and change management. University-specific partners will include Purchasing leaders and staff, the Sustainability Institute, department/unit heads, students, faculty, all employees, the Smeal College of Business, the Office of Physical Plant, the Office of General Counsel, Environmental Health and Safety, and Housing and Food Services. Penn State's waste stream also affects the wider community, so partnering with goods and services suppliers, state and municipal agency partners, and logistics suppliers will be critical for success as well. Coordinating across all these internal and external organizations, staying abreast of best practices, developing, updating and implementing procurement policies, all these activities will require a new full time Purchasing position: Sustainable Procurement Program Coordinator.

Purchasing will also need resources such as the Sustainable Operations Council, training and education, change management, and software/tracking solutions. The subcommittee estimates six to twelve months would be needed for policy implementation, with an additional twelve months for success measurements.

Returns and Impacts

Quantifiable returns and impacts are to be determined. These strategies should be reexamined semi-annually.

Traditional Recycling Streams

This section of the Task Force report is focused on those materials collected through Penn State's central sorting stations in the buildings across campus, where faculty, staff, and students place their waste and recyclable materials. Housing, food courts, and athletic venues are covered in other sections. The 2018 Office of Physical Plant Waste Year-End Summary Report indicated that although Penn State was successful in diverting more than 56% of our waste from the landfill, there are many areas for improvement. OPP created this summary report by gathering information from the Centre County Recycling and Refuse Authority (CCRRA), Organic Material Processing and Education Center (OMPEC), and Lion Surplus to offer the big picture of the University's total waste and diversion rate. Perhaps the two most important challenges today are first, to reduce overall waste through purchasing decisions and education; and second, to reduce the number of misplaced items (contamination) with sorting infrastructure changes and effective education.

When most people in the Penn State community think about recycling, they think about our multi-bin sorting stations for paper, metal, glass, plastic, and compost. Because this is the face of the Penn State recycling program it is vitally important that it is done well. Separating these many streams of "traditional" recyclables at the source has helped us achieve high diversion rates and, until recently, contamination rates were well within specification for both the CCRRA (which handles and markets recyclables at University Park) and for our own composting operations. However, contamination levels have exceeded allowable rates recently, leading to high rejection rates. Additionally, increased levels of paper and plastic film in our composting system through post-consumer organics collection become windblown litter at the University Park composting site, complicating the composting process and increasing costs.

There is a growing recognition that these systems are no longer enough. It will be important to design a system that can achieve high diversion and low contamination rates while simple and convenient for users. With continuous turnover of students, staff, and visitors, and nearly every member of the Penn State community interacting with the sorting stations daily, traditional recycling is both a tremendous and important educational challenge and opportunity.

A multi-faceted approach is needed to meet these near-term and long-term challenges. In the near term, the recycling sorting station infrastructure must be reconfigured to meet the specifications of current markets with flexibility for the future. Also in the near term, and prior to significant changes, an education and awareness plan is needed to help the community understand what and how to sort. There are several long-term recommendations in this report that could significantly impact these recycling streams, reduce waste, and impact the design of the recycling program even further.

Recommended goals and principles to impact Penn State's traditional recycling waste streams:

Short term

- *Decrease waste and increase diversion from the landfill* – The first principle in any waste management system should be to reduce total waste and increase diversion. This principle is frequently overlooked because ways to reduce waste often involve

fundamental changes to how people live and work. There should be an increased emphasis on waste reduction education and awareness as well as procurement practices that promote the same.

- *Simplify and future-proof the post-consumer collection system* – Most contamination issues and misplaced materials were found in the plastics categories. In academic buildings the 2018 Kessler waste audit observed contamination rates of up to 50% in the miscellaneous plastics category; most of this contamination was misplaced plastic bottles and recyclable plastic film that belonged in a neighboring bin. Simplifying the post-consumer collection system to promote effective behavior change is necessary to reduce contamination and increase participation.
- *Maximize participation and recycle stream quality* – This should be an overarching principle for changes to the recycling sorting and collection system. Recommended actions that follow are in large part structured to achieve this.
- *Assure efficient investment* – Recommendations should consider economics as a primary criterion.

Long term

- Educate the Penn State community about the importance of thoughtful consuming. Constant education reinforcing the principle of thoughtful consuming will ensure ongoing success.
- Increasing diversion from the landfill
- Reducing contamination and fees
- Enhancing Penn State's reputation as a leader in sustainability
- Reducing greenhouse gas emissions from reduced trips to the landfill

Implementation

All aspects of this plan for traditional recycling streams necessitates a collaborative effort among the waste management staff and communicators, and the incorporation of behavioral psychology theories in designing programs, campaigns, and messaging. Access to student and staff orientations must be granted by Residence Life and Human Resources, respectively. Recycling training is already part of Finance & Business new staff orientation.

To implement these recommendations, funding will be needed to create and fill a Waste Reduction and Recycling Program Manager position (see description in Appendix V: Proposed Waste Reduction and Recycling Program Manager Position Draft). This person will implement waste reduction strategies. improve the recycling collection infrastructure, and work to develop a branding and educational campaign. This new position will work closely with other waste stakeholders across campus including the Sustainability Institute, Housing and Food Services, the HUB-Robeson Center, Athletics, the Libraries, eateries, and more.

Action plan with target dates

Phase 1: Short Term measures

1. **Sorting and Bin Changes**
    a. Reduce the number of bins in the central sorting stations from seven to six. There are presently 15,500 bins on the University Park campus.

i. Eliminate miscellaneous plastics collection and remove or convert the miscellaneous plastic bins to plastic bottles, jugs, and jars.
    1. Due to market limitations, CCRRA does not accept miscellaneous plastics and presently, the University is paying fines for contamination in the form of recycled miscellaneous plastics taken to them.[2]
    2. Based on the results of the 2018 waste audit, this option would decrease Penn State's recovery rate slightly, but has the potential to reduce contamination.
    3. Eliminate the collection of miscellaneous plastics as soon as signs can be replaced, recycling stations can be modified, and an educational awareness campaign can be conducted.

ii. These recommendations should be in place by fall semester 2019.

b. Eliminate the collection of stretchy plastic in the plastic bottles recycling stream.
    i. Plastic film (plastic bags) is recyclable only as a clean, homogenous stream and not mixed with other plastics as is currently collected on campus.
    ii. According to the 2018 waste audit, "film" collection is a small part of the waste stream. There is not enough plastic film disposed at the central recycling stations to justify separate collection. The University community will be encouraged to take bags to area grocery stores for recycling.
    iii. Continue to collect plastic film generated at places where a large amount of consistent and clean material is produced, such as dining halls, central receiving, and, in certain cases, scientific labs.
    iv. These recommendations should be in place as soon as the signage can be altered.

c. Make six-bin sorting stations that are not built into the infrastructure the new standard, allowing for greater flexibility in the future. Signage should be fixed to the bin, rather than the wall. Other station design recommendations include:
    i. Wherever possible, use consistent station design in terms of dimensions, color scheme, signage placement, etc.
    ii. Provide a few choices of collection bin styles that will match the aesthetic of the building or location.
    iii. Use a consistent ordering of material categories (i.e., how they are arranged from left to right).
    iv. Bin openings should not be individualized for different material. This limits flexibility if the items able to be recycled changes in the future.
    v. Color code containers and sections of the recovery station as visual cues to the types of materials (e.g., blue for recyclables, green for compost, and gray for refuse).
    vi. Wherever possible, provide complete six-bin collection stations so that the person recycling can make the right choice when disposing material.

[2] In one month, we sent 276 tons of dock materials to CCRRA, and they rejected 80 tons, costing the University $9,200 in contamination fees in addition to $14,000 charged for disposal.

vii. Changing the design standard to eliminate built-in infrastructure should be in place for the start of fall semester 2019.

d. Consider reducing the number of outdoor garbage cans or place them more strategically. A pilot should be conducted in the 2019-2020 academic year testing how to encourage people to dispose their waste inside of a building.
    i. Outdoor garbage cans will remain at strategic public gathering places, such as plazas, public transportation stops, and outdoor eating areas.

2. Waste Reduction Strategies

Waste reduction is the first principle in the mantra Reduce, Reuse, Recycle. It is recognized as the most effective way to divert waste from the landfill. Penn State should increase its focus on waste reduction strategies.

a. Encourage reusable mugs and beverage cups. Reducing single-serve cups will not only reduce waste but will also reduce contamination, as the 2018 waste audit found that single-serve beverage cups were a significant source of contamination in both the paper recycling and compost streams.[3]
    i. All beverages served at Penn State retail dining facilities should be discounted with any reusable cup.
    ii. It is necessary to more effectively communicate this discount on a regular basis so that more people are aware and will participate.

b. Green 2 Go (GTG) containers
    i. At the University Park campus, student interns, the SI and H&FS staff, and a College of Communications class will be studying ways to improve the program in the 2019-2020 academic year. Educating cashier staff is seen as a key step toward improvements, as well as relocation of GTG collection stations.
    ii. Explore the possibility of enabling faculty and staff use of GTG containers at University Park eateries.
    iii. Outside of University Park campus, G2G will attempt to build pilot programs addressing challenges seen at University Park. These programs will be tailored to each sponsored Commonwealth Campus and evidence of improvement or lack thereof, will be reported back to G2G student interns.

c. Explore replacing paper towels with rags that could be laundered to wipe down fitness equipment at Rec Hall and the IM Building. Campus Recreation already offers reusable towels for personal use at the IM Building. Explore whether this could be expanded to other recreational facilities and consider whether microfiber towels could be used.
    i. A large portion of the waste from recreation facilities is paper towels. A pilot should be conducted in the 2019-2020 academic year testing the use

[3] Presently, Penn State provides a $.25 discount for all reusable cup use across all the Housing and Food Service locations. Au Bon Pain provides a refill price of $1.39 for now. Panda Express does not have a discount price, except free refills, while Saxby's offers a 10% reuse cup discount and the Bookstore café also discounts $.25 on refills. These discounts are provided on any beverage. The Berkey Creamery sells a travel mug that can be used to earn a $.25 discount on coffee.

of reusable towels to wipe down equipment, along with the best ways to maintain and launder them.

d. Reduce plastic bags on campus. Expand and better promote existing programs on campus.
    i. The Eco Coin program, now in use at Barnes and Noble at University Park is expanding to the Barnes and Noble locations at the Commonwealth Campuses. Nineteen campuses have signed up thus far, and this expansion will be rolled out in the 2019-2020 academic year.
    ii. Sell reusable bags at these locations to promote the Eco Coin program.
    iii. Explore Retail Dining working with eateries to reduce plastic bags.
    iv. For fall 2019, Housing is including information to new students about bringing their own bag to school.
e. All recommendations should be improved, piloted, or implemented during the 2019-2020 academic calendar.

3. Compost

The University Park community diverted nearly 11,000 tons from the landfill in 2018. Food and landscape waste comprised about 4,800 tons (41%) and was processed at the Organic Material Processing and Education Center (OMPEC) producing compost and mulch to be used on campus for landscape purposes, in research, and sold to the community.

Of the over 1,500 tons of food waste collected 1,275 tons (85%) were pre-consumer waste collected from dining and food service areas around campus. This food waste collection program has been in place since 1999, it is a good feedstock for making high-quality compost as it is relatively free of contamination. The remaining 225 tons (15%) was from post-consumer, office composting. This collection began in 2015 and is in most campus buildings. This stream is highly contaminated with non-compostable items, which then become litter or are screened out during the composting process. This contamination is 90% of litter generated at OMPEC, and subsequently, roughly 50-60% of this litter is taken to the CCRRA transfer station as trash. The remaining pieces make their way into the finished compost resulting in an inferior product.

The 2018 waste audit indicates that organic material has one of the highest potentials in the waste stream for increased capture. This potential cannot be realized given our current capabilities at OMPEC.

Very few schools are able to divert their food waste, and this is an area in which Penn State has been leading the way. Most foodservice operations on campus currently appear to do a very good job of diverting pre-consumer food waste to OMPEC, and the systems in place for composting this material are very cost effective. Continuous education of new employees is essential, but beyond that there may not be much improvement Penn State can make in this area, and thus the potential for further returns may be minimal.

For post-consumer composting, the potential is great based on the tonnages that are not recovered and the high levels of contamination that could be reduced, but quantifiable returns are unknown at this time as potential solutions need more extensive study. There are very few places around the country that are succeeding with post-consumer composting due to the high percentage of contamination. Substantial investments in organics management are needed to effectively process greater volumes

and reducing contamination. These include procuring more biodegradable food service items and better communications to educate and inform students, employees, and visitors in dining areas, which can result in more participation and less contamination. Investments are also needed to address residual contamination and improve processing, and options like depackaging equipment, anaerobic digestion, and increased compost screening should all be considered. A renovated system is likely to have a cost of collection and processing that is higher than landfilling but similar to traditional recycling. This is an area where integration with procurement and partnerships with Dining, Housing, and Vendors is needed.

a. Maintain collection of compost at central sorting stations until the entire composting program is reviewed.
    i. Office composting is viewed by the University community as an integral part of the recycling program. Unfortunately, office compost is problematic in its current state as it is expensive to collect yet contributes little value to the compost stream and overall diversion from the landfill.[4] However, since there is great potential to increase diversion by capturing more organics for composting or anerobic digestion, we should maintain the office composting program until a final course of action is determined.
b. Instruct Custodial and housekeeping employees to handle clean pizza boxes as OCC and soiled pizza boxes as refuse.
    i. Pizza boxes do not break down and are screened/raked out as litter.
c. Create a dedicated team to investigate and evaluate options, partnering with food service item vendors and firms experienced with post-consumer food waste composting and anaerobic digestion to design, pilot, and implement an integrated and effective system.

4. Reduced Contamination

Reducing contamination is a function of the collection system and education and awareness. Suggestions for designing the collection system have been made earlier in this section. Recommendations for educating the University community can be found in the Education and Awareness section of the report.

a. Redesign the recycling program brand (Mobius) and develop a broad-scale public awareness program to launch concurrently with changes in material categories and redesigned recovery stations.
    i. Specifically focus on redesigning signage and program literature to clearly define material categories in simple terms and high-impact images. Although many programs have relied primarily on pictures as examples of materials, it is also critical to develop simple, widely understood catch phrases that describe acceptable and unacceptable materials.
b. Conduct periodic mini-audits of each unit's recycling effectiveness to provide feedback to the units on how they are doing and where they can improve. Curbside recycling participants in Centre County receive this type of feedback immediately as the CCRRA will not collect unacceptable material, leaving

[4] Custodial and solid waste management expends approximately $200,000 annually on labor and material (compostable bags) to collect compost and remove litter.

noncompliant materials in curbside bins so that participants learn that item is not recyclable. This has proven to be one of the most effective education efforts for CCRRA.

c. These recommendations should be studied in the 2019-2020 academic year and implemented for fall semester 2020.

5. **Review Penn State Policy AD34**
    a. The policy should be reviewed and updated to reflect implemented recommendations of this report.

Phase 2: Long Term measures

1. Explore other methods of reducing the number of bins in our centralized sorting stations, including enhancing our relationship with CCRRA by investing in their collection and sorting capabilities; investigating sending recyclables to recycling centers other than CCRRA; further combining recyclables into fewer streams; or having our own Materials Recovery Facility (MRF). All these measures could enhance participation and reduce contamination by simplifying the sorting and collection process.
    a. One long-term measure to improving waste management at Penn State might be an onsite Material Recovery Facility used to collect, sort, and market waste streams to end-user manufacturers. Based on a model designed and implemented at Michigan State University, a similarly sized Big Ten institution, an on campus MRF could lead to cost reductions and better management of materials over the long term. Moreover, it allows for an integration of educational programs and projects such as campus living lab opportunities that directly align with Penn State's mission, vision, and institutional values. (Case Study: Materials Recovery Facility at Penn State)
2. Replace all existing bins (not built-ins) throughout campus to achieve consistency of the collection system and signage. New bins should have integrated signage that is easily changed for future flexibility. This will provide consistency across campus, which should result in increased participation and reduced contamination.
    a. Currently there are inconsistencies in material capture found across campus, as many facilities seem to "do their own thing," using unsanctioned bins and incorrect signage, causing confusion for students, staff, faculty, and visitors. Replacing existing bins and signage should alleviate this issue.
    b. Implement a standardized bin program for all campus facilities. The standardized bin system would provide three bin style choices in order to address appropriate aesthetics for each facility.
        i. **Standard bins** – Rubbermaid Slim Jim® or equivalent with lid and affixed signage.
        ii. **Mid-Level** – To be determined later after vendor bin evaluation and potential RFP to obtain pricing. These bins would replace metal cubes which have been eliminated due to safety issues and deterioration of appearance over time.
        iii. **High-End** – To be determined later after vendor bin evaluation and potential RFP to obtain pricing. These bins would replace "built-in" stations and credenzas to ensure flexibility when streams change.

c. Implement a standardized signage program for all bins and stations. The new program would require all signage to be affixed to bins, enhancing flexibility when streams change, and reducing costs when signage changes become necessary. All facilities will use standardized signage for each commodity.

Examples of standardized Bin and Signage programs are provided below.

Sample Standardized Bin and Signage Program with Accompanying Costs

Standard (Slim Jim®)

Assume 9,000 bins currently in field		
Cost for Top	$29.25/ea	$263,250
Cost for Signage	$26.00/ea	$234,000
Total Cost to add lids and signage		**$497,250**
*$45/Slim Jim® for new or replacement		

Mid-Level

Busch Systems Evolve ™

Assume 2,250 currently in field	
$300/bin	
$1,800/station	
Total Cost to replace Mid-Level bins	**$675,000**

High End

Clean River Transition ® TWZ

Cost per station (6 commodities)	**$4,000/station** $667/commodity

*Approximate cost per station for future projects
**No more built-in stations or credenzas for major renovation or new construction
***Requesting designated/recessed recycling areas in design standards

3. At this time there are several potential solutions that could be implemented to increase organics collection on campus that need further study.
   a. Consider sending all pre-consumer food waste to an anerobic digester, either on campus or elsewhere.
      i. This would be a very good fuel source for the digester but would need to be 90% free of contamination.

        ii. Consider contracting with an outside company, such as Reinford Farms in Mifflintown, which has depackaging equipment and experience managing food waste in an anaerobic digester.
        iii. If contamination can be reduced and managed, investigate the use of Penn State's new farm anaerobic digestor for food waste. See Case Study: Anaerobic Digestion at Penn State.
    b. Invest in the Organic Materials Processing and Education Center (OMPEC) so that it can accept a larger volume and variety of compostable materials and appropriately break them down into usable product. Changes to OMPEC would increase our composting capabilities, justifying keeping composting as part of the traditional recycling stream collection at centralized stations.
        i. Currently OMPEC uses aerated or turned windrow composting but this does not work well for compostable food-service ware items.
        ii. Other methods to consider including:
            1. Aerated static pile composting
            2. In-vessel composting
    c. Study the feasibility of all food retailers that serve campus to use only BPI-certified bioproduct and food containers.
        i. Establish standards for compostable packaging for all food services campus-wide. Some concessionaires may challenge such standards due to the increased cost of compostable service ware and the challenge of finding compostable packaging options for the wide range of brands, vendors, and food categories available on campus. Food Service has calculated that fully converting to compostable food-service ware would cost an additional one million dollars annually.
        ii. Benchmark with other schools and the U.S. Composting Council.
        iii. Ensure that organics are only collected in compostable bags. Several instances were observed where compost was placed in non-compostable bags, for example if a bag ripped, the bag and contents were placed in a standard plastic bag. Film plastic is particularly problematic for compost facilities. Custodial staff should be trained to never place compost in a non-compostable plastic bag.
4. Explore resuming custodial services in offices to improve the collection of recyclable materials and reduce contamination.
    a. The thinking behind this recommendation is that custodial employees would provide quality control by collecting recyclables from offices and sorting according to the current requirements. This would assure recycling was done correctly and reduce the education and commitment required of faculty and staff.
    b. Faculty and staff would see a corollary benefit of less time spent on recycling. However, this would require additional custodial staff to perform the collection and sorting tasks in offices.
    c. A high-level cost analysis of resuming custodial services in offices will consider the following:
        i. First-cost investment in new office deskside receptacles (waste, recycling, and compost) and utility carts used for collection from offices.

ii. Additional annual recurring labor cost associated with increased service to offices, as well as estimated increase in additional employees.
iii. Cost offsets associated with exploration of removing a percentage of centralized recycling stations.

d. Detailed cost analysis below in Tables 1, 2, and 3:

Table 1 – First Cost for carts and bins	
First cost of utility carts	$260,000
First cost of waste basket	$63,000
First cost of recycling bin	$53,000
First cost of compost bin	$88,300
Total First Cost Investment for Office	$464,300

Table 2 – Increased Custodial Office Service Annual Labor Cost Increase			
Total increased hours per week	**Total Hours per year**	**Annual Increased Cost**	**Added FTE**
393	19650	$506,970	10

*For reference, there are 10,513 offices at UP

Table 3 – Cost Offsets Associated with Central Station Reduction			
Percentage of Stations Removed	**Cost Offset**	**Net Annual Cost Increase after considering Central Station Reduction**	**Net Required FTE after considering Central Station Reduction**
50%	$362,813	$144,157	4
40%	$290,250	$216,720	6
30%	$217,688	$289,282	8

Returns and Impacts

The changes recommended to traditional recycling have the potential increase to diversion from the landfill and reduce contamination and associated fees, while reducing greenhouse gas emissions and enhancing Penn State's reputation as a leader in sustainability.

Case Study: Materials Recovery Facility at Penn State

A Materials Recovery Facility (MRF) is a system designed to help manage waste generated by an institution or community. Its primary duty is to accept incoming waste (usually, source separated into acceptable streams such as plastics, metal, paper) and prepare those streams for marketing to end-user manufacturers. There are two main types of MRFs: *clean* and *dirty*. Clean MRFs accept source-separated streams and prepare for markets; whereas dirty MRFs accepts a solid waste stream and then process and separate streams onsite for end-user manufacturers.

Currently, Penn State sends their separated waste streams to the Centre County Recycling and Refuse Authority (CCRRA) to be processed at their *clean* MRF. Thus, the CCRRA has direct control over materials and can select the streams to process on their site based on market value. The University needs to comply with the regulations (contamination rates, streams accepted, etc.) set by the County which can lead to increased costs for disposal if standards are not met. Based on this knowledge, Penn State has charged the Waste Stream Task Force to identify how a MRF would function at the university and research best practices of other institutions similar in size and location.

For solid waste management the standout university within the Big Ten is Michigan State University. Based on size, location, and limited-access markets, they can serve as a model for Penn State. They are also eager to share detailed information and advice. Information provided by Michigan State staff for their project is provided below:

Site	Square Feet	Description
Total Facility	74,000	This includes: the MRF, Surplus Store, and office space
Material Recovery Facility	18,000	

Equipment	Amount	Description
Bobcat	2	Used to move and manage waste on the tipping floor
Bailer	1	Usted to compact waste and maximize space
Sortline	1	Conveyor belt that uses human labor to manually sort waste into proper streams

Labor Force	# Employees	Notes
Bobcat Operator	1	Full time employee certified in operating heavy machinery
Bailer Operator	1	Full time employee certified in operating heavy machinery
Student Sorter	10	Paid students on the sortline that manage the waste streams

Waste Stream	Flow Rate (tons/year)	Notes
Total	5,000	The waste streams collected at the Recovery Facility are: Office Paper, Mixed Paper, Newspaper, Books, Plastic 1-7, Metal, Cardboard, and Glass (all colors)

To finance this project, Michigan State gained funding by an internal university loan with an expected payback period of 20 years. Currently, the facility has been operating for 10 years and has been making full payments towards the loan, including all their costs for operating and maintenance. Once their payback period is complete, and the loan paid off, this facility will have full control over its revenues and budget, leading to more projects, programs, and initiatives in the future.

The success of this facility is multi-faceted. Not only has MSU gained control of their waste stream, they've built upon their successful Surplus Store, and have integrated student involvement such as internships, employment, and campus-as-a-lab projects. The MSU template directly aligns with Penn State's University Mission, Vision, and Institutional Values. By designing and implementing an on-campus MRF at Penn State, the university will have direct control over their own waste streams. More importantly, they will increase opportunities for education and student engagement while simultaneously signaling to the nation that Penn State cares about sustainability and preservation of planetary resources.

Based on these findings, the Waste Stream Task Force recommends that a feasibility study of an onsite MRF for Penn State be conducted.

Housing

The Housing subcommittee suggests a comprehensive on-going campaign from the student's point of decision to attend Penn State through the entirety of their on-campus residency. The campaign would help to engage the resident with the culture and practice of the University's solid waste management systems, in part by partnering with Residence Life, Admissions, and other groups to build pre-arrival awareness. Once the student arrives on campus, the EcoReps -- a peer-to-peer education group -- could deliver programming.

The specific focus areas of the subcommittee included educating those in all of the on-campus residences about the solid waste reduction plan and building a culture around the new collection system; reducing the volume/tonnage of solid waste during move-in and move-out periods; and developing and installing a comprehensive composting system in all on-campus residences. This last topic assumes comprehensive composting will be an integral part of the new collection system, as previously discussed in this report. These focus areas were identified due to the less than ideal collection/diversion numbers for recycling and composting in the residence halls, even after significant efforts to educate first-year students once they have arrived on campus.

Recommended goals and principles to impact Penn State's housing waste stream:
Short term

- Revised procurement standard operating procedure, which reduces onboarding of waste
- Immediate adoption of the University's redesign and roll-out of collection/separation areas
- Develop a timeline/tactical plan for implementation of support activities;
    - Change signage to equal the overall redesign product.
    - Add color coding and lids to existing collection areas.
    - Upgrade certain collection areas' infrastructure.
    - Investigate the collection of "food waste" vs. "compost," using language as an alternative strategy to reduce contamination.

Long term

- Reduced contamination of collection streams
- Increased landfill diversion rates
- Increased adherence to desired culture surrounding waste management across the enterprise
- Re-introduction of compost collection.
- Identify/implement additional avenues to reduce move-out waste (complimentary to Trash to Treasures).

Success for these goals will be measured by periodic collection/diversion measurements of recycling in the residence halls, as well as surveying residence hall students regarding knowledge and practice of sustainable behaviors.

Implementation

Achieving these goals will require internal Penn State partners, including subject matter experts and educators; the Office of the President, with strong messaging development and support; the Sustainability Institute; and Shaver's Creek Environmental Center. Groups to partner with externally include subject matter and industry consultants and educators; the Centre County Recycling and Refuse Authority; and appropriate outside vendors.

Resources needed for implementation include a comprehensive University-wide, perpetual marketing campaign; administrative support; and finances.

The subcommittee's target date for expansion of current initiatives is August 2020.

Returns and Impacts

The initial cost to implement this campaign would include funding to replace/modify current collection sites as well as funding for print materials and signage design. To sustain this plan long-term will require $150,000 annually to fund the residence hall-wide EcoReps program. Financial benefits will include opportunities for energy reduction and behavior modification, as well as negligible return on investment for recycling, given the current global markets.

Other benefits to be expected include a highly conscientious student body/citizens caring for the environment as a lifestyle choice; student leadership development enhancing the Penn State brand; peer education in the residence halls and dining commons, student leadership development; synchronizing classroom education with living/learning experiences; and positively impacting communities external to the University. Also, the University will be able to avoid future liabilities for toxicity and end-of-life disposal.

Operationally there will be a positive impact on the morale of the Housing team, who care about doing the right thing for the environment; enhanced cleanliness in the residence halls physically surrounding the refuse/recycling centers; cost-saving opportunities in energy reduction; and a lower carbon footprint of daily operations.

Possible research opportunities include studying behaviors and behavior modification theories in the residence halls around the campaign.

These strategies should be reevaluated annually.

Benefits of the above expenditures are difficult to monetize. There will be a cost benefit for increased diversion vs. tipping fees. However, the costs are substantial and it is not anticipated that the program will be net-neutral. The real benefit will be to affirm the University's commitment to recycling and waste reduction with each first-year class. Perpetual training/education will simultaneously be an ongoing benefit and a cost as indicated above.

The EcoRep group will also provide the opportunity to engage students in a sharable, research-oriented direction. The hands-on peer focused learning opportunities within the residence hall system are both vast and diverse.

Food & Beverage/Special Events/ Hotel/Dining/Sports Venues

Penn State's University Park campus sees in excess of a million visits per year from persons attending sporting events, concerts, etc. This represents an excellent opportunity to engage and educate about sustainability, but it also presents significant challenges for materials management. We suggest the University continue with its current best practices while addressing the many challenges associated with the extremely diverse set of venues and events that occur annually at University Park. Back-of-the-house collection of food items should be mandated for all on-campus operations while also investigating options for increased post-consumer collection of food and food service items. Collection of recyclables must be streamlined to make it easier for fans/customers while also conforming to the realities of collection systems. Persons with purchasing authority must have and follow guidelines for procuring items that will break down in whatever system the University is using for biomass management.

This subcommittee focused on the main waste streams from athletic events and other special events taking place on the University Park campus and at Penn State lodging properties and on-campus eateries. The subcommittee identified opportunities, barriers, and constraints, as well as possible solutions for reducing waste and costs while achieving environmentally preferable outcomes. The current systems for materials management, as well as items being purchased, sold, and consumed at these locations were also examined.

Recommended goals and principles to impact Penn State's food & beverage, special events, hotel, dining, and athletics waste streams:
Short term

- Collect all back-of-the-house food items for composting
    - This is already happening with food prepared by Hospitality and many campus food service locations.
    - This should be mandated as part of a new policy and would apply to any location at which food is being prepared.
- Remove all miscellaneous plastic waste stream collection bins from venues
- Streamline collection of recyclable items and remove/change all non-conforming or confusing collection systems.
    - There are many different "systems" currently in place across campus. Some units appear to make their own policies or are not aware of Penn State waste management best practices (e.g., Student Affairs uses blue Slim Jim trashcans that are imprinted with recycling logos in the IM Building to collect trash. In some locations there are signs asking users to "recycle here" even though the materials collected are not recyclable. Pegula Arena still has signs in restrooms asking patrons to recycle their paper towels).
    - Collection of waste and recycling varies from venue to venue. These variations need to be identified and then individual collection plans created for each venue.

    - The Education and Awareness subcommittee should endeavor to make the system more consistent and usable.
- Create/revise system for staff to collect recyclable containers (e.g., plastic bottles) after all sports and special events.
    - Practices are currently in place at most events held at the Bryce Jordan Center and Pegula Ice Arena in which ushers sweep the stands after fans leave.
- Ensure that anyone purchasing "compostable" items knows what items will work in Penn State's system (e.g., BPI certified) and no non-approved items are purchased.

Long term

- Increase purchase of compostable foodservice items for use at on-campus events, if OMPEC has capacity to take increased volumes.
- Require that all catered events on campus be zero waste. This would require using compostable or recyclable foodservice items, as well as having a collection system in place.
- Develop and use a common system for materials collection at the various venues on campus. This could include stand-alone entities, such as the BJC with the caveat that different venues may have different solutions for their environment.
- Develop and use a common system for signage/communication at venues
- Any future renovations to Beaver Stadium and other Intercollegiate Athletics venues should include sustainability improvements
- Consistent principles should be developed and applied to the purchase of food and foodservice items sold at Athletics and special events
- Rewrite contracts with branded retail dining establishments so that their operations are more aligned with Penn State sustainability goals
- Consider options for all special events, such as Special Olympics or THON, to reduce waste footprint. This could range from mandates for compostable foodservice items to the Office of Physical Plant (OPP) providing materials collections systems at any event.
- Work with Athletics Concessions to ensure future purchases dovetail with overall waste management goals.

Success will be measured by improved diversion rates and increased purchase of compostable items.

Implementation

A combination of the Office of Physical Plant, Athletics, Hospitality Services, and other Auxiliary and Business Services (A&BS) units would be necessary for implementation of these recommendations. Management at these units will have to be on board and willing to make investments in time and manpower as needed. Ultimately, leadership in A&BS will have to mandate that many actions take place and investments are made.

Specific Penn State partners needed to implement these recommendations are the Office of Physical Plant, Athletics, Hospitality Services, Housing and Food Services, and venue management. Externally, the Green Sports Alliance, industry partners (such as PepsiCo), and Centre County Recycling and Refuse Authority could be collaborators.

Implementation costs have not been quantified, and some are discussed in more detail elsewhere. Regardless, investments will be needed for 1) compost management to deal with greater volume and address contamination, and 2) improved infrastructure for materials management, and better communications to educate and inform students, employees, and visitors. A significant amount of funds would need to be allocated for OMPEC and then, presumably, for increased cost of the purchase of compostable items. The Sustainability Institute or the Office of Physical Plant should have a person charged as the waste reduction and recycling programs manager with oversight of these areas.

Short-terms goals could be completed as soon as Fall 2019, while long-term goals are most likely a 12- to 24-month process.

Returns and Impacts

Operationally, quantifiable returns are unknown currently. However, it is reasonable to assume that there will be small reductions in waste fees for all campus foodservice providers if they can send additional waste to OMPEC instead of to the landfill. It is unknown whether the true cost of one ton of material processed via OMPEC is less expensive than sending one ton to the landfill. Because most foodservice operations currently appear to do a very good job of diverting pre-consumer food waste to OMPEC, there may not be much improvement Penn State can make in this area, and thus the returns may be minimal.

Academically, there are many possible angles for resident education to work with the Office of Physical Plant, Athletics, and others to gain experience working on the "Living Lab" that Penn State operations provides. The University has a strong relationship with PepsiCo and other corporate partners that should be leveraged and should continue working to grow partnerships with external groups such as the NFL. The Department of Recreation, Park, and Tourism Management is an example of an academic unit that could provide coursework for students who want to learn from this process.

The complexity and breadth of the Penn State University Park campus operations provide a plethora of options for research. Both undergraduate and graduate students could gain valuable experience while also assisting the University. The Sustainable Operations Council could work with the Sustainability Institute to allow the academic and operational sides of the house to work together. This could be the conduit for both research and educational collaborations.

Depending on the investments made in infrastructure, communications, etc., reevaluating these strategies on a bi-annual basis would be recommended.

Specialty Waste Streams

The specialty waste streams targeted in this section range from hazardous chemical and biomedical wastes to construction debris and farm wastes. Because of the inherent risk chemical, biological, and radiological waste pose, they are the most heavily regulated waste streams, have the highest hazard to personnel, and pose the greatest environmental liability. Some of these specialty waste streams are relatively small quantities but highly hazardous, while the large volume materials may also have contamination concerns such as asbestos (construction debris) or pesticides (farm wastes). The unique nature of each specialty waste stream and specific regulatory requirements do not allow for common solutions among this diverse group of materials. The chemical, biological (regulated medical waste), and radiological wastes are all directly tied to Penn State research activities and increase in both quantities and management complexity as the research portfolio of the University continues to grow. Recovery of other materials, such as Lion Surplus can represent a significant financial opportunity. Thus it is imperative that the University continue to carefully and responsibly manage these waste streams.

This subcommittee focused on six specialty waste streams: hazardous building materials; construction debris; chemical, biological, and radioactive waste; "universal waste," including batteries, oil, and fluorescent lights; waste from Lion Surplus; and farm organic waste. A set of goals and principles were developed along with a series of recommendations as indicated below.

Recommended goals and principles to impact Penn State's specialty waste streams:
Short term

- Minimize purchased quantities and maximize recycling and reuse without compromising regulatory compliance.

Long term

- Ensure a sustainable and cost effective best management practices, as well as all necessary equipment, facilities, and trained staff are in place to ensure future quantities of each unique waste stream are managed safely and efficiently.

Goals for each specialty waste stream

- **Hazardous building materials:** Write purchasing specification that explicitly bans purchasing of building materials that contain asbestos, lead, polychlorinated biphenyl (PCB), or heavy metal with an exemption for research applications. These materials are known to create serious liabilities both during use and at end-of-life, and safer substitutes are available.
- **Construction debris:** Establish bidding and selection criteria for contractors that awards points for building materials recycled from demolition work. Modify the Design & Construction Standards 31 30 00 Structural Backfill and Compaction and 33 00 00 Utilities such that used clean concrete and brick could be considered a backfill material. For abatement and demolition projects contractors are given specific scopes of work that detail how materials are to be disposed and/or recycled, but compliance has often been questionable and there has been limited enforcement. Review the Office of Physical Plant

Design C&D waste management plan implementation and develop a process to enforce compliance with the plan and improve data collection on C&D recycling for all projects, especially those over $1,000,000.

- **Chemical, biological, and radioactive waste:** Most of our systems for these wastes are well organized and compliance is good. However, the University's incinerator for biological tissues and animal mortalities is aging and near end-of-life, so that downtime could become a serious liability. Over the last several decades the best available technology for this waste stream has shifted from combustion to chemical tissue digestion. Therefore, the primary goal in this area is to design, construct, and operationalize a chemical tissue digester to replace the University's aging incinerator. This investment will address both regulated medical waste (bio-waste) and large animal carcass disposal concerns. Several specific equipment options are described on a following page.
- **Universal waste:** Establish a new design standard that eliminates new installation of fluorescent lights and replaces existing ones as renovations are completed. This will have a positive impact on both energy and environment.
- **Lion Surplus:** Create a purchasing disincentive or ban on office furnishings made from particle board, which are not durable, not recyclable, and create serious end-of-life challenges. Expand and simplify the surplus operation to encourage and enhance reuse on campus as well as broader off-campus sales.
- **Farm Organic Waste:** Identify/quantify greenhouse, farm, and other agricultural wastes that are generated on or off campus, to determine which could be captured to augment current organic recycling practices:
    - Identify specific organic wastes that are significant enough in quantity to warrant separation from other farm waste streams and targeting for reuse, recycling, composting, or some other innovation.
    - Assure that recycling efforts for any newly separated wastes do not violate existing regulations for land application, water quality, pathogen control, and any other requirements.
    - On-farm animal waste streams are currently land applied for nutrient recycling, and management practices are compliant with Act 38, Pennsylvania's Nutrient Management Act. Construction is currently underway to install an anaerobic digester, located at the Dairy Complex, which allows for further stabilization of soil nutrients, odor reduction, energy generation, and sand separation/recycling (sand is used as an inert animal bedding material). How can this system serve as a living lab and complement OMPEC as part of an integrated organics recycling program?

Progress toward these goals can be assessed by many of the measures previously discussed in the Metrics section of this report. Other avenues of determining success include compliance, benchmarking with "best in class" especially at other Big Ten universities, and unit volume/cost trends over time. However, construction debris and farm organic waste have slightly different measures or success, as follows.

Success for construction debris should be measured by the amount (tons/yd^3, etc.) of material that has been assigned a second use through this program. Considering the costs associated with project delays, labor, trucking and handling of construction debris, success for

this initiative should not be measured purely by economics. The conventional methods of managing construction debris as either building demolition waste in a landfill or using as clean fill are currently very low cost and do not face immediate regulatory pressure, but will likely become more expensive and inconvenient in the future. Because of the large tonnages involved, careful tracking and maximizing recovery options can significantly increase the University's overall recycling rate.

Advances in farm organic waste management could also be measured in several different ways. Identifying a new farm organic waste, diverting it from the landfill stream, and reaping an economic benefit would count as a success. The nutrient management plan will need to be reevaluated after the digester comes online, with an assessment to help determine the resultant net economic impact, odor reduction during land application, the net economic benefit of energy generation from the digester, and the net economic benefit from sand separation and recycling.

Implementation

As previously mentioned, each specialty waste stream is different and thus will need a different implementation plan. In many cases this should start with procurement and contracting. For example, Environmental Health and Safety should write the policy for the **hazardous building materials** waste stream with input from impacted business units, mainly the Office of Physical Plant. A process then needs to be established where the requirements are referenced in building and design standards and/or contracts.

Similarly, the Office of Physical Plant Design and Construction unit should develop a process for the **construction debris** waste stream and then develop an agreement and create alignment with Housing and Food Services, Athletics, and the Applied Research Laboratory, to ensure all are utilizing the same process. OPP Engineering Services along with Design and Construction will need to modify specifications to allow the use of used concrete and brick as a backfill material. These are activities that the new sustainable procurement staff member may be able to assist with.

The Animal Diagnostic Laboratory will need to develop a long-term business plan for managing large animal carcasses, as described below in the section on the **chemical, biological, and radioactive** waste stream. That plan should assess different options, develop a feasibility study, establish a timeframe, and estimate a rough order of magnitude budget. Hopefully with this information the optimum choice should become obvious.

The Office of Physical Plant Engineering Services should perform a cost benefit analysis looking at full life-cycle costs along with environmental liabilities for the **universal waste** stream. If proven to be a positive return on investment, Engineering Services would then write the design and construction standard to cover lighting purchases.

For the **Lion Surplus** waste stream, other methods of sales and reuse should be explored by having an outside consultant evaluate and make recommendations. Investments will be needed at Lion Surplus to deal with greater volume, improved infrastructure for materials management, and better communications to educate and inform students, employees, and visitors. While these investments are likely to be substantial, the rewards aver very substantial as well.

For the farm waste component, the number of sources for greenhouse and other on-campus agricultural and **farm organic** waste streams is relatively small. Direct contact with facility managers and collection staff can determine items, quantities, any contamination

concerns and possible separation methods for these items. Regular reassessment intervals for larger off-campus animal waste steams will generate data suitable for measuring achievement.

These issues should be studied as time and funding allows in the next two years.

Returns and Impacts

Hazardous Building Materials & Construction Debris

Current disposal costs (July 2019):

Clean fill: $6.00/ton
Construction debris: $70.00
Residual Waste (friable asbestos): $60.00/ton
Special Handling Municipal (non-friable asbestos): $60.00/ton

Most of the disposal costs for Penn State construction debris are built into construction contracts, so are difficult to assess. However, it is expected costs will increase, no matter what option is followed. The long-term environmental benefits would include reduced impacts to available and future landfill capacity; re-use of building materials which could lower the need for new materials; and the environmental impacts of producing building products solely from raw materials.

Chemical, Biological, and Radioactive Waste

These specialty waste streams represent very high liability risk, both in terms of human health and regulatory compliance. Each one of these waste streams needs to develop a tracking metric that can identify efficiencies but also assure the needed funds will be available to match the program growth over time. The chemical waste stream has been underfunded for several years and the infrastructure needs upgrades. In addition, each of these three waste streams needs a business contingency plan that is reviewed regularly and understood by the relevant employees. It is recommended that a third-party environmental consulting firm perform a compliance audit (under attorney-client privilege) for the chemical waste operations. The radiological waste stream had a peer review performed in 2018 and all recommendations have been enacted. The biological waste stream issued a request for proposal (RFP) for outsourcing the process; the response proposals serve as the process contingency plan. The RFP was completed in 2016 and was verified to still be accurate in 2018.

Of particular concern is the aging incinerator used to dispose of biological tissue from large animal carcasses from animal science facilities, laboratory animals, etc. The outsourcing contingency described in the previous paragraph is not a cost effective long term solution. Current state-of-the-art technology for this waste stream is called chemical tissue digestion, and there are several manufacturers that have supplies systems for peer institutions. Prices range from $800,000 to $3.5 million for units capable of processing 3000 to 10,000 lbs/day, with permitting and construction timelines of 6 months to over 3 years depending on state regulations.

Universal Wastes

Like the chemical, biological, and radiological waste streams, each of the Universal Waste streams requires a metric and process tracking mechanism. Currently, we rely entirely on regulators for compliance measurement. It is recommended that Universal Waste be included in

any environmental compliance audit. Data for the quantity, broken down by stream and points of generation, is currently not readily available. Noting that "what gets measured gets managed," Penn State should establish measures and oversight reporting channels. This Task Force report presents a timely opportunity for tightening our compliance program for each of the universal waste streams.

Opportunities include: training, labeling, packaging, and inventory management. Fluorescent light generation is very different than our waste oil generation and requires different processes. These waste streams are also prone to episodic events where large quantities are generated in a short period of time with little to no notice for downstream handlers. This puts a strain on the entire management process.

Lion Surplus

The result of success with Lion Surplus could result in less material ending up in the landfill. If new or upgraded facilities are required the near term costs might be slightly higher, but in the long term a more effective materials recovery system will decrease landfill costs and increase revenue with Surplus sales.

Farm Organic Waste

The previously mentioned farm waste inventory will provide vital information with which to explore near term and mid-term efficiencies, opportunities, and the potential for revenue generation. The new anaerobic digester required a large capital investment in both facilities and equipment, and there is substantial capacity that is currently undersubscribed.

A few long-term benefits from anaerobic digestion include odor reduction, reduced loss of soil nutrients, and teaching, research, and extension opportunities. Long term costs and financial benefits for anaerobic digestion will include:

- Equipment and facility maintenance (cost)
- Labor (cost)
- Capital replacement (cost)
- Energy production (benefit)
- Potential for reduced soil nutrient purchases (benefit)
- Reduced sand purchases (benefit)

These strategies should be reexamined at a three-year interval.

Case Study: Anaerobic Digestion at Penn State

The United Nations' 17 Sustainable Development Goals of 2030 include increased renewable energy use as a critical target (Goal #7).[5] While Penn State has made great progress on its internal goals, over 200,000 mt of CO_2 eq must still be reduced in order to reach a carbon neutral University status by 2030.[6] While current renewable energy projects will help a great deal, the University does not have a strategy in place that will account for the reduction of 200,000 mt of CO_2 eq by 2030. Beyond that, further reductions will require a paradigm shift that will include both energy efficiency and negative carbon emission strategies to offset those positive emissions from transportation, including airfare and community. In this context, the University should investigate all potential waste to energy strategies that will capitalize on a waste stream problem and transform it into a renewable energy solution.

A feasibility study is needed to determine the economic and environmental costs and benefits of utilizing the University's pre- and/or post-consumer food waste (grease, scraps, etc.) and the University Airport's propylene glycol (de-icing fluid) at the Wastewater Treatment Plant's primary anaerobic digesters. Adding these additional feedstocks into the digester's current mixture of sewage sludge could generate a greater production of biogas from the operation. It has been observed that gas production rate (GPR) can increase 0.8-5.5 times when co-digesting food and dairy manure when compared to digesting dairy manure alone.[7] This could thus incentivize use of the biogas to generate electricity in a Combined Heat and Power (CHP) facility for the University's use and ultimately drawdown the total amount of methane and carbon dioxide emissions produced.

Anaerobic digestion can also serve as a useful waste management tool as it can provide a nutrient rich effluent for fertilizer use. In the case of University Park's wastewater treatment plant, land application of biosolids is not currently feasible in accordance with DEP regulations. A feasibility analysis should be conducted to conclude whether or not application of these biosolids to reclaimed mining territory or upgrading the biosolids to a Class A verification for direct land use would be more practical for the University to pursue in order to prevent the biosolids from entering the landfill.

Additional investments, either at the composting site or integrated with an anaerobic digester, will be required to address the contamination issue detailed at the beginning of this report. An immediate switch to more biodegradable food service ware will create challenges of its own. The current compost facility at University Park does not have the proper pre-processing equipment needed to handle the increased levels of compostable material (cutlery, plates, cups, etc.) generated at the University. A feasibility study would help determine whether pre-processing equipment, multiple screening mechanisms, and/or an on-site de-packager machine is needed. In addition, it is recommended that the University investigate the use of an in-vessel compost system like that of Ohio University.

Ultimately, the University must implement an integrated and effective strategy to manage pre and post-consumer food waste. If the co-digestion feasibility study demonstrates that only pre-consumer food waste is best to include in the digester, then an audit and feasibility study for

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[5] United Nations. "Energy - United Nations Sustainable Development." *United Nations*, United Nations, www.un.org/sustainabledevelopment/energy/.

[6] Penn State University. (2018). Office of Physical Plant Energy Report. Retrieved from Robert Cooper.

[7] Li, R., Chen, S. & Li, X. Applied Biochemistry Biotechnology (2010) 160: 643. https://doi.org/10.1007/s12010-009-8533-z.

managing post-consumer waste must be conducted. If composting is determined to be the best way to manage post-consumer food waste (e.g. office composting, front of house dining purchases), potential options to explore include an in-vessel rotating drum or an aerated composting system. The ultimate solution will be determined by the Office of Physical Plant and other university stakeholders.

Commonwealth Campuses

Penn State is a large university with 24 campuses spread across Pennsylvania. Most of the recommendations throughout this report are focused on the operations of its largest campus, University Park. However, because this is a University-wide task force, it is important to examine waste reduction and materials management at each of the campuses to determine the impact of the task force's recommendations.

A survey was administered to help task force members better understand the complexities and individual challenges of managing waste across the University system. Prior to developing the survey, initial efforts to research waste management practices at the Commonwealth Campuses led to the conclusion that there is currently no central source for much of this information. Therefore, a secondary purpose for administering the survey was to collect information on waste management practices in a standardized format that could potentially serve as a baseline for future inquires. Much of the survey focused on best practices for reducing solid waste in higher education institutions. These practices were identified through review of applicable literature, sustainability websites of leading universities, as well as institutional reports submitted to the Association for the Advancement of Sustainability in Higher Education (AASHE) Sustainability Tracking, Assessment & Rating System (Stars) Program. Institutional reports reviewed were selected based on institutional characteristics and institutional performance on "Waste Management and Diversion" criteria.

Recommended goals and principles to impact the Commonwealth Campuses' waste streams:

Short term

- Determine the impact, if any, of changes in University Park waste management processes on Commonwealth Campuses
- Asses the feasibility and potential value of adapting recommendations from the overall task force to the Commonwealth Campuses
- Distribute the Education committee's plan and materials to the campuses, as they have similar behavioral challenges as at University Park
- In fall 2019, two pilot studies will be conducted on Green 2 Go containers at two Commonwealth Campuses, collaborating with classes to perform the research on barriers and program improvement.

Long term

- Provide educational and financial resources to allow flexibility for Commonwealth Campuses to implement waste-reduction initiatives that best fit their needs.
    - Survey results suggested the primary factors impacting waste reduction efforts are widely shared among many of the Commonwealth Campuses. Predominantly among these are financial and human resources constraints. Nearly three-quarters of responding campuses noted such constraints as barriers to reducing solid waste. Similarly, approximately 42 percent of responding campuses identified the provision of funding as how the University could best support their waste reduction efforts.

- Provide guidance and training opportunities to support the waste-reduction initiatives being pursued at the Commonwealth Campuses.
    - Nearly 62 percent of responding campuses specifically noted Food and Housing Services as an area offering the greatest opportunity for reducing solid waste. Survey results suggest that most campuses would like to do more composting of food and biomass. However, compost systems can be somewhat expensive to operate and maintain while needing a critical mass of materials. These reasons, combined with others, have reduced the prevalence of materials being composted on the campuses. About a quarter of responding campuses also identified education programs as the greatest opportunity for reducing waste

- Explore the feasibility of establishing a voluntary group purchasing organization to support procurement of waste-hauling services for multiple campuses.
    - All campuses reported utilizing private companies for transporting solid waste away from campus (as opposed to county/municipal haulers). At least a third of responding campuses noted contracting Waste Management for these services. Since the survey did not include any items that explicitly asked what company manages waste transport, it is very likely that the proportion of campuses contracting with Waste Management is much higher. Respondents from multiple campuses also commented they have only one or two providers to choose from for waste hauling services. Lack of market competition and relatively small campuses sizes presumably limit their abilities to negotiate broader services at reasonable rates.

- This survey did not collect data on actual costs of recycling and waste management at the campuses, nor the actual volumes of various materials. A future goal could be to determine costs associated with materials management and determine if it is significant enough to warrant additional investment in recycling and composting. Given that the campuses contract with outside haulers for all services they may be too constrained by the current system to make meaningful changes. Further, the capturable volume of recyclables/compostables may be too small to warrant large investments in infrastructure or human resources.

Data collected to identify current practices and develop long-term goals

The Survey of Waste Reduction and Materials Management Practices at Penn State Commonwealth Campuses was intended help task force members better understand the complexities and individual challenges of managing waste across the University system. Topics addressed in the survey included waste collection and transportation, recycling streams and accepted materials, composting, common practices for reducing waste, barriers to and opportunities for reducing waste, and the University's role in supporting waste reduction efforts at the Commonwealth campuses. The online survey was administered to the Director of Business Services at each campus in mid-August 2018. Respondents representing 20 of the Penn State campuses completed the survey. Results from the survey are summarized below. The full survey can be found in

Appendix VI: Survey of Waste Reduction and Materials Management Practices at Penn State Commonwealth Campuses

Survey Conclusions:

- Each Commonwealth Campus faces unique challenges in managing solid waste.
- All campuses are facing challenges related to human behavior (e.g., student and employee) that is inconsistent with recycling objectives, while attempting to mitigate drastic changes in markets for recyclable materials.
- All campuses appear to be short of funds that could be used for infrastructure improvement, training, etc. that would lead to improved diversion rates. The most frequently cited barrier to advancing waste reduction efforts on campus was financial and/or human resources constraints.
- Most campuses identified Food and Housing Services as the most promising area for opportunities to reduce solid waste
- A major factor that already has or likely will impact waste reduction efforts at campuses across the University system is market shifts resulting from China's National Sword policy on imports of recyclable materials. Considering the prevalence of Waste Management as the contracted waste hauler among Commonwealth Campuses, it seems very likely that many campuses may soon be faced with changing waste collection policies. For instance, Penn State Erie has been forced to make substantial changes to its recycling collection processes due to policy changes imposed by Waste Management in early 2018. Penn State Harrisburg also noted the challenges it was presented by changes in Waste Management policies. The new realities of the market for recyclables have diminished leadership's ability to make a "business case" for more comprehensive recycling programs.

The primary challenge to reducing waste across the Commonwealth Campuses is the highly varied needs among them. Each campus contends with different constraints and challenges that could significantly impact the efficacy of any broadly prescribed practice. For this reason, many campus Directors of Business Services expressed a need from the University for both support and flexibility. Providing resources, financial or otherwise, to support waste reduction efforts on a campus by campus basis would require new procedures for assessing the need and potential impact of each proposed project.

As alluded to above, quantifiable returns and impacts of implementing the subcommittees' recommendations would be dependent on campus investments and need to be analyzed on a case by case basis. For example, survey results suggested that most campuses would like to do more composting of food and biomass. The financial impact of establishing an on-site composting operation would depend on many factors and differ substantially from one location to the next, but would no doubt be expensive if done on a commercial scale. In terms of educational impact, however, many campuses could benefit greatly from such operations assuming a critical mass of faculty and student interest exists to support it.

The formation of a voluntary group purchasing organization for procuring waste-hauling services may have greater potential for positive financial and operational impacts, but again would require an assessment of feasibility and participation interest among the campuses.

Education and Awareness

The Education and Awareness subcommittee is prioritizing coordinated communication between all relevant waste management decision-makers in order for consistent communication to be planned and implemented by University stakeholders. A protocol will be put into place for all University units to follow prior to making any changes to waste management. Access to educational materials will be improved via development of a centralized website, which will be managed jointly by the Office of Physical Plant and the Sustainability Institute; a possible app; and improved online engagement. Sustainability initiatives will be branded through signage and organizational messaging to increase trust and transparency in waste management initiatives that should lead to increased involvement among constituents.

This subcommittee focused on effectively communicating Penn State initiatives regarding waste to various stakeholders (e.g., students, faculty, and staff, as well as visitors to both campus and sporting events) via consistent but easily modifiable messaging. Without appropriate communication or messaging, efforts to reduce waste made by the University are unlikely to be successful. Individuals need to have, at a minimum, proper information about appropriate behavior (e.g., how to recycle and compost appropriately at Penn State campuses as well as education regarding benefits and programs to reuse water bottles, mugs, and food containers). However, information / education alone is not enough for a successful campus-wide waste reduction campaign as individuals also need to have the motivation to follow through (via removal of barriers to desired behavior and social norms). This necessary shift in behavior could be achieved through greater awareness and appropriate messaging that resonates with engaged individuals.

The recommendations below are supported by a Fall 2018 Pulse survey of 1,228 Penn State students, which found that 58 percent wanted more information on sustainable living, including recycling. Ninety-two percent either somewhat or strongly agreed that the University should pay attention to the impact of its actions on the environment, as it does on diversity and health issues. More recently, in a survey distributed University-wide following the Waste Stream Task Force Community Discussion, less than five percent of respondents (44 of 975) were completely satisfied with Penn State's current waste management practices and 20% (197 of 975) reported some level of dissatisfaction with current practices. The survey received 975 completed responses, (31% students, 16% faculty, and 52% staff).

In the spring 2019 survey, of the 375 respondents that chose to leave open-ended comments, over 25% (96 of 375) left a comment pertaining to a request for better education to understand how to appropriately sort their waste. When asked specifically about information on appropriate sorting of waste, 76% indicated a desire for such information. Of these individuals, 31% (229 of 774) requested information via a Mobile App and 69% (521 of 744) requested information via a website, which would include responses to FAQs. Thus, additional educational efforts are needed that provide clear, comprehensive information that will make it easier to recycle.

Given that it is critical to move beyond increasing recycling rates to have meaningful behavior change, this survey also assessed reuse. Importantly, 87% of respondents agreed with the recommendation to reduce waste via reusable mugs, bottles, to-go containers, bags, etc. (with

62% selecting “strongly agree”). Moreover, 20% of respondents who left open-ended comments spontaneously mentioned the importance of increasing reusables with appropriate infrastructure and/or eliminating disposables.

Thus, there is a demand among students, faculty, and staff for both better communication and stronger initiatives regarding waste management.

Recommended education and awareness goals and principles to impact Penn State’s waste stream:

Short term

- Launch a new waste reduction campaign with a new, fresh brand
- Motivate behavior change
- Develop messaging and signage that is clear, fun, and easily modifiable as recycling and waste management information changes both over time as well as across campus locations with different facilities so that confusion regarding sorting is not a barrier to recycling and contamination rates.

Long term

- Create a brand image around waste reduction that is recognized and respected by all stakeholders. When waste management concerns shift focus (for example there are changes in accepted recyclables or compostable material, or changes in materials procured, such as removing disposables and offering reusable bottes and mugs), this established brand will effectively communicate the appropriate updated information to constituents in a timely manner.
- Develop infrastructure to support reusables so single-use materials can be eliminated. The necessary infrastructure would include dishwashers in eateries as well as mug/bottle-washing stations (e.g., constructing public-use sinks beyond those in restrooms) and adding more water-bottle filling stations. This long-term recommendation is supported by survey respondents as noted earlier (87% agreed with the recommendation to reduce waste via reusable mugs, bottles, to-go containers, bags, etc., with 62% indicating “strongly agree”). Moreover, 20% of respondents who left open-ended comments spontaneously mentioned the importance of increasing reusables with appropriate infrastructure and/or eliminating disposables.

Success will be measured several ways. First, after a campaign is conducted, we will use surveys and in-person interviews to assess general brand awareness among constituents as well as understanding of appropriate waste management practices. Additionally, we can assess actual reduction in waste following the campaign. Waste reduction success will be determined by greater recycling rates and less contamination in recycling bins (and thus fewer contamination fees from CCRRA), which will be assessed via waste audits. Following longer-term efforts to increase reusables and eliminate disposables, we can also assess reductions in total waste based on the University’s quantity of landfill waste. For example, eliminating the approximately 4 million disposable hot coffee cups that are sold at Penn State’s University Park campus each year, as well as the nearly 6 million disposable cold coffee and Pepsi cups sold on campus, would have a substantial decrease in Penn State’s post-consumer waste by removing over 10 million disposable cups from the landfill each year.

Implementation

Branding

Elaborating on the short-term goals and how they will be met, a committee should be established to create a marketing campaign and the associated branding. The goal would be to develop consistent branding and messaging to reach different audiences, tailoring to location and group-specific issues. The design should be such that it can be relatively easily modified as changes occur (e.g., recycling supply and demand, materials purchased/sold on campus).

Two quotes obtained for the branding campaign ranged from $4,000 to $4,520. Both companies' quotes include a brand book: color scheme, fonts, a few tag lines, and bin signage redesign based on SI and OPP research and prototypes. When taking into consideration printed materials, an advertising campaign, and a redesigned website (where all the rebranded elements would need to appear), costs could approach $25,000.

In addition, clarification is needed to determine materials management communications roles as well as deciding on how the final messaging should be applied to the Commonwealth Campuses. The key aspect of this plan is to establish a credible (likeable and trusted) as well as familiar brand image regarding sustainability (waste management) at Penn State. Then all messaging and information relevant to sustainability will come from this brand, which increases consistency in messaging as well as a point of contact as waste management practices change given change is inherent in this area. The Waste Reduction and Recycling Programs Manager would lead this brand and communications, perhaps selecting one particular issue/theme to highlight each semester or month (e.g., reusable mugs; reusing and refilling water bottles; all about composting; all about recycling/sorting/contamination; reusable food containers, etc.) for there to be consistent communications and brand awareness (thus also a long-term goal).

Committee members would need to include representatives from:

- Strategic Communications
- Office of Physical Plant
- College of Communications (Lee Ahern)
- Department of Psychology (Janet Swim)
- Auxiliary and Business Services Marketing Team
- Sustainable Operations Council
- Commonwealth Campuses
- Sustainability Institute
- HUB Marketing
- University Libraries Marketing
- Athletics
- Consumer Behavior (Karen Winterich)
- Retail Dining

Motivating Behavior Change

First, it is proposed that the Sustainability Institute hire a behavioral science graduate student for three years to provide advice to SI, OPP, the Sustainable Operations Council, all of its sub-task forces, and all other Finance and Business units on ways for behavior change tools to be integrated into their programs, as well as designing pilots that classes could conduct to test program improvements. It is hoped that by the end of the three-year term, the program managers

in many F&B departments will have gained knowledge and skills and be able to apply these concepts to their program independently. The position description, budget, and example projects are included in Appendix VII: Proposed Behavioral Science Graduate Student Position Draft .

Additionally, the Waste Reduction and Recycling Programs Manager, in concert with the Sustainability Institute will work with Strategic Communications, New Student Orientation, Global Programs for International Student Orientation, New Employee Orientation, the HUB, and Housing to create an information blitz, showing the impact of recyclables and the importance of contamination issues, and therefore correct sorting. These touchpoints will also be used to discuss the readily available opportunities (and any potential incentives) for reuse/reduction.

Sustainability Institute staff will work with the Materials Research Institute and the College of Arts and Architecture to showcase reuse of materials. One possibility is to use the display area in the HUB lounge to show fleece jackets, carpets, and other products made from recyclable feedstocks. Another opportunity would be to host a presentation by Pepsi and other Penn State partners to showcase recycling impact.

Film screenings showing reusing and recycling as normal in everyday life should be sponsored by both professionals and students. Some ideas for themes include playing upon the "We are…" theme, using "Sustain State," or "Recycling/Reuse: It's what we do, and this is how we do it."

Another way to motivate behavior change is to work with Athletics to play PSAs at games that encourage recycling and have information on the "how to" for common stadium/game disposables/recyclables. This would include information on empty bottles only and when/what it is acceptable to trash (describing non-recyclables that are often wish-cycled) to reduce contamination.

And finally, partner with the Sustainable Communities Collaborative for fall 2019 to develop fun, in-person campaigns for behavior change.

Expand sorting skills

To expand the sorting skills on campus, it is recommended that the former Mobius recycling game be updated by working with College of Liberal Arts, whose IT department has offered to update this game for Penn State. This should be finished in time to coordinate with OPP's changing of the bins.

Another approach to support sorting skills is an app. Last year, two College of Information Sciences and Technology classes created a prototype showing two possible app designs. Using their models, we've met with two firms to develop the ideas further into two options, each with a price point, scope, and timeline as follows:

Option A: Launch a high performing, robust **mobile app** that will provide an interactive way to recycle successfully, act as a two-way communication tool to provide recycling updates to users, collect data on behaviors, offer real-time feedback to help track successes/challenges of the Penn State recycling program, and other features. This option would take 6-9 months to develop with an outside firm and cost up to $250,000 plus annual fees for updates and changes. A mobile app requires ongoing maintenance and updates in order to continually function across all platforms but offers substantial opportunities for gathering user feedback and data which has the potential to shape future changes to the recycling program.

Option B: Launch a high-performing **web app**, accessed via the user's internet browser, that has less advanced features than a mobile app but is more interactive than a website. While the features are not as complex, a web app is easier to maintain, less expensive, and is more suitable for student work. Consulting fees from a professional firm, at cost of up to $50,000, would enhance the success and usability of a web app.

Whether or not either of these apps are developed, it will be important to launch a comprehensive **website**, www.recycle.psu.edu. The website will offer thorough details on recycling best practices, FAQs, tips on reuse and waste reduction, and be the definitive resource for recycling and consumer waste management information across the University. This can be developed by the Sustainability Institute in partnership with OPP and with student involvement. The website will be 'mobile friendly,' but not as convenient and interactive as a web app could be. The Sustainability Institute will work with staff and students to develop and launch this site in the coming six months.

Investing in this online FAQ guide is critical given 69% of those requesting information would like to be able to access information on a website with FAQ. Additionally, of the 76% of survey respondents requesting more information, 31% indicated interest in an app and 49% indicated interest in online games.

The creation of a set of email templates, similar to those created for the Green Teams, is needed to motivate and educate about reduction, reuse, and recycling, including proper preparation techniques for recycling, such as rinsing and emptying liquids. The topics would be identified from the Penn State waste audit conducted in 2018. Each email would focus on a specific product or material and include pictures of the item and the correct bin. These would be sent to Green Teams and Facilities Coordinators and all marketing contacts. Though we recognize many people are inundated by extraneous emails, 19% of survey respondents indicate an email newsletter as a preferred way to receive information about appropriate sorting.

The Sustainability Institute created a "Recycling Roadshow" in 2016 to demonstrate sorting techniques using miniature recycling bins. Three demonstration kits exist. Two to three recycling ambassador internships could be created to present the Roadshow for colleges and units. The roadshow could be useful as 30% of those requesting more information wanted in-person information sessions These students could also oversee a social media campaign focused on reduce, reuse, and recycle information.

Short podcasts or videos could be created about both plastics bins and compost that could be rolled out through social media. The help of marketing or communications classes could be enlisted in fall 2019 to help create these videos.

Reducing contamination

Reducing contamination will be a key aspect to making our solid waste management efforts successful. The best way to reduce contamination is to educate the community on proper recycling practices.

It is recommended that waste education should be integrated into New Student Orientation and a freshman seminar, called Living Sustainably at Penn State, as well as New Staff Orientation. This long-term recommendation is supported by survey respondents (85% agreed with the recommendation, with 62% selecting "Strongly Agree"). Moreover, 20% of

respondents who left open-ended comments on the survey requested more training on appropriate sorting of waste, many specifically mentioning training via New Student and New Staff Orientations.

Additionally, a strategy should be developed to improve messaging about responsible consumerism and disposal. As part of its outreach and education, Penn State should make it clear that liquids need to be drained from containers either into the sink (for kitchen staff) or into the refuse container before being placed in the appropriate recycling container. Also, a specific public awareness campaign should be launched to combat wish-cycling (contamination that occurs when someone "hopes" that a non-compliant material can be recycled so places there rather than as trash), e.g., "when in doubt, throw it out."

It is also important to remember that the current Penn State and Centre County recovery program is unique. Many students coming to State College likely are accustomed to single stream recycling. Extra outreach and education is necessary to reach high levels of participation and understanding of proper material separation for a multi-sort program like the current one. As such, it is recommended that a team of "recovery champions" is engaged to assist during program transition to focus on specific buildings and stakeholder groups. Also, the potential to implement a Community-Based Social Marketing campaign to impact social norms and behaviors should be investigated. Finally, University units that provide/control communication outlets to various University constituencies should include recycling education in their message This includes student and staff orientations, housing, athletics, etc. The investment in a new brand and the hiring of a Waste Reductions and Recycling Programs Manager will make it more manageable for these units to implement such messaging while keeping the message consistent for the respective audience.

Clarification is needed regarding a leadership role as well as appropriate roles among the Office of Physical Plant, the Sustainability Institute, Auxiliary and Business Services, and Strategic Communications to effectively educate Penn State constituents. Student classes and organizations can assist with waste audits for educational purposes. For example, the EcoReps could conduct residence hall audits, Net Impact for the Smeal College of Business audit, and SUST200 or an Industrial Engineering class for other waste audits. Additionally, classes (perhaps through the Sustainable Communities Collaborative) as well as the Office of Student Affairs could help assess knowledge and awareness among the student population.

Implementation of the recommendations would require the partnership of the offices mentioned above as well as and specifically New Student Orientation, Global Programs for International Student Orientation, New Employee Orientation, Housing, the HUB, Dining Services, and Athletics. Externally, partners necessary for successful implementation include the Centre County Recycling and Refuse Authority and the Pennsylvania Recycling Markets Center to foresee upcoming changes in the market, as well as a potential external communications firm to launch a campaign. Resources needed for a successful implementation of this initiative would include funding for the rebranding initiative, hiring a waste reduction and recycling programs manager, the behavioral science GA, as well as time commitments from Penn State partners.

If revisions to procurement, compost facilities, waste reduction strategies, and recycling are known by Summer 2019, then the launch of the proposed campaign will occur in Fall 2019 with training for custodial, dining, catering, housing, and facilities coordinators as well as New Student Orientation. Football games and other fall athletic events would also be part of this phase of the campaign. Other efforts will be ongoing to manage communications prior to changes by

independent units via the adopted protocol as well as encourage waste reduction and reuse initiatives on an ongoing basis for consistent brand awareness and engagement.

Returns and Impact

The biggest initial cost to implement these recommendations would be investing in a waste reduction and recycling programs manager. This position will be an ongoing investment,.

Operationally, the recommendations will result in less recycling contamination with better recycling rates and reduced landfill waste, which will decrease University costs and increase the value of the recyclables to potential buyers.

Academically, student classes and organizations can assist with campaign roll out and other educational awareness, as well as waste audits and measurement of impact. Educational awareness opportunities for classes could include app development for updated info and a Q&A by a College of Information Sciences and Technology class; a sorting game updated by the IT staff in the College of Liberal Arts; and a legacy project for students. The campaigns can also be tested for effectiveness via brand awareness, behavioral knowledge, and waste audits.

Other long-term benefits include the alignment of University actions with its Strategic Plan, increased confidence from the student body and other University stakeholders due to greater transparency, increasing trust and buy-in in initiatives, and University recognition as a leader in waste management in higher education. Ongoing communications with a protocol for changes will help circumvent the uncertainty of the recycling market. If waste management communications are not managed or are done poorly, the trust that University constituents have in the University will decline.

With increased awareness among Penn State constituents on campus, behaviors should also change off campus, which will reduce contamination and improve reduction, reuse, and recycling in everyday life. This will also bring increased awareness of composting, which is consistent with State College borough efforts.

These communication strategies should be reexamined on an ongoing basis given unknown and potentially sudden changes to the recycling market. This ongoing examination will be handled by the waste reduction and recycling programs manager. In addition, it is recommended that upcoming changes are considered each year in January for communications to be planned in the spring, implemented in the summer, and ready each fall.

Advocacy Network

In spring 2019 the Waste Stream Task Force surveyed the University community to assess the satisfaction, importance, and understanding of waste management at Penn State. Of the more than 1,000 respondents, reducing greenhouse gas emissions and eliminating waste from the landfill were the most common reasons for Penn State to invest in more sustainable waste management practices. Students, staff, and faculty desire a solid waste system where decision processes are open and transparent, there is regular dissemination of high quality information as well as education regarding effective waste management strategies at Penn State.

Their strong interest of the University community in this topic, with a desire to stay connected and informed regarding waste stream management. To satisfy this interest and maintain enthusiasm as new programs are developed, we recommend establishment of a network of stakeholders, including students, faculty, staff as well as internal and external partners. Important external stakeholders include local entities such as the Centre County Refuse and Recycling Authority (CCRA) and local government organizations, including State College Borough and the other Centre Region municipalities. Student groups that focus on waste management, advocacy, and education include EcoReps, Eco Action, and the Lion's Pantry. Further resources include the University's Office of Physical Plant (OPP), Environmental Health Services (EHS), Housing, Food Services, and Residence Life, as well as the Lion Surplus Store and Auxiliary and Business Services.

Appendix I: 2018 Kessler Waste Audit Report

PENNSYLVANIA STATE UNIVERSITY

SOLID WASTE SYSTEM ASSESSMENT OF THE UNIVERSITY PARK CAMPUS

July 2019

Prepared for: **Penn State University**
Office of the Physical Plant
University Park, PA 16802

Submitted by: **Kessler Consulting, Inc.**
fainnovative waste solutions
14620 N. Nebraska Ave., Bldg. D
Tampa, FL 33613

Kessler Consulting, Inc. is a member of, or was awarded, the following:

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Section 1 Introduction

1.1 Purpose and Scope

Pennsylvania State University (Penn State) contracted Kessler Consulting, Inc. (KCI) to conduct a solid waste audit and develop a Solid Waste Management System Assessment that evaluates the solid waste management system at Penn State's University Park Campus[1] and assesses potential opportunities to improve the campus recovery system.

The objective of the audit was to access the quantity and composition/quality of refuse, recycling, and compost streams from selected buildings on the Penn State Campus. A total of 22 buildings were audited. The buildings were categorized into eight types: academic, administrative, apartment, athletic, dining hall, dormitory, library, and student union. The results of the audit, as well as additional research conducted by KCI, were used to evaluate options and recommendations for Penn State to improve its solid waste management system.

1.2 Background

Penn State is a land-grant university located within Central Pennsylvania's Happy Valley in Centre County (County), with majority of the campus in the Borough of State College (Borough). The 8,000-acre campus is home to approximately 40,000 undergraduate students, 6,000 graduate students, and 19,000 faculty and staff. Approximately 13,700 students live on campus, including all first-year students.

The Penn State's Sustainability Institute was formed through merging the Center for Sustainability and Campus Sustainability Office. The Institute has adopted the United Nations' 17 Sustainable Development Goals. The Sustainability Work Plan 2018-2021 (Plan) outlines Penn State's plan in the near future towards reaching these goals. Key to meeting several of these goals is the sustainable management of waste.

Every three years, Penn State assesses it sustainability performance Sustainability Tracking Assessment and Rating System (STARS) developed by the Association for the Advancement of Sustainability in Higher Education (AASHE). In 2017, it received a gold rating (just below the highest level of platinum). In the area of waste minimization and diversion, it received 2.96 points out of a possible 8.0. Scores for other Big Ten university that have completed STARS reports range from 2.24 to 3.34.

The Waste Stream Task Force is a multi-stakeholder organization formed in 2018 to address issues in the solid waste system and develop solutions to sustainably divert waste from disposal. This Assessment has been developed to assist the Task Force in this effort and specifically addresses refuse, recyclables, and organics from major building types at Penn State.

[1] Henceforth the use of "Penn State" will be synonymous with the University Park campus, unless otherwise stated.

1.3 Organization of this Assessment

This Assessment assesses the solid waste management system at Penn State, specifically the potential to improve the quantity and quality of recycling and compost collected on campus. The Assessment is divided into the follow sections:

- Section 2: Current Solid Waste System – This section summarizes the current collection of material on campus and the recycling program.
- Section 3: Waste Audits Methodology and Results – This section discusses the two waste audits KCI conducted for Penn State and provides a summary of the audit results.
- Section 4: Campus-Level Generation and Recovery – This section extrapolates the results of the audit to all campus buildings of the types included in the audit and discusses the overall tonnage of recovered and unrecovered materials.
- Section 5: Assessment of Existing Collection System – This section evaluates observations made during the audits of how materials are collected on campus.
- Section 6: Local and State Solid Waste Framework – This section reviews the solid waste environment that Penn State operates within, including Pennsylvania state laws, Centre County and State College Borough ordinances, and the Centre County Recycling and Refuse Authority (CCRRA). This section also discusses regional processing options.
- Section 7: Opportunities to Improve – This section evaluates the overall recovery system and presents options for Penn State to improve this system based on the prior section.
- Section 8: Summary

This Assessment focuses on the refuse, recycling, and compost streams of the eight building types included in the audits: academic, administrative, apartment, athletic, dining hall, dormitory, library, and student union. The Assessment does not address waste generated from other types of buildings or large athletic or special events, such as football games. Likewise, material outside of the refuse, recycling, and compost streams, such as construction and demolition waste, Lion Surplus, and yard waste collection are not addressed in this Assessment. While the Assessment includes some discussion of operation improvements and financial implications of the recommendations and options discussed, a full operational analysis and cost assessment is not within the scope of this Assessment.

1.4 Acknowledgement

KCI would like to acknowledge and thank all Office of Physical Plant (OPP) staff members who assisted with this study, in particular Ryan McCaughy, Nadine Davitt, Ed Nyman, and the staff responsible for collecting and delivering waste during the audits. Their cooperation throughout the project enabled us to successfully and effectively complete our work.

Section 2
Current Solid Waste System

2.1 Overview of Collection

Penn State collects discarded materials separated into seven material categories: refuse, recyclable paper, plastic bottles and film, miscellaneous plastics, metal, glass, and compost. In most buildings on campus, collection stations are located throughout the building, with separated containers for all or most of these streams. The streams accepted at each collection station depends on the types of nearby activities. For example, compost collection containers are concentrated in dining halls and other buildings with food services. Additionally, corrugated cardboard (OCC) and other bulky recyclable items are collected loose at buildings which generate these materials.

Penn State's solid waste collection system is largely overseen by the OPP. Solid waste generated in on-campus buildings is first collected in receptacles at collection stations located through the buildings. The OPP's Custodial Operations services more than 260 academic, athletic and administrative buildings with a staff of over 400. Auxiliary and Business Services provides custodial services for residential buildings and food services.

Staff collects each material category separately in clear plastic bags from collection stations and transports them to various consolidation points and containers outside of buildings. The consolidation points consist of dumpsters, roll-off containers, roll carts (toters), or designated areas where bags are placed curbside (non-containerized). In most cases, bags of plastic and metal cans are consolidated into a single container. Table 2-1 breaks down the list of collection containers used around campus. Penn State recently completed improvements to the consolidation area of the East Dorms by adding compactors for refuse, OCC and paper, as well as roll-offs for recycling. Plans are underway to add compactors to additional areas of campus.

Table 2-1: Collection Containers Used for Penn State Solid Waste Collection

Container Type	Material Type	Number
Dumpster	Refuse	154
Dumpster	OCC	102
Dumpster	Mixed Paper	71
Dumpster	Recycling (Plastic & Metal)	13
Compactor	Refuse	11
Compactor	Mixed Paper	2
Compactor	OCC	1
Roll-off Container	Recycling (Plastic & Metal)	12
Toters	Compost	317
Toters	Glass	65
Non-containerized Locations	Recycling (Plastic & Metal)	63

OPP's Waste Management Department collects discarded materials from the consolidation points on regular routes using a variety of collection vehicles and methods, including front- and rear-load compactor trucks, cable trucks, box truck, and stake body trucks. Refuse and some

recyclables, such as OCC, are hauled directly to the CCRRA's transfer station and recycling processing facility. Other recyclables and some bulky items are delivered to the OPP's Bar Pit on Fox Hollow Road for further consolidation and accumulation before ultimately being delivered to the CCRRA facility.

Glass, mixed paper, and OCC are delivered as source separated material streams to CCRRA intermediate processing facility (IPF). The separate bags of plastics and metals from internal collection points are typically placed in the same container at consolidation points and the Bar Pit and then delivered to the CCRRA IPF. The bags of plastics and metals are sometimes referred to by OPP as "dock material."

Compost is delivered to Penn State's Organic Materials Processing and Education Center (OMPEC) located on the north end of campus where is it composted in a turned windrow compost system. The OMPEC also receives leaf waste collected by State College Borough.

OPP runs a separate collection service for major sporting events and associated tailgating activities. Multiple collection points are set up for events that consist of two bags – clear blue for recyclable bottles and cans and clear for refuse. OPP staff collect the bags and consolidate them in roll-of containers which are then transported to CCRRA where bags of recyclables are manually sorted.

In addition to OPP's collection operation, Penn State has contract haulers on campus. They primarily haul construction and demolition debris from various building projects. Penn State is also involved in a number of other waste recycling and recovery efforts. These include hazardous waste collection through its Environmental Health and Safety program, salvage materials and e-waste recycling though Lion Surplus, asphalt and concrete recycling though OPP's Utility Service, and grass-cycling through the OPP's Grounds Maintenance.

2.2 Annual Tonnage

Penn State staff provided KCI with monthly scale house reports as well as the annual recycling report it provides to the CCRRA. Table 2-2 summarizes the annual tonnage for 2017 and 2018. Note: These tonnages are significantly different than the tonnages the CCRRA reported for the state performance grants (Section 6.3.3), specifically the mixed paper is about 3,200 tons lower than what was reported by the CCRRA as coming from Penn State.

Table 2-2: Annual Tonnages as Reported by Penn State

Material	Destination	2017	2018
Materials Addressed in this Assessment			
Recycled			
OCC	CCRRA – Recycling	759	783
Mixed Paper	CCRRA – Recycling	832	687
Plastics	CCRRA – Recycling	158	94
Glass	CCRRA – Recycling	83	67
Metal Cans	CCRRA – Recycling	126	83
Food Waste	OMPEC	1,584	1,539
Disposed			
Refuse	CCRRA – Disposal	5,795	6,160
Other Materials			
Recycled			
Scrap Metal	CCRRA – Recycling	122	32
Tires	CCRRA – Recycling	16	18
Wood Waste	CCRRA – Recycling	3,226	214
Wood Waste	OMPEC		1,443
Waste Soil	OMPEC	593	556
Yard & Leaf Waste	OMPEC	Not reported	2,042
Grass-cycling	n/a		1,200
C&D & Asphalt	Various	849	273
Textiles	Trash to Treasure	40	44
Scrap Metal	Lion Surplus, Service Garage	219	266
Hazardous & E-waste	Various	664	618
Salvage	Lion Surplus	750	900
Disposed			
Residue*	CCRRA – Disposal	19	66
C&D Debris – disposed	CCRRA – Disposal	1,774	1,516
Total Generated		**20,064**	**18,604**
Total Recovered		**12,476**	**10,861**
Recovery Rate		**62%**	**58%**

* Recyclable materials CCRRA rejects due to contamination.

2.3 CCRRA Tip Fees

Table 2-3 shows the 2019 tip fees that Penn State pays for sending material to CCRRA. In addition to the inbound tip fee, CCRRA charges a penalty per ton of contamination for all recyclables it rejects, based on the level of contamination of each load.

Table 2-3: 2019 Penn State Tip Fees to CCRRA

Material	Fee
Municipal Waste (Refuse)	$70/ton
Tires – Residential	$70/ton
Tires – Commercial	$150/ton
Tires – Pit	$10 each
Source Separated Recyclables*	$20/ton

Commercial Toters	$46/month
Dock Material (metal & plastics)	$66/ton
Bagged Glass	$40/ton
Contamination Penalty	
<3%	No charge
3.1 to 10%	$100/ton
10.1 to 20%	$150/ton
>20.1%	$250/ton

*OCC, mixed paper, and bagged glass are delivered source separated. Metal and plastic are generally delivered as dock material.

2.4 Recycling Education Program

The public face of Penn State's Recycling Program is the Mobius program managed by the Sustainability Institute. Most of the collection bins are branded with this program, including the blue bag program for tailgating recycling. Figure 2-1 below is the Mobius flyer that explains the program and specifies what materials are recyclable in which streams.

Later sections of this report provide a more comprehensive assessment of the effectiveness of the Mobius program and its suitability relative to industry recycling practices and commodity markets.

Figure 2-1: Penn State's Mobius Program

Section 3
Waste Audits Methodology and Results

3.1 Overview

KCI conducted two separate 2-week (10-day) waste audits at Penn State: one in Spring 2018 and one in Fall 2018. The audits were designed to target specific types of on-campus buildings based on their function. The Spring audit focused on academic, athletic, and administrative buildings, while the fall audit focused on housing and dining facilities. The audit for each building consisted of three aspects:

1. Material Generation: Measured the daily generation of each material stream.
2. Waste Composition: Conducted a weight-based composition study (WCS) on the daily refuse.
3. Recycling Contamination: Conducted a visual assessment of contamination in the daily recycling and compost streams.

The goal of the audits was to quantify the amount and composition of materials generated by each building and evaluate the performance of these buildings' recycling programs, i.e., what recyclable materials and how much of them are not being separated and remain in the refuse and what are the major contamination issues in the recycling and compost streams. The results of the audits were then extrapolated to assess campus wide waste generation and recovery program performance.

This section of the Assessment is a brief summary of the methodology and results of the audits. More detailed results and discussions were provided in previous technical memoranda.

3.2 Methodology

3.2.1 Overview and Audited Buildings

KCI conducted the waste audits over the weeks of April 16-27 (Spring Audit) and November 5-16, 2018 (Fall Audit) at OPP's Bar Pit. All material was delivered to the site by OPP staff. Measurements, assessments, and sorting was conducted by KCI staff and KCI-contracted temporary laborers.

Twelve on-campus building were selected in the Spring Audit and ten buildings in the Fall Audit, selection of which was based on the discussion with Penn State staff while planning the audits. The Fall Audit specifically focused on housing and dining buildings. Table 3-1 shows the list of building names, types, and gross square footage that were selected for the audit. Prior to the start of the audit week, all containers were emptied in the selected building. During the audit, all materials generated within the buildings over each 24-hour period (or 48- or 72-hour period over the weekend) were collected in bags, labeled by custodial staff according to stream type, aggregated in a designated container by custodial staff on a daily basis, and staged in a dedicated area for daily collection by OPP staff. OPP staff then delivered all materials to the Bar

Pit separately for each building. Each building was audited over seven consecutive days. Specific days for each building varied to accommodate the custodial staff and the KCI sorting crew.

Table 3-1: Buildings in the Audits

Building Name	Audit	Building Type	Gross Area (ft^2)
Davey	Spring	Academic	147,080
Frear North and South	Spring	Academic	159,158
Thomas	Spring	Academic	124,157
Willard	Spring	Academic	135,422
Kern Graduate Building	Spring	Administrative	63,279
Office of Physical Plant	Spring	Administrative	154,307
Shields	Spring	Administrative	107,474
Smeal (aka "HUB North")	Spring	Administrative	224,841
White Course	Fall	Apartment	213,616
Intramural Building	Spring	Athletic	266,842
Rec Hall	Spring	Athletic	309,616
Pollock	Fall	Dining Hall	96,538
Redifer	Fall	Dining Hall	68,997
Waring	Fall	Dining Hall	72,950
Beaver	Fall	Dormitory	117,648
Cooper-Hoyt	Fall	Dormitory	68,913
Earle	Fall	Dormitory	96,500
Hamilton	Fall	Dormitory	149,425
Leete	Fall	Dormitory	68,554
Pattee & Paterno Libraries	Spring	Library	483,737
HUB Administrative Areas	Fall	Student Union	141,234*
HUB Dining	Spring	Student Union	141,234*

*Allocated half of the total square footage to each part of HUB.

3.2.2 Material Generation

To measure daily material generation, KCI separated each building's bagged materials by material stream (according to how custodial staff labeled the bags). Each stream was loaded into 95-gallon roll carts and total net weight was recorded using a floor scale provided by Penn State. The volume of material was also estimated by recording how full each roll cart was. For this audit, seven material streams were evaluated:

- Refuse
- Paper
- Plastic Bottles & Film
- Miscellaneous Plastics
- Metal
- Glass
- Compost

In addition to the seven streams, loose OCC delivered with the material was weighed and recorded separately. For exceptionally large amounts of OCC, dumpsters were filled and a weight was obtained using a front-load truck on the truck scale. Any loose, non-recyclable, bulky materials were included in the refuse stream.

Some considerations had to be made for certain material streams and building types.

- During the Fall Audit, KCI was not able to accurately distinguish which bags of plastics were intended for the Miscellaneous Plastics and which were intended for Plastic Bottles & Film. Therefore, these streams were combined for these building types: apartment, dormitory, dining hall, and student union.
- Recycling streams from White Course were collected once at the end of the weeklong audit period and weighed in the collection vehicle. Therefore, KCI was not able to assess contamination levels, but instead made general observations once the truck tipped the material. Additionally, White Course does not collect any compost, and plastic and metal are collected together.
- Compost from the dining halls and most of HUB Dining was collected in roll carts and weighed separately by building in the vehicle, then tipped at the compost facility. Therefore, contamination was not able to be assessed quantitatively, but was observed while the truck tipped to a roll-off container. A portion of HUB Dining was collected and assessed with the refuse and recycling streams.

3.2.3 Contamination Assessment

Each day's and building's recyclables and compost were visually assessed separately by stream in order to estimate the types and percentage by volume of misplaced recyclables (i.e., non-target recyclables in incorrect streams) and contamination (i.e., non-recyclables/compostables in the recycling stream). Attachment A defines the categories of recyclables and contamination of the visual assessment. KCI assessed contamination by examining the entire daily volume through the transparent bags in which recyclables and compost were collected, opening bags when needed to more closely examine the material. The percent by volume of target material, non-target recyclables, and different types of contaminants were estimated and recorded. For the compost stream, target material included not only food waste, but any compostable material accepted in Penn State's program. The same KCI supervisor conducted all visual assessments for consistency.

3.2.4 Waste Composition

After weighing, KCI measured the composition of each building's daily refuse stream. If the total volume of refuse was less than 2 cubic yards (four 95-gallon carts), the entirety of the material was sorted. If the total refuse was greater than 2 cubic yards, a subsample of at least 2 cubic yards in volume or weighing 200 pounds, was randomly selected for sorting. Refuse was hand-sorted into 46 material categories defined in Attachment A.

Following completion of the sorting event, the percentage by weight of each material category of refuse, as measured in the WCS, was calculated for each building. Where appropriate, 90 percent confidence intervals were calculated, using a standard statistical t-test, for each

material category.[2] Confidence intervals would not be appropriate for the visual assessment results because these are visual estimates rather than recorded data.

3.3 Results

3.3.1 Introduction to Results

A summary of the results by building for the material generation and visual assessment are presented in this section

For the purposes of the waste composition results, materials were grouped into nine broad categories based on Penn State's recycling streams and diversion potential:

- Recyclable Paper: These are materials that are accepted in the Penn State's paper recycling stream, consisting of the following material categories:
  - Newspaper
  - OCC
  - Mixed Recyclable Paper
  - Books
- Plastic Bottles & Film: These are materials that are accepted in the Penn State's plastic bottle and film recycling stream, consisting of the following material categories:
  - PET Bottles (#1)
  - HDPE Bottles (#2)
  - Recyclable Plastic Film
- Miscellaneous Plastics: These are materials that are accepted in the Penn State's miscellaneous plastics stream, consisting of the following material categories:
  - Non-Bottle Plastics (#1 and #2)
  - Other Plastic Containers (#3-#7)
  - Plastic Cups
- Recyclable Metals: These are materials that are accepted in the Penn State's metal stream. It consists of the following material categories:
  - Tin/Steel Cans
  - Ferrous Scrap Metals
  - Aluminum Cans
  - Aluminum Foil and Trays
  - Non-Ferrous Scrap Metals

[2] The confidence interval indicates that, with a 90 percent level of confidence, the actual arithmetic mean is within the upper and lower limits shown. This provides an understanding of how much variation occurred in the quantity of that material category found in the samples sorted. Generally, the more homogeneous the waste stream and the greater the number of samples sorted, the higher the level of accuracy achieved and the narrower the margin between the upper and lower bounds of the confidence interval. Because this is a statistical analysis, the lower end of the confidence interval may be a negative number.

- Glass Containers: These are glass bottles and jars of any color that are accepted in Penn State's glass recycling stream.
- Food Waste: This includes food waste, which is accepted in Penn State's composting stream. However, this does not include packaged food waste that would require depackaging either through source-separation or through depackaging equipment.
- Potential Recoverables: These are materials that have the potential to be recovered or recycled but are not currently collected for recycling in Penn State's recycling program. Some of these materials, such as textiles/leather and construction and demolition (C&D) debris, would require source-separation and/or additional processing to recover. These materials consist of the following material categories:
    - Aseptic/Polycoated Containers
    - Bulky Rigid Plastics
    - Food Service Expanded Polystyrene (EPS)
    - Bulk Packaging EPS
    - Special Wastes
    - Electronics (E-waste)
    - Electronic Media
    - Textiles and Leather
    - C&D Debris
    - Furniture
    - Tires and Rubber
- Potential Compostables: These are other materials that, while technically compostable, are not currently accepted in the Penn State's composting program in large quantities, such as paper towels from restrooms. These materials consist of the following material categories:
    - Paper Towels, Napkins, Tissues
    - Compostable Food Containers & Cups
    - Yard Waste
    - Other Organics
    - Clean Wood Waste
- All Other Materials: These are any materials not classified above and require specialized programs or technology to be recovered, consisting of the following material categories:
    - Non-Compostable Paper Food Serviceware
    - Non-Recyclable Plastic Film
    - All Other Plastics
    - Other Glass
    - Lab Glass
    - Household Batteries
    - Treated Wood Waste
    - Small Appliances
    - Diapers
    - Disposable Gloves
    - All Other Garbage
    - Liquids

- Grit
- Tires and Rubber

3.3.2 Material Generation

Table 3-2 shows the combined material weekly generation of each material stream for all buildings in the audit and the overall recycling rate for each building (total recovery/total generation). Please note that this recycling rate only uses the tonnage of material collected in each stream as recycled and does not account for any non-recyclable contamination in the stream.

On a per building level, the three dining halls had the highest generation of material, as well as the higher recovery, which was mostly due to the large amount of compost collected. HUB Dining had a high generation rate but much lower recovery rate. The five dormitories had some of the lower recovery rates of any building type.

Table 3-2: Total Weekly Generation of Materials for All Audited Buildings

Building	Refuse	Paper	Plastic Bottles &Film	Misc Plastics	Metal	Glass	Compost	OCC	Total Recovery	Total Generation	Recycling Rate
Davey	430.6	170.9	22.5	28.5	5.7	8.5	81.4	3.6	321.2	751.8	**43%**
Frear	597.2	47.6	13.8	3.1	7.6	0.0	33.7	0.0	105.8	703.0	**15%**
Thomas	827.4	297.7	112.3	82.4	33.3	56.1	118.9	118.3	819.1	1,646.5	**50%**
Willard	681.6	198.0	177.6	78.2	15.1	52.8	85.2	5.6	612.4	1,294.1	**47%**
Kern	182.4	24.7	49.8	64.6	7.3	4.6	46.6	1.2	198.8	381.2	**52%**
OPP	316.6	270.2	37.1	17.2	11.0	17.3	146.7	0.0	499.5	816.1	**61%**
Shields	327.2	240.7	44.4	0.8	24.2	1.8	115.4	0.0	427.3	754.5	**57%**
Smeal	1,380.8	519.0	177.6	67.1	38.1	39.8	186.4	112.6	1,140.6	2,521.4	**45%**
White Course	3,254.9	160.0	420.0			125.0	n/a	180.0	885.0	4,139.9	**21%**
IM	508.6	36.5	51.9	18.6	13.2	2.3	13.7	18.3	154.4	663.0	**23%**
Rec Hall	1,144.1	105.2	101.1	12.9	83.8	0.3	28.8	130.1	462.2	1,606.3	**29%**
Pollock	2,421.3	130.0	472.3		265.9	13.3	13,060.0	2,636.8	16,578.3	18,999.7	**87%**
Redifer	6,014.2	51.7	556.0		352.8	109.3	9,160.0	3,722.8	13,952.6	19,966.8	**70%**
Waring	2,720.1	64.7	377.0		270.6	16.9	11,140.0	2,291.1	14,160.3	16,880.4	**84%**
Beaver	2,378.0	20.8	104.7		5.4	40.9	73.7	102.6	348.0	2,726.0	**13%**
Cooper-Hoyt	1,651.0	0.0	47.5		0.0	0.0	43.4	75.6	166.5	1,817.5	**9%**
Earle	1,869.4	46.4	157.8		16.9	17.0	85.2	164.2	487.5	2,356.9	**21%**
Hamilton	2,505.2	26.7	100.8		11.5	23.1	26.0	129.2	317.2	2,822.4	**11%**
Leete	783.1	9.6	74.5		1.8	5.2	42.0	104.8	237.9	1,021.0	**23%**
Pattee	2,270.0	611.2	277.6	279.8	52.8	69.5	313.8	12.0	1,616.8	3,886.7	**42%**
HUB	2,055.8	171.6	295.2	49.0	55.8	42.7	500.1	0.4	1,114.7	3,170.5	**35%**
HUB Dining	8,616.5	150.2	971.9		195.2	78.4	4,214.1	1,406.7	7,016.5	15,633.0	**45%**

Notes: All units are pounds per week.

3.3.3 Contamination Assessment

Table 3-3 (following pages) shows the results of the visual assessment for contamination for each building. This provided important insights into the actual performance of students, faculty, and staff, i.e., how well they do at properly separating the targeted materials. It is important to

note that the visual assessment was based on the volume of target and non-target materials, so light-weight materials like plastic bottles and film represent a much larger volumetric percentage than weight-based percentage. Key findings are as follows:

- *Least Contaminated Recyclables*: Overall, recyclable metal and recyclable paper had the highest percentages of target materials (lowest percentage of non-target materials). Common non-target materials in the metal recyclables were food contaminated metals (e.g., catering trays) and misplaced recyclable plastics. Non-recyclable paper (primarily paper cups and other serviceware) was the primary contaminant in the paper stream.
- *Most Contaminated Recyclables:* Miscellaneous plastics, which were only evaluated in the Spring Audit, had the lowest percentage of target material. Food contaminated plastics, non-recyclable paper, and misplaced plastic bottles were significant non-target materials in this stream.
- *Plastics and Glass:* Plastic bottles & film and glass were moderately clean on average. Both had notable amounts of both misplaced recyclables and contamination. Full or nearly full bottles were a primary contaminant in the plastic bottles & film stream, while both streams had non-recyclable paper contamination.
- *Compostables*: The compost stream (not including dining hall compost) had relatively high contamination, between 25 to 55 percent contamination. Major contaminants were non-compostable paper food serviceware and rigid plastics.
- *Buildings with Least Contamination*: Dining halls had exceptionally clean recycling streams as a whole. However, it should be noted a small amount of the recycling, specifically those collected in public areas rather than the kitchen and food preparation areas, had a much higher amount of contamination than pre-consumer recyclables, which were virtually free of contaminants. Dormitory and athletic buildings also had fairly clean recyclables.
- *Buildings with Most Contamination*: HUB and Patee & Paterno Libraries had the highest amount of non-target materials. On average, recyclables and compost stream only contained about 60 percent target materials.

Table 3-3: Contamination Assessment Results

Building	Recyclable Paper				Plastic Bottles				Misc Plastics			
	CY/ week	Target Material	Other Recyclables	Contam.	CY/ week	Target Material	Other Recyclables	Contam.	CY/ week	Target Material	Other Recyclables	Contam.
Davey	0.81	90%	<5%	10%	0.50	85%	10%	10%	0.81	65%	15%	15%
Frear	0.22	95%	0%	<5%	0.42	90%	10%	<5%	0.04	65%	30%	5%
Thomas	2.47	70%	10%	20%	2.29	65%	15%	20%	1.55	45%	25%	25%
Willard	1.64	75%	<5%	25%	2.59	60%	25%	15%	1.65	45%	15%	45%
Kern	0.69	40%	<5%	55%	1.06	45%	35%	20%	1.26	40%	10%	50%
OPP	1.50	95%	<5%	5%	0.64	85%	5%	10%	0.32	70%	10%	15%
Shields	1.76	95%	<5%	<5%	1.39	80%	10%	5%	0.00	90%	<5%	<5%
Smeal	3.53	80%	5%	10%	3.29	70%	10%	20%	2.12	50%	15%	40%
White Course												
IM	0.12	95%	<5%	5%	0.55	80%	10%	10%	0.21	60%	25%	15%
Rec Hall	0.85	95%	0%	<5%	0.92	85%	5%	10%	0.07	65%	25%	10%
Pollock*	1.92	80%	<5%	20%	10.26	95%	<5%	5%				
Redifer*	0.75	80%	<5%	20%	13.29	95%	0%	5%				
Waring*	0.54	90%	0%	10%	8.28	90%	<5%	5%				
Beaver*	0.50	90%	0%	10%	2.31	95%	<5%	<5%				
Cooper-Hoyt*					0.71	90%	<5%	10%				
Earle*	1.07	90%	<5%	10%	2.52	85%	<5%	10%				
Hamilton*	0.75	90%	0%	10%	2.47	85%	<5%	10%				
Leete*	0.16	90%	<5%	5%	1.51	90%	<5%	10%				
Pattee	6.35	70%	5%	20%	5.76	60%	20%	20%	4.06	40%	20%	35%
HUB	1.76	70%	5%	20%	4.51	35%	25%	40%	0.75	45%	20%	40%
HUB Dining	1.94	50%	10%	40%	15.99	65%	<5%	35%				

Note: Percentages for each materials category by building type may not add to 100% due to the nature of the volume estimation procedure used in the audit.
*For these buildings, miscellaneous plastics are included in the plastic bottles & film stream due to how they were collected in the Fall Audit.
**Compost was not quantitatively evaluated at the dining halls.

Table 3-3: Contamination Assessment Results (continued)

	Metal				Glass				Compost		
Building	CY/ week	Target Recyclable	Other Recyclables	Contam.	CY/ week	Target Recyclable	Other Recyclables	Contam.	CY/ week	Target Recyclable	Contam.
Davey	0.08	95%	2.5%	2.5%	0.05	95%	0%	2.5%	0.67	75%	25%
Frear	0.02	100%	0%	0%					0.36	65%	35%
Thomas	0.31	65%	15%	15%	0.26	70%	20%	10%	1.38	75%	25%
Willard	0.47	90%	5%	2.5%	0.34	60%	25%	15%	1.41	65%	35%
Kern	0.05	75%	15%	10%	0.03	75%	10%	15%	0.71	35%	65%
OPP	0.09	100%	0%	2.5%	0.09	80%	15%	2.5%	0.95	75%	25%
Shields	0.44	95%	2.5%	2.5%	0.01	70%	0%	30%	0.63	80%	20%
Smeal	0.67	85%	2.5%	15%	0.26	75%	20%	10%	2.03	70%	30%
White Course											
IM	0.16	65%	2.5%	35%	0.01	65%	35%	0%	0.04	70%	30%
Rec Hall	0.20	100%	2.5%	0%	0.00	100%	0%	0%	0.23	80%	20%
Pollock**	4.07	100%	2.5%	0%	0.03	95%	0%	5%			
Redifer**	5.29	95%	0%	2.5%	0.51	85%	5%	10%			
Waring**	3.78	95%	0%	5%	0.03	100%	0%	<5%			
Beaver	0.08	90%	0%	10%	0.15	95%	2.5%	2.5%	0.34	75%	25%
Cooper-Hoyt									0.38	30%	70%
Earle	0.22	95%	2.5%	2.5%	0.05	95%	5%		0.40	90%	10%
Hamilton	0.23	95%	0%	2.5%	0.12	90%	0%	10%	0.09	90%	10%
Leete	0.03	85%	15%	0%	0.01	100%	0%	0%	0.11	95%	5%
Pattee	1.18	70%	10%	20%	0.44	65%	20%	20%	1.45	60%	40%
HUB	0.68	75%	0%	25%	0.21	85%	10%	5%	5.53	45%	55%
HUB Dining	2.98	90%	2.5%	10%	0.37	45%	25%	35%	9.41	50%	55%

Note: Percentages for each materials category by building type may not add to 100% due to the nature of the volume estimation procedure used in the audit.

*For these buildings, miscellaneous plastics are included in the plastic bottles & film stream due to how they were collected in the Fall Audit.

**Compost was not quantitatively evaluated at the dining halls.

3.3.4 Overall Refuse Composition

Table 3-4 (next page) summarizes the refuse composition from each building, grouped by major material type and diversion potential. Key findings from these results include:

- *Targeted materials found in refuse:* Materials targeted for recovery (recyclables and food waste) that were in the refuse stream ranged from 18 percent to nearly 60 percent.
- *Unrecovered recyclables by building:* The dorms and White Course had the highest percentage of recyclables in their refuse, followed by academic and administrative buildings. Dining halls, athletic buildings, and HUB Dining had the least percentage of recyclables.
- *Recyclable material type comparison:* On average, recyclable paper and plastics comprised the highest percentage of recyclables in the refuse.
- *Unrecovered food waste:* As expected, dining halls, HUB, dorms, and apartments had significantly higher amounts of food waste in their refuse than the other building types.
- *Potential compostables:* The WCS also separated potentially compostable materials that are not food waste. This category was predominantly paper towels, tissues, and napkins and compostable food serviceware. This represents between 7 and 54 percent of the refuse stream. Athletic, library, and academic buildings had the highest percentage of these.

Table 3-4: Refuse Composition by Major Material Category & Building Type

Building	Recyc. Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass	OCC	**Total Target Recyclables**	Food Waste	**Total Target Recoverables**	Potential Recoverables	Potential Compostables	All Other Materials
Davey	5.4%	4.6%	8.2%	2.3%	2.4%	0.7%	**23.5%**	14.7%	**38.2%**	3.8%	22.4%	35.6%
Frear	2.5%	2.0%	3.8%	1.1%	0.2%	1.4%	**11.0%**	6.4%	**17.4%**	8.3%	17.3%	57.0%
Thomas	6.9%	5.9%	8.3%	1.3%	1.9%	0.4%	**24.7%**	16.2%	**40.9%**	1.6%	23.1%	34.4%
Willard	5.0%	3.7%	7.5%	1.0%	0.2%	1.3%	**18.6%**	11.9%	**30.6%**	2.4%	29.7%	37.4%
Kern	2.7%	3.2%	12.0%	0.4%	0.3%	0.6%	**19.2%**	18.9%	**38.1%**	1.3%	10.7%	49.8%
OPP	5.3%	3.4%	4.0%	1.2%	0.6%	1.6%	**16.1%**	19.1%	**35.3%**	4.0%	31.3%	29.4%
Shields	15.0%	3.2%	6.3%	1.7%	0.7%	0.5%	**27.5%**	15.9%	**43.3%**	2.5%	23.5%	30.7%
Smeal	4.4%	5.4%	6.0%	0.9%	2.6%	1.3%	**20.5%**	15.4%	**35.9%**	3.1%	25.0%	36.1%
White Course	7.8%	3.6%	2.6%	2.1%	3.1%	3.8%	**23.0%**	35.7%	**58.7%**	2.9%	7.3%	31.1%
IM	2.4%	6.0%	1.5%	1.1%	0.2%	0.8%	**12.0%**	5.9%	**17.9%**	1.2%	54.0%	27.0%
Rec Hall	4.0%	4.2%	2.4%	1.4%	0.9%	1.1%	**14.1%**	5.8%	**19.9%**	10.6%	23.2%	46.3%
Pollock	4.5%	2.4%	1.8%	2.3%	0.4%	1.1%	**12.5%**	19.7%	**32.2%**	2.7%	5.6%	59.6%
Redifer	3.4%	2.9%	4.3%	1.6%	0.7%	1.1%	**14.0%**	31.1%	**45.0%**	8.1%	8.7%	38.1%
Waring	3.1%	1.4%	3.2%	1.9%	0.4%	0.4%	**10.3%**	34.2%	**44.5%**	2.7%	13.7%	39.0%
Beaver	6.1%	9.3%	4.0%	1.4%	2.9%	2.1%	**25.7%**	26.2%	**52.0%**	6.3%	7.8%	34.0%
Cooper-Hoyt	5.4%	8.4%	4.2%	0.9%	6.4%	2.6%	**28.0%**	27.8%	**55.9%**	4.4%	4.5%	35.2%
Earle	6.0%	7.6%	3.9%	1.6%	5.8%	2.6%	**27.5%**	23.1%	**50.6%**	4.1%	9.9%	35.4%
Hamilton	5.6%	8.3%	3.9%	1.6%	3.8%	2.7%	**25.9%**	26.4%	**52.3%**	5.1%	6.1%	36.5%
Leete	5.8%	7.6%	3.9%	1.0%	1.5%	1.4%	**21.3%**	29.6%	**50.9%**	3.4%	8.4%	37.3%
Pattee	3.2%	4.5%	8.5%	1.0%	1.2%	0.6%	**19.1%**	12.4%	**31.5%**	2.1%	27.7%	38.7%
HUB	5.7%	3.9%	8.8%	1.9%	0.9%	1.2%	**22.4%**	24.5%	**46.8%**	2.6%	9.9%	40.7%
HUB Dining	3.6%	2.9%	4.3%	1.5%	0.6%	0.6%	**13.5%**	35.4%	**48.8%**	4.4%	16.5%	30.3%

Section 4
Campus-Level Generation and Recovery

In order to better assess the solid waste program on a campus level, the data gathered during audits was extrapolated to calculate the amounts of solid waste generated by the building types targeted in the audit. The first step of the process was to compile a list of buildings at Penn State. Using a list provided by University OPP staff and through conducting research on Penn State and OPP website, KCI categorized each building by its primary function(s). To account for the different sizes of the buildings in the audit, KCI normalized material generation rates by the gross square footage of each building, as listed on the OPP-provided list.

Table 4-1 below lists building types, number of buildings, the total gross square footage on campus, and names of buildings included in the audit for each type (if applicable). The audits focused on a subset of buildings and building types that account for the majority of waste generation. Other building types[3] were not included in the audit, so generation and recovery metrics data were not available to include them in the campus-wide generation and recovery estimates. Additionally, the audit did not evaluate the generation or composition of waste collected outside of buildings in collection barrels throughout the campus. Despite this, the generation, recovery and contamination data gathered during the audits provided very detailed information that KCI believes make it possible to identify the primary opportunities and challenges to improve Penn State's recovery programs across the entire campus.

Table 4-1: Summary of Campus Buildings and Building Area

Building Types Targeted by Audits	Number of Buildings	Total Area (ft^2)	Buildings in Audits
Academic	86	5,979,214	Davey, Frear - North & South, Thomas, Willard
Administrative	52	1,526,884	Smeal, Kern, OPP, Shields
Apartment	52	511,309	White Course (all buildings)
Athletic	7	932,869	IM, Rec Hall
Dining Hall	5	434,647	Pollock, Redifer, Waring
Dormitory	61	3,834,351	Beaver, Cooper-Hoyt, Earle, Hamilton, Leete
Library	2	483,737	Pattee & Paterno
Student Union	1	282,469	HUB (all areas)
Total	**266**	**13,985,480**	

4.1 Material Generation

The annual, campus-level material generation was calculated by first dividing the weekly generation of each material stream measured from each building during the audit by the total square footage. The generation by area for each building was averaged for all buildings audited

[3] Barns, greenhouses, hotel, laboratories, maintenance/storage/utilities, parking garages, stadiums/arenas, and other.

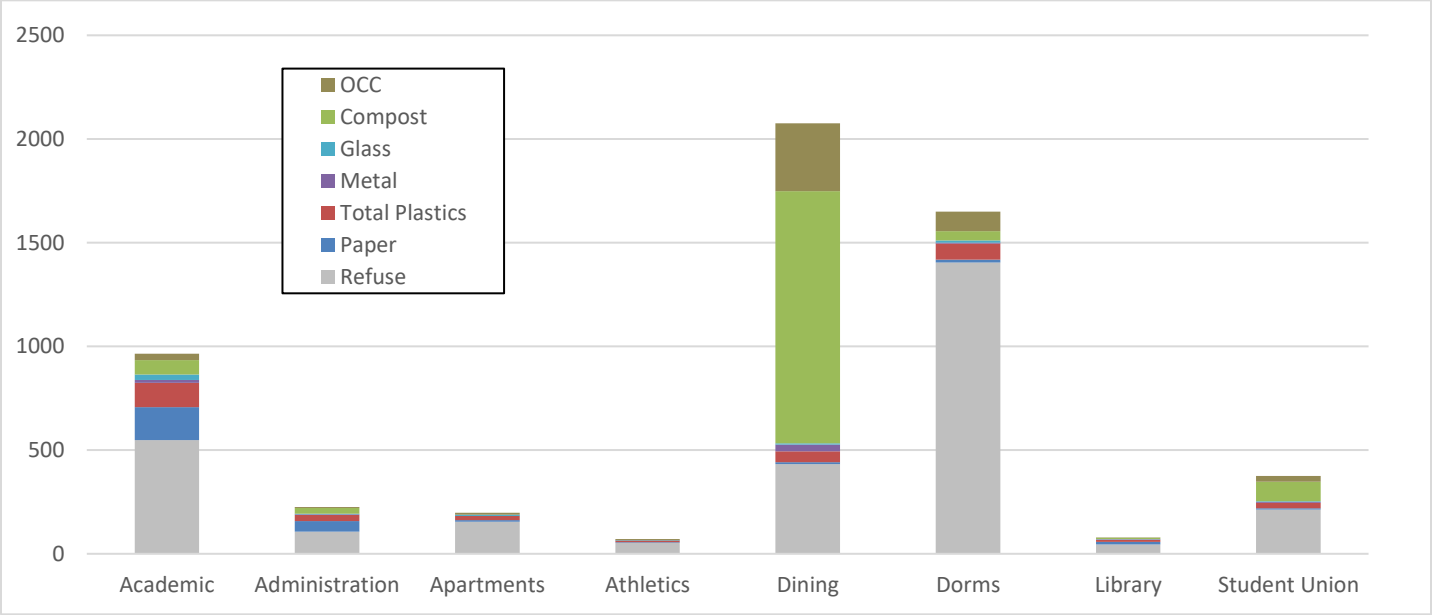
for each building type. This average was multiplied by the total area of all buildings of the specific type on campus. Finally, annual generation was calculated by multiplying the weekly total generation by 40 weeks (16 weeks each for the spring and fall semester plus 8 weeks for the summer semester[4]). Table 4-2 and Figure 4-1 show the estimated annual generation and overall recovery for each building type included in this Assessment.

Table 4-2: Estimated Campus-Level Generation for Audited Building Types

Building	Refuse	Paper	Plastic Bottles &Film	Misc. Plastics	Metal	Glass	Compost	OCC	Total Generated	Total Recovered	% of Total Campus Recovery	Recycling Rate
Academic	548	158.8	73.3	43.4	13.9	26.8	70.2	30.4	965	417	16%	43%
Admin	108	51.0	17.0	11.0	4.4	2.9	27.4	4.0	225	118	4%	52%
Apt	156	7.6	20.1	0.0	0.0	6.0	0.0	8.6	198	42	2%	21%
Athletic	52	4.4	4.8	1.0	3.0	0.1	1.3	4.6	71	19	1%	27%
Dining	432	8.6	52.4	0.0	33.5	5.6	1,216.7	325.8	2,075	1,643	61%	79%
Dorm	1,404	14.9	76.2	0.0	5.0	11.5	44.8	92.8	1,649	245	9%	15%
Library	45	12.2	5.5	5.6	1.1	1.4	6.3	0.2	78	32	1%	42%
Stud. Un.	213	6.4	25.3	1.0	5.0	2.4	94.1	28.1	375	162	6%	43%
Total	**2,958**	**264.0**	**274.6**	**61.9**	**65.8**	**56.8**	**1,460.8**	**494.5**	**5,637**	**2,678**	**100%**	**48%**

Note: All units are in tons/year or percent by weight.

Figure 4-1: Estimated Campus-Level Generation for Audited Building Types



[4] While the summer semester is 12 weeks, our analysis uses 8 weeks to account for the reduced generation of material during the summer semester. Using OPP tonnage reports, the summer months (May – August) had about two-thirds the generation of waste as the spring and fall months (January – April) and (September – December).

It is important to understand why the campus-level 48 percent recycling rate for audited buildings is less than the campus-wide recycling rate of 58 percent reported for 2018 (see Table 2-2). The primary reason is that campus-wide recovery includes a much broader array of recovered materials than what is generated in the audited buildings, in particular wood waste, yard waste, grass, and C&D.

Some keys points from this analysis include:

- Despite only including 5 buildings and less than 450,000 ft^2, dining halls generated approximately 37 percent of the solid waste and 60 percent of the recovered material from the building types targeted by the audits. Compost alone from dining halls accounts for approximately 45 percent of all recovery from the target building types. Because of this, dining halls had by far the highest recovery rate of any building type audited.
- Dormitories had the second highest overall generation. However, they had the lowest recovery rate of any building type.
- Academic, due to their high number and total square footage, had the third highest generation and a moderate recovery rate.
- The Student Union had the second highest generation rate on a square footage basis, after dining halls.

4.2 Generation and Recovery by Stream

This subsection discusses the various recovery streams as well as the recoverable materials in the refuse stream for each building type. This information will be used to identify opportunities to improve the quality and/or quantity of recyclables collected. As mentioned previously, because the contamination assessment was on a volumetric basis, the tons collected in the recyclables stream is the gross weight of the material as they are generated and does not account for the contamination and non-target materials in these streams. Therefore, it is not possible to adjust recovery tonnage calculations to exclude contamination and the total tons recovered of each material includes the contamination in that stream.

A note about the graphs presented below: the dark section of the bar represents the total weight of the recovered material stream. The lighter part of the bar is the weight of these materials in the refuse stream. Therefore, the total bar is the total generation of that material type from each building type on campus (as tons per year). The dots represent the purity of the recycling stream (i.e., the percent by volume that is target material) as estimated in the contamination assessment. As mentioned in Section 3, contamination was not quantified for the apartment recyclables, dining hall compost, or OCC.

4.2.1 Paper and OCC

Figures 4-2 and 4-3 show the annual total tons of paper and OCC, respectively, collected for recycling stream and discarded in the refuse stream, as well as the purity of the streams.

Some key findings of this analysis include:

- Academic buildings have by far the highest overall generation of recyclable paper. They have one of the highest recovery rates of paper and OCC, and they have relatively clean material. This indicates that they play a significant role in campus-level paper recovery and are doing a decent job of it.
- Dorms have the second highest total generation of paper and the highest amount of unrecovered paper. They also have very little contamination in the paper stream. This suggests that paper recycling participation rates are very low in dorms, but those that do recycle do a good job of keeping contaminants out.
- The library and student union have relatively small quantities of paper compared to the other building types and have the lowest purity. This demonstrates that these buildings are not significant generators of paper and cardboard but can be a significant source of contamination.
- Overall, the OCC recovery rate from audited buildings is very high.
- The dining halls generate the vast majority of OCC from audited building types and they achieve a very high recovery rate, which means they play a central role in campus-level OCC recycling.
- Dorms have the highest quantity of discarded OCC, but the majority is still recovered.

Figure 4-2: Campus-Level Recyclable Paper Recovered and Discarded

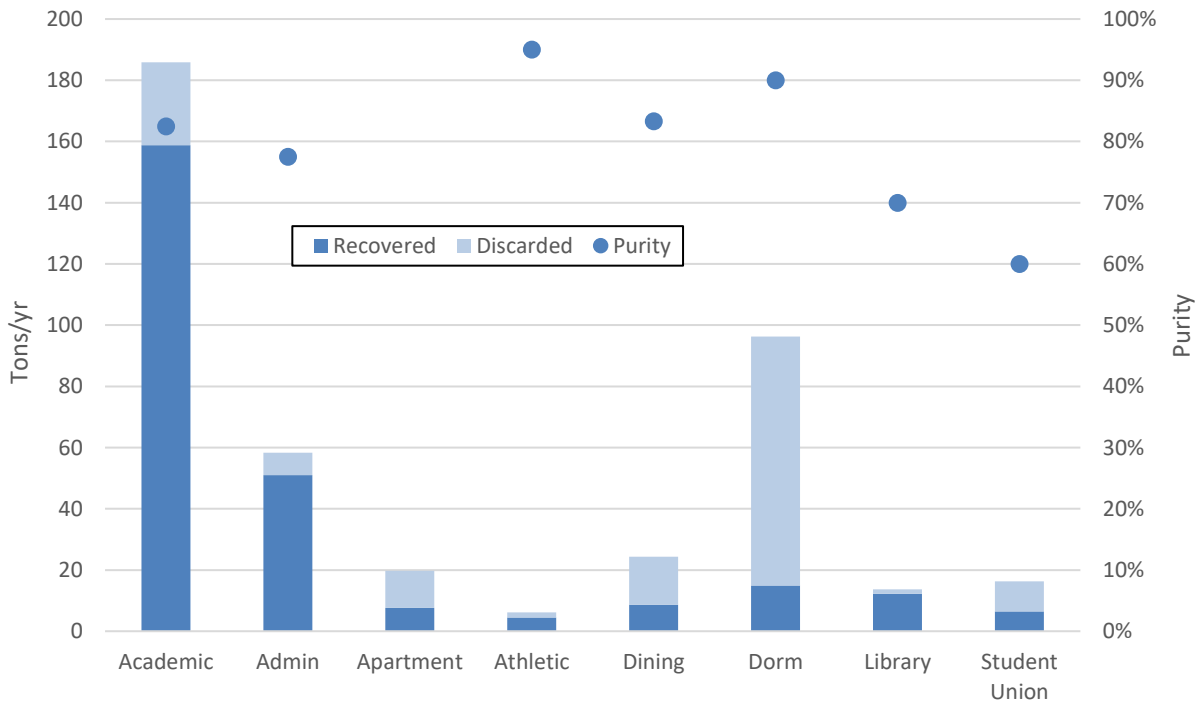
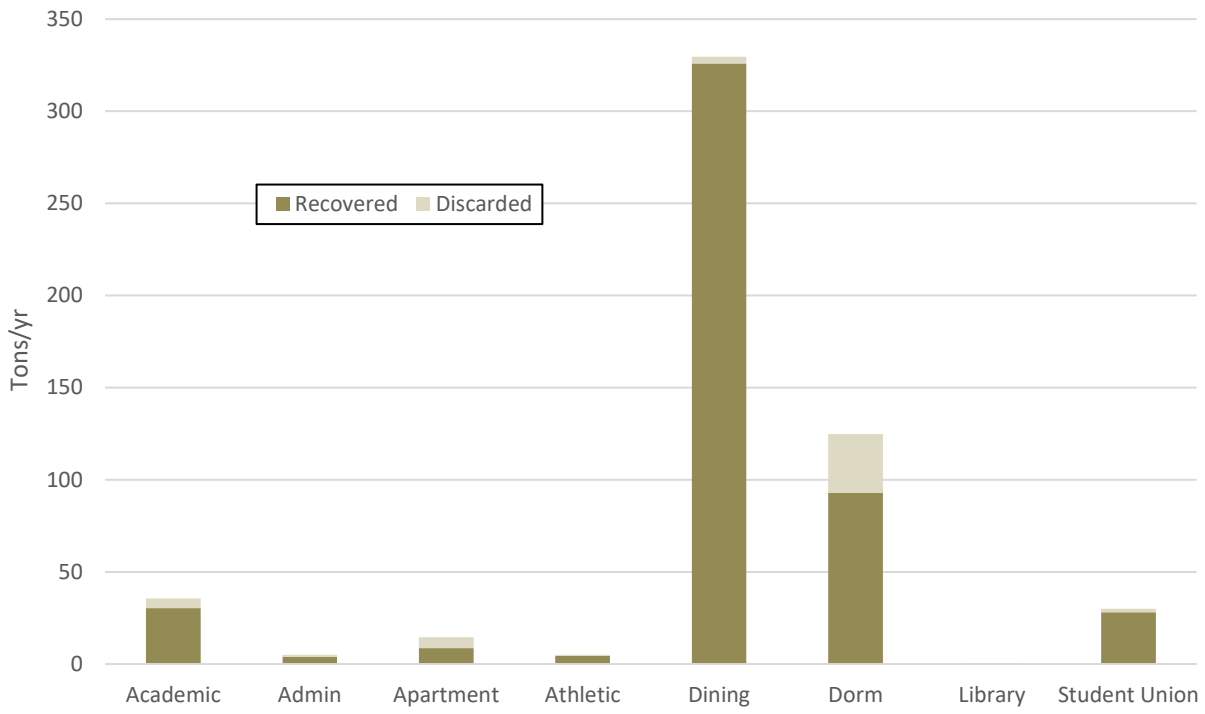


Figure 4-3: Campus-Level OCC Recovered and Discarded



4.2.2 Plastics

Figures 4-4, 4-5, and 4-6 show the amount of plastic bottles & film, miscellaneous plastics, and total recyclable plastics, respectively, collected though the recycling stream and discarded in the refuse stream, as well as the purity of the streams. Total plastics are shown for apartments, dining halls, and dormitories, and student union because the plastics recycling streams were not able to be separately audited in the Fall Audit.

Some key findings of this analysis include:

- Plastic bottles & film tend to have higher purity (lower contamination) in the range of 60 to 80 percent versus miscellaneous plastics with purity in the range of 40 to 70 percent.
- Dorms have the highest generation (nearly 250 tons per year), but the lowest recovery rate, about 30 percent, of its targeted recyclable plastics (see Figure 4-6). Most of this unrecovered weight was plastic bottles. They also had a relatively high purity. This again indicates that recovery participation rates are low in dorms, but those that do recycle do a good job of separating the targeted materials without contamination.
- Academic buildings have the second highest generation of recyclable plastics. Most of which is plastic bottles & film. The recovery rate for plastic bottles & film (about 75 percent) is significantly higher than for miscellaneous plastics (about 50 percent). In addition, miscellaneous plastics had a much lower purity than bottles & film. This suggests that public understanding is low regarding what miscellaneous plastics includes.

- The dining halls have the third highest generation rate of plastics and the cleanest material. About 70 percent of plastics are recovered. It's important to note that the vast majority of the material (observed not quantified) is pre-consumer recyclables (mostly large plastic jars and bottles) that are much cleaner than the post-consumer material.
- Conversely, the student union, has one the lowest purity of recyclable plastics, with a recovery rate of about 55 percent. Most of the plastics were recovered from the first floor (HUB Dining). Roughly half of this was from pre-consumer areas. As with dining halls, these were vastly cleaner than post-consumer material. Figure 4-7 shows a side-by-side of the pre- and post-consumer plastics. This indicates that general understanding and/or compliance with separation of plastics is poor in public areas.

Figure 4-4: Campus-Level Plastic Bottles & Film Recovered and Discarded

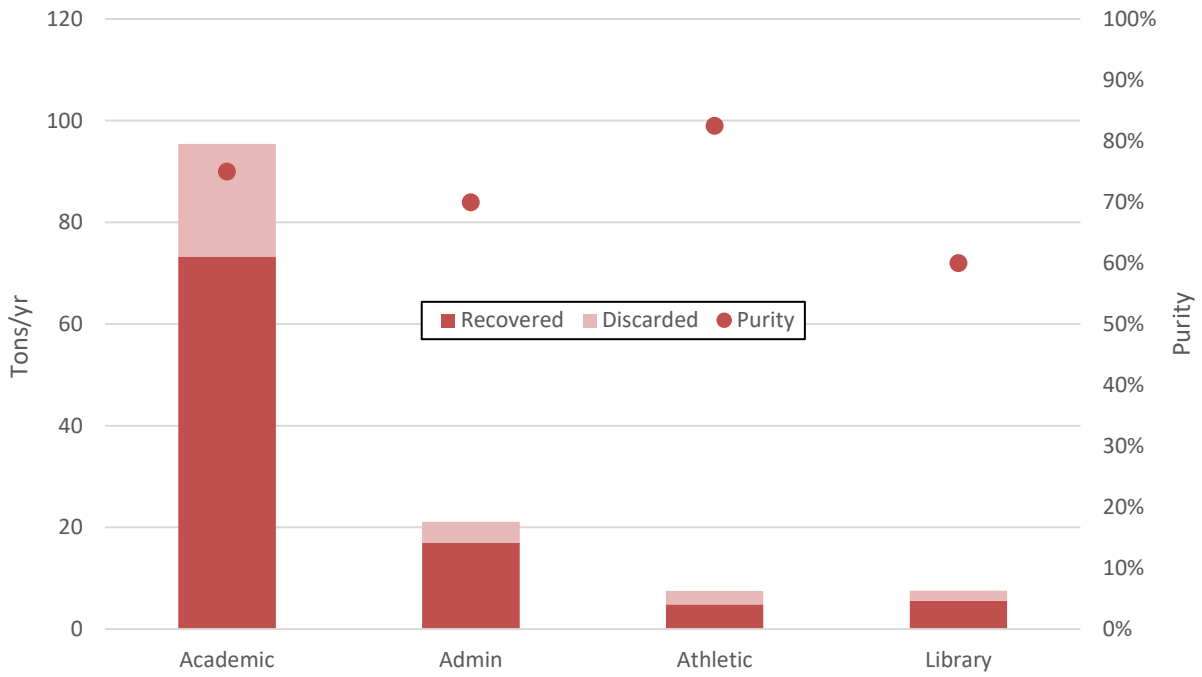


Figure 4-5: Campus-Level Miscellaneous Plastics Recovered and Discarded

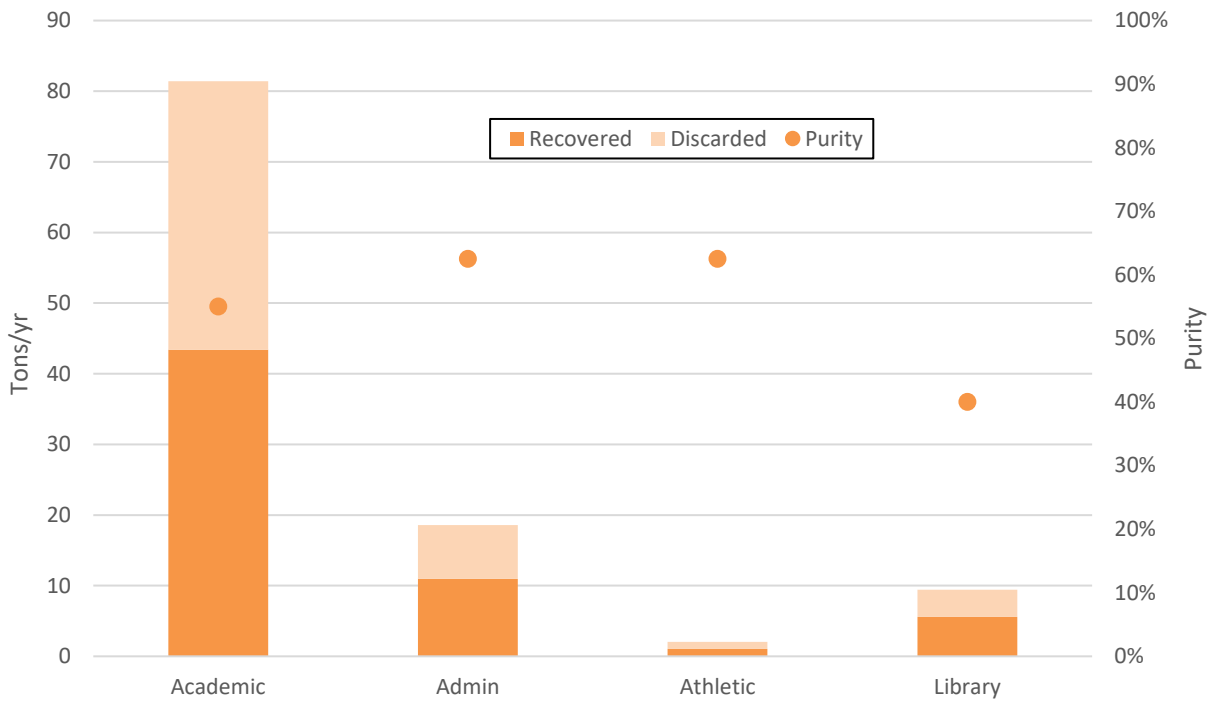


Figure 4-6: Campus-Level Total Recyclable Plastics Recovered and Discarded

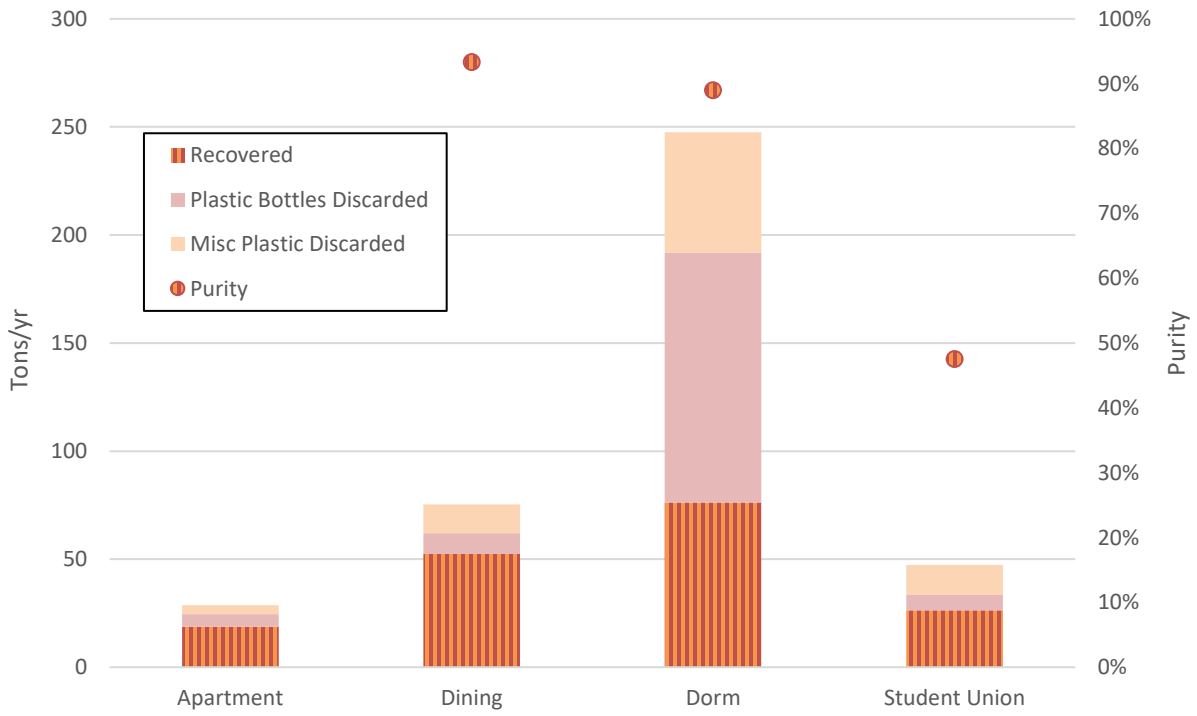


Figure 4-7: Pre-Consumer Versus Post-Consumer Plastics

4.2.3 Metal & Glass

Figures 4-8 and 4-9 show the annual total tons of metal and glass, respectively, collected though the recycling stream and discarded in the refuse stream, as well as the purity of the streams.

Some key findings of this analysis include:

- All metal streams were relatively clean. Only the library had less than 80 percent purity.
- Dining halls generate the largest amount of metal and recover about 80 percent of what was generated. As observed during the audit, the vast majority of this is large steel food cans from the kitchen areas of the buildings (Figure 4-10). Bags of pre-consumer cans were exceptionally pure and most of the contamination from dining halls was in the minimal amount of post-consumer metals collected. This demonstrates that recycling stations in public areas of the dining halls are a primary source of contamination while being a minor source of tonnage.
- Dorms and academic buildings both generate significant quantities of metals. While academic buildings recover the major of metals generated, dorms only recover about 20 percent. Apartments also recover only about 25 percent of the metal generated, although comparatively much less was generated.
- Dorms generate more glass than all other building types combined. Less than 20 percent is recovered. The glass that is recovered from dorms has very little contamination.
- These findings are consistent with those for other materials indicating the dorms have consistently low participation rates but low contamination in what little is recovered.

- Academic buildings have the second highest glass generation and approximately 80 percent is recovered, however what is recovered has high levels of contamination.
- Libraries and student union do not generate much glass, but what is recovered is very contaminated, which suggests these buildings are significant sources of contamination.

Figure 4-8: Campus-Level Metal Recovered and Discarded

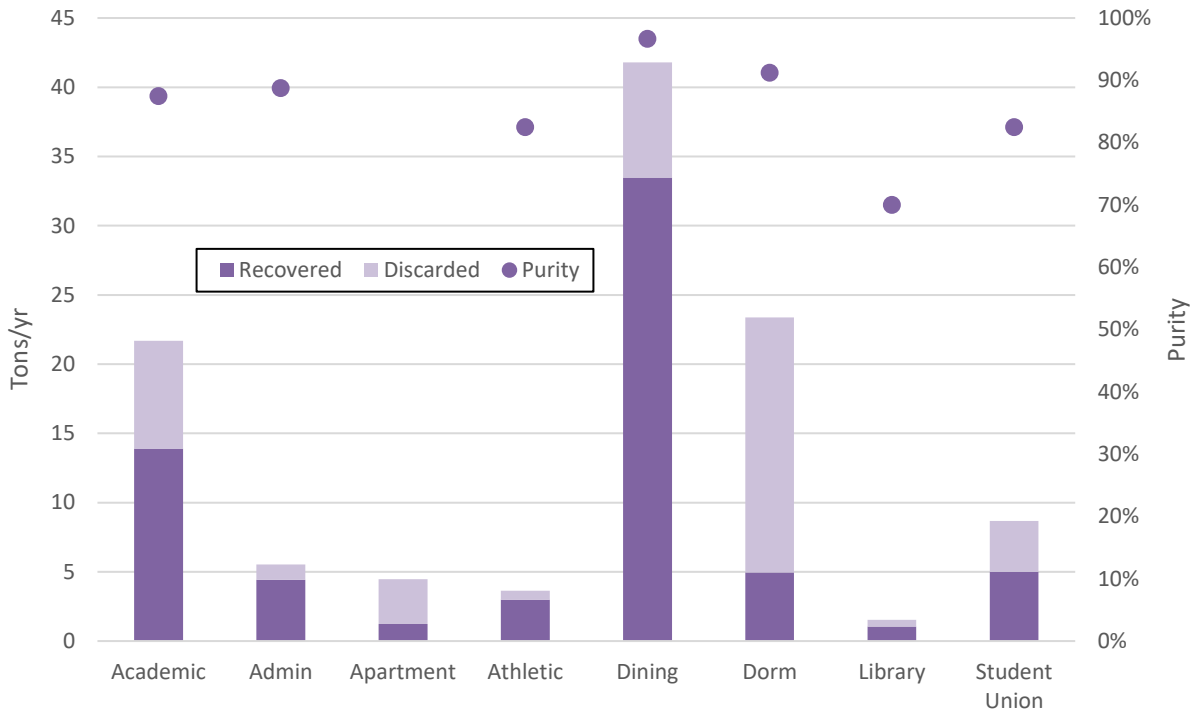


Figure 4-9: Campus-Level Glass Recovered and Discarded

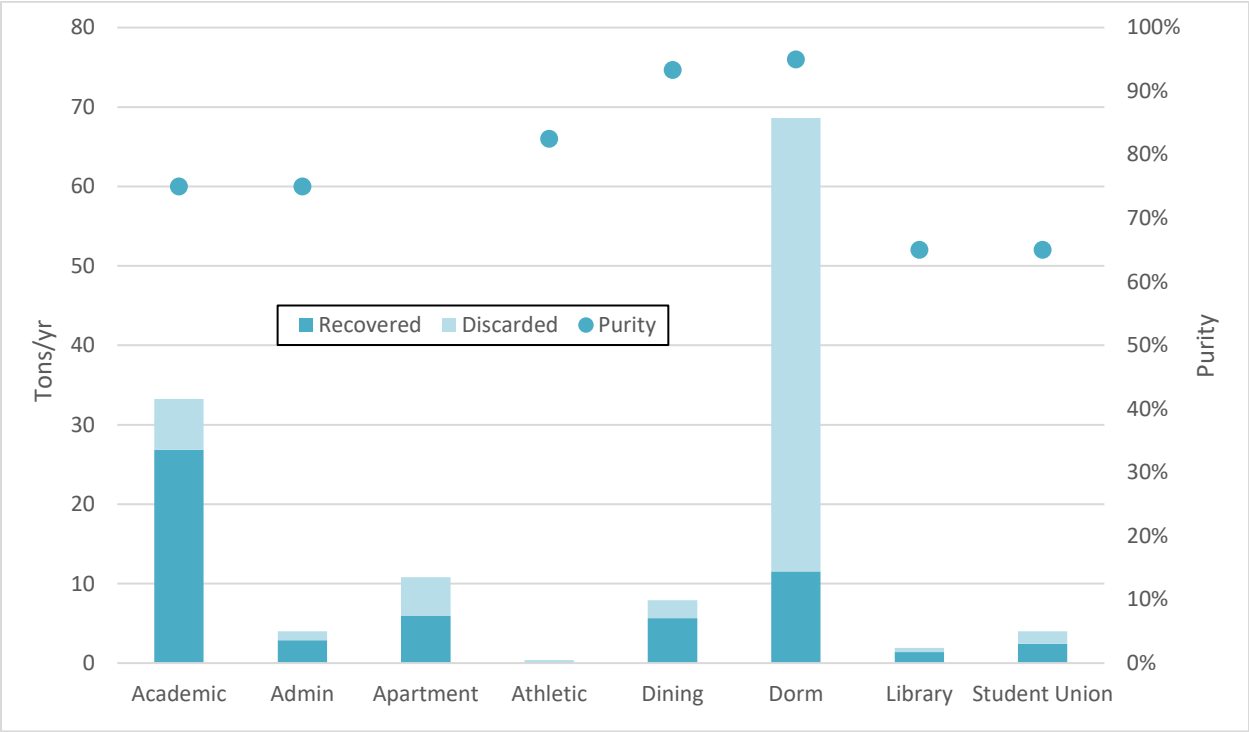


Figure 4-10: Pre-Consumer Metal Cans from Dining Halls

4.2.4 Compost/Food Waste

Figures 4-11 shows the annual total tons of compost collected for composting and the food waste discarded in the refuse stream, as well as the purity of the streams. The discarded material only accounts for the food waste in the refuse stream, not other potential compostables. However, when measuring purity, other potential compostable materials are not considered contamination.

Some key findings of this analysis include:

- As mentioned above compost from dining halls is the most significant recovered material stream. Over 90 percent of compost generated is recovered. However, KCI did observe several instances of food waste, primarily packaged food waste being discarded in the refuse stream from dining hall (see Figure 4-12). While the purity of compost from the dining halls was not quantitatively assessed, observations made when it was tipped at the compost facility indicated it had very minimal contamination, which is likely to due to high-level of understanding and compliance in food preparation areas and kitchens.
- As with other streams, dorms had the highest amount of unrecovered food waste. Only about 10 percent of food waste from dorms was recovered.
- The student union has the third highest amount of compost generated. The purity shown in Figure 4-11 is only for material assessed at the Bar Pit, which was primarily post-consumer material. Pre-consumer food waste tipped at the OMPEC was much cleaner (Figure 4-13). By weight the pre-consumer compost stream tipped at OMPEC was much smaller than the post-consumer weighed at the Bar Pit. The assessment of post-consumer organics strongly indicates that it is the primary source of contamination.
- Relatively minimal compost of moderate purity was generated from other building types.

Figure 4-11: Campus-Level Compost/Food Waste Recovered and Discarded

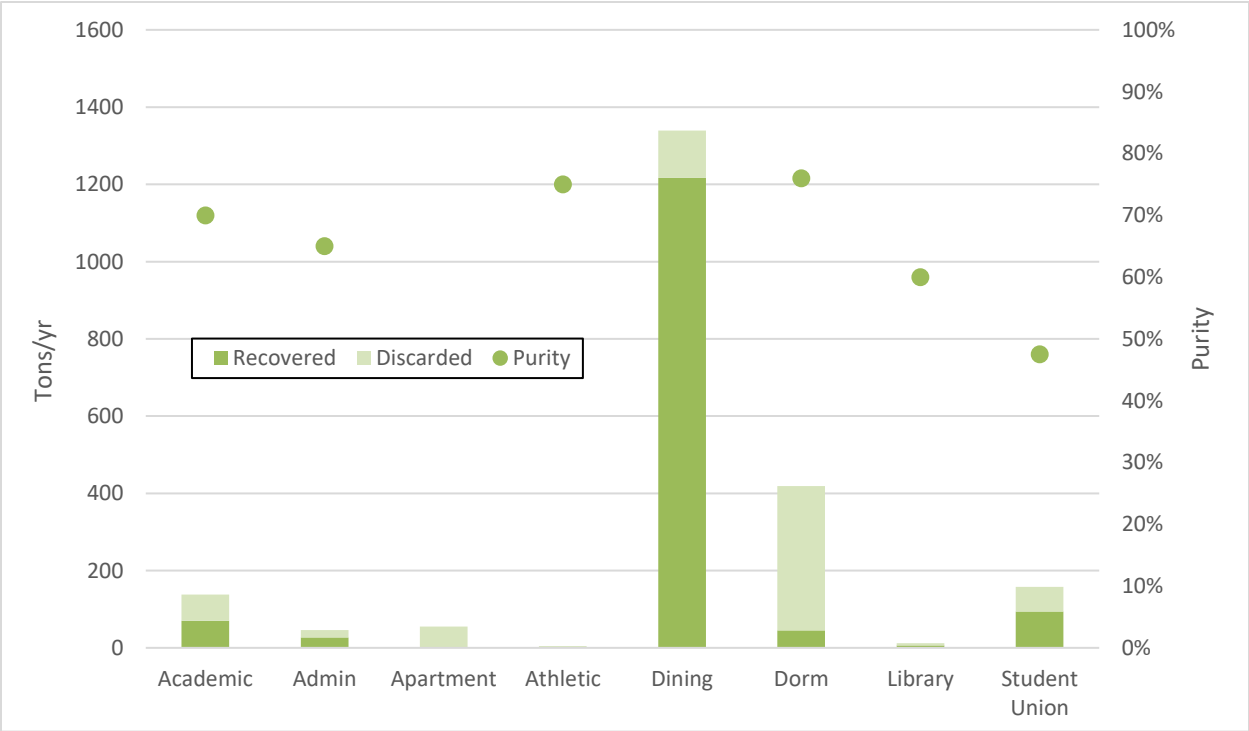


Figure 4-12: Discarded Packaged Food Waste from Dining Halls

Figure 4-13: Pre-Consumer Compost (left) and Post-Consumer Compost (right)

Section 5
Assessment of Existing Collection System

5.1 Overall Program Participation and Compliance

Results of the audits indicated that the campus population generally supports and participates in the campus recovery programs. First, as shown in the bar charts in Section 4, the material-specific recovery rates of targeted recyclables are greater than 50% for most buildings' recycling stream, meaning more of the recyclables are being recovered than discarded in refuse. The major exception to this is dorms. Second, targeted materials account for the majority of volume in most buildings' recycling and compost streams, indicated by the purity/contamination rates.

However, despite these indications of general support and participation, the visual audit found significant amounts of misplaced recyclables and contamination in recycling and compost containers, especially in the miscellaneous plastics and compost streams at certain building types. This indicates problems with getting the campus population to understand and/or comply with the material category and separation requirements, which may be attributable to one or more of the following:

- The campus population does not understand what items are included in each material category.
- The signs and instructions do not effectively communicate and promote proper materials segregation.
- The signs and instructions are not consistent from one place to another, in terms of design, images, and definitions of acceptable materials.
- The design of collection containers and/or their placement within buildings leads to improper collection or contamination.
- Separating materials into seven different categories requires more effort (thinking, decision-making, and time) than people are willing or able to invest. This could be especially problematic for the predominantly temporary student population on campus, many of whom may come from municipalities with very different recycling programs.
- The campus population includes a number of "wish-cyclers" that want to recycle as much as possible, and when they are unsure if something is a targeted material, they put it in a recycling container that seems appropriate and hope for the best.

Penn State may want to undertake further research such as campus surveys and focus groups to assess current awareness, understanding, and opinions about the current recovery program, material categories, collection containers, etc. And use these as a basis for redesigning and reinvigorating the campus recycling program and its communications program.

5.2 Compatibility with Processing Facilities and Markets

Because Penn State delivers its recyclables to the CCRRA, the materials Penn State collects needs to comply with the capabilities of its processing facility. The CCRRA requires that recyclables be separated by material type because its facility has very limited ability to sort mixed recyclables, as described later in Section 6.

The CCRRA allows Penn State to blend bags of individual materials in the loads it delivers, provided that each material stream is segregated by bag, with the notable exception of glass and OCC which must be delivered in dedicated loads. CCRRA then hand separates the bags by material at their facility. The CCRRA, upon separating these bags, documents, photographs, and rejects any bags of recyclables that it deems to be too contaminated to recycle and not complying with the CCRRA material specifications. Common reasons given for rejection include materials being contaminated by food and/or includes non-compliance materials (cups, lids, straws, silverware, food wrappers, bags, film, etc.). In the case of glass bottles, which the CCRRA specifies must be source separated and delivered separately from other recyclables, any non-glass bottles, even bags of aluminum cans, are considered contamination. These rejected bags are sent to the CCRRA's transfer station and Penn State must pay a fee. In 2018, the CCRRA rejected 66 tons of recyclables from Penn State. Figure 5-1 includes example photos that it provided to Penn State to document rejected materials.

It is important to note that while the CCRRA considers these to be contaminated materials, most dual or single stream processors would accept some of the materials being rejected, like those in Figure 5-1. At the same time, the visual contamination audit clearly documents that contamination levels in some recyclables exceed what can be considered acceptable.

Figure 5-1: Examples of Rejected Loads from CCRRA

Contamination in Glass Stream

Food Contamination, Cups, and Lids

Milk Contamination

Styrofoam Trays and Film

Below are KCI's observations regarding the incompatibility of specific material streams being collected by Penn State versus the recovery facilities taking those materials.

Plastic Bottles and Film

The current material separation program at Penn State combines plastic bottles and recyclable film in one collection container. However, CCRRA does not generally accept plastic film. And more generally plastic film is considered a contaminant by most municipal recycling facilities. Combining these materials into the same stream is not compatible with most material processing methods and technologies available in the industry.

Furthermore, CCRRA cites plastic film in bags as a reason to reject otherwise clean loads of plastic bottles. It was noted that in some cases, particularly pre-consumer materials from dining halls, plastic film and plastic bottles are being collected and bagged separately, which could be easily segregated at the CCRRA facility. Results of the visual assessment suggest that plastic film accounted for a significant amount of the material in this category, although much of this was segregated film in separate bags.

Miscellaneous Plastics

This category includes all rigid plastic containers other than plastic bottles. The visual audit found that miscellaneous plastics had the lowest percentage of targeted materials and had the highest amount of contamination of any category, the most predominant contaminants being food-contaminated packaging and non-recyclable paper (e.g., paper cups and plates). Local processing facilities are not readily equipped to handle this level of contamination. In addition, end-use markets for mixed plastics are limited, in particular plastics other than #1 PET, #2 HDPE, and #5 PP. It's also important to note that even materials specifically targeted by Penn State in the miscellaneous plastics (e.g., plastic cups and trays) were cited as reasons for rejecting bags of recyclables by CCRRA.

Food Waste and Other Compostables

Materials currently designated for composting include food waste and other compostable materials like pizza boxes, compostable packaging, and paper napkins and towels. The visual audit estimated that true compostables ranged from 30 to 95 percent of the compostables stream by volume, with a median value of about 70 percent, for buildings in the audits. However, on average, around one third of the compost stream (by volume) consisted of food

waste. A large majority of the compost stream consisted of paper and paper packaging (both compostable and non-compostable). Even though food waste is relatively denser and accounts for a much higher percentage on a weight basis, the audit results clearly indicate that most of the compostables collected are not food waste (Figure 5-2). The notable exception is for pre-consumer organics collected from dining halls and the HUB which are predominantly food waste. These results are generally in line with KCI's observations at other similar post-consumer organics collection programs.

Figure 5-2: Paper Serviceware in the Compost Stream

One issue with the large amount of non-food waste and non-compostable contamination collected with organics is that Penn State's composting facility is not designed or equipped to handle large amounts of packaging and paper. It lacks the kinds of pre-processing equipment (e.g., grinding and depackaging) and post-processing technologies (multi-deck screening) needed to effectively handle large amounts of packaging and contamination.

Additionally, the compost stream contained both compostable and non-compostable food serviceware. Even if the compost facility had proper equipment to fully compost or remove this material, neither solution is optimal. If the non-compostable serviceware was pre-processed (ground), the resulting compost would be contaminated with small pieces of the plastic liner in these materials. Alternatively, if screens (pre- or post-processing) were used to remove the materials, it would also remove the compostable materials.

5.3 Signage and Containers

During the audits, KCI was able to observe collection stations in a few buildings on campus, primarily the HUB and Pattee & Paterno Library. While this was not intended to be a comprehensive evaluation it did provide KCI with important observations into Penn State's collection system.

Inconsistent Signage and Materials

Between and even within buildings, signage is not consistent on collection stations.

Figure 5-3 shows different signs being used for miscellaneous plastics. Some signs included EPS in the stream, despite the CCRRA program not accepting EPS in their miscellaneous plastics. Other signs used the term "hard plastics" instead of "miscellaneous plastics," which could lead to confusion about what the difference is between the two and if plastic bottles, for example, should be placed in hard plastics. Also, the signs include non-container plastics, such as plastic

utensils, which are not be generally accepted in municipal recycling programs and considered contamination by CCRRA. Furthermore, the middle and right sign indicate that Styrofoam is accepted in the bin, which contradicts the Mobius Program brochures.

Confusion over miscellaneous plastics is likely a major reason why the miscellaneous plastics recovery rate is low and contamination rate is high. If people do not know what miscellaneous plastics are, they won't know to recycle them while also putting in the wrong materials.

Similarly signs for the plastics bottles and film stream were not always consistent or clear (Figure 5-4). For example, the "Plastic" sign in Figure 5-4 was adjacent to the "Misc. Plastic" sign shown in Figure 5-3; both of which list bottles as accepted material in the stream. "Stretchy" plastic is also not a clear description of plastic film. As mentioned, it is recommended that film is not included in this stream.

Within the HUB, we observed two very different branding schemes of signage, even in the same room in the food court (Figure 5-5), which can lead to further confusion.

Figure 5-3: Inconsistent Miscellaneous Plastics Signage

Figure 5-4: Inconsistent Plastic Bottles & Film Signage

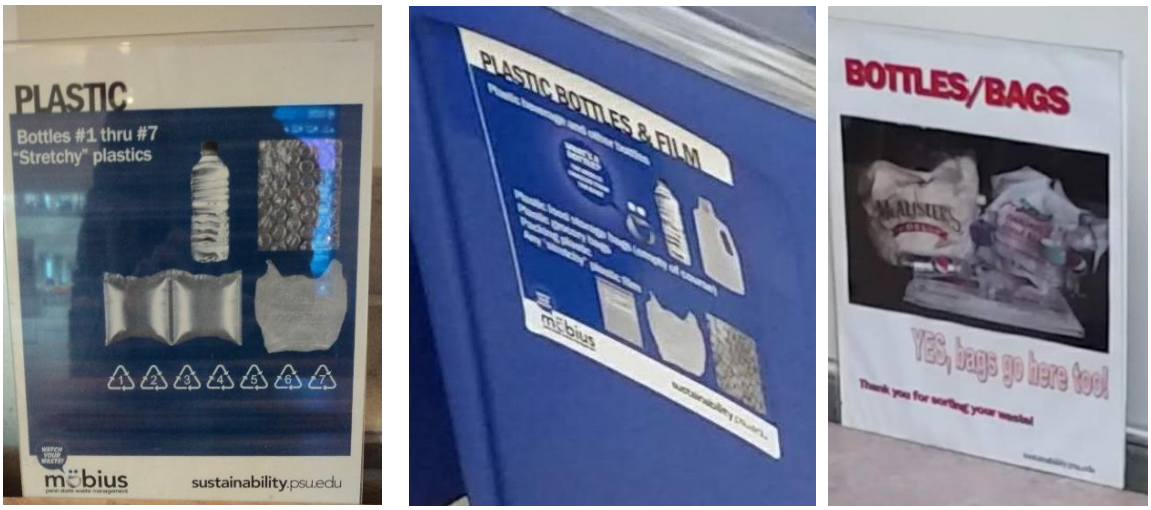


Figure 5-5: Different Signage Themes in the HUB

Inconsistent Containers

While it is understandable that different locations and different buildings require different types and placement of collection containers, KCI observed instances where inconsistencies in the design of collection stations and types of collection container could lead to contamination and misplaced recyclables and negatively impact participation.

The opening of the containers could indicate to the user what material it accepts. In Figure 5-5 above a long narrow opening is used for both plastic bottles & film in one and miscellaneous plastics in the another. Typically, an opening like this indicates paper recycling; however, some stations in the HUB had the narrow opening for plastics (Figure 5-6, right picture). Other times, collection stations had the round openings for all material types (Figure 5-7). In these cases, different size and shape of openings would be a visual cue that they are different streams. For collection areas using individual containers as shown in Figure 5-7, bottom picture, lids could be used for this purpose. Also, signs on the front of individual containers are difficult to see from normal head level, especially if walking by in a crowded area. The signs should be placed on the wall above the containers for easier identification.

Figure 5-6: Variety of Collection Stations in the HUB

Figure 5-7: Stations with Similar Openings

Collection Stations without All Material Categories

Due to the number of streams that Penn State includes in its recycling program, it is not always possible to have all seven streams at every station. However, this could lead to misplaced material or contamination. For example, if a station does not include refuse (Figure 5-8), someone may discard their refuse there any way because they may not take the time to find a refuse container if it is not immediately adjacent. Alternatively, if a refuse container is not paired with a recycling container, recyclables may be placed into the refuse (Figure 5-9). Also, note that the compost container does not have a compost sign in Figure 5-9. People may confuse this for a recycling container and place their recyclables into the compost container here. Additionally, some stations did not include certain streams, for example the left-hand station in Figure 5-8 is missing recyclable paper and miscellaneous plastics. While this may have been an intentional omission, it still creates confusion and lacks cohesion with other stations.

Figure 5-8: Recycling Stations Without a Paired Refuse Container

Figure 5-9: Refuse Containers Without a Paired Recycling Container

Section 6
Local and State Solid Waste Framework

Penn State's waste management system operates within the context of the programs, facilities and ordinances of the Borough and Centre County as well as Pennsylvania's solid waste laws and rules. This Section provides a general overview of the local and state regulatory, institutional, and programmatic framework as it relates to Penn State.

6.1 Government Structure and Authority for Municipal Solid Waste

Pennsylvania has 67 counties that are subsequently subdivided into municipalities (townships, boroughs, and cities). Local autonomy is highly valued. Municipalities are categorized by population and depending on their classification may enact and enforce varying degrees of local ordinances on numerous issues. Counties have minimal statutory powers which enable them to adopt ordinances or policies controlling the actions of municipalities. The state has the power to create policies which mandate actions from both lower forms of government.

With regard to solid waste, municipalities have broad powers regarding storage, collection, and transportation of municipal waste. Counties have the power to control the flow of municipal solid waste. Other controls and stipulations regarding the handling of municipal waste can be incorporated into a county solid waste management plan if ratified by the municipalities. The state maintains legislative and regulatory authority over solid waste permitting, licensing, and facility operations.

Intergovernmental agreements are often used when counties and/or municipalities recognize the benefits of surrendering their authority to a collective initiative. The economies of scale for regional solid waste and recycling initiatives are a common catalyst for partnerships.

In Centre County, most of the power and control for disposal and for recycling has been assumed by the CCRRA via their delegation agreement with the County and through the county's solid waste management plan.

6.2 Pennsylvania Laws

6.2.1 Act 97

The Solid Waste Management Act (Act 97 of 1980) is the base legislation typically referenced for solid waste management in Pennsylvania. It forms the foundation for the bulk of solid waste management regulations in the state (PA Code Title 25. Chapter 271-299). Act 97 sets forth the requirements for storage, collection, transportation, processing treatment and disposal of solid waste. The Solid Waste Management Act does not address recycling, per se, but is applicable in the event those materials were improperly managed, illegally disposed, or discharged.

6.2.2 Act 101

The Municipal Solid Waste Planning, Recycling, and Waste Reduction Act (Act 101 of 1988) establishes the foundation for integrated solid waste management systems in Pennsylvania.

Duties and Responsibilities of Centre County

Act 101 grants counties the primary responsibility to plan for future disposal needs, to ensure the use of proper waste management practices, and to promote recycling and waste minimization efforts necessary to attain the goals of the Commonwealth. Counties are required to:

- Develop a 10-year solid waste management plan and renew it every 10 years.
- Secure disposal capacity assurances for the ten-year planning period.
- Develop and adopt ordinances, rules & regulations to implement and enforce the goals and objectives of the plan.
- Designate an entity responsible for implementing and enforcing the plan.
- Track, monitor, and report recycling performance to the Department of Environmental Protection.
- Demonstrate how, collectively, stakeholders within the county will meet the state's recycling goal. The law established a 25% recycling goal, while state policy has established a 35% goal.

Counties may delegate by ordinance their duties and responsibilities. Centre County's Solid Waste Management Ordinance delegates many of the powers, duties and responsibilities granted to the County under Act 101 to the CCRRA.

Duties and Responsibilities of State College Borough

Act 101 places unique mandates upon municipalities like the Borough which have populations of 10,000 or more, including the following:

- An ordinance that requires all residents to have waste and recycling collection service, including:
    - Curbside recycling collection at least once per month.
    - Curbside leaf waste collection at least once per month, or alternatively, twice per year if a drop-off collection area is accessible between collections.
- An ordinance that requires a commercial recycling program.
- Collection of at least three recyclable materials (glass, aluminum or bi-metal containers, plastics #1 or #2, newspaper, office paper and cardboard).
- A residential and business recycling education program.
- Designation of a person or entity as the recycling coordinator.
- An enforcement program that monitors participation, receives complaints and issues warnings and provides fines, penalties, or both.
- A program for the recycling of special materials.

- A program to prevent illegal dumping and/or littering problems.

Funding Mechanisms and Other Features

Act 101 establishes a Recycling Fund (Fund) to support a grant program that rewards recycling performance and authorizes funding for program development and equipment. Although funding is available for public sector programs, the law requires municipalities and counties to utilize the capabilities of the private sector to the greatest extent possible. Funding and other features of Act 101 include the following:

- Recycling Fund supported by a fee assessed on solid waste disposed in Pennsylvania landfills. The Fund supports a series of grant programs:
    - Weight-based recycling performance grants.
    - Reimbursement for county recycling coordinators wages and expenses.
    - 80% reimbursement for planning, reports and studies.
    - 90% reimbursement for development and implementation and equipment costs.
- Requirement that disposal facilities pay mandatory host municipality fees and allowance for voluntary negotiations of county host fees.
- Stipulations that disposal facility permit conditions require compliance with county plans/flow control.
- Establishment of tracking, monitoring and reporting criteria for waste and recycling.
- Provisions for recycling markets development.

6.2.3 Act 90

The Waste Transportation Safety (Act 90 of 2002) requires all waste transportation vehicles transporting municipal or residual waste to waste processing or disposal facilities in Pennsylvania to have a valid Waste Transporter Authorization. The law prohibits processing and disposal facilities from accepting waste from waste transportation vehicles that do not have a valid authorization.

Vehicles hauling recyclables are not required to obtain authorization. If on a regular basis, however, a transporter hauls MRF residuals or contaminated recyclables, then Act 90 Authorization is required. No regulations have been promulgated for this Act.

6.2.4 Act 108

The Covered Device Recycling Act (CDRA) (Act 108 of 2010) bans from disposal all desktop computers, monitors, laptops, computer peripherals and televisions. Manufacturers of these devices are required to develop and implement plans to recover discarded items from consumers and very small businesses. The manufacturer's recovery quota is based on a pre-determined weight that represents a percentage of the weight of their current sales. Outlets that accept one or more of these materials must be made available to 85% of the population. No regulations have been promulgated for this Act. Amendments to the legislation have been proposed.

6.2.5 Political and Regulatory Climate

Pennsylvania Department of Environmental Protection (PADEP)

During the past decade of ongoing budgetary conflicts in the General Assembly, the PADEP's resources were dramatically reduced. Overall staff was decreased by 30 percent. The Bureau of Waste Management experienced some of the heaviest losses, due in part to seniority and attrition.

Aside from the depleted staff, millions of dollars were repeatedly withdrawn from the Recycling Fund to balance the state's budget. Thus, funding to grow local recycling programs has suffered. Contributing to the shrinking recycling coffers is the decrease in waste disposal in Pennsylvania landfills, particularly for those once reliant on out-of-state-waste. In addition to the Recycling Fund, other fees and taxes were added to support programs like Growing Greener, making Pennsylvania's landfills less competitive pricewise than contiguous states.

With no discretionary funds and minimal staff, PADEP has little interest in new programming and is reluctant to consider regulatory improvements.

The Recycling Fund Advisory Committee did recently engage stakeholders in a series of meetings to discuss recommended changes to Act 101. The final report from the workgroup was due to the PADEP Secretary in February 2019.

The General Assembly's goals of deregulation and minimizing the PADEP's role in rulemaking and enforcement are reflected in the ongoing budgetary cuts. Although the General Assembly held several hearings on Act 101 and CDRA, there appears to be no serious call to action on either issue.

6.3 Centre County

6.3.1 Municipal Waste Management Ordinance

In 1991, the Centre County Board of Commissioners adopted Ordinance Number 2 of 1991, the Municipal Waste Management Ordinance. It was later amended and restated as Ordinance Number 3 of 2003, which fully replaces and supersedes the original version. The Ordinance provides for the delegation of many of the powers, duties and responsibilities granted to the County under Act 101 to the CCRRA.

6.3.2 CCRRA Rules and Regulations

The Municipal Waste Management Ordinance grants CCRRA the power to create rules and regulations necessary to implement and enforce the Centre County Municipal Waste Management Plan. Important elements of the Ordinance include:

- **Waste flow control.** Establishes a flow control mechanism for municipal solid waste generated within the jurisdictional borders of Centre County (Section 4). Determines which components of municipal solid waste will be flow controlled. Notably, source-separated recyclables are not included (Section 6).

- **Regulated waste.** Defines the waste streams governed by the Ordinance to include is not only all waste generated within the county, but also any waste brought into the County (Section 1 (r)).
- **Responsibility for recycling program.** Defines its role in implementing a County recycling program including a fee schedule (Section 8).
- **CCRRA facilities.** Prevents any other waste or recycling facilities from being located in the County unless provided for in the Centre County Solid Waste Management Plan. Prevents the establishment of any waste or recycling facility within Centre County without the approval of CCRRA (Section 9).
- **User fees and facility guidelines.** It also allows the CCRRA to establish user fees and guidelines for the transfer and recycling facility (Section 6).
- **Rules and regulations.**
    - Determines which source separated recyclables may be delivered to CCRA's facility at any given time.
    - Establishes waste sheds in which waste will be delivered to disposal facilities designated in the Centre County Solid Waste Management Plan.

It should be noted that there are minor inconsistencies between the ordinance and the rules and regulations. In such cases, an ordiance would prevail as rules and regulations must be authorized by an ordinance.

6.3.3 CCRRA Operations and Tonnages

CCRRA recycling collection services include 25,000 curbside residents, 60 recycling drop-off locations, and over 1,000 commercial establishments throughout the County. Curbside residential and commercial recyclables are curb-sorted by CCRRA crews into multi-compartment trucks and trailers. Drop-off sites consist of enclosed multi-compartment roll-off containers. CCRRA also provides cardboard collection to commercial and institutional generators using frontload trucks.

To help residents manage discarded electronics, CCRRA offers year-round e-waste recycling drop-off collection. In addition, it hosts an annual household hazardous waste (HHW) collection targeted at specific hard-to-manage materials. The CCRRA is not the sole outlet for recyclable materials generated in Centre County. A network of private recyclers manages white goods, scrap metals, and other miscellaneous materials.

CCRRA owns and operates an intermediate processing facility (IPF) and solid waste transfer station in Bellefonte. The IPF receives recyclables and prepares them for marketing. Curb-sorted recyclables are dropped into separate bunkers. Mixed metals are sorted using a magnet to separate steel from aluminum. Mixed plastics containers are manually sorted on a conveyor belt into specific resins. All materials are inspected by CCRRA staff to remove contamination prior to being baled for markets.

The CCRRA transfer station receives solid waste collected throughout the County and consolidates it into large transfer trailer loads that are hauled to an out-of-county landfill. The Bellefonte facility also manages other waste materials including e-waste, HHW, tires, scrap metals, and shingles

CCRRA receives Act 101 recycling performance grants based on the amount of certain materials recovered. These include aluminum and bi-metals cans, plastic bottles, jugs, and other containers, glass bottles and jars, mixed paper and corrugated cardboard. According to the PADEP's reporting system for 2017 (the most recent data available at the time of this report), CCRRA reported a total 81,334 tons of recyclables recovered in the County eligible for recycling performance grants (65,478 tons of commercial recyclables and 15,856 tons residential recyclables).

Penn State Contribution

The Act 101 performance grant eligible materials reported from the Penn State University Park campus represented approximately 8 percent of the commercial tonnage and approximately 6 percent of the combined tonnage from all sources in Centre County submitted for performance grants awards for 2017. Table 6-1 shows the summary of the 2017 tonnages of the grant eligible and non-grant eligible materials as reported to the PADEP. Mixed paper and corrugated cardboard weighed 4,913 tons, or 90 percent of the total grant eligible tons reported by Penn State.

Table 6-1: 2017 Tonnage from Penn State as Reported by CCRRA to PADEP

Material	Tons
Grant Eligible Materials	
OCC	896
Mixed Paper	4,017
Plastics	205
Glass	96
Metal Cans	208
Subtotal – Grant Eligible	*5,422*
Not Grant Eligible Materials	
Scrap Metal	555
Hazardous & E-waste	611
Tires	36
C&D & Asphalt	282
Furniture & Misc.	715
Textiles	120
Food Waste	990
Yard & Leaf Waste	1876
Wood Waste	749
Subtotal – Not Grant Eligible	*5,937*
Total Recovered	**11,359**

In addition to funding obtained from Act 101 performance grant, the CCRRA also received the revenue from sale of recycled commodities that it handles. The CCRRA also receives revenue from the tipping fees that it charges for recyclable materials brought to its IPF by Penn State (see Table 2-3).

6.4 Borough of State College

The Borough of State College meets the population and population density criteria for municipalities mandated by Act 101 to adopt ordinances requiring residents and commercial and institutional establishments to recycle. Act 101 also requires mandated municipalities to provide for a curbside collection program for recycling and leaf waste. In State College, the local requirements for waste management and recycling are incorporated into the overall Code of Ordinances in Chapter VIII for garbage and refuse regulations. Requirements of the ordinance include:

- Section 8-204. Prevents recyclables normally intended for CCRRA to be separated, stored, collected or delivered in any manner outside of CCRRA's program, unless approved by the Borough or CCRRA.
- Section 8-205. Officially declares the Borough to be part of the CCRRA recycling program.
- Section 8-205. Requires all residents and businesses to comply with CCRRA rules and regulations.
- Section 8-208. Grants the municipality, and subcontractor CCRRA, the sole right to collect, convey and dispose/process waste and recyclables generated, except in select commercial areas.
- Section 8-211. Allows any person to donate or sell recyclable materials to individuals or organizations.

6.5 Regional Recycling and Composting Infrastructure

Given the rural nature of central Pennsylvania, there is a limited number of recycling and composting facilities other than what is currently available in Centre County, i.e., CCRRA's IPF. Other regional facilities include:

- Lycoming County owns and operated a single stream materials recovery facility (MRF) in Montgomery approximately 75 miles from Penn State. Recyclables can be transferred this distance for processing and marketing. The facility has expressed willingness in the past to accept Penn State's material.
- Clinton County owns and operates a small processing facility in McElhattan approximately 45 miles from Penn State. However, its capacity is limited and has limited ability to sort mixed recyclables. Advanced Disposal owns and operates a small processing facility in Brockway approximately 70 miles from Penn State. Like the Clinton County facility, it has limited capacity and ability to sort mixed recyclables.
- Other single stream MRFs are more distant from State College located south of Harrisburg or in Pittsburgh.
- Other than Penn State's composting facility and the Borough's leaf composting site, there are no major composting facilities in the region. It is rumored that CCRRA may be planning a $2 million composting operation. Also, Altoona is exploring the possibility of developing a small-scale anaerobic digester that would accept organic wastes and sewage sludge.

6.6 Summary – Key Issues Impacting Penn State

Significant parts of Penn State are in the Borough of State College, a mandated municipality. For the purpose of this report, it is assumed that the Penn State waste management system needs to conform to both the terms and conditions of the Borough's ordinance as well as the CCRRA rules and regulations.

The flow control of municipal waste is one of the primary tenets of the Centre County Municipal Solid Waste Plan. Penn State must direct all its solid waste to CCRRA designated facilities – currently the CCRRA transfer station located in Bellefonte. Although recyclables from other small commercial establishments are processed at the CCRRA facility, Penn State appears to be the primary large, non-residential generator using the facility.

It is important to note that ambiguity exists in County and Borough ordinances and CCRRA rules and regulations regarding whether Penn State's recyclables are subject to flow control. While the Borough's Ordinance appears to require that recyclables are handled only by the CCRRA program, unless approved otherwise, this may not be enforceable on Penn State. Commercial and institutional recyclables are not typically subject to flow control due to protections for private commerce. The Borough allows entities to donate or sell recyclables to another organization, which implies that Penn State has control over the disposition of the recyclables generated on campus.

The County ordinance prohibits any new solid waste facilities from being developed and operated without CCRRA's permission. However, it is unclear if this restriction applies only to operations that would be accepting materials from outside parties. For example, if Penn State were to develop and operate a captive facility solely for its needs and purposes, it may be exempt from the County prohibition.

Section 7
Opportunities to Improve

Based on the preceding assessments of the existing solid waste management system, results of the waste audits, and the unique characteristics of the local and regional solid waste management system, KCI has identified a series of potential opportunities for improvement focused primarily on modifying the recovery program, increasing the quantity and quality of materials diverted from disposal, and improving the operational effectiveness.

Following is a series of opportunities for improving the design of Penn State's recovery program to achieve the three goals. It must be noted that these opportunities are not independent of each other, but that multiple initiatives would need to be taken in a coordinated manner to maximize impact on recovery and contamination.

7.1 Designated Materials

7.1.1 Modify Definitions of Recyclable Materials

The CCRRA regularly rejects loads of Penn State's recyclables due to contamination and materials not being segregated according to their material specifications. This is particularly problematic for the two plastic categories (plastic bottles and film and miscellaneous plastics).

Plastic Bottles and Film

Any decision to further redefine this category of plastics should be done in coordination with a decision on how to handle miscellaneous plastics going forward. Regardless, Penn State should modify this material category to be more compatible with downstream processing systems and commodity markets, specifically not mixing plastic film with plastic containers.

The Mobius program currently designates bottles to be just water and soda. The CCRRA currently accepts a general category of plastic bottles, jugs, and jars in its curbside recycling program.

Possible options that Penn State may want to consider include:

- Defining it as all plastic bottles, jugs, and jars.
- Defining it as only #1 PET and #2 HDPE bottles, jugs, and jars. These two plastic resins account for the vast majority of plastic containers being generated and have stronger commodity markets than some of the other resins.
- Eliminating plastic film entirely from the recovery program.
- Eliminating plastic film from collection stations and only collecting it separately from generators, such as the dining halls, that are able to produce large amounts of consistent and clean material.

Miscellaneous Plastics

Currently, the Mobius program defines this category as all rigid plastics other than water and soda bottles. This definition aligns well with CCRRA's definition of miscellaneous plastics.

However, CCRRA has indicated that due to lack of markets it is no longer able to recycle miscellaneous plastics. Additionally, Penn State's miscellaneous plastics stream consistently has high contamination and contributes very little to the campus's recovery rate.

Possible options for this category include:

- Specifically define it as plastic bottles, jugs, and jars other than #1 PET and #2 HDPE, which does not include any other types of rigid plastics that have traditionally been included in CCRRA's miscellaneous plastics category (e.g., tubs, clamshells, trays and plates). Limiting the category to narrow neck containers and jars may make it possible for CCRRA to secure a market.
- Eliminate the category all together. Doing this would reduce possible confusion between two categories of plastic. Based on the results of the audits, this option would decrease Penn State's recovery rate slightly, but has the potential to reduce contamination problems and charges being incurred for excessive contamination.

Liquids in Containers

While remnants of liquids are often not an issue for dual or single stream recycling programs, the CCRRA has rejected material due to remnant liquids being in bags of otherwise clean recyclables. As part of its outreach and education, Penn State should make it clear that liquids need to be drained from containers either into the sink (for kitchen staff) or into the refuse container before being placed in the appropriate recycling container.

7.1.2 Modify Definition of Compostable Materials

The compost category is current defined to include both food waste and compostable packaging, including biodegradable plastic packaging and food service items. As noted earlier the OMPEC composting facility is designed to handle clean food waste and yard waste and is not properly equipped to handle significant amount of compostable plastics.

In addition, the facility currently receives an unacceptable amount of contamination, i.e., non-compostable materials (see Figure 7-1). The facility cannot easily remove contamination, which reduces the visual and functional value of the compost it produces.

In addition to contamination, the composting facility has problems handling the amount of compostable paper and plastic packaging mixed into the food waste that is collected. Due to the low level of technology employed at the facility (basic turned windrow composting), some of the compostable materials do not fully decompose.

Figure 7-1: Contamination in Compost

To be more compatible with the existing composting operations, Penn State should consider modifying its organics recovery programs in one or several ways:

- Collect compost only from food preparation areas, kitchens, and service lines (back-of-house) and accept only food waste and do not accept any packaging or service items. This would eliminate compost collection from public areas (front-of-house). While not quantified in the audit, observations strongly indicate that the vast majority of compost weight collected came from back-of-house, while the lesser amount of compost coming from front-of-house was the primary source of contamination and compostable packaging.
- Continue to collect organics front-of-house but limit the acceptable materials to just food waste and paper napkins (i.e., plate scrapings) and no packaging.
- Establish uniform standards for and usage of compostable packaging for all food services campus-wide. In tandem with this, the compost facility would need to be upgraded with pre-processing equipment to handle compostable packaging and remove contamination (e.g. a grinder, depackaging machine, and specialized compost screening equipment). Penn State may face pushback from independent concessionaires due to the increased cost of compostable serviceware and the challenge of finding compostable packaging options for the wide range of brands, vendors, and food categories available on campus.
- Ensure that organics are only collected in compostable bags. A number of instances were observed where compost was placed in non-compostable bags, for example if a bag ripped, the bag and contents were placed in a standard plastic bag. Film plastic is particularly problematic for compost facilities. Custodial staff should be trained to never place compost in a plastic bag.

7.2 Program Design

Any changes to program design must focus on two goals: increasing the recovery rate of targeted materials and decreasing the amount of contamination. The recovery rate is actually the product of two factors: participation (the number of generators who participate) and

capture (the amount of targeted materials generated by participants that they actually separate for recovery).

Many factors combine to affect recovery and contamination, including social behavior norms, awareness of recovery programs, understanding of how they work, the level of effort and thinking required to separate materials properly, and the convenience of the collection stations.

7.2.1 Redesign Recovery Stations

As noted in Section 5, Penn State has deployed a diversity of recovery stations. One of the core strategies of effective recovery programs is to make collection stations as consistent as possible campus-wide. Currently, students, faculty and staff need to re-think how the recycle depending on where they are. Confusion and the extra effort required inevitably leads to lower recovery and higher contamination.

At the same time, some variation in collection stations is necessary depending on where they are located, i.e., adapting them to physical space constraints, the specific materials being targeted there, and the quantities of material being generated.

Given these parameters, Penn State should consider the following guidelines for redesigning recovery stations.

- Use consistent stations design in terms of dimensions, color scheme, signage placement, etc.
- Use a consistent ordering of material categories (e.g., how they are arranged from left to right).
- Use a consistent pattern of openings (e.g., round for containers, square for compost, narrow slots paper, and rectangles for refuse).
- Color code containers and sections of recovery station as visual cues to the types of materials (e.g., blue for recyclables, green for compost, and gray for refuse).
- Pair all recycling and compost containers with refuse containers immediately next to them.

7.2.2 Develop a New Communication Program

Section 5 included examples of how the signs at recovery stations are inconsistent from place to place and differ from the Mobius program literature. It was also noted that the signage and educational materials do not clearly and effectively describe the materials included in each category. As with the design of recovery stations, inconsistent and/or ineffective signage and program literature can cause confusion leading to lower recovery and higher contamination. Penn State should consider a comprehensive re-visioning of its communications program, which could include addressing the following aspects.

- Develop new material category definitions that are consistent campus-wide. In particular, plastics which are currently the source of the most inconsistency.
- Re-design the recovery program brand and develop a broad-scale public awareness program to launch concurrently with changes in material categories and re-designed recovery stations.

- Specifically focus on re-designing signage and program literature to clearly define material categories in simple terms and high-impact images. Although many programs have focused on picture examples of materials, it is also critical to develop simple, widely understood catch phrases that describe acceptable and unacceptable materials.
- Engage a team of "recovery champions" to assist during program transition to focus on specific buildings and stakeholder groups.
- Investigate the potential to implement a Community-Based Social Marketing campaign to impact social norms and behaviors.
- Launch a specific public awareness campaign to combat wish-cycling, e.g., "when in doubt, throw it out."
- It is also important to remember that the current Penn State and Centre County recovery program is unique. Many students coming to State College likely are accustomed to single stream recycling. Extra outreach and education is necessary to reach high levels of participation and understanding of proper material separation for a multi-sort program like the current one.

7.2.3 Prioritize Categories by Building and Area

The generation, recovery and purity graphs in Section 4 clearly identify which buildings are the major sources of recoverable materials. Conversely, those graphs also identify building types that have low generation and high contamination. This information provides a good basis for determining whether and which materials should be targeted for recovery in different buildings and areas on campus. It must be noted that eliminating material categories in some locations creates inconsistencies from place to place. This can be a source of confusion and runs counter to the overarching need for campus-wide consistency. Therefore, any efforts to adjust material categories must be carefully planned and implemented with active measures that address potential confusion.

As a starting point, Penn State should consider the following options aimed primarily at reducing contamination without significantly affecting its overall recovery rate, but also including opportunities to boost recovery where possible.

- Eliminate compost collection from all buildings and areas that are not directly associated with food services. As noted previously, composting collection could also be restricted only to back-of-house. Dining halls generate the vast majority of food waste/compost and it generally has low contamination. Conversely, compost from buildings with minimal generation had much higher levels of contamination. If Penn State only collects compost from dining halls and pre-consumer food waste from the HUB, contamination at the compost facility would be drastically reduced with a minimal decrease in the total tons collected for compost.
- Concentrate outreach and education efforts on increasing recovery in residential housing. The audits revealed that dorms are a significant source of recyclable paper, metal, plastic bottles, and glass, but recovery rates are currently very low compared to other buildings.

- While miscellaneous plastics generally have high levels of contamination, this is particularly a problem in the libraries. Libraries also have comparatively high levels of contamination of plastic bottles.
- As noted above, having different categories in different buildings increase potential for confusion. To address this, recovery stations and signage must be customized to explicitly describe what to do with materials that would otherwise be recycled in other locations.
- Also, it is important to note that if Penn State implements switching from a multi-sort programs to dual stream or single stream, much of the need for prioritization would be eliminated for recyclables.

7.3 Program Operations

As reflected in this report, the project scope focused primarily on evaluating the generation and composition of discarded recyclables, compostables, and refuse in order to identify potential opportunities to improve Penn State's waste management system. While the project did not include an in-depth assessment of OPP's collection operations, several opportunities were identified based on field observations, discussions with staff and the assessment of local and regional solid waste system presented in Section 6.

7.3.1 Evaluate Source Separation Alternatives

Penn State's multi-sort recovery program is based on the requirements and structure of the CCRRA recovery system. The regional system has developed over many years and Penn State and the CCRRA have a long history of partnership and cooperation. At the same time, the recycling industry has evolved significantly. Many university and municipal recycling programs have switched to dual stream or single stream recycling. Dual stream collects two streams: commingled containers and mixed paper; while single stream collects all recyclable containers and paper together.

Multi-sort programs like Penn State's require significantly more commitment and effort. Students, faculty, and staff must spend more time separating recyclables into multiple categories and effort to understand the definition of each category. The CCRRA curbside collection program addresses this by having its collection crews do the sorting truck-side to reduce the work that households must do. However, this can't be implemented at Penn State (e.g., custodial staff separating mixed recyclables from recovery stations).

As part of a comprehensive effort to improve its recovery program, Penn State may want to assess the feasibility of switching to dual stream or single stream recycling. Such an assessment could address the following items.

- Capital costs associated with deploying new recovery stations.
- Operational and cost impacts on custodial and OPP collection activities.
- Potential opportunities to collaborate with CCRRA to modify its processing facility.
- Availability of regional processing facilities and their capacity to handle Penn State's materials.

- Potential opportunities for Penn State to develop some level of its own recycled material processing and/or transfer capacity.
- The legal and regulatory feasibility of processing options.
- Financial implications of local and regional processing and marketing alternatives.

7.3.2 Train Custodial Staff Regarding Contamination

The custodial staff service recovery stations and transport discarded materials to a central collection point for OPP collection crews. They are in effect the first line of defense against contamination as well as intelligence about where and how it arises. Penn State should consider a variety of possible opportunities to engage custodial staff more directly in the operational improvements and performance of the recovery program.

- Custodians can perform a general visual assessment of recyclable materials and discard heavily contaminated loads as refuse. This could be supported by training and signage on the dumpster/recycling containers with photos of what is clean and what is too dirty.
- Conduct periodic meeting with custodial staff to identify "problem" locations that can then be targeted for focused outreach, education, and inspection.
- Periodically conduct focus group meetings with custodial staff to identify opportunities to improve material handling operations, share recovery program results, and build a vested interest in program performance.

7.3.3 Establish Centralized Consolidation Points

OPP recently developed a centralized cluster of compacting roll-off containers and bins that now services a cluster of East Halls dorms. This kind of multi-building consolidation point has the potential to significantly improve OPP collection efficiency compared to the current practice of stopping at multiple buildings to collect smaller amounts of materials.

At the same time, Penn State's campus is highly diverse ranging from centuries-old, tightly spaced buildings with limited vehicle access to more recent wide-spread development. It should assess the financial and operational feasibility of developing additional multi-building consolidation points, elsewhere on campus. It is expected that the gain in operational efficiency will provide a pay-back for the financial investment as well as improvements in the overall appearance and cleanliness of individual buildings.

7.4 Pursue Opportunities to Increase Recovery

Contamination is the major issue facing Penn State's recycling program. However, through conducting the audits, KCI identified some opportunities to increase recovery of materials currently disposed in refuse.

Food Waste

Overall food waste represented the highest percentage of any material currently targeted for recovery, with housing and dining buildings having highest percentage of all the building types in the audit. Meaning it has the highest potential to increase Penn State's recovery rate.

Apartments had the highest percent of food waste in their refuse stream. However, the total generation is relatively minimal. Food waste in dorms represents a significant opportunity to increase recovery. Dorms also had a relatively clean compost stream. Focus on recovery of food waste from dorms, especially in dorms with kitchen areas, could increase recovery. However, this must be weighed against the potential to exacerbate the contamination issues in the recycling stream. Therefore, Penn State may want to first address the contamination already in its compost stream before expanding compost collection further.

Also, while the vast majority of food waste is being recovered from dining halls a significant amount by weight relative to other material streams and other building types is in the refuse. Much of this was packaged food waste. Penn State could educate kitchen staff to open these packages and empty the food waste in the compost bin. Even more beneficial, the kitchen staff could implement any number of monitoring programs available to track and reduce food waste from commercial kitchens.

Targeted Recyclables

Targeted recyclables represented around 20 percent of the refuse stream campus-wide. Dorms have a far lower overall recovery rate of targeted recyclables than other building types. Due to the large number of dorms on campus, targeting dorms for increased diversion efforts could significantly increase the amount of material diverted.

Academic buildings also had significant amount of targeted recyclables in their refuse stream. Focusing on these buildings could also increase recovery. However, as with increasing collection of food waste. Any expansion must be carefully undertaken so to not increase the issue of contamination in the recycling stream.

Potential Recyclables

While the WCS portion of the audit identified a number of other potentially recyclable materials (e.g., EPS, textiles, construction debris, and bulky rigid plastics), these accounted for less than 5 percent of mixed waste from most building types. So, they do not represent a significant opportunity to increase recovery. Furthermore, the potentially recyclable materials have additional processing requirements and limited end-use markets that pose both operational and economic challenges. Penn State would need to carefully evaluate the costs and benefits before adding any of these other materials to the recovery program.

Potential Compostables

For most building types other than dorms, apartments, and dining halls, potential compostables represented a significant opportunity to increase recovery, representing 17 to 54 percent of the refuse. Potential compostables consisted primarily of paper towels, which appeared to have been collected from restrooms and wash facilities, or napkins from cafes and food courts. As noted previously, Penn State's composting facility cannot readily handle large amounts of materials other than food waste and yard waste. To properly handle these materials, the current composting process and equipment would ideally be modified and also require facility expansion. Penn State would need to carefully consider the pros and cons of expanding the compost program to target these materials.

Section 8
Summary

This Solid Waste Management System Assessment of the Penn State University Park Campus entailed an in-depth analysis of the generation and composition of recyclables, compostables, and refuse in common types of buildings that comprise the campus. The analysis provided extensive insight regarding several important aspects of Penn State's materials management and recovery program, including the following:

- What building types are significant generators of various types of recyclables and compostables that are currently or could be targeted for recovery.
- How effective the campus population (e.g., students, faculty and staff) is at separating the targeted materials for recovery and how much remains unseparated in refuse.
- How much contamination is present in targeted recyclables and compostables, including unacceptable materials (contamination) as well as improperly separated acceptable materials (cross-contamination).

Project work also entailed limited observation of waste collection operations, review of existing public awareness and informational materials, and inspection of recovery stations in various buildings around the campus.

Together this research and analysis provide the basis for identifying a series of specific opportunities to improve Penn State's solid waste management system focused in four key areas:

- Realigning the categories of materials designated for recovery.
- Redesigning the solid waste management hardware in buildings on campus (recovery stations, signage, container, etc.).
- Developing new comprehensive and consistent communications program.
- Evaluating collection and processing alternatives other than the current multi-sort program.

Given the wide range of potential opportunities and the unique and complex nature of the Penn State recovery program within the local context of Centre County and State College Borough, it is necessary to evaluate the feasibility of various opportunities before specific information can be developed regarding potential financial implications and impacts. Many opportunities exist that will have varying impacts on recovery, cost, and relationships between local stakeholders.

Appendix A: Material Categories

Table A-1: Material Categories for the WCS of Refuse

Type	Material Categories	Description of Categories
Paper	**Newspaper**	Newspaper (loose or tied) including other paper normally distributed inside newspaper such as ads, flyers, etc. and other items made from newsprint such as advertising guides. Newspaper found inside plastic sleeve will be removed from plastic and sorted accordingly.
	Corrugated Cardboard (OCC)	Uncoated cardboard boxes with a wavy core (no plastic liners, waxy coatings). Examples include shipping and moving boxes, packing boxes, and non-soiled pizza boxes.
	Books	All hard-covered books.
	Mixed Recyclable Paper	All other recyclable paper not included in categories above. Examples include white, colored, coated and uncoated papers, envelopes, index cards, file folders, magazines, telephone books, catalogs, paperboard, chipboard, brown paper bags, mail, paperback books, blueprints, and other printed material on glossy and non-glossy paper.
	Aseptic/Polycoated Containers	Gable-top cartons, aseptic juice boxes, and other similar containers made of coated paperboard. *Does not plastic drink pouches (e.g Capri-Suns)*
Plastics	**PET Bottles (#1)**	Clear and colored bottles and jars made of polyethylene terephthalate (PET #1). Examples include soda bottles, water bottles, etc. *Does not include loose caps.*
	HDPE Bottles (#2)	Clear/natural and opaque, pigmented bottles made of high-density polyethylene (HDPE #2). Examples include milk jugs, detergent bottles, some pill bottles etc. *Does not include loose caps and lids.*
	Non-Bottle PET and HDPE Containers (#1 and #2)	Clear and colored plastic non-bottle containers coded PET #1. Examples include to-go "clamshell" containers, and fruit or vegetable platters. Excludes plastic drink cups. Wide-mouthed tubs and containers coded HDPE #2 including lids. Examples include large plastic coffee containers, and plastic chip tubes.
	Other Plastic Containers (#3-#7)	All plastic containers coded #3, #4, #5, #6, or #7. Examples include yogurt cups, plastic to-go "clam-shell" containers (except those coded #1), some pill bottles, Arizona Iced Tea™ gallon jugs. *Does not include expanded polystyrene containers labeled #6.*
	Plastic Cups	Plastic drink cups of any resin code.
	Bulky Rigid Plastics	Non-container rigid plastic items such as plastic drums, crates, buckets, baskets, toys, refuse totes, lawn furniture, flower pots, laundry baskets, and other large plastic items. *Does not include electronic toys.*
	Food Service Expanded Polystyrene (EPS) Foam (Styrofoam®)	Food service materials made of expanded polystyrene, which are typically white but may be pigmented. Examples include coolers, egg cartons, clam-shell containers, and disposable cups and plates.
	Bulk Packaging EPS	Non-container materials used in packaging made of expanded polystyrene, which are typically white but may be pigmented. Examples include packaging materials and packing peanuts.

Table A-1: Material Categories for the WCS of Refuse (Continued)

Type	Material Categories	Description of Categories
Plastics (continued)	**Recyclable Plastic Film**	Clear and clean plastic shrink wrap, re-sealable bags (i.e. Ziploc®), Saran™ wrap, bubble wrap, and retail plastic bags.
	Non-Recyclable Plastic Film	Colored, wet and/or contaminated film, such as garbage bags or food packaging. *Does not include foil lined plastic film (e.g. chip bags)*
	All Other Plastics	Any plastic materials not categorized above, such as plastic utensils, straws, tooth brushes, deodorant cases, broom heads, etc.
Metals	**Tin/Steel Cans**	Tin-plated steel cans, usually food containers and aerosol cans, including labels. Also includes steel caps and lids.
	Ferrous Scrap Metals	Non-container ferrous (magnetic) metal materials. Examples include clothes hangers, sheet metal products, pipes, miscellaneous metal scraps, pots and pans, and other magnetic metal items.
	Aluminum Cans	Aluminum soft drink, beer, and some food and aerosol cans.
	Aluminum Foil and Trays	Aluminum foil and food trays, such as disposal pie plates and catering trays.
	Non-Ferrous Scrap Metals	Non-container non-ferrous (non-magnetic) metal materials. Examples include aluminum pots and pans, copper wiring and tubing, and brass fixtures.
Glass	**Glass Containers**	Clear, green, blue, and amber glass bottles and jars, as well as pieces of broken glass bottles and jars.
	Other Glass	Window panes, mirrors, ceramics, drinking glasses, and glass containers other than clear, green, blue, or amber.
	Lab Glass	Pyrex® and Laboratory-type glass.
Organics	**Yard Waste**	Shrub and brush prunings, household bedding plants, weeds, leaves, grass clippings, and other landscaping and gardening wastes. Includes planting media (soil, compost, peat moss, etc.)
	Food Waste	Packaged or loose meat and vegetable waste (includes coffee grounds and tea bags). Includes single-us coffee pods (i.e. K-cups)
	Clean Wood Waste	Untreated and unpainted lumber, pallets, and dimensional lumber. Also includes untreated/unpainted wood furniture including chairs, cabinets, dressers, etc.
	Other Organics	Other organic material such as pet waste (e.g. bagged dog waste and cat litter), natural fiber or wicker products, corks, lint, and hair.
	Paper Towels, Napkins, and Tissues	Low-grade, compostable paper including napkins, tissues, paper towels.
	Compostable Food Containers and Cups	Certified compostable cups, plates, and utensils (paper or PLA), paper plates without a heavy plastic coating, food-soiled food containers (e.g. pizza boxes).

Table A-1: Material Categories for the WCS Of Refuse (Continued)

Type	Material Categories	Description of Categories
Other	**Non-Compostable Paper Food Serviceware**	Non-compostable, non-recyclable paper products with a heavy plastic coating (e.g. paper plates, paper to-go cups, french fry containers, coated paper plates, and ice cream tubs), fast-food wrappers, and wax and parchment paper.
	Textiles and Leather	Clothing apparel, rags, leather, blankets, curtains, shoes, wallets, purses, belts, and scrap leather.
	Special Wastes	Cleaners, oil, paint, pesticides, pool chemicals, fluorescent lights, medical waste, solvents, rechargeable batteries, etc., that are considered household hazardous waste. *Does not include syringes without needles.*
	Electronics (E-waste)	Electronic devices (i.e. items with a circuit board), including televisions, computers, cell phones, cordless telephones, PDA, handheld devices, etc. *Does not include electric devices (i.e. battery or electric-powered items without a circuit board), extension cords and chargers, headphones and earbuds, and electronic media (e.g. DVDs and CDs).*
	Electronic Media	CDs, DVDs, cassettes, and VHS tapes.
	Household Batteries	Non-rechargeable household batteries including AA, AAA, C, D, 9-volt, and button types.
	Treated Wood Waste	Treated and painted lumber, pallets, and dimensional lumber.
	C&D Debris	Construction and demolition debris including concrete and other inert debris (brick, rocks, sand), carpet and padding, drywall, insulation, full and empty caulk tubes, paint supplies, and roofing materials.
	Furniture	All types of furniture, including wood, metal, desks, chairs, etc.
	Tires and Rubber	Small and large tires and other items made of rubber.
	Small Appliances	Household appliances such as coffee makers, microwaves, fans, irons, hair driers, and electrical kitchen ware.
	Diapers	All child and adult diapers and incontinence aids. Includes feminine hygiene products.
	Disposable Gloves[5]	Disposable gloves of any material.
	All Other Garbage	All other wastes not included in the other categories, including products that are composite of materials such as waxy OCC, cigarette packages, binders, electrical devices other than electronics or small appliances, CDs & DVDs, extension cords, string lights, Pringle's® cans, chip bags, etc.
	Liquids	All liquids found within containers. Containers will be sorted into their appropriate category.
	Grit	Any grit or fines remaining on the sort table that cannot be defined in the other categories.

[5] A significant number of disposable gloves were found in dining hall waste; therefore, this category was added.in the fall audit.

Table A-2: Material Categories for the Visual Assessment of Recyclables

Type	Material Categories	Description of Categories
Recyclables	**All Recyclable Paper**	Includes Newspaper, OCC, Mixed Recyclable Paper, and Books, as defined in the WCS.
	All Plastic Bottles	Includes PET #1 Bottles and HDPE #2 Bottles, as defined in the WCS
	Miscellaneous Plastic Containers	Includes Non-Bottle PET and HDPE Containers (#1 and #2), Plastic Cups, and Other Plastic Containers (#3-#7), as defined in the WCS
	Recyclable Plastic Film	Same definition as the WCS.
	All Metals	Includes Steel Cans, Aluminum Cans, Aluminum Foil and Trays, and Ferrous and Non-Ferrous Scrap Metals, as defined in the WCS
	Glass Bottles	Same definition as the WCS.
Contamination	**Food-Contaminated Target Recyclable**	Recyclable material of the type in the correct stream with excessive food contamination (e.g. a dirty peanut butter jar in the miscellaneous plastics stream)
	Food-Contaminated Non-Target Recyclables	Any recyclable material not in the correct stream with excessive food contamination (e.g. a dirty peanut butter jar in the plastic bottles stream)
	Bulky Rigid Plastics	Same definition as the WCS.
	All EPS	Includes Food Service and Bulk Packaging EPS, as defined in the WCS
	Non-Recyclable Plastic Film	Same definition as the WCS.
	All Other Plastics	Same definition as the WCS.
	Other Glass	Includes Other Glass and Lab Glass, as defined in the WCS
	Non-Recyclable Paper	Includes Paper Towels, Napkins, and Tissues, Compostable Food Containers and Cups, Non-Compostable Paper Food Containers and Cups, as defined in the WCS
	All Organics	Includes Food Waste, Yard Waste, All Other Organics, Clean Wood Waste, as defined in the WCS
	Aseptic/Polycoated Containers	Same definition as the WCS.
	Liquids	Same definition as the WCS.
	All Other Contamination	All other non-recyclable materials not included above.

Table A-3: Material Categories for the Visual Assessment of Compost

Type	Material Categories	Description of Categories
Compostables	**Loose Food Waste**	All loose food waste of any type. Includes napkins and paper towels not easily separated from food waste. Includes coffee filters and tea bags.
	Yard Waste	Same definition as the WCS.
	Paper Towels, Napkins, and Tissues	Same definition as the WCS.
	Clean Wood Waste	Same definition as the WCS.
	Compostable Food Containers and Cups	Same definition as the WCS.
Contaminants	**Packaged Food Waste**	Food waste contained in any type of packaging
	Non-Compostable Paper Food Containers and Cups	Same definition as the WCS.
	All Rigid Plastics	Includes PET Bottles (#1), HDPE Bottles (#2), Non-Bottle PET and HDPE Containers (#1 and #2), Other Plastic Containers (#3-#7), Plastic Cups, Bulky Rigid Plastics, All Other Plastics, as defined in the WCS
	Non-Rigid Plastic Film and Bags	Includes Recyclable and Non-Recyclable Plastic Film, as defined in the WCS. *Does not includes compostable bags.*
	All EPS	Includes Food Service and Bulk Packaging EPS, as defined in the WCS
	All Metals	Includes Steel Cans, Aluminum Cans, Aluminum Foil and Trays, and Ferrous and Non-Ferrous Scrap Metals, as defined in the WCS
	All Glass	Includes Glass Containers, Other Glass, and Lab Glass, as defined in the WCS
	Liquids	Same definition as the WCS.
	All Other Contamination	All other non-compostable materials not included above.

Appendix B: Building Profiles and Results

Davey Lab

Building Facts

Type: Academic

Year Constructed: 1972

Service Area**:** Area 4

Gross Square Footage**:** 147,080

Season Audited: Spring 2018

Description: Davey Lab is home to the Department of Physics and Department of Astronomy and Astrophysics, as well as the Physical and Mathematical Sciences Library. It also houses a rooftop observatory, a planetarium, and a state-of-the-art molecular beam epitaxy (MBE) facility, which is part of Penn State's $17.8M NSF-funded Two-Dimensional Crystal Consortium-Materials Innovation Platform (2DCC-MIP) national user facility.

Audit Results

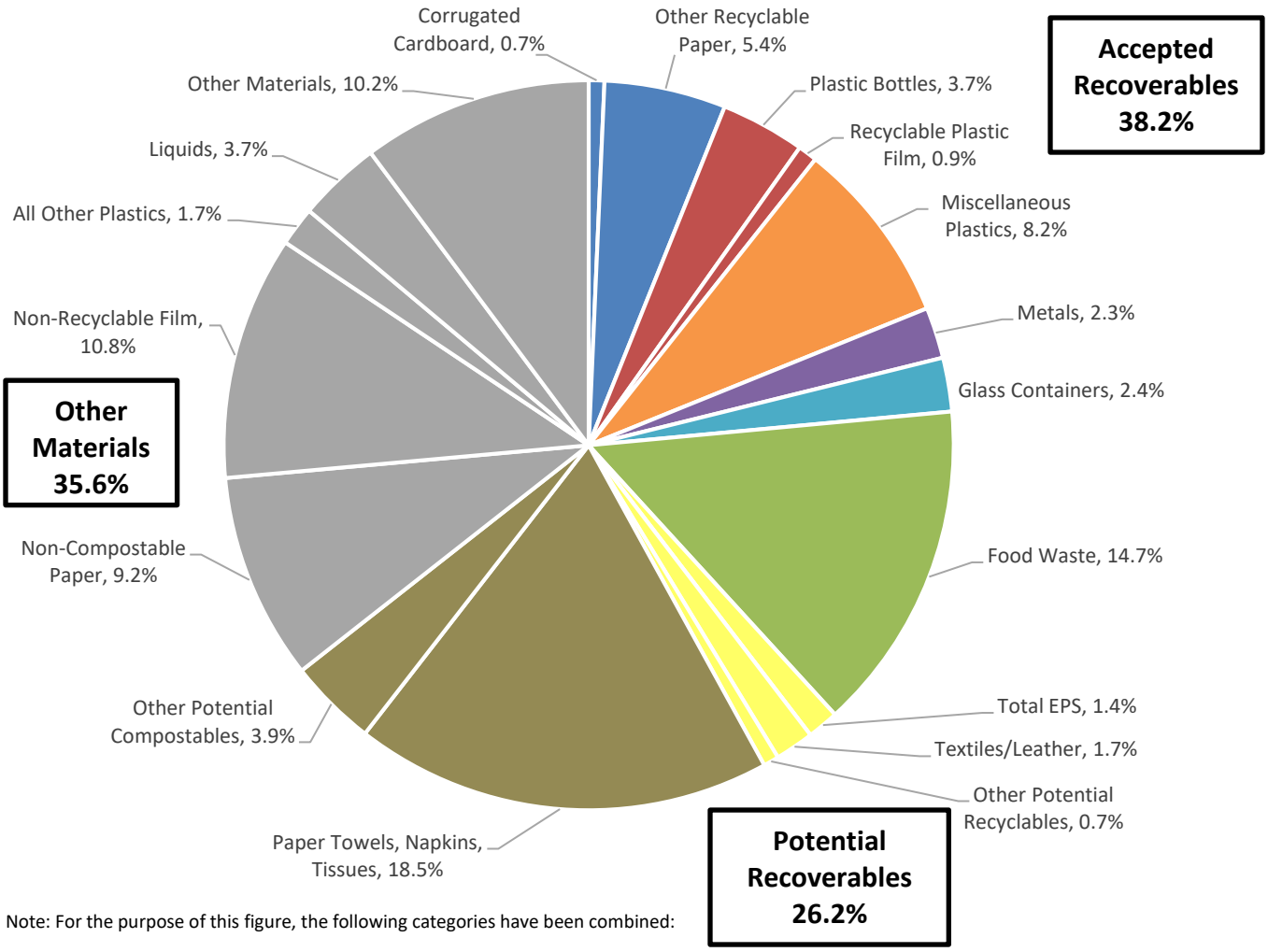
Some key findings from the results for Davey include:

- About 430 pound of refuse, 240 pounds of recycling, and 80 pounds of compost were generated from Davey during the week, for a **recycling rate of 43 percent**.
- WCS Results:
  - Over 23 percent of the refuse stream was accepted recyclable materials, with a significant amount of each recyclable material stream.
  - Nearly 15 percent of the refuse was food waste.
  - Paper towels, napkins, and tissues comprised over 18 percent of the refuse, and compostable food containers comprised over 3 percent. Both of which could be potentially composted.
  - Similar to many other buildings, non-compostable paper food serviceware, all other garbage, and non-recyclable plastic film were all significant categories in the all other materials group.
- Visual Assessment Results:
  - Davey had very clean recycling streams, except for miscellaneous plastics, which was in line with other buildings. Miscellaneous plastics had a combination of misplaced recyclables, food-contaminated recyclables, and other contaminants.
  - Compost was similar to other buildings with about a quarter of non-compostable paper cups.

Daily Material Generation at Davey Lab

Weight (lbs)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	Mon (4/23)	Tue (4/24)	**Weekly Total**	**% of total weight**
Refuse	99.3	74.0	91.6	97.2	73.8	88.9	**430.6**	57.3%
Paper	74.3	0.0	63.7	50.7	9.0	20.6	**170.9**	22.7%
Plastic Bottles	6.0	0.0	7.8	4.6	5.6	3.0	**22.5**	3.0%
Misc Plastics	17.4	0.0	9.5	3.3	4.4	5.2	**28.5**	3.8%
Metal	1.3	0.0	4.0	0.0	0.0	2.1	**5.7**	0.8%
Glass	6.5	0.0	0.0	0.0	0.0	10.5	**8.5**	1.1%
Compost	15.7	13.7	12.2	24.8	16.6	12.6	**81.4**	10.8%
OCC	0.0	0.0	0.0	0.0	3.6	0.0	**3.6**	0.5%
Total								100.0%
Volume (cy)								
Refuse	0.9	0.9	1.9	1.4	1.4	1.9	**7.1**	
Paper	0.4	0.0	0.2	0.2	0.1	0.2	**0.8**	
Plastic Bottles	0.0	0.0	0.2	0.2	0.1	0.1	**0.5**	
Misc Plastics	0.6	0.0	0.2	0.1	0.2	0.1	**0.8**	
Metal	0.0	0.0	0.1	0.0	0.0	0.0	**0.1**	
Glass	0.0	0.0	0.0	0.0	0.0	0.1	**0.0**	
Compost	0.1	0.1	0.2	0.2	0.1	0.0	**0.7**	
Total								

Composition of Refuse at Davey Lab (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Davey Lab (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.0%	0.0%	0.0%
Corrugated Cardboard (OCC)	0.7%	0.0%	1.4%
Mixed Recyclable Paper	5.4%	4.2%	6.6%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	6.1%		
PET Bottles (#1)	3.6%	2.6%	4.5%
HDPE Bottles (#2)	0.2%	-0.1%	0.5%
Recyclable Plastic Film	0.9%	0.1%	1.6%
Total Plastic Bottles and Film	4.6%		
Non-Bottle Plastics (#1 and #2)	1.0%	0.5%	1.5%
Other Plastic Containers (#3-#7)	2.9%	2.3%	3.5%
Plastic Cups	4.3%	3.7%	4.9%
Total Miscellaneous Plastics	8.2%		
Tin/Steel Cans	0.1%	-0.1%	0.2%
Ferrous Scrap Metals	0.3%	-0.1%	0.7%
Aluminum Cans	0.9%	0.7%	1.2%
Aluminum Foil and Trays	0.5%	0.4%	0.7%
Non-Ferrous Scrap Metals	0.4%	-0.3%	1.1%
Total Recyclable Metal	2.3%		
Glass Containers	2.4%	1.1%	3.7%
Food Waste	14.7%	13.1%	16.3%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	1.3%	0.9%	1.7%
Bulk Packaging EPS	0.1%	0.0%	0.2%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.4%	-0.3%	1.1%
Electronic Media	0.2%	-0.1%	0.4%
Textiles and Leather	1.7%	0.2%	3.3%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	3.8%		
Paper Towels, Napkins, Tissues	18.5%	17.8%	19.2%
Compostable Food Containers and Cups	3.4%	2.6%	4.2%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.4%	-0.4%	1.3%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	22.4%		
Non-Compostable Paper Food Serviceware	9.2%	8.3%	10.0%
Non-Recyclable Plastic Film	10.8%	9.1%	12.6%
All Other Plastics	1.7%	1.4%	2.1%
Other Glass	0.2%	-0.2%	0.6%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.1%	-0.1%	0.4%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.2%	-0.1%	0.4%
All Other Garbage	9.7%	7.1%	12.4%
Liquids	3.7%	0.9%	6.5%
Grit	0.0%	0.0%	0.0%
All Other Materials	35.6%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Davey Lab (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		90%	**85%**	**65%**	**95%**	**95%**
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles			5%		
	Recyclable Film			10%	<5%	
	Misc Plastics	<5%	10%			
	Metal					
	Glass Bottles					
	Total Misplaced Recyclables	**<5%**	**10%**	**15%**	**<5%**	
Contamination	Food-Cont. Target Recyclable	<5%	<5%	10%	<5%	
	Food-Cont. Non-Target Recyclables		<5%			
	Bulky Rigid Plastics					
	All EPS			<5%		
	Non-Recyclable Plastic Film	<5%				
	All Other Plastics	<5%		<5%		
	Other Glass					
	Non-Recyclable Paper	<5%	<5%	<5%		<5%
	Organics			<5%		
	Aseptic/Polycoated Containers					
	Liquids					
	All Other Contamination	<5%	<5%	<5%		
	Total Contamination	**10%**	**10%**	**15%**	**<5%**	**<5%**

Target Materials		Compost
		75%
Compostable Materials	Loose Food Waste	20%
	Yard Waste	
	Paper Towels, Napkin, Tissue	10%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	35%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	25%
	All Rigid Plastics	
	Non-Rigid Plastic Film and Bags	
	All EPS	<5%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**25%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Frear North and South Buildings

Building Facts

Type: Academic

Year Constructed: 1940 (North) 1969 (South)

Service Area**:** Area 4

Gross Square Footage**:** 159,158 (combined)

Season Audited: Spring 2018

Description: Frear North and South Buildings, two buildings named for prominent Penn State chemist William Frear (1860-1922), houses members of the Department of Biology and Department of Biochemistry and Molecular Biology.

Audit Results

Some key findings from the results for Frear include:

- Approximately 600 pounds of refuse, 70 pounds of recyclables, and 30 pounds of compost were generated from Frear, for a **recycling rate of 15 percent.**
- WCS Results:
  - About 11 percent of the refuse was accepted recyclables, mostly recyclable paper and miscellaneous plastics. Another 6 percent was food waste.

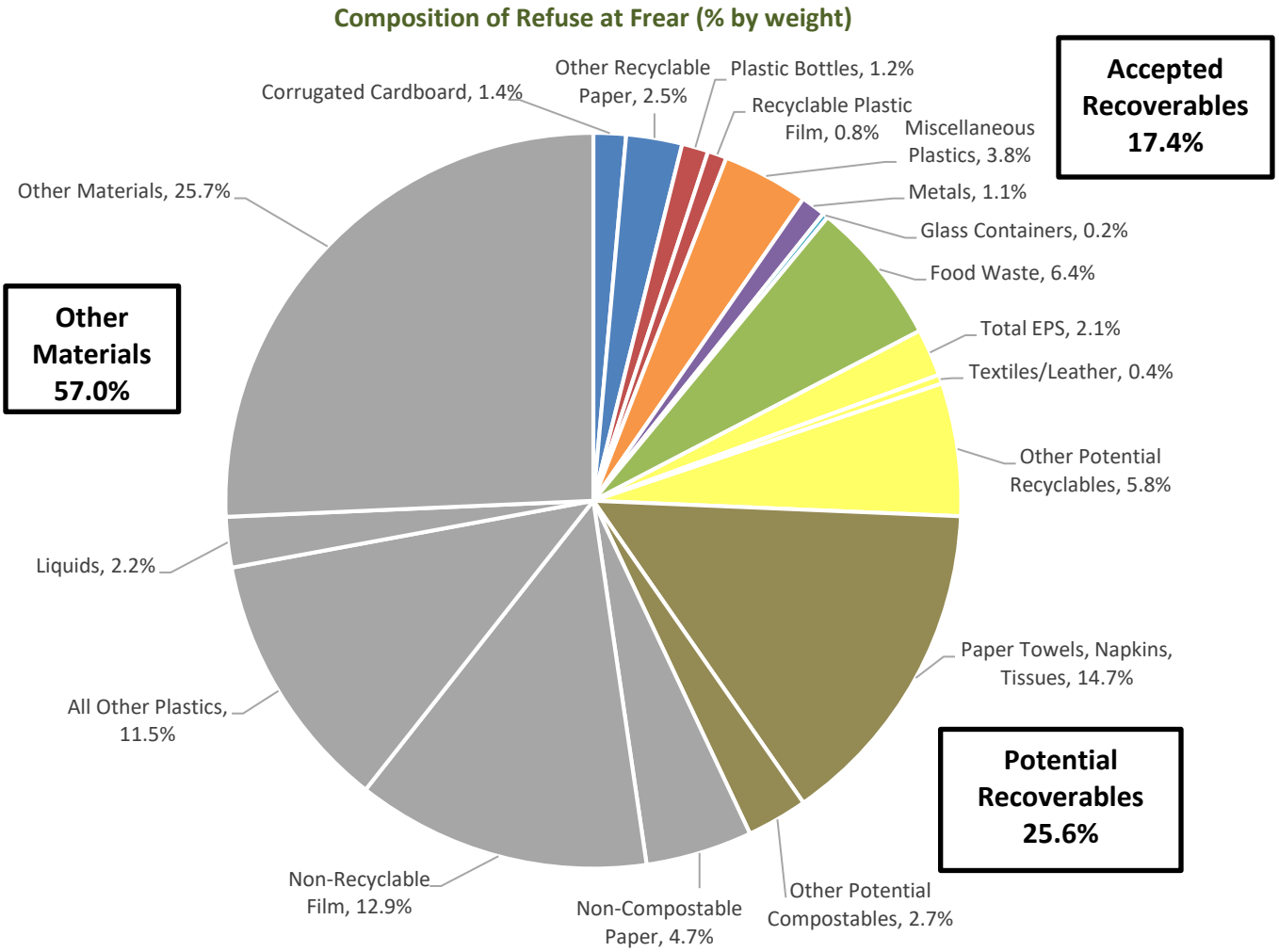
- Potential recyclables comprised about 8 percent of the refuse, most of this was bulky rigid plastics, such as large plastic laboratory implements.
- Almost 15 percent of the refuse was paper towels, napkins, and tissues. This was on the lower end compared to other buildings.
- Frear had the highest percent composition of all other materials of the audit, at about 57 percent. This was mainly due to the number of non-recyclable materials associated with laboratory activities. Non-recyclable plastic film, all other plastic, lab glass, and all other garbage (e.g. discarded clean agar plates) were primary components of all other materials.

- Visual Assessment Results:
  - Recyclables from Frear were very clean with only negligible contamination. However, on most days several recycling streams were not generated; no glass was collected all week.
  - Compost was moderately contaminated, as at other buildings, this was mostly non-compostable paper cups and containers.

Daily Material Generation at Frear

Weight (lbs)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	Mon (4/23)	Tue (4/24)	**Weekly Total**	**% of total weight**
Refuse	79.4	151.9	76.2	161.6	98.6	138.4	**597.2**	**85.0%**
Paper	3.2	2.1	3.8	4.9	1.9	66.4	**47.6**	**6.8%**
Plastic Bottles	1.3	0.0	5.0	5.3	0.0	5.6	**13.8**	**2.0%**
Misc Plastics	0.0	0.0	0.0	0.0	0.0	6.2	**3.1**	**0.4%**
Metal	0.0	0.0	0.0	0.0	0.0	15.2	**7.6**	**1.1%**
Glass	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0%**
Compost	4.6	2.9	7.2	10.1	5.2	11.8	**33.7**	**4.8%**
OCC	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0%**
Total	**88.5**	**156.9**	**92.3**	**181.9**	**105.7**	**243.7**	**703.0**	**100.0%**

Volume (cy)							
Refuse	0.9	1.9	1.4	2.8	1.4	1.9	**8.9**
Paper	0.0	0.0	0.1	0.0	0.0	0.2	**0.2**
Plastic Bottles	0.0	0.0	0.2	0.2	0.0	0.2	**0.4**
Misc Plastics	0.0	0.0	0.0	0.0	0.0	0.1	**0.0**
Metal	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Glass	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Compost	0.1	0.0	0.1	0.1	0.0	0.1	**0.4**
Total	**1.1**	**1.9**	**1.7**	**3.1**	**1.5**	**2.5**	**10.0**



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Frear (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.0%	0.0%	0.0%
Corrugated Cardboard (OCC)	1.4%	0.3%	2.6%
Mixed Recyclable Paper	2.5%	1.6%	3.3%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	3.9%		
PET Bottles (#1)	0.9%	0.8%	1.1%
HDPE Bottles (#2)	0.2%	0.0%	0.4%
Recyclable Plastic Film	0.8%	0.4%	1.2%
Total Plastic Bottles and Film	2.0%		
Non-Bottle Plastics (#1 and #2)	0.4%	0.1%	0.8%
Other Plastic Containers (#3-#7)	1.4%	1.1%	1.8%
Plastic Cups	1.9%	1.3%	2.5%
Total Miscellaneous Plastics	3.8%		
Tin/Steel Cans	0.0%	0.0%	0.0%
Ferrous Scrap Metals	0.3%	0.0%	0.7%
Aluminum Cans	0.1%	0.0%	0.2%
Aluminum Foil and Trays	0.6%	0.3%	0.9%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.1%		
Glass Containers	0.2%	-0.2%	0.7%
Food Waste	6.4%	2.8%	9.9%
Aseptic/Polycoated Containers	0.0%	0.0%	0.1%
Bulky Rigid Plastics	5.8%	0.4%	11.2%
Food Service EPS	0.4%	0.2%	0.7%
Bulk Packaging EPS	1.7%	0.2%	3.1%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.4%	-0.2%	1.0%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	8.3%		
Paper Towels, Napkins, Tissues	14.7%	12.5%	16.8%
Compostable Food Containers and Cups	0.5%	0.3%	0.7%
Yard Waste	1.5%	-0.7%	3.6%
Other Organics	0.5%	-0.1%	1.2%
Clean Wood Waste	0.2%	-0.1%	0.6%
Potential Compostables	17.3%		
Non-Compostable Paper Food Serviceware	4.7%	2.9%	6.5%
Non-Recyclable Plastic Film	12.9%	7.9%	18.0%
All Other Plastics	11.5%	7.5%	15.5%
Other Glass	0.0%	-0.1%	0.1%
Lab Glass	10.3%	0.5%	20.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.6%	0.0%	1.2%
All Other Garbage	14.8%	5.0%	24.6%
Liquids	2.2%	0.6%	3.8%
Grit	0.0%	0.0%	0.0%
All Other Materials	57.0%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Frear (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		95%	**90%**	**65%**	**100%**	
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles			20%		
	Recyclable Film			10%		
	Misc Plastics		10%			
	Metal					
	Glass Bottles					
	Total Misplaced Recyclables		**10%**	**30%**		
Contamination	Food-Cont. Target Recyclable		<5%			
	Food-Cont. Non-Target Recyclables					
	Bulky Rigid Plastics					
	All EPS					
	Non-Recyclable Plastic Film					
	All Other Plastics			5%		
	Other Glass					
	Non-Recyclable Paper	<5%				
	Organics					
	Aseptic/Polycoated Containers					
	Liquids					
	All Other Contamination					
	Total Contamination	**<5%**	**<5%**	**5%**		

Target Materials		Compost
		65%
Compostable Materials	Loose Food Waste	25%
	Yard Waste	
	Paper Towels, Napkin, Tissue	15%
	Clean Wood Waste	
	Comp. Containers & Cups	20%
	Pizza Boxes	5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	35%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	<5%
	All EPS	<5%
	All Metals	<5%
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**35%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Thomas Building

Building Facts

Type: Academic

Year Constructed: 1992

Service Area**:** Area 4

Gross Square Footage**:** 124,157

Season Audited: Spring 2018

Description: Thomas Building is home to the Eberly College of Science Dean's Office and Department of Statistics. It also houses members of the Forensic Science program, as well as general purpose classrooms and auditoriums.

Audit Results

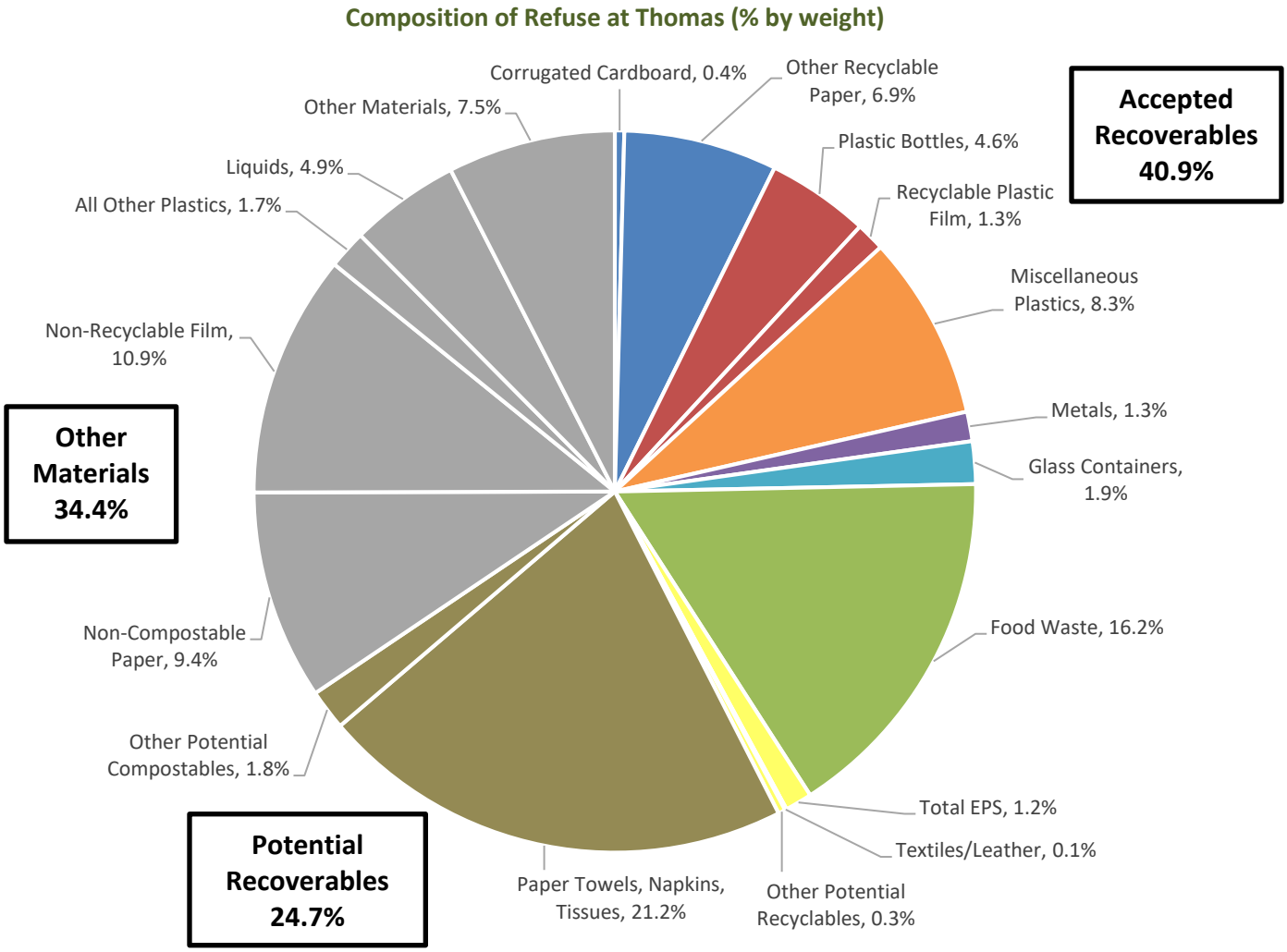
Some key findings from the results for Thomas include:

- About 830 pounds of refuse, 700 pounds of recyclables, and 120 pounds of compost were generated from Thomas over a week, for a **recycling rate of about 50 percent.**
- WCS Results:
  - Nearly 25 and 16 percent of the refuse was recycling and food waste, respectively, that could be accepted in the University's current recycling and compost program.
  - Paper towels, napkins, and tissues that could be potentially composted comprised an additional 21 percent of the refuse stream.
  - Non-compostable paper food serviceware (mostly disposal drink cups) and non-recyclable plastic film (e.g. garbage bags) comprised about 9 and 11 percent of refuse, respectively.

- Visual Assessment Results:
  - Miscellaneous plastics had the lowest percentage of target recyclables. About 25 percent of the stream was misplaced recyclables (plastic bottles and film) and another 25 percent was contamination, such as food-contaminated miscellaneous plastics.
  - No recycling stream was exceptionally clean. They all had a fair amount of non-target recyclables and contamination.
  - The compostable stream was moderately contaminated, with mostly non-compostable paper containers and cups.

Daily Material Generation at Thomas

Weight (lbs)	Fri (4/13)	Mon (4/16)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	Mon (4/23)	**Weekly Total**	**% of total weight**
Refuse	222.4	168.0	155.1	199.4	157.3	110.1	130.8	**827.4**	**50.3%**
Paper	108.4	63.5	31.5	41.2	59.2	56.7	103.1	**297.7**	**18.1%**
Plastic Bottles	28.8	19.6	27.0	17.6	19.3	30.2	18.1	**112.3**	**6.8%**
Misc Plastics	18.7	14.1	17.3	19.6	15.3	15.2	12.4	**82.4**	**5.0%**
Metal	7.9	6.4	8.8	4.2	8.6	6.4	2.8	**33.3**	**2.0%**
Glass	12.1	11.7	9.2	8.0	21.2	6.9	4.8	**56.1**	**3.4%**
Compost	31.8	18.1	30.1	25.7	24.8	11.3	15.4	**118.9**	**7.2%**
OCC	30.8	19.2	39.2	12.4	14.4	16.6	38.0	**118.3**	**7.2%**
Total	**461.0**	**320.6**	**318.3**	**328.0**	**320.1**	**253.3**	**325.4**	**1646.5**	**100.0%**
Volume (cy)									
Refuse	3.3	2.4	2.4	2.4	1.4	1.9	1.9	**10.8**	
Paper	0.9	0.5	0.5	0.5	0.4	0.5	0.5	**2.5**	
Plastic Bottles	0.5	0.4	0.5	0.5	0.5	0.5	0.5	**2.3**	
Misc Plastics	0.4	0.2	0.4	0.5	0.2	0.2	0.2	**1.6**	
Metal	0.0	0.2	0.1	0.0	0.0	0.0	0.0	**0.3**	
Glass	0.1	0.1	0.0	0.0	0.0	0.0	0.0	**0.3**	
Compost	0.4	0.1	0.2	0.5	0.2	0.2	0.2	**1.4**	
Total	**5.5**	**3.9**	**4.0**	**4.3**	**2.8**	**3.3**	**3.3**	**19.1**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Thomas (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.3%	-0.1%	0.7%
Corrugated Cardboard (OCC)	0.4%	0.0%	0.8%
Mixed Recyclable Paper	6.6%	5.2%	7.9%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	7.3%		
PET Bottles (#1)	3.8%	3.0%	4.6%
HDPE Bottles (#2)	0.8%	-0.3%	1.9%
Recyclable Plastic Film	1.3%	0.6%	2.0%
Total Plastic Bottles and Film	5.9%		
Non-Bottle Plastics (#1 and #2)	2.3%	-0.5%	5.2%
Other Plastic Containers (#3-#7)	1.3%	0.7%	1.9%
Plastic Cups	4.6%	4.0%	5.2%
Total Miscellaneous Plastics	8.3%		
Tin/Steel Cans	0.1%	0.0%	0.3%
Ferrous Scrap Metals	0.1%	-0.1%	0.3%
Aluminum Cans	0.6%	0.5%	0.8%
Aluminum Foil and Trays	0.3%	0.0%	0.6%
Non-Ferrous Scrap Metals	0.1%	-0.1%	0.4%
Total Recyclable Metal	1.3%		
Glass Containers	1.9%	0.9%	2.9%
Food Waste	16.2%	12.4%	20.1%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	0.9%	0.5%	1.3%
Bulk Packaging EPS	0.3%	-0.1%	0.7%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.1%	-0.1%	0.2%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.2%	-0.2%	0.6%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	1.6%		
Paper Towels, Napkins, Tissues	21.2%	19.3%	23.2%
Compostable Food Containers and Cups	1.2%	0.6%	1.8%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.6%	-0.1%	1.3%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	23.1%		
Non-Compostable Paper Food Serviceware	9.4%	8.2%	10.6%
Non-Recyclable Plastic Film	10.9%	8.7%	13.1%
All Other Plastics	1.7%	0.9%	2.6%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.1%	-0.1%	0.2%
Treated Wood Waste	0.1%	0.0%	0.2%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.2%	-0.1%	0.5%
All Other Garbage	7.2%	5.1%	9.3%
Liquids	4.9%	1.9%	8.0%
Grit	0.0%	0.0%	0.0%
All Other Materials	34.4%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Thomas (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		70%	**65%**	**45%**	**65%**	**70%**
Misplaced Recyclables	Recyclable Paper		<5%	<5%	5%	5%
	Plastic Bottles	<5%		10%	5%	<5%
	Recyclable Film	<5%		10%	<5%	10%
	Misc Plastics	<5%	15%		<5%	
	Metal	<5%	<5%			
	Glass Bottles		<5%	<5%	<5%	
	Total Misplaced Recyclables	**10%**	**15%**	**25%**	**15%**	**20%**
Contamination	Food-Cont. Target Recyclable	<5%	10%	10%	<5%	<5%
	Food-Cont. Non-Target Recyclables	<5%				<5%
	Bulky Rigid Plastics					
	All EPS			<5%	<5%	<5%
	Non-Recyclable Plastic Film					
	All Other Plastics		<5%	<5%	<5%	<5%
	Other Glass					
	Non-Recyclable Paper	10%	<5%	<5%	<5%	<5%
	Organics	<5%	<5%			
	Aseptic/Polycoated Containers					
	Liquids				<5%	
	All Other Contamination	<5%	5%	<5%	<5%	
	Total Contamination	**20%**	**20%**	**25%**	**15%**	**10%**

Target Materials		Compost
		75%
Compostable Materials	Loose Food Waste	15%
	Yard Waste	
	Paper Towels, Napkin, Tissue	5%
	Clean Wood Waste	
	Comp. Containers & Cups	15%
	Pizza Boxes	40%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	25%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	
	All EPS	<5%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**25%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Willard Building

Building Facts

Type**:** Academic

Year Constructed: 1949

Service Area**:** Area 3

Gross Square Footage**:** 135,422

Season Audited: Spring 2018

Description: "Old and new" Willard houses some of the University's general purpose classrooms, faculty offices for the Donald P. Bellisario College of Communications and various department/centers for the College of Liberal Arts.

Audit Results

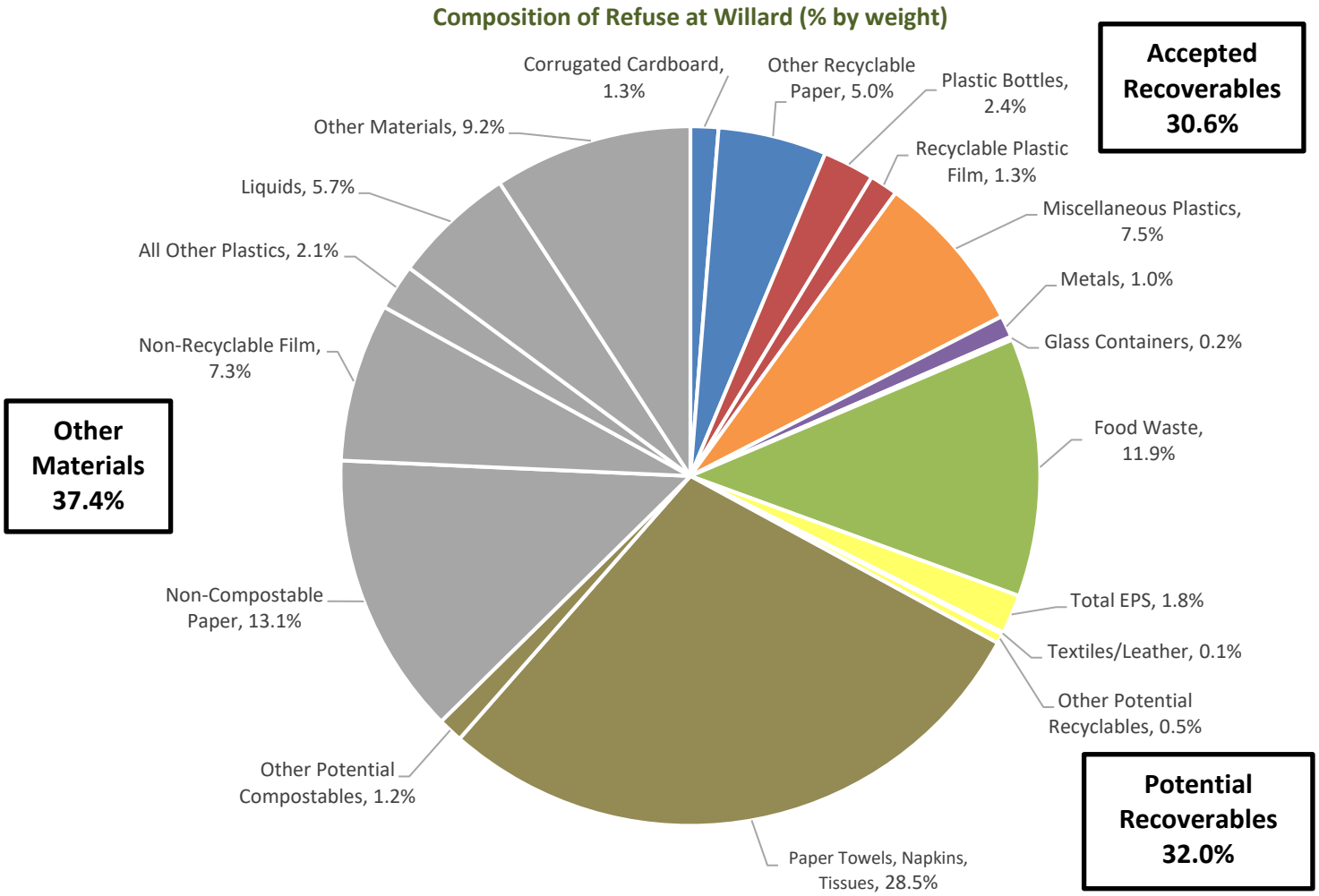
Some key findings from the results for Willard include:

- About 680 pounds of refuse, 530 pounds of recyclables, and 90 pounds of compost were generated from Willard over the week, for a **recycling rate of about 47 percent.**
- WCS Results:
  - Nearly 19 percent of the refuse stream were materials that are accepted in the University's recycling stream. Mixed recyclable paper and plastic cups were about half of this. Approximately 12 percent of the refuse stream was food waste.
  - Paper towels, napkins, and tissues had the highest percentage of any material in the Willard refuse at 28.5 percent.
  - Non-compostable food serviceware was the second most prominent category, compromising 13 percent of the refuse. All other garbage, non-recyclable plastic film, and liquids were other significant material categories.
- Visual Assessment Results:
  - Miscellaneous plastic had the highest contamination of any of the recycling stream, with food contaminated plastics as the most significant contaminant. Plastic bottles & film and glass streams also had a relatively high level of misplaced miscellaneous plastics.
  - The compost stream had a significant amount of non-compostable paper containers and cups, which contaminated the compost stream.

Daily Material Generation at Willard

Weight (lbs)	Fri (4/13)	Mon (4/16)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Weekly Total	% of total weight
Refuse	134.0	131.2	168.8	145.0	102.6	**681.6**	**52.7%**
Paper	53.3	35.5	42.3	30.6	36.3	**198.0**	**15.3%**
Plastic Bottles	47.2	29.6	38.5	41.6	20.8	**177.6**	**13.7%**
Misc Plastics	19.6	11.2	14.4	15.0	17.8	**78.2**	**6.0%**
Metal	4.9	2.6	2.5	2.4	2.6	**15.1**	**1.2%**
Glass	12.5	7.0	13.3	14.0	5.9	**52.8**	**4.1%**
Compost	24.4	14.0	13.1	23.3	10.4	**85.2**	**6.6%**
OCC	5.6	0.0	0.0	0.0	0.0	**5.6**	**0.4%**
Total	**301.5**	**231.2**	**292.9**	**272.0**	**196.5**	**1294.1**	**100.0%**

Volume (cy)						
Refuse	2.8	2.4	3.3	2.4	1.9	**12.7**
Paper	0.5	0.1	0.5	0.2	0.4	**1.6**
Plastic Bottles	0.9	0.2	0.6	0.5	0.4	**2.6**
Misc Plastics	0.5	0.1	0.4	0.4	0.4	**1.6**
Metal	0.1	0.1	0.1	0.1	0.0	**0.5**
Glass	0.1	0.0	0.1	0.0	0.0	**0.3**
Compost	0.5	0.1	0.2	0.5	0.1	**1.4**
Total	**5.4**	**3.1**	**5.2**	**4.0**	**3.1**	**20.8**



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Willard (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.3%	-0.1%	0.8%
Corrugated Cardboard (OCC)	1.3%	0.3%	2.3%
Mixed Recyclable Paper	4.7%	2.2%	7.2%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	6.3%		
PET Bottles (#1)	2.4%	1.7%	3.0%
HDPE Bottles (#2)	0.0%	0.0%	0.0%
Recyclable Plastic Film	1.3%	0.9%	1.7%
Total Plastic Bottles and Film	3.7%		
Non-Bottle Plastics (#1 and #2)	1.4%	-0.4%	3.1%
Other Plastic Containers (#3-#7)	1.6%	0.6%	2.5%
Plastic Cups	4.6%	4.2%	4.9%
Total Miscellaneous Plastics	7.5%		
Tin/Steel Cans	0.0%	0.0%	0.0%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.3%	0.2%	0.5%
Aluminum Foil and Trays	0.7%	0.4%	0.9%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.0%		
Glass Containers	0.2%	-0.2%	0.5%
Food Waste	11.9%	10.6%	13.3%
Aseptic/Polycoated Containers	0.4%	-0.1%	0.9%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	1.8%	1.2%	2.4%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	-0.1%	0.1%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.1%	0.0%	0.2%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	2.4%		
Paper Towels, Napkins, Tissues	28.5%	25.3%	31.8%
Compostable Food Containers and Cups	0.8%	-0.1%	1.6%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.4%	-0.5%	1.3%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	29.7%		
Non-Compostable Paper Food Serviceware	13.1%	10.1%	16.0%
Non-Recyclable Plastic Film	7.3%	6.8%	7.8%
All Other Plastics	2.1%	0.6%	3.7%
Other Glass	0.4%	-0.7%	1.5%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.4%	-0.1%	0.8%
All Other Garbage	8.4%	6.0%	10.9%
Liquids	5.7%	1.8%	9.6%
Grit	0.0%	0.0%	0.0%
All Other Materials	37.4%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Willard (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		75%	**60%**	**45%**	**90%**	**60%**
Misplaced Recyclables	Recyclable Paper		<5%	<5%		
	Plastic Bottles	<5%		5%		5%
	Recyclable Film			5%	<5%	
	Misc Plastics	<5%	25%		<5%	20%
	Metal					
	Glass Bottles					
	Total Misplaced Recyclables	**<5%**	**25%**	**15%**	**5%**	**25%**
Contamination	Food-Cont. Target Recyclable	10%	5%	20%		5%
	Food-Cont. Non-Target Recyclables		<5%	<5%		
	Bulky Rigid Plastics					
	All EPS	<5%		<5%		<5%
	Non-Recyclable Plastic Film	<5%		<5%		
	All Other Plastics		<5%	5%		
	Other Glass					
	Non-Recyclable Paper	10%	5%	5%	<5%	5%
	Organics	<5%		<5%		
	Aseptic/Polycoated Containers					
	Liquids					
	All Other Contamination		<5%		<5%	<5%
	Total Contamination	**25%**	**15%**	**45%**	**<5%**	**15%**

Target Materials		Compost
		65%
Compostable Materials	Loose Food Waste	10%
	Yard Waste	
	Paper Towels, Napkin, Tissue	10%
	Clean Wood Waste	<5%
	Comp. Containers & Cups	<5%
	Pizza Boxes	40%
Contamination	Packaged Food Waste	<5%
	Non-Comp. Paper Containers & Cups	25%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	<5%
	All EPS	<5%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**35%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Kern Graduate Building

Building Facts

Type: Administrative

Year Constructed: 1970

Service Area**:** Area 2

Gross Square Footage**:** 63,279

Season Audited: Spring 2018

Description: Kern Building is home to the College of the Liberal Arts' Department of Economics, the University Faculty Senate, and The Graduate School at Penn State, one of the largest graduate schools in the nation.

Audit Results

Some key findings from the results for Kern include:

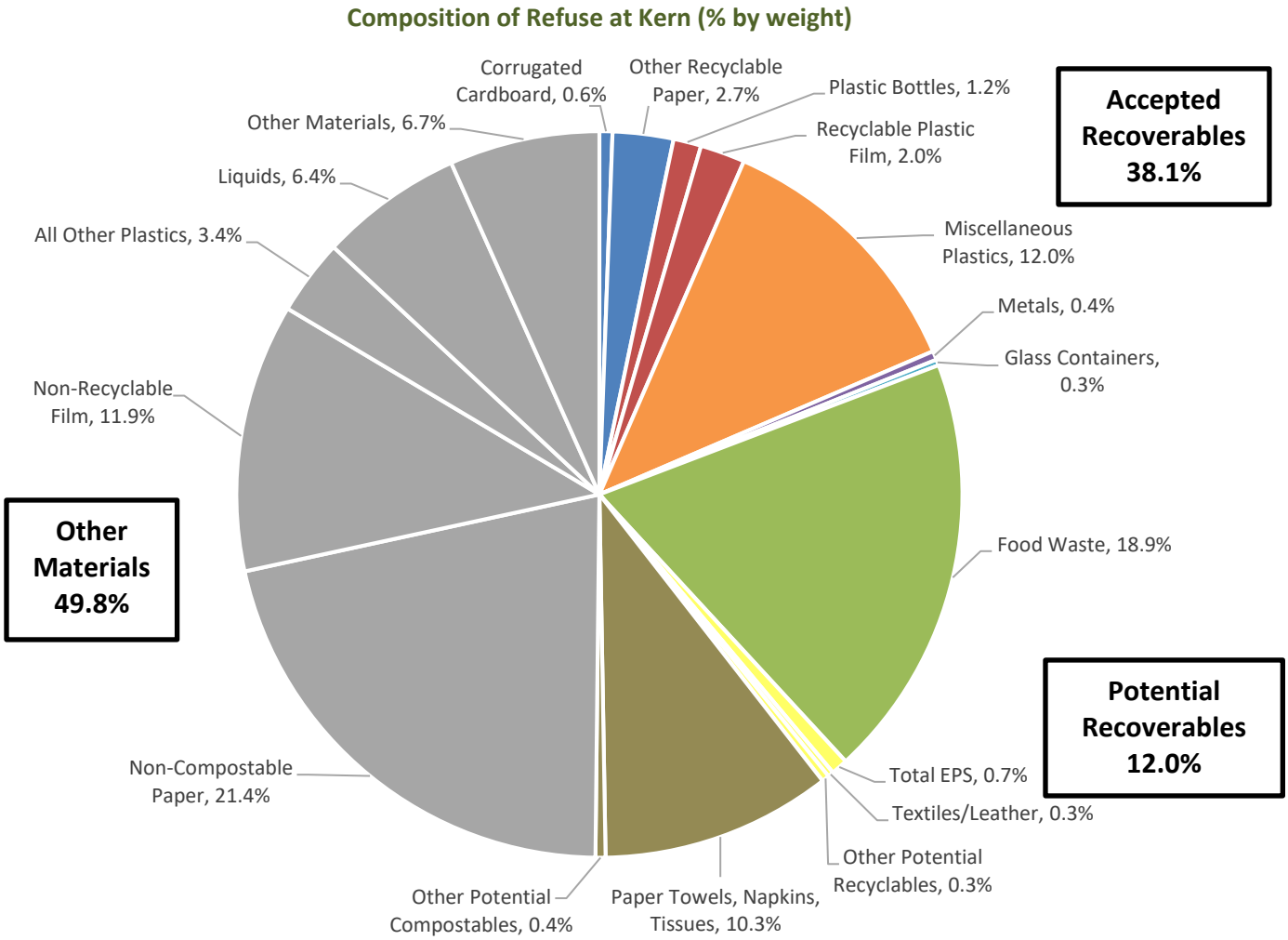
- Over the week, approximately 180 pounds of refuse, 150 pounds of recycling, and 50 pounds of compost were generated from Kern for a **recycling rate of 52 percent**.
- WCS Results:
  - Nearly 20 percent of the refuse was accepted recyclables, over half of this consisted of miscellaneous plastics. Another 10 percent of the refuse was food waste.
  - About 10 percent of the refuse was paper towels, napkins, and tissues, which could potentially be composted.

- The largest category was non-compostable paper food serviceware, at over 21 percent. This consisted primarily of disposal cups and bowls from the quick-service restaurant in Kern. Another 12 percent was non-recyclable plastic film.

- Visual Assessment Results:
  - Kern had exceptionally high percentage of non-target materials and contamination in most of its recyclable stream. Both the paper and miscellaneous plastic streams had a significant percentage of non-recyclable paper (mostly disposal paper cups and bowls). The plastic bottles and film stream had a high percentage of misplaced miscellaneous plastics.
  - The compostable stream was also very contaminated (only about a third was actually compostable materials). Again, the contamination was mostly non-compostable paper cups and containers. But also had a significant amount of rigid plastics such as plastic clam shells.

Daily Material Generation at Kern

Weight (lbs)	Fri (4/13)	Mon (4/16)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	**Weekly Total**	**% of total weight**
Refuse	79.2	26.0	27.4	38.7	30.4	40.5	**182.4**	**47.8%**
Paper	6.0	9.4	4.0	3.4	2.8	4.0	**24.7**	**6.5%**
Plastic Bottles	25.6	7.3	6.4	9.7	9.2	8.9	**49.8**	**13.1%**
Misc Plastics	19.6	14.5	13.4	13.0	8.3	11.0	**64.6**	**16.9%**
Metal	2.0	0.9	1.0	0.9	3.4	0.1	**7.3**	**1.9%**
Glass	0.9	0.0	0.4	1.8	1.5	1.0	**4.6**	**1.2%**
Compost	20.9	12.3	9.7	5.6	4.6	7.9	**46.6**	**12.2%**
OCC	2.4	0.0	0.0	0.0	0.0	0.0	**1.2**	**0.3%**
Total	**156.7**	**70.4**	**62.3**	**73.2**	**60.1**	**73.5**	**381.2**	**100.0%**
Volume (cy)								
Refuse	1.4	0.5	0.5	0.5	0.5	0.5	**2.8**	
Paper	0.1	0.2	0.2	0.1	0.1	0.1	**0.7**	
Plastic Bottles	0.2	0.2	0.2	0.2	0.2	0.2	**1.1**	
Misc Plastics	0.2	0.1	0.4	0.4	0.2	0.2	**1.3**	
Metal	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Glass	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Compost	0.2	0.2	0.1	0.1	0.1	0.1	**0.7**	
Total	**2.3**	**1.3**	**1.3**	**1.3**	**1.0**	**1.0**	**6.6**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Kern (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.1%	0.0%	0.1%
Corrugated Cardboard (OCC)	0.6%	0.0%	1.1%
Mixed Recyclable Paper	2.6%	1.1%	4.2%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	3.3%		
PET Bottles (#1)	1.1%	0.2%	2.0%
HDPE Bottles (#2)	0.1%	0.0%	0.3%
Recyclable Plastic Film	2.0%	0.5%	3.5%
Total Plastic Bottles and Film	3.2%		
Non-Bottle Plastics (#1 and #2)	4.1%	0.9%	7.4%
Other Plastic Containers (#3-#7)	3.2%	0.4%	6.0%
Plastic Cups	4.7%	3.3%	6.2%
Total Miscellaneous Plastics	12.0%		
Tin/Steel Cans	0.0%	0.0%	0.0%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.1%	0.0%	0.3%
Aluminum Foil and Trays	0.3%	0.0%	0.5%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	0.4%		
Glass Containers	0.3%	0.0%	0.5%
Food Waste	18.9%	12.1%	25.8%
Aseptic/Polycoated Containers	0.2%	0.0%	0.4%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	0.7%	0.4%	1.1%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.1%	0.0%	0.2%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.3%	-0.3%	0.8%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	1.3%		
Paper Towels, Napkins, Tissues	10.3%	5.8%	14.7%
Compostable Food Containers and Cups	0.4%	-0.1%	0.9%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	10.7%		
Non-Compostable Paper Food Serviceware	21.4%	15.3%	27.6%
Non-Recyclable Plastic Film	11.9%	4.5%	19.4%
All Other Plastics	3.4%	1.9%	4.8%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.1%	-0.1%	0.3%
All Other Garbage	6.6%	2.3%	10.9%
Liquids	6.4%	0.7%	12.1%
Grit	0.0%	0.0%	0.0%
All Other Materials	49.8%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Kern (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		40%	**45%**	**40%**	**75%**	**75%**
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles	<5%		<5%		5%
	Recyclable Film			5%		
	Misc Plastics	<5%	35%		15%	5%
	Metal					
	Glass Bottles					
	Total Misplaced Recyclables	**<5%**	**35%**	**10%**	**15%**	**10%**
Contamination	Food-Cont. Target Recyclable	5%	5%	15%		
	Food-Cont. Non-Target Recyclables		<5%	<5%		
	Bulky Rigid Plastics					
	All EPS			<5%		
	Non-Recyclable Plastic Film					
	All Other Plastics	<5%	<5%	5%	<5%	
	Other Glass					
	Non-Recyclable Paper	45%	5%	20%	<5%	15%
	Organics	<5%	<5%	<5%	<5%	
	Aseptic/Polycoated Containers					
	Liquids				<5%	
	All Other Contamination	<5%	<5%	<5%	<5%	
	Total Contamination	**55%**	**20%**	**50%**	**10%**	**15%**

Target Materials		Compost
		35%
Compostable Materials	Loose Food Waste	15%
	Yard Waste	
	Paper Towels, Napkin, Tissue	10%
	Clean Wood Waste	
	Comp. Containers & Cups	<5%
	Pizza Boxes	10%
Contamination	Packaged Food Waste	<5%
	Non-Comp. Paper Containers & Cups	40%
	All Rigid Plastics	20%
	Non-Rigid Plastic Film and Bags	<5%
	All EPS	
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**65%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Office of Physical Plant Building

Building Facts

Type: Administrative

Year Constructed: 1965

Service Area**:** Area 1

Gross Square Footage**:** 154,307

Season Audited: Spring 2018

Description: The central hub for the University's physical plant operation, which provides quality facility services and safety programs in support of the University's mission.

Audit Results

Some key findings from the results for OPP include:

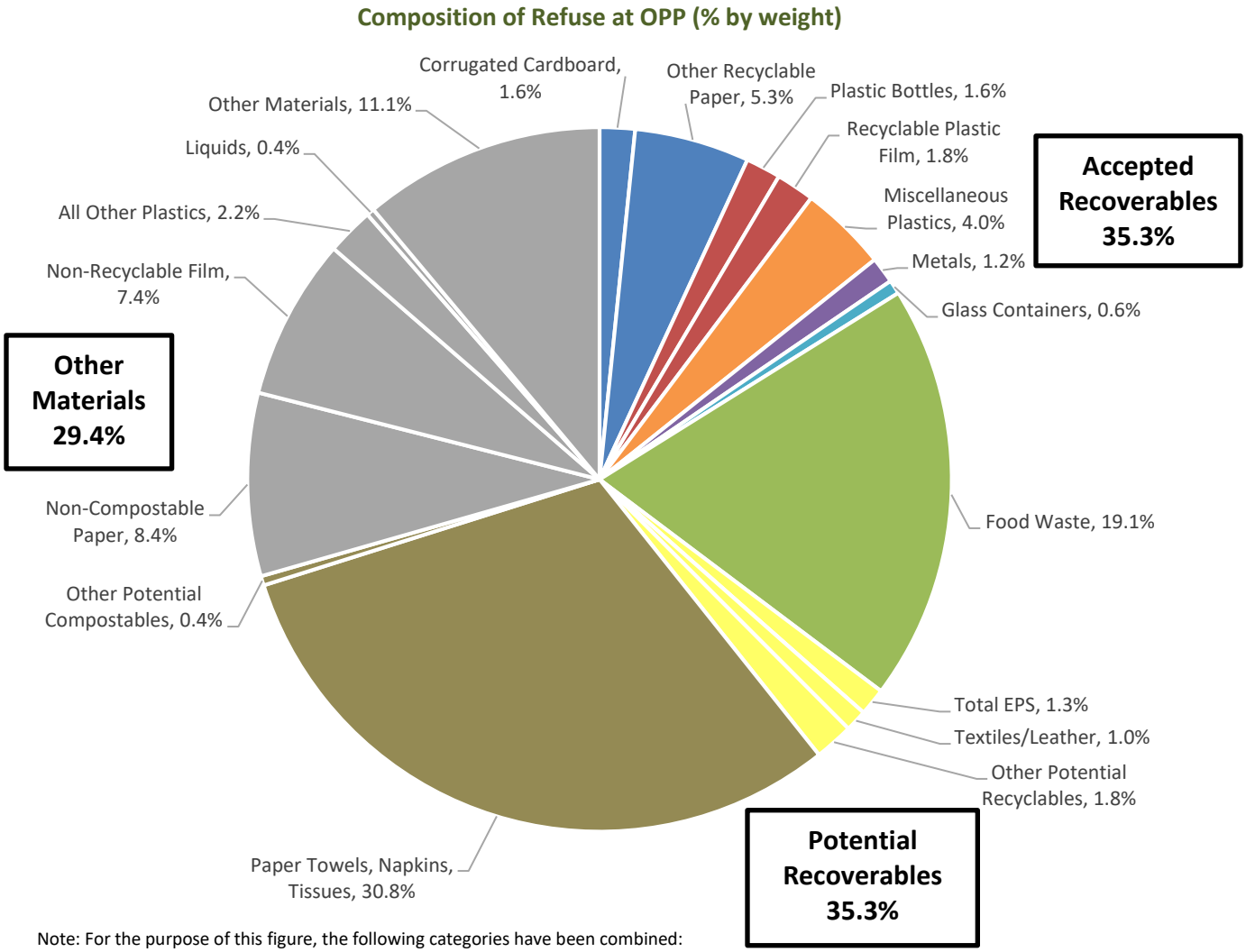
- About 320 pounds of refuse, 350 pounds of recyclables, and 150 pounds of compost were generated from OPP, for a **recycling rate of 61 percent**.
- WCS Results:
  - About 16 percent of the refuse was accepted recyclables (mostly recyclable paper and miscellaneous plastics) and 19 percent was food waste.
  - Over 30 percent of the refuse was paper towels, napkins, and tissues.
- Visual Assessment:
  - All other materials comprised nearly 30 percent of the refuse, almost all of this was all other garbage, non-compostable paper food serviceware, and non-recyclable plastic film.

- OPP had some of the cleanest recycling streams. Miscellaneous plastic was only moderately contaminated, most predominantly with EPS.
- The compost stream was moderately contaminated; non-compostable paper cups and containers comprising about a quarter of the material.

Daily Material Generation at OPP

Weight (lbs)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	Mon (4/23)	Tue (4/24)	**Weekly Total**	**% of total weight**
Refuse	48.5	57.2	56.9	63.6	85.8	57.8	**316.6**	**38.8%**
Paper	29.0	89.6	67.0	55.2	35.9	15.8	**270.2**	**33.1%**
Plastic Bottles	7.6	9.0	7.2	10.5	0.0	13.4	**37.1**	**4.6%**
Misc Plastics	2.6	4.4	6.5	3.2	0.0	3.4	**17.2**	**2.1%**
Metal	0.0	7.8	3.1	0.0	0.0	0.0	**11.0**	**1.3%**
Glass	0.0	8.8	0.0	4.3	0.0	8.2	**17.3**	**2.1%**
Compost	17.5	48.4	15.6	41.8	26.2	12.0	**146.7**	**18.0%**
OCC	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0%**
Total	**105.2**	**225.3**	**156.3**	**178.7**	**147.8**	**110.6**	**816.1**	**100.0%**

Volume (cy)							
Refuse	0.5	0.5	0.9	0.9	0.9	0.9	**4.0**
Paper	0.1	0.5	0.5	0.2	0.2	0.1	**1.5**
Plastic Bottles	0.0	0.1	0.2	0.2	0.0	0.2	**0.6**
Misc Plastics	0.0	0.0	0.2	0.1	0.0	0.1	**0.3**
Metal	0.0	0.0	0.1	0.0	0.0	0.0	**0.1**
Glass	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**
Compost	0.1	0.5	0.2	0.2	0.1	0.0	**1.0**
Total	**0.6**	**1.6**	**2.0**	**1.8**	**1.3**	**1.4**	**7.6**



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at OPP (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.5%	-0.1%	1.0%
Corrugated Cardboard (OCC)	1.6%	0.5%	2.7%
Mixed Recyclable Paper	4.8%	1.6%	8.1%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	6.9%		
PET Bottles (#1)	1.4%	0.0%	2.8%
HDPE Bottles (#2)	0.2%	-0.1%	0.5%
Recyclable Plastic Film	1.8%	0.7%	2.9%
Total Plastic Bottles and Film	3.4%		
Non-Bottle Plastics (#1 and #2)	0.5%	0.0%	0.9%
Other Plastic Containers (#3-#7)	2.7%	1.2%	4.3%
Plastic Cups	0.8%	0.5%	1.2%
Total Miscellaneous Plastics	4.0%		
Tin/Steel Cans	0.2%	-0.1%	0.4%
Ferrous Scrap Metals	0.1%	-0.1%	0.4%
Aluminum Cans	0.3%	0.1%	0.5%
Aluminum Foil and Trays	0.5%	0.3%	0.8%
Non-Ferrous Scrap Metals	0.1%	0.0%	0.2%
Total Recyclable Metal	1.2%		
Glass Containers	0.6%	-0.5%	1.8%
Food Waste	19.1%	15.5%	22.8%
Aseptic/Polycoated Containers	0.3%	0.1%	0.6%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	1.2%	-0.1%	2.5%
Bulk Packaging EPS	0.1%	-0.1%	0.2%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	1.3%	-1.5%	4.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.0%	-1.0%	2.9%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.2%	-0.2%	0.6%
Potential Recyclables	4.0%		
Paper Towels, Napkins, Tissues	30.8%	19.3%	42.4%
Compostable Food Containers and Cups	0.2%	-0.2%	0.7%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.2%	-0.2%	0.7%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	31.3%		
Non-Compostable Paper Food Serviceware	8.4%	5.9%	10.9%
Non-Recyclable Plastic Film	7.4%	5.5%	9.3%
All Other Plastics	2.2%	0.9%	3.4%
Other Glass	0.5%	-0.5%	1.4%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.1%	-0.1%	0.2%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.4%	-0.6%	1.3%
All Other Garbage	10.2%	6.4%	14.0%
Liquids	0.4%	0.0%	0.7%
Grit	0.0%	0.0%	0.0%
All Other Materials	29.4%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at OPP (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		95%	**85%**	**70%**	**100%**	**80%**
Misplaced Recyclables	Recyclable Paper					15%
	Plastic Bottles	<5%		<5%		<5%
	Recyclable Film			10%		
	Misc Plastics	<5%	5%			<5%
	Metal					
	Glass Bottles					
	Total Misplaced Recyclables	**<5%**	**5%**	**10%**		**15%**
Contamination	Food-Cont. Target Recyclable	<5%	5%	<5%		
	Food-Cont. Non-Target Recyclables					
	Bulky Rigid Plastics					
	All EPS			10%		
	Non-Recyclable Plastic Film			<5%		
	All Other Plastics		<5%	<5%		
	Other Glass					
	Non-Recyclable Paper	5%				<5%
	Organics					
	Aseptic/Polycoated Containers					
	Liquids					
	All Other Contamination		<5%	<5%	<5%	
	Total Contamination	**5%**	**10%**	**15%**	**<5%**	**<5%**

Target Materials		Compost
		75%
Compostable Materials	Loose Food Waste	25%
	Yard Waste	
	Paper Towels, Napkin, Tissue	25%
	Clean Wood Waste	
	Comp. Containers & Cups	15%
	Pizza Boxes	15%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	25%
	All Rigid Plastics	
	Non-Rigid Plastic Film and Bags	
	All EPS	
	All Metals	<5%
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**25%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Shields Building

Building Facts

Type: Administrative

Year Constructed: 1967

Service Area**:** Area 1

Gross Square Footage**:** 107,474

Season Audited: Spring 2018

Description: The Shields Building, built in 1966, holds the essential University offices that assist students throughout their entire duration as a student. The first floor houses two offices for current students: the Office of the University Registrar, which helps students with such items as scheduling, enrollment, and transcripts; and the Office of the Bursar, which handles tuition billing and student account details.

The second floor is home to the Undergraduate Admissions Office, which processes all applications to Penn State and provides walk-in counselor appointments for prospective and current students, as well as campus tours and information sessions.

The third floor of the Shields Building houses the Office of Student Aid. This office manages all the many types of financial aid provided to Penn State students and also features walk-in appointments for prospective and current students.

The final office located on the ground floor of Shields is Teaching and Learning with Technology (TLT), an office that works to guide the University in the appropriate use of technology to enrich teaching and learning. In addition to offices, the space includes an experimental classroom space, virtual reality technology, 3D printer, Lightboard for visitors to try, and a One Button Studio.

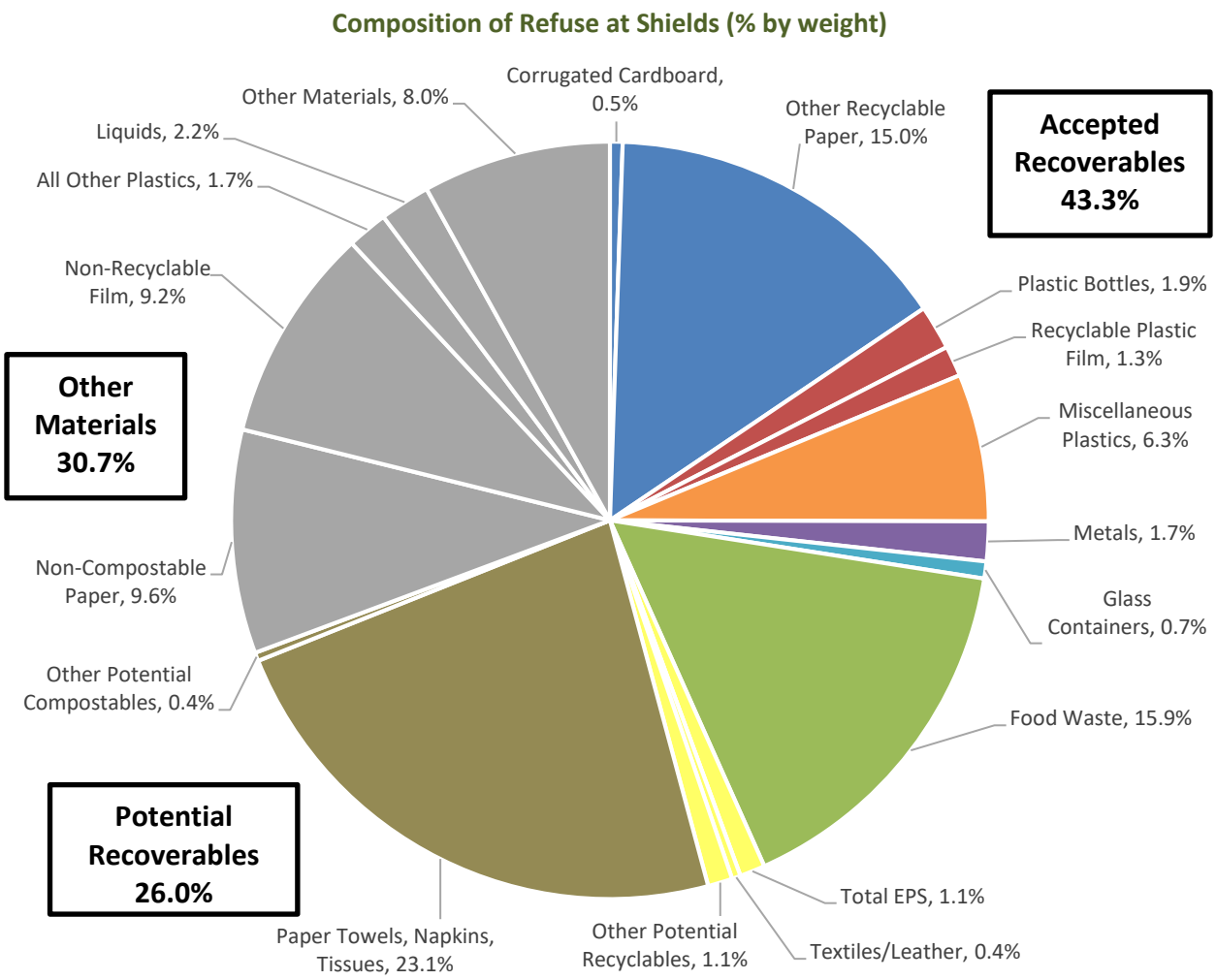
Audit Results

Some key findings from the results for Shields include:

- About 330 pounds of refuse, 310 pounds of recyclables, and 120 pounds of compost were generated from Shields, for a **recycling rate of 57 percent**.
- WCS Results:
  - Approximately 28 percent of the refuse was accepted recyclables. Recyclable paper comprised over half of this due to a high percentage of mixed recyclable paper, and one day in which a high volume of books was in the refuse. Food waste comprised another 16 percent of the refuse.
  - Paper towels, napkins, and tissues comprised about 23 percent of the refuse.
  - All other materials comprised over 30 percent of the refuse, and as in other buildings, was mostly paper food serviceware, all other garbage, and non-recyclable plastic film.
- Visual Audit Results:
  - Shields had exceptionally clean recycling streams. Even miscellaneous plastics had very little contamination; however, not much of this stream was collected, less than a pound over the week.
  - The compost stream was also relatively clean, but still with a noticeable amount of non-compostable paper food containers and cups.

Daily Material Generation at Shields

Weight (lbs)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	Mon (4/23)	Tue (4/24)	**Weekly Total**	**% of total weight**
Refuse	93.9	58.7	69.5	63.9	56.5	63.1	**327.2**	**43.4%**
Paper	49.0	119.4	42.2	31.7	11.1	23.4	**240.7**	**31.9%**
Plastic Bottles	1.3	8.3	13.0	11.4	7.5	7.2	**44.4**	**5.9%**
Misc Plastics	0.0	0.0	0.5	0.1	0.0	0.3	**0.8**	**0.1%**
Metal	0.0	6.6	5.9	5.4	3.9	4.9	**24.2**	**3.2%**
Glass	0.0	1.0	0.0	0.7	0.0	0.1	**1.8**	**0.2%**
Compost	18.8	21.2	21.9	24.2	24.8	27.8	**115.4**	**15.3%**
OCC	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0%**
Total	**163.0**	**215.3**	**153.0**	**137.4**	**103.8**	**126.9**	**754.5**	**100.0%**
Volume (cy)								
Refuse	0.9	0.7	0.9	1.4	0.9	0.9	**4.9**	
Paper	0.2	0.6	0.5	0.4	0.2	0.2	**1.8**	
Plastic Bottles	0.0	0.4	0.4	0.4	0.2	0.2	**1.4**	
Misc Plastics	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Metal	0.0	0.2	0.1	0.1	0.0	0.1	**0.4**	
Glass	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Compost	0.2	0.1	0.1	0.1	0.1	0.2	**0.6**	
Total	**1.3**	**1.9**	**2.0**	**2.3**	**1.5**	**1.6**	**9.2**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Shields (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.3%	0.0%	0.5%
Corrugated Cardboard (OCC)	0.5%	0.1%	1.0%
Mixed Recyclable Paper	6.8%	5.4%	8.1%
Books	8.0%	-2.7%	18.7%
Total Recyclable Paper	15.5%		
PET Bottles (#1)	1.7%	0.7%	2.7%
HDPE Bottles (#2)	0.2%	0.0%	0.4%
Recyclable Plastic Film	1.3%	0.6%	2.0%
Total Plastic Bottles and Film	3.2%		
Non-Bottle Plastics (#1 and #2)	0.7%	-0.4%	1.8%
Other Plastic Containers (#3-#7)	3.9%	2.8%	5.0%
Plastic Cups	1.7%	1.0%	2.5%
Total Miscellaneous Plastics	6.3%		
Tin/Steel Cans	0.3%	-0.1%	0.6%
Ferrous Scrap Metals	0.5%	-0.2%	1.1%
Aluminum Cans	0.5%	0.3%	0.7%
Aluminum Foil and Trays	0.5%	0.2%	0.7%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.7%		
Glass Containers	0.7%	-0.3%	1.8%
Food Waste	15.9%	11.2%	20.5%
Aseptic/Polycoated Containers	0.5%	0.3%	0.8%
Bulky Rigid Plastics	0.2%	-0.2%	0.6%
Food Service EPS	1.1%	0.8%	1.4%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.1%	0.0%	0.3%
Electronic Media	0.2%	0.0%	0.5%
Textiles and Leather	0.4%	-0.1%	0.9%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	2.5%		
Paper Towels, Napkins, Tissues	23.1%	18.0%	28.3%
Compostable Food Containers and Cups	0.4%	0.2%	0.5%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	23.5%		
Non-Compostable Paper Food Serviceware	9.6%	7.5%	11.6%
Non-Recyclable Plastic Film	9.2%	8.1%	10.3%
All Other Plastics	1.7%	1.2%	2.3%
Other Glass	0.9%	-0.3%	2.1%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.0%	0.0%	0.0%
All Other Garbage	7.2%	6.0%	8.3%
Liquids	2.2%	0.1%	4.2%
Grit	0.0%	0.0%	0.0%
All Other Materials	30.7%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Shields (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		95%	**80%**	**90%**	**95%**	**70%**
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles					
	Recyclable Film	<5%		<5%		
	Misc Plastics		10%		<5%	
	Metal					
	Glass Bottles					
	Total Misplaced Recyclables	**<5%**	**10%**	**<5%**	**<5%**	
Contamination	Food-Cont. Target Recyclable	<5%	<5%		<5%	
	Food-Cont. Non-Target Recyclables		<5%			
	Bulky Rigid Plastics					
	All EPS					
	Non-Recyclable Plastic Film					
	All Other Plastics		<5%	<5%		
	Other Glass					
	Non-Recyclable Paper	<5%	<5%			20%
	Organics					10%
	Aseptic/Polycoated Containers		<5%			
	Liquids					
	All Other Contamination					
	Total Contamination	**<5%**	**5%**	**<5%**	**<5%**	**30%**

Target Materials		Compost
		80%
Compostable Materials	Loose Food Waste	25%
	Yard Waste	
	Paper Towels, Napkin, Tissue	35%
	Clean Wood Waste	
	Comp. Containers & Cups	15%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	15%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	
	All EPS	<5%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**20%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Smeal (HUB North) Building

Building Facts

Type: Administrative

Year Constructed: 2005

Service Area**:** Area 5

Gross Square Footage**:** 224,841

Season Audited: Spring 2018

Description: The Business Building is home to the internationally ranked Penn State Smeal College of Business and recognized by The Princeton Review as the best business school facility in the nation. Dedicated in 2005, this 210,000-square-foot building was designed by renowned Robert A.M. Stern Architects and is located near the eastern gateway to the University Park campus.

Modern architecture and state-of-the-art learning technology connect thousands of students, faculty, and staff, promoting an environment of openness, innovation, and collaboration at Smeal. The building features ample classroom space for students from across Penn State as well as a host of other amenities including wireless access and video-conferencing technologies, team study and recruiter interview rooms, an auditorium, and a café-style restaurant.

Audit Results

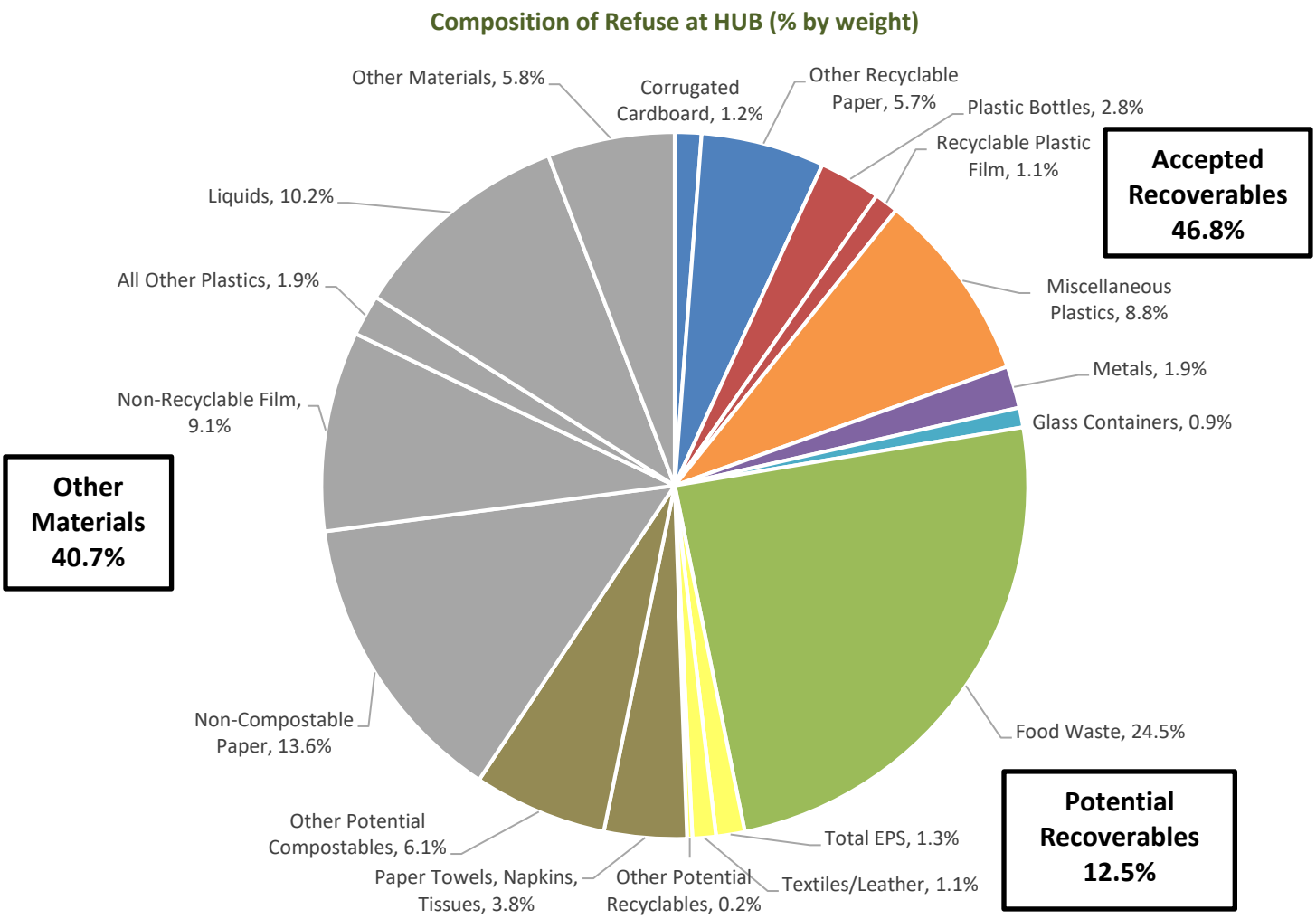
Some key findings from the results for HUB include:

- About 2,060 pounds of refuse, 610 pounds of recyclables, and 500 pounds of compost were generated from HUB over the week, for **a recycling rate of 35 percent.**

- WCS Results:
  - Over 22 percent of the refuse was accepted recyclables, this was mostly miscellaneous plastics and paper. Nearly 25 percent of the refuse was food waste.
  - Compared to other buildings, HUB's refuse had an exceptionally low percentage of paper towels, napkins, and tissues (4 percent), and had the highest percentage of compostable food containers and cups (6 percent).
  - Non-compostable paper food serviceware and liquids were significant categories of the refuse, at about 14 and 10 percent respectively. Total all other materials comprised over 40 percent.
- Visual Assessment Results:
  - Plastic bottles & film and miscellaneous plastics streams were heavily contaminated. Food contaminated materials and non-recyclable paper were significant contaminants. Each stream also had a fair amount of misplaced materials from the other stream. Paper, metal, and glass were only moderately contaminated.
  - The compost stream was also heavily contaminated (over half), predominantly by non-compostable paper containers & cups and rigid plastics.

Daily Material Generation at HUB

Weight (lbs)	Thu (4/19)	Fri (4/20)	Sat & Sun (4/21 & 4/22)	Mon (4/23)	Tue (4/24)	Wed (4/25)	**Weekly Total**	**% of total weight**
Refuse	292.8	129.6	456.0	349.2	396.4	431.8	**2055.8**	**64.8%**
Paper	39.0	30.3	23.0	36.6	19.7	22.9	**171.6**	**5.4%**
Plastic Bottles	49.5	91.4	29.7	47.2	44.6	32.8	**295.2**	**9.3%**
Misc Plastics	21.6	0.0	2.5	5.0	4.4	15.4	**49.0**	**1.5%**
Metal	3.0	29.5	0.0	14.2	8.8	0.3	**55.8**	**1.8%**
Glass	7.4	0.0	7.4	10.1	0.0	17.9	**42.7**	**1.3%**
Compost	77.6	100.2	132.2	61.7	64.2	64.2	**500.1**	**15.8%**
OCC	0.0	0.0	0.0	0.0	0.4	0.0	**0.4**	**0.0%**
Total	**490.8**	**381.0**	**650.7**	**524.1**	**538.6**	**585.3**	**3170.5**	**100.0%**
Volume (cy)								
Refuse	3.3	0.5	4.2	3.8	4.7	4.7	**21.2**	
Paper	0.4	0.2	0.2	0.4	0.2	0.4	**1.8**	
Plastic Bottles	0.6	1.1	0.5	0.8	0.9	0.6	**4.5**	
Misc Plastics	0.2	0.0	0.0	0.1	0.1	0.4	**0.7**	
Metal	0.0	0.4	0.0	0.2	0.1	0.0	**0.7**	
Glass	0.0	0.0	0.0	0.1	0.0	0.1	**0.2**	
Compost	0.9	0.9	1.4	0.8	0.5	0.9	**5.5**	
Total	**5.5**	**3.1**	**6.4**	**6.1**	**6.5**	**7.0**	**34.6**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at HUB (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.3%	0.1%	0.5%
Corrugated Cardboard (OCC)	1.2%	0.8%	1.6%
Mixed Recyclable Paper	5.4%	4.1%	6.6%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	6.9%		
PET Bottles (#1)	2.6%	1.3%	4.0%
HDPE Bottles (#2)	0.2%	0.0%	0.4%
Recyclable Plastic Film	1.1%	0.7%	1.4%
Total Plastic Bottles and Film	3.9%		
Non-Bottle Plastics (#1 and #2)	0.6%	0.1%	1.1%
Other Plastic Containers (#3-#7)	3.2%	2.3%	4.1%
Plastic Cups	5.0%	3.6%	6.3%
Total Miscellaneous Plastics	8.8%		
Tin/Steel Cans	0.5%	-0.1%	1.1%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.3%	0.2%	0.4%
Aluminum Foil and Trays	1.1%	0.3%	1.8%
Non-Ferrous Scrap Metals	0.1%	0.0%	0.2%
Total Recyclable Metal	1.9%		
Glass Containers	0.9%	0.5%	1.3%
Food Waste	24.5%	20.1%	28.8%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	1.3%	1.0%	1.6%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.1%	-0.2%	2.3%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.1%	-0.1%	0.4%
Potential Recyclables	2.6%		
Paper Towels, Napkins, Tissues	3.8%	1.5%	6.0%
Compostable Food Containers and Cups	5.8%	3.2%	8.4%
Yard Waste	0.2%	-0.2%	0.7%
Other Organics	0.0%	0.0%	0.1%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	9.9%		
Non-Compostable Paper Food Serviceware	13.6%	11.5%	15.7%
Non-Recyclable Plastic Film	9.1%	7.9%	10.4%
All Other Plastics	1.9%	0.1%	3.7%
Other Glass	0.1%	-0.1%	0.2%
Lab Glass	0.1%	-0.1%	0.2%
Household Batteries	0.0%	0.0%	0.1%
Treated Wood Waste	0.6%	-0.5%	1.7%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.3%	-0.1%	0.7%
All Other Garbage	4.8%	3.0%	6.6%
Liquids	10.2%	3.3%	17.2%
Grit	0.0%	0.0%	0.0%
All Other Materials	40.7%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at HUB (% by volume)

		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
Target Material		**70%**	**35%**	**45%**	**75%**	**85%**
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles	<5%		15%		<5%
	Recyclable Film			<5%		
	Misc Plastics	<5%	25%			<5%
	Metal	<5%	<5%			<5%
	Glass Bottles	<5%				
	Total Misplaced Recyclables	**5%**	**25%**	**20%**		**10%**
Contamination	Food-Cont. Target Recyclable	<5%	15%	15%	15%	
	Food-Cont. Non-Target Recyclables		10%	5%		
	Bulky Rigid Plastics					
	All EPS	<5%	<5%	<5%		
	Non-Recyclable Plastic Film	<5%				
	All Other Plastics			<5%		
	Other Glass					
	Non-Recyclable Paper	15%	10%	10%	5%	5%
	Organics		<5%	<5%		
	Aseptic/Polycoated Containers			<5%		
	Liquids					
	All Other Contamination	<5%			<5%	
	Total Contamination	**20%**	**40%**	**40%**	**25%**	**5%**

		Compost
Target Materials		**45%**
Compostable Materials	Loose Food Waste	10%
	Yard Waste	
	Paper Towels, Napkin, Tissue	20%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	30%
	All Rigid Plastics	15%
	Non-Rigid Plastic Film and Bags	<5%
	All EPS	<5%
	All Metals	<5%
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**55%**

Note: All percentage are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measures. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

White Course Complex

Building Facts

Type: Apartment

Year Constructed: 2001

Service Area**:** Area 3

Gross Square Footage**:** 213,616

Season Audited: Fall 2018

Description: White Course Complex offers apartments for graduate students and families.

Audit Results

Some key findings from the results for White Course include:

- Over 1.5 tons of refuse and nearly 1 ton of recyclables and OCC were generated from White Course over the week, for a **recycling rate of about 21 percent.**
- WCS Results:
  - Approximately 23 percent of the refuse stream were materials that are accepted in the University's recycling streams. Mixed recyclable paper and OCC were about half of this.
  - Nearly 36 percent of the refuse was food waste, much higher than the dorms.
  - Potential recoverables comprised over 10 percent of the refuse, mostly paper towels, napkins, and tissues.
  - Over 30 percent of the refuse was non-recoverable materials. All other garbage, non-recyclable plastic film, and diapers were the largest categories of these.
- Visual Assessment Results:
  - Qualitative visual observations of the recyclables indicate that paper and glass were fairly clean.

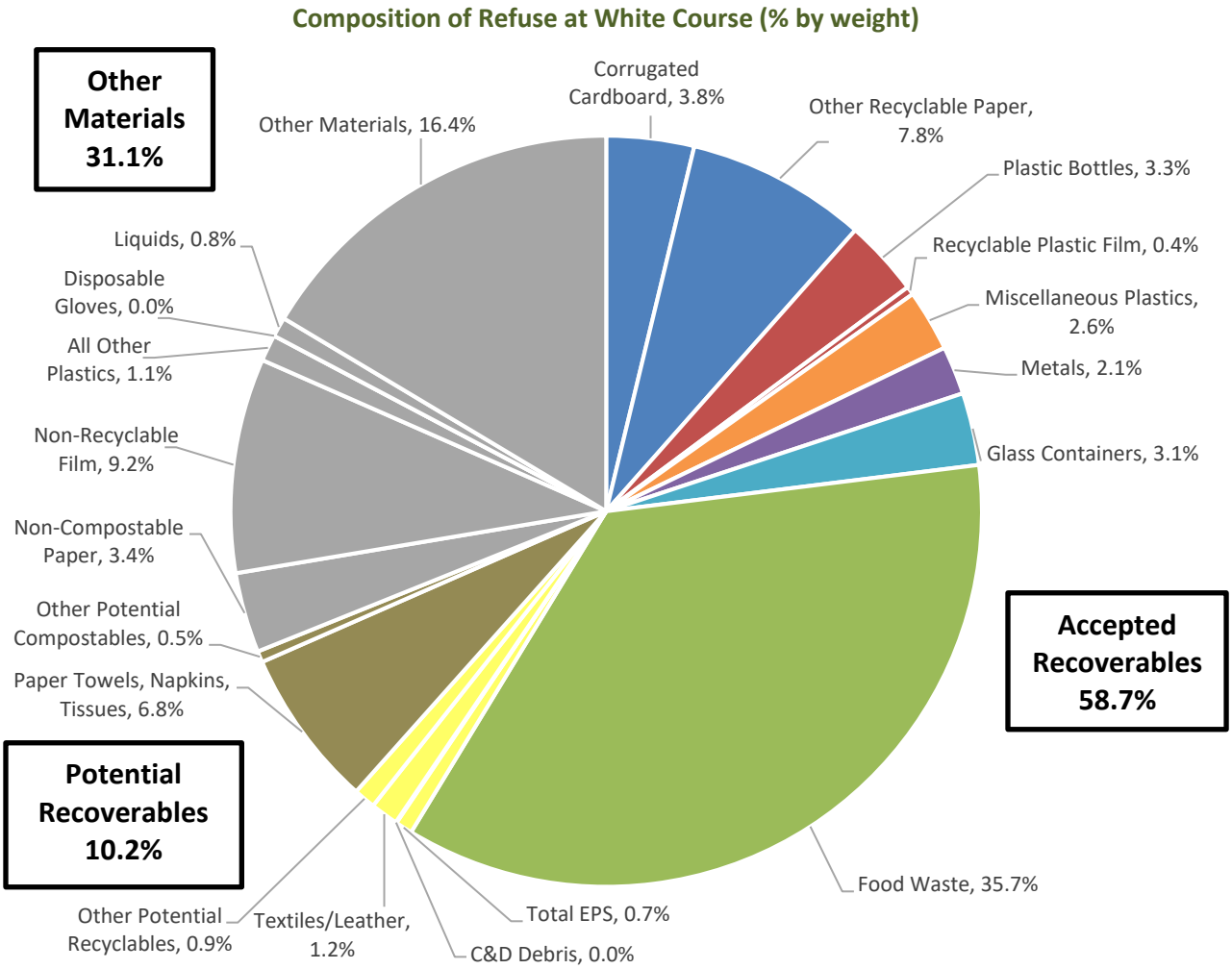
- The mixed recyclables stream (metal and plastic), while it appeared to have minimal contamination, did have a significant amount of loose plastic bags and bagged recyclables.

Daily Material Generation at White Course

Weight (lbs)	Thu (11/1)	Fri-Sat (11/2-11/3)	Sun (11/4)	Mon (11/5)	Tue (11/6)	Wed (11/7)	**Weekly Total**	**% of total weight**
Refuse	373.3	987.0	418.4	551.2	389.0	536.0	**3,254.9**	78.6%
Paper	**	**	**	**	**	**	**160.0**	3.9%
Mixed Recyclables*	**	**	**	**	**	**	**420.0**	10.1%
Glass	**	**	**	**	**	**	**125.0**	3.0%
OCC	**	**	**	**	**	**	**180.0**	4.3%
Total	**373.3**	**987.0**	**418.4**	**551.2**	**1,274.0**	**536.0**	**4,139.9**	**100%**
Volume (cy)								
Refuse	2.8	7.5	3.3	4.7	3.8	3.8	**25.9**	
Total	**2.8**	**7.5**	**3.3**	**4.7**	**3.8**	**3.8**	**25.9**	

*Plastic and metal are collected together.

**Recyclables from White Course were weighed for the entire week.



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at White Course (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.0%	-0.1%	0.1%
OCC	3.8%	1.6%	5.9%
Mixed Recyclable Paper	7.7%	2.5%	13.0%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	11.5%		
PET Bottles (#1)	2.2%	1.8%	2.7%
HDPE Bottles (#2)	1.1%	0.5%	1.6%
Recyclable Plastic Film	0.4%	0.1%	0.7%
Total Plastic Bottles and Film	3.6%		
Non-Bottle Plastics (#1 and #2)	0.7%	0.3%	1.1%
Other Plastic Containers (#3-#7)	1.4%	0.7%	2.1%
Plastic Cups	0.5%	0.2%	0.9%
Total Miscellaneous Plastics	2.6%		
Tin/Steel Cans	0.8%	0.1%	1.4%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.5%	0.3%	0.7%
Aluminum Foil and Trays	0.5%	0.2%	0.8%
Non-Ferrous Scrap Metals	0.3%	-0.3%	0.9%
Total Recyclable Metal	2.1%		
Glass Containers	3.1%	0.9%	5.3%
Food Waste	35.7%	30.6%	40.8%
Aseptic/Polycoated Containers	0.5%	0.3%	0.6%
Bulky Rigid Plastics	0.5%	-0.1%	1.0%
Food Service EPS	0.7%	0.5%	0.9%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.2%	0.1%	2.3%
C&D Debris	0.0%	0.0%	0.1%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	2.9%		
Paper Towels, Napkins, Tissues	6.8%	2.3%	11.4%
Compostable Food Containers and Cups	0.4%	-0.1%	0.9%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.1%
Clean Wood Waste	0.1%	0.0%	0.1%
Potential Compostables	7.3%		
Non-Compostable Paper Food Serviceware	3.4%	1.2%	5.7%
Non-Recyclable Plastic Film	9.2%	7.0%	11.5%
All Other Plastics	1.1%	0.7%	1.6%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.7%	-0.1%	1.5%
Diapers	6.0%	3.8%	8.2%
Disposable Gloves	0.0%	0.0%	0.0%
All Other Garbage	9.7%	6.4%	12.9%
Liquids	0.8%	0.1%	1.6%
Grit	0.0%	0.0%	0.0%
All Other Materials	31.1%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Intramural Building

Building Facts

Type: Athletic

Year Constructed: 1975

Service Area**:** Area 1

Gross Square Footage**:** 266,842

Season Audited: Spring 2018

Description: The recently renovated Intramural Building is the flagship recreational facility at University Park. The building houses a fitness center, rock climbing and bouldering walls, an indoor track and turf field, racquetball and squash courts, and open gym spaces. The building also houses the Health Promotion and Wellness offices and includes a relaxation room.

Audit Results

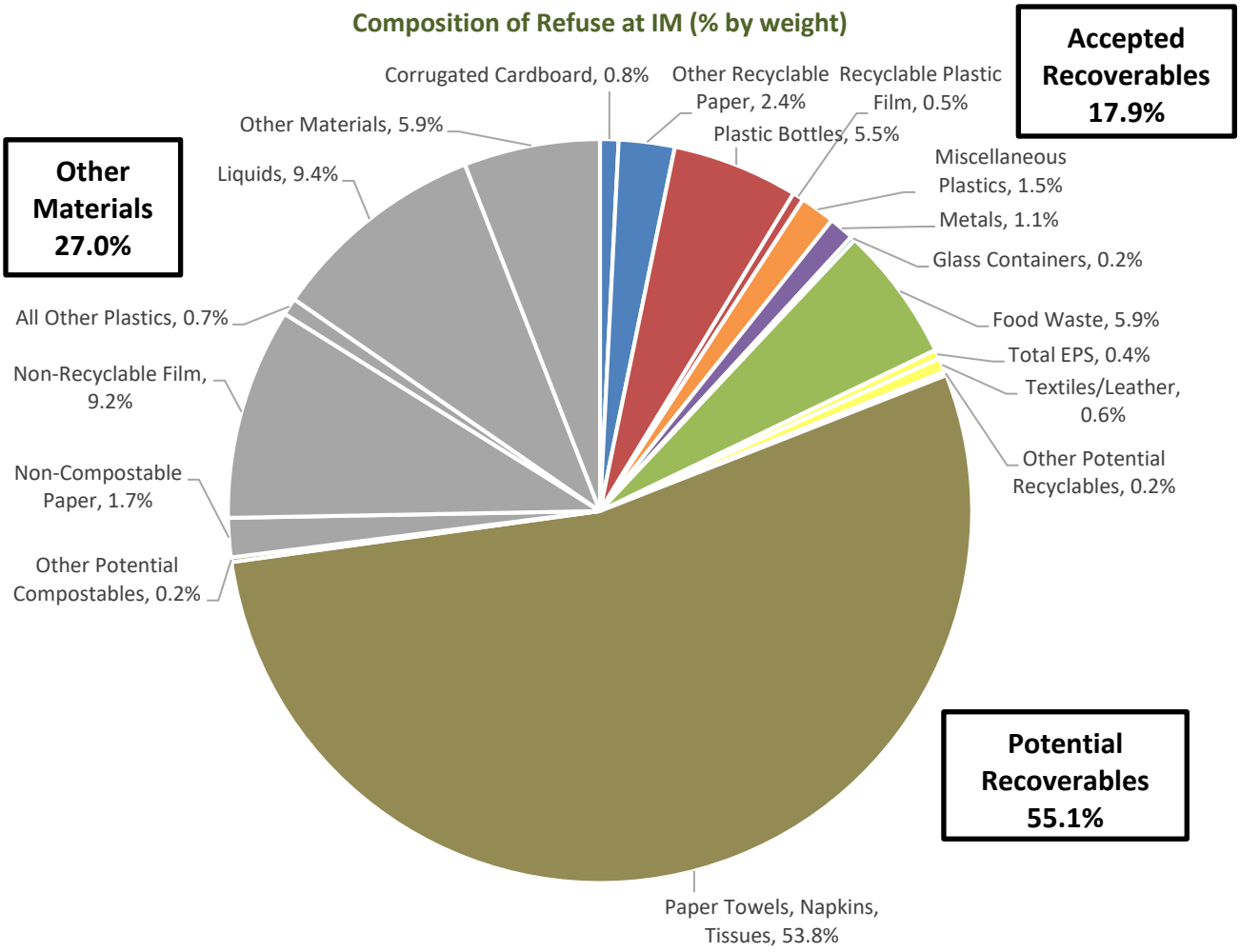
Some key findings from the results for IM include:

- About 510 pounds of refuse, 140 pounds of recyclables, and 14 pounds of food waste was generated over the week from IM, for a **recycling rate of about 23 percent**.
- WCS Results:
  - Approximately 12 percent of the refuse was accepted recyclable material. About half of this was PET bottles. Only about 6 percent of the refuse was food waste.
  - More than 50 percent of the refuse was paper towels, napkins, and tissues. When applied to the generation data over 40 percent of the material generated from IM was paper towels, napkin, and tissues.

- Visual Assessment Results:
  - Liquids and non-recyclable plastic film each comprised about another 9 percent of the refuse.
  - The paper and plastic bottles & film recycling streams were relatively clean. Most of the non-target material in the miscellaneous plastics and glass streams was misplaced recyclables. The metal stream had one instance of contamination due to food contaminated catering trays.
  - The compost stream had a moderate degree of contamination from non-compostable paper cups and containers.

Daily Material Generation at IM

Weight (lbs)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri-Sun (4/20-4/22)	Mon (4/23)	Tue (4/24)	**Weekly Total**	**% of total weight**
Refuse	71.2	105.4	119.2	94.9	97.7	111.7	**508.6**	**76.7%**
Paper	2.2	21.6	9.8	2.6	0.2	2.6	**36.5**	**5.5%**
Plastic Bottles	8.1	5.0	11.0	14.7	12.6	9.0	**51.9**	**7.8%**
Misc Plastics	5.2	7.4	0.4	7.0	0.0	2.2	**18.6**	**2.8%**
Metal	4.0	0.4	0.0	10.2	0.1	0.8	**13.2**	**2.0%**
Glass	2.7	0.9	0.0	0.0	0.0	0.0	**2.3**	**0.3%**
Compost	1.6	3.8	2.4	4.6	0.3	3.6	**13.7**	**2.1%**
OCC	3.8	3.8	3.6	4.2	1.8	6.0	**18.3**	**2.8%**
Total	**98.8**	**148.4**	**146.4**	**138.1**	**112.8**	**136.0**	**663.0**	**100.0%**
Volume (cy)								
Refuse	0.9	1.4	1.4	1.4	1.4	1.4	**6.8**	
Paper	0.0	0.1	0.0	0.0	0.0	0.0	**0.1**	
Plastic Bottles	0.0	0.0	0.2	0.2	0.2	0.1	**0.5**	
Misc Plastics	0.0	0.0	0.0	0.2	0.0	0.0	**0.2**	
Metal	0.0	0.0	0.0	0.2	0.0	0.0	**0.2**	
Glass	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Compost	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Total	**1.0**	**1.5**	**1.6**	**1.9**	**1.6**	**1.6**	**7.9**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at IM (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval	
		Lower Bounds	Upper Bounds
Newspaper	0.5%	0.0%	1.0%
Corrugated Cardboard (OCC)	0.8%	0.3%	1.3%
Mixed Recyclable Paper	1.9%	1.1%	2.8%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	3.2%		
PET Bottles (#1)	5.2%	4.4%	6.0%
HDPE Bottles (#2)	0.3%	0.1%	0.5%
Recyclable Plastic Film	0.5%	0.2%	0.8%
Total Plastic Bottles and Film	6.0%		
Non-Bottle Plastics (#1 and #2)	0.5%	0.2%	0.9%
Other Plastic Containers (#3-#7)	0.5%	0.2%	0.8%
Plastic Cups	0.5%	0.2%	0.9%
Total Miscellaneous Plastics	1.5%		
Tin/Steel Cans	0.3%	0.0%	0.6%
Ferrous Scrap Metals	0.2%	-0.1%	0.4%
Aluminum Cans	0.4%	0.3%	0.5%
Aluminum Foil and Trays	0.2%	0.1%	0.4%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.1%		
Glass Containers	0.2%	-0.1%	0.4%
Food Waste	5.9%	4.2%	7.5%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	0.4%	0.3%	0.5%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.6%	0.3%	0.9%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.1%	-0.1%	0.3%
Potential Recyclables	1.2%		
Paper Towels, Napkins, Tissues	53.8%	47.6%	59.9%
Compostable Food Containers and Cups	0.2%	0.0%	0.3%
Yard Waste	0.0%	-0.1%	0.1%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	54.0%		
Non-Compostable Paper Food Serviceware	1.7%	0.9%	2.5%
Non-Recyclable Plastic Film	9.2%	8.0%	10.4%
All Other Plastics	0.7%	0.4%	1.1%
Other Glass	0.4%	-0.4%	1.2%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.2%	-0.1%	0.6%
All Other Garbage	5.3%	2.7%	7.9%
Liquids	9.4%	5.8%	13.1%
Grit	0.0%	0.0%	0.0%
All Other Materials	27.0%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at IM (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		95%	**80%**	**60%**	**65%**	**65%**
Misplaced Recyclables	Recyclable Paper		<5%	<5%		
	Plastic Bottles			15%		15%
	Recyclable Film			10%	<5%	20%
	Misc Plastics		5%			
	Metal	<5%	<5%	<5%		
	Glass Bottles					
	Total Misplaced Recyclables	**<5%**	**10%**	**25%**	**<5%**	**35%**
Contamination	Food-Cont. Target Recyclable	<5%	10%	<5%	35%	
	Food-Cont. Non-Target Recyclables			5%		
	Bulky Rigid Plastics					
	All EPS			<5%		
	Non-Recyclable Plastic Film					
	All Other Plastics			<5%		
	Other Glass					
	Non-Recyclable Paper	<5%	<5%	<5%		
	Organics					
	Aseptic/Polycoated Containers	<5%				
	Liquids					
	All Other Contamination	<5%	<5%		<5%	
	Total Contamination	**5%**	**10%**	**15%**	**35%**	

Target Materials		Compost
		70%
Compostable Materials	Loose Food Waste	40%
	Yard Waste	10%
	Paper Towels, Napkin, Tissue	10%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	25%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	
	All EPS	
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**30%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Rec Hall

Building Facts

Type: Athletic

Year Constructed: 1929

Service Area**:** Area 3

Gross Square Footage**:** 309,616

Season Audited: Spring 2018

Description: Recreation Building or Rec Hall, as it is more commonly known, is Penn State's busiest and most versatile athletics venue, as five varsity teams which participate throughout all three collegiate seasons, call it home. Located in the heart of the University Park campus, the historic structure hosts events for Nittany Lion Men's and Women's Volleyball, Men's and Women's Gymnastics, and Wrestling. Until 1996, Rec Hall also served as the home of Penn State Basketball.

Audit Results

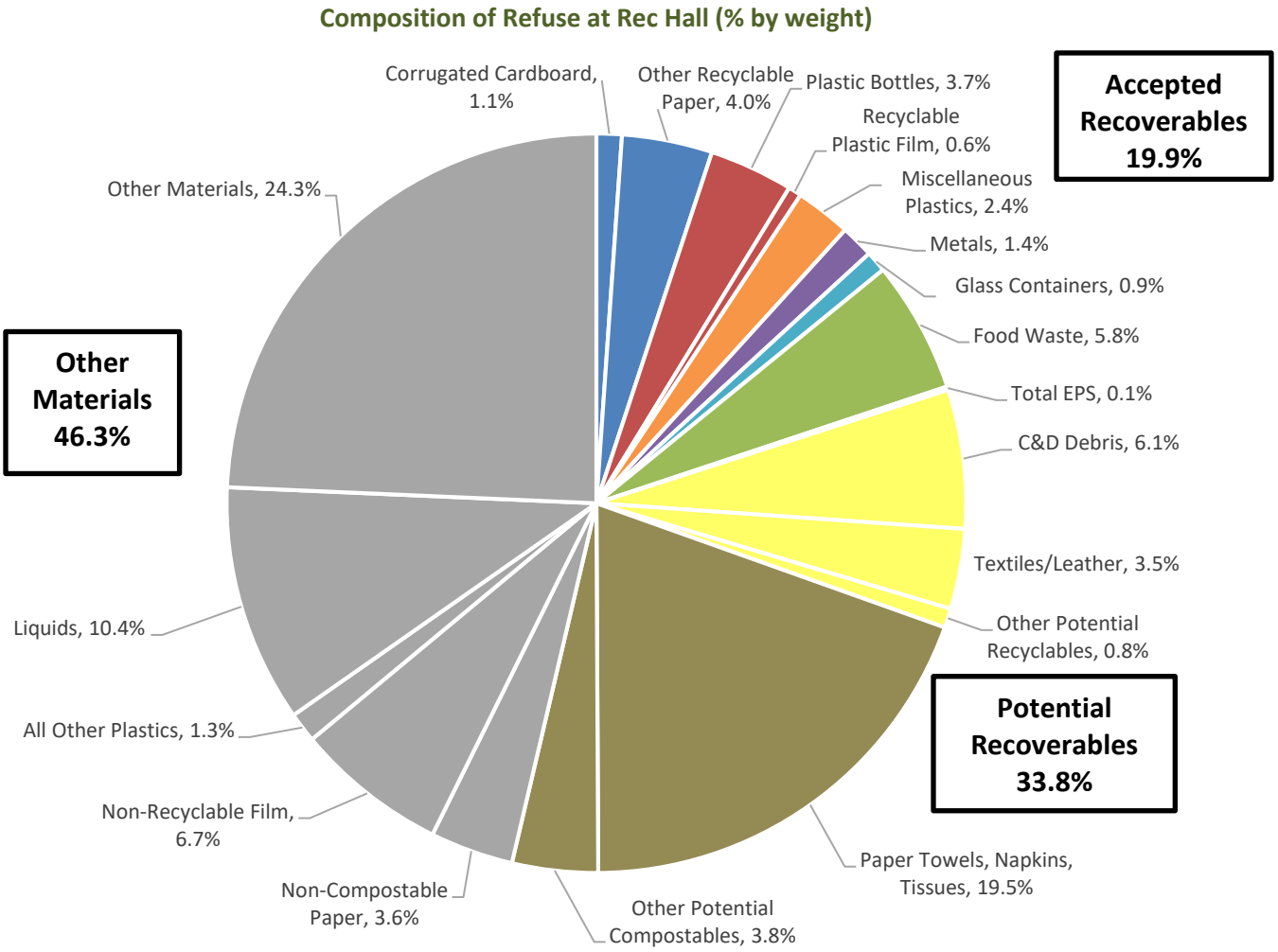
Some key findings from the results for Rec Hall include:

- About 1,140 pounds of refuse, 430 pounds of recyclables, and 28 pounds of compost were generated over the week from Rec Hall, for **a recycling rate of 29 percent**. Much of the weight in refuse was due to bulky items.
- WCS Results:
  - About 14 percent of the refuse was accepted recyclable materials. Most of this was mixed recyclable paper and PET bottles. Food waste comprised less than 6 percent of the refuse.
  - Rec Hall had a significant amount of potentially recyclable material. This was mostly C&D debris and textile & leather. The C&D debris appeared to be a result of renovations to the building.
  - Paper towels, napkins, and tissues comprised almost 20 percent of the refuse.
  - Treated wood waste and all other garbage comprised a high percentage of all other materials. These were mostly bulky materials, such as wood panels and a volley ball net, found in the refuse.
- Visual Assessment Results:
  - The recyclables from Rec Hall were comparatively clean, but with miscellaneous plastics still having a relatively high percentage of misplaced recyclables.

- The compost stream was also relatively clean but with some non-compostable paper cups and containers.

Daily Material Generation at Rec Hall

Weight (lbs)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri-Sun (4/20-4/22)	Mon (4/23)	Tue (4/24)	Wed (4/25)	Weekly Total	% of total weight
Refuse	203.0	113.6	182.2	345.8	235.8	276.6	167.3	**1144.1**	**71.2%**
Paper	25.9	24.3	15.8	43.0	6.0	11.1	19.7	**105.2**	**6.6%**
Plastic Bottles	14.6	8.5	63.9	8.3	7.8	16.2	2.7	**101.1**	**6.3%**
Misc Plastics	2.7	3.5	2.6	1.8	2.4	2.2	3.6	**12.9**	**0.8%**
Metal	0.0	8.1	0.8	76.8	1.0	2.4	0.0	**83.8**	**5.2%**
Glass	0.0	0.0	0.0	0.3	0.0	0.0	0.0	**0.3**	**0.0%**
Compost	2.3	5.7	16.8	4.8	1.2	4.1	0.0	**28.8**	**1.8%**
OCC	6.4	71.0	22.2	15.8	11.4	45.0	39.0	**130.1**	**8.1%**
Total	**255.0**	**234.8**	**304.3**	**496.6**	**265.5**	**357.6**	**232.4**	**1606.3**	**100.0%**
Volume (cy)									
Refuse	2.4	0.5	2.4	3.3	3.8	2.6	2.1	**13.2**	
Paper	0.2	0.2	0.2	0.2	0.0	0.2	0.2	**0.8**	
Plastic Bottles	0.4	0.2	0.1	0.2	0.2	0.2	0.1	**0.9**	
Misc Plastics	0.0	0.0	0.0	0.0	0.0	0.0	0.1	**0.1**	
Metal	0.0	0.0	0.0	0.1	0.0	0.1	0.0	**0.2**	
Glass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Compost	0.0	0.2	0.1	0.0	0.0	0.0	0.0	**0.2**	
Total	**3.0**	**1.1**	**2.7**	**3.9**	**4.0**	**3.0**	**2.6**	**15.4**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes the categories of newspaper, books, and mixed recyclable paper.
- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Rec Hall (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.2%	0.0%	0.3%
Corrugated Cardboard (OCC)	1.1%	0.4%	1.8%
Mixed Recyclable Paper	3.8%	1.6%	6.0%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	5.1%		
PET Bottles (#1)	3.5%	2.3%	4.7%
HDPE Bottles (#2)	0.2%	0.0%	0.3%
Recyclable Plastic Film	0.6%	0.3%	0.9%
Total Plastic Bottles and Film	4.2%		
Non-Bottle Plastics (#1 and #2)	0.5%	0.0%	0.9%
Other Plastic Containers (#3-#7)	1.3%	0.7%	1.8%
Plastic Cups	0.7%	0.3%	1.0%
Total Miscellaneous Plastics	2.4%		
Tin/Steel Cans	0.0%	0.0%	0.1%
Ferrous Scrap Metals	0.8%	-0.6%	2.3%
Aluminum Cans	0.3%	0.2%	0.5%
Aluminum Foil and Trays	0.2%	-0.2%	0.5%
Non-Ferrous Scrap Metals	0.0%	-0.1%	0.2%
Total Recyclable Metal	1.4%		
Glass Containers	0.9%	0.4%	1.4%
Food Waste	5.8%	4.0%	7.5%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.3%	-0.4%	1.0%
Food Service EPS	0.1%	0.1%	0.2%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	3.5%	0.1%	6.9%
C&D Debris	6.1%	0.1%	12.1%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.4%	-0.3%	1.2%
Potential Recyclables	10.6%		
Paper Towels, Napkins, Tissues	19.5%	14.1%	24.8%
Compostable Food Containers and Cups	0.1%	0.0%	0.2%
Yard Waste	2.2%	-2.5%	7.0%
Other Organics	0.6%	0.1%	1.1%
Clean Wood Waste	0.8%	-1.0%	2.5%
Potential Compostables	23.2%		
Non-Compostable Paper Food Serviceware	3.6%	0.7%	6.6%
Non-Recyclable Plastic Film	6.7%	4.3%	9.0%
All Other Plastics	1.3%	0.2%	2.5%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.1%
Treated Wood Waste	11.0%	-1.7%	23.8%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.2%	-0.1%	0.4%
All Other Garbage	13.1%	6.4%	19.8%
Liquids	10.4%	4.3%	16.6%
Grit	0.0%	0.0%	0.0%
All Other Materials	46.3%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Rec Hall (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		95%	**85%**	**65%**	**100%**	**100%**
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles			5%	<5%	
	Recyclable Film			15%	<5%	
	Misc Plastics		5%			
	Metal					
	Glass Bottles		<5%		<5%	
	Total Misplaced Recyclables		**5%**	**25%**	**<5%**	
Contamination	Food-Cont. Target Recyclable		5%	5%		
	Food-Cont. Non-Target Recyclables			<5%		
	Bulky Rigid Plastics					
	All EPS					
	Non-Recyclable Plastic Film		<5%	<5%		
	All Other Plastics			<5%		
	Other Glass					
	Non-Recyclable Paper	<5%				
	Organics			<5%		
	Aseptic/Polycoated Containers					
	Liquids					
	All Other Contamination		<5%	<5%		
	Total Contamination	**<5%**	**10%**	**10%**		

Target Materials		Compost
		80%
Compostable Materials	Loose Food Waste	45%
	Yard Waste	
	Paper Towels, Napkin, Tissue	10%
	Clean Wood Waste	
	Comp. Containers & Cups	5%
	Pizza Boxes	25%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	20%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	
	All EPS	
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**20%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

Pollock Dining Hall

Building Facts

Type: Dining Hall

Year Constructed: 1960

Service Area**:** Area 1

Gross Square Footage**:** 96,538

Season Audited: Fall 2018

Description: Pollock Dining Commons, located on the second floor of Pollock Commons, is an all-you-care-to-eat dining area that features platform style service, offering an endless variety of food and beverages that suits every guest's tastes.

Audit Results

Some key findings from the results for Pollock include:

- Over 1 ton of refuse, 880 pounds of recyclables, 6.5 tons of compost, and 1 ton of OCC were generated from Pollock over the week, for a **recycling rate of about 87 percent.**
- WCS Results:
  - Over 12 percent of the refuse stream were materials that are accepted in the University's recycling stream. Mixed recyclable paper and tin/steel cans were about half of this.
  - Approximately 20 percent of the refuse stream was food waste. This was a smaller percentage than the other dining halls.
  - Less than 10 percent were potentially recoverable materials, which were mostly paper towels, napkins, and tissues.

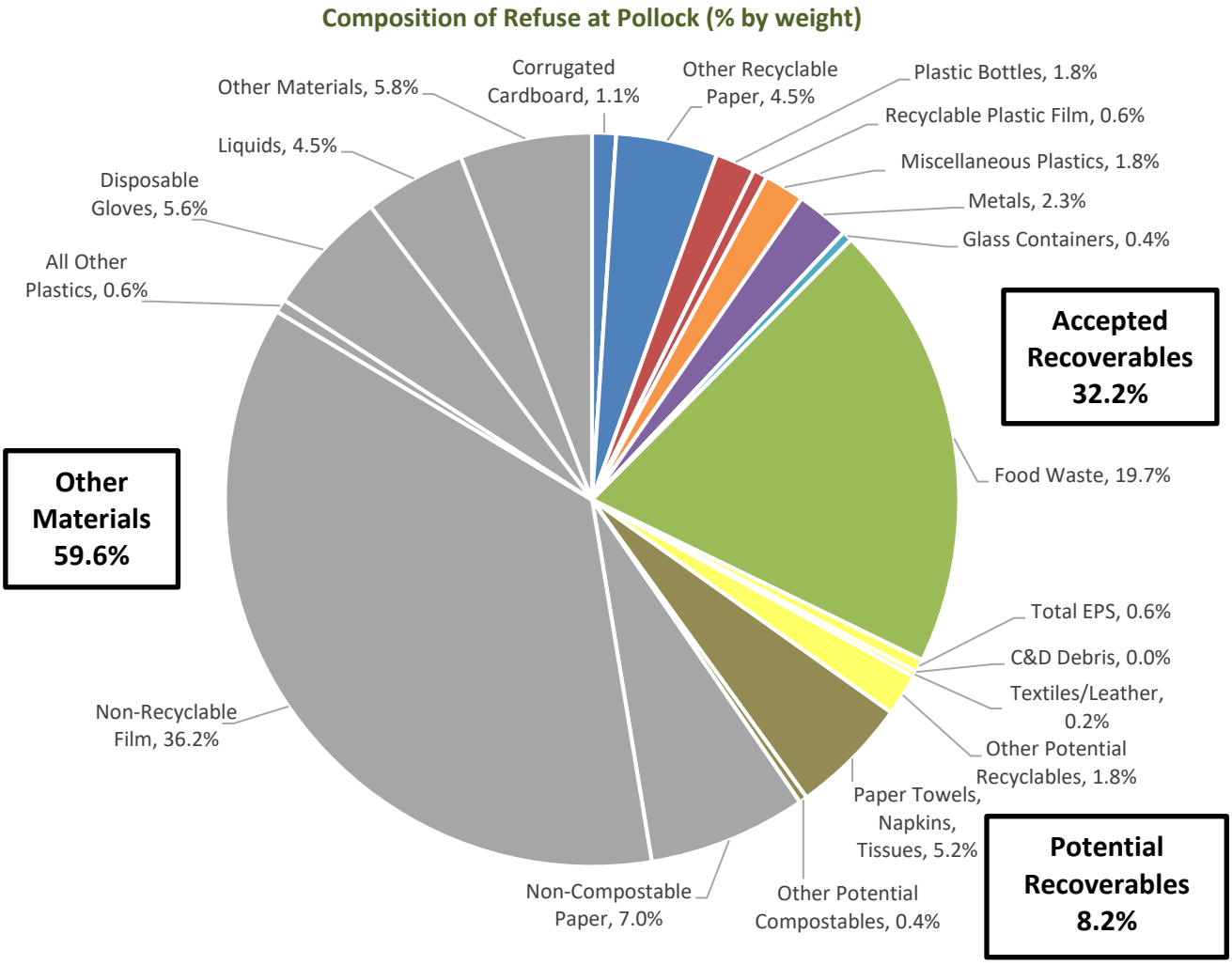
- Nearly 60 percent of the refuse was non-recoverable material. The was due to a very high percentage of non-recyclable plastic film (36 percent). Disposable gloves, non-compostable paper were, and liquids were also major contributors.

- Visual Assessment Results:
  - As with the other dining halls, recyclables were very clean, but with minimal amount of more highly contaminated post-consumer material.
  - Compost materials, which included HUB Dining's compost, was assessed at the compost tipping pad. It appeared to be mostly clean, similar to Redifer and Waring.

Daily Material Generation at Pollock

Weight (lbs)	Thu (11/8)	Fri-Sat (11/9-11/10)*	Sun (11/11)	Mon (11/12)	Tue (11/13)	Wed (11/14)	**Weekly Total**	**% of total weight**
Refuse	397.2	503.2	286.4	450.7	461.2	322.6	**2,421.3**	12.7%
Paper	32.4	18.6	10.4	26.0	31.0	11.7	**130.0**	0.7%
Recyclable Plastics	106.7	86.3	70.8	63.1	87.1	58.1	**472.3**	2.5%
Metal	79.2	57.8	19.6	30.1	23.7	55.5	**265.9**	1.4%
Glass	7.6	1.7	-	-	-	3.9	**13.3**	0.1%
Compost	1,940.0	4,680.0		2,080.0	2,380.0	1,980.0	**13,060.0**	68.7%
OCC	520.2	622.8	291.4	529.4	351.8	321.2	**2,636.8**	13.9%
Total	**3,083.4**	**1,290.5**	**5,358.6**	**3,179.3**	**3,334.8**	**2,753.1**	**18,999.7**	**100%**
Volume (cy)								
Refuse	5.2	5.5	2.8	4.7	4.7	3.8	**26.7**	
Paper	0.5	0.1	0.2	0.4	0.5	0.3	**1.9**	
Recyclable Plastics	1.9	2.1	1.5	1.4	1.7	1.6	**10.3**	
Metal	0.9	1.0	0.4	0.5	0.4	0.9	**4.1**	
Glass	<0.1	<0.1	-	-	-	<0.1	**0.0**	
Compost	Volume not measured							
Total	**8.5**	**8.8**	**4.9**	**6.9**	**7.2**	**6.6**	**42.9**	

* Friday & Saturday's material could not be weighed due to weather. Collected data was extrapolated for these days.



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Pollock (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.1%	0.0%	0.2%
OCC	1.1%	0.4%	1.7%
Mixed Recyclable Paper	4.4%	2.5%	6.3%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	5.5%		
PET Bottles (#1)	1.2%	0.7%	1.6%
HDPE Bottles (#2)	0.6%	0.2%	1.0%
Recyclable Plastic Film	0.6%	-0.2%	1.4%
Total Plastic Bottles and Film	2.4%		
Non-Bottle Plastics (#1 and #2)	0.3%	-0.1%	0.6%
Other Plastic Containers (#3-#7)	0.5%	0.0%	1.1%
Plastic Cups	1.0%	0.4%	1.5%
Total Miscellaneous Plastics	1.8%		
Tin/Steel Cans	1.8%	0.6%	2.9%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.1%	0.0%	0.1%
Aluminum Foil and Trays	0.4%	0.0%	0.8%
Non-Ferrous Scrap Metals	0.1%	-0.1%	0.2%
Total Recyclable Metal	2.3%		
Glass Containers	0.4%	0.0%	0.9%
Food Waste	19.7%	12.2%	27.3%
Aseptic/Polycoated Containers	1.6%	0.9%	2.3%
Bulky Rigid Plastics	0.2%	-0.3%	0.8%
Food Service EPS	0.6%	0.2%	1.0%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.2%	0.0%	0.5%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	2.7%		
Paper Towels, Napkins, Tissues	5.2%	2.9%	7.5%
Compostable Food Containers and Cups	0.3%	0.0%	0.5%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.1%	0.0%	0.2%
Potential Compostables	5.6%		
Non-Compostable Paper Food Serviceware	7.0%	4.2%	9.7%
Non-Recyclable Plastic Film	36.2%	30.7%	41.7%
All Other Plastics	0.6%	0.1%	1.1%
Other Glass	0.0%	-0.1%	0.2%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.1%	-0.1%	0.3%
Diapers	0.0%	0.0%	0.0%
Disposable Gloves	5.6%	4.6%	6.5%
All Other Garbage	5.7%	3.3%	8.0%
Liquids	4.5%	-1.9%	10.9%
Grit	0.0%	0.0%	0.0%
All Other Materials	59.6%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Pollock (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		80%	**40%**	**25%**	**30%**	**100%**	**95%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles	<5%				<5%	
	Recyclable Film						
	Misc Plastics						
	Metal		<5%				
	Glass Bottles						
	Total Misplaced Recyclables	**<5%**	**<5%**			**<5%**	
Contamination	Food-Cont. Target Recyclable	<5%	<5%				
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS						
	Non-Recyclable Plastic Film						
	All Other Plastics						
	Other Glass						
	Non-Recyclable Paper	15%	<5%				5%
	Organics						
	Aseptic/Polycoated Containers						
	Liquids						
	All Other Contamination		<5%				
	Total Contamination	**20%**	**5%**				**5%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Redifer Commons

Building Facts

Type: Dining Hall

Year Constructed: 1957

Service Area**:** Area 1

Gross Square Footage**:** 68,997

Season Audited: Fall 2018

Description: Redifer Commons is open 24 hours/day for students to utilize. The Commons features several study spaces, the Redifer Commons Desk, and several dining locations.

Audit Results

Some key findings from the results for Redifer include:

- Over 3 tons of refuse, 0.5 tons of recyclables, 4.5 tons of compost, and 1.5 tons of OCC were generated from Redifer over the week, for a **recycling rate of about 70 percent.**
- WCS Results:
  - Approximately 14 percent of the refuse stream were materials that are accepted in the University's recycling streams. Mixed recyclable paper and other plastic containers (#3-7) had the highest percentage of individual categories of recyclables.
  - Food waste comprised the largest percentage of the refuse at over 30 percent.
  - Nearly 17 percent of the refuse were potentially recoverable materials. This was predominantly food service EPS and paper towels, napkins, and tissues.
  - The second largest category of refuse was non-recyclable plastic film, which was mostly garbage bags and food-service related bags and plastic wrap. This accounted for most of the non-recoverable material.

- Visual Assessment Results:
  - All recycling streams at Redifer had limited contamination and non-target recyclables. Nearly all of the material appeared to be pre-consumer recyclables from the kitchen. Post-consumer recyclables were minimal, but were significantly more contaminated than the pre-consumer material. This was especially true for the paper and plastic streams.
  - Compost materials, which included Waring's compost, was assessed at the compost tipping pad. It appeared to be mostly clean, but some non-compostable paper cups were observed.

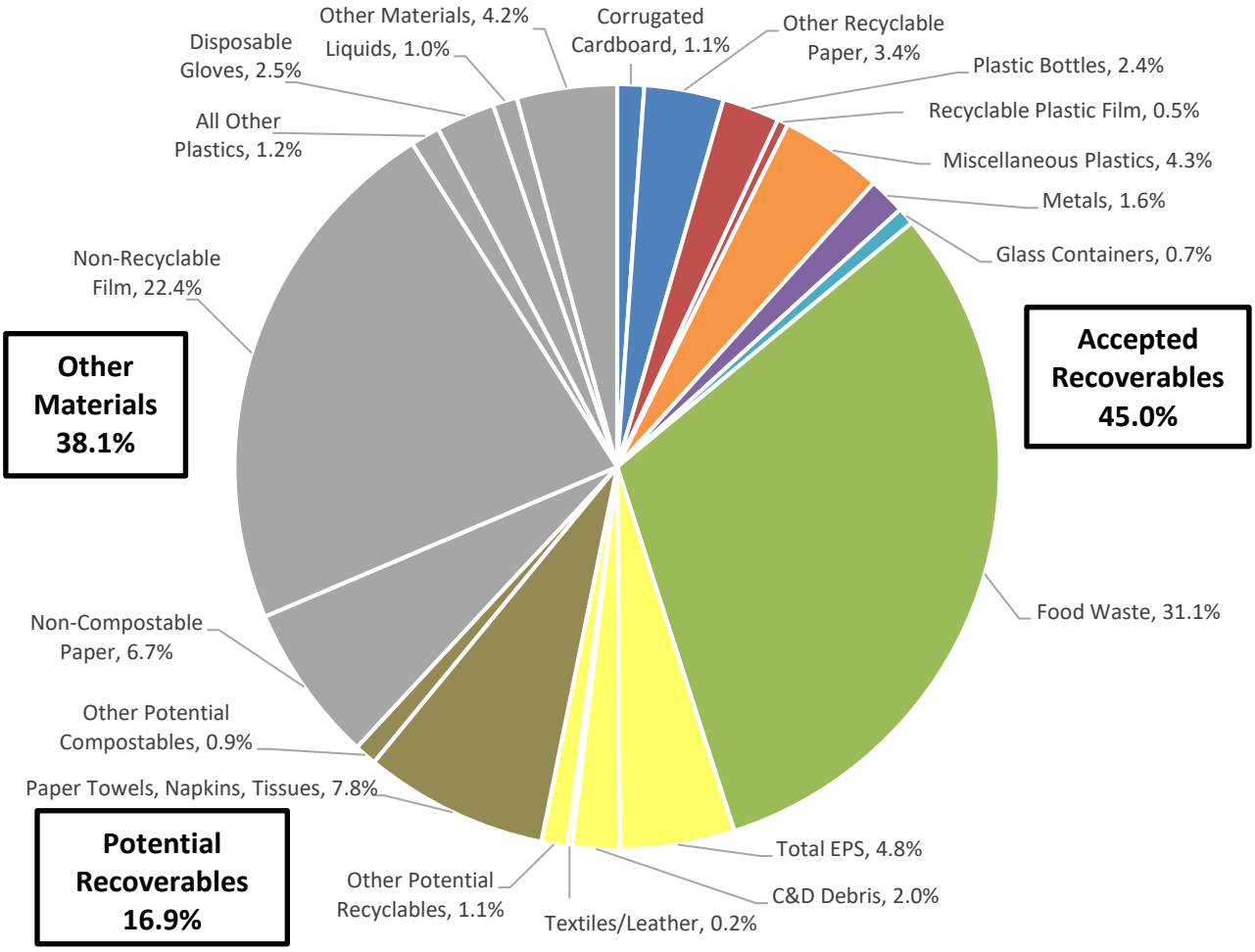
Daily Material Generation at Redifer

Weight (lbs)	Thu (11/1)	Fri (11/2)	Sat (11/3)	Sun (11/4)	Mon (11/5)	Tue (11/6)	Wed (11/7)	**Weekly Total**	**% of total weight**
Refuse	1,045.8	780.2	387.8	749.0	1,044.2	1,010.0	997.2	**6,014.2**	**30.1%**
Paper	10.3	10.4	-	13.2	13.5	4.3	-	**51.7**	**0.3%**
Recyclable Plastics	72.8	55.7	39.2	126.0	116.7	72.3	73.3	**556.0**	**2.8%**
Metal	55.9	45.8	42.2	35.3	46.2	65.0	62.4	**352.8**	**1.8%**
Glass	-	9.8	18.7	-	38.1	-	42.6	**109.3**	**0.5%**
Compost	1,260.0	3,140.0			1,560.0	1,780.0	1,420.0	**9,160.0**	**45.9%**
OCC	750.0	460.0	256.2	484.6	728.8	523.2	520.0	**3,722.8**	**18.6%**
Total	**3,194.9**	**1,362.0**	**744.1**	**4,548.0**	**3,547.5**	**3,454.8**	**3,115.6**	**19,966.8**	**100%**

Volume (cy)

Refuse	9.4	8.9	4.7	8.5	11.8	11.3	10.8	**65.4**
Paper	0.2	<0.1	-	0.2	0.2	0.1	-	**0.8**
Recyclable Plastics	1.4	1.5	0.9	3.1	2.5	1.6	2.2	**13.3**
Metal	0.7	0.7	0.9	0.5	0.6	0.9	0.9	**5.3**
Glass	-	0.0	0.1	-	0.1	-	0.3	**0.5**
Compost	Volume not measured							
Total	**11.8**	**11.2**	**6.7**	**12.2**	**15.1**	**14.0**	**14.3**	**85.2**

Composition of Refuse at Redifer (% by weight)



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Redifer (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.1%	0.0%	0.2%
OCC	1.1%	0.0%	2.2%
Mixed Recyclable Paper	3.3%	1.4%	5.1%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	4.5%		
PET Bottles (#1)	1.9%	1.5%	2.3%
HDPE Bottles (#2)	0.5%	0.1%	1.0%
Recyclable Plastic Film	0.5%	-0.1%	1.0%
Total Plastic Bottles and Film	2.9%		
Non-Bottle Plastics (#1 and #2)	0.8%	0.4%	1.2%
Other Plastic Containers (#3-#7)	2.3%	0.9%	3.7%
Plastic Cups	1.2%	0.8%	1.6%
Total Miscellaneous Plastics	4.3%		
Tin/Steel Cans	1.0%	-1.2%	3.1%
Ferrous Scrap Metals	0.1%	-0.1%	0.2%
Aluminum Cans	0.1%	0.0%	0.2%
Aluminum Foil and Trays	0.5%	0.2%	0.7%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.6%		
Glass Containers	0.7%	0.4%	1.0%
Food Waste	31.1%	25.1%	37.1%
Aseptic/Polycoated Containers	0.6%	0.4%	0.8%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	4.8%	3.7%	6.0%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.2%	0.0%	0.4%
C&D Debris	2.0%	-2.4%	6.4%
Furniture	0.5%	-0.3%	1.3%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	8.1%		
Paper Towels, Napkins, Tissues	7.8%	5.0%	10.5%
Compostable Food Containers and Cups	0.9%	0.2%	1.5%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.1%	0.0%	0.2%
Potential Compostables	8.7%		
Non-Compostable Paper Food Serviceware	6.7%	3.0%	10.4%
Non-Recyclable Plastic Film	22.4%	17.7%	27.1%
All Other Plastics	1.2%	0.8%	1.7%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.0%	0.0%	0.1%
Disposable Gloves	2.5%	1.0%	3.9%
All Other Garbage	4.2%	1.7%	6.7%
Liquids	1.0%	0.0%	2.1%
Grit	0.0%	0.0%	0.0%
All Other Materials	38.1%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to

Composition of Recycling and Compost Streams at Redifer (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		80%	**65%**	**15%**	**15%**	**95%**	**85%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles						
	Recyclable Film	<5%					<5%
	Misc Plastics						<5%
	Metal						<5%
	Glass Bottles						
	Total Misplaced Recyclables	**<5%**					**5%**
Contamination	Food-Cont. Target Recyclable		<5%			<5%	
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS						
	Non-Recyclable Plastic Film						
	All Other Plastics		<5%				
	Other Glass						
	Non-Recyclable Paper	20%	<5%			<5%	10%
	Organics						
	Aseptic/Polycoated Containers						
	Liquids						
	All Other Contamination						
	Total Contamination	**20%**	**5%**			**<5%**	**10%**

Target Materials		Compost
		n/a
Compostable Materials	Loose Food Waste	n/a
	Yard Waste	n/a
	Paper Towels, Napkin, Tissue	n/a
	Clean Wood Waste	n/a
	Comp. Containers & Cups	n/a
	Pizza Boxes	n/a
Contamination	Packaged Food Waste	n/a
	Non-Comp. Paper Containers & Cups	n/a
	All Rigid Plastics	n/a
	Non-Rigid Plastic Film and Bags	n/a
	All EPS	n/a
	All Metals	n/a
	All Glass	n/a
	Liquids	n/a
	All Other Contamination	n/a
	Total Contamination	**n/a**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Waring Dining Hall

Building Facts

Type: Dining Hall

Year Constructed: 1950

Service Area**:** Area 2

Gross Square Footage**:** 72,950

Season Audited: Fall 2018

Description: Waring Commons is open 24 hours/day for students to utilize. The Commons features a study lounge, a classroom, the Waring Commons Desk, ResCom, and several dining locations.

Audit Results

Some key findings from the results for Waring include:

- Nearly 1.5 tons of refuse, 700 pounds of recyclables, 5.5 tons of compost, and 1 ton of OCC were generated from Waring over the week, for a **recycling rate of approximately 84 percent.**
- WCS Results:
  - Approximately 10 percent of the refuse stream were materials that are accepted in the University's recycling streams. As at Redifer, mixed recyclable paper and other plastic containers (#3-7) had the higher percentages.
  - Over one third of the refuse was food waste, which was the largest category in the refuse.
  - Over 16 percent of the refuse was potentially recoverable, nearly all of which was paper towels, napkins, and tissues.

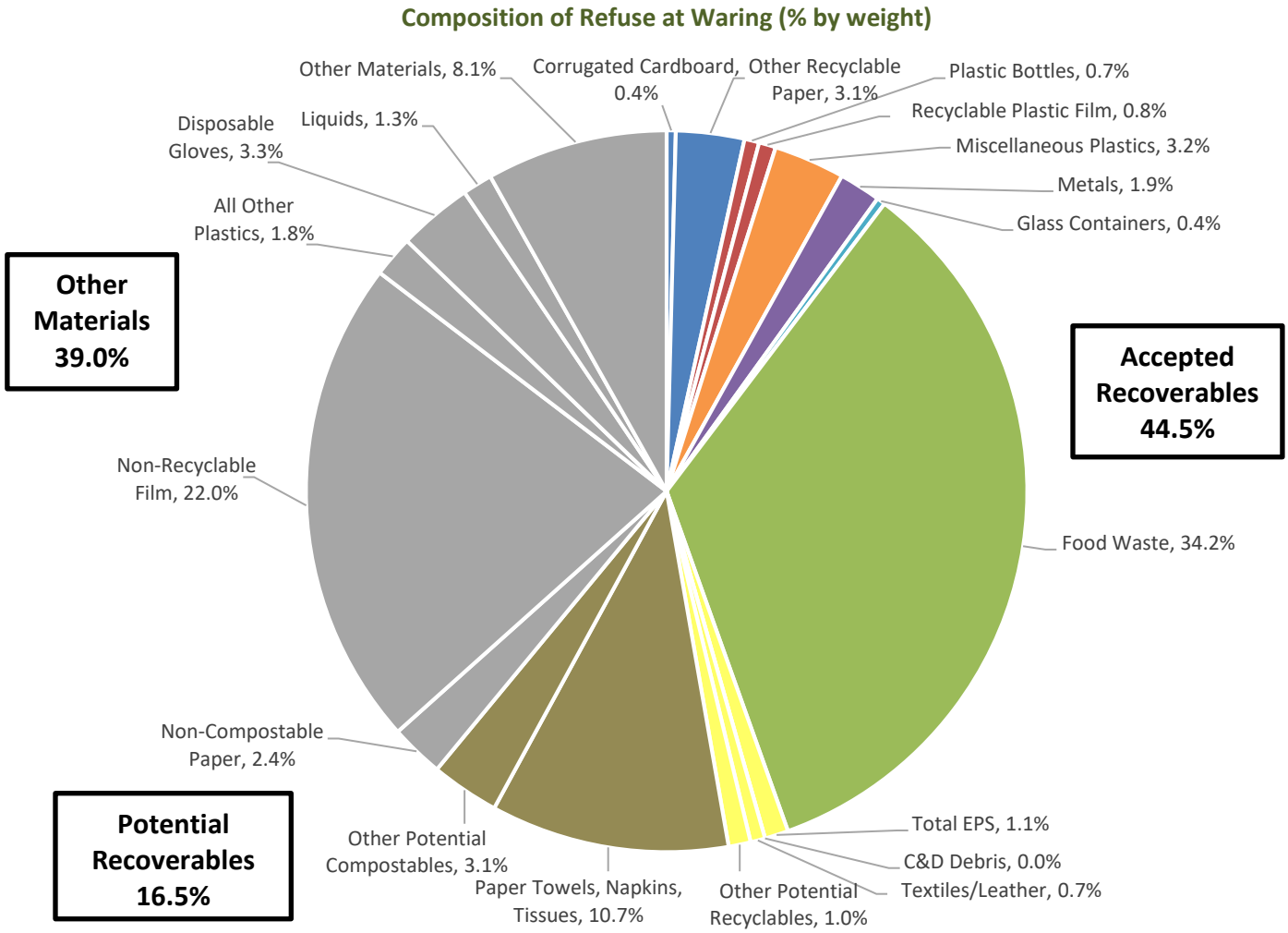
- Almost 40 percent of the refuse were non-recoverable materials, over half of which was non-recyclable plastic film.

- Visual Assessment Results:
  - On average, the recycling streams from Waring were very clean. While post-consumer recyclables had much higher contamination than pre-consumer materials, which had little to no contamination, the volume of pre-consumer material was much greater.
  - Compost materials, which included Waring's compost, was assessed at the compost tipping pad. It appeared to be mostly clean, but some non-compostable paper cups were observed.

Daily Material Generation at Waring

Weight (lbs)	Thu (11/1)	Fri (11/2)	Sat (11/3)	Sun (11/4)	Mon (11/5)	Tue (11/6)	Wed (11/7)	**Weekly Total**	**% of total weight**
Refuse	434.4	364.6	237.8	292.7	505.2	432.8	452.6	**2,720.1**	**16.1%**
Paper	18.9	3.5	1.9	2.3	10.3	8.7	19.1	**64.7**	**0.4%**
Recyclable Plastics	80.9	31.0	42.4	46.0	67.6	47.2	61.9	**377.0**	**2.2%**
Metal	44.3	43.6	6.6	26.2	56.3	64.5	29.2	**270.6**	**1.6%**
Glass	-	-	-	10.3	1.4	5.1	-	**16.9**	**0.1%**
Compost	1,600.0	3,800.0			2,020.0	1,740.0	1,980.0	**11,140.0**	**66.0%**
OCC	381.4	447.4	194.2	200.0	414.9	282.8	370.4	**2,291.1**	**13.6%**
Total	**2,559.9**	**890.1**	**482.9**	**4,377.5**	**3,075.7**	**2,581.1**	**2,913.2**	**16,880.4**	**100%**

Volume (cy)								
Refuse	3.8	2.8	2.4	3.3	4.2	4.2	4.7	**25.4**
Paper	0.2	<0.1	<0.1	<0.1	<0.1	0.2	0.2	**0.5**
Recyclable Plastics	1.9	0.9	0.9	1.2	1.5	1.3	0.5	**8.3**
Metal	0.6	0.6	0.1	0.5	0.7	1.0	0.4	**3.8**
Glass	-	-	-	<0.1	<0.1	<0.1	-	**<0.1**
Compost	Volume not measured							
Total	**6.4**	**4.4**	**3.4**	**5.0**	**6.5**	**6.6**	**5.7**	**38.0**



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Waring (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.0%	0.0%	0.0%
OCC	0.4%	0.2%	0.6%
Mixed Recyclable Paper	3.1%	2.0%	4.1%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	3.5%		
PET Bottles (#1)	0.6%	0.2%	1.1%
HDPE Bottles (#2)	0.0%	0.0%	0.1%
Recyclable Plastic Film	0.8%	-0.3%	1.8%
Total Plastic Bottles and Film	1.4%		
Non-Bottle Plastics (#1 and #2)	0.7%	-0.2%	1.5%
Other Plastic Containers (#3-#7)	1.9%	0.6%	3.2%
Plastic Cups	0.6%	0.2%	0.9%
Total Miscellaneous Plastics	3.2%		
Tin/Steel Cans	1.2%	0.0%	2.3%
Ferrous Scrap Metals	0.0%	0.0%	0.1%
Aluminum Cans	0.4%	0.1%	0.7%
Aluminum Foil and Trays	0.2%	0.1%	0.3%
Non-Ferrous Scrap Metals	0.1%	0.0%	0.3%
Total Recyclable Metal	1.9%		
Glass Containers	0.4%	0.1%	0.6%
Food Waste	34.2%	24.1%	44.3%
Aseptic/Polycoated Containers	0.8%	0.4%	1.1%
Bulky Rigid Plastics	0.2%	0.0%	0.5%
Food Service EPS	1.1%	0.6%	1.5%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.7%	0.3%	1.1%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	2.7%		
Paper Towels, Napkins, Tissues	10.7%	9.1%	12.3%
Compostable Food Containers and Cups	3.0%	0.8%	5.2%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	13.7%		
Non-Compostable Paper Food Serviceware	2.4%	1.5%	3.3%
Non-Recyclable Plastic Film	22.0%	16.9%	27.0%
All Other Plastics	1.8%	1.0%	2.7%
Other Glass	2.6%	-1.1%	6.4%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.0%	0.0%	0.0%
Disposable Gloves	3.3%	1.1%	5.6%
All Other Garbage	5.5%	3.9%	7.1%
Liquids	1.3%	0.3%	2.4%
Grit	0.0%	0.0%	0.0%
All Other Materials	39.0%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to

Composition of Recycling and Compost Streams at Waring (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		90%	**65%**	**15%**	**10%**	**95%**	**100%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles						
	Recyclable Film						
	Misc Plastic						
	Metal		<5%				
	Glass Bottles						
	Total Misplaced Recyclables		**<5%**				
Contamination	Food-Cont. Target Recyclable		<5%			<5%	
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS		<5%				
	Non-Recyclable Plastic Film						
	All Other Plastics		<5%				<5%
	Other Glass						
	Non-Recyclable Paper	10%	<5%				
	Organics					<5%	
	Aseptic/Polycoated Containers						
	Liquids						
	All Other Contamination						
	Total Contamination	**10%**	**5%**			**5%**	**<5%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Beaver Hall

Building Facts

Type: Dormitory

Year Constructed: 1960

Service Area**:** Area 1

Gross Square Footage**:** 117,648

Season Audited: Fall 2018

Description: Beaver Hall, located in the Pollock Housing Area, houses approximately 600 first-year and upper-class students. Beaver Hall is a traditional residence hall, housing students in a double room and features a communal bathroom on each floor. Supplemental Housing is located on every other floor.

Audit Results

Some key findings from the results for Beaver include:

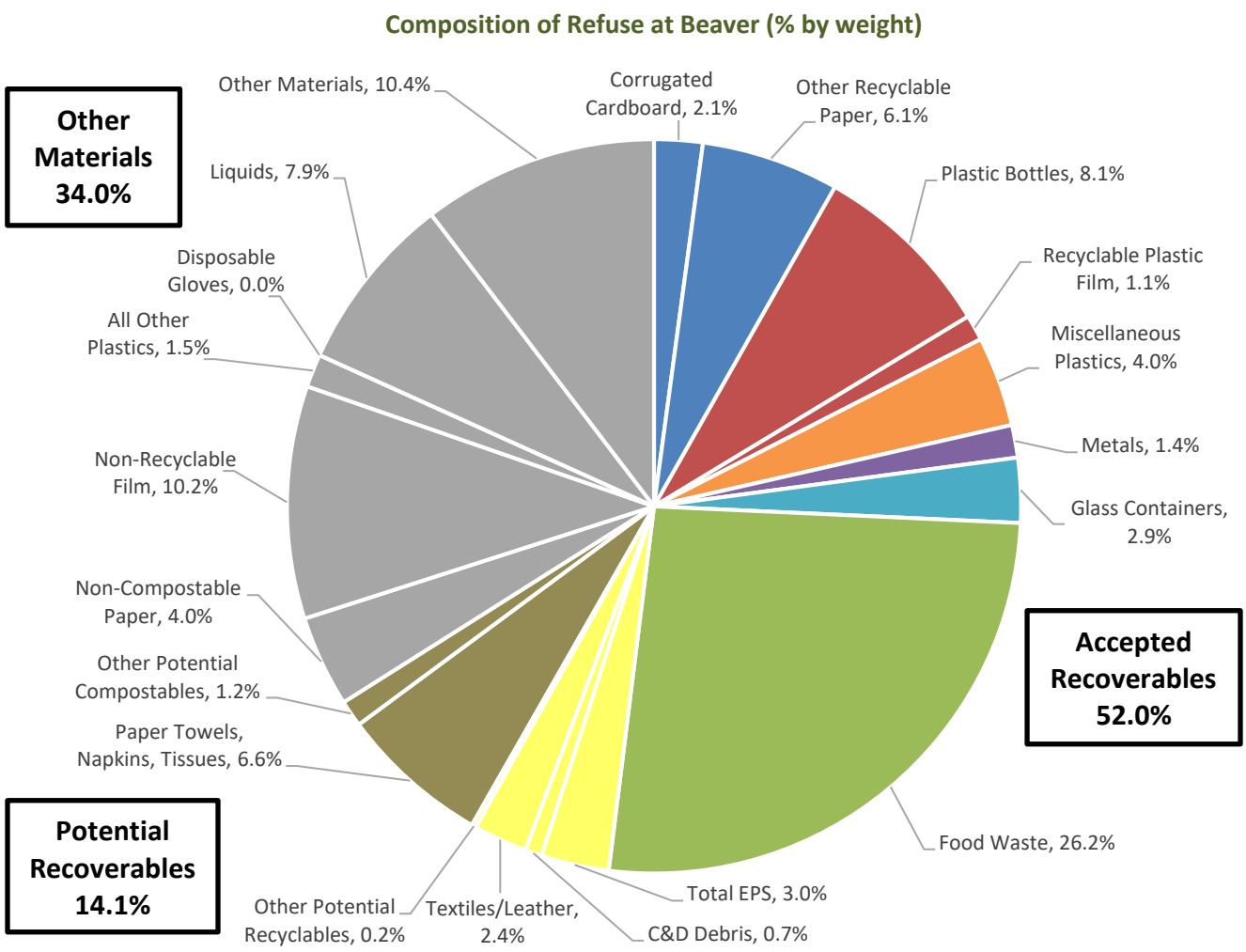
- Over 1 ton of refuse, 270 pounds of recyclables and OCC, and 70 pounds of compost were generated from Beaver over the week, for a **recycling rate of about 13 percent.**
- WCS Results:
  - Over 25 percent of the refuse stream were materials that are accepted in the University's recycling streams. Mixed recyclable paper and PET bottles were over half of this.
  - Approximately 26 percent of the refuse stream was food waste.
  - About 14 percent of the refuse was potential recoverables, mostly food service EPS, textiles/leather, and paper towels, napkins, and tissues.
  - Non-recoverable materials comprised about 34 percent of the refuse. As with other dorms, most of this was non-recyclable plastic film, all other garbage, and liquids.

- Visual Assessment Results:
  - Recycling streams were very clean, similar to other dorms.
  - The compost stream was mostly clean, although EPS was a significant contaminant.

Daily Material Generation at Beaver

Weight (lbs)	Thu (11/8)	Fri-Sat (11/9-11/10)	Sun (11/11)	Mon (11/12)	Tue (11/13)	Wed (11/14)	**Weekly Total**	**% of total weight**
Refuse	315.4	628.2	476.0	308.2	314.0	336.2	**2,378.0**	**87.2%**
Paper	-	-	8.6	0.5	5.1	6.5	**20.8**	**0.8%**
Recyclable Plastics	8.7	26.7	11.4	14.3	16.2	27.3	**104.7**	**3.8%**
Metal	-	-	-	-	-	5.4	**5.4**	**0.2%**
Glass	-	-	-	6.7	14.0	20.1	**40.9**	**1.5%**
Compost	5.0	18.9	18.7	8.0	9.1	13.9	**73.7**	**2.7%**
OCC	28.2	40.2	7.5	5.7	8.8	12.2	**102.6**	**3.8%**
Total	**357.3**	**714.0**	**522.2**	**343.5**	**367.3**	**421.6**	**2,726.0**	**100%**

Volume (cy)							
Refuse	4.7	7.5	6.1	3.8	4.2	4.7	**31.0**
Paper	-	-	0.2	<0.1	0.1	0.2	**0.5**
Recyclable Plastics	0.2	0.5	0.4	0.4	0.5	0.5	**2.3**
Metal	-	-	-	-	-	0.1	**0.1**
Glass	-	-	-	<0.1	<0.1	0.1	**0.2**
Compost	<0.1	0.1	<0.1	<0.1	0.1	0.1	**0.3**
Total	**4.9**	**8.1**	**6.7**	**4.2**	**4.9**	**5.6**	**34.4**



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Beaver (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.0%	0.0%	0.0%
OCC	2.1%	1.7%	2.6%
Mixed Recyclable Paper	6.1%	5.2%	7.0%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	8.2%		
PET Bottles (#1)	7.0%	6.2%	7.8%
HDPE Bottles (#2)	1.2%	0.7%	1.7%
Recyclable Plastic Film	1.1%	0.5%	1.8%
Total Plastic Bottles and Film	9.3%		
Non-Bottle Plastics (#1 and #2)	0.4%	0.2%	0.7%
Other Plastic Containers (#3-#7)	2.1%	1.6%	2.6%
Plastic Cups	1.4%	1.1%	1.7%
Total Miscellaneous Plastics	4.0%		
Tin/Steel Cans	0.4%	0.0%	0.7%
Ferrous Scrap Metals	0.0%	0.0%	0.1%
Aluminum Cans	0.8%	0.2%	1.5%
Aluminum Foil and Trays	0.2%	0.1%	0.3%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.4%		
Glass Containers	2.9%	1.4%	4.3%
Food Waste	26.2%	21.3%	31.2%
Aseptic/Polycoated Containers	0.2%	0.0%	0.4%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	3.0%	2.5%	3.5%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	2.4%	1.0%	3.8%
C&D Debris	0.7%	-0.5%	2.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	6.3%		
Paper Towels, Napkins, Tissues	6.6%	3.0%	10.2%
Compostable Food Containers and Cups	1.1%	0.9%	1.4%
Yard Waste	0.0%	0.0%	0.1%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	7.8%		
Non-Compostable Paper Food Serviceware	4.0%	3.2%	4.8%
Non-Recyclable Plastic Film	10.2%	8.6%	11.9%
All Other Plastics	1.5%	1.2%	1.7%
Other Glass	0.4%	-0.7%	1.6%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	1.0%	-0.3%	2.2%
Disposable Gloves	0.0%	0.0%	0.0%
All Other Garbage	8.9%	7.9%	10.0%
Liquids	7.9%	4.7%	11.0%
Grit	0.0%	0.0%	0.0%
All Other Materials	34.0%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Beaver (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		90%	**80%**	**5%**	**10%**	**90%**	**95%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles						<5%
	Recyclable Film						
	Misc Plastics						
	Metal		<5%				
	Glass Bottles		<5%				
	Total Misplaced Recyclables		**<5%**				**<5%**
Contamination	Food-Cont. Target Recyclable		<5%				<5%
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS						
	Non-Recyclable Plastic Film						
	All Other Plastics		<5%				
	Other Glass						
	Non-Recyclable Paper	10%	<5%				<5%
	Organics						
	Aseptic/Polycoated Containers						
	Liquids					10%	
	All Other Contamination						
	Total Contamination	**10%**	**<5%**			**10%**	**<5%**

Target Materials		Compost
		75%
Compostable Materials	Loose Food Waste	45%
	Yard Waste	<5%
	Paper Towels, Napkin, Tissue	5%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	5%
	All Rigid Plastics	5%
	Non-Rigid Plastic Film and Bags	<5%
	All EPS	15%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**25%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Cooper-Hoyt Halls

Building Facts

Type: Dormitory

Year Constructed: 1957

Service Area**:** Area 1

Gross Square Footage**:** 68,913

Season Audited: Fall 2018

Description: Cooper and Hoyt Halls, located in the South Housing Area, were built in 1957 and renovated in 2014. Approximately 250 upper-class women who belong to a Sorority Chapter reside in Cooper-Hoyt Halls. Cooper-Hoyt Halls houses students in double rooms and features individual, private-use bathrooms on each floor.

Audit Results

Some key findings from the results for Cooper-Hoyt include:

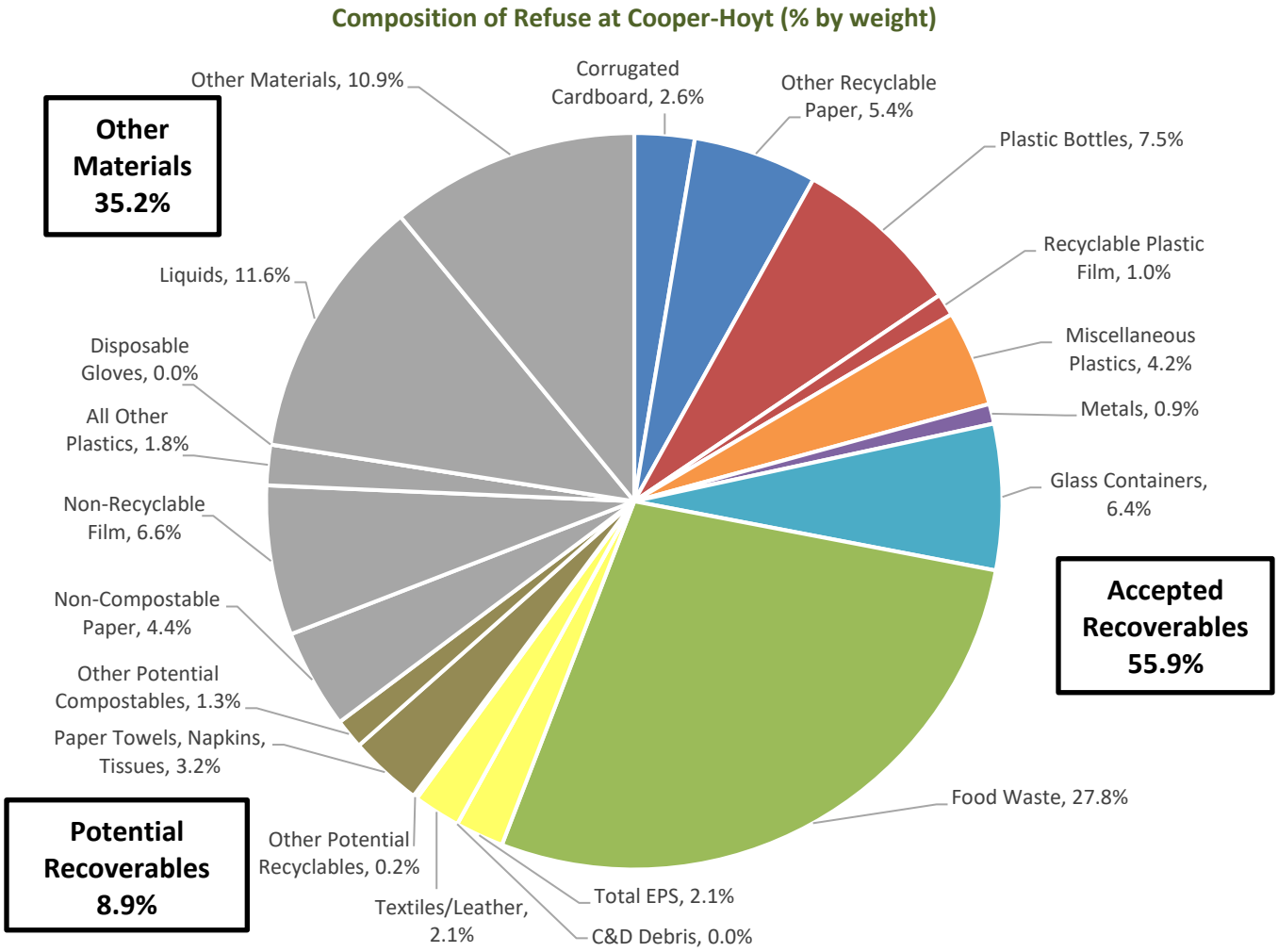
- Over 1600 pounds of refuse, 120 pounds of recyclables and OCC, and 40 pounds of compost were generated from Cooper-Hoyt over the week, for a **recycling rate of less than 10 percent.**
- WCS Results:
  - About 28 percent of the refuse stream were materials that are accepted in the University's recycling stream. Similar to other dorms, mixed recyclable paper, PET bottles, and glass bottles were the major categories of recyclables in the refuse.
  - Nearly 28 percent of the refuse stream was food waste.
  - Only about 9 percent of the refuse was potential recoverables, mostly food service EPS, textiles/leather, and paper towels, napkins, and tissues.
  - Over 35 percent of the waste was non-recoverable materials. Liquids was exceptionally high, at over 11 percent of the refuse. All other garbage and non-recyclable plastic film were also major contributors of non-recoverable materials.

- Visual Assessment Results:
  - Recyclable plastics, which were the only recyclables generated in the audit (besides OCC), were very clean.
  - The compost stream, however, was highly contaminated. Rigid plastics (e.g. plastic cups and bottles) were the most prominent contaminants. Glass bottles, which are especially problematic for compost facilities, was found in the compost as well.

Daily Material Generation at Cooper-Hoyt

Weight (lbs)	Thu (11/8)	Fri-Sat (11/9-11/10)	Sun (11/11)	Mon (11/12)	Tue (11/13)	Wed (11/14)	**Weekly Total**	**% of total weight**
Refuse	220.4	264.6	361.2	312.2	376.0	116.6	**1,651.0**	90.8%
Paper*	-	-	-	-	-	-		-
Recyclable Plastics	-	8.1	6.7	8.9	23.7	-	**47.5**	2.6%
Metal*	-	-	-	-	-	-	-	-
Glass*	-	-	-	-	-	-	-	-
Compost	4.0	-	8.0	17.6	9.9	3.9	**43.4**	2.4%
OCC	31.4	12.5	6.9	6.9	13.4	4.5	**75.6**	4.2%
Total	**255.8**	**285.2**	**382.8**	**345.7**	**423.0**	**125.0**	**1,817.5**	**100%**
Volume (cy)								
Refuse	2.4	2.4	4.2	3.3	3.8	0.9	**16.9**	
Paper*	-	-	-	-	-	-	-	
Recyclable Plastics	-	0.1	0.2	0.1	0.3	-	**0.7**	
Metal*	-	-	-	-	-	-	-	
Glass*	-	-	-	-	-	-	-	
Compost	<0.1	-	<0.1	0.2	0.1	<0.1	**0.4**	
Total	**2.4**	**2.5**	**4.4**	**3.6**	**4.2**	**1.0**	**18.0**	

*Paper, metal, and glass recyclables were not generated from Cooper-Hoyt during the audit.



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Cooper-Hoyt (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.0%	0.0%	0.0%
OCC	2.6%	1.4%	3.9%
Mixed Recyclable Paper	5.4%	4.4%	6.5%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	8.1%		
PET Bottles (#1)	6.4%	4.4%	8.4%
HDPE Bottles (#2)	1.1%	0.5%	1.7%
Recyclable Plastic Film	1.0%	0.5%	1.4%
Total Plastic Bottles and Film	8.4%		
Non-Bottle Plastics (#1 and #2)	0.8%	0.4%	1.3%
Other Plastic Containers (#3-#7)	2.3%	1.8%	2.8%
Plastic Cups	1.1%	0.8%	1.4%
Total Miscellaneous Plastics	4.2%		
Tin/Steel Cans	0.1%	0.0%	0.3%
Ferrous Scrap Metals	0.0%	0.0%	0.1%
Aluminum Cans	0.4%	0.2%	0.5%
Aluminum Foil and Trays	0.3%	0.2%	0.4%
Non-Ferrous Scrap Metals	0.0%	-0.1%	0.2%
Total Recyclable Metal	0.9%		
Glass Containers	6.4%	2.5%	10.3%
Food Waste	27.8%	20.7%	35.0%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	-0.1%	0.1%
Food Service EPS	2.1%	1.5%	2.7%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	2.1%	0.0%	4.1%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	4.4%		
Paper Towels, Napkins, Tissues	3.2%	1.6%	4.8%
Compostable Food Containers and Cups	1.3%	0.9%	1.7%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	4.5%		
Non-Compostable Paper Food Serviceware	4.4%	3.1%	5.6%
Non-Recyclable Plastic Film	6.6%	5.1%	8.0%
All Other Plastics	1.8%	1.3%	2.2%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.3%	-0.1%	0.7%
Diapers	1.1%	-1.3%	3.5%
Disposable Gloves	0.0%	0.0%	0.0%
All Other Garbage	9.5%	4.8%	14.3%
Liquids	11.6%	6.7%	16.4%
Grit	0.0%	0.0%	0.0%
All Other Materials	35.2%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Cooper-Hoyt (% by volume)

Target Materials		Paper*	Recyclable Plastic			Metal*	Glass*
			Bottles	Film	Misc.		
		n/a	**75%**	**5%**	**10%**	**n/a**	**n/a**
Misplaced Recyclables	Recyclable Paper		<5%			n/a	n/a
	Plastic Bottles	n/a				n/a	n/a
	Recyclable Film	n/a				n/a	n/a
	Misc Plastics	n/a				n/a	n/a
	Metal	n/a					n/a
	Glass Bottles	n/a				n/a	
	Total Misplaced Recyclables	**n/a**	**<5%**			**n/a**	**n/a**
Contamination	Food-Cont. Target Recyclable	n/a	5%			n/a	n/a
	Food-Cont. Non-Target Recyclables	n/a				n/a	n/a
	Bulky Rigid Plastics	n/a				n/a	n/a
	All EPS	n/a				n/a	n/a
	Non-Recyclable Plastic Film	n/a				n/a	n/a
	All Other Plastics	n/a	<5%			n/a	n/a
	Other Glass	n/a				n/a	n/a
	Non-Recyclable Paper	n/a				n/a	n/a
	Organics	n/a				n/a	n/a
	Aseptic/Polycoated Containers	n/a				n/a	n/a
	Liquids	n/a				n/a	n/a
	All Other Contamination	n/a				n/a	n/a
	Total Contamination	**n/a**	**10%**			**n/a**	**n/a**

Target Materials		Compost
		30%
Compostable Materials	Loose Food Waste	15%
	Yard Waste	
	Paper Towels, Napkin, Tissue	<5%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	15%
	All Rigid Plastics	30%
	Non-Rigid Plastic Film and Bags	
	All EPS	10%
	All Metals	
	All Glass	10%
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**70%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

*Paper, metal, and glass recyclables were not generated from Cooper-Hoyt during the audit.

Earle Hall

Building Facts

Type: Dormitory

Year Constructed: 2017

Service Area**:** Area 1

Gross Square Footage**:** 96,500

Season Audited: Fall 2018

Description: Earle Hall, located in the East Housing Area, was built in 2017 and houses approximately 360 first-year students. Earle Hall houses students in double rooms and features individual, private-use bathrooms on each floor. Quads, used as supplemental housing, are located on every floor.

Audit Results

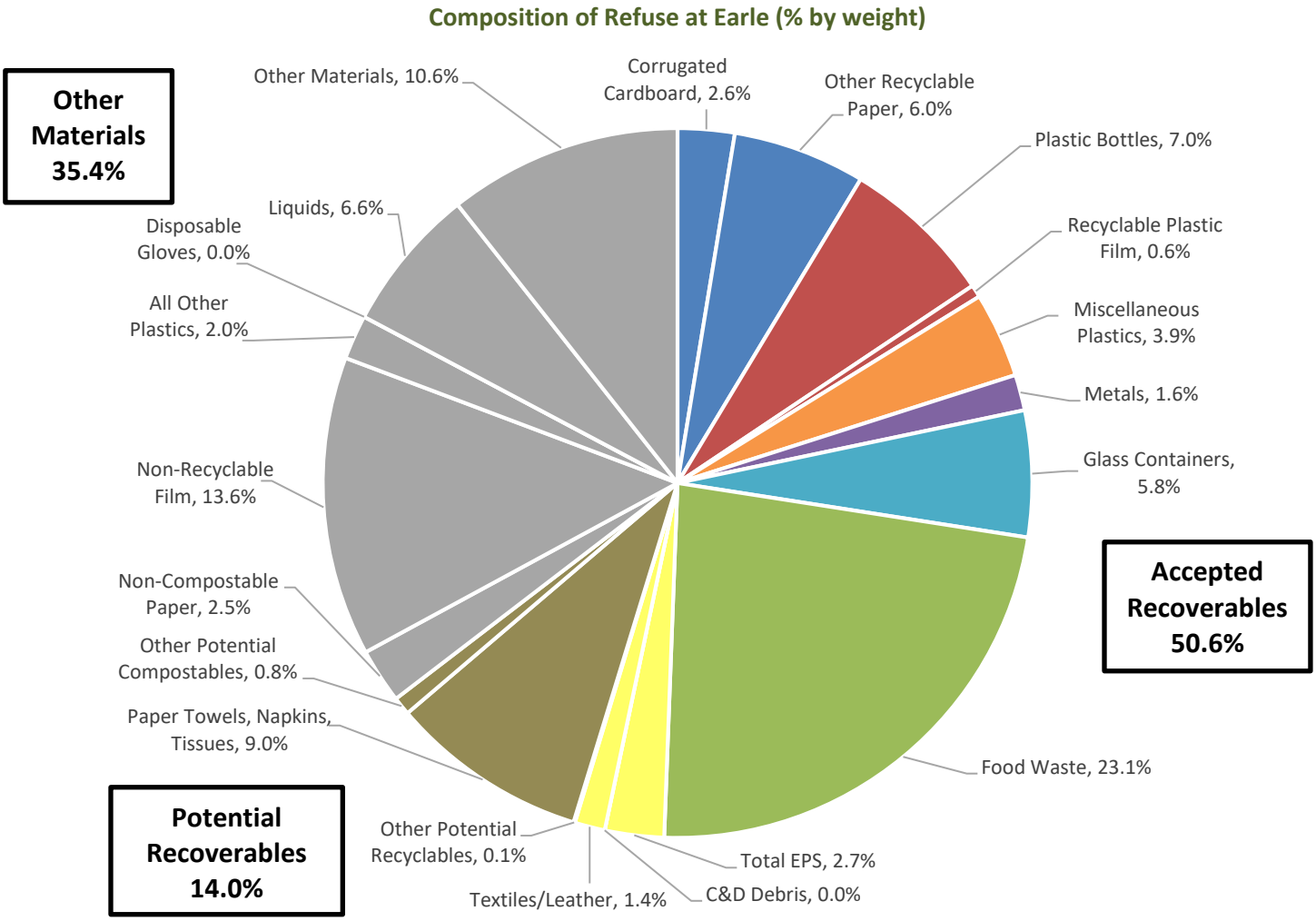
Some key findings from the results for Earle include:

- Nearly 1 ton of refuse, over 230 pounds of recyclables, 85 pounds of compost, and 160 pounds of OCC were generated from Earle over the week, for a **recycling rate of about 21 percent.**
- WCS Results:
  - Over 27 percent of the refuse stream were materials that are accepted in the University's recycling stream, the largest categories of which were mixed recyclable paper, PET bottles, and glass bottles.
  - Approximately 23 percent of the refuse stream was food waste.
  - Potential recoverables comprised about 14 percent of the refuse. As with Leete, this was mostly paper towels, napkins, and tissues.
  - Approximately 35 percent of the refuse was non-recoverable materials, mostly non-recyclable film and all other garbage. Liquids found inside containers was also significant.

- Visual Assessment Results:
  - Similar to Leete, the recycling and compost streams were mostly clean with minimal non-target materials or contamination.

Daily Material Generation at Earle

Weight (lbs)	Thu (11/1)	Fri (11/2)	Sat (11/3)	Sun (11/4)	Mon (11/5)	Tue (11/6)	Wed (11/7)	**Weekly Total**	**% of total weight**
Refuse	376.2	184.2	255.0	345.0	389.2	196.4	123.3	**1869.4**	**79.3%**
Paper	8.7	11.4	1.6	14.9	4.7	0.7	4.3	**46.4**	**2.0%**
Recyclable Plastics	50.9	29.4	6.7	37.6	16.3	3.0	13.8	**157.8**	**6.7%**
Metal	-	-	4.3	4.2	5.1	-	3.2	**16.9**	**0.7%**
Glass	-	-	-	3.7	9.2	-	4.1	**17.0**	**0.7%**
Compost	31.5	4.5	18.3	22.8	1.2	0.7	6.1	**85.2**	**3.6%**
OCC	81.6	22.8	20.8	19.7	4.6	-	14.7	**164.2**	**7.0%**
Total	**549.0**	**252.4**	**306.8**	**448.0**	**430.3**	**200.8**	**169.6**	**2,356.9**	**100%**
Volume (cy)									
Refuse	4.2	2.4	2.8	4.2	4.2	2.8	0.5	**21.2**	
Paper	0.1	0.2	0.1	0.5	0.2	0.0	0.1	**1.1**	
Recyclable Plastics	0.8	0.6	0.1	0.2	0.2	0.1	0.5	**2.5**	
Metal	-	-	-	0.1	0.1	-	<0.1	**0.2**	
Glass	-	-	-	<0.1	<0.1	-	<0.1	**0.1**	
Compost	0.1	0.1	0.2	<0.1	<0.1	<0.1	<0.1	**0.4**	
Total	**5.2**	**3.2**	**3.2**	**5.0**	**4.7**	**2.9**	**1.1**	**25.4**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Earle (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.1%	-0.3%	0.6%
OCC	2.6%	0.9%	4.2%
Mixed Recyclable Paper	5.9%	3.6%	8.3%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	8.6%		
PET Bottles (#1)	5.9%	4.9%	6.8%
HDPE Bottles (#2)	1.1%	0.7%	1.6%
Recyclable Plastic Film	0.6%	-0.1%	1.3%
Total Plastic Bottles and Film	7.6%		
Non-Bottle Plastics (#1 and #2)	0.4%	-0.1%	0.9%
Other Plastic Containers (#3-#7)	2.4%	2.0%	2.8%
Plastic Cups	1.1%	0.8%	1.3%
Total Miscellaneous Plastics	3.9%		
Tin/Steel Cans	0.1%	0.0%	0.3%
Ferrous Scrap Metals	0.1%	0.0%	0.2%
Aluminum Cans	0.8%	0.2%	1.3%
Aluminum Foil and Trays	0.7%	0.3%	1.0%
Non-Ferrous Scrap Metals	0.0%	-0.1%	0.2%
Total Recyclable Metal	1.6%		
Glass Containers	5.8%	3.0%	8.5%
Food Waste	23.1%	19.7%	26.6%
Aseptic/Polycoated Containers	0.1%	-0.1%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	2.7%	1.5%	3.8%
Bulk Packaging EPS	0.0%	0.0%	0.1%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.4%	0.6%	2.2%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	4.1%		
Paper Towels, Napkins, Tissues	9.0%	6.3%	11.8%
Compostable Food Containers and Cups	0.8%	0.4%	1.2%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	9.9%		
Non-Compostable Paper Food Serviceware	2.5%	1.8%	3.2%
Non-Recyclable Plastic Film	13.6%	10.1%	17.2%
All Other Plastics	2.0%	1.5%	2.5%
Other Glass	0.1%	-0.1%	0.3%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.1%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.2%	0.0%	0.5%
Disposable Gloves	0.0%	0.0%	0.0%
All Other Garbage	10.3%	7.1%	13.5%
Liquids	6.6%	4.9%	8.2%
Grit	0.0%	0.0%	0.0%
All Other Materials	35.4%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Earle (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		90%	**60%**	**10%**	**15%**	**95%**	**95%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles	<5%					
	Recyclable Film						
	Misc Plastics	<5%				<5%	5%
	Metal		<5%				
	Glass Bottles						
	Total Misplaced Recyclables	**<5%**	**<5%**			**<5%**	**5%**
Contamination	Food-Cont. Target Recyclable	<5%	5%			<5%	
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS	<5%					
	Non-Recyclable Plastic Film						
	All Other Plastics		<5%				
	Other Glass						
	Non-Recyclable Paper	5%					
	Organics						
	Aseptic/Polycoated Containers						
	Liquids						
	All Other Contamination					<5%	
	Total Contamination	**10%**	**10%**			**<5%**	

Target Materials		Compost
		90%
Compostable Materials	Loose Food Waste	50%
	Yard Waste	20%
	Paper Towels, Napkin, Tissue	<5%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	
	All Rigid Plastics	5%
	Non-Rigid Plastic Film and Bags	5%
	All EPS	
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**10%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Hamilton Hall

Building Facts

Type: Dormitory

Year Constructed: 1950

Service Area**:** Area 2

Gross Square Footage**:** 149,425

Season Audited: Fall 2018

Description: Hamilton Hall, located in the West Housing Area, houses are approximately 630 first-year and upper-class students. Hamilton Hall is a traditional residence hall, housing students in a double room and features a communal bathroom on each floor.

Audit Results

Some key findings from the results for Hamilton include:

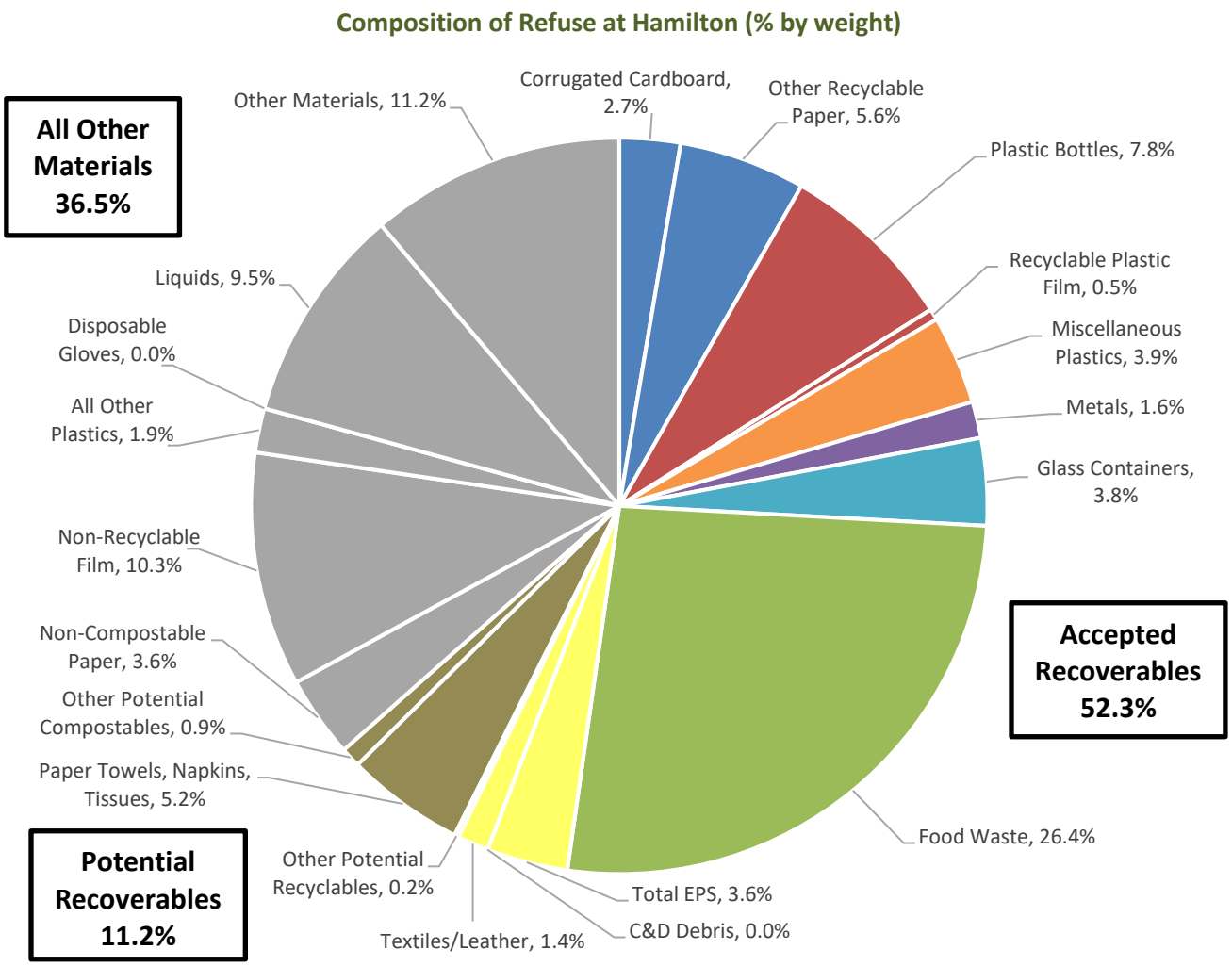
- Over 1 ton of refuse, nearly 300 pounds of recyclables and OCC, and 26 pounds of compost were generated from Hamilton over the week, for a **recycling rate of about 11 percent.**
- WCS Results:
  - Nearly 26 percent of the refuse stream were materials that are accepted in the University's recycling streams. Mixed recyclable paper and PET bottles were the most significant materials.
  - Approximately 26 percent of the refuse stream was food waste.
  - Potential recoverables comprised about 11 percent of the refuse. This was mostly food service EPS and paper towels, napkins, and tissues.

- Non-recoverable materials comprised about 34 percent of the refuse. As with other dorms, most of this was non-recyclable plastic film, all other garbage, and liquids.

- Visual Assessment Results:
  - All four recycling and the compost streams were fairly clean.

Daily Material Generation at Hamilton

Weight (lbs)	Thu (11/8)	Fri-Sat (11/9-11/10)	Sun (11/11)	Mon (11/12)	Tue (11/13)	Wed (11/14)	**Weekly Total**	**% of total weight**
Refuse	419.4	606.6	424.2	310.6	324.4	420.0	**2,505.2**	88.8%
Paper	-	2.7	8.8	-	-	15.2	**26.7**	0.9%
Recyclable Plastics	8.4	13.3	23.6	13.9	17.6	24.1	**100.8**	3.6%
Metal	0.7	-	0.9	-	3.9	6.0	**11.5**	0.4%
Glass	-	0.9	-	-	-	22.1	**23.1**	0.8%
Compost	6.0	6.5	2.8	2.2	6.7	1.7	**26.0**	0.9%
OCC	57.0	8.6	11.5	6.5	15.8	29.8	**129.2**	4.6%
Total	**491.5**	**638.7**	**471.8**	**333.2**	**368.3**	**518.9**	**2,822.4**	**100%**
Volume (cy)								
Refuse	6.1	8.0	5.2	4.7	4.2	2.6	**30.8**	
Paper	-	0.1	0.2	-	-	0.5	**0.7**	
Recyclable Plastics	0.2	0.5	0.5	0.2	0.5	0.6	**2.5**	
Metal	<0.1	-	<0.1	-	<0.1	0.2	**0.2**	
Glass	-	<0.1	-	-	-	0.1	**0.1**	
Compost	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	
Total	**6.4**	**8.6**	**5.9**	**4.9**	**4.8**	**3.9**	**34.5**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Hamilton (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.2%	-0.2%	0.5%
OCC	2.7%	1.4%	4.0%
Mixed Recyclable Paper	5.4%	3.9%	6.9%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	8.2%		
PET Bottles (#1)	6.6%	5.6%	7.7%
HDPE Bottles (#2)	1.2%	0.8%	1.5%
Recyclable Plastic Film	0.5%	0.1%	0.8%
Total Plastic Bottles and Film	8.3%		
Non-Bottle Plastics (#1 and #2)	0.6%	0.3%	0.9%
Other Plastic Containers (#3-#7)	2.2%	1.9%	2.4%
Plastic Cups	1.1%	0.9%	1.4%
Total Miscellaneous Plastics	3.9%		
Tin/Steel Cans	0.3%	0.2%	0.5%
Ferrous Scrap Metals	0.0%	0.0%	0.1%
Aluminum Cans	1.0%	0.3%	1.7%
Aluminum Foil and Trays	0.2%	0.2%	0.3%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.6%		
Glass Containers	3.8%	2.0%	5.7%
Food Waste	26.4%	24.9%	27.9%
Aseptic/Polycoated Containers	0.2%	0.0%	0.4%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	3.6%	2.6%	4.6%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.1%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.4%	0.4%	2.4%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	5.1%		
Paper Towels, Napkins, Tissues	5.2%	4.6%	5.8%
Compostable Food Containers and Cups	0.9%	0.6%	1.1%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	6.1%		
Non-Compostable Paper Food Serviceware	3.6%	2.6%	4.5%
Non-Recyclable Plastic Film	10.3%	7.8%	12.8%
All Other Plastics	1.9%	1.5%	2.3%
Other Glass	0.1%	-0.1%	0.3%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.3%	0.0%	0.6%
Disposable Gloves	0.0%	0.0%	0.0%
All Other Garbage	10.7%	9.0%	12.5%
Liquids	9.5%	6.1%	13.0%
Grit	0.0%	0.0%	0.0%
All Other Materials	36.5%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Hamilton (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		90%	**70%**	**5%**	**10%**	**95%**	**90%**
Misplaced Recyclables	Recyclable Paper		<5%				
	Plastic Bottles						
	Recyclable Film						
	Misc Plastics						
	Metal		<5%				
	Glass Bottles		<5%				
	Total Misplaced Recyclables		**<5%**				
Contamination	Food-Cont. Target Recyclable		<5%				
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS		<5%				
	Non-Recyclable Plastic Film						
	All Other Plastics		<5%				
	Other Glass						
	Non-Recyclable Paper	10%	<5%			<5%	
	Organics						
	Aseptic/Polycoated Containers						
	Liquids						10%
	All Other Contamination		<5%			<5%	
	Total Contamination	**10%**	**10%**			**<5%**	**10%**

Target Materials		Compost
		90%
Compostable Materials	Loose Food Waste	85%
	Yard Waste	
	Paper Towels, Napkin, Tissue	
	Clean Wood Waste	
	Comp. Containers & Cups	
	Pizza Boxes	5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	10%
	All Rigid Plastics	
	Non-Rigid Plastic Film and Bags	
	All EPS	
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**10%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Leete Hall

Building Facts

Type: Dormitory

Year Constructed: 1959

Service Area**:** Area 5

Gross Square Footage**:** 68,554

Season Audited: Fall 2018

Description: Leete Hall, located in the North Housing Area, was built in 1959 and renovated in 2005. Approximately 230 first-year and upper-year students live Leete Hall, which houses students in suite-style rooms. Options include 1-bedroom/1-person, 2-bedroom/2-person, or 2-bedroom/4-person suites. All suites feature a semi-private bathroom. Supplemental housing suites are located throughout the building.

Audit Results

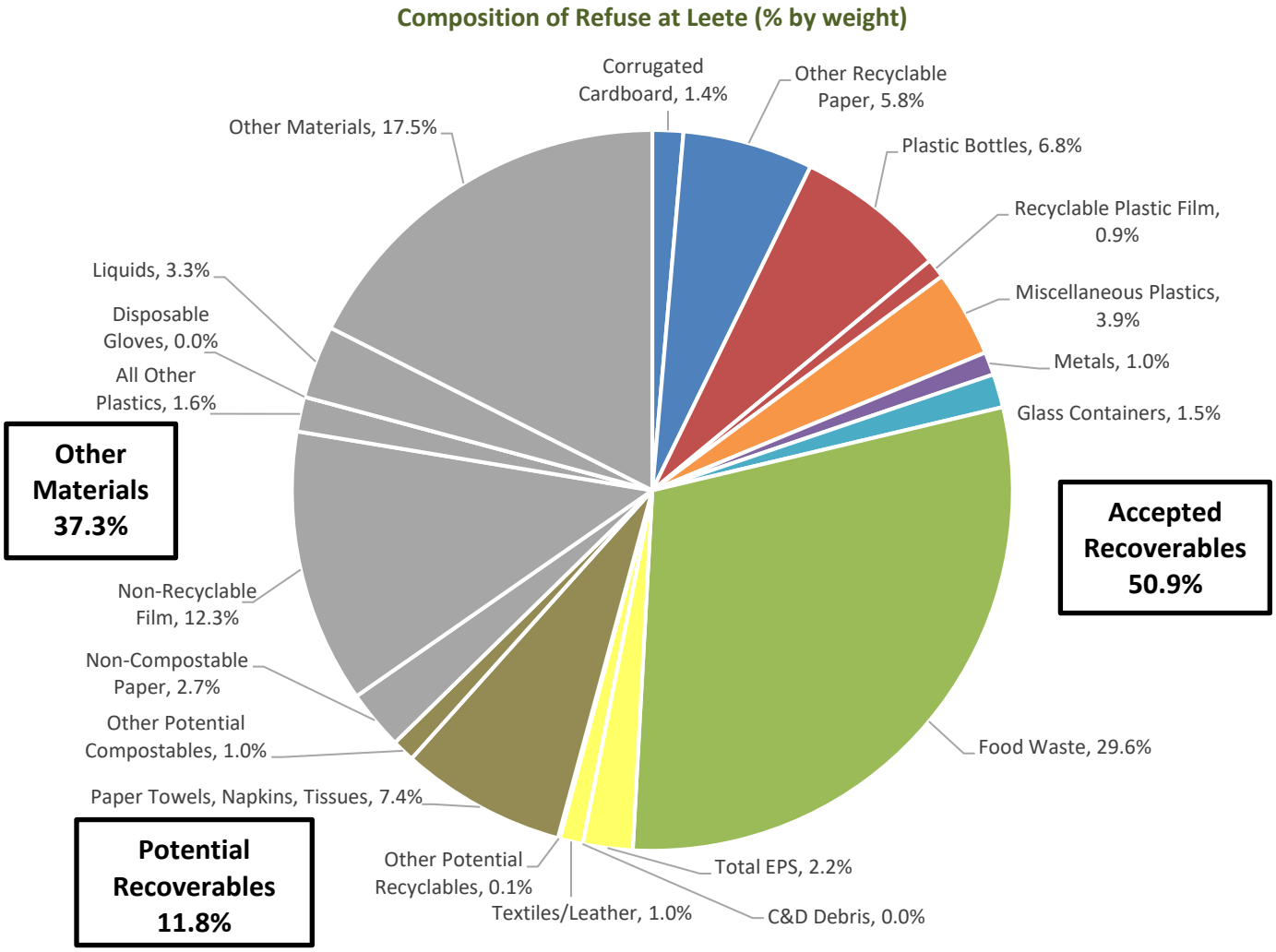
Some key findings from the results for Leete include:

- About 783 pounds of refuse, 190 pounds of recyclables and OCC, and 40 pounds of compost were generated from Leete over the week, for a **recycling rate of about 23 percent.**
- WCS Results:
  - Over 20 percent of the refuse stream were materials that are accepted in the University's recycling streams. Mixed recyclable paper and PET bottles were more than half of these.
  - Almost 30 percent of the refuse stream was food waste.
  - Nearly 12 percent of the refuse stream was potentially recoverable materials, which was mostly paper towels, napkins, and tissues.
  - Over a third of the refuse stream was non-recoverable material. Most of this was non-recyclable film and all other garbage. However, on one day, over 20 percent of the sample were adult diapers, which resulted in the average of over 5 percent diapers for the week.

- Visual Assessment Results:
  - Although the amount of recyclables and compost were minimal compared to the dining buildings, they had very little non-target material and contamination.

Daily Material Generation at Leete

Weight (lbs)	Thu (11/1)	Fri (11/2)	Sat (11/3)	Sun (11/4)	Mon (11/5)	Tue (11/6)	Wed (11/7)	**Weekly Total**	**% of total weight**
Refuse	74.9	87.7	91.9	191.6	93.5	42.4	201.0	**783.1**	**76.7%**
Paper	-	2.7	-	0.7	2.1	-	4.0	**9.6**	**0.9%**
Recyclable Plastics	26.0	6.9	3.8	9.2	5.8	-	22.9	**74.5**	**7.3%**
Metal	-	1.8	-	-	-	-	-	**1.8**	**0.2%**
Glass	-	-	-	5.2	-	-	-	**5.2**	**0.5%**
Compost	5.8	6.4	3.2	4.9	17.3	0.7	3.8	**42.0**	**4.1%**
OCC	3.8	8.9	3.4	0.0	78.8	2.2	7.7	**104.8**	**10.3%**
Total	**110.4**	**114.4**	**102.2**	**211.6**	**197.5**	**45.3**	**239.5**	**1,021.0**	**100%**
Volume (cy)									
Refuse	0.5	1.4	1.4	1.9	1.4	0.5	3.3	**10.3**	
Paper	-	<0.1	-	<0.1	0.1	-	<0.1	**0.2**	
Recyclable Plastics	0.8	0.2	0.1	<0.1	0.2	-	0.2	**1.5**	
Metal	-	<0.1	-	-	-	-	-	**0.0**	
Glass	-	-	-	<0.1	-	-	-	**<0.1**	
Compost	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	
Total	**1.3**	**1.7**	**1.5**	**1.9**	**1.7**	**0.5**	**3.6**	**12.2**	



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Leete (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	Upper Bounds
Newspaper	0.0%	0.0%	0.1%
OCC	1.4%	0.0%	2.8%
Mixed Recyclable Paper	5.8%	3.6%	8.0%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	7.2%		
PET Bottles (#1)	6.0%	5.3%	6.8%
HDPE Bottles (#2)	0.7%	0.3%	1.1%
Recyclable Plastic Film	0.9%	0.2%	1.6%
Total Plastic Bottles and Film	7.6%		
Non-Bottle Plastics (#1 and #2)	0.3%	0.1%	0.5%
Other Plastic Containers (#3-#7)	2.6%	1.1%	4.0%
Plastic Cups	1.0%	0.5%	1.6%
Total Miscellaneous Plastics	3.9%		
Tin/Steel Cans	0.3%	0.1%	0.5%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.6%	0.4%	0.9%
Aluminum Foil and Trays	0.1%	-0.1%	0.2%
Non-Ferrous Scrap Metals	0.0%	-0.1%	0.2%
Total Recyclable Metal	1.0%		
Glass Containers	1.5%	0.8%	2.2%
Food Waste	29.6%	24.3%	34.9%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	2.0%	0.7%	3.3%
Bulk Packaging EPS	0.2%	-0.4%	0.8%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.0%	0.3%	1.8%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	3.4%		
Paper Towels, Napkins, Tissues	7.4%	5.3%	9.5%
Compostable Food Containers and Cups	0.7%	0.1%	1.3%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.3%	-0.1%	0.6%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	8.4%		
Non-Compostable Paper Food Serviceware	2.7%	2.2%	3.1%
Non-Recyclable Plastic Film	12.3%	9.5%	15.1%
All Other Plastics	1.6%	1.1%	2.1%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	5.4%	-2.0%	12.8%
Disposable Gloves	0.0%	0.0%	0.0%
All Other Garbage	12.1%	6.5%	17.8%
Liquids	3.3%	1.8%	4.7%
Grit	0.0%	0.0%	0.0%
All Other Materials	0.0%	0.0%	0.1%
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Leete (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		90%	**60%**	**20%**	**10%**	**85%**	**100%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles	<5%				15%	
	Recyclable Film						
	Misc Plastics	<5%					
	Metal		<5%				
	Glass Bottles						
	Total Misplaced Recyclables	**<5%**	**<5%**			**15%**	
Contamination	Food-Cont. Target Recyclable		<5%				
	Food-Cont. Non-Target Recyclables						
	Bulky Rigid Plastics						
	All EPS		<5%				
	Non-Recyclable Plastic Film		<5%				
	All Other Plastics		<5%				
	Other Glass						
	Non-Recyclable Paper	<5%	<5%				
	Organics						
	Aseptic/Polycoated Containers						
	Liquids						
	All Other Contamination	<5%					
	Total Contamination	**5%**	**10%**				

Target Materials		Compost
		95%
Compostable Materials	Loose Food Waste	85%
	Yard Waste	
	Paper Towels, Napkin, Tissue	<5%
	Clean Wood Waste	
	Comp. Containers & Cups	<5%
	Pizza Boxes	
Contamination	Packaged Food Waste	<5%
	Non-Comp. Paper Containers & Cups	<5%
	All Rigid Plastics	
	Non-Rigid Plastic Film and Bags	
	All EPS	<5%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	
	Total Contamination	**5%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

Pattee & Paterno Libraries

Building Facts

Type: Library

Year Constructed: 1940/1999

Service Area**:** Area 2

Gross Square Footage**:** 483,737

Season Audited: Spring 2018

Description: Named for Fred Lewis Pattee, author of the Penn State Alma Mater and regarded as the first professor of American literature, Pattee Library was built between 1937-1940 as a Public Works Administration-General State Authority project. Major expansions added the "Stacks" or Stack Building (1953), "West Pattee" (1966) and "East Pattee," now Paterno Library (1973).

West Pattee Library includes the technology-rich Knowledge Commons, News & Microforms Library, Arts and Humanities Library, and Music and Media Center. Central Pattee houses Adaptive Technology and Services and Hamer Center for Maps and Geospatial Information.

The former East Pattee Library underwent expansion from 1998-2000 and was rededicated as Paterno Library for its fundraising campaign chairs. It is home to Foster Auditorium, four subject libraries and the first floor Eberly Family Special Collections Library, which includes rare books and manuscripts and the University Archives.

The floors above it are the Social Sciences Library, Schreyer Business Library, Life Sciences Library, and Education and Behavioral Sciences Library. Paterno Library also houses the Libraries' administrative offices.

Audit Results

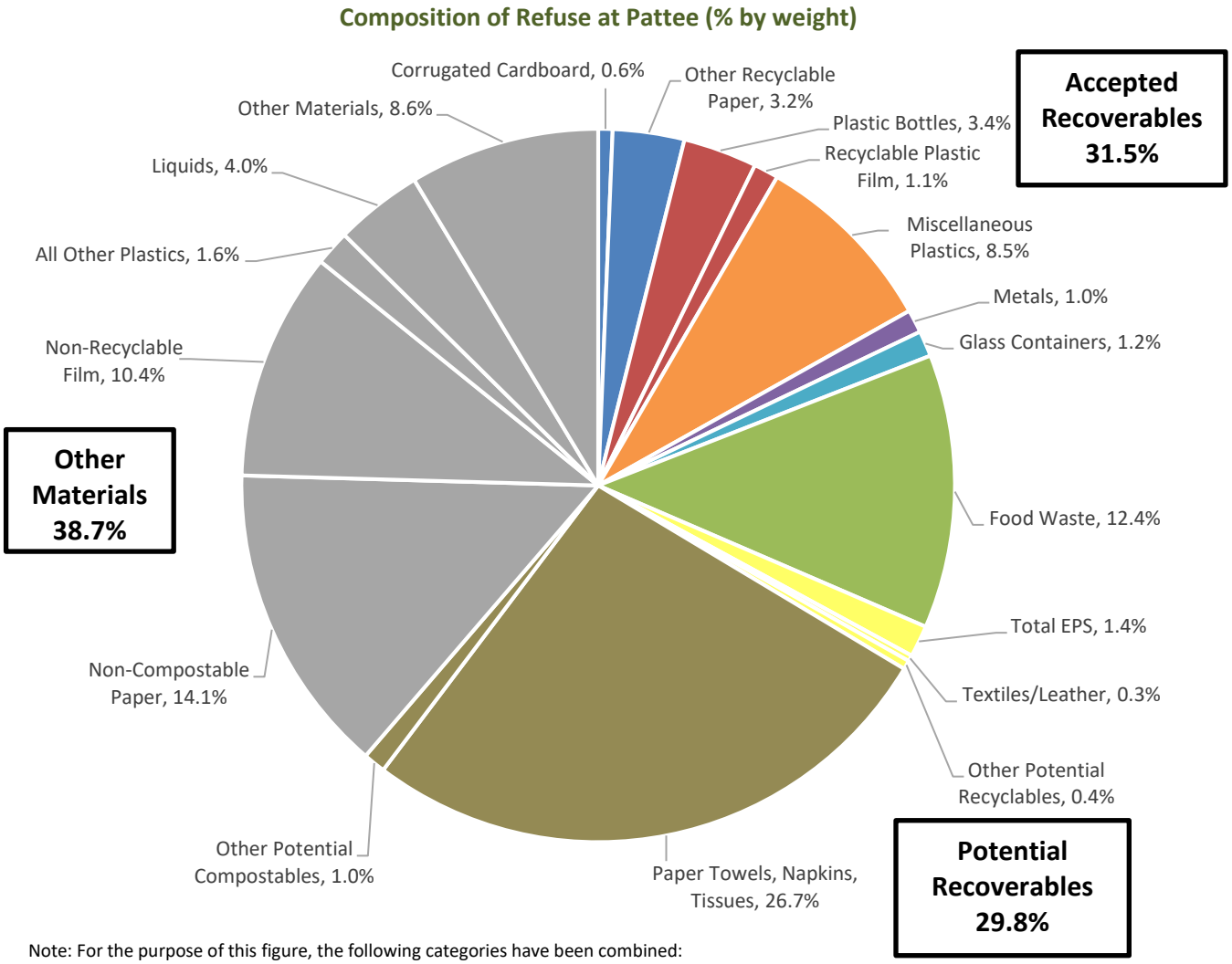
Some key findings from the results for Pattee include:

- Approximately 2,270 pounds of refuse, 1,300 pounds of recyclables, 310 pounds of compost were generated over the week at Pattee, for a **recycling rate of 42 percent**. Pattee had the highest total generation of any building evaluated in this study.
- WCS Results:
  - Accepted recyclable materials comprised about 19 percent of the refuse stream, about half of this was miscellaneous plastics. About 12 percent of the refuse was food waste.
  - By far, the material category comprising the highest percentage of the refuse was paper towels, napkins, and tissues, at nearly 27 percent.
- Another 14 and 10 percent of refuse was non-compostable paper food serviceware and non-recyclable plastic film, again these were the most significant materials in all other materials.
- Visual Assessment Results:
  - Recycling streams from Pattee were all highly to moderately contaminated. Again, miscellaneous plastics had the highest contamination, which was food contaminated materials and non-recyclable paper (cups, etc.). A fair amount of plastic bottles were also in the miscellaneous plastic. Miscellaneous plastics were also in the plastic bottles & film stream.
  - The compost stream was almost half contamination, mostly non-compostable paper cups and containers, as well as some food waste remaining in its packaging.

Daily Material Generation at Pattee

Weight (lbs)	Fri (4/13)*	Sat & Sun (4/14 & 4/15)	Mon (4/16)	Tue (4/17)	Wed (4/18)	Thu (4/19)	Fri (4/20)	**Weekly Total**	**% of total weight**
Refuse	57.8	367.4	449.2	440.0	460.8	421.4	131.2	**2270.0**	**58.4%**
Paper	0.0	72.0	91.6	219.6	81.8	121.9	24.5	**611.2**	**15.7%**
Plastic Bottles	0.0	63.5	20.5	68.8	58.4	57.2	9.1	**277.6**	**7.1%**
Misc Plastics	0.0	43.5	58.2	60.9	52.8	58.4	5.9	**279.8**	**7.2%**
Metal	0.0	10.6	11.7	13.4	8.0	9.1	0.0	**52.8**	**1.4%**
Glass	0.0	12.5	13.6	17.4	17.6	8.4	0.0	**69.5**	**1.8%**
Compost	5.6	62.4	53.2	54.0	78.3	47.6	18.4	**313.8**	**8.1%**
OCC	0.0	12.0	0.0	0.0	0.0	0.0	0.0	**12.0**	**0.3%**
Total	**63.4**	**643.8**	**698.0**	**874.1**	**757.7**	**724.0**	**189.1**	**3886.7**	**100.0%**
Volume (cy)									
Refuse	0.9	5.6	6.6	6.6	6.6	6.1	0.5	**32.0**	
Paper	0.0	1.4	1.1	1.6	0.9	1.2	0.2	**6.5**	
Plastic Bottles	0.0	0.9	1.1	1.2	1.2	1.3	0.2	**5.9**	
Misc Plastics	0.0	0.9	1.1	0.1	0.9	0.9	0.2	**4.2**	
Metal	0.0	0.2	0.2	0.2	0.2	0.2	0.0	**1.2**	
Glass	0.0	0.1	0.1	0.1	0.1	0.0	0.0	**0.4**	
Compost	0.0	0.5	0.2	0.2	0.2	0.4	0.1	**1.5**	
Total	**1.0**	**9.7**	**10.3**	**10.0**	**10.2**	**10.2**	**1.2**	**51.6**	

*The material collected from Pattee on Friday 4/13 was not complete; therefore, it is not included in the weekly totals.



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at Pattee (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.0%	0.0%	0.1%
Corrugated Cardboard (OCC)	0.6%	0.1%	1.2%
Mixed Recyclable Paper	2.7%	1.5%	4.0%
Books	0.5%	-2.4%	3.4%
Total Recyclable Paper	3.9%		
PET Bottles (#1)	3.2%	1.9%	4.5%
HDPE Bottles (#2)	0.1%	0.0%	0.3%
Recyclable Plastic Film	1.1%	0.4%	1.8%
Total Plastic Bottles and Film	4.5%		
Non-Bottle Plastics (#1 and #2)	0.7%	-0.7%	2.2%
Other Plastic Containers (#3-#7)	2.8%	1.9%	3.7%
Plastic Cups	4.9%	4.1%	5.7%
Total Miscellaneous Plastics	8.5%		
Tin/Steel Cans	0.0%	-0.1%	0.2%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.7%	0.3%	1.1%
Aluminum Foil and Trays	0.3%	0.1%	0.4%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.0%		
Glass Containers	1.2%	0.5%	1.8%
Food Waste	12.4%	5.9%	18.9%
Aseptic/Polycoated Containers	0.2%	0.0%	0.4%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	1.4%	0.9%	1.9%
Bulk Packaging EPS	0.0%	0.0%	0.1%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	-0.1%	0.2%
Electronic Media	0.2%	-0.3%	0.7%
Textiles and Leather	0.3%	-0.3%	0.9%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	2.1%		
Paper Towels, Napkins, Tissues	26.7%	19.6%	33.8%
Compostable Food Containers and Cups	0.8%	0.5%	1.2%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.2%	-0.3%	0.6%
Clean Wood Waste	0.0%	0.0%	0.0%
Potential Compostables	27.7%		
Non-Compostable Paper Food Serviceware	14.1%	10.8%	17.5%
Non-Recyclable Plastic Film	10.4%	7.9%	12.8%
All Other Plastics	1.6%	0.9%	2.3%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.1%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.1%	-0.1%	0.2%
All Other Garbage	8.5%	6.4%	10.5%
Liquids	4.0%	2.1%	5.9%
Grit	0.0%	0.0%	0.0%
All Other Materials	38.7%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at Pattee (% by volume)

Target Material		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
		70%	**60%**	**40%**	**70%**	**65%**
Misplaced Recyclables	Recyclable Paper		<5%	<5%		<5%
	Plastic Bottles	<5%		15%	<5%	<5%
	Recyclable Film			5%	<5%	<5%
	Misc Plastics	<5%	20%		<5%	<5%
	Metal		<5%	<5%		5%
	Glass Bottles			<5%		
	Total Misplaced Recyclables	**5%**	**20%**	**20%**	**10%**	**20%**
Contamination	Food-Cont. Target Recyclable	5%	10%	10%	<5%	<5%
	Food-Cont. Non-Target Recyclables		<5%	<5%		5%
	Bulky Rigid Plastics					
	All EPS			<5%	<5%	<5%
	Non-Recyclable Plastic Film		<5%			<5%
	All Other Plastics		<5%	5%		
	Other Glass					
	Non-Recyclable Paper	10%	5%	15%	5%	<5%
	Organics			<5%	<5%	
	Aseptic/Polycoated Containers					
	Liquids					
	All Other Contamination	<5%	<5%	<5%	5%	<5%
	Total Contamination	**20%**	**20%**	**35%**	**20%**	**20%**

Target Materials		Compost
		60%
Compostable Materials	Loose Food Waste	20%
	Yard Waste	
	Paper Towels, Napkin, Tissue	25%
	Clean Wood Waste	
	Comp. Containers & Cups	15%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	10%
	Non-Comp. Paper Containers & Cups	20%
	All Rigid Plastics	<5%
	Non-Rigid Plastic Film and Bags	
	All EPS	<5%
	All Metals	
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**40%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

HUB Student Union

Building Facts

Type: Student Union

Year Constructed: 1955

Service Area**:** Area 4

Gross Square Footage**:** 141,234*

Season Audited: Fall 2018

Description: The Hetzel Union Building-Robeson Center, more commonly referred to as the "HUB", is the Penn State student union building. It serves as the main hub for student activities on campus, offering an assortment of dining options, student radio station, recreation room, performance venues, auditoriums, meeting spaces, lounges, art gallery and displays, student organization offices and much more.

*Allocated half of the total square footage to each part of HUB (Student Union and Administrative areas). This Appendix covers to the Administrative areas, i.e. first floor and up.

Audit Results

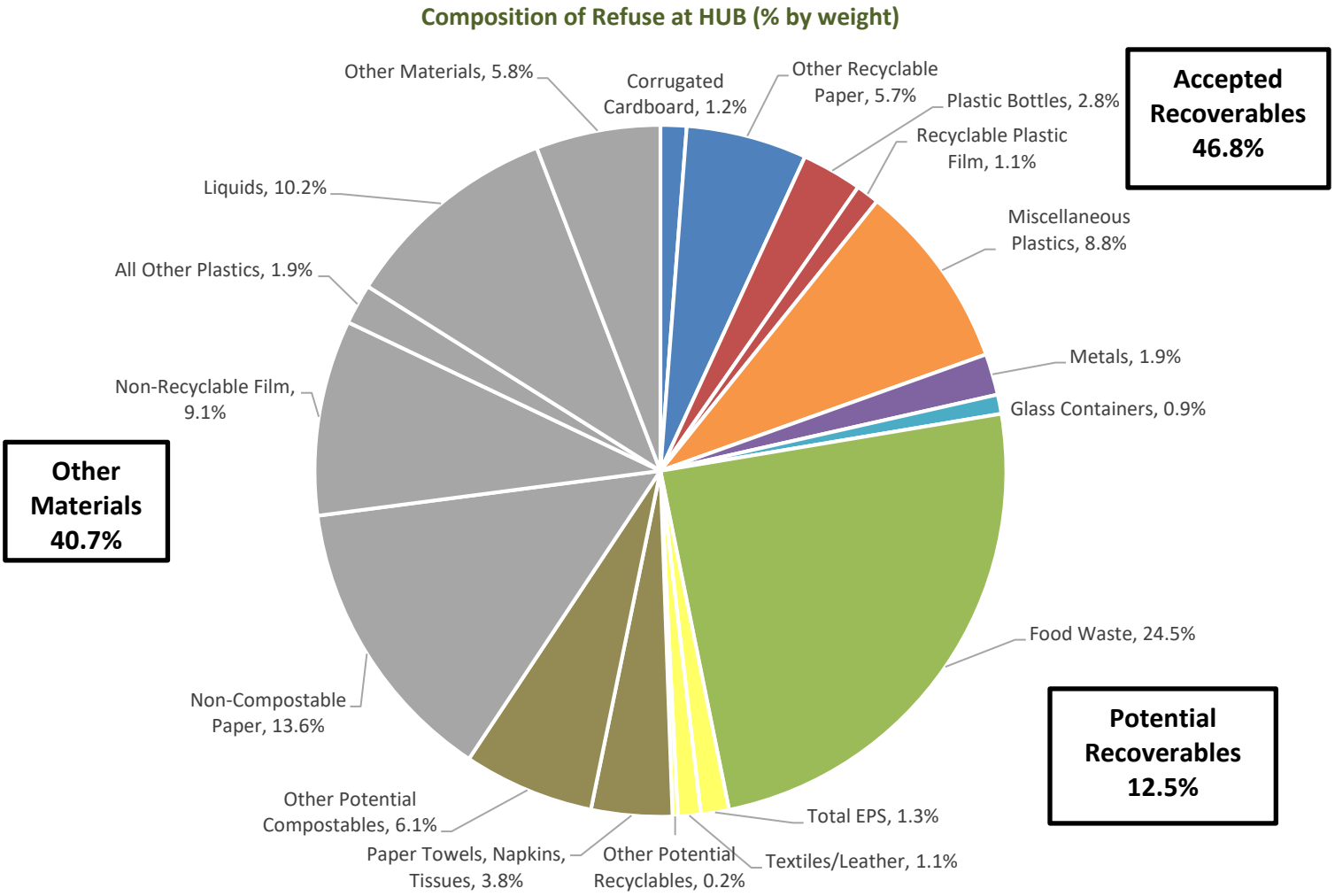
Some key findings from the results for HUB Dining include: *Allocated half of the total square footage to each part of HUB (Student Union and Administrative areas). This Appendix covers to the Administrative areas, i.e. first floor and up.

- About 2,060 pounds of refuse, 610 pounds of recyclables, and 500 pounds of compost were generated from HUB over the week, for **a recycling rate of 35 percent.**
- WCS Results:
  - Over 22 percent of the refuse was accepted recyclables, this was mostly miscellaneous plastics and paper. Nearly 25 percent of the refuse was food waste.
  - Compared to other buildings, HUB's refuse had an exceptionally low percentage of paper towels, napkins, and tissues (4 percent), and had the highest percentage of compostable food containers and cups (6 percent).
  - Non-compostable paper food serviceware and liquids were significant categories of the refuse, at about 14 and 10 percent respectively. Total all other materials comprised over 40 percent.
- Visual Assessment Results:
  - Plastic bottles & film and miscellaneous plastics streams were heavily contaminated. Food contaminated materials and non-recyclable paper were significant contaminants. Each stream also had a fair amount of misplaced materials from the other stream. Paper, metal, and glass were only moderately contaminated.
  - The compost stream was also heavily contaminated (over half), predominantly by non-compostable paper containers & cups and rigid plastics.

Daily Material Generation at HUB

Weight (lbs)	Thu (4/19)	Fri (4/20)	Sat & Sun (4/21 & 4/22)	Mon (4/23)	Tue (4/24)	Wed (4/25)	**Weekly Total**	**% of total weight**
Refuse	292.8	129.6	456.0	349.2	396.4	431.8	**2055.8**	**64.8%**
Paper	39.0	30.3	23.0	36.6	19.7	22.9	**171.6**	**5.4%**
Plastic Bottles	49.5	91.4	29.7	47.2	44.6	32.8	**295.2**	**9.3%**
Misc Plastics	21.6	0.0	2.5	5.0	4.4	15.4	**49.0**	**1.5%**
Metal	3.0	29.5	0.0	14.2	8.8	0.3	**55.8**	**1.8%**
Glass	7.4	0.0	7.4	10.1	0.0	17.9	**42.7**	**1.3%**
Compost	77.6	100.2	132.2	61.7	64.2	64.2	**500.1**	**15.8%**
OCC	0.0	0.0	0.0	0.0	0.4	0.0	**0.4**	**0.0%**
Total	**490.8**	**381.0**	**650.7**	**524.1**	**538.6**	**585.3**	**3170.5**	**100.0%**

Volume (cy)							
Refuse	3.3	0.5	4.2	3.8	4.7	4.7	**21.2**
Paper	0.4	0.2	0.2	0.4	0.2	0.4	**1.8**
Plastic Bottles	0.6	1.1	0.5	0.8	0.9	0.6	**4.5**
Misc Plastics	0.2	0.0	0.0	0.1	0.1	0.4	**0.7**
Metal	0.0	0.4	0.0	0.2	0.1	0.0	**0.7**
Glass	0.0	0.0	0.0	0.1	0.0	0.1	**0.2**
Compost	0.9	0.9	1.4	0.8	0.5	0.9	**5.5**
Total	**5.5**	**3.1**	**6.4**	**6.1**	**6.5**	**7.0**	**34.6**



Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recoverables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- All other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at HUB (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.3%	0.1%	0.5%
Corrugated Cardboard (OCC)	1.2%	0.8%	1.6%
Mixed Recyclable Paper	5.4%	4.1%	6.6%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	6.9%		
PET Bottles (#1)	2.6%	1.3%	4.0%
HDPE Bottles (#2)	0.2%	0.0%	0.4%
Recyclable Plastic Film	1.1%	0.7%	1.4%
Total Plastic Bottles and Film	3.9%		
Non-Bottle Plastics (#1 and #2)	0.6%	0.1%	1.1%
Other Plastic Containers (#3-#7)	3.2%	2.3%	4.1%
Plastic Cups	5.0%	3.6%	6.3%
Total Miscellaneous Plastics	8.8%		
Tin/Steel Cans	0.5%	-0.1%	1.1%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.3%	0.2%	0.4%
Aluminum Foil and Trays	1.1%	0.3%	1.8%
Non-Ferrous Scrap Metals	0.1%	0.0%	0.2%
Total Recyclable Metal	1.9%		
Glass Containers	0.9%	0.5%	1.3%
Food Waste	24.5%	20.1%	28.8%
Aseptic/Polycoated Containers	0.1%	0.0%	0.2%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	1.3%	1.0%	1.6%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.0%	0.0%	0.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	1.1%	-0.2%	2.3%
C&D Debris	0.0%	0.0%	0.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.1%	-0.1%	0.4%
Potential Recyclables	2.6%		
Paper Towels, Napkins, Tissues	3.8%	1.5%	6.0%
Compostable Food Containers and Cups	5.8%	3.2%	8.4%
Yard Waste	0.2%	-0.2%	0.7%
Other Organics	0.0%	0.0%	0.1%
Clean Wood Waste	0.0%	0.0%	0.1%
Potential Compostables	9.9%		
Non-Compostable Paper Food Serviceware	13.6%	11.5%	15.7%
Non-Recyclable Plastic Film	9.1%	7.9%	10.4%
All Other Plastics	1.9%	0.1%	3.7%
Other Glass	0.1%	-0.1%	0.2%
Lab Glass	0.1%	-0.1%	0.2%
Household Batteries	0.0%	0.0%	0.1%
Treated Wood Waste	0.6%	-0.5%	1.7%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.3%	-0.1%	0.7%
All Other Garbage	4.8%	3.0%	6.6%
Liquids	10.2%	3.3%	17.2%
Grit	0.0%	0.0%	0.0%
All Other Materials	40.7%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at HUB (% by volume)

		Paper	Plastic Bottles & Film	Misc. Plastics	Metal	Glass
Target Material		**70%**	**35%**	**45%**	**75%**	**85%**
Misplaced Recyclables	Recyclable Paper					
	Plastic Bottles	<5%		15%		<5%
	Recyclable Film			<5%		
	Misc Plastics	<5%	25%			<5%
	Metal	<5%	<5%			<5%
	Glass Bottles	<5%				
	Total Misplaced Recyclables	**5%**	**25%**	**20%**		**10%**
Contamination	Food-Cont. Target Recyclable	<5%	15%	15%	15%	
	Food-Cont. Non-Target Recyclables		10%	5%		
	Bulky Rigid Plastics					
	All EPS	<5%	<5%	<5%		
	Non-Recyclable Plastic Film	<5%				
	All Other Plastics			<5%		
	Other Glass					
	Non-Recyclable Paper	15%	10%	10%	5%	5%
	Organics		<5%	<5%		
	Aseptic/Polycoated Containers			<5%		
	Liquids					
	All Other Contamination	<5%			<5%	
	Total Contamination	**20%**	**40%**	**40%**	**25%**	**5%**

		Compost
Target Materials		**45%**
Compostable Materials	Loose Food Waste	10%
	Yard Waste	
	Paper Towels, Napkin, Tissue	20%
	Clean Wood Waste	
	Comp. Containers & Cups	10%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	30%
	All Rigid Plastics	15%
	Non-Rigid Plastic Film and Bags	<5%
	All EPS	<5%
	All Metals	<5%
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**55%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact measurements. Columns may not appear to calculate correctly due to rounding. Comp. = Compostable.

HUB Student Union – Dining

Building Facts

Type: Student Union

Year Constructed: 1955

Service Area**:** Area 4

Gross Square Footage**:** 141,234*

Season Audited: Fall 2018

Description: The Hetzel Union Building-Robeson Center, more commonly referred to as the "HUB", is the Penn State student union building. It serves as the main hub for student activities on campus, offering an assortment of dining options, student radio station, recreation room, performance venues, auditoriums, meeting spaces, lounges, art gallery and displays, student organization offices and much more.

*Allocated half of the total square footage to each part of HUB (Student Union and Administrative areas). This Appendix covers to the dining area, i.e. ground floor.

Audit Results

Some key findings from the results for HUB Dining (also referred to as “Hetzel Union Building”, “the HUB” and “HUB Robeson Cultural Center”) include:

- Over 4 tons of refuse, 1400 pounds of recyclables, 2 tons of compost, and 1400 pounds of OCC were generated from HUB Dining over the week, for a **recycling rate of about 44 percent.**
- WCS Results:

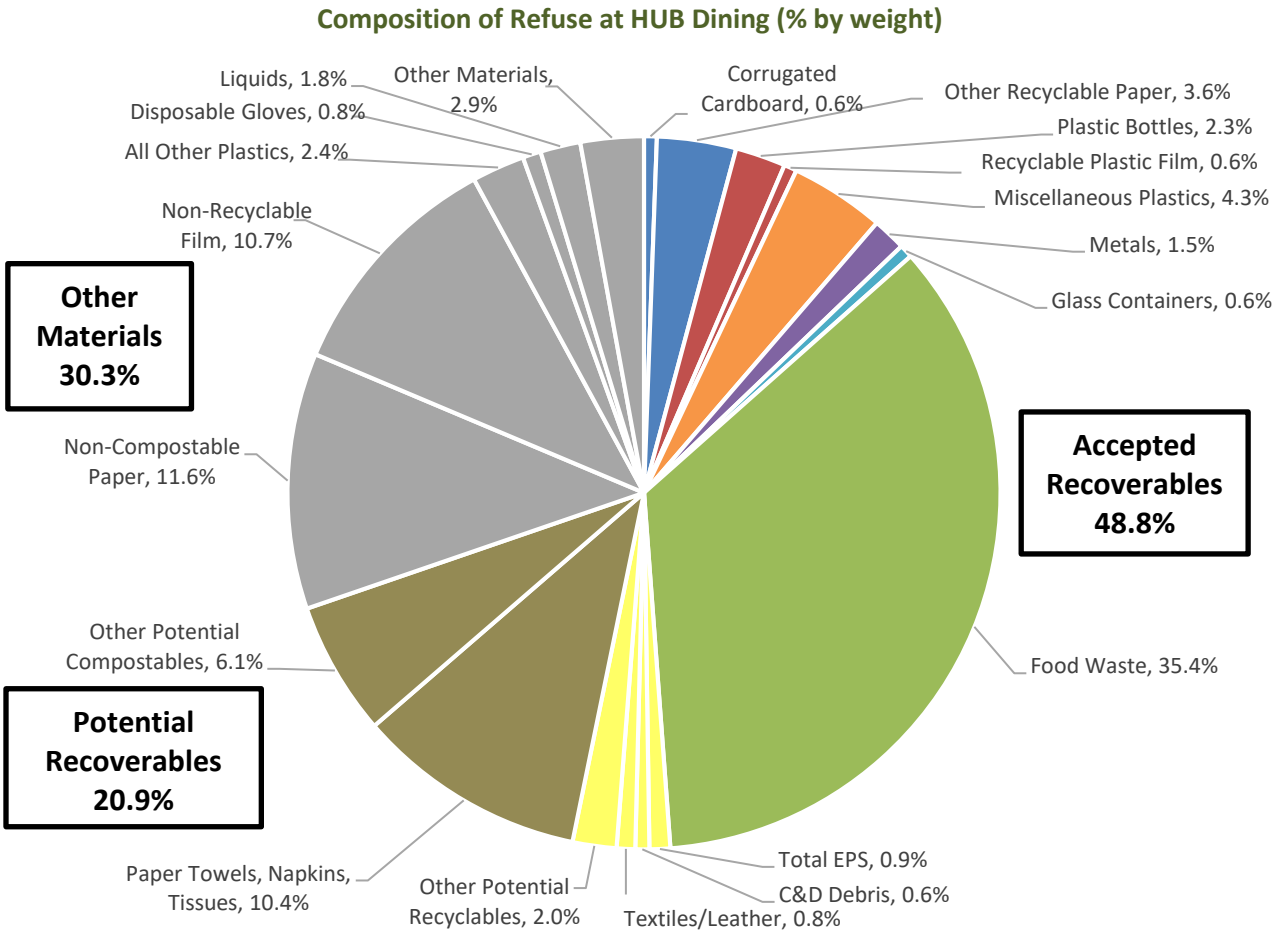
- Nearly 14 percent of the refuse stream were materials that are accepted in the University's recycling stream. Mixed recyclable paper and PET bottles had the highest percentage.
- Over a third of the refuse stream was food waste.
- Over 20 percent of the refuse was potentially recoverable. Paper towels, napkins, and tissues was about half of this, and compostable food containers also contributed a significant percentage.
- Nearly a third of the refuse was non-recoverable materials, mostly non-compostable paper serviceware and non-recyclable plastic film.

- Visual Assessment Results:
  - As a whole, recyclables from HUB Dining were exceptionally more contaminated than from the dining halls. Similar to those, pre-consumer recyclables were fairly clean, but post-consumer recyclables were extremely contaminated and were greater at HUB dining than the dining halls. KCI weighed the pre- and post-consumer plastics separately; post-consumer plastics were 68 percent of the total generation for the week. The glass stream, which was almost all post-consumer, had the lowest percentage of target recyclables. Meanwhile, metal, which was mostly pre-consumer had the highest percentage of target material. One of the most prominent type of contamination in all streams was non-recyclable paper, particular particularly paper cups and other food serviceware.
  - The portion of compostables received at the Bar Pit, which appeared to be post-consumer material, was only about 20 percent of the total weight. This was significantly contaminated, mostly by non-compostable paper products and rigid plastics.
  - The compost observed at the compost facility was both bagged and unbagged. Unbagged material appeared to be mostly clean while the bagged material appeared to be about as contaminated as the material received at the Bar Pit. The volume of bagged material was about the same as at the Bar Pit. It should be noted that some of the bagged compost at the facility was in non-compostable bags.

Daily Material Generation at HUB Dining

Weight (lbs)	Thu (11/8)	Fri-Sun (11/9-11/11)	Mon (11/12)	Tue (11/13)	Wed (11/14)*	**Weekly Total**	**% of total weight**
Refuse	1,565.4	1,934.6	1,908.2	1,537.8	1,670.5	**8,616.5**	**55.1%**
Paper	50.6	19.2	34.8	12.8	32.8	**150.2**	**1.0%**
Recyclable Plastics	147.7	241.6	256.1	143.9	182.6	**971.9**	**6.2%**
Metal	27.1	68.0	35.8	32.5	31.8	**195.2**	**1.2%**
Glass	4.6	28.4	20.3	12.5	12.5	**78.4**	**0.5%**
Compost	746.7	1,291.2	560.5	670.0	945.7	**4,214.1**	**27.0%**
OCC	5.3	311.0	445.7	370.8	273.9	**1,406.7**	**9.0%**
Total	**2,547.5**	**3,894.1**	**3,261.5**	**2,780.2**	**3,149.7**	**15,633.0**	**100%**
Volume (cy)							
Refuse	15.5	17.4	18.8	15.5	16.6	**83.9**	
Paper	0.5	0.5	0.5	0.2	0.4	**1.9**	
Recyclable Plastics	3.4	1.4	4.7	2.8	3.6	**16.0**	
Metal	0.5	0.9	0.6	0.5	0.5	**3.0**	
Glass	<0.1	0.1	0.2	<0.1	0.1	**0.4**	
Compost**	1.9	1.9	2.4	1.4	1.9	**9.4**	
Total	**21.8**	**22.2**	**27.1**	**20.4**	**23.1**	**114.6**	

*Wednesday's material could not be weighed due to weather. These numbers are extrapolated from the other days.
**This volume is only for compost received at the Bar Pit.



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Note: For the purpose of this figure, the following categories have been combined:

- Other recyclable paper includes newspaper, books, and mixed recyclable paper.
- Plastic bottles include PET bottles (#1) and HDPE bottles (#2).
- Miscellaneous plastics include non-bottle plastic containers #1 and #2, other plastic containers #3-#7, and plastic cups.
- Metals include tin/steel cans, ferrous scrap metals, aluminum cans, aluminum foil and trays, and non-ferrous scrap metals.
- Total EPS includes food service EPS and bulk packaging EPS.
- Other potential recyclables include aseptic/polycoated containers, bulky rigid plastics, special wastes, electronics, electronic media, furniture, and tires and rubber.
- Other potential compostables include compostable food containers and cups, yard waste, other organics, and clean wood waste.
- Other materials include other glass, lab glass, household batteries, treated wood waste, small appliances, diapers, all other garbage, and grit.

Composition of Refuse at HUB Dining (% by weight)

Material Categories	Weighted Avg.	90% Confidence Interval Lower Bounds	90% Confidence Interval Upper Bounds
Newspaper	0.1%	-0.1%	0.4%
OCC	0.6%	-0.4%	1.6%
Mixed Recyclable Paper	3.5%	1.4%	5.5%
Books	0.0%	0.0%	0.0%
Total Recyclable Paper	4.2%		
PET Bottles (#1)	2.2%	0.6%	3.7%
HDPE Bottles (#2)	0.1%	-0.2%	0.4%
Recyclable Plastic Film	0.6%	0.3%	0.9%
Total Plastic Bottles and Film	2.9%		
Non-Bottle Plastics (#1 and #2)	1.4%	0.1%	2.6%
Other Plastic Containers (#3-#7)	1.3%	0.4%	2.2%
Plastic Cups	1.6%	1.0%	2.2%
Total Miscellaneous Plastics	4.3%		
Tin/Steel Cans	0.5%	-0.2%	1.1%
Ferrous Scrap Metals	0.0%	0.0%	0.0%
Aluminum Cans	0.1%	0.0%	0.2%
Aluminum Foil and Trays	0.9%	0.3%	1.6%
Non-Ferrous Scrap Metals	0.0%	0.0%	0.0%
Total Recyclable Metal	1.5%		
Glass Containers	0.6%	0.1%	1.1%
Food Waste	35.4%	25.0%	45.7%
Aseptic/Polycoated Containers	1.7%	-0.1%	3.4%
Bulky Rigid Plastics	0.0%	0.0%	0.0%
Food Service EPS	0.9%	0.5%	1.4%
Bulk Packaging EPS	0.0%	0.0%	0.0%
Special Wastes	0.0%	0.0%	0.0%
Electronics (E-waste)	0.3%	-0.4%	1.0%
Electronic Media	0.0%	0.0%	0.0%
Textiles and Leather	0.8%	0.0%	1.6%
C&D Debris	0.6%	-0.7%	2.0%
Furniture	0.0%	0.0%	0.0%
Tires and Rubber	0.0%	0.0%	0.0%
Potential Recyclables	4.4%		
Paper Towels, Napkins, Tissues	10.4%	8.6%	12.3%
Compostable Food Containers and Cups	6.0%	4.7%	7.2%
Yard Waste	0.0%	0.0%	0.0%
Other Organics	0.0%	0.0%	0.0%
Clean Wood Waste	0.1%	0.0%	0.2%
Potential Compostables	16.5%		
Non-Compostable Paper Food Serviceware	11.6%	5.2%	18.0%
Non-Recyclable Plastic Film	10.7%	9.6%	11.9%
All Other Plastics	2.4%	1.4%	3.4%
Other Glass	0.0%	0.0%	0.0%
Lab Glass	0.0%	0.0%	0.0%
Household Batteries	0.0%	0.0%	0.0%
Treated Wood Waste	0.0%	0.0%	0.0%
Small Appliances	0.0%	0.0%	0.0%
Diapers	0.0%	0.0%	0.0%
Disposable Gloves	0.8%	0.1%	1.6%
All Other Garbage	2.9%	0.9%	4.8%
Liquids	1.8%	1.1%	2.6%
Grit	0.0%	0.0%	0.0%
All Other Materials	30.3%		
Total	100.0%		

Note: Columns may not appear to calculate correctly due to rounding.

Composition of Recycling and Compost Streams at HUB Dining (% by volume)

Target Materials		Paper	Recyclable Plastic			Metal	Glass
			Bottles	Film	Misc.		
		50%	**40%**	**10%**	**15%**	**90%**	**45%**
Misplaced Recyclables	Recyclable Paper						
	Plastic Bottles					<5%	10%
	Recyclable Film	5%					<5%
	Misc Plastics					<5%	10%
	Metal	<5%	<5%				<5%
	Glass Bottles						
	Total Misplaced Recyclables	**10%**	**<5%**			**<5%**	**25%**
Contamination	Food-Cont. Target Recyclable	5%	10%			<5%	
	Food-Cont. Non-Target Recyclables						<5%
	Bulky Rigid Plastics	<5%					
	All EPS		<5%				
	Non-Recyclable Plastic Film					<5%	
	All Other Plastics	<5%	<5%				<5%
	Other Glass		<5%				
	Non-Recyclable Paper	30%	10%			<5%	25%
	Organics	<5%	5%				<5%
	Aseptic/Polycoated Containers						
	Liquids						
	All Other Contamination		<5%			<5%	
	Total Contamination	**40%**	**35%**			**10%**	**35%**

Target Materials		Compost*
		50%
Compostable Materials	Loose Food Waste	15%
	Yard Waste	
	Paper Towels, Napkin, Tissue	10%
	Clean Wood Waste	
	Comp. Containers & Cups	20%
	Pizza Boxes	<5%
Contamination	Packaged Food Waste	
	Non-Comp. Paper Containers & Cups	30%
	All Rigid Plastics	15%
	Non-Rigid Plastic Film and Bags	
	All EPS	5%
	All Metals	<5%
	All Glass	
	Liquids	
	All Other Contamination	<5%
	Total Contamination	**55%**

Note: All percentages are average estimates based on visual assessment. Averages are rounded to the nearest 5% because they are not exact.

*These data are only for compost received and assessed at the Bar Pit, which was mostly post-consumer, not material at the compost facility.

Appendix II: Proposed Sustainable Purchasing Policy

ADXX Sustainable Purchasing Policy

Policy Status: Draft

Subject Matter Expert:

Policy Steward: (TBD)

CONTENTS:

- Purpose
- Scope
- Definitions
- Standards
- Policy

PURPOSE:
The Pennsylvania State University is committed to establishing itself as a leader in sustainability. With this policy, we are establishing a sustainable purchasing program that will help to bring sustainability to each facet of the University's operations.
This policy will strengthen and enhance Penn State's Sustainability Strategic Plan and integrate sustainable purchasing decisions at the earliest stages of the lifecycle of the products and services that are purchased for use by the Penn State community.

SCOPE:
Penn State's sustainable purchasing policy will address the environmental, social and economic impacts associated with the University's purchases of goods and services.

Sustainable purchasing shall ensure that the suppliers we use and the products and services that they supply offer value for the money and generate benefits for the University and for the environment, society and the economy.

This policy applies to all individuals responsible for university purchases, regardless of procurement mechanism.

DEFINITIONS:

Circular economy- An *e*conomy that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles.

Conflict materials- natural resources extracted in a conflict zone and sold to finance the fighting. Conflict materials include metals tantalum, tin, tungsten, and gold.

Energy Star- The U.S. Environmental Protection Agency (EPA) requires all ENERGY STAR products to be third-party certified. Products are tested in an EPA-recognized laboratory and reviewed by an EPA-recognized certification body before they can carry the label.

EPEAT standards- The EPEAT program provides independent verification of manufacturers' claims and the EPEAT online Registry lists sustainable products from a broad range of manufacturers. National governments, including the United States, and thousands of private and public institutional purchasers around the world use EPEAT as part of their sustainable procurement decisions.

Ethical behavior- behavior that demonstrates respect for key moral principles including honesty, fairness, equity, diversity and human rights.

Greenhouse gases- atmospheric gases responsible for causing global warming and climate change. The major greenhouse gases are carbon dioxide, methane, and nitrous oxide. Less prevalent, but very powerful, greenhouse gases are hydrofluorocarbons, perfluorocarbons, and Sulphur hexafluoride.

Impact-The impact of a good or service includes the direct and indirect consequences of its production, distribution, use and disposal upon environmental, social and economic sustainability.

Key performance indicator (KPI)- demonstrates how effectively the University is achieving success according to objectives; helps evaluate various functions and processes important to achieving goals.

Life cycle- consecutive and interlinked stages of a goods or services system, from "cradle to grave", e.g. from resource generation and raw material acquisition through production, use and final disposal.

Life cycle costing- method for calculating the costs of goods or services throughout their life cycle. It includes total cost of ownership and positive or externalities which can be monetized to the University.

Material impact- Refers to the relative significance or importance of a specific environmental, social and or economic impact.

Sustainability criteria- requirements pertaining to the sustainable quality of a product and its sustainable production, which must be fulfilled in order to acquire a sustainability status or certification.

Sustainable performance-refers to the extent to which a product, service, or supplier supports the natural, social and economic systems on which we depend.

Sustainable purchasing- means making sure that the University's suppliers and the products and services they supply deliver value for the money and generate benefits not only for the University, but also for the environment, society and economy.

Sustainable purchasing program- the set of activities undertaken by the University to implement sustainable purchasing, whether unified as a centrally managed program or policy or decentralized as a collection of potentially uncoordinated programs or policies.

Sustainability spend analysis- a process for identifying: 1) sustainability-related risks and opportunities across the University's overall portfolio of spending; and 2) priorities for action based on the relative significance of spend categories, suppliers, regions of origin, or other factors.

Sustainably sourced wood- wood that is Forest Stewardship Council (FSC) certified, recycled, savage, or from an ecological restoration forestry project.

Supplier diversity- sourcing from businesses that are owned or operated by individuals who belong to groups that have historically faced barriers to employment and/or economic opportunity. These may include businesses that are owned or operated by women, minorities, veterans and LGBT individuals or have been historically disadvantaged in the marketplace for other reasons. Supplier diversity has many benefits including customer satisfaction, cost savings, community relations and investor relations.

Total cost of ownership (TCO)- a financial estimate intended to help buyers and owners determine the direct and indirect costs of a product or system over the lifetime of its use and disposal.

Value for money- the optimum combination of whole life costs and quality. Factors considered in defining value for money include quality, fitness for purpose, total cost of ownership, risk, sustainability issues and the factors relating to the University's overall goals.

STANDARDS

The University shall utilize available standards to determine whether the products and services offered by its various Suppliers are sustainable. A product which is manufactured, harvested, or sold by a company will have to meet certain accepted standards and criteria. These criteria, often robust and impartial, are the way this product is "judged", which usually indicate that the product is socially responsible, has minimal environmental impact, and is financially beneficial for all those involved. These standards and criteria are usually determined by an organization,

sometimes an industry trade group, or international organization, in order to compare products across regions in an equal manner. Standards will be outlined in greater detail in the Sustainability Guidelines.

Several key tenets of a sustainability standard:

Independent - Typically these standards (or ratings, indices, etc.) are developed by either an independent third-party group (such as an NGO, for example), or some form of industry and third-party group collaboration. While involving industry might seem to taint the process, it's unlikely that outside parties will have the inside industry knowledge to set applicable guidelines and expectations.

Standards Based - There's usually some form of guidelines or standards to be met in order to qualify, or some baseline score to achieve, in order to obtain the certification. This prevents spurious claims by companies looking to out-do their competition.

Verifiable - Conformance to the standards can, and usually are, available for verification. The best certifications require robust third-party certification by credible, independent auditing agencies. Think ISO third party verification.

Voluntary - These are not required or mandated - yet.

Little or No Government Regulatory Requirements - While government participation may be present in some cases (such as USEPA Energy Star), normally these standards don't involve the government. They are market driven, making them far more adaptable and flexible than might normally be expected from the cumbersome regulatory process.

Additional criteria may be applied to Sustainability Standards to ensure that University purchases support social and economic sustainability. Adoption of recognized labor standards that mandate child labor avoidance, permit freedom of association, seek collective bargaining, ensure regular hours of work and overtime pay laws are observed, prohibit discrimination and pay the prevailing wage for the country of production or observe living wage minimum wage or laws. Inclusion of Small Business Administration Agency (SBA) certified small businesses and Women, Minority and Veteran Owned businesses in the RFP and RFQ process will also act to achieve social and economic sustainability objectives.

POLICY

The Director of Procurement Services, to include agencies with limited purchasing authority, shall engage with other University departments to identify areas of opportunity to make sustainable purchasing decisions by selecting Suppliers and products that meet recognized Sustainability Certifications and Standards, where they exist, and set minimum mandatory requirements of sustainably sourced products. *(e.g. percentage of recycled copy paper or paper office supplies, Energy Star certification, textile certifications, etc.)* This process shall become part of the RFP and RFQ selection criteria and prospective suppliers shall be asked to identify any certifications that they have been awarded and include information on packaging and

transportation. Sustainability certifications/standards shall become a part of a supplier's overall score as part of the RFP evaluation criteria.

The University reserves the right to ask for documentation from any supplier if enough evidence is presented that the supplier is in violation of this policy. The University also reserves the right to sever all dealings with any supplier in violation of this policy.

Purchasing departmental staff will identify products and sources for products covered by this policy. This policy does not impede or impinge the requirements for competitive bidding or solicitation of such products and the appropriate and required documentation for these transactions.

Sustainable Purchasing Guidelines shall be developed and updated to provide guidance in each commodity purchased by the University including building materials, paper goods, cleaning chemicals, furniture and carpeting, clothing and uniforms, equipment and electronics, and classroom teaching materials. The Sustainable Operations Committee (SOC) shall review and approve these Guidelines annually.

Appendix III: Proposed Sustainable Purchasing Policy Guidelines Draft

Product or Service Category	**Recognized Certifications and Standards**	**Required Level** (minimum mandatory requirements)	**Preferred Level**
Electronics/Appliances	ENERGY STAR ® EPEAT	ENERGY STAR ® EPEAT Bronze	ENERGY STAR ® EPEAT Gold
Cleaning Supplies	Green Seal UL Ecologo EPA Safer Choice FSC (for janitorial paper products)	A minimum of 25% of purchases are certified by one of the recognized certifications	At least 75% of purchases are certified by of the recognized certifications
Office Supplies			
Copy Paper	FSC Recycled Post-consumer recycled content (PCRC) Processed Chlorine Free (PCF)2 Green Seal (GS-07) Agricultural residue3 content	A minimum of 30% PCRC or agricultural residue content (or GS-07 certified)	100% PCRC or agricultural residue content, or FSC Recycled labelled, with additional preference for paper that is PCF
Paper Office Supplies (other than copy paper)	FSC - Chain of Custody Sustainable Forestry Initiative (SFI) Post consumer recycled content (PCRC)	A minimum of 30% PCRC4	100% recycled content with minimum 50% PCRC; 90% PCRC wire components; water-based or plant-based adhesives; and additional preference for PCF, FSC,

	Total recycled content Processed Chlorine Free (PCF) Green Seal (GS-07)		and/or SFI labelled products5

Product or Service Category	**Recognized Certifications and Standards**	**Required Level** (minimum mandatory requirements)	**Preferred Level**
Non-paper Office Supplies	Post-consumer recycled content (PCRC) Total recycled content Non-antimicrobial EPA Comprehensive Procurement Guidelines (CPG) Northeast Recycling Council (NERC) Model EPP Specifications and Purchasing Guidelines for Office Supplies	Meets the minimum CPG recycled-content levels for Non-Paper Office Products, and a minimum 30% recycled content for all writing utensils (dry- erase markers, highlighters, markers, pens, and pencils) or other plastic-based accessories	Meets the recycled content specifications in the Preferred EPP Specifications as listed by the Northeast Recycling Council (NERC), and free of antimicrobial coatings
Toner	Remanufactured High yield	Meets one of the recognized standards	Meets both recognized standards
Indoor Furniture	GREENGUARD Gold SCS Indoor Advantage Gold Cradle to Cradle (C2C) BIFMA Level	Must meet all the following: ● GREENGUARD Gold or SCS Indoor Advantage Gold	Must have at least one of the following additional certifications: ● BIFMA Level certified

	Meets the Healthier Hospitals Initiative (HHI) Safer Chemicals Challenge and is listed on the Healthier Hospitals Healthy Interiors Goal website FSC (for products containing wood) Textile certifications: ● GOTS ● Standard 100 by Oeko-Tex ● STeP by Oeko-Tex ● Cradle to Cradle Facts Health Product Declaration (HPD) Declare Label	● Free of the 6 classes of chemicals of concern	(preference for 2 or 3) ● C2C Certified (preference for Silver or Gold) ● HHI compliant with published product list on their website ● FSC Certified wood ● Textiles certified by one of the recognized certifications ● Complete HPD ● Complete Declare label
Product or Service Category	**Recognized Certifications and Standards**	**Required Level** (minimum mandatory requirements)	**Preferred Level**
Compostable Food Service Ware	Biodegradable Products Institute (BPI) Green Seal GS-35 Cedar Grove Accepted Items List for Commercial Composability	Certified Compostable by BPI or GS-35, or made 100% from uncoated, unlined, obviously plant-based material, and appears on the Cedar Grove Accepted Items List	Meets additional criteria as described in the Compostable Food Service Ware section below
Water Appliances/Fixtures	WaterSense®	WaterSense® Certified	WaterSense® Certified
Building Materials Paint Carpet and Floor Coverings	*Input from subject matter experts and PSU Waste Stream Task Force sought on appropriate*		

Ceiling Tile Adhesives	*standards or certifications*		
Vehicles Light Duty Motor Vehicles Passenger Agricultural	*Input from subject matter experts and PSU Waste Stream Task Force sought on appropriate standards or certifications*		
Freight and Delivery	*Input from subject matter experts and PSU Waste Stream Task Force sought on appropriate standards or certifications*		
Packaging	*Input from subject matter experts and PSU Waste Stream Task Force sought on appropriate standards or certifications*		
Product or Service Category	**Recognized Certifications and Standards**	**Required Level (minimum mandatory requirements)**	**Preferred Level**
Lighting	*Input from subject matter experts and PSU Waste Stream Task Force sought on appropriate standards or certifications*	LED? Per AD64	LED?
Landscaping/Agricultural Supplies and Equipment			
Laboratory and Medical Supplies			

POLICY CROSS REFERENCES:
BS07 Authority and Procurement
BS09 Initiating Purchases from Vendors Outside the University
BS18 Procurement or Acquisition of Light-Duty Motor Vehicles

Appendix IV: Proposed Sustainable Procurement Program Coordinator Position Draft

Sustainable Procurement Program Coordinator

This position exists to support both the University as a whole, and individual campuses in developing, measuring, and achieving a broad spectrum of sustainable procurement goals. This position will identify sustainable opportunities that intersect with procurement and help to promote, integrate, and advance sustainability throughout the University's procurement process. These opportunities include, but are not necessarily limited to, product and service selection and usage, life cycle cost analysis, awareness campaigns, participation in appropriate sustainability organizations and conferences, identification of critical supplier partnerships, and building relationships with key University and supplier stakeholders. This position will also have ownership of outfacing sustainability activities and awareness, including website content, scheduled communication, and direction of enterprise wide sustainable procurement meetings and objectives. This position will assist in establishing and monitoring a strategic approach to product usage and product catalog content. Success in this position will be heavily dependent on identifying those opportunities and relationships which will enhance overall sustainability goals. The Sustainable Procurement Program Coordinator will work with all purchasing units to facilitate these goals, as well as campus and supplier entities. This position reports to the Director of Procurement Services.

Duties and Responsibilities:

Duties and responsibilities of the position include, but are not limited to:

50% - **Procurement Services and University Engagement:**

- Develop a roadmap of procurement related sustainability initiatives.
- Collaborate with internal procurement stakeholders in implementing sustainability initiatives.
- Collaborate with external stakeholders to include members from the Sustainability Institute in identifying and implementing viable sustainability initiatives for the entire University.
- Maintain current knowledge of applicable sustainability laws, regulations, products, programs, and best practices and ensure that information is distributed appropriately to stakeholders.
- Provide input on new sourcing events to ensure sustainable practices are considered and followed in all events.
- Prioritize and organize campus outreach events, end-user engagement surveys, communication with stakeholders, and website content related to sustainability.

- Measure and report progress for sustainability initiatives.
- Respond to sustainability requests from Procurement Services customers.
- Provide input to department business plans and initiatives to ensure continuous achievement of department goals as it relates to commitment to sustainable practices.
- Act as primary point of contact and resource for sustainability procurement policies and practices.

25% - **Supplier Engagement:**

- Create meaningful sustainability supplier partnerships by building upon existing and new supplier relationships to insure product selection, price point, sustainable product attributes, and catalog functionality are all aligned with overall sustainability goals.
- Works with key suppliers to ensure their supply chain also meets our goals, i.e. packaging and logistic activities.
- Support supplier events/shows on the campuses as appropriate.

15% - **Measuring Success:**

- Create meaningful measurements and success indicators for the program, including assisting campuses with their reporting requirements as appropriate.

10% - **Special Projects:**

- Execute other projects as assigned which support the mission of Procurement Services.
- Identify and adapt sustainability best practices.
- Keep the administration advised of changes in laws/regulations that may affect policies, require the implementation of new policies, or affect operating budgets.

Knowledge, Skills, and Abilities:

To be successful in this position, candidates will need the following:

- Knowledge of sustainability best practices.
- Knowledge of proven negotiation methods and the ability to critically analyze a negotiation.
- Knowledge of purchasing processes and best practices.
- Skilled in data management tools and reporting.
- Proficiency with the Microsoft Office suite.
- Ability and skill to manage projects from inception to completion.
- Excellent written and oral communications skills.
- Ability to work with multiple internal and external stakeholders.
- Ability to work independently in a fast-paced environment, manage multiple concurrent tasks, meet critical deadlines, and effectively manage changing priorities.
- Organizational skills, including meeting facilitation and critical decision-making.

Appendix V: Proposed Waste Reduction and Recycling Program Manager Position Draft

Waste Reduction and Recycling Program Manager
Recommended Job Profile: Facilities Manager 2 or 3 (this is tbd)

Position Summary
This position will have overall responsibility for waste reduction and recycling at University Park. The position will provide direction and guidance to operational and academic units to implement strategies, educational and outreach initiatives and programs to reduce waste and increase recycling activities on campus furthering Penn State's sustainability goals. This position will reside in the Office of Physical Plant (OPP) and work with key stakeholders internal and external to the University such as the Sustainability Institute (SI), Procurement Services, Lion Surplus, Facilities Coordinators, facility managers and building coordinators, Eco Reps, Environmental Health and Safety (EHS), Centre County Recycling and Refuse Authority (CCRRA), and other state and local governmental and municipal authorities and agencies.

Duties and Responsibilities

- Work with OPP personnel and other departments to develop and implement programs and processes to collect and remove all recycled materials from University buildings and property.
- Establish goals with OPP leadership, the Sustainable Operations Council (SOC), and SI annually for waste reduction and recycling efforts and submit an annual report.
- Develop and conduct ongoing waste reduction and recycling educational campaigns for all audiences, including students, faculty, staff, and visitors. Work collaboratively with Procurement Services to reduce waste and increase recycling by implementing and promoting sustainable procurement strategies and policies.
- Promote the support of and participation in waste reduction and recycling programs by University departments, faculty, students and staff.
- Responsible for maintaining and enforcing design and operational standards for collection processes, containers, equipment, and storage areas inside and outside of campus buildings.
- Collaborate with SI to enhance waste reduction and recycling efforts among student, faculty and staff.
- Maintain all records that are essential for financial and informational reports.
- Work closely within OPP and other stakeholders to coordinate waste reduction, refuse collection and recycling efforts.
- Represent the University at public forums, discussions, and negotiations with various governmental agencies and community groups.

- Develop and implement methods to measure success of reduction and recycling efforts at the building and departmental level and provide feedback to customers to improve waste reduction and recycling efforts.
- Work with the Centre County Recycling and Refuse Authority, EHS, OPP, and others to develop and implement waste reduction and recycling programs that comply with all relevant local, state, and federal ordinances, laws, and requirements.
- Manage budget effectively.
- Other duties as assigned.

Educational Requirements

Bachelor's degree with master's preferred in environmental science, engineering, urban planning, business, or another related field.

Experience

Should have a minimum of four years' experience in community engagement and outreach programs related to sustainability and waste minimization, solid waste management, and recycling programs.

Skills

- Experience with Microsoft Office suite with the ability to organize information, extract relevant data for preparing reports and communications.
- Skill in planning and implementing sustainability focused practices. Ability to define program goals and objectives, implement effective practices, target campus audiences, and develop and deliver successful education and outreach strategies to expand campus involvement in a collaborative, but results-driven manner.
- Ability to build collaborative relationships and business partnerships working passionately with diverse populations at all levels of the organization, including students, staff and faculty.
- Strong verbal and written interpersonal communication skills, including active listening, flexibility, and critical thinking. Experience communicating verbally, in writing, and using various social media platforms.
- Ability to multitask, meet deadlines, work with accuracy and ensure effective time management. Experience to work productively in a high volume, multiple demand, environment.

Appendix VI: Survey of Waste Reduction and Materials Management Practices at Penn State Commonwealth Campuses

Penn State Waste Stream Management Task Force

Survey of Waste Reduction and Materials Management Practices at Penn State Commonwealth Campuses:

Summary Report

by

Nathan Elser

Ph.D. Candidate, Biorenewable Systems
Department of Agricultural and Biological Engineering

Fall 2018

Contents

[1] Summary of campus waste management updates presented at Regional Sustainability Forums in May 2019, compiled by Danielle Malpeli. Added as Appendix D in June 2019.

1. Introduction

In support of the Waste Stream Management Task Force's charge of creating goals and/or principals to guide University decisions related to solid waste management, an online survey was developed to gather information about current practices at the Commonwealth campuses. The survey was intended help taskforce members better understand the complexities and individual challenges of managing waste across the University system.

Prior to developing the survey, initial efforts to research waste management practices at the Commonwealth campuses led to the conclusion that there is currently no central source for much of this information. Therefore, a secondary purpose for administering the survey was to collect information on waste management practices in a standardized format that could potentially serve as a baseline for future inquires.

The survey was developed by Nathan Elser in consultation with Phil Melnick, Lydia Vandenbergh, and Dr. Judd Michael. Topics addressed in the survey included waste collection and transportation, recycling streams and accepted materials, composting, common practices for reducing waste, barriers to and opportunities for reducing waste, and the University's role in supporting waste reduction efforts at the Commonwealth campuses. The online survey was administered to the Director of Business Services at each campus in mid-August, 2018. Respondents representing 20 of the Penn State Commonwealth campuses completed the survey.

Key findings include:

- About half (*n*=11) of campuses employ single stream recycling for collecting standard recyclables in common areas (six use multi-stream, three use dual stream).
- 70% (*n*=14) of campuses report having Custodial services/Housekeeping collect solid waste from individual trash receptacles located in private offices and rooms. Six campuses report having faculty/staff sort and dispose of their own waste in separate receptacles located in common areas of buildings.
- Only one campus reported having a formal collection program for organic/compostable materials (ex. food scraps, kitchen waste, paper napkins, landscaping debris, animal bedding, etc.) available to campus users (i.e., students, staff, faculty, visitors).
    - Five campuses did report having such programs available to campus operations (ex. grounds maintenance, food services, event planning). Of these, four indicated they compost landscaping debris and three indicated they compost back of the house kitchen waste.
- The most frequently cited barrier to advancing waste reduction efforts on campus was financial and/or human resources constraints (*n* = 8, accounting for approximately 50% of responses).
- Among those campuses providing a response, about 60% noted Housing and/or Food Services as an area of opportunity for waste reduction (*n* = 8).

2. Survey Methodology

The identified target population for the survey was the Director of Business Service or equivalent title at each campus (see Appendix 1 for respondent list). The initial survey invitation was emailed early morning on Friday, August 10th (sent from PSU_WasteTaskForce@qualtrics-survey.com) with a requested completion date of Friday, August 24th. A follow-up email was then sent Thursday, August 16th, to those who hadn't yet responded (from my personal address, nce5000@psu.edu). A third email reminder was sent on Thursday, August 23rd (from Lydia Vandenbergh, lbv10@psu.edu). Representatives of 18 campuses completed the survey by the requested deadline. Final attempts to reach the contacts of the remaining campuses were made the following week. Ultimately respondents from 20 of the 22 campuses completed the online survey[1].

The survey structure included nine blocks of items representing different topics/item types. The core of the survey consisted of ten multiple choice items and six open-ended items. Each block also included a text box allowing for notes or comments relating to the respective topic. The survey was expected to require 10-15 minutes to complete, though some respondents took considerably more time as they provided more in-depth responses to the open-ended items.

Respondent Campuses
Abington
Altoona
Beaver
Berks
Brandywine
Dickinson School of Law
DuBois
Erie
Fayette
Great Valley
Greater Allegheny
Harrisburg
Hazleton
Lehigh Valley
Mont Alto
Schuylkill
Shenango
Wilkes-Barre
Worthington Scranton
York

3. Results

3.1 Collection and Hauling of Solid Wastes

All campuses report utilizing private companies for transporting solid waste away from campus (as opposed to county/municipal haulers). At least a third of responding campuses noted contracting Waste Management for these services. Since the survey did not include any items that explicitly asked what company manages waste transport, it is very likely that the proportion of campuses contracting with Waste Management is much higher. As noted in the comments below, some campuses (ex., Fayette) may have only one or two providers to choose from for waste hauling services.

Most campuses report having custodial services manage the collection of all solid waste in both the common areas and office spaces of buildings on campus (n=14, 70%). Six campuses reported having faculty/staff separate and/or dispose of their own recyclables in receptacles located in common areas of buildings.

[1] Non-responding campuses were Hershey College of Medicine and New Kensington (see Appendix A for more information.

About half of the responding campuses report using single stream recycling for collecting standard recyclables (*n*=11, 55%). Three campuses reported using duel stream, where paper/cardboard products are separated from plastics, glass, and metals (15%). The remaining six campuses reported using multiple streams that further separate different types of materials (30%). It is worth noting that of the six campuses in which faculty/staff separate their own recyclable materials, five utilize single stream recycling.

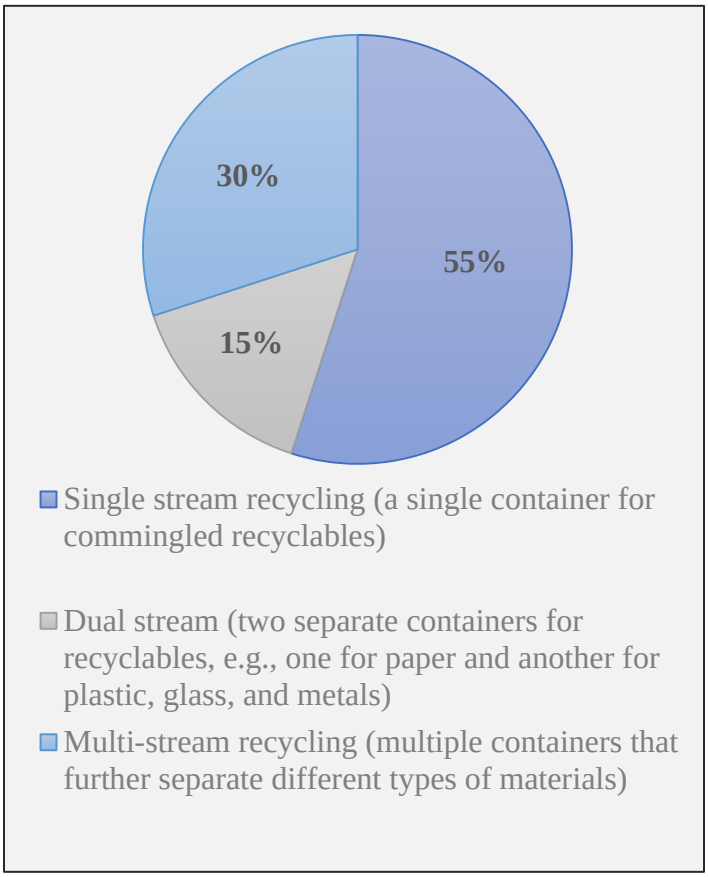
Which of the following methods does your campus primarily employ for collecting standard recyclables (i.e., paper, plastic, glass, metals) in common areas?

Campus [a]	Recycling Method
Harrisburg	Multi-stream *
Erie	Single stream *
Abington	Single stream
Altoona	Dual stream
Berks	Single stream *
Brandywine	Multi-stream
Worthington Scranton	Single stream *
York	Single stream
Lehigh Valley	Single stream
Mont Alto	Single stream
Hazleton	Single stream
Schuylkill	Single stream
Beaver	Dual stream
Fayette	Multi-stream
DuBois	Multi-stream
Greater Allegheny	Dual stream
Shenango	Multi-stream
Wilkes-Barre	Single stream *
Great Valley	Single stream *
Dickinson School of Law	Multi-stream

[a] Campus list organized from largest to smallest, based on total enrollments in Fall 2017

* Campuses known to contract with Waste Management

Yellow background: Denotes campuses where faculty/staff separate and/or dispose of own recyclables

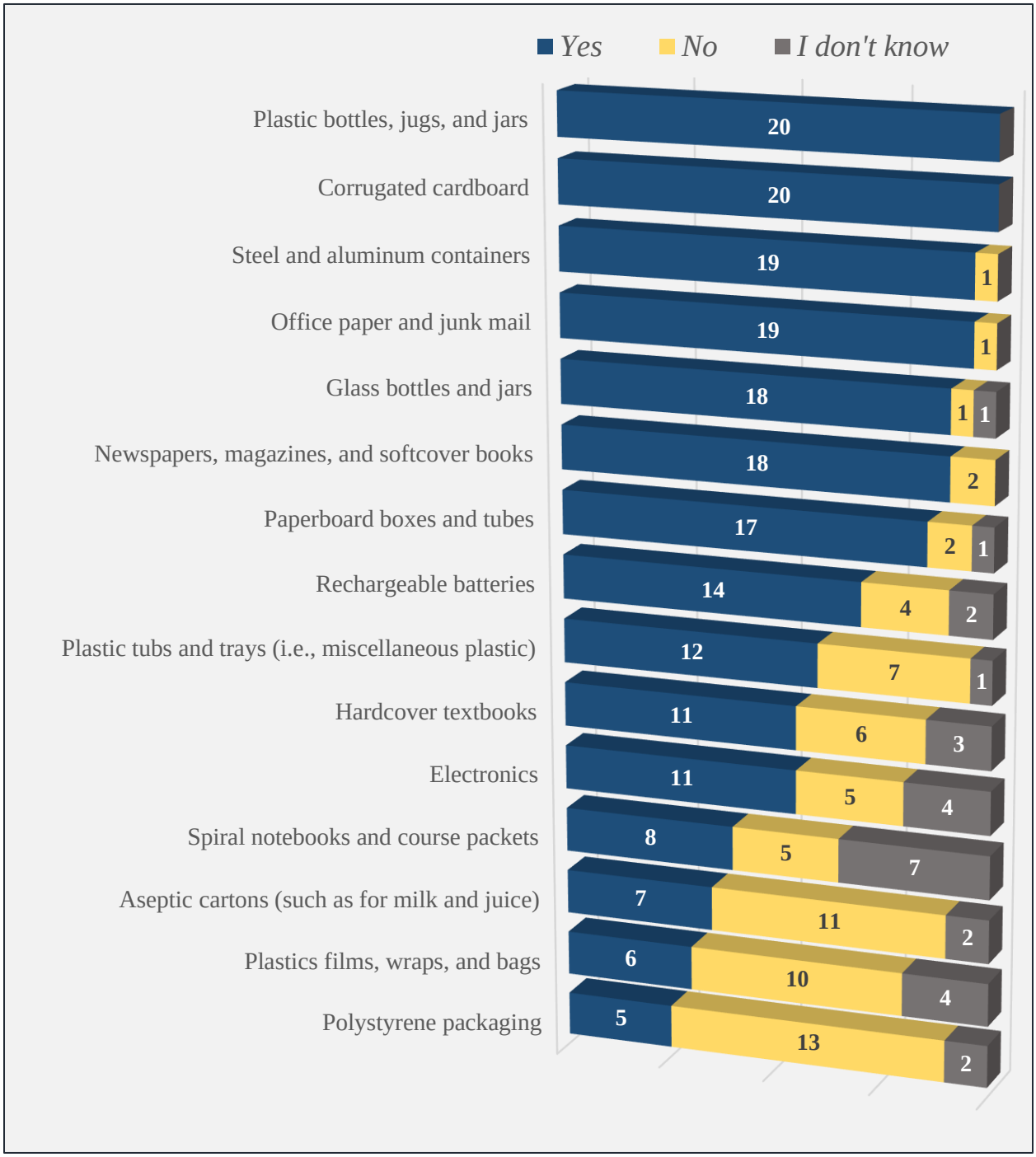


Comments Related to Waste Hauling and Recycling
"Advance Disposal serves the campus and is the only hauler for North Union Township residents; Goodwill provides recycling bins on the campus to collect glass, cardboard, plastic, aluminum. They empty containers bi-weekly. There is no charge for this service." – *Jason Bush, Fayette*
"Recycling with Waste Management has migrated to the big 4 which eliminates paper and non corrugated cardboard, thus reducing the number of streams and increasing our tonnage for trash." – *Chuck Garber, Harrisburg*

3.2 Materials Collected for Recycling

Respondents were asked about the availability of recycling on their campuses for 15 commonly recycled materials. The chart below presents results from these items, with materials listed by frequency of "yes" responses. The table on the following page provides the full responses from each campus for all materials, as well as related comments.

Which of the following commonly recycled materials are widely collected on your campus?



Campus [a]	Recyclable Materials Categories (*see key below*)														
	A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***K***	***L***	***M***	***N***	***O***
Harrisburg [1]															
Erie [2]															
Abington															
Altoona															
Berks															
Brandywine															
Worthington Scranton [3]															
York															
Lehigh Valley [4]															
Mont Alto															
Hazleton [5]															
Schuylkill															
Beaver															
Fayette [6]															
DuBois															
Greater Allegheny															
Shenango															
Wilkes-Barre															
Great Valley [7]															
Dickinson School of Law															
% Yes	*100*	*100*	*95*	*95*	*90*	*90*	*85*	*70*	*60*	*55*	*55*	*40*	*35*	*30*	*25*

[a] Campus list organized from largest to smallest, based on total enrollments in Fall 2017

Blue Cells = *Yes*	Yellow Cells = *No*	Gray Cells = *I don't know*
A Plastic bottles, jugs, and jars	**F** Newspapers, magazines, and softcover books	**K** Electronics
B Corrugated cardboard	**G** Paperboard boxes and tubes	**L** Spiral Notebooks and course packets
C Steel and aluminum containers	**H** Rechargeable batteries	**M** Aseptic cartons (such as for milk and juice)
D Office paper and junk mail	**I** Plastic tubs and trays (i.e., misc. plastic)	**N** Plastics films, wraps, and bags
E Glass bottles and jars	**J** Hardcover textbooks	**O** Polystyrene packaging

Comments Related to Materials Collected for Recycling (*numbers refer to campus response in table above*)

1	"This represents the most recent changes implemented by Waste Management" – *Chuck Garber, Harrisburg*
2	"Office paper is collected, junk mail is not. Electronics are collected once yearly and shipped to University Park for recycling. Spiral notebooks can be collected if the plastic spiral is removed. Departments are directed to send their own rechargeable batteries to be recycled" – *Randy Geering, Erie*
3	"Our textbooks are taken by the truckload to a local recycler at no cost or reimbursement to the campus. Remaining items are hauled by Waste Management." – *Gene Grogan, Worthington Scranton*
4	"Electronics are sent to Surplus and Salvage" – *Helene Miksitz, Lehigh Valley*
5	"Does not include Housing and Food Services" – *Michael Morrison, Hazleton*
6	"Batteries are processed thru EH&S Hazardous Waste" – *Jason Bush, Fayette*
7	"We recycle batteries, but not through Waste Management. We offer once a year recycling on campus for electronics, etc., but again not through Waste Management" – *Maria Zuccato, Great Valley*

3.3 Composting

Participants were also asked about the availability of composting programs for campus users (i.e., students, staff, faculty, visitors) and campus operations (ex. grounds maintenance, food services, event planning). These items asked about the existence of a "formal collection program" for organic waste. This wording was chosen so that informal, small-scale composting efforts, such as what might occur among a small group of employees in a particular department or unit, would be excluded[2].

Only Penn State Shenango reported having a formal collection program for organic waste available to campus users (*i.e.*, students, staff, faculty, visitors). Five campuses (Shenango, Harrisburg, Erie, Schuykill, and Abington) reported having formal collection programs available to campus operations. Of those campuses, all but Shenango reported widely collecting landscaping debris for composting. Shenango, Erie, and Abington reported collecting back of the house kitchen waste (see table below). All but Abington indicated having a composting operation located on campus property.[3]

[2] Penn State Beaver reported having a very small-scale pilot composting program organized by the campus green team (see comments on following page).

[3] Penn State Worthington Scranton commented that landscaping debris are deposited in a wooded area of campus, though did not report having a formal collection program or composting operation on campus (see comments on following page).

Campus	*Does your campus have a formal collection program for organic/compostable materials (ex. food scraps, kitchen waste, paper napkins, landscaping debris, animal bedding, etc.) available to:*		*Which of the following materials generated from campus operations are widely collected for composting?*			*Is there a composting operation located on your campus?*
	Campus users[a]	**Campus operations**[b]	**Landscaping debris**	**Back of the house kitchen waste**	**Animal bedding and/or manure**	
Shenango	Yes	Yes		X		Yes
Harrisburg	No	Yes	X			Yes
Erie	No	Yes	X	X		Yes
Schuylkill	No	Yes	X			Yes
Abington	*nr*	Yes	X	X		No
Altoona	No	No				
Berks	No	No				
Brandywine	No	No				
Worthington Scranton	No	No				
York	No	No				
Lehigh Valley	No	No				
Mont Alto	No	No				
Hazleton	No	No				
Beaver	No	No				
Fayette	No	No				
DuBois	No	No				
Greater Allegheny	No	No				
Wilkes-Barre	No	No				
Great Valley	No	No				
Dickinson School of Law	No	No				

Comments Related to Composting

"It is a small operation run by Greener Behrend with cooperation from Food Service and Maintenance"
- *Randy Geering, Erie*

"Campus yard waste, brush, leaves, etc., are deposited at lower end of campus in a wooded area"
- *Gene Grogan, Worthington Scranton*

"We began a very small organic compost as a trial run primarily organized by our green team. Our sustainability coordinator is now looking into a larger compost in conjunction with Housing and Food Services" - *Adam Rathbun, Beaver*

"Not enough volume to warrant collection of these materials"
– *Jason Bush, Fayette*

[a] i.e., students, staff, faculty, visitors; [b] ex. grounds maintenance, food services, event planning; *nr* = no response

3.4 Waste Diversion

Participants were asked if their campus measures the amount of waste diverted from landfill (i.e., materials recycled, composted, donated). Only two of the 20 responding campuses (10%) reported tracking waste diversion metrics: Worthington Scranton, which reported that its most recent landfill diversion rate was 12%; and Berks, which reported its most recent rate at 15%. Two other campuses noted that their waste haulers have this information available (see comments below)[4].

Comments Related to Measures of Waste Diversion
"The campus does not measure this, but our provider does" – *Anne Miller, Mont Alto*
"The above % does not include textbook tonnage nor scrap metal taken to recyclers, nor yard waste. This amount represents solid vs. single stream recyclable materials" - *Gene Grogan, Worthington Scranton*
"We measure this only for construction projects through OPP" – *Maria Zuccato, Great Valley*
"Waste Management is our trash/recycling hauler and has that information which they can provide" - *Randy Geering, Erie*
"Goodwill does not provide this data to my knowledge" – *Jason Bush, Fayette*

3.5 Waste Reduction Practices

The final section of multiple choice items focused on best practices for reducing solid waste in higher education institutions. These practices were identified through review of applicable literature, sustainability websites of leading universities, as well as institutional reports submitted to the Association for the Advancement of Sustainability in Higher Education (AASHE) Sustainability Tracking, Assessment & Rating System (Stars) Program. Institutional reports reviewed were selected based on institutional characteristics and institutional performance on "Waste Management and Diversion" criteria.[5]

For each practice, respondents were asked if their campus:

a) has already or intends to implement it
b) is currently considering implementing it
c) has considered but decided against implementing

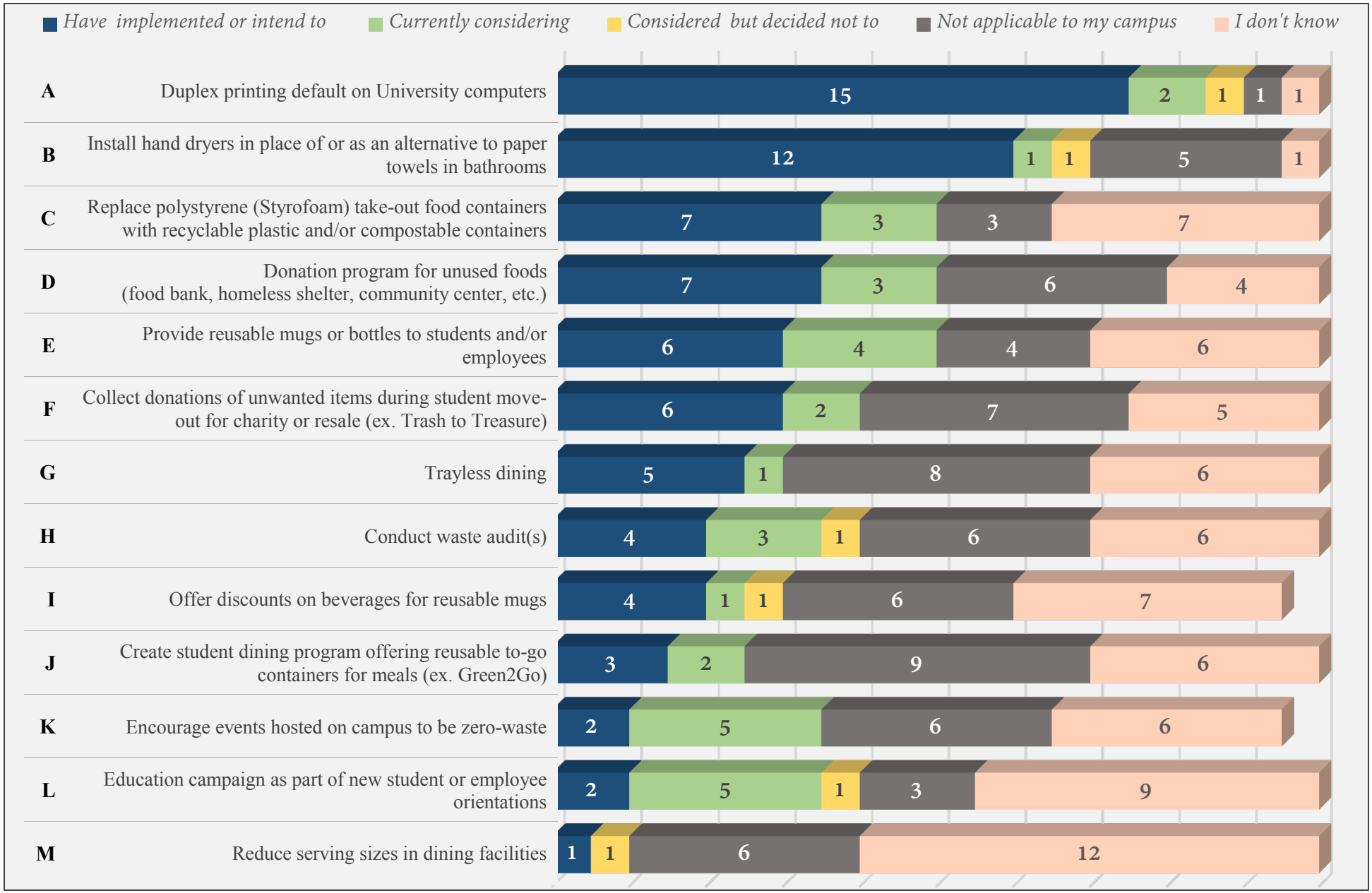
Respondents were also provided a "not applicable to my campus" option, since some practices pertain to services that are not offered at all campus locations (ex., university housing).

Comments Related to Waste Reduction Practices
"We send all of our scrap metals to salvage" – *Anne Miller, Mont Alto*
"As indicated, we supply recycling containers for both offices, classrooms and buildings" - *Gene Grogan, Worthington Scranton*
"We are with a private vendor food service provider until our cafe renovation project is complete in 2020, then we will be with the University's chosen vendor Metz, who will provide more sustainability opportunities" – *Helene Miksitz, Lehigh Valley*
"Some of these ideas were mentioned today: waste audit, education program for new student orientation. We have had duplex printing on all of our public printers for many years. Some bathrooms are hand dryer only, others have both." - *Randy Geering, Erie*
"Our food service is currently contracted out to Metz. Scale and resources are a challenge at many of the smaller campuses" - *Jason Bush, Fayette*

[4] Interviews with personnel at Penn State Erie also suggest that Waste Management charges by the cubic yard, potentially making diversion calculations by weight difficult to obtain.

[5] For example, see Penn State's performance information for the Waste Management and Diversion credits here: https://stars.aashe.org/institutions/pennsylvania-state-university-pa/report/2017-09-14/OP/waste/OP-19/

Has your campus implemented or considered implementing any of the following practices for reducing waste?



Campus [a]	Waste Reduction Practices (*see key below*)												
	A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***K***	***L***	***M***
Harrisburg													
Erie													
Abington													
Altoona													
Berks									*nr*				
Brandywine													
Worthington Scranton													
York													
Lehigh Valley													
Mont Alto											*nr*		
Hazleton													
Schuylkill													
Beaver													
Fayette													
DuBois													
Greater Allegheny													
Shenango													
Wilkes-Barre													
Great Valley													
Dickinson School of Law													
% Implemented or intend to	75	60	35	35	30	30	25	20	20	15	10	10	5

[a] Campus list organized from largest to smallest, based on total enrollments in Fall 2017
nr = no response

Blue Cells = *Have implemented or intend to*	Green Cells = *Currently considering*	Yellow Cells = *Considered but decided not to*	Gray Cells = *Not applicable to my campus*	Orange Cells = *I don't know*

A	Duplex printing default on University computers
B	Install hand dryers in place of or as an alternative to paper towels in bathrooms
C	Replace polystyrene (Styrofoam) take-out food containers with recyclable plastic and/or compostable containers
D	Donation program for unused foods (food bank, homeless shelter, community center, etc.)
E	Provide reusable mugs or bottles to students and/or employees
F	Collect donations of unwanted items during student move-out for charity or resale (ex. Trash to Treasure)
G	Trayless dining
H	Conduct waste audit(s)
I	Offer discounts on beverages for reusable mugs
J	Create student dining program offering reusable to-go containers for meals (ex. Green2Go)
K	Encourage events hosted on campus to be zero-waste
L	Education campaign as part of new student or employee orientations
M	Reduce serving sizes in dining facilities

3.6 Open-ended Items

The survey included six open-ended items to provide respondents with an opportunity to share their own insights and unique experiences related to waste reduction efforts at their campus. Topics covered in this final section of the survey include educational efforts and outreach, opportunities and barriers, the University's role, and transferable practices for other campuses.

1. *Please briefly describe any educational efforts on your campus to promote recycling and waste reduction among University employees*

Campus	Response
Harrisburg	Discussions held during team meetings to ensure we maximize our recycling of metals and acceptable waste - *Chuck Garber*
Erie	With the recent changes in the recycling industry our process for collecting recycling has changed drastically. We just (today) had a recycling forum (50 in attendance) to educate faculty and staff on those changes. We have sent emails to the list serve as well. We see this as an ongoing effort to educate so we can clean up our recycling stream. - *Randy Geering*
Altoona	Sustainability Council promotes recycling - *Michael Long*
Berks	Campus has formed a Sustainability Committee - *Kim Berry*
Worthington Scranton	Office recycling containers are located in each office for single stream recycling. New recycling containers were recently purchased and placed throughout the campus hallways for single stream recycling. We don't have/offer any "educational" programs. - *Gene Grogan*
York	New trash receptacles in the Ruhl Student Center highlight recycling. - *Holly Gumke*
Lehigh Valley	We have a Sustainability Committee that conducts events to encourage recycling and create signage. - *Helene Miksitz*
Mont Alto	Our campus Sustainability Committee widely promotes recycling and waste reduction efforts. - *Anne Miller*
Beaver	Very little is done to promote recycling. We have some flyers around campus to help faculty/staff/students know what they can and can not recycle. Our sustainability initiative is gaining strength and we hope to improve in this area. - *Adam Rathbun*
Fayette	Sustainability Forum participation. Sustainability website resources shared among campus listserves - *Jason Bush*
DuBois	Emails and messages from our "Green Team" - *John Luchini*
Shenango	We have an Agricultural Club that monitors and works with sustainability programs. - *William Dungee*
Great Valley	We have an active Sustainability Committee that suggests sustainable practices to the business office, shows educational films, and celebrates Earth Day. - *Maria Zuccato*
Dickinson School of Law	Just containers for specific recyclable materials - *Kar Souders*

2. *Please briefly describe any educational efforts on your campus to promote recycling and waste reduction among University* *students*

Campus	Response
Harrisburg	Signage and posters - *Chuck Garber*
Erie	The Student Government is involved and will be working to provide education to the student body. We are charging the Student Affairs Committee of the Faculty Senate to work on an education program. Strategic Communications will be sending out information to the campus community about the changes and new process. - *Randy Geering*
Altoona	Students are on the above listed council - *Michael Long*
Berks	Campus works with students through clubs, orientation, and signage - *Kim Berry*
Worthington Scranton	Every building and most classrooms have recycling containers in these areas. We don't have/offer any educational programs for recycling. - *Gene Grogan*
York	New trash receptacles in the Ruhl Student Center highlight recycling. - *Holly Gumke*
Lehigh Valley	We teach SUST 200 and 400 level courses and one of our faculty runs a program called CHANCE, info can be found at this link. www.chance.psu.edu - *Helene Miksitz*
Mont Alto	Our campus Sustainability Committee widely promotes recycling and waste reduction efforts. - *Anne Miller*
Schuylkill	We provide recycling containers in all locations. - *Stephanie Wood*
Beaver	Same as above. In addition, we do provide more recycling options at the end of the semester (mainly spring) for those moving out of the residence hall. - *Adam Rathbun*
Fayette	I tried to connect with our Student Affairs Office to see what programming is happening. - *Jason Bush*
DuBois	Emails and messages from our "Green Team" - *John Luchini*
Great Valley	We have signage and plenty of receptacles to promote recycling. - *Maria Zuccato*

3. *What, if any, barriers do you see preventing your campus from further engaging in solid waste reduction initiatives?*

Campus	Response
Harrisburg [1, 2]	Resources; money and human - *Chuck Garber*
Erie [3]	Buy-in from faculty/students/staff. We don't see enough of a commitment to reduce waste and recycle responsibly - *Randy Geering*
Berks [4]	Limited storage - *Kim Berry*
Worthington Scranton [3]	Lack of student involvement or participation. Hard to believe for a generation that has been recycling, when they come to the campus they don't think it is their responsibility to do so? - *Gene Grogan*
Lehigh Valley [4]	We do not have the space, we only have 29 acres. - *Helene Miksitz*
Mont Alto [1]	Funding. - *Anne Miller*
Hazleton	None - *Michael Morrison*
Schuylkill [1, 2]	Budget constraints and lack of manpower - *Stephanie Wood*
Beaver [1, 3]	Cost of implementation may be the biggest barrier followed by campus-wide participation. - *Adam Rathbun*
Fayette	I think getting a waste hauler that has single stream recycling would be advantageous for us, but this is dictated by North Union Township & Fayette County. Due to scale and volume is doesn't make sense for us to participant in some of these initiatives. - *Jason Bush*
DuBois [1, 2]	Increased costs and effort required - *John Luchini*
Shenango [2]	Individual dedicated towards serving and leading this initiative. - *William Dungee*
Wilkes-Barre	None if some other initiatives were brought to our attention. - *Gary Beisel*
Great Valley [1]	Cost. Disposable, compostable flatware, plates, and cups are more expensive. - *Maria Zuccato*
Dickinson School of Law [1]	Cost - *Kar Souders*

[1] Related to financial constraints (n = 7)
[2] Related to human resources constraints (n = 4)
[3] Related to lack of campus participation (n = 3)
[4] Related to lack of space (n = 2)

4. *Where do you believe are the greatest opportunities for reducing solid waste on your campus?*

Campus	Response
Harrisburg [1]	H&FS - *Chuck Garber*
Erie [2]	Education; we need to have a fundamental shift in the way we think about waste and recycling starting with what and how we purchase goods - *Randy Geering*
Berks [1]	HFS - *Kim Berry*
Worthington Scranton [2]	Continue awareness through educational programs to promote the positives of recycling. - *Gene Grogan*
York [1]	Continued recycling efforts. New programs in food service with a new food service provider now in place. - *Holly Gumke*
Lehigh Valley [2]	Continue to educate about recycling and sustainability. - *Helene Miksitz*
Mont Alto [1]	Housing & Food Services could install a compost station. - *Anne Miller*
Schuylkill [1]	Cafeteria Food Services - *Stephanie Wood*
Beaver [1]	Housing and Food Operations. - *Adam Rathbun*
Fayette [1]	I think the campuses have minimized solid waste over the years simply due to frugal budgets. An opportunity may be working with our contracted food service to look at where they can participate in terms of using recyclable paper products. These operations are subsidized due to lack of volume so it's difficult telling them we need to be using recyclable materials when they are more expensive. - *Jason Bush*
Shenango	Expanding the compost area. - *William Dungee*
Wilkes-Barre [1]	Probably in Food Services. - *Gary Beisel*
Great Valley	Some faculty still insist on making paper copies of materials for their students. - *Maria Zuccato*

[1] Related to Housing and/or Food Services (n = 8)
[2] Related to education programs (n = 3)

5. *How could the University best support solid waste reduction efforts on your campus?*

Campus	Response
Harrisburg	Finding new outlets we can work with to recycle more than the Big 4 - *Chuck Garber*
Erie [1]	University-wide education campaign. - *Randy Geering*
Berks [2]	Funding for collection stations and signage - *Kim Berry*
Worthington Scranton [1]	Again, educational programs that tout successes of recycling and what is does for the environment. - *Gene Grogan*
Lehigh Valley	I'm not sure. - *Helene Miksitz*
Mont Alto [2]	Funding. - *Anne Miller*
Schuylkill [1, 2]	Provide financial resources and training for additional staff - *Stephanie Wood*
Beaver [1]	Guidance on implementation of programs. For example, composting of food. - *Adam Rathbun*
Fayette [1]	Provide guidance in areas we can support related to sustainability initiatives. Provide regional training that our campus participants can attend. - *Jason Bush*
Shenango [2]	Funding towards these efforts. - *William Dungee*
Wilkes-Barre [1]	By providing a list of some of the potential initiatives and giving us a chance to pick and choose those that we might be able to implement. - *Gary Beisel*
Great Valley [2]	Augment campus committees comprised of volunteers with an appointment charged with sustainability practice implementation as an assigned work duty. Offer financial incentives to campuses and start-up funding. - *Maria Zuccato*

[1] Related to education programs, training, or guidance (n = 6)
[2] Related to funding (n = 5)

6. *Of the recycling and/or waste reduction efforts successfully employed at your campus, which do you feel are most transferable to other campuses?*

Campus	Response
Harrisburg	Landscape waste - *Chuck Garber*
Erie	Not sure, we are still working through many of the changes. We are interested in anything that has been done at other campuses that has worked. - *Randy Geering*
Berks	Conduct an annual shredding event - *Kim Berry*
Worthington Scranton	I think the placement of recycling containers in classrooms and more prominent containers throughout the campus has been a successful. - *Gene Grogan*
York	Trash receptacles for recycling. - *Holly Gumke*
Lehigh Valley	The CHANCE program is offered University-wide. - *Helene Miksitz*
Mont Alto	Contracting a sustainable solid waste vendor. - *Anne Miller*
Schuylkill	Not at this time - *Stephanie Wood*
Beaver	Hard to answer as I'm not sure what other campus have been doing. - *Adam Rathbun*
Fayette	Single stream recycling - *Jason Bush*
Shenango	Agriculture Club working with our Sustainability Committee. - *William Dungee*
Wilkes-Barre	We pretty much do standard recycling that most campuses do. - *Gary Beisel*
Great Valley	Bring your own cups, plates, etc. to meetings. Add dishwashers to faculty/staff main lounges. - *Maria Zuccato*

4. Conclusions

Results from this survey indicate that many of the Commonwealth Campuses face unique challenges in managing solid waste. For example, Penn State Fayette has only one waste hauler available for it to contract with (see pp. 3, 8, 10). This, combined with its relatively small scale, presumably limits the campus' ability to negotiate broader services at a reasonable rate. Another example is Penn State Lehigh Valley, which cited the small size of its property as a major barrier to engaging in waste reduction initiatives (see p. 13).

Despite these unique challenges, the survey results also suggest the primary factors impacting waste reduction efforts are widely shared among many of the Commonwealth Campuses. Predominantly among these are financial and human resources constraints. Nearly three-quarters of responding campuses noted such constraints as barriers to reducing solid waste (see p. 13). Similarly, approximately 42% of responding campuses identified the provision of funding as how the University could best support their waste reduction efforts (see p. 15).

Another major factor that already has or likely will impact waste reduction efforts at campuses across the University system is market shifts resulting from China's National Sword policy on imports of recyclable materials. Considering the prevalence of Waste Management as the contracted waste hauler among Commonwealth Campuses, it seems very likely that many campuses may soon be faced with changing waste collection policies. For instance, Penn State Erie has been forced to make substantial changes to its recycling collection processes due to policy changes imposed by Waste Management in early 2018 (pp. 11, 16). Penn State Harrisburg, too, noted the challenges it was presented by changes in Waste Management policies (pp. 3, 5). The new realities of the market for recyclables have diminished leadership's ability to make a "business case" for more comprehensive recycling programs.

Many Commonwealth Campuses also identified similar opportunities. Nearly 62% of responding campuses specifically noted Food and Housing Services as an area offering the greatest opportunity for reducing solid waste. Survey results suggest that most campuses would like to do more composting of food and biomass. However, compost systems can be somewhat expensive to operate and maintain while needing a critical mass of materials. These reasons, combined with others, have reduced the prevalence of materials being composted on the campuses. About a quarter of responding campuses also identified education programs as the greatest opportunity for reducing waste (see p. 14).

In summary, nearly all campuses seem to be striving for better waste management even though leadership faces the proverbial uphill battle. All campuses appear to be short of funds that could be used for infrastructure improvement, training, etc. that would lead to improved diversion rates. All campuses are also facing challenges related to human behavior (e.g., student and employee) that is inconsistent with recycling objectives, while attempting to mitigate drastic changes in markets for recyclable materials. Interestingly, University methods for procuring goods was mentioned only once among respondent comments: "We need to have a fundamental shift in the way we think about waste and recycling starting with what and how we purchase goods" (Randy Geering, Penn State Erie) (see p. 14).

APPENDIX A
Respondent Information

Campus	Respondent Name	Respondent Title	Respondent Email
Abington	Alexis Donohue	Assistant Director of Business Services	axa259@psu.edu
Altoona	Michael Long	Assistant Director, Business Operations; Director, Facilities and Operations	mgl103@psu.edu
Beaver	Adam Rathbun	Director of Finance & Business Service	awr130@psu.edu
Berks	Kim Berry	Sr. Director of Business & Community Service	krb11@psu.edu
Brandywine	Margaret Buban	Director of Finance and Business Service	mmb89@psu.edu
Dickinson School of Law	Kar Souders	Director of Business Services (Carlisle)	krs8@psu.edu
DuBois	John Luchini	Director of Finance & Business Service	jbl1@psu.edu
Erie	Randy Geering	Sr. Director of Business & Operations	rrg3@psu.edu
Fayette	Jason Bush[1]	Director of Finance & Business Service	qjb4@psu.edu
Great Valley	Maria Zuccato	Director of Finance & Business Service	mnz1@psu.edu
Greater Allegheny	Dave DeNardo	Director of Finance & Business Service	ddd92@psu.edu
Harrisburg	Chuck Garber	Interim Director of Business Services	cwg13@psu.edu
Hazleton	Michael Morrison	Director of Finance and Business Service	mjm87@psu.edu
Lehigh Valley	Helene Miksitz	Business Coordinator	hqm1@psu.edu
Mont Alto	Anne Miller	Director of Business Service	amc267@psu.edu
Schuylkill	Stephanie Wood	Director of Finance and Business Service	smw32@psu.edu
Shenango	William Dungee	Director of Finance & Business Service	whd10@psu.edu
Wilkes-Barre	Gary Beisel	Director of Business Service	geb4@psu.edu
Worthington Scranton	Gene Grogan	Director of Business Service	etg1@psu.edu
York	Holly Gumke	Director of Business Service	hlg4@psu.edu

[1] Jason Bush also serves as the Director of Finance & Business Service at Penn State New Kensington. He was asked to complete the survey only once, from the perspective of Penn State Fayette.

APPENDIX B
Example of Educational Materials

Informational flyer recently provided by Waste Management for use at Penn State Erie

APPENDIX C
Survey Instrument

PennState

Survey of Waste Reduction and Materials Management Practices at Penn State Commonwealth Campuses

This survey is part of a larger effort to study the University's waste management practices and recommend measures for improving the efficacy and sustainability of how solid waste is managed throughout the University. An immediate objective of these efforts is to reduce the total amount of solid waste generated at Penn State as well as increase diversion rates of waste from landfills.

To help us better understand the complexities and individual challenges of managing waste across the University system, we request you complete this survey by:

Friday, August 24th

Your responses will automatically be saved and you may return to the survey using the link that was emailed to you. If you feel there is another person on your campus who could also provide valuable input on these topics, please contact Nathan Elser. Questions about the survey can also be directed to Nathan:
nce5000@psu.edu

(814) 865-9485

Thank you for your assistance in this important endeavor.

Phillip R. Melnick
Senior Director, Buildings and Grounds

Tom Richard
Director, Institutes of Energy and the Environment
Professor of Agricultural and Biological Engineering

What type of hauler does your campus utilize for transporting solid waste from campus?

- Private Company
- Municipal/County Service
- University Employees
- I don't know

Notes or comments related to waste transport:

Which of the following methods does your campus primarily employ for collecting standard recyclables (i.e., paper, plastic, glass, metals) in common areas?

- Single stream recycling (a single container for commingled recyclables)
- Dual stream (two separate containers for recyclables, e.g., one for paper and another for plastic, glass, and metals)
- Multi-stream recycling (multiple containers that further separate different types of materials)

Notes or comments related to recycling streams:

How is solid waste generally collected in buildings on your campus?

- ○ Faculty/staff sort and dispose of their own waste in separate receptacles located in common areas of buildings
- ○ Custodial services/Housekeeping collect waste from individual trash receptacles located in private offices and rooms
- ○ Another method

Notes or comments related to waste collection:

Which of the following commonly recycled materials are widely collected on your campus?

	Yes, these are collected	**No**, these are not collected	I don't know
Plastic bottles, jugs, and jars 	○	○	○
Plastic tubs and trays (i.e., miscellaneous plastic) 	○	○	○

	Yes, these are collected	**No**, these are not collected	I don't know
Plastics films, wraps, and bags 	○	○	○
Aseptic cartons (such as for milk and juice) 	○	○	○
Polystyrene packaging 	○	○	○

	Yes, these are collected	**No**, these are not collected	I don't know
Glass bottles and jars 	○	○	○
Steel and aluminum containers 	○	○	○

	Yes, these are collected	**No**, these are not collected	I don't know
Office paper and junk mail 	○	○	○
Newspapers, magazines, and softcover books 	○	○	○
Hardcover textbooks 	○	○	○

	Yes, these are collected	**No**, these are not collected	I don't know
Spiral notebooks and course packets 	○	○	○
Paperboard boxes and tubes 	○	○	○

	Yes, these are collected	**No**, these are not collected	I don't know
Corrugated cardboard 	○	○	○
Electronics 	○	○	○
Rechargeable batteries 	○	○	○

Notes or comments related to materials accepted for recycling:

Are there any local ordinances or laws that regulate solid waste collection or recycling practices at your campus?

- ○ Yes
- ○ No
- ○ I don't know

Notes or comments related to local regulations for managing solid waste:

* Item only presented if respondent selected "Yes" to compost program for Campus operations (below)

** Item only presented if respondent selected "Yes" to either type of compost program (below)

Does your campus have a formal collection program for organic/compostable materials (ex. food scraps, kitchen waste, paper napkins, landscaping debris, animal bedding, etc.) available to:

	Yes	No	I don't know
Campus users? (i.e., students, staff, faculty, visitors)	○	○	○
Campus operations? (ex. grounds maintenance, food services, event planning)	○	○	○

* Which of the following materials generated from campus operations are widely collected for composting?

- ☐ Landscaping debris
- ☐ Back of the house kitchen waste
- ☐ Animal bedding and/or manure

** Is there a composting operation located on your campus?

- ○ Yes
- ○ No
- ○ I don't know

Notes or comments related to collection of organic/compostable materials:

* Item only presented if respondent selected "Yes" to measuring waste diversion (below)

Does your campus measure the amount of waste diverted from landfill (i.e., materials recycled, composted, donated)?

- Yes
- No
- I don't know

* What was the most recent landfill diversion rate (as a percentage; may be approximate)?

Notes or comments related to landfill diversion:

Please briefly describe any educational efforts on your campus to promote recycling and waste reduction among University employees.

Please briefly describe any educational efforts on your campus to promote recycling and waste reduction among University students.

Has your campus implemented or considered implementing any of the following practices for reducing waste?

	Have implemented or intend to	Currently considering	Considered but decided not to	Not applicable to my campus	I don't know
Conduct waste audit(s)	○	○	○	○	○
Duplex printing default on University computers	○	○	○	○	○
Reduce serving sizes in dining facilities	○	○	○	○	○
Trayless dining	○	○	○	○	○
Offer discounts on beverages for reusable mugs	○	○	○	○	○

	Have implemented or intend to	Currently considering	Considered but decided not to	Not applicable to my campus	I don't know
Provide reusable mugs or bottles to students and/or employees	○	○	○	○	○
Create student dining program offering reusable to-go containers for meals (ex. Green2Go)	○	○	○	○	○
Replace polystyrene (Styrofoam) take-out food containers with recyclable plastic and/or compostable containers	○	○	○	○	○

	Have implemented or intend to	Currently considering	Considered but decided not to	Not applicable to my campus	I don't know
Install hand dryers in place of or as an alternative to paper towels in bathrooms	○	○	○	○	○
Donation program for unused foods (food bank, homeless shelter, community center, etc.)	○	○	○	○	○

	Have implemented or intend to	Currently considering	Considered but decided not to	Not applicable to my campus	I don't know
Encourage events hosted on campus to be zero-waste	○	○	○	○	○
Education campaign as part of new student or employee orientations	○	○	○	○	○
Collect donations of unwanted items during student move-out for charity or resale (ex. Trash to Treasure)	○	○	○	○	○

Please describe any other waste reduction practices that have been (or are in the process of being) implemented on your campus:

What, if any, barriers do you see preventing your campus from further engaging in solid waste reduction initiatives?

Where do you believe are the greatest opportunities for reducing solid waste on your campus?

How could the University best support solid waste reduction efforts on your campus?

Of the recycling and/or waste reduction efforts successfully employed at your campus, which do you feel are most transferable to other campuses?

APPENDIX D
Updates from 2019 Regional Sustainability Forums

The following chart comprises the Commonwealth Campuses' waste efforts and progress reported at the 2019 Sustainability Regional Forums.

Northeastern Region		
Campus	**Green Team, Committee**	**Programs/Progress**
Scranton	Forming a Sustainability Council	Single stream recycling saves $1,900 annually 12% of solid waste recycled, producing 6.25 tons recyclables. With hydration stations, avoided 400,000 single use disposable water bottles annually. Adding 5 more stations this summer. Discount for refillable mugs. Biodegradable plastics to replace Styrofoam. SGA began giving out reusable cups, lids and straws. Wants to install dishwasher in kitchen but told that instead, they will use chemical sanitation.
Schuykill		Used many reclaimed materials in on campus renovations, including student café. Eco coin to launch in the Fall
Hazleton	Sustainability Committee	Eco coin to launch in the Fall Residence Life put recycling information in 1st year student arrival packets Added recycling bins in all the offices – model for all the students. Designated bulletin board space in the Fall in dorms to share green tips Residence Life/Conduct/BTMT/Care Team has moved almost entirely to paperless productions Addition of recycling bins to all offices with an expectation model Continuing use of Green 2 Go containers Putting pressure on Housing and Food Services to stop the use of Styrofoam and move toward sustainable products SGA created a "sustainability chair" and a committee and next spring will promote educational programming
Lehigh Valley	Sustainability Committee	Want to install dishwasher, but not allowed by Food service. Eco coin to launch in the Fall
Wilkes-Barre		Waste Management Single Source Recycling Scrap Metal Recycling Eco coin to continue in the Fall Interested in composting.

Southeastern Region		
Campus	**Green Team, Committee**	**Programs/Progress**
Brandywine	Sustainability Committee	Education regarding waste issues through Level 3 of Green Paws; prioritize the actions. On campus café implementing programs to reduce waste and promote healthy living Eco coin to launch in Fall Collaboration with Tyler Arboretum – change from plastic straws to paper.
Mont Alto	Sustainability Committee	Implemented recycling within all academic buildings Monthly tidbits about sustainability, including waste on building monitors Eco Coin to launch in Fall Career closet program repurposes clothing and aids students in preparation for interviewing. Launching Green Paws Program campuswide this fall. By next January: incorporating recycling games into NSO.
York	None	Continuing success with dishwashing in lieu of paper products in the Student Center Continuation of Campus single stream recycling Eco Coin to launch in Fall Dr. Robert Farrell, research faculty, eliminated organic solvents for RNA research and uses non-toxic kits instead.
Great Valley	Green Team	Launched Green Paws Certification Program Glass water dispensers being used vs. individual plastic bottles Switched to compostable flatware in on campus café Encouraging the reuse of building materials in construction Eco coin to launch in Fall
Harrisburg	Forming a Sustainability Council	Starting 3rd year of on campus special living option for students interested in sustainability Testing different materials for sustainable building renovations Evaluating waste materials to purify wastewater (using fruit peels) Eco coin to launch in Fall Interested in composting Hosts the Recycling Market Center on campus.
Berks	Sustainability Team	Sustainability Team hosted "Earthfest 2019" Not able to expand composting efforts/acknowledges recycling dilemma Describes waste reduction as "daunting and complex"-no staffing, complex, and time intensive logistics Hosts a website with sustainability information Students for Sustainability club began composting Challenge involving more faculty from different departments and divisions Eco Coin to launch in Fall Student engagement is good but turn-over due to graduation or transfer

Western Region		
Campus	**Green Team, Committee**	**Programs/Progress**
Abington	Sustainability Champion	Students and a few faculty held a meeting and want to focus on food waste and composting of food.
Beaver	Green Team	Community partnership with Shell (County recycling, wetlands baseline measurements)
New Kensington	No Specification	Shredding changed to Westmoreland Blind Association (materials are now recycled) Completed all 4 levels of Green Paws
Dubois	Sustainability Committee	Needs reorganization of Sustainability Committee Continuing Eco coin program Challenges with recycling management, strategic plan, funding and reorganization of the sustainability committee Goal to improve on campus composting efforts
Greater Allegheny	Green Team	On campus café has returned to metal-ware, reusable plates, and metal straws Continuation of green 2 go containers Experimented with Cupanion program Canvas bags made available for use at campus store Eco coin to launch in the Fall
Altoona	Sustainability Council	Continuation of Eco coin program Continuation of Green 2 Go containers
Behrend	Green Team	Reports challenges with STARS Eco coin to launch in the Fall
Fayette		Eco coin to launch in the Fall

Appendix VII: Proposed Behavioral Science Graduate Student Position Draft

Behavioral Science Graduate Assistance Position

Purpose
Over the past few years, organizations have recognized that effective programs to change individual and community decisions about electricity use; material purchasing, use and disposal; transportation and other topics under the "operations" umbrella incorporate social and behavioral science approaches. Although there is a substantial body of knowledge in this scholarship area, the insights from this literature are difficult for programmatic managers in OPP, Food Service, Housing and Transportation Departments to access and deploy due to limited exposure and time restrictions. This shortchanges the potential impacts of their efforts and programmatic funds.

Especially as the University launches the WSTF recommendations, it is proposed that the Sustainability Institute hire a behavioral science graduate student for three years to provide advice to Finance and Business units on ways for behavior change tools to be integrated into their programs, as well as designing pilots that classes could conduct to test program improvements. It is hoped that by the end of the three-year term, the program managers in many F&B departments will have gained knowledge and skills and be able to apply these concepts to their program independently.

Examples for the year 1 projects:

- Knowing the convenience is the greatest predictor of recycling, this position will provide advice to OPP in selecting new bins and designing new signage for recycling stations, balancing ease of access with regulatory, labor and economic considerations.
- Improving the Green to Go and other reuse programs have the potential of driving down Penn State's solid waste. This position will work with UP and Commonwealth campus classes to design pilots to improve participation in the program using Community Based Social Marketing approaches.

Subsequent year projects:

- Science buildings use four times the energy resource of other academic and administrative facilities on a University campus. Harvard and other tier 1 research institutions have successfully mounted "Shut the Sash" campaigns in labs to reduce energy use. Harvard reported saving between $200,000 and $250,000 annually from this campaign. This position could assist OPP and the Environmental Health & Safety Department in designing such a campaign for Penn State's UP campus.
- A sustainable purchasing policy could allow Penn State to use its buying power to increase the sustainability of its suppliers. However, Penn State has a distributed

purchasing system in place. This position could educate and market the benefits of the sustainable purchasing policy to increase its adoption.

Position Summary
Important duties:

- Position would report to the Sustainability Institute's Director of Operations and Partnerships and work in cooperation with the Sustainable Operations Council, OPP and F&B's Change Management office.
- The position would offer 20 hours per week of assistance to Finance and Business units, learning their operational challenges and advising them on how behavioral science tools could increase participation and impact of their programs.
- It is expected that this person will work closely with the Sustainable Communities Collaborative to help create Living Lab projects that will not only benefit operations units with improved programs, but simultaneously engage students in applied learning.
- This position will offer a one-hour seminar each semester for F&B staff on behavioral science tools and applications using examples from Penn State.
- In the first year, this graduate student will help implement the WSTF recommendations. For example, the graduate student could help vendors implement reusable cup programs with the appropriate behavior change tools so they are more successful as well as educate on appropriate compostable material, depending on the recommendations that are implemented from the WSTF report.

The position will be funded with $75,000 per year for three years. Note that this funding would include tuition expenses for a graduate student. Alternatively, this could be a post-doc position in which tuition would not be needed and the funds could be used to hire a recent graduate student with work in this area at the appropriate post-doc salary.