Bin Half Full: Construction Waste Recycling Solutions

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Bin Half Full

Construction Waste Recycling Solutions

Master of Urban and Regional Planning Portland State University
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Project Description and Methodology

**Project Description**

According to the City of Portland’s Office of Sustainable Development (OSD), construction, remodeling, and demolition (CR&D) waste comprises 20 percent of the City’s waste stream. Additionally, per capita waste generation in this sector is increasing faster than in the residential or commercial sectors. However, the current amount of CR&D waste that is landfilled can be reduced: 90 percent of the waste from a typical project can be diverted from landfill disposal.

Although OSD currently requires that 50 percent of CR&D waste from every project is recycled, the City estimates that contractors recycle slightly less than this. OSD’s Portland Recycles! Plan (PRP) mandates that CR&D waste that contractors recycle or salvage and reuse increase to 75 percent of the total weight of a project’s waste by 2015.

This document synthesizes the findings of Project Team Bin Half Full (BHF) and provides recommendations to help general contractors meet OSD’s new mandate. Additional recommendations for haulers, facilities, policy makers and the recycling process are also provided.

**Methodology**

**Existing Conditions**

To formulate these recommendations, BHF identified existing conditions in Portland’s CR&D waste management system through interviews with the players in that system, including construction managers, haulers, facility representatives, and policy makers. We document the existing conditions as diagrams of the four possible pathways that waste can follow from the construction site to the landfill or secondary source. The pathways provide a backdrop for understanding where in the system barriers to recycling occur and where the barriers should be addressed as recommendations.

**Policy Analysis**

BHF analyzed relevant State, regional, and local policies through document review, online research, and interviews. The policies create the context in which the existing conditions exist. The analysis examines that context, identifying ways in which policy significantly affects the existing conditions. This informed our recommendations for policy makers in making PRP’s mandate easier to meet, and for contractors, haulers, and facilities in meeting the mandate.

Bin Half Full: Construction Waste Recycling Solutions - Master of Urban and Regional Planning Portland State University
Project Description and Methodology

Case Studies

BHF then performed case studies analyzing the waste management practices of six different construction or remodeling projects through interviews with construction managers and occasionally the hauler and facility associated with the given project. The case studies illustrate barriers to and achievements in recycling on individual projects and pathways used, informing our recommendations.

To ensure that we studied a representative sampling of cases, we categorized projects by characteristics such as LEED status and cost (please see the table on this page). We kept company names associated with the case studies confidential; BHF and OSD agreed that if the agency would like additional information the team will first contact the companies involved and secure their approval before revealing their names and contact information.

Findings and Recommendations

From these previous steps, BHF established findings resulting from: research and interviews documented in the policy analysis and case studies; additional interviews summarized in Appendix D; data analysis of Metro’s 2006 Building Contractor Survey; evaluation of OSD’s Recycling Plan Form; and review of other cities’ best management practices (BMPs) for achieving high recycling rates for CR&D waste summarized in Appendix A.

Our findings summarize the barriers and benefits that each player in the CR&D waste management system faces in each of the four pathways; and identify the two pathways meeting the single criterion in that they allow contractors to meet PRP’s mandate to recycle 75 percent of their CR&D waste.

We then formulated recommendations that utilize one or both of the chosen pathways. We categorized the identified barriers by type, such as space or cost barriers; and listed recommendations for each player for overcoming each type of barrier in a matrix and associated text.

Several recommendations are detailed further in the Appendices. BHF drafted a new Recycling Plan Form (Appendix C); explained non-recycling waste reduction strategies such as Advanced Framing techniques (Appendix B); and summarized other cities’ BMPs (Appendix A).

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Introduction

The existing conditions in Portland’s CR&D waste management system are depicted in the following diagrams. The conditions are organized into four pathways through which CR&D waste travels from the project site to its destination at a landfill or secondary source for recycled materials. These pathways are a Commingled Pathway, a Commingled and Source Separated Pathway, a Trash Only Pathway, and a Source Separated Pathway.

Later in this document, barriers and benefits will be associated with each pathway. Placing these barriers to recycling in time and space within the linear waste management system is vital in translating and understanding a complicated and multi-faceted problem into practical recommendations.
The Commingled Pathway provides one bin for all recyclable materials and one bin for trash. Trash is sent to a material recovery facility (MRF) or straight to a landfill, while the commingled bin is sent to a MRF or Recycling Center, or both. From these facilities, marketable materials are sent to secondary sources and all else is sent to the landfill.
The Commingled and Source Separated Pathway provides bins for some source separated items - usually the marketable materials such as metal, concrete, and wood - while the rest is commingled. Trash has its own bin, which is sent to a MRF or directly to a landfill. The commingled items are sent to a MRF or a Recycling Center or both, and the source separated items are sent to a Recycling Center or straight to a secondary source.
Existing Conditions: Trash Only Pathway

The Trash Only Pathway combines all trash and recyclables into one bin (this is considered a "mixed load"). This bin is taken to a MRF and its contents separated out and sent to Recycling Centers, secondary sources and landfills; or, the bin is taken directly to a landfill.
The Source Separated Pathway provides separate bins for each recyclable material, and an additional bin for trash. The trash is taken to a MRF or directly to a landfill, while the source separated items are taken to Recycling Centers or secondary sources.
Conclusion

These four pathways will be referenced throughout this document as they interact with State, regional and local policies in our policy analysis and as they are represented in our case study projects. The findings section of this document includes a summary of the barriers and benefits to each of these pathways as unveiled in our research, documented from the perspective of contractors, haulers, MRFs and recycling centers, and policy makers.
**Policy Analysis Introduction**

BHF’s analysis of relevant policies identified four significant ways in which these policies significantly affect Portland’s CR&D waste management system: (1) the Department of Environmental Quality (DEQ) has an important role in data collection and management of municipal recycling plans; (2) Metro’s recycling policies and the City of Portland’s recycling goals are irreconcilable; (3) haulers ignore the laws and policies that regulate them; and (4) OSD does not use their granted authority.

**DEQ’s Role**

Oregon Senate Bill 66 passed in 1991 with the express purpose of expanding recycling programs at the municipal level, exploring markets for additional recycled materials, and creating a State solid waste management plan through DEQ, which monitors compliance with State, Federal, and local laws as they pertain to solid waste.

The Oregon Revised Statute (ORS) 459 and House Bill 3456 further clarified DEQ’s role in solid waste management by allowing DEQ to enforce solid waste statutes and regional recovery goals, and to give approval of local waste reduction plans. DEQ also issues grants to local governments to encourage recycling, reuse, and waste reduction through local waste management programs, as well as administers tax credits to private companies for material and/or facility upgrades that will help to offset solid waste in Oregon. Through these incentives, DEQ supports local jurisdictions in their recycling efforts.

Oregon Senate Bill 66 requires that DEQ conduct an annual material recovery survey and a waste composition survey, which track the quantities and types of waste recovered per sector.

DEQ reports that one of the primary problems in calculating the material recovery rate is that the material processors routinely provide different recovery rates than the recycler (end user) reports receiving. In the case of a discrepancy, DEQ generally uses the recycler’s data rather than the processor’s data. This discrepancy may suggest that recyclers are over-estimating the amount of recovered material, skewing the recovery rates throughout the entire CR&D waste management system.

Nonetheless, various localities use much of the data obtained by DEQ to better understand and target specific components of their waste stream.
Analysis: Current Policy Review

The City of Portland & Metro

Portland’s Role
In June 2006, prompted by data from DEQ’s waste composition study indicating that at least 90 percent of Oregon’s wastestream is recyclable, Portland’s City Council directed OSD to develop a solid waste management plan. Goals of the resulting Portland Recycles! Plan (PRP) include reducing per capita waste generation to levels below 2005 by 2015, meeting a new recovery goal of 75 percent by the year 2015, and promoting the highest value use of recovered materials. DEQ data also lead to the conclusion that 20 percent of the wastestream is comprised of CR&D waste. As a result, a portion of PRP focuses on CR&D waste. Recommendations for the CR&D sector are to increase mandatory CR&D recycling to 75 percent, provide additional educational and technical assistance, improve verification of compliance, promote salvage, reuse and recycled content products in projects, and to “develop new hauler requirements and strengthen the regulatory approval process” by requiring that haulers provide “equipment and services to allow their customers to reach the 75 percent recycling goal.”

All of PRP’s recommendations for the CR&D sector focus on how construction companies and haulers can help to increase the recycling rate. The PRP does not have any regulatory control over MRFs or other end users.

Metro’s Role
Oregon Senate Bill 66 mandated that the State recover 50 percent of post-consumer waste by the year 2000. However, the State did not meet the mandate, and in 2001 the State Senate passed ORS 459A, extending the goal’s deadline to the year 2009 with an interim state recovery goal of 45 percent by the year 2005. The Statute also set target recovery rates for individual wastesheds and specified that the Portland Metropolitan wasteshed recover 64 percent of its total waste by 2009. As such Metro is required to meet a 64 percent recovery goal, while PRP requires that Portland meet a 75 percent recovery goal.

In order to help achieve a recovery rate of 64 percent, Metro originally created the Regional Solid Waste Management Plan (RSWMP) that targeted construction and demolition (C&D) waste by encouraging salvage and reuse, developing effective C&D recovery programs, and supporting markets for recyclables. Through a variety of programs involving educational outreach, waste prevention, online services, and facility regulation, Metro has successfully ushered the region into a 53 percent recovery rate. However, based on current recovery trends, RSWMP will not meet the 64 percent recovery rate, primarily due to unrecovered materials remaining in the commercial, organics, business, and C&D waste streams.

In 2007, Metro created the Enhanced Dry Waste Recycling Plan (EDWRP) to help meet the regional recycling goal by 2009. Specifically targeting the C&D communities’ impact on waste, EDWRP requires that every mixed dry waste load, trash load, and commingled load be processed at a MRF before it reaches a landfill. Materials targeted for recovery are those with existing reliable markets, including wood, yard debris, metal, plastics, cardboard and paper.
Analysis: Current Policy Review

Beginning in January of 2009, EDWRP will change the way recovery is measured, which may increase the facilities’ recovery rates. Previously, loads entering MRFs were subject to a 25 percent minimum recovery rate, which was measured at the “front end” of the recovery process, which means that MRFs were required to retrieve 25 percent of the incoming load for recycling. This became problematic if recyclables comprised less than 25 percent of the original load. Loads that came in without a lot of recyclables would not allow the recovery facility to meet Metro’s goal. This led to facilities rejecting these loads and forcing haulers to go elsewhere. Under EDWRP, designated recyclables can comprise no more than 15 percent of the residual of landfill-destined load. This new method of measuring will eliminate the facilities’ concerns with loads that do not contain a lot of recyclables. Under this measuring scheme, small pieces of recyclable material do not have to be recycled as they are not counted against the facility in estimating its 15 percent residual.

Comparing PRP and EDWRP

Metro’s EDWRP and OSD’s PRP target the C&D wastestream at different points in time and space. OSD targets the wastestream onsite, at the beginning of the C&D process, and when the waste is in route to the landfill or to be recycled. Metro targets the wastestream towards the end of the process once the recyclables or trash have been received by the landfill or MRF.

However, neither policy guarantees that contractors will meet the City of Portland’s new 75 percent mandate. Even when a contractor attempts to comply with Portland’s recycling mandate, once the waste leaves the site, it is out of the contractor’s control. Contractors rely on haulers to get their waste loads to the correct location and haulers rely on MRFs to separate out recyclables from trash in an efficient and cost-saving manner. The process of CR&D waste management is one system that is regulated by two policies and two agencies’ mandates. When contractors are unable to source separate their materials, they rely solely on MRFs to meet PRP’s mandates: but MRFs are not bound by PRP’s mandate.

Further complicating the picture is EDWRP’s technique for measuring recovering rates and the reliance on self-reporting from all sections of the process. According to several interviews with MRFs, components of residual CR&D debris are quantified through visual assessments of individual loads. Without accurate measures assessing the current state of the CR&D recycling system, future compliance with new mandates is difficult.

Hauler Regulations

Along with increasing recycling rate goals throughout the state, ORS 459A made it illegal for waste haulers to charge more to haul recycled materials than to haul landfill-destined materials. ORS 459A also requires haulers to provide recycling “options” to customers in any municipality with a population of 4000 or more.
This mandate to haulers was further enforced through Portland’s City Code (Chapter 17) which requires that any hauler disposing of recyclables may charge less, but not more, for the removal of source separated materials. Chapter 17 of the Portland City Code also requires OSD to collect commercial solid waste collection permits and gives the Director of OSD the authority to impose fines of up to $1500 per incident to any hauler that is in violation of commercial permit regulations.

Portland Administrative Rules for Commercial Solid Waste, Recycling, and Compostables also place restrictions on haulers by requiring them to keep an accurate and up-to-date record regarding the disposal, recycling, and origin of any load ten cubic yards or larger and submit quarterly reports of their waste to OSD (Rule 4.4 D1). The Rules also reiterates ORS 459A, requiring contractors to offer recycling to all customers and provide customers with basic recycling information.

A contractor must submit the Portland Recycles Plan Form (the same form contractors must submit to OSD) to a city-permitted hauler so that the hauler can meet the recycling needs of the customer, as haulers are mandated to do under ORS 459.A070 and City Code Chapter 17.102.

According to the interviews conducted during this analysis, not all haulers are providing adequate recycling options for their clients. This is due to the unique pricing structure of the CR&D hauling industry, which differs substantially from the pricing structure offered to residences and businesses with regular weekly service. Additionally, the clients are not providing the hauler with their Recycling Plan Forms.

Although Portland’s Administrative Rules explain that the failure of businesses or haulers to implement Portland’s commercial recycling requirements is considered an infraction punishable by up to $500 for the first incident (Rule 4.5 B9), this is rarely enforced.

OSD’s Unused Authority

Through several policies that pertain to solid waste management, OSD has the authority to fine and to regulate. As mentioned above, Chapter 17 of Portland’s City Code and Portland’s Administrative Rules provide the Director of OSD with the ability to enforce regulations that are placed on the CR&D wastestream. However, interviews from OSD, construction companies, and haulers revealed that these regulations are not enforced.

City Code also gives the Director of OSD the authority to adopt administrative rules regarding the collection of solid waste and recycling in the City of Portland urban services area. However, if these rules are not enforced they may not be followed. In interviews, construction and facility managers consistently suggested enforcement as the best way for the industry to meet PRP’s 75 percent recycling mandate.
Analysis: Current Policy Review

Portland’s Administrative Rules give Portland the ability to regulate contractors and force them comply with mandates. One way that Portland has done this is through the Portland Recycles Form. However, it became evident in interviews that not only is this form rarely filled out, it does not provide much information and is rarely looked at by OSD.

Policy Analysis Conclusion

The policy analysis shows that there are ways in which policy helps recycling efforts and ways in which policies can work against each other. Policies are in place which support DEQ’s goal to help local jurisdictions recycle, direct haulers as to how to assist construction companies in meeting recycling mandates, and authorize OSD to enforce policies that encourage recycling.

However, OSD’s lack of enforcement and haulers’ inability to provide the types of recycling support that construction companies need have proven to be weak links in achieving higher recycling goals in the City of Portland. Construction companies rely on others to achieve PRP’s mandate who are not held to the same standards.

Further, Portland’s recycling plan and Metro’s recycling plan are at odds with one another and do not support each other in reaching a united goal. Without the ability for Portland to hold MRFs to the same 75 percent recovery goal, the likelihood of these facilities recovering this amount of recyclables is low.
Analysis: Case Studies

Case Studies Introduction

Case Studies were employed to examine how construction companies exceed, meet, or fail to meet OSD's goals and mandates. Projects were first selected by identifying a variety of characteristics such as cost, LEED status, and location in order to ensure a representative sample of Portland's CR&D industry. In each project chosen for a case study, vital statistics are identified that make the project unique. Each case study also identifies which pathway was used for the specific project as described in Existing Conditions, and, finally, barriers to each of the case studies are identified, with the barriers specifically called out for easy reference.

These case studies provide an understanding of the conditions that construction companies face in Portland today, with a description of each project, the company's waste management plan, and recycling challenges and solutions each project faced.
Recreational Facility Redevelopment Case Study

Description: Currently under construction, this 4-story new recreational facility includes amenities such as basketball courts, changing facilities, swimming pool, and workout equipment. This project is currently pursuing LEED Platinum with aspirations of recycling 95 percent of its construction waste.

Company Waste Management Plan: The construction company contracted for this project is known as a leader in construction sustainability. The company hired an Environmental Manager who developed methodologies for high recycling rates and tours each project site periodically to check on compliance. Prior to contracting with a dry waste recovery facility, the company will tour the facility and will continue to tour the contracted facility once a year in order to ensure high recycling rates are achieved. Over the last seven years the company has saved over a million dollars worldwide due to construction waste recycling. The company set the goal of an average 90 percent recycling rate for all of its projects, measured by weight. Currently, it is recycling at an average 75 percent world-wide. The company tracks demolition and construction waste both as part of the LEED requirement and as part of the company’s policy.

PATHWAY: Source Separation and Commingled

BARRIERS: Lack of secondary sources

Subcontractors tend to bring 10% more material on site than needed
Recycling Challenges and Solutions: With nearby vacant space, this project is source separating metal, wood, concrete, plastic, cardboard, and paper. The remainder is thrown into a commingled dumpster and taken to a MRF. The company expects recycling rates on this redevelopment site to be high, as demolition waste is 95-99 percent recyclable. The construction company did not believe it could achieve 95 percent recycling rates had it not been for the inclusion of demolition.

This early in the project, the construction company has not yet faced many challenges. It anticipates difficulty recycling drywall and Styrofoam, which are used in large quantities on construction sites and are extremely hard to recycle in the Portland area. According to the company, there are only one or two places to recycle these materials; the company has found that the materials may not actually be recycled at these locations, which increases cost for additional movement of the material. A possible remedy to this problem would be to more closely monitor secondary sources.

For this project, as with most projects, the company’s representative noted that each subcontractor brings approximately 10 percent more material onto the site than they actually need. This allows subcontractors to waste materials, creating additional unused material such as smaller pieces of wood. Currently, these materials are put into the dumpster and left to be recycled or thrown into a landfill. The company representative believes that in order to reduce total waste, there should be some regulations for subcontractors.
University Renovation Case Study

Description: This University is renovating its engineering building and will add 40,000 square feet to make it the largest building on campus. Renovations include new laboratories, larger classrooms, and upgraded water and electrical infrastructure. This project began in January and CR&D waste data is available for only the first month at this time.

Company Waste Management Plan: The construction company assigns a specialist to every project to develop an extensive construction waste management plan and to track monthly progress toward construction waste reduction goals. The plan tracks the type and amount (in tons) of waste material generated, which facility the material is sent to, and how the company reused, recycled, or disposed of the material. Information is tracked through an online waste tracking system. Each month, the specialist calculates the percentage of material diverted from the wastestream and submits these data to compile a company-wide report.

The construction company also developed a field check-list of construction waste reduction practices for the specialists to reference that is designed to help projects earn LEED certification. The construction company aims to recycle 95 percent of the CR&D waste produced through reuse and recycling practices.

Recycling Challenges and Solutions: Due to site size constraints on campus, there is not enough room to source separate onsite. Recyclable C&D waste is collected in commingled drop-boxes. The construction company has contracted with a hauler that brings the commingled recyclables to the nearest MRF. If the construction company finds that the diversion rate for commingled recycling is less than 50 percent for any MRF, its policy is to source separate at least some of the recyclables such as concrete and steel.

The MRF that receives this project’s waste receives 150-170 loads of CR&D waste per day and sorting each load takes up to 1.5 hours (the MRF relies on a pick-sorting method). The driver who delivers the drop-box to the MRF visually estimates the percentage of recycled and land-filled material per drop box, a challenging task. The MRF claims to meet a 95 percent recycling rate.

PATHWAY: Commingled and Source Separated

BARRIERS: Site constricitions on campus prevented source separation

Cost - Hauling rates for commingled and source separated materials were identical
The hauling company provides receipts to the contractor based on the recycling rate of each load for its internal and LEED record-keeping. The hauler would prefer to use a more scientific method for estimating the percentage of recycled content load by load, but no immediate solution seems apparent. The hauling company would like the LEED program to provide more direction in addressing this challenge.

The hauler charges the construction company $74 per drop box load plus a $22 fuel surcharge, totaling $96 per load. This fee applies both to source separated and commingled recycling regardless of whether the destination is a MRF, recycling center, or landfill, but rates do vary by the location of the facility. Therefore, depending on the location of the local landfills and MRFs, the construction company may experience either a savings or incur an increased cost by recycling construction waste.

In addition to recycling goals, the contractor reused demolition materials on the remodeled building as a strategy for reducing their construction waste. The demolition company saves the bricks from the old university building, stores them on their property, and returns the bricks to the site for later use. The contractor estimates that the project can reuse 60 percent of the salvaged brick for the new building’s façade. Concrete rubble is also reused onsite, by crushing it and then reusing it for concrete pours during new construction. The demolition company also removes the aluminium from the windows and separately recycles it for a profit.

After the first month of demolition, the project has achieved a recycling rate of 93 percent, just shy of its target of 95 percent. Out of a total of 365.91 tons of C&D waste produced in their first month, the contractor reports diverting 198.26 tons of concrete, 31.07 tons of metal, 33.57 tons of wood, and 78.01 of miscellaneous tonnage (such as bricks) from the landfill.
Analysis: Tenant Improvement Case Study

Tenant Improvement Case Study

Description: Currently undergoing renovation, this tenant improvement (TI) project is for a commercial space that encompasses 7,500 square feet. Once completed, the building will house a restaurant. The total cost of the project is estimated at 3.5 million dollars. Most of the expense comes from the appliances required for the restaurant.

Company Waste Management Plan: The construction company contracted for this project has started to address recycling internally through its “Green Team Committee.” This team is developing a document similar to that required by LEED to track construction waste. As of April 2008, the company estimates that it recycles 50 to 75 percent of the construction waste it generates per project.

Because this is a restaurant, there is not as much recyclable material as is normally associated with TI projects. The construction company performing the work is utilizing the option of weighing the material to keep track of recycling. As of April 2008, the project generated 46,480 pounds of construction waste. 52 percent of this was landfilled and approximately 48 percent of it was recycled. Once finished, the project will yield an estimated recycling rate of 75 percent due to the project-induced increase in wood and scrap metal, easy to recycle, that will come with the next phase of the project.

Recycling Challenges and Solutions: As with most TI projects, site size is very constrained. 7,500 square feet of space does not allow for the number of bins required to source separate all recyclable material. Fortunately, the project is adjacent to vacant land owned by the City of Portland. The construction company and the City have worked out an agreement that allows the waste and recycling bins to be located on the vacant land as long as the construction company pays a portion of the property taxes. The vacant land is also being utilized by other companies, which allows the cost to be shared.

PATHWAY: Source Separation & Commingling

BARRIERS: Space - Due to existing building size

Construction Debris - Large appliances have styrofoam

Crew Apathy - Lack of crew participation
Analysis: Tenant Improvement Case Study

Although the type of bins have varied during the different phases of the project, in general, the project has source separated wood, metal, and Styrofoam. All other forms of recycling such as cardboard, cans, bottles, and paper are commingled. Once a week, the contracted hauler picks up the bins and disposes of, or recycles, the waste. The hauler charges $125 per trip and an additional tipping fee depending on the material. The construction company saves money recycling by paying lower tipping fees for certain material such as wood. Also, the hauler does not charge the construction company to pick up commingled loads. However, at this point the exact amount saved from recycling is unclear since the company has not tracked this figure.

One of the struggles the construction manager is facing is apathy towards recycling from his crew. In order to combat this and encourage recycling, the construction manager placed one of his crew members in charge of overseeing the recycling efforts. This has allowed a sense of ownership from certain crew members and has helped to increase the recycling efforts. The construction manager has also saved some of the highly valued marketable recycling material, such as metal, and has received enough cash to pay for his crew’s lunch a few times.

VITAL STATISTICS

Type: Restaurant
Size: 7,500 SF
Cost: $3.5 Million
C&D Waste: 46,480 lbs
Landfilled: 24,240 lbs
Recycled: 22,240 lbs
Styrofoam: 8,500 lbs
Wood: 3,440 lbs
Metal: 7,800 lbs
Comingled: 2,500 lbs
LEED Status: N/A
Affordable Housing Case Study

**Description:** This affordable housing project is currently underway and involves new home construction. The project hopes to achieve LEED Gold for residential construction.

**Company Waste Management Plan:** The construction company contracted for this project specializes in market-rate and affordable infill housing in the Portland area. Despite this specialization, the company’s fees remain competitive with its conventional counterparts. The high recycling rates achieved by this company do not preclude it from competing successfully in this market. One way it keeps costs down is by cultivating good relationships with its waste haulers and, over the years, has been instrumental in facilitating relationships between waste haulers and recyclers and between recyclers and secondary markets.

The construction company has recycled construction debris for over thirty years and the company’s recycling plan has evolved along with the growing market for recyclables. Currently, the company’s strategy involves source separating the majority of its construction debris. It also has one four-yard bin for commingled recyclables, which involves primarily contractor lunch debris and plastics. Because the company is committed to recycling and is a contractor on LEED projects, it pays for this bin to be sorted at a MRF. It is through this strategy that the company is able to achieve a 95-99 percent recycling rate on any given project. As of February 2008, this project had an overall recycling rate of approximately 98 percent.

**PATHWAY:**
Source Separation & commingled

**BARRIERS:**
None; they regularly overcome all barriers in order to achieve a 98-99% recycling rate
Recycling Challenges and Solutions: The construction company believes it is cheaper to recycle than pay for waste loads to be landfilled. In order to reduce the consumption of materials at the onset of project construction, the company uses wood forms for concrete and employs advanced framing techniques (Appendix B).

Space is a barrier to source separation on this small residential infill project. However, the company manages space creatively by staggering the delivery of materials or waiting until materials are consumed before ordering recycling bins.

Because all of the company’s subcontractors are contracted in-house except for sheetrockers, the contractor is able to cultivate best management practices amongst their employees. (The company only contracts with sheetrockers who haul their debris to a sheetrock recycling facility.) The company holds a preconstruction meeting with all of its contractors to comprehensively analyze the building’s plans and identify where waste generated by one contractor can be reused by another. While this meeting can be time-consuming, the money saved on both construction materials and waste hauling makes it financially viable.

VITAL STATISTICS

Type: Mixed-Use Infill, Residential Affordable, For-Sale Housing

Size: 48,000 sq ft

Cost: $4 million

CR&D Waste: Recycled: 98%

LEED Status: Pursuing Gold
**Residential Remodel Case Study**

*Description:* This recently completed project added a free standing 800 square foot accessory building on a residential lot in NE Portland.

*Company Waste Management Plan:* This residential remodeling company markets itself as a sustainable business, and as part of its mission is committed to recycling. However, because the company’s projects vary between demolition, remodeling, and new construction, its recycling plan varies from site to site depending on the materials associated with a specific project. Generally, however, the company owns a trailer reserved primarily for wood and/or cardboard debris, which it then self-hauls at the end of a project. For metals, it stages an area on the job site and either contacts a local scrap metal collector for removal or self-hauling. For other waste such as plastic from lunch debris, and because its crews are small, it uses its clients’ recycling bins. The company also puts small wood scraps in yard debris bins. Through these actions, the company estimates that it achieves a recycling rate of around 90 percent per project. However, the company is not involved in projects that are currently available for LEED certification and has not started tracking recovery rates on its own.

In addition to a commitment to recycling, price also drives many of the recycling decisions the company makes on a given project. In the past, the company used commingled bins contracted from recycling haulers, but it often finds that self-hauls source separated materials is cheaper than either paying for a hauler or disposing of commingled loads at Metro. Self-hauling is a viable option for the company in part because the majority of its projects are in NE Portland, which has a number of convenient recycling facilities. However, when needed, they have used Metro’s Toolkit to locate haulers and facilities. Overall, the company does not feel that there is a shortage of educational materials available to contractors.
Recycling Challenges and Solutions: Because of this company’s small size, sheet-rock remains the most difficult material for it to recycle. It is aware of only one sheetrock recycling facility in Clackamas, but it is cost prohibitive on this site to haul the small amount of sheetrock waste it generates the hour round trip it takes to drive there. Space for source-separated recyclables is also an issue; however, the company has been able to work around it by utilizing creative techniques such as storing metal or cardboard under the trailer until it can be hauled.

As part of its commitment to sustainability, this company tries to use salvaged material whenever possible. Although the time associated with salvaging can sometimes be prohibitive, the accessory building in this project included double-paned windows recycled from Builder’s Supply and wood from The Rebuilding Center.

In order to increase recycling efforts on this site and others, the company’s owner is taking coursework in the sustainable building advisory program through Portland Community College to further educate himself about sustainable building techniques. He has taken several courses in advanced framing techniques and believes that it is a viable method for reducing construction material consumption, as it was on this project.

Although the company is familiar with the City of Portland’s Recycling Plan Form, it does not generally fill it out because it believes that the form is not mandatory. The company is also aware of the City of Portland’s mandatory recycling rate, as well as its plans to increase the rate to 75 percent. Because it already exceed this rate on most projects, reaching a 75 percent recycling goal will not be difficult.

VITAL STATISTICS
Type: Mixed-Use Free Standing Accessory Building, Residential and Retail
Size: 800 sq ft
Cost: $80,000
CR&D Waste: N/A
Company does not gather this information
LEED Status: none
Analysis: Mixed-Use Development Case Study

Mixed-Use Construction Case Study

Description: Currently under construction, this mixed-use project is a 31-story residential building with 17,000 square feet of ground floor retail. This project is currently pursuing LEED Gold, with aspirations of recycling 75 percent of its construction waste.

Company Recycling Plan: The construction company contracted for this project has worked on many similar LEED projects and has developed an internal spreadsheet to keep track of LEED requirements. However, in projects without the LEED requirement for construction waste, the company does not track any waste, recyclable or not, after it exits the site. In these cases, there is normally one drop box for all mixed waste, with metal as a possible exception because of its high value.

In February 2008, the building had most of its frame in place. During this phase of construction, there was an enormous amount of recyclable concrete and steel present on the project site. For this reason, the project was recycling 97 percent of the 944 tons of waste that had been generated on site by that time. Once the building begins to add drywall and other interior components, the company expects that the recycling rate will decrease.

Recycling Challenges and Solutions: Using LEED guidelines, the construction company is source separating wood, metal, and concrete, while commingling the other materials in a separate bin. This commingled approach is not due to site constraints but rather to the hauler’s limited resources. The hauler does not supply construction companies with separate recycling bins for plastic or cardboard, which is something that the construction company for this project specifically asked for and was denied. Therefore, the construction crew must throw paper, cardboard, and plastic into the commingled bin with trash, drywall, and other material, thus possibly reducing the recycling rate of the project.

PATHWAY:
Commingled and Source Separated

BARRIERS:
Hauler does not provide requested bins
Bin confusion and crew apathy increased material contamination
Also, the construction company noted that it received the City of Portland’s Recycling Plan Form each time it pulled a permit for a change order on the project. By February 2008, the construction company had filled out 28 of these forms and submitted them to the City.

The MRF accepting this project’s commingled loads estimates the amount of recycled material for LEED requirements simply by looking at the load. According to the facility’s representative, additional weighing presents a prohibitive cost to the construction company. Because the facilities self-test, most facilities do not accurately report their numbers. In fact, this individual had haulers/other facilities describe the ways in which to “cheat the system.” In an attempt to rectify this situation, the representative believes that Metro should install a third-party monitoring system so that everyone is held accountable to the same standards.

The MRF believes that it recycles more than other facilities because they do not have access to a landfill. According to the facility representative, the difference in cost to landfill versus recycle the materials is so miniscule that those recycling facilities with a landfill will tend to throw commingled loads away, rather than taking the time to recycle. Additionally, the facility representative believes MRFs are turning away loads they believe will not allow them to meet Metro’s current requirements. Instead, these loads end up in landfills. Due to the risk of rejection from facilities, some haulers have been “conditioned” to drive their loads straight to landfills if they believe their loads do not contain enough recyclable materials. While this problem may be resolved with EDWRP’s new mandate requiring all loads to be MRFd, this has yet to be confirmed, and may continue to lead to an unknown quantity of recyclable materials ending up in landfills.

Overall, the MRF representative believes that this commingled and source separating approach jeopardizes the MRFs by reducing their recycling rates, as all of the marketable materials are source separated and sent directly to secondary sources. Furthermore, the MRF believes that all materials should be commingled, as contractor confusion and contamination is a problem, and as such, this MRF considers even source separated bins “contaminated” and must utilize labor to separate out materials, making the initial source separation process inefficient and ineffective.

**VITAL STATISTICS**

**Type:** Mixed-Use, Residential and Retail Construction

**Size:**
- 545,000 sq ft
- Residential 17,000 sq ft
- Ground floor Retail

**Cost:** $150 Million

**C&D Waste:**
- Produced: 944 tons
- Recycled: 97%
- Target: 75%

**LEED Status:** Pursuing Gold
Findings and Recommendations

Introduction

Discovered through the policy analysis, case studies, and additional research, the barriers and benefits of the four pathways and the CR&D waste management system in general have been summarized in the matrices on the following two pages. It was found that only two of the four pathways allow contractors to meet PRP’s 75 percent recycling mandate and EDWRP’s 15 percent residual rate mandate. These pathways are the Source Separated and Source Separated & Commingled Pathways.

The Commingled Only and Trash Only Pathways do not currently have the ability to meet the new mandates. However, it was found that a high recycling rate using a strictly commingled approach was possible in theory, but was not assured for two reasons: 1. Metro’s 15 percent residual requirement for MRFs does not coincide with the City of Portland’s 75 percent requirement, and as such, there are no guarantees that the MRF will hit the required mandate; and 2. Metro allows the MRFs to self-test, which poses the opportunity for fraud, and thus, lower than perceived recycling rates. Because there are complications associated with the two policies and issues concerning regulation associated with the commingled approach, source separation was found to provide the highest “assured” rates of recycling. The fourth pathway, the Trash Only, was immediately discarded as it afforded the least amount of assurances for high recycling rates.

Recommendations were formulated for overcoming the barriers along the two chosen pathways, increasing CR&D waste recycling and improving the efficiency of the operation of the overall waste system. To present these recommendations, the plethora of barriers that are documented in the Barriers Matrix on the following page were organized into several categories: space, cost, waste management tracking, C&D waste tracking, and communication/recycling ethic. These categories, and recommendations for overcoming them for each player in the CR&D system, are presented in our Recommendations Matrix and associated text. Additional recommendations requiring further elaboration are in the Appendices.
| Barriers                          | Commingled Pathway                                                                                                                                                                                                 | Commingled and Source Separated                                                                                                                                                                                                 | Trash Only                                                                                                                                                                                                 | Source Separated                                                                                                                                                                                                 |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Material Recovery Facilities** | 1. More labor intensive due to EDWRP targeted materials and non-EDWRP materials are commingled. 2. Commingled loads are more likely to be dirty/damaged and will not be marketable.                                                | 1. Potential reduction in MRF recycling rates due to dirty material and construction companies recycling marketable materials themselves.                                                                                                                                 | 1. Potential reduction in MRF recycling rates. 2. Significant contamination from C&D and wet waste. 3. Significant increase in manpower with significantly lower returns. 4. Makes it more difficult to meet EDWRPs goals.                                       | 1. Decreases profits because marketable material is recovered by contractor.                                                                                                                                                                                                 |
| **Haulers**                      | 1. Loads that only contain trash may not be accepted by MRFs.                                                                                                                                                           | 1. Could be turned away because of “clean” loads with low profitable material.                                                                                                                                                                                                         | 1. Not as much profit generated due to limited number of bins on site.                                                                                                                                                                                                                  | 1. More likely to be turned away from MRF due to unprofitable loads.                                                                                                                                                                                                       |
| **Construction Companies**       | 1. Tipping fees for commingled loads are normally the same as tipping trash. 2. May not be able to meet LEED standards or PRP mandate.                                                                                   | 1. Extra bins may result in confusion and could significantly contaminate source separated bins.                                                                                                                                                                                    | 1. Will not be able to meet LEED standards or PRP mandate.                                                                                                                                                                                                                           | 1. Space Constraints. 2. Apathy from crews. 3. Higher overall hauling fees occur 4. More manpower/effort, increased costs and loss of time. 5. Potential need for additional haulers/contracts.                                       |
| **Recycling Centers**            | 1. All loads received must be sorted, increasing costs. 2. Commingled loads are more likely to be dirty/damaged and will not be marketable. 3. Less marketable material to sell.                                               | N/A                                                                                                                                                                                                                                                                                   | 1. Relies solely on MRFs for profit generation. 2. Most likely will not be able sustain this process.                                                                                                                                                                               | 1. If supplier demands completely clean loads then source separated loads will be MRFd, Increasing the cost of the load. 2. Source Separation is not 100% recyclable due to damage from transportation and contamination.                                |
| **System as a Whole**            | 1. If its not one of EDWRP targeted materials then it is more likely that it will be landfilled. 2. Smaller material will be landfilled. 3. Material is more likely to be dirty and therefore it will not be recycled, decreasing the amount recycled. | 1. Increase in trip generation, which results in increased gas emissions.                                                                                                                                                                                                           | 1. Significantly lowers recycling rates.                                                                                                                                                                                                                                           | 1. Increases trip generation. 2. Bin may be half full.                                                                                                                                                                                                                 |
## Findings: Benefits Matrix

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Commingled Pathway</th>
<th>Commingled and Source Separated</th>
<th>Trash Only</th>
<th>Source Separated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Recovery Facilities</td>
<td>1. More business because both commingled and trash loads must be MRFed. 2. More marketable materials to sell.</td>
<td>1. Easier to meet EDWRPs goals compared to commingling. 2. Potential to make money off of marketable material.</td>
<td>1. Potential to make money off of marketable material.</td>
<td>1. Makes it easier to meet EDWRPs goal.</td>
</tr>
<tr>
<td>Haulers</td>
<td>N/A</td>
<td>1. More business due to more bins.</td>
<td>1. Less confusion and manpower needed for each job site. 2. Fewer pick ups will reduce expenses.</td>
<td>1. Potential for more business through increased load pick ups. 2. Does not have to pay to MRF material, taken directly to Recycling Center (RC) or secondary source. 3. Many destinations to send source separation to. Increasing competition.</td>
</tr>
<tr>
<td>Construction Companies</td>
<td>1. Easier execution. 2. Takes up less space than source separation. 3. Great for smaller jobs or those with no space.</td>
<td>1. Maybe cheaper than source separating all debris. 2. Capture money from marketable materials 3. Can meet PRP mandate. 4. Easier than just source separating. 5. Allows more flexibility by achieving a comprise between high recycling rate and effort.</td>
<td>1. Maybe cheaper than source separation and/or commingling due to reduced number of hauling and tipping fees. 2. Takes less manpower. 3. Do not have to fight employees’ apathy.</td>
<td>1. Potential ability to make money by selling to secondary sources directly. 2. Increases likelihood of meeting recycling goals including PRP Mandate. 3. Dumping fees for recyclable material is smaller than mixed-materials. $0-35 (Metros Toolkit).</td>
</tr>
<tr>
<td>Recycling Centers</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1. RC will not pay someone to source separate, decreasing cost of the load and increasing revenue. 2. Loads will come in cleaner and make the material more marketable. 3. Easier for recycling.</td>
</tr>
<tr>
<td>System as a Whole</td>
<td>1. Increases the amount recycled compared to throwing everything in one bin.</td>
<td>1. Allows flexibility in the system. 2. Can create a pathway where both EDWRP and PRP are met.</td>
<td>N/A</td>
<td>1. Less trash enters landfill. 2. Highest possible recycling rate. 3. Bypassing MRFs saving time, energy money &amp; labor. 4. Meets the requirements of PRP.</td>
</tr>
<tr>
<td>Barriers</td>
<td>Recommendations Matrix</td>
<td>Recommendations</td>
<td></td>
<td></td>
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<tr>
<td>------------------------------</td>
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<tr>
<td><strong>FOR CONTRACTORS (.1)</strong></td>
<td><strong>FOR HAULERS (.2)</strong></td>
<td><strong>FOR FACILITIES (.3)</strong></td>
<td><strong>FOR OSD (.4)</strong></td>
<td></td>
</tr>
<tr>
<td>1.1.1 Stagger the delivery of bins.</td>
<td>1.2.1 Provide a wide range of bin sizes.</td>
<td>N/A</td>
<td>1.4.1 Provide a list of space saving examples to contractors.</td>
<td></td>
</tr>
<tr>
<td>1.1.2 Store larger bins off-site.</td>
<td>1.2.2 Educate contractors about recycling options.</td>
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<tr>
<td>1.1.3 Use creative space management.</td>
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<td>1.1.4 Commingle some recyclables.</td>
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<tr>
<td>1.1.5 Reduce and Reuse materials.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>(1.) SPACE</strong></td>
<td><strong>(2.) COST</strong></td>
<td><strong>(3.) WASTE MANAGEMENT TRACKING</strong></td>
<td><strong>(4.) C&amp;D WASTE QUALITY</strong></td>
<td><strong>(5.) COMMUNICATION/RECYCLING ETHIC</strong></td>
</tr>
<tr>
<td>2.1.1 Contract with haulers who provide incentives to source separate.</td>
<td>2.2.1 Offer cheaper recycling options to contractors for marketable materials.</td>
<td>3.2.1 Haul to facilities with 3rd Party Verification.</td>
<td>4.1. Source separate.</td>
<td>5.1.1 Hire subcontractors who actively engage in recycling.</td>
</tr>
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<td>2.1.2 Shift purpose of bins.</td>
<td>2.2.2 Stagger the hauling fee for bins proportionate to weight.</td>
<td>3.3.1 Improve auditing of loads.</td>
<td>4.1.1 Source separate.</td>
<td>5.1.2 Allow staff to use the money redeemed from recyclables/salvage sales.</td>
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<td>2.1.3 Commingle some recyclables.</td>
<td></td>
<td>3.3.2 Waive tipping fees for source separated recyclables.</td>
<td>4.1.2 Protect recyclables from elements.</td>
<td>5.1.3 Clearly label recycling dumpsters.</td>
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<td></td>
<td></td>
<td>3.3.3 Demand cleaner loads.</td>
<td>4.1.3 Deconstruct.</td>
<td>5.1.4 Assign one team member to be recycling leader.</td>
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<td></td>
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<td>3.1.1 Source separate.</td>
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<td>4.2.1 Provide magnetic labels.</td>
<td>5.1. Source subcontractors who actively engage in recycling.</td>
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<td>3.1.2 Follow up and track material.</td>
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Recommendations: Overcoming Barriers

1. SPACE

While space may be an issue on some job sites, it is not an insurmountable barrier to source separation. The space barrier can be created for multiple reasons. 1. The square footage of the site is small 2. Source separation increases the amount of bins needed for CR&D waste, which decreases the amount of space available for bins 3. A surplus of construction debris, often resulting from over ordering construction materials, competes with space needed for recycling containers.

1.1 Recommendations for Contractors

1.1.1 Stagger the delivery of bins. Staggering the delivery of bins according the sequence of material consumption will eliminate unnecessary bins and create more room. Order bins as needed in lieu of at the project’s onset, storing piles of recyclables on the jobsite or in the building until bins arrive.

1.1.2 Store larger bins off-site. Contractors can enter into agreements with adjacent sites to use their empty space. Places such as vacant lots or parking lots are great examples (Tenant Improvement Case Study). Subcontractors may also be a great resource for additional space. They can provide off-site storage of C&D waste or salvaged materials (University Dept. Case Study). Curbside parking permits for dumpsters can also be arranged through the City.

1.1.3 Use Creative Space Management. Creative space management can make room for bins, and includes ideas such as storing flat materials like cardboard under existing bins. Label (large magnetic labels can be ordered online) and reuse bins for different materials as projects progress through different phases. In the absence of the availability of correct bin size, create makeshift bins or reuse scrap lumber to create sections in large dumpsters until space becomes available. If creating or adapting bins is not possible, designate and label certain areas of a job site for specific recyclable materials.
Recommendations: Overcoming Barriers

1.1.4 Commingle some recyclables. Source separating some recyclables and commingling the remaining recyclables will save on space compared to exclusive source separation and will increase the likeliness of meeting the 75 percent recycling mandate compared to commingling all recyclables.

1.1.5 Reduce and Reuse Materials. Employing Advanced Framing Techniques eliminates the need to overorder (see Appendix B for more information). Reuse materials from demolished buildings (University Dept. Case Study). Classes are offered at Portland Community College (PCC) that can help inform contractors about many of these techniques.

1.2 Recommendations for Haulers

1.2.1 Provide a wider range of bin sizes. Because space constraints on-site limits the number of bins a contractor can accommodate, providing a wider range of bin sizes and educating contractors about recycling options are among the best management practices recommended for haulers. Providing source separated as well as commingling options to contractors is, in fact, required by state law and city code.

1.2.2 Educate contractors about recycling options. Do not wait for contractors to ask about recycling options. Provide these options upfront.

1.3 Recommendations for Facilities

1.4 Recommendations for OSD

1.4.1 Provide a list of space saving examples to contractors. Examples of practices that allow more materials to be source separated include using smaller containers and increasing the frequency of pickup, using scrap lumber to divide dumpsters, and renting a trailer to contain the major recyclable material generated during the current phase of construction and self haul to a recycling center. This list could be included in the Metro Toolkit, a publication that 42 percent of construction related companies use. OSD could also consider holding free workshops to coach contractors on these strategies.
2. COST

Source separating can increase the cost of recycling due to the additional bins required and the labor hours demanded to sort the recyclables. Accounting for labor and additional bin costs, source separating recyclables adds $1-2 per square foot of building area to the cost of the project (U.S. Army Corps of Engineers).

Typically, a dumpster runs $300 for 6 cubic yards (2 tons), $385 for 10 cubic yards (4 tons), $650 for 30 cubic yards (10 tons) and $775 for 40 cubic yards (13 tons) (U.S. Army Corps of Engineers). This common pricing scheme offers economies of scale to those that commingle. It would cost only $775 to commingle 40 cubic yards of construction waste recycling whereas it could cost up to $3,100 to source separate wood, metal, and cardboard with 1 additional dumpster for mixed waste. Due to the fixed hauling fee structure assessed to each bin, this pricing scheme creates a cost barrier to source separating recyclables for some contractors.

Some hauling companies (University Dept. Case Study) do not differentiate between source separated, commingled, and mixed loads of construction waste in their pricing scheme and favor pricing based on hauling distance instead. This eliminates any potential savings in tipping fees earned for source separation or even commingling, compared to just trash.

Source separation does, however, increase the values of the recyclables. Some contractors may recoup the additional cost of separating recyclables on site by selling valuable materials or by recycling them at reduced prices or for free at some facilities.

Another cost issue arises between commingled loads and trash loads. Although commingled loads have more recyclables than trash loads, they are often charged the same tipping fee at the MRF, therefore not creating incentives to commingle loads if source separation is not an option.

2.1 Recommendations for Contractors

2.1.1 Contract with haulers who provide incentives to source separate. Given the wide range of hauling options available to contractors, it is recommended that contractors only hire haulers who provide them with incentives to source separate. This would involve haulers who provide bins at a substantially lower cost for marketable materials such as wood and metal.
2.1.2 **Shift purpose of bins to accommodate the most common materials produced at the time.** The types of debris produced at a construction site change as the project progresses. Because of this, a separate bin for every kind of recyclable produced at the site is not needed concurrently; the purpose of the bins can therefore be shifted to accommodate the most prevalent type of debris at each phase in development. Contractors need only switch the signage on the bins and communicate changes to their employees and the hauler. This strategy saves on both space and cost.

2.1.3 **Commingle some recyclables.** Commingling some recyclables will save on the cost of the bins and, in the case of self-hauled CR&D waste, will cost less to drop off at the recycling facility.

### 2.2 Recommendations for Haulers

2.2.1 **Offer cheaper recycling options to contractors for marketable materials.** Providing substantially cheaper recycling options to contractors for marketable materials such as wood, cardboard and metal, as many haulers already do, can also encourage source separation. According to the Metro survey, 19 percent of contractors and construction-related employees said that free and lower fees would make it easier to recycle and reuse construction debris.

2.2.2 **Stagger the hauling fee for bins proportionate to weight.** Staggering the hauling fee for bins to be proportionate to their weight, rather than having one, fixed hauling fee, could further encourage source separation. This way bin size is not directly related to the cost of pickup, rather the weight of recyclables or waste within the bin is the defining cost structure. Lighter loads can also reduce gas consumption in vehicles.

### 2.3 Recommendations for Facilities

2.3.1 **Waive tipping fees for source separated recyclables.** Waiving tipping fees for source separated materials will significantly increase the likelihood of receiving source separated materials.

2.3.2 **Create a sliding scale tipping fee.** In the absence of waiving the tipping fee for source separated materials, a sliding scale fee structure could be implemented so that contractors and haulers are encouraged to source separate and commingle. Loads that are source separated should be free or tipped at a significantly reduced fee, commingled loads should also have a reduced tipping fee (slightly above the source separated fee) and trash should have the most expensive tipping fee associated with it.
2.4 Recommendations for OSD

2.4.1 Compile list of haulers who structure their fees to favor source separation. Compile and issue a list of haulers who already engage in BMPs for the industry, which include providing lower hauling rates for source separated materials, labels for bins, a variety of bin sizes, and contracts with 3rd-party-tested MRFs and recyclers.

2.4.2 Franchise. Similar to the residential waste industry, franchising the commercial haulers would allow greater regulation and control of pricing and business practices.

2.4.3 License. In the absence of franchising, OSD should consider issuing separate or discounted licenses to haulers who can prove they meet a certain standard of business, which include the above-mentioned BMPs.

2.4.4 Enforce. Through regulation either by OSD, Metro, or 3rd party oversight, ensure that haulers are supplying contractors with similar recycling options as other businesses and that haulers are complying with state law. (Mixed-Use Case Study).

3. WASTE MANAGEMENT TRACKING

Unless contractors source separate all materials, it is difficult to know exactly how much CR&D waste from each load is recycled at the facility. The amount of waste recycled is normally visually estimated by the hauling company’s driver at the time of drop-off or by a MRF employee. This method produces approximate and potentially inaccurate figures. Though the percentage recycled per load may be approximate, receipts provided by the facility are necessary to a complete waste management plan whether required by OSD or not. This issue can be specifically detrimental to LEED projects, which place great weight on receiving very high recycling rates, which can sometimes only be achieved through commingling.

3.1 Recommendations for Contractors

3.1.1 Source Separate. Source separation is a preferred method for tracking recycling rates because there is less contamination of materials and higher recycling rates are achievable. Recycling rates for source separated loads are more certain than commingled loads because they can bypass the MRFs and head straight to the recycling centers. Additionally, contractors can deliver loads themselves without having to rely on haulers.
3.1.2 **Follow and track materials.** Contractors bear the burden of creating a Waste Management Plan that ensures they meet Portland’s mandate and comply with LEED ratings, therefore following up on material once they have left the job site is critical to ensuring accurate data.

3.2 **Recommendations for Haulers**

3.2.1 **Haul to facilities with 3rd Party Verification:** 3rd party verification will more accurately guarantee correct recovery rates, which is specifically important for LEED designated projects.

3.3 **Recommendations for Facilities**

3.3.1 **Waive tipping fees for source separated recyclables.** This will encourage contractors to source separate, and therefore, enable more reliable estimations of the percentage of each load that is ultimately recycled.

3.3.2 **Improve auditing of loads.** Currently, the method of estimating the percentage of a construction waste load that is recycled is a cumbersome and inaccurate process. Generally, haulers or MRF employees visually estimate the amount of recyclables in each load and report this estimation back to the contractor. This process would be improved with a consistent region-wide program that produced reliable and comparable figures. Alternatively, the overall recycling rate of a facility, estimated by Metro, could be used to estimate how much is recycled per load rather than an estimation for each individual load. This method is done in King County, Washington.

3.3.3 **Demand cleaner loads.** Demand that only “cleaner” loads (loads that only contain the materials with active markets such as wood, cardboard, metal, paper and rigid plastic) are commingled. This provides for richer loads and decreases the facilities’ cost associated with commingled loads, which would allow facilities to decrease commingled load tipping fees.
Recommendations: Overcoming Barriers

3.4 Recommendations for OSD

3.4.1 Promote source separation. OSD can promote source separation through education, a list of space saving techniques, and classes.

3.4.2 Work with Metro to audit recycling rates of MRFs. Due to the fact that recycling rates for commingled loads vary from facility to facility, it would be useful to contractors and haulers to know the recycling rates generally achieved by each facility. This would help inform their choices in where to take construction waste and whether to source separate due to unsatisfactory recycling rates. For example, King County, Washington relies on the facilities’ overall recycling rates for commingled loads rather than the haulers’ estimation of how much is recycled per load.

3.4.4 Utilize Unused Authority. Through the policy analysis, it became apparent that OSD has the authority to regulate and enforce the mandates and standards it has put in place. Prior to permitting, and with OSD recycling form, contractors should estimate total project waste and cost. In order to receive permitting the contractor should provide a deposit that can range up to $50,000 depending on the value of the project. An annual report should be provided to OSD that reports the recycling rate of the project. If the contractor is not meeting PRP’s mandate, a letter should be sent to the property owner stating the City’s disappointment at the project not achieving the City’s mandate and once again reiterating the mandate and consequences associated with noncompliance. Once projects are complete, the City should refund the deposits if the builders can show, through receipts, that they recycled at least 75 percent of all CR&D waste at a certified Recycling Facility. However, for each percentage point the recycler does not meet the mandate, the City will withhold somewhere between $500-1000 (Appendix A).

4. CR&D WASTE QUALITY

Commingling can decrease the value of recyclables due to damage caused by the heaviest types of debris. Additionally, source separation can help create higher-end markets for recyclables. Source-separated construction waste is more suitable for manufacturing recycled-content building materials.

Certain materials are specifically prone to destruction, such as cardboard and styrofoam. On the other hand a material like sheetrock are both easily damaged and can easily damage other materials in a commingled bin. Many of these materials may leave the site in perfect condition but will get damaged during transportation and will become unmarketable in the long.
4.1 Recommendations for Contractors

4.1.1 Source separate. Contractors can avoid some damage by, at minimum, recycling the heaviest types of debris in separate bins. Examples of materials that should be recycled separately to avoid damaging the load include rubble, shingles, and sheetrock. Source separating all construction waste debris is ideal for ensuring high quality recycling.

4.1.2 Protect recyclables from elements. Placing recyclables in bins undercover will help protect them from the elements. If no space under cover can be found, ask the hauler for bin lids or create makeshift bins with plywood or other materials.

4.1.3 Deconstruct. Deconstruction is a technique of dismantling buildings in the reverse order they were constructed in order to keep building materials as intact as possible. This technique improves the quality of the materials to be recycled or permits them to be re-used (Appendix B).

4.2 Recommendations for Haulers

4.2.1 Provide magnetic labels. Providing magnetic labels to construction companies that wish to source separate or commingle material will reduce confusion and ensure that the correct materials are thrown into the correct bins.

4.3 Recommendations for Facilities

4.3.1 Purchase equipment for recycling more types of recyclables. As technology continues to increase, higher-tech machines will become available. Keeping abreast on new products can give MRFs a recycling edge.

4.3.2 Promote source separation. Promote source separation of those materials prone to break-down and contamination, such as sheetrock, Styrofoam, and rubble.

4.4 Recommendations for OSD

4.4.1 Increase markets for problem recyclables. In conjunction with Metro, identify those recyclables that do not currently have a strong market. Promote these markets through researching alternative uses and providing incentives for businesses recycling these materials. Two such materials identified in this study are Styrofoam and sheetrock.
4.4.2 Help facilities purchase equipment to recycle additional materials. Work with Metro to provide incentives for facilities that upgrade their equipment. This could be through reduced permitting fees, subsidies, DEQ grants, or organizing bulk purchases with other facilities.

5. COMMUNICATION/RECYCLING ETHIC

Getting staff and subcontractors on board with a recycling plan can be challenging. Staff may be unclear on the expectations and procedures set in the plan or may not personally value recycling. Staff and subcontractors must understand the plan and expectations for recycling and must follow through in order for a recycling plan to be successful. Changes in bin location and bin material designation may also lead to increased confusion among workers.

5.1 Recommendations for Contractors

5.1.1 Hire subcontractors who actively engage in recycling. Subcontractors should be informed of the recycling protocol when they begin work at a jobsite and required by the contractor to follow the established protocol. Working with subcontractors to understand the recycling protocol should be an element of all recycling plans. Easy-to-understand signage will help subcontractors participate as well.

5.1.2 Allow staff to use the money redeemed from recyclables/salvage sales. Reward construction crew by allowing them to use the money redeemed by recyclables to be used for lunches, cash rewards, etc.

5.1.3 Clearly label recycling dumpsters. Labeling bins makes it easier for the contractor to source separate and ensures cleaner loads, which makes it easier not just for the contractor but for the facility as well.

5.1.4 Assign one team member to be recycling leader. Establishing and following a recycling plan takes time, effort, and knowledge. Assigning one team member to being a recycling leader can save time on everyone’s part especially when this person can carry company recycling protocol from one job site to another.
Recommendations: Overcoming Barriers

5.1.5 Conveniently locate recycling bins throughout site. In Metro’s survey of contractors and construction-related professionals, 17 percent said having more recycling bins on site and 21 percent said general convenience would make it easier to recycle. To increase convenience and the number of recycling sites, contractors could consider several small rolling bins and setting up recycling stations nearby where construction debris is being produced.

5.2 Recommendations for Haulers

5.2.1 Provide magnetic labels. Labeling bins makes it easier for contractor employees to recycle by minimizing confusion.

5.3 Recommendations for Facilities

5.4 Recommendations for OSD

5.4.1 Use the Recycling Form to Educate Contractors. OSD can play a critical role in encouraging source separation on the job site. One of the more common and consistent avenues for communication between the contractor and OSD is the Recycling Plan Form. Though the form is sent out to every contractor who is applying for a permit, only 50 percent are returned to OSD, and of the contractors we interviewed for this project who did not return the form, the reason they gave was because they didn’t feel it was necessary or did not know it was mandatory. In that the form originates at the Bureau of Development Services, a simple way to encourage its return is to withhold the building permit until the form is completed and returned. Modifying the language on the form to state clearly the city’s requirements for business recycling rates, as well as the contractors anticipated recycling rate per material consumed, could both improve upon the data as well as continue to educate the contractor about recycling requirements. An example new form has provided in Appendix C.

5.4.2 Collaborate with Metro’s Toolkit. OSD should collaborate with Metro to include educational messages about source separation and space-saving techniques, incentives for deconstruction, or ongoing classes in the Toolkit. Because 42 percent of construction companies report using the Toolkit, this is a good medium for written outreach material. OSD should also consider surveying the construction community to find out how widely the G/Rated Tenant Guide is used if they have not already done so.


5.4.3 Create a technical assistance program. In such a program, staff would visit a construction job site and assist contractors with ways to increase their recycling rates. This could include waste management plan development assistance and implementation and monitoring. OSD could partner with Community Environmental Services at Portland State University to provide this service using trained student staff.

5.4.4 Educate property owners. OSD should reach out to property owners to educate them about green building and construction waste reduction and diversion. The G/Rated Tenant Improvement Guide provides several suggestions for the property owner on demands to make of the contractor such as cooperatively identifying materials to reuse in the remodel or simply demanding the recycling occur. This type of education should continue with the aim of reaching a wider audience so more property owners will request green building practices.

5.4.5 Reduced enrollment fees. Provide educational incentives for contractors who want to learn more about salvage and reduce or Advanced Framing Techniques. A partnership with PCC could be arranged to subsidize tuition or provide scholarships (Residential Remodel Case Study).

References

Conclusion and Next Steps

The City of Portland’s decision to increase the required construction recycling rate from 50 percent to 75 percent unveiled the need for a holistic review of the construction waste recycling process and development of recommendations. Initially, BHF was asked to develop a list of Best Management Practices for construction companies to aid in their compliance with the new mandate. After some initial research, it was found that a construction company’s ability to recycle 75 percent of its waste was directly linked to the performance of its hauler, MRF, as well as to its policy context. The scope of work was subsequently broadened to include analyses and recommendations for all parties involved, including policy makers.

BHF reviewed the related state and local policies associated with construction waste recycling, interviewed a wide variety of construction companies, haulers and MRFs, and reviewed Best Management Practices in other jurisdictions. From this information BHF developed a list of four specific pathways that are currently utilized by construction companies. The pathways include commingling all construction waste with a separate bin for trash, source separating all construction waste, source separating some recycling and commingling the rest, and placing trash and recyclables in one mixed bin. Each pathway was reviewed for its compliance with associated state and local policies and a list of barriers and benefits was generated to facilitate the identification of the preferred pathways and associated recommendations to overcome key barriers for construction companies, haulers, and MRFs.

There were two pathways that stood out as preferred strategies to recycle construction waste at the highest possible rate, and thus, were recommended by the project team. The two recommended pathways include source separating all construction waste recycling, and source separating some recyclables, while commingling the remaining recyclable material. The other two pathways were discarded as unfeasible options for meeting recycling mandates.

The barriers associated with the two recommended pathways were developed into a matrix to provide a comprehensive list of recommendations to help achieve high recycling rates for haulers, construction companies, MRFs, and OSD, given the current constraints. Highlights of these recommendations include third party testing for MRFs, enforcing hauler laws to ensure they provide adequate bins for all recyclable materials, and providing educational opportunities to the construction companies to ensure they are aware of the mandate and associated fees or incentives. In addition, there is an apparent lack of available secondary markets for recyclables, so the development or discovery of additional secondary sources is prudent. Without a secondary market, recyclable material will end up in the landfill.
Conclusion and Next Steps

The construction waste recycling issue is a complicated web of interconnected policies which are not necessarily coordinated with one another, and there seems to be a lack of much-needed regulation. Additional regulation in the form of fees, incentives or deposits will ensure construction waste companies source separate and recycle as much as possible. From there, additional verification that haulers are providing appropriate bins and that the facilities are recycling at the rates they are currently projecting are important steps to increase recycling rates.

This document outlined a vast array of recommendations for construction companies, haulers, MRFs, and policy makers. Many of these recommendations may be deemed infeasible, while others may have merit and warrant further exploration and possible implementation. To ensure follow-through, the BHF Team recommends that OSD carry out these next steps:

1. Complete the formation of the Technical Advisory Committee and present this document as a starting point to understanding the construction arena as BHF understands it today.
2. Review the list of recommendations outlined in this document to determine political and economic feasibility.
3. Add to this list any additional recommendations not currently covered in the document.
4. Develop a list of preferred recommendations which OSD plans to pursue.
5. Develop plans to integrate the preferred recommendations into existing systems and policies.
6. Review all plans and changes to existing systems and policies to outline potential future issues associated with implementation.
7. Implement all plans deemed feasible.
8. Monitor the implementation of preferred recommendations and revise as needed.
9. Periodically review the feasibility of those recommendations which had merit but were deemed infeasible in today’s economic and/or political climate.
10. Further explore ways to make property owners more responsible for their project’s recycling rates.
About Bin Half Full

BHF is a team of six student-consultants from Portland State University’s Master of Urban and Regional Planning (MURP) program.

The MURP program culminates with a two-quarter Planning Workshop that partners students with local jurisdictions and public organizations to carry out critical planning projects. Students seek out clients, define the scopes of the projects, and sign contracts to act as consultants.

BHF is thrilled to work with City of Portland’s Office of Sustainable Development (OSD) to develop Construction Waste Recycling Solutions. BHF would like to thank Babe O’Sullivan and Alisa Kane from OSD for offering us the opportunity to work on this project and for directing our work to ensure that our product is useful to OSD in its efforts to increase recycling rates in Portland. We would also like to thank our faculty advisors Ethan Seltzer and Sy Adler for sharing their vast experience as planners and academics in Oregon and for challenging us to be creative and meticulous.

Wendy Gibson received her B.S. in Sociology from Santa Clara University in 2002 and will complete her master’s degree in Urban and Regional Planning from Portland State University in June of 2008.

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Amy Twilegar is a MURP student and plans to graduate in the spring with an environmental specialization. She is interested primarily in rural and small town planning, and intends to move back to her home state of Idaho upon graduation.
Appendix A: Best Management Practices

Seattle - King County Solid Waste Division

In 1993, King County began the construction, demolition and land clearing (CDL) program. Using a market-based approach to promote construction waste recycling, King County encourages developers to recycle voluntarily by identifying the economic reasons why recycling is more cost effective. The County is very adamant about ensuring that recycling is voluntary and they discourage government subsidies for recycling incentives.

Instead of mandates and grants, the County has set up a website that allows developers and builders to tailor their own recycling programs at levels that they choose. With County dumping fees at or around $85 a ton, encouraging construction waste recycling for $55 a ton is pretty easy. The CDL program provides a number of services including on-site presentations for construction workers on reusing building materials and educational handouts. Staff of the CDL department also provide site visits to assess how projects are performing and provide research assistance to connect materials that are difficult to recycle with businesses that use them.

San Francisco – SF Environment Department;

In 2006, San Francisco adopted a recycling goal similar to Portland’s current mandate. California State law requires the City to adopt an ordinance that would increase recovery of demolition waste from 50 percent to 75 percent by 2010 and to 100 percent by 2020. Ordinance No. 27-06 supports San Francisco’s goal by outlining the state requirement. The ordinance places the responsibility to comply with all standards set forth in the ordinance on the building permit holder or property owner.

The City does not mandate that loads be source separated or commingled; it states that either method is acceptable if specific guidelines are followed. All co-mingled loads must be transported off-site using a City-registered transporter and taken to a City-registered material recovery facility; 65 percent of each load must be diverted from the waste stream. Full demolition projects are also mandated to divert at least 65 percent of demolition waste for recycling and are required to provide a waste diversion plan prior to receiving a demo permit. The City has the authority to enforce these standards by suspending permits and issuing civil penalties of between $1000 and $5000 per day that the violation occurs, and as much as 6 months in jail for gross misconduct.
Appendix A: Best Management Practices

New York – New York City Department of Sustainable Design and Construction

The City of New York does not currently have a C&D Waste Recycling Ordinance that requires builders to comply with recycling mandates. The City’s Department of Design and Construction takes an approach similar to that of Seattle by providing technical assistance and information for builders to encourage them to recycle project waste. The City has a healthy market for C&D Construction materials which has helped it maintain a rate of 50 percent for a number of years.

In 2003, the City produced a comprehensive C&D Waste Recycling Handbook identifying a number of goals to increase the recycling rate for construction projects. In addition, the City now mandates that all projects have an approved Waste Management Plan that is used to estimate waste and track recycling results. Although not enforced with civil or criminal penalties, builders can make up for missing Waste Management Plan targets by providing documentation showing a good faith effort was made to meet a waste diversion rate.

Los Angeles – County of Los Angeles Department of Public Works

In 2005, Los Angeles County adopted the Construction and Demolition (C&D) Debris Reuse and Recycle Ordinance. Adhering to state requirements, the County mandated a C&D current recovery rate of 50 percent. By 2010 recovery rate will increase to 75 percent and to 100 percent by 2020. In order for builders to receive a building permit, the County has to approve a Reuse and Recycle Plan. The ordinance applies to all new construction projects with a cost over $100,000 and all grading and demo permits regardless of project cost.

Throughout a project, builders are required to provide Annual Progress reports for projects which cross the March 30th date, and a Final Compliance report 45 days prior to the completion of a project. Failure to file either report will put projects in violation of code and can result in civil and/or criminal penalties. All projects that are found to be in violation are fined $100 initially and then $200 per violation within the first calendar year. Any violation that occurs after one calendar year from the first recorded violation will cost $500. The total cost of penalties cannot exceed 15% of the value of the project, or $50,000, whichever is less.
Appendix A: Best Management Practices

San Diego – San Diego Environmental Services Department

Among the last of California’s major cities to adopt a plan, San Diego approved the Construction and Demolition (C&D) Debris Deposit Ordinance in 2007, and will implement the plan in July of 2008. Prior to permitting, builders will complete a Waste Management Form, which estimates total project waste, and provide a deposit that can range between $200 and $50,000 depending on the value of the project. Builders are required to take all waste to City-registered facilities. Once projects are complete, the City will refund the deposits if the builders can show through receipts that they recycled at least 50 percent of all C&D waste at a certified Recycling Facility. Adhering to State law, the percentage of recycled C&D waste will increase to 75 percent in 2010 and 100 percent in 2020. Other than the loss of the deposit, there are no civil or criminal penalties associated with not complying with the C&D Debris Deposit Ordinance.

Chicago – Chicago Department of Environment

In 2005, the City of Chicago amended its Construction or Demolition Site Waste Recycling Ordinance and mandated a C&D Recycling rate of 25 percent. The mandate increased to 50 percent in 2007. Projects that fall under this ordinance include new construction or demolition of all residential projects with four or more units and all other projects that are greater than 4,000 square feet.

Builders are given compliance forms when they apply for building permits and are required to return them completed at the end of projects with documentation from haulers and facilities that they recycled at a rate of 50 percent or greater. If compliance forms are not turned in or proper documentation is not used to track recycling rates, the City has the authority to withhold occupancy permits. Failure to comply with the ordinance can lead to fines between $500 and $1000 per percentage point of difference between the required recycling rate and the achieved rate. In addition, general contractors who submit false statements, data, or fail to respond to audit instructions can face fines between $2000 and $5000 and the loss or suspension of their licenses.
Appendix B: Non-Recycling Waste Reduction

Non-Recycling Waste Reduction Strategies

The following are waste reduction techniques other than recycling that are designed to reduce consumption of construction materials and divert construction debris from the landfill. These strategies are targeted toward the early stages of construction, remodel, and demolition projects. This includes the ordering and material selection stage and the demolition stage.

Ordering and Material Selection Stage

Construction waste reduction begins with preventative action in the ordering and material selection phase. Just like at home, the greatest step one can take toward waste reduction is reducing consumption in the first place. Contractors that plan ahead can consume less and save money as well. Examples of reduction strategies contractors can rely on are advanced framing and use of salvaged materials to reduce consumption.

Advanced Framing

Advanced framing involves designing buildings on two-foot framing modules to allow for better use of conventional sheet products. Advanced framing reduces both material and labor cost by spacing studs on two-foot centers (in lieu of the conventional 16” on center), by generating less overall waste through the more efficient use of sheet products, and by reducing the time involved with construction as a consequence. Advanced framing also involves the use of engineered hardware to eliminate the need for headers and additional lumber involved in window framing and non-load-bearing walls. It aligns roof, wall, and floor framing so loads are transferred appropriately and a more structurally sound building results. Advanced framing also increases energy efficiency by reducing the number of thermal gaps (as a result of using fewer studs), which allows for more surface area to be insulated. Estimates of total cost savings vary, and depend on the local cost of building products and labor, but generally a single
family home (1200-2400 square feet) employing advanced framing techniques can expect a material cost savings of $500-$1000, a labor cost savings of 3-5 percent, and an annual heating and cooling cost savings of up to 5 percent (National Renewable Energy Laboratory, 2008).

Advanced framing could be promoted by OSD by rewarding contractors and building owners who employ its techniques. This could be most efficiently implemented by involving the Bureau of Development Services (BDS), as they not only approve building plans but also determine permit cost. In addition to providing educational material on advanced framing, the BDS could also significantly lower the Systems Development Charges of a permit application if advanced framing is used. By educating both contractors and building owners of its benefits, and by (temporarily) encouraging its use, advanced framing could effectively become an integrated and mainstream preference in the building industry.

Additional Resources for Advanced Framing:

NAHB Research Center
www.nahbrc.org

U.S. Department of Energy’s Oak Ridge National Laboratory
Buildings Technology Center
www.ornl.gov/ORNL/BTC

U.S. Department of Energy’s National Renewable Energy Laboratory
303-275-3000
www.nrel.gov/buildings_thermal

Southface Energy Institute,
www.southface.org

Demolition Stage

Demolition waste accounts for a significant portion of construction waste. In 2003, the US Environmental Protection Agency (EPA) estimated roughly 164 million tons of C&D waste from buildings was generated in the US annually and of this quantity, 9 percent was construction waste, 38 percent was renovation waste material, and 53 percent was demolition debris. Because demolition waste composes over half of the nation’s construction waste, it makes sense for contractors to implement strategies specific to this stage aimed at diverting waste from the landfill and for OSD to invest in demolition target programs and recommendations.

Deconstruction/Recovery

Deconstruction is a method of demolition that involves carefully dismantling buildings piece by piece rather than by destroying the building with conventional methods such as wrecking balls. Recovery involves removing components whole from the building without disturbing their integrity so they can be directly reused.

Demolition and recovery take additional time, but allow a greater portion of the existing materials to be reused either on-site on the current project, by other
Appendix B: Non-Recycling Waste Reduction

projects in the company, or to be sold to other companies for reuse, thus reducing cost in the long run. Deconstruction and recovery techniques excel in making lumber and architectural fixtures available for reuse. Careful deconstruction and recovery can dramatically reduce the amount of demolition waste sent to the landfill (Army Corps of Engineers). Hand demolition and removing major portions of buildings intact can divert 90 percent of building waste from the landfill. Because demolition waste accounts for over 50 percent of construction waste nation-wide and because 90 percent of demolition waste that is diverted from the landfill can be reused rather than recycled, deconstruction and recovery are practices that stand to make the biggest difference in decreasing the ecological toll and landfill burden imposed by construction projects.

Barriers
Demolition may take a few days, whereas deconstruction and recovery takes around 1 man-hour per .3 square feet (Army Corps of Engineers). At this slow rate, a small 2,000 square foot building with a crew of 10 people would take 2-3 weeks to demolish.

The care required to deconstruct buildings and recover materials makes the process more expensive compared to demolition. Demolition and recovery can cost $5-7 per square foot compared to $3-4 for demolition alone. Comparing these costs makes deconstruction and recovery appear unattractive, however, tipping fees later increase the cost of demolition further and reuse and sale of recovered and deconstructed materials can re-coup a share of the cost of deconstructing and recovering.

Recommendations
The Solid Waste Management Plan Stakeholder Working Group on C&D recommended several incentives during a January meeting in 2007. One suggestion, fast-track deconstruction permits, addresses the time barrier. To address the cost barrier, OSD could partner with BDS to offer a reduced price permit or other permit-based incentives for deconstruction permits (OSD, 2007).

Additional recommendations included a recognition program for deconstruction projects. This would help businesses develop their deconstruction practices and educate other companies about the benefits. The workgroup also suggested requiring demolition and recovery on public projects (perhaps all State and/or City funded projects) (OSD, 2007). This recommendation would help encourage more demolition companies to become skilled in deconstruction projects so they could secure these projects. It would also help establish a larger base of projects that could serve as examples of demolition projects.
The Recycling Plan Form can be a valuable tool serving multiple purposes for OSD. OSD can use the form to gather information on the types of materials generated and recycled on construction and demolition projects, ensure that an adequate Waste Management Plan is in place, and educate the general contractor or property owner on Best Management Practices. Since all construction and demolition projects over $50,000 are required to fill out the form, the form is an avenue for OSD to routinely interact with a large audience of general contractor or property owner.

**Form Review**

BHF examined similar preconstruction recycling forms for eight jurisdictions with forms posted online to assess the types of material that are commonly required of contractors to report. BHF also examined the additional information typically required of the contractor to report, such as a summary of the waste management-communication plan or salvage practices. Additionally, BHF noted the educational outreach messages typically included on the forms such as lists of haulers and facilities. This investigation of other forms' content (construction waste materials, waste management practices, and educational outreach) helped inform BHF's revision of OSD's Recycling Plan Form. BHF redesigned the form with these findings in mind and with the intent to improve the form's construction waste recycling educational content to better encourage a waste prevention and diversion strategy.

**Form Comparison**

The existing Recycling Plan Form asks only about 5 materials: rubble, land clearing debris, cardboard, metals, and wood. There is room for the contractor to specify 1 additional material. Compared to other forms examined, this is a very short list. Asking for recycling plans with more materials might increase the amount of waste diverted from the landfills and improve the variety of materials recycled by requiring the contractor or property owner to consider recycling/salvage/reuse options for each listed material.

Portland’s existing form asks the contractor to indicate whether each material will be commercially hauled, self-hauled, or re-used onsite. The form could be improved by asking how the materials will be collected: source separated or commingled, and to which facility the materials will be hauled. This would help OSD estimate how likely the project will meet the 75 percent recycling mandate based on the pathway chosen.

Most forms (6 out of 8) go an additional step by requiring that the contractors resubmit the form with hauling receipts after completing the project and report the total construction waste generated and percentage diverted from the landfill. While this is recommended it is understo-
Appendix C: Pre-construction Form Revision

ood that this step may be an unnecessary administrative burden on OSD.

Revised Form

The revised form begins as before with a statement on city code and expectations. The next section, as before, asks for contact information and general job site/permit information.

The third section of the form directs the contractor or property owner to acknowledge, by initialing, OSD’s construction waste management requirements and to acknowledge the basic actions he/she will take to communicate the plan to the construction workers and subcontractors. Initialing is used in this section as a technique to improve commitment and follow-through on these requirements and on the communication plan suggestions. Written commitments are a powerful tool found in one study of curbside recycling in Salt Lake City to improve recycling participation better than fliers, face-to-face communication, and telephone calls (Werner et al., 1995). Four out of eight of the forms reviewed asked for a description of the communication plan, a requirement the current form lacks.

The fourth section asks for the project type: New Construction, Addition/Alteration/Replacement, Demolition, or Deconstruction. This question encourages contractors and property owners to consider deconstruction as an option for this jobsite or at least for a future jobsite. Asking about deconstruction on the Recycling Plan Form could lay the initial steps toward offering a fast-track permit for projects that chose deconstruction over demolition (a recommendation from the C&D Solid Waste Management Plan Stakeholder Working Group).

The next section, titled “Salvage/Reuse Plan” asks the contractor or property owner to list all the materials generated on the jobsite that will be reused or salvaged. Five out of eight forms reviewed asked about plans for reusing and salvaging materials.

Since over half the C&D waste produced in the Nation is from demolition (EPA) and since deconstruction and reuse are techniques demonstrated to divert high amounts (over 80%) from the landfill (U.S. Army Corps of Engineers) plans for salvage and reuse should be included on the form. Their inclusion on this form is meant to stimulate voluntary plans for salvage and reuse without setting a requirement. The grey box that follows this section provides a brief educational message about salvage/reuse and subsequent cost savings and lists further resources.

The reverse side begins with a section titled “Recycling Plan.” This section, as on the existing form, asks the contractor or property owner to indicate his/her plans for recycling the listed C&D materials. The revised form still asks how the materials will be transported (self-hauled or hauled by another company). The revised form asks how the materials will be collected (commingled or source separated) and where they will be hauled to aid OSD in estimating the diversion rate.
Appendix C: Pre-construction Form Revision

The chosen materials in this portion of the form are the 10 most frequently listed materials on the other forms reviewed.

The form concludes with the original required signatures of understanding and a final listing of additional educational resources.

The example revised form is provided as a visual aid to demonstrate how these recommendations might be included in a future edition of the PreConstruction Recycling Form.

References


Currently, the location of this facility only has a landfill and recycling center associated with it. Loads that are dropped off here are source separated, commingled and mixed. As such, only those loads that are source separated are recycled. The company that runs this location is currently in the process of building a MRF due to EDWRPs new regulations. The company’s representative that was interviewed manages several other MRF locations for the company and expressed the increased difficulty to meet the old 25 percent recovery rate. He believes it will be much easier to meet the 15 percent residual rate. At the location where the MRF is being built, they will continue to accept source separated, commingled and mixed loads. However, once the MRF is operating they will put all loads through the MRF in order to retrieve as many recyclables as possible and to ensure that only the cleanest loads come out of the facility. The representative estimated that each load that enters the site is touched three times. Right now the market prices for materials is not off-setting the cost for separating the materials.

Appendix D: General Interview Information

Material Recovery Facility

This dry waste facility is located on the outskirts of the metropolitan area. The company used to be privately owned but approximately five years ago was bought out by larger public waste company. This location handles both residential and C&D debris, however they only take loads from their own company’s haulers for residential loads. They also accept both source separated and mixed loads. According to the representative, no outside third party tracks how much is actually recovered. The company self-reports to Metro about four times per year and as of the last time they reported their recovery rate was around 40 percent. He mentioned the 25 percent recovery rate is getting harder to meet and the 15 percent residual rate will be much easier to meet. The company has noticed a trend that they have been getting “lower-end recyclables” which generate a lower selling price. He would prefer if everyone commingled so that richer loads would come in and their costs would be covered. The representative believes that everyone should provide incentives and do more to encourage companies with small recycling markets to stay in business. The company provides an added incentive for LEED loads by charging a lower tipping fee for these commingled loads. According to the representative, on average, LEED loads are richer in marketable recyclables and can cover most of their recovery costs. The representative also believes there should be stronger enforcement from the government so that everyone is on an even playing field.
Appendix D: General Interview Information

Material Recovery Facility

This material recovery facility accepts source separated wood, metal, glass, and corrugated cardboard as well as commingled loads of CR&D waste. From the commingled loads, workers recover wood, corrugated cardboard, metal, and some types of plastic. This MRF targets 65 percent of all incoming waste for recycling, but that figure is unreachable if a load is not full of these prime recyclables; often workers find that a load is contaminated only after the contents from the bottom of the drop-box reach the sorting floor and it is too late to reject the load.

Success at reaching this target is also affected by market cycles. The representative noted that end markets are increasing for recyclables, driven by Asian consumption, making it easier for this MRF to increase recycling rates. Metal and cardboard provide the highest returns; local companies such as Schnitzer Steel and Metro Metals purchase the metal and Weyerhauser purchases the cardboard to make into new cardboard. Glass is purchased to be made into reflective paint. This MRF turns wood into hog fuel, burned to power paper plants; it does not make or lose money here. This MRF also gives away concrete, asphalt, rock, and debris; any return it receives here is on the front end.

This MRF encourages recycling by providing its own hauling services, catering to the needs of its customer on the construction site; it also charges a lesser tipping fee for garbage than for recyclables. It questions the environmental ethics of shipping recyclables to Asia; most of its products stay within a 30-mile radius of the facility. However, like most haulers, it charges contractors per box of waste that it hauls, rather than by weight, effectively discouraging source separation and “clean” loads of prime recyclables.

Mid-size Construction Company

This construction company has completed a number of LEED projects, though most of their projects are not pursuing LEED certification. This company was not aware of the 50 percent construction waste recycling requirements, but was aware of the Recycling Plan Form, which they receive “often” throughout projects. In their view, the form should only be required once, and included on the form should be a description of the 50 percent recycling requirement. The representative of this company noted that unless a project is pursuing LEED, they do not source separate any materials. In fact, they do not pay attention to waste and recycling at all, as they thought there was no requirement to do so. However, this company has thought up creative ways to source separate in tight quarters. On one space-constrained project, the construction company, attempting to reach 95 percent recycling rates, used small separate bins for metal, wood, and concrete. These smaller bins were then taken to larger bins at their company’s headquarters, which were then hauled off by their contracted hauler as needed. The company hauled these smaller loads from the site to its headquarters using its own vehicles. Despite its great efforts, the company, still commingled drywall, plastic, and paper along with trash and other material.
Appendix D: General Interview Information

**Hauler/MRF**

This company is a third generation commercial hauler and material recovery facility in Washington County. In that it is franchised, it does little work in the City of Portland. It is familiar with EDWRP and doesn’t mind the change to a 15 percent residual; according to METRO’s inspection data, it regularly achieves around a 4 percent residual, which is one of the highest in the region. When asked about Portland’s plans to increase the mandatory business recycling rate to 75 percent, it said that though it thinks that “it is the right thing to do,” it feels that Washington County has been able to achieve as much behavioral change through education as Portland has through regulation. When asked about the economics of material recovery, this hauler mentioned that the cost to separate commingled loads roughly equals the profits achieved by selling recyclables to secondary sources. For this reason, it offer bins for source separated recyclables with active markets (cardboard, wood, and metal) at significantly lower costs to haul and tip, so that they can increase their efficiencies and reap a higher profit for materials when sold.

**Mid-size Construction Company**

This construction company is a mid-size company, whose projects average between 4 & 5 million dollars per year. They have been in business for less than ten years. When it started, it didn’t recycle any of their construction debris and regularly ordered 5 percent more lumber than was called for in construction plans, in order to accommodate for mistakes. Now, it source separates cardboard, wood and metal when they can. It also only orders the amount of lumber called for in the plans and practice advanced framing techniques. When asked why it has adopted these practices, it responded that economics is the driving factor. For the company, it is cheaper to source separate recyclables and additional money is saved by ordering less overall lumber. Combined, these savings can be significant. Additionally, this company was aware of Portland’s mandatory increase of the business recycling rate and felt this would not be difficult to achieve. When asked what it felt were some of the barriers to achieving a 75 percent recovery rate, it stated that space was sometimes an issue; they also stated that sometimes haulers do not provide the appropriate bins to source separate. It has overcome this barrier by making its own recycling bins to better fit its jobsite.
## Appendix E: Secondary Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Accepts</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB</td>
<td>Sheetrock</td>
<td>9602 SE Clackamas Rd, Clackamas, OR</td>
<td>503.659.7004</td>
</tr>
<tr>
<td>Knez Building Material</td>
<td>Flimsy plastic</td>
<td>12301 SE Highway 212, Clackamas, OR</td>
<td>503.655.1991</td>
</tr>
<tr>
<td>Pacific Land Clearing and Recycling</td>
<td>Styrofoam</td>
<td>16020 S. Park Place Ct., Oregon City, OR</td>
<td>503.656.7793</td>
</tr>
<tr>
<td>Metro Metals</td>
<td>Metals</td>
<td>5611 NE Columbia Blvd, Portland, Oregon</td>
<td>503.287.8861</td>
</tr>
<tr>
<td>Schnitzer Steel</td>
<td>Ferrous Metals</td>
<td>12005 N Burgard Road, Portland, OR</td>
<td>503.286.5771</td>
</tr>
<tr>
<td>Weyerhauser</td>
<td>Cardboard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix F: Definitions

- **Activity** means a primary operation or function that is performed in a Solid Waste Facility or at a Disposal Site, including but not limited to Resource Recovery, Composting, Energy Recovery, and other types of Processing; Recycling; Transfer; Incineration; and disposal of Solid Waste; but excluding operations or functions such as Segregation that serve to support the primary Activity.
- **Code** means the Metro Code.
- **Compost** means the stabilized product of composting.
- **Composting** means the controlled biological decomposition of organic material.
- **Composting Facility** means a site or facility which utilizes organic material to produce a useful product through the process of composting.
- **Council** means the Metro Council.
- **DEQ** means the Department of Environmental Quality of the State of Oregon.
- **Deconstruction** means the dismantlement of a structure for the purpose of rebuilding or recycling.
- **Direct haul** means the delivery of Putrescible Waste from a Solid Waste Facility directly to Metro’s contract operator for disposal of Putrescible Waste. Direct Haul is an Activity under this chapter.
- **Disposal site** means the land and facilities used for the disposal of Solid Wastes whether or not open to the public, but does not include transfer stations or processing facilities.
- **Dry waste** is mixed waste that does not contain food or other organics.
- **Franchise** means the grant of authority or privilege given by the Council to operate a Disposal Site, Transfer Station, or an Energy Recovery facility.
- **License** means the permission given by the Council or Chief Operating Officer to operate a Solid Waste Facility not exempted or requiring a Franchise under this chapter that Transfers, and Processes Solid Waste, and may perform other authorized Activities.
- **Licensee** means the person to whom a License is granted by the Council or Chief Operating Officer under this chapter.
- **Local Transfer Station** means a Transfer Station that serves the demand for disposal of Putrescible Waste that is generated within a single Service Area, and may provide fewer disposal services than are provided by a Regional Transfer Station.
- **Material recovery facility** means a type of Resource Recovery that is limited to facilities that used mechanical methods of obtaining from solid waste materials which still have useful physical or chemical properties and can be reused, recycled, or composted for some purpose.
- **Metro Designated Facility** means a facility in the system of transfer stations, Metro Franchised facilities and landfills authorized under Metro Code Chapter 5.05 to accept waste generated in the area within the jurisdiction of Metro.
Appendix F: Definitions

“Non-putrescible waste” means any waste that contains no more than trivial amounts of putrescible materials or minor amounts of putrescible materials contained in such a way that they can be easily separated from the remainder of the load without causing contamination of the load. This category includes construction waste and demolition waste but excludes Cleanup Materials Contaminated by Hazardous Substances, Source-Separated Recyclable Material, special waste, land clearing debris and yard debris.

“Process,” “Processing” or “Processed” means a method or system of altering the form, condition or content of wastes, including but not limited to composting, vermicomposting and other controlled methods of biological decomposition; classifying; separating; shredding, milling, pulverizing, or hydropulping; but excluding incineration or mechanical volume reduction techniques such as baling and compaction.

“Processing facility” means a place or piece of equipment where or by which solid wastes are processed. This definition does not include commercial and home garbage disposal units, which are used to process food wastes and are part of the sewage system, hospital incinerators, crematoriums, paper shredders in commercial establishments, or equipment used by a recycling drop center.

“Processing residual” means the solid waste destined for disposal which remains after resource recovery has taken place.

“Recyclable material” means material that still has or retains useful physical, chemical, or biological properties after serving its original purpose(s) or function(s), and that can be reused, recycled, or composted for the same or other purpose.

“Recycle” or “Recycling” means any process by which waste materials are transformed into new products in such a manner that the original products may lose their identity.

“Recycling center” means a facility that receives and temporarily stores multiple source separated recyclable materials, including but not limited to glass, scrap paper, corrugated paper, newspaper, tin cans, aluminum, plastic and oil, which materials will be transported or sold to third parties for reuse or resale.

“Regional Transfer Station” means a Transfer Station that may serve the disposal needs of more than one service area and is required to accept solid waste from any person who delivers authorized solid waste to the Regional Transfer Station.

“Resource recovery” means a process by which useful material or energy resources are obtained from solid waste.

“Reuse” means the return of a commodity into the economic stream for use in the same kind of application as before without change in its identity.

“Segregation” means the removal of prohibited wastes, unauthorized wastes, bulky material incidental to the transfer of solid waste. Segregation does not include resource recovery or other processing of solid waste. The sole intent of segregation is not to separate useful material from the solid waste but to remove prohibited, unauthorized waste or bulky materials that could be hard to handle by either the facility personnel or operation equipment.
Appendix F: Definitions

“Solid waste” means all Putrescible and Non-Putrescible Wastes

“Solid waste facility” means the land and buildings at which Solid Waste is received for Transfer, Resource Recovery, and/or Processing but excludes disposal.

“Source Separate” or “Source Separated” or “Source Separation” means that the person who last uses recyclable material separates the recyclable material from Solid Waste.

“Source separated recyclable material” or “Source separated recyclables” means solid waste that has been Source Separated by the waste generator for the purpose of Reuse, Recycling, or Composting.

“Transfer” means the Activity of receiving Solid Waste for purposes of transferring the Solid Waste from one vehicle or container to another vehicle or container for transport. Transfer may include segregation, temporary storage, consolidation of Solid Waste from more than one vehicle, and compaction, but does not include Resource Recovery or other Processing of Solid Waste.

“Transfer station” means a Solid Waste Facility whose primary Activities include, but are not limited to, the Transfer of Solid Waste.

“Trash Only” means mixed waste

“Useful material” means material that still has or retains useful physical, chemical, or biological properties after serving its original purpose(s) or function(s), and which, when separated from Solid Waste, is suitable for use in the same or other purpose(s).

“Waste” means any material considered to be useless, unwanted or discarded by the person who last used the material for its intended and original purpose.

“Waste hauler” means any person who is franchised, licensed or permitted by a local government unit pursuant to state law to collect and haul Solid Waste.

Relevant Definitions taken from those listed in Metro’s Code, Title V: Solid Waste
DEQ estimates that recyclable wood waste accounts for approximately 12 percent of the waste disposed of in the Portland Metro Area, or roughly 152,000 tons annually, generated across the industrial, residential and commercial sectors, (RSWMP, 2005). Despite the high volume disposed, wood also remains one of the most viable recyclable material with active markets. The majority of this wood waste is shredded and delivered as fuel to boilers in the wood and paper mill industries.

Washington State has done considerable research on the viability of expanding hog fuel markets in the region. One of problems researchers have found with the hog fuel market is that, despite competition for the resource, prices per ton remain low. Throughout the research, MRFs and recyclers stated that the cost to process hog fuel (which, after it is separated from other debris requires a grinder) plus the cost to deliver the fuel to a secondary source, roughly equals the market cost. In some cases it is processed and delivered free of charge to a secondary source. Because the overwhelming majority of hog fuel feeds boilers in the wood and paper industries, who already produce a substantial amount of their own wood waste and hence, are able to supply their own fuel needs. In Washington State, over 95 percent of hog fuel is burned by these industries alone. (Washington State Department of Ecology, 2005).

Moving the market for hog fuel beyond the pulp or paper industries, perhaps as a heating or electricity source for government-owned buildings within either the region or the State, is a viable avenue to increasing the wood recycling market. Many schools and older industrial buildings use large boilers as a primary heating source.

Currently, most industrial boilers in use are designed to accommodate a wide range of fuel, including coal, natural gas, oil, mixed fuel, and wood.

While efficiency is often cited as a reason not to convert a boiler from, for example, coal to wood, aggregate efficiencies are often not taken into account in these comparisons.
Appendix G: Hogfuel Information

For example, while a coal-fired boiler used for electricity might operate between at a 25-40 percent efficiency level, while a wood-fired boiler in the same scenario might only operate between a 15-25 percent efficiency level (Council of Industrial Boiler Owners, 2003), the modeling does not account for the energy required to extract, process and transport coal to the desired market.

While particulate and toxic emissions remain a concern when burning hogfuel in industrial boilers, emissions vary considerably depending on both the moisture content and treatment of the wood. Clean, dry wood (i.e. pallet wood) burns the cleanest, with relatively low emissions. For a comprehensive analysis of hogfuel emissions, please refer to the Washington State Dept. of Ecology document entitled, “Hogfuel Boiler RACT Determination” cited below.

Regionally, wood is an abundant, renewable resource that accounts for a substantial percentage of landfilled debris. Of the wood that is recycled, it is essentially “given” away as a free fuel source. It is recommended to work toward expanding the markets for hogfuel beyond the pulp or paper industries.

References:
Clark County Department of Solid Waste, Clark County Solid Waste Management Plan, 2000 (www.clark.wa.gov/recycle/documents/)
9%20Energy%20Recovery%20Incineration.pdf)
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In Tech, Algorithm Efficiencies in a Crude Context, 2004 (http://www.isa.org)