

Materials Infrastructure Analysis

Lloyd EcoDistrict

Submitted by:

Eric T. Crum

Nate Forst

Erin Anderson

Lauren Bruschi

February 10, 2014

Director

Research and Development Manager

Project Lead

Project Assistant

Community Environmental Services

Portland State University

PO Box 751 – CES

Portland, OR 97207

LLOYD eco DISTRICT



LLOYD eco DISTRICT



METRO



Portland State
UNIVERSITY

Table of Contents

Executive Summary	1
Phase I	1
Phase II	1
Phase III	1
Cost Analysis	2
Next Steps	3
Section 1: Materials Infrastructure Introduction and Background	4
Materials Management in the Lloyd EcoDistrict	4
Project Overview	4
Section 2: Existing Waste Assessment Data– <i>Phase I</i>	6
Section 3: Material Characterization Assessments – <i>Phase II</i>	9
Section 4: Combined Landfill-Bound Material Composition Data – <i>Phase III</i>	11
Findings	13
Section 5: Cost Analysis	15
Limitations	15
Section 6: Disposal Costs and Secondary Commodity Values	16
Landfill Disposal Savings and Secondary Commodity Values	16
Commingle Recycling Material Composition Estimates	16
Estimated Landfill-Bound and Commingled Recycling Value	18
Section 7: Alternative Materials Management Programs to Capture Value	19
Lloyd EcoDistrict Alternative Materials Management Program Recommendations	19
Section 8: Next Steps	21
Appendix A: Material Composition Data by Building Usage Type	22
Appendix B: Cost Analysis	23

Executive Summary

The Lloyd EcoDistrict, with generous funding provided by Metro Regional Government, partnered with Community Environmental Services (CES) at Portland State University to conduct a materials infrastructure analysis project to better understand the landfill-bound material stream being generated by the district and also identify opportunities for the district to capture value from the waste materials while reaching its sustainability goals.

The project was conducted in three phases. The findings from each phase are discussed below.

Phase I

A district-wide inventory of buildings, by usage type and square footage, was created and existing waste generation and material composition data was compiled using existing CES, City of Portland, and Metro studies. Twenty five percent of the square footage within the district had material composition data from previous material assessments, this included 97% of the square footage for event spaces and 26% for offices. This highlighted the building usage types where additional material composition data was needed. Five (5) buildings were proposed for additional assessments. The proposed buildings would result in material assessments and composition data representing 54% of the district.

Phase II

The proposed material assessments, identified in the previous Phase, were conducted on the landfill-bound materials for the following buildings (usage type):

1. Double Tree Hotel (Hospitality)
2. Crowne Plaza Hotel (Hospitality)
3. Kaiser Permanente Administrative Headquarters (Office)
4. Calaroga Terrace (Residential)
5. Lloyd Center Mall (Retail) – two (2) proposed assessments

Material assessments included hand sorting the landfill-bound materials into various material categories to determine the types of materials being disposed of and provide insight to what waste items were generated throughout the district. Once the landfill-bound materials were sorted each category was weighed to provide quantitative data regarding the composition of the waste stream.

Phase III

The material assessment data from the existing buildings and those completed in Phase II were combined into a comprehensive database to compare and combine the findings. All data was extrapolated to represent one day (24-hours) of material generation and was also projected to represent the entire Lloyd EcoDistrict.

The results from the material assessments showed that 15,203 pounds (7.6 tons) of landfill-bound materials were generated in the district in a one-day (24-hours) period. Projected out, the district would generate 5,548,837 pounds (2,774 tons) of material in one year.

Within the landfill-bound materials, 61% could have been diverted:

- 13% was readily recyclable materials, which included items that could be recycled through standard recycling services offered by commercial haulers in the Portland-Metro region.
- 9% was other recoverable materials, which include items that can be recycled but not through the readily recyclable systems and would require a special material processor.
- 39% of the materials were compostable food and fibers, which could have been diverted through the City of Portland's commercial composting program.

Within the readily recyclable materials, mixed paper was the most common material representing 50% of the readily recyclables and 7% of all generated materials. Plastic film and rigid plastic were the most common other recoverable materials, representing 69% of the other recoverables and 6% of all generated materials.

Cost Analysis

The findings from Phase III were used to perform a cost analysis examining the price to dispose of the landfill-bound materials and the value of the items being disposed of. The cost analysis calculated disposal costs beginning at the point of disposal at a region transfer station, which is regulated by Metro, and does not include the costs associated with individual commercial waste hauling services because these are not regulated costs. The projected Lloyd EcoDistrict landfill-bound material generation figures show that it **costs \$522,680 annually** to dispose of the materials. If all of the divertible materials (61%) found within the landfill-bound waste stream were removed and properly sorted, the district could **save \$320,835 annually** from avoided disposal costs, including **\$73,000 a year** from diverting the compostable food and fibers which represented 39% of all generated materials.

The cost analysis also calculated the value of the recyclable materials disposed in the landfill-bound waste stream utilizing current, real-market prices for secondary commodities. Within the landfill-bound waste stream, 2,818 pounds of recyclable materials were disposed of per day. If these materials were diverted and sold as secondary commodities, they could generate **\$183 per day** or **\$66,795 annually**.

The above figures only represent materials that were disposed in the landfill-bound material stream and do not include the secondary commodities that are currently being recycled through the commingled recycling systems. In order to understand the value of the secondary commodities in the commingled recycling stream and identify additional opportunities for the district, CES estimated the amount and types of materials being generated in the commingled recycling stream for the district. These estimates showed that the district could **generate \$628 per day** and **\$229,329 annually** from the secondary commodities found in the commingled recycling stream.

The combined net value from readily recyclable materials found in the landfill-bound and commingled recycling streams in the district is nearly **\$300,000 a year**.

Next Steps

Various innovative programs currently exist in the region that maximize secondary commodity value from materials generated as a result of day-to-day organizational activities. It is recommended that Lloyd EcoDistrict further explore these programs as a potential model for district operations. However to best understand the case for a similar approach in the Lloyd EcoDistrict, more information is necessary. A deeper analysis of the recycling material stream is recommended to gain a better understanding of the materials being generated and their potential secondary commodity values. This will offer a more impactful business case to examine alternative materials management programs that would serve to improve both the financial and environmental impact of materials management in the district.

Section 1: Materials Infrastructure Introduction and Background

In March 2013, the Lloyd EcoDistrict partnered with Community Environmental Services (CES), a research and service unit at Portland State University, to conduct a district-wide waste materials infrastructure analysis. The following report provides background information about the Lloyd EcoDistrict's materials management goals followed by the findings from the materials infrastructure analysis project conducted by CES.

Materials Management in the Lloyd EcoDistrict

In 2012, the Lloyd EcoDistrict Roadmap was created as a guide for growth and economic development. The roadmap provided an assessment of baseline conditions, adopted performance goals, and recommended strategies to support the district in becoming the most sustainable businesses district in North America.

In the Roadmap, the City of Portland's Climate Action Plan (CAP) waste reduction goals, a 25% reduction in total waste generation and 90% recovery of all waste generation by 2035, were used as goals to guide the district's materials management practices. The Roadmap used baseline assumptions of waste generation, per square foot, to estimate the total waste within the district. Projected development growth figures were then used to determine the level of reduction required for the district to meet the 2035 CAP goals.

To achieve the waste reduction and sustainability goals of the district, the Roadmap suggests the Lloyd EcoDistrict develop a materials management program that is self-funding and self-sustaining that generates value back to the district (Roadmap page 37). However, in order to develop a program a more complete understanding of the existing materials infrastructure and the landfill-bound waste materials being generated in the district was necessary. The following materials infrastructure analysis project was proposed by the Lloyd EcoDistrict and CES to assist with fully understand the waste materials being generated in the district.

Project Overview

The materials infrastructure analysis was conducted in the following three phases describe in detail below. During Phase I, the Lloyd EcoDistrict and CES formed a Technical Advisory Committee (TAC) comprised of local materials management experts from the City, Metro, PSU, and other organizations within the district. The TAC provided technical guidance and expertise on various elements of the analysis throughout the duration of the project.

Phase I: The first phase of the project included a large-scale secondary research evaluation of all available waste-related data pertaining to the Lloyd EcoDistrict utilizing extant CES, City of Portland, and Metro data sets. This existing data included waste generation and waste composition data (what type of materials make up the waste stream) on multiple organizations within the district, including Bonneville Power Administration, the Liberty Centre, Oregon Convention Center, and the Moda Center (formerly the Rose Garden Arena). All waste composition data was then synthesized into a comprehensive waste data tracking system where gaps within the district waste generation and composition data set were identified by CES and the TAC.

Phase II: The second phase of the project used the identified gaps in the comprehensive waste data tracking system to select specific businesses for additional waste characterization assessments. For this phase, CES executed six (6) landfill-bound material assessments on the materials generated at Double Tree Hotel, Kaiser Permanente Administrative Headquarters, Crowne Plaza Hotel, Calaroga Terrace, and the Lloyd Center Mall.

Phase III: The results of the additional material assessments performed in Phase II were then merged with the comprehensive waste data tracking system. A district-wide materials infrastructure analysis was conducted on the comprehensive waste data tracking system to evaluate opportunities for new or existing solutions for reduction, repurposing, monetizing, and recycling of high-volume and high-value materials. Through this process, CES also identified the 3-5 materials currently present in the landfill-bound waste stream that present the greatest opportunity for the district to either: 1) generating revenue for the district and its participating members; and/or 2) realize cost off-sets and savings for the district by improved or additional collection.

Section 2: Existing Waste Assessment Data– Phase I

A survey of total square footage (Sq. Foot) of buildings in the district was first conducted by CES using information from Regional Land Information System (RLIS) datasets from Metro and the City of Portland and data from the Lloyd EcoDistrict. Buildings were classified into the following usage types:

- Events: includes buildings used for large events such as the Rose Garden and the Oregon Convention Center.
- Office: buildings that are used for traditional office activities.
- Retail: includes food service businesses, and buildings of various sizes for retail stores.
- Hospitality: includes hotels and similar overnight facilities.
- Residential: includes both multifamily and assisted living facilities.
- Industrial: facilities zoned for industrial uses.
- Other: includes churches and colleges within the district.

Table 2.1 below provides the square footage of each type and the percent of the district each represents.

BUILDING USAGE TYPE		SQ FOOT	% OF TOTAL DISTRICT
	EVENTS	1,278,633	14%
	OFFICE	3,655,784	41%
	RETAIL	1,889,739	21%
	HOSPITALITY	1,115,338	12%
	RESIDENTIAL	689,123	8%
	INDUSTRIAL	38,168	0.4%
	OTHER	313,576	3%
TOTAL SQ FOOT		8,980,361	100%

Table 2.1: Square footage of building usage type

The total square footage in Table 2.1 differs from the total square footage reported by the City of Portland and the Lloyd EcoDistrict Roadmap document because the above square footage only represents buildings and does not include right of way, open space, and parking lot area.

Table 2.2 below provides the square footage for buildings in the district that CES had previously conducted material waste assessments for and the percent of each building usage type that the existing data represents.

BUILDING USAGE TYPE		SQ FOOT	% OF TOTAL DISTRICT	CES COVERAGE	SQ FOOT	% OF TOTAL TYPE COVERED
	EVENTS	1,278,633	14%	Moda Center, OCC	1,241,744	97%
	OFFICE	3,655,784	41%	BPA, Liberty Centre	961,844	26%
	RETAIL	1,889,739	21%	-	-	
	HOSPITALITY	1,115,338	12%	-	-	
	RESIDENTIAL	689,123	8%	-	-	
	INDUSTRIAL	38,168	0.4%	-	-	
	OTHER	313,576	3%	-	-	
SQ FOOT		8,980,361	100%		2,203,588	25%

Table 2.2: Existing waste assessment data

From the existing material waste assessment data, multiple material waste assessments were proposed for buildings within each usage type, with input from the Lloyd EcoDistrict TAC, to supplement the existing dataset and provide a more comprehensive understanding of the landfill-bound waste stream generated in the district. Table 2.3 below provides the proposed buildings, their square footage, the updated coverage, and percent of building usage type with waste data.

BUILDING USAGE TYPE		SQ FOOT	% OF TOTAL DISTRICT	CES COVERAGE	SQ FOOT	% OF TOTAL TYPE COVERED	PROPOSED SORTS		TOTAL COVERED FOLLOWING PROPOSED SORTS	
		SQ FOOT	% OF TOTAL DISTRICT	CES COVERAGE	SQ FOOT	% OF TOTAL TYPE COVERED	PROPOSED BUILDING	SQ FOOT	UPDATED COVERAGE	% OF TOTAL TYPE COVERED
	EVENTS	1,278,633	14%	Moda Center, OCC	1,241,744	97%	-		1,241,744	97%
	OFFICE	3,655,784	41%	BPA, Liberty Centre	961,844	26%	KAISER	300,000	1,261,844	35%
	RETAIL	1,889,739	21%	-	-		LLOYD CENTER	1,347,555	1,347,555	71%
	HOSPITALITY	1,115,338	12%	-	-		DOUBLE TREE & CROWNE PLAZA	767,838	767,838	69%
	RESIDENTIAL	689,123	8%	-	-		CALAROGA	267,299	267,299	39%
	INDUSTRIAL	38,168	0.4%	-	-		-			-
	OTHER	313,576	3%	-	-		-			-
SQ FOOT		8,980,361	100%		2,203,588	25%			4,886,280	54%

Table 2.3: Proposed waste assessments and coverage

With the additional proposed building waste assessment data, the comprehensive waste stream coverage would include material composition data for 54%, by square footage, of the Lloyd EcoDistrict. Figure 2.1 below shows the level of coverage (both existing and proposed) by square foot for each building usage type.

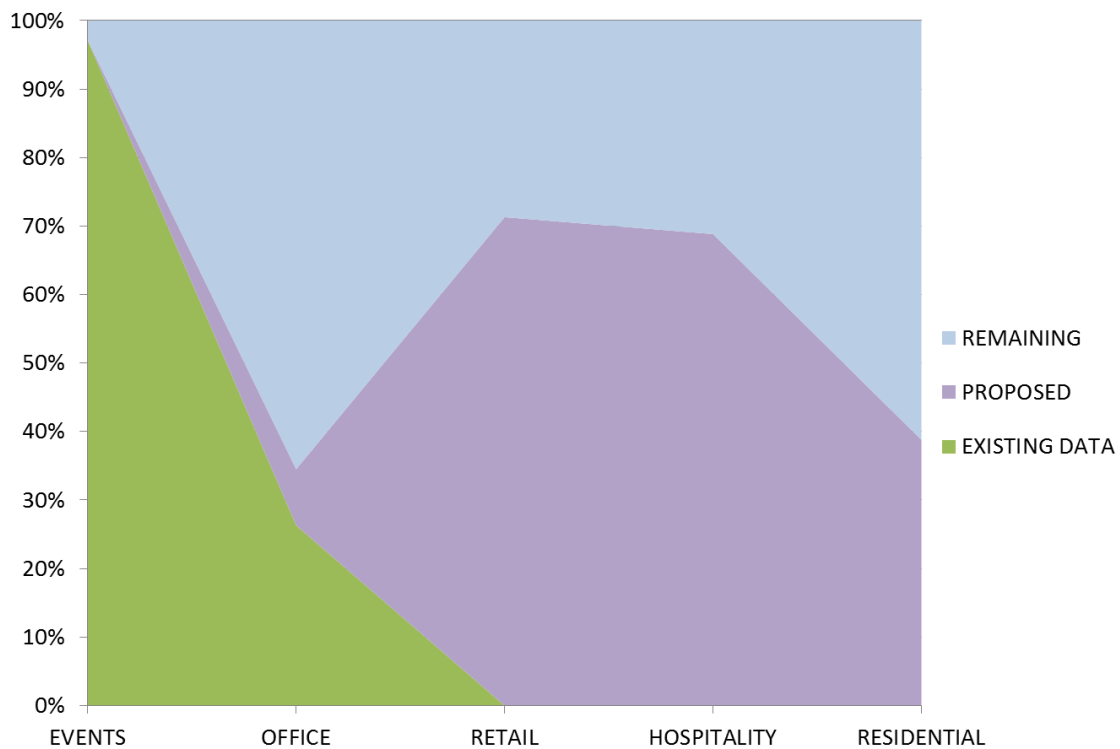


Figure 2.1: Coverage of waste stream data by building usage type

This level of material waste stream coverage is the most comprehensive dataset available and provides landfill-bound material composition data gathered from material assessments performed within the last two years.

Section 3: Material Characterization Assessments – Phase II

The following five buildings were proposed for material characterization assessments to add waste stream composition data to the existing Lloyd EcoDistrict dataset:

1. Double Tree Hotel (Hospitality)
2. Crowne Plaza Hotel (Hospitality)
3. Kaiser Permanente Administrative Headquarters (Office)
4. Calaroga Terrace (Residential)
5. Lloyd Center Mall (Retail) – two (2) proposed assessments

One material waste assessment, analyzing the contents of landfill-bound materials, was conducted for each building, except the Lloyd Center Mall where two assessments were conducted on two separate material loads (wet waste and dry waste). Each assessment was conducted at the Metro Central Transfer Station, except for Calaroga Terrace which was conducted on-site, where the contents of each building's landfill-bound container were transported.

The contents of each building's waste were hand sorted into multiple material categories (additional material categories were added when necessary for individual waste assessments and then combined for analysis), which were grouped into the following material classifications (details shown in table below):

- *Readily recyclable materials* are items that are collected by commercial haulers in the Portland metro area, most of which are required by Metro regional government to be recycled by businesses.
- *Other recoverables* are materials that cannot be recycled in the readily recyclable stream but can be diverted through specific additional recycling collection systems.
- *Non-recoverable materials* are items that cannot be diverted from the landfill through existing systems in the Portland Metro region due to lack of markets or processing facilities in the region.

Readily Recyclable	Other Recoverables	Non-Recoverable
Corrugated cardboard	Compostable food and fibers	Restroom waste
Mixed paper	Styrofoam	Single use cups (paper and plastic)
Mixed metals	Plastic film	To-go containers (paper and plastic)
Plastic bottles and tubs	Rigid plastics	Liquids
Glass bottles and jars	Wood	True waste
	Textiles	
	Vinyl	
	Office reuse/donation	
	E-waste	
	Fluorescent lights	
	Batteries	

Each material category was then separately weighed to determine the material composition, and percent of each material present, of the waste stream. Because materials are analyzed by weight, lighter materials such as plastic film and Styrofoam may represent a large percentage of volume but when considered by weight alone they may not appear as significant.

Each material assessment provides a “snap shot” of the type and amount of each material disposed in the waste stream during that generation period. The generation period varied depending on the building ranging from 24-hours to six weeks’ worth of materials. For buildings that had compactors (Double Tree, Kaiser, and Lloyd Center), the generation period ranged from one (1) week to six (6) weeks and a representative sample, estimated to be 10% by volume, was strategically extracted from throughout the load to be sorted. The material loads from Crowne Plaza and Calaroga Terrace were disposed in small dumpsters, during a 24-hour period, and CES was able to sort the entire load.

Section 4: Combined Landfill-Bound Material Composition Data – *Phase III*

The raw data from the individual building waste assessments was first compiled into one document and organized by material category. In order to apply the waste assessment findings from *Phase I* and *Phase II* to the entire district, the data needed to be extrapolated to a common generation period. CES utilized the following methodology to extrapolate the waste generation data:

1. Material composition findings were extrapolated to the entire load. For the buildings where a representative sample of the load was sorted (BPA, Liberty Centre, OCC, Moda Center, Double Tree, Kaiser, and both Lloyd Center assessments) the findings were extrapolated to include the weight of the entire landfill-bound load.
2. The material composition findings for each building were then calculated to represent one day (24-hours) of materials. To calculate this, the total weight of the landfill-bound load for each building was divided by the number of generation days, assuming an even amount of materials were generated each day.
3. The individual building data was then combined by building usage type and projected to represent all buildings of that type in the Lloyd EcoDistrict.

Table 2.4 below provides the extrapolated material generation and composition results, for one day (24-hours) and for one year, by building usage type for the entire Lloyd EcoDistrict.

Material Composition by BUILDING USAGE TYPE -Projected to entire LED (1 Day)

	OFFICE	EVENTS	HOSPITALITY	RETAIL	RESIDENTIAL	TOTAL	TOTAL %		1 Year	
CATEGORY	LBS	LBS	LBS	LBS	LBS	LBS	%		LBS	Tons
Corrugated Cardboard	40.87	65.28	16.74	156.88	10.92	290.70	1.91%	13.41%	106,106.13	53.05
Mixed Paper	345.17	147.95	86.69	376.81	54.05	1,010.68	6.65%		368,897.07	184.45
Metals	60.22	49.29	10.25	63.50	15.95	199.21	1.31%		72,712.32	36.36
Plastic Bottles and Tubs	96.38	93.59	23.54	141.32	13.51	368.34	2.42%		134,443.25	67.22
Glass Bottles and Jars	50.62	23.14	19.59	54.82	20.97	169.15	1.11%		61,738.54	30.87
Food and Fibers	1,724.25	1,097.64	209.59	1,663.23	1,232.08	5,926.79	38.99%	38.99%	2,163,276.94	1,081.64
Styrofoam	7.28	2.06	2.77	7.90	0.10	20.12	0.13%	8.99%	7,342.82	3.67
Plastic Film (Shrink, Bubble, Packaging)	192.44	116.12	10.56	248.30	11.54	578.96	3.81%		211,320.76	105.66
Rigid Plastics	96.02	110.83	8.68	138.34	16.15	370.03	2.43%		135,060.23	67.53
Wood	2.75	2.67	0.00	29.08	0.00	34.50	0.23%		12,592.66	6.30
Textiles	0.00	0.00	39.51	60.29	0.00	99.80	0.66%		36,428.53	18.21
Vinyl	0.00	1.65	0.00	0.00	0.00	1.65	0.01%		602.06	0.30
Office Reuse / Donation	17.73	11.57	29.51	91.37	36.67	186.85	1.23%		68,199.86	34.10
E-Waste	29.93	0.52	9.70	28.73	0.00	68.87	0.45%		25,138.69	12.57
Fluorescent Lights	0.00	0.00	0.00	3.91	0.00	3.91	0.03%	1,425.42	0.71	
Batteries	0.00	0.00	0.14	0.77	0.49	1.40	0.01%	510.64	0.26	
Construction	219.16	18.71	0.00	0.00	0.00	237.86	1.56%	38.62%	86,819.64	43.41
Restroom Waste	318.68	682.82	50.24	277.94	142.72	1,472.40	9.69%		537,426.84	268.71
Single Use Cups (paper and plastic)	98.52	24.28	11.08	234.50	35.23	403.61	2.65%		147,316.07	73.66
To-Go Containers (paper and plastic)	68.02	0.00	10.56	162.26	0.00	240.85	1.58%		87,908.54	43.95
Liquid	9.86	142.89	27.80	37.95	15.15	233.65	1.54%		85,282.41	42.64
True Waste / Non-Recyclables	1,021.06	1,299.47	258.47	476.88	227.10	3,282.98	21.60%		1,198,287.39	599.14
TOTAL	4,398.97	3,890.48	825.44	4,254.77	1,832.64	15,202.29	100.00%		5,548,836.80	2,774.42

Table 2.4: Landfill-bound material composition for the Lloyd EcoDistrict

Findings

The results from the material assessments and extrapolated data show that 15,203 pounds (7.6 tons) of landfill-bound materials are generated in the district in a one-day (24-hour) period. Projected out, the buildings in the district will generate 5,548,837 pounds (2,774 tons) of landfill-bound materials in one calendar year. District tonnage is based on conservative daily operation figures and does not account for special events or high traffic periods where material generation would be increased.

Within the landfill-bound materials, 61% could have been diverted, 13% is readily recyclable, 39% is compostable food and fibers, 9% is other recoverable materials, and only 39% is non-recoverable. Common materials found in the landfill-bound waste that could be diverted included:

- *Mixed paper* which represented 7% of all landfill-bound materials and 50% of the readily recyclable items.
- *Plastic film* which represented 4% of all materials and 42% of the other recoverables.
- *Rigid plastic* which represented 2% of the entire waste stream and 27% of the expanded recyclables.
- *Compostable food and fibers* which represented 39% of the entire waste stream.

The following were common recoverable materials observed within each building usage type (full data is available in **Appendix A**):

- **Office** (61% of materials could have been diverted)
 - » Readily recyclable materials represented 13% of the waste stream and these common recyclable materials included *mixed paper* (8% of all materials, 58% of readily recyclables) and *plastic bottles and tubs* (2% of all materials, 16% of readily recyclables).
 - » *Compostable food and fibers* represented the largest recoverable material, 39% of all generated materials.
 - » Other recoverable materials represented 8%, which largely consisted of *plastic film* (4% of all materials, 56% of other recoverable materials) and *rigid plastic* (2% of all materials, 28% of other recoverables).
- **Events** (44% of materials could have been diverted)
 - » Readily recyclable materials represented 10% of all materials, which largely consisted of *mixed paper* (4% of all materials, 39% of readily recyclables) and *plastic bottles and tubs* (2% of all materials, 25% of readily recyclables).
 - » *Compostable food and fibers* represented 28% of all materials.

- » *Plastic film* (3% of all materials, 47% of other recoverables) and *rigid plastic* (3% of all materials, 45% of other recoverables) were the most common other recoverables (6% of the entire stream).
- **Hospitality** (57% of materials could have been diverted)
 - » *Mixed paper* was by far the largest readily recyclable material representing 11% of the entire stream and 55% of the readily recyclable materials.
 - » *Compostable food and fibers* represented 25% of all materials.
 - » Other recoverables represented 12% of the materials and mainly consisted of *textiles*, representing 5% of all materials and 39% of the other recoverables.
- **Retail** (72% of materials could have been diverted)
 - » Readily recyclables represented a combined 19% of all materials, with *mixed paper* (9% of all materials and 48% of readily recyclables) and *cardboard* (4% of all materials and 20% of readily recyclables) as the most common.
 - » *Compostable food and fibers* represented 39% of all materials.
 - » *Plastic film* (6% of all materials and 41% of other recoverables) and *rigid plastic* (3% of all materials and 23% of other recoverables) were the most common other recoverable materials which represented 14% of all materials.
- **Residential** (77% of materials could have been diverted)
 - » Readily recyclable materials represented 6% of all materials, which largely consisted of *mixed paper* (3% of all materials and 47% of readily recyclables) and *glass bottles and jars* (1% of all materials and 18% of readily recyclables).
 - » *Compostable food and fibers* represented 67% of all materials.
 - » Other recoverables only represented a combined 4% of all materials.

Compostable food and fibers was the most common material found in the landfill-bound material stream for each building usage type that could have been diverted. The amount of readily recyclable materials found varied depending on building usage type ranging from 6% (residential) to 19% (retail and hospitality). Other recoverable materials were primarily found in hospitality (12%), and mainly consisted of textiles and items for reuse or donation, and retail (14%) which largely consisted of rigid and film plastics.

The material composition of landfill-bound waste generated in the district was then used to identify valuable materials and other alternative material management programs to economically benefit the Lloyd EcoDistrict.

Section 5: Cost Analysis

The material composition findings from the landfill-bound waste stream were used in a district-wide cost analysis that examined the costs associated with disposing of materials and the value of the materials within the waste stream. For this analysis the “disposal cost” only includes the charge that is incurred at regional transfer stations to dispose of materials (either by sending it to the landfill or to a composting facility). This cost is established and regulated by Metro (<http://www.oregonmetro.gov/index.cfm/go/by.web/id=31448>). Not included in “disposal cost” are the charges associated with an individual businesses’ service or hauling agreement with their commercial waste hauler. Because the City of Portland has an open market system for commercial waste hauling service, these rates are not regulated and therefore individual commercial waste haulers impose varying and inconsistent fees for service. This analysis utilizes the regulated disposal costs for non-recoverable landfill-bound materials and compostable materials and also assumes that there is not a cost associated with disposing of readily recyclable or other recoverable materials.

Using the projected Lloyd EcoDistrict material composition figures, the district is currently **paying \$1,432 per day** to dispose of the 15,202 pounds of landfill-bound material, or **\$522,680 annually**.

The value of the disposed materials was determined using secondary commodity prices of recyclable materials. Recyclable materials are considered secondary commodities because they are used as raw materials in the manufacturing of new products. Secondary commodity prices are based on two primary sources, the Official Board Markets (OBM) “Yellow Sheet” prices and the Standard Market Prices (SMP) index. OBM and SMP indexes are industry standard pricing guidelines for material suppliers, purchasers, and processors.

The landfill-bound materials stream contained 2,818 pounds of recyclable materials that are generated each day. This recyclable material could be sold as secondary commodities with a current market value of **\$183 per day** or **\$66,795 annually**.

Limitations

While the above cost analysis uses the most current disposal costs and secondary commodity prices, they only represent a portion of the costs associated with materials management in the district. Because the City of Portland has an open market system for commercial hauling, the cost of service for hauling is not regulated and varies significantly among the waste haulers providing service to the businesses in the district. Cost of service and hauling fees can be negotiated by individual businesses, however the disposal figures utilized in the above cost analysis are defined and regulated by Metro and apply to all commercially generated waste.

Another limitation to fully understanding the potential of an alternative materials management program in the district results from an incomplete look at district-wide materials data. The analysis herein only studied the landfill-bound material data to determine the potential revenue opportunities for the district and does not include commingled recycling materials. The majority of the secondary commodities value would be found within the commingled recycling material. With this in mind, CES estimated the quantity and secondary commodity value of the commingled recycling generated in Lloyd Ecodistrict. The proceeding section utilizes the estimated material composition figures to project the quantity and value within the district’s commingled recycling stream.

Section 6: Disposal Costs and Secondary Commodity Values

The following sections utilize the results from the comprehensive landfill-bound material stream data and the cost analysis to further evaluate potential materials management programs to benefit the Lloyd EcoDistrict.

Landfill Disposal Savings and Secondary Commodity Values

Further investigation of the cost analysis executed by CES shows the following different scenarios for Lloyd EcoDistrict to understand.

If all of the recoverable materials (readily recyclable, other recoverables, and compost) in the landfill-bound stream (61%) were properly diverted, the district would pay **\$553 per day** for landfill disposal. This would represent a potential cost **savings of \$879 per day**. These reduced disposal costs could result in a **yearly savings of \$320,835** across the district.

Compostable food and fibers represented 39% of the entire landfill-bound material generated in the district. The disposal of this material as landfill-bound waste costs the district **\$558 per day** to dispose of. If the district were to properly divert this material into the compost material stream the cost for disposal (as compost) would be **\$358 per day**, saving the district **\$200 per day**. Yearly, this could result in a **\$73,000 savings** for the district.

Within the landfill-bound materials are valuable secondary commodities. The most commonly found valuable materials were mixed paper, plastic bottles and tubs, and plastic film. If these three (3) materials were collected separately and processed and sold as secondary commodities direct to market, the district could **earn \$56,575 annually**. The potential earnings plus the avoided landfill disposal costs from removing these materials would result in **\$153,665 annually**.

An annual **savings of \$73,000** for properly diverting compostable food and fibers, or **\$153,665** for diverting mixed paper, plastic bottles and tubs, and plastic film from the landfill and processing it as a secondary commodity may seem insignificant to some of the larger businesses in the district, however that value could benefit the Lloyd EcoDistrict operations.

Comingle Recycling Material Composition Estimates

As previously mentioned, the above figures only represent the opportunities found within the landfill-bound material stream. To fully evaluate the benefits to the district through an alternative materials management program, a materials analysis for readily recyclable and other recoverable materials needs to be conducted to help create a baseline of all materials being generated in the district as well as determine the material composition.

In an attempt to estimate the potential value to the district found within the commingled recycling stream, CES estimated the total generation of commingled recycling in the district using the City of Portland business recycling requirements. Currently, all businesses within the city are required to divert 50% of the waste materials they generate from the landfill. CES assumed that all businesses within the district were meeting this requirement by diverting 50% of the materials gener-

ated in the district through commingled recycling. This assumption shows that the district generates approximately 30,405 pounds (15.2 tons) of waste materials in total each day (24-hours), which includes landfill-bound (15,202 pounds) and commingled recycling (15,202 pounds) materials.

To determine the material composition of the commercially-generated commingled recycling, the findings from the 2011 State of Oregon Department of Environmental Quality *Composition of Commingled Recyclables Before and After Processing* study was used (<http://www.deq.state.or.us/lq/pubs/docs/sw/CompositionCommingledRecyclablesBeforeAfter-Processing.pdf>). This study collected information on commingled recycling composition of residential and commercial loads. The following material composition was found to make up the commercial loads generated in the Portland metro area:

- Mixed paper 33%
- Cardboard 49%
- Plastic bottles and tubs 2%
- Mixed metals 3%
- *Film plastic 3%
- *Rigid plastic 2%
- *Other contaminants 8%

Materials with an asterisk are considered contaminants in the commingled recycling stream.

This material composition was then applied to the estimated weight per day of commingled recycling generated in the district. Table 3.1 below provides the estimated results.

		OFFICE	EVENTS	HOSPITALITY	RETAIL	RESIDENTIAL	TOTAL
	DEQ %	LBS	LBS	LBS	LBS	LBS	LBS
Mixed paper	33%	1452	1284	272	1404	605	5017
Cardboard	49%	2155	1906	404	2085	898	7449
Plastic bottles and tubs	2%	88	78	17	85	37	304
Mixed metals	3%	132	117	25	128	55	456
*Film plastic	3%	132	117	25	128	55	456
*Rigid plastic	2%	88	78	17	85	37	304
*Contaminants	8%	352	311	66	340	147	1216
TOTAL		4399	3890	825	4255	1833	15202

Table 3.1: Commingled recycling material composition estimates

The estimated daily generation of commingled recycling was then used to calculate the secondary commodity value within the material stream. If all materials were processed as secondary commodities, and were receiving their current market value, the district could **generate \$628 per day** or **\$229,329 annually**. The most valuable commodities would be cardboard, which could generate **\$141,255 annually**, and mixed paper, which could generate **\$46,720 annually**.

Estimated Landfill-Bound and Commingled Recycling Value

Using the cost analysis conducted for the landfill-bound materials and the secondary commodity value for the estimated commingled recycling, the Lloyd EcoDistrict could generate the following:

- Daily disposal **savings of \$879** by properly diverting all recyclable and recoverable materials found in the landfill-bound stream – **\$320,835 annually**.
 - » Daily disposal **savings of \$200** just by diverting compostable food and fibers from the landfill stream into the composting stream – annually **\$73,000**.
- Daily revenue **earnings of \$811** from secondary commodities generated in the district – **\$296,015 annually**.
 - » **\$183** generated daily for secondary commodities disposed in the landfill-bound materials stream – **\$66,795 annually**.
 - » **\$628** generated daily for secondary commodities disposed in the commingled recycling stream – **\$229,329 annually**.

The following section provides alternative scenarios for capturing the value, both from the secondary commodities being generated and the avoided disposal costs, as discussed above.

Section 7: Alternative Materials Management Programs to Capture Value

There are various examples of alternative materials management programs in the Portland area that generate value from their secondary commodities to help offset the costs of the program. The following programs, in place at the Port of Portland and Portland State University, generate value from the commingled recycling, while the program at Providence Healthcare generates value from materials that cannot be recycled in the commingled stream.

Portland State University, through their commercial hauler, receives a standard *floor rate* reimbursement price for their commingled recycling material each time a load is tipped at a Materials Recovery Facility (MRF). Floor rates are reimbursement prices that the MRF agrees to give individual waste haulers as a base rate per ton to pay for all of the commingled materials. The floor rate does vary as the OBM and SMP markets ebb-and-flow. However, in the case of this example, the hauler passes the floor rate reimbursement price directly back to PSU in the form of a quarterly check.

The Port of Portland utilizes a different approach for the materials that are generated at Portland International Airport. The Port receives market value for secondary commodity materials within their commingled recycling. A material composition assessment is conducted annually to determine the amount and type of materials present in a typical commingled recycling load. The material composition that is realized is then applied to the weight (as a percentage of the total) of the commingled recycling load picked up. The Port is rebated, based on individual material, for the projected amount of materials and the current secondary commodity price for each material within the commingled load.

Providence Healthcare employs a program that has received national attention for its ability to efficiently ensure maximum diversion while achieving cost offsets. Providence receives maximum value from the secondary commodities they generate utilizing a centralized material collection program, whereby specific materials are separated and transported to a centralized facility where they are then consolidated and sold directly to material vendors.

While the above examples are for individual organizations there are elements of each that can be applied to a district-level materials management program such as a district-wide floor rate for commingled recycling. Capturing value from secondary commodities using a program similar to the Port of Portland or Providence Healthcare are more difficult because the secondary commodities generated throughout the district would need to be collected. The following two models, based off elements of existing programs in the Portland area, are recommended as the most effective methods for capturing the secondary commodities generated in the Lloyd EcoDistrict.

Lloyd EcoDistrict Alternative Materials Management Program Recommendations

A **route-based model** utilizes an established route to collect materials from businesses on a regular schedule. Utilizing a route based model distributes the hauling costs among participating businesses, provides more frequent pick up of materials being generated from businesses, and ensures the vendor is maximizing their efficiency. The Port of Portland created a route-based model to

reduce the cost of compost collection service from Portland International Airport (PDX) with surrounding businesses in 2004, before the city had developed their current program. When the Port implemented their program, they were paying a higher hauling fee because the commercial hauler was sending one designated truck to PDX just to service a few compost collection containers. PDX was also responsible for the full cost of disposal and tipping fees at the local transfer station. By partnering with businesses that were located near PDX, the Port and the participating businesses were able to distribute the hauling and tipping costs across the multiple businesses. Because the commercial hauler was able to establish new contracts and maximize the efficiency of their route, the Port and participating businesses were able to negotiate lower hauling and service fees. This model additionally helps to guarantee the material vendor acquires a full load of material while allowing businesses that do not generate a large quantity of materials on a regular basis to participate in the new diversion program. In the case of the Port, the targeted material was compostable food and fibers, but this model could be expanded to include other specific materials such as cardboard, plastic film or other recyclable commodities.

Another alternative program to be considered is a **centralized materials recovery facility (MRF)**. This program would be similar to the program currently in place at Providence Healthcare. Providence has created a program where specific materials (both commingled and individual) are separated and collected from their different, geographically dispersed, buildings around the metro area. These materials are then transported, using their own trucks, to a central MRF where they are hand sorted by staff, processed, and then sold as secondary commodities directly into the market. Providence has created relationships with local material processors and vendors who will pick up and pay for the secondary commodities separated by Providence. This model allows Providence to ensure material quality and demand higher, less-volatile, commodity prices for the clean and processed materials. In addition, the program led to the development of ten jobs aimed at the underemployed.

Section 8: Next Steps

While this analysis provides the necessary data for understanding the Lloyd EcoDistrict's landfill-bound material stream, as the district moves toward developing alternative materials management programs that create value for the district, more data will be necessary. The value from the landfill-bound material stream can be realized through more efficient material diversion throughout the district and avoided landfill disposal costs. The landfill-bound material composition data showed that 61% of the materials being disposed could have been diverted, reducing disposal costs by **\$320,835 annually**. Included in those figures are compostable food and fiber materials that represented 39% of the landfill-bound stream and could **save \$73,000 annually** in avoided landfill disposal costs. Within the landfill-bound materials was **\$66,795** worth of secondary commodities, which if realized and combined with the avoided landfill disposal cost could **generate \$387,630** for the district annually.

Only a limited amount of secondary commodities are disposed in the landfill-bound material stream. The majority of the commodities are disposed through the commingled recycling stream. In order to fully understand the potential value of the commodities within the district, the material composition of the commingled recycling stream was estimated and then analyzed. The estimated figures showed that the district could potentially **generate \$229,328 annually** from secondary commodities located in the commingled recycling stream. Further detailed analysis of commingled and other recoverable recycling streams will provide a more complete view of the total material generation in the district and will allow for a more in-depth projection of the total secondary commodity values.

Once the commingled recycling and other recoverable material streams are analyzed and the true secondary commodity values are calculated, the potential value of various alternative material management programs can be evaluated. Currently, the Lloyd EcoDistrict, with assistance from CES, has partnered with a Portland State University MBA class to better understand two of the models discussed in this report: 1) a route based collection system; and 2) a centralized facility to collect materials and capture their secondary commodity value. The students will be conducting a financial analysis of the two different models to determine the total costs associated with operating each model, as well as using the findings from this materials infrastructure analysis to make financial estimates and evaluate potential for an alternative materials management approach that adds value for the Lloyd EcoDistrict.

With further analysis of the two alternative materials management models and a more complete understanding of the commingled recycling composition and other recoverable materials streams, the Lloyd EcoDistrict can continue to develop a district-wide materials management program that will capture value for the district while creating a more efficient and effective system.

Appendix A: Material Composition Data by Building Usage Type

Material Composition by BUILDING USAGE TYPE -Projected to entire LED (1 Day)

	OFFICE		EVENTS		HOSPITALITY		RETAIL		RESIDENTIAL	
CATEGORY	LBS	%	LBS	%	LBS	%	LBS	%	LBS	%
Corrugated Cardboard	40.87	0.93%	65.28	1.68%	16.74	2.03%	156.88	3.69%	10.92	0.60%
Mixed Paper	345.17	7.85%	147.95	3.80%	86.69	10.50%	376.81	8.86%	54.05	2.95%
Metals	60.22	1.37%	49.29	1.27%	10.25	1.24%	63.50	1.49%	15.95	0.87%
Plastic Bottles and Tubs	96.38	2.19%	93.59	2.41%	23.54	2.85%	141.32	3.32%	13.51	0.74%
Glass Bottles and Jars	50.62	1.15%	23.14	0.59%	19.59	2.37%	54.82	1.29%	20.97	1.14%
Food and Fibers	1,724.25	39.20%	1,097.64	28.21%	209.59	25.39%	1,663.23	39.09%	1,232.08	67.23%
Styrofoam	7.28	0.17%	2.06	0.05%	2.77	0.34%	7.90	0.19%	0.10	0.01%
Plastic Film (Shrink, Bubble, Packaging)	192.44	4.37%	116.12	2.98%	10.56	1.28%	248.30	5.84%	11.54	0.63%
Rigid Plastics	96.02	2.18%	110.83	2.85%	8.68	1.05%	138.34	3.25%	16.15	0.88%
Wood	2.75	0.06%	2.67	0.07%	0.00	0.00%	29.08	0.68%	0.00	0.00%
Textiles	0.00	0.00%	0.00	0.00%	39.51	4.79%	60.29	1.42%	0.00	0.00%
Vinyl	0.00	0.00%	1.65	0.04%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Office Reuse / Donation	17.73	0.40%	11.57	0.30%	29.51	3.57%	91.37	2.15%	36.67	2.00%
E-Waste	29.93	0.68%	0.52	0.01%	9.70	1.18%	28.73	0.68%	0.00	0.00%
Fluorescent Lights	0.00	0.00%	0.00	0.00%	0.00	0.00%	3.91	0.09%	0.00	0.00%
Batteries	0.00	0.00%	0.00	0.00%	0.14	0.02%	0.77	0.02%	0.49	0.03%
Construction	219.16	4.98%	18.71	0.48%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Restroom Waste	318.68	7.24%	682.82	17.55%	50.24	6.09%	277.94	6.53%	142.72	7.79%
Single Use Cups (paper and plastic)	98.52	2.24%	24.28	0.62%	11.08	1.34%	234.50	5.51%	35.23	1.92%
To-Go Containers (paper and plastic)	68.02	1.55%	0.00	0.00%	10.56	1.28%	162.26	3.81%	0.00	0.00%
Liquid	9.86	0.22%	142.89	3.67%	27.80	3.37%	37.95	0.89%	15.15	0.83%
True Waste / Non-Recyclables	1,021.06	23.21%	1,299.47	33.40%	258.47	31.31%	476.88	11.21%	227.10	12.39%
TOTAL	4,398.97	100.00%	3,890.48	100.00%	825.44	100.00%	4,254.77	100.00%	1,832.64	100.00%

Appendix B: Cost Analysis

Lloyd EcoDistrict Materials Infrastructure Analysis (1 day of generation) Landfill-Bound Materials

100% Diversion							
	MATERIALS	LANDFILL BOUND WASTE		Current Program (Disposal Cost)	Secondary Commodity Value	Effective Materials Management Program (Disposal Cost Savings + Secondary)	1 Year Extrapolation
		lb	%				
READILY RECYCLABLE	Corrugated Cardboard	290.70	1.9%	(\$27.37)	\$15.26	\$42.64	\$15,562.06
	Mixed Paper	1010.68	6.6%	(\$95.17)	\$25.27	\$120.44	\$43,959.62
	Mixed Metals	199.21	1.3%	(\$18.76)	\$4.78	\$23.54	\$8,592.05
	Plastic Bottles and Tubs	368.34	2.4%	(\$34.68)	\$66.30	\$100.99	\$36,859.63
	Glass Bottles and Jars	169.15	1.1%	(\$15.93)	\$0.00	\$15.93	\$5,813.61
OTHER RECOVERABLE MATERIALS	Compostable Food and Fibers	5926.79	39.0%	(\$558.10)	(\$358.21)	\$199.88	\$72,956.51
	Styrofoam	20.12	0.1%	(\$1.89)	\$0.00		\$0.00
	Plastic Film	578.96	3.8%	(\$54.52)	\$63.69	\$118.20	\$43,144.30
	Rigid Plastic	370.03	2.4%	(\$34.84)	\$7.40	\$42.24	\$15,419.15
	Wood	34.50	0.2%	(\$3.25)	\$0.00		\$0.00
	Textiles	99.80	0.7%	(\$9.40)	\$0.00		\$0.00
	Vinyl	1.65	0.0%	(\$0.16)	\$0.00		\$0.00
	Office Reuse/Donation	186.85	1.2%	(\$17.59)	\$0.00		\$0.00
	E-Waste	68.87	0.5%	(\$6.49)	\$0.00		\$0.00
	Fluorescent Lights	3.91	0.0%	(\$0.37)	\$0.00		\$0.00
	Batteries	1.40	0.0%	(\$0.13)	\$0.00		\$0.00
NON- RECOVERABLE MATERIALS	Construction Waste	237.86	1.6%	(\$22.40)	\$0.00	(\$22.40)	(\$8,175.37)
	Restroom Waste	1472.40	9.7%	(\$138.65)	\$0.00	(\$138.65)	(\$50,606.80)
	Single Use Cups (paper and plastic)	403.61	2.7%	(\$38.01)	\$0.00	(\$38.01)	(\$13,872.02)
	Single Use To-Go Containers (paper and plastic)	240.85	1.6%	(\$22.68)	\$0.00	(\$22.68)	(\$8,277.91)
	Liquid	233.65	1.5%	(\$22.00)	\$0.00	(\$22.00)	(\$8,030.62)
	True Waste	3282.98	21.6%	(\$309.14)	\$0.00	(\$309.14)	(\$112,836.73)
Total		15202.29	100%				

Lloyd EcoDistrict Materials Infrastructure Analysis (1 day of generation)

Commingled Recycling

		OFFICE	EVENTS	HOSPITALITY	RETAIL	RESIDENTIAL	TOTAL	Secondary Commodity Value	
	DEQ %	LBS	LBS	LBS	LBS	LBS	LBS	1 Day	1 Year
Mixed paper	33%	1452	1284	272	1404	605	5017	\$ 125.42	\$ 45,777.90
Cardboard	49%	2155	1906	404	2085	898	7449	\$ 391.08	\$ 142,743.83
Plastic bottles and tubs	2%	88	78	17	85	37	304	\$ 54.73	\$ 19,975.81
Mixed metals	3%	132	117	25	128	55	456	\$ 10.95	\$ 3,995.16
*Film plastic	3%	132	117	25	128	55	456	\$ 50.17	\$ 18,311.16
*Rigid plastic	2%	88	78	17	85	37	304	\$ 6.08	\$ 2,219.53
*Contaminants	8%	352	311	66	340	147	1216	-	-
TOTAL		4399	3890	825	4255	1833	15202	\$ 638.42	\$ 233,023.40

© 2013 Portland State University, all rights reserved. If any portion of the information contained herein is used, copied, displayed, distributed or referenced, attribution of such information shall be made to Portland State University and the College of Urban & Public Affairs: Community Environmental Services.

This information may only be used, reproduced, published or re-published, or otherwise disseminated by Lloyd EcoDistrict in accordance with the Contract Letter of Agreement, effective May 2013. The use of this information is intended for informational and educational purposes only, and selling this report, information, or any portion thereof is strictly prohibited.



COMMUNITY ENVIRONMENTAL SERVICES
Center for Urban Studies