State of Delaware

Assessment of Commercial and Industrial Recycling Activity

FINAL REPORT

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Introduction

The Delaware Solid Waste Authority has had a long-term commitment to the collection of data on waste generation, composition and recycling in Delaware, including:

- A state-wide, four-season waste composition study of wastes disposed at the four DSWA facilities (SCS Engineers, 1996);
- A comprehensive assessment of Delaware solid waste discards and the potential for recycling of materials using the US EPA mass balance approach (Franklin Associates, 2000);
- An analysis of the impact of a yard waste ban on landfill quantities (DSM, 2004); and,
- An analysis of estimated statewide residential recycling rates (DSM, 2004).

In addition, the DSWA maintains a database of commercial and industrial recycling activities in Delaware for use in reporting on recycling in DSWA's Annual Report. Each contact is mailed a questionnaire each year asking for quantities of non-residential materials that were recycled in Delaware in the past year. However, DSWA acknowledges that this database is incomplete, that the responses are voluntary, and that double-counting occurs (e.g., a metal recycler reports quantities that are included in quantities reported by CitiSteel).

Except for the waste composition study, all of the other data collected on recycling are based on either national data or reported data, without on-the-ground verification. As a consequence, DSWA was interested in conducting a comprehensive survey of Delaware recycling activity that would both quantify non-residential recycling in Delaware, and result in a more complete list of contact information for future updates of DSWA's database. This "on-the-ground" data collection would also serve to validate the accuracy of the *Franklin Associates* production and consumption data used in their assessment of the potential for recycling.

This report presents the results of this intensive nine month effort, based on telephone and on-site interviews with approximately 150 recyclers and generators, both in and outside of Delaware.

Project Approach

Calculating a recycling rate requires good information on both the numerator (the quantity recycled) and the denominator (the amount disposed and recycled) of the equation. To achieve this, the project was divided in two parts.

The **first,** and easiest, was to verify the denominator. Surveys were conducted at DSWA landfills to confirm DSWA's methodology for allocating landfill deliveries as commercial/industrial waste versus residential waste. Data were also gathered on quantities of non-residential waste disposed at non-DSWA disposal facilities, both within Delaware and in adjacent states.

The **second,** and much more difficult part of the project, was to conduct a comprehensive survey (either by personal interview or telephone) of as many recyclers and end users of recovered materials as could be identified throughout the State of Delaware.

A detailed description of the methodology for each component is described below.

Verifying the Denominator: Non-Residential Waste Disposed

Delaware is relatively unique in that almost all waste generated within the State is disposed in one of the three DSWA landfills, and only Delaware waste is delivered to these landfills.[1] This allows for much more accurate data on total waste disposed than is possible in most states, where imports and exports of waste make it difficult to accurately determine how much waste from in-state sources is being generated for disposal.

DSWA maintains accurate data on deliveries to all of its landfills by truck number and broad waste category. However, in many cases there is no way to accurately verify whether the truck is delivering waste from residential or non-residential sources. As such DSWA has used as a surrogate that all rear loading trucks are assumed to be delivering residential waste while all front loading and container trucks are assumed to be delivering non-residential waste. Clearly this is not always the case, with some rear loaders operating on commercial routes with dumpsters, or collecting a mix of residential and commercial waste. And, front loaders and container trucks can be serving apartment or condominium complexes.

For this reason, the first task was to attempt to more accurately quantify the breakdown between residential and commercial waste deliveries to the DSWA landfills. This was accomplished by surveying trucks arriving at the three landfills over a two-week period. The type of truck was recorded (e.g., rear loader, front loader, container truck) and the driver was asked whether he had collected residential, commercial or industrial waste, or a mix of more than one. If he answered that it was a mix, he was asked his best estimate of the amount of each type (as a percentage of the total).

The survey data by truck type were averaged (weighted by truck weights), by landfill to develop "conversion factors" that could be applied to each truck type to estimate the amount of each generator type of waste being delivered by truck type. For example, the weighted average for rear loading trucks delivering waste to the Cherry Island landfill was 91 percent residential and 9 percent commercial. Therefore, DSWA could now allocate 9 percent of each rear loader delivering waste to the Cherry Island landfill as commercial waste and 91 percent as residential, as compared to the previous allocation which would have assumed that all rear load waste was residential.[2]

Table 1 presents the result of applying these "conversion factors" by truck type to total FY 05 weigh data by landfill. The net result is that residential waste deliveries to DSWA landfills are approximately 46 percent of total deliveries, with non-residential deliveries at 56 percent. Excluding C&D deliveries, residential and non-residential deliveries are split evenly.

[1] Relatively small quantities of Delaware waste are disposed out-of-state at the Covanta facility in Pennsylvania, or via the ESE transfer station in southern Delaware. In addition, there is one private landfill, the Waste Management/DRPI landfill located in Delaware that accepts primarily C&D waste. Waste Management is required to report to the State on quantities of waste accepted from in-state and out-of-state sources.

[2] In reality the allocation is more complex in that Department of Public Works trucks from Wilmington and Newark were still assumed to be 100 percent residential.

Table 1 - Allocation of Landfill Deliveries by Generator Type
(FY 05 Landfill Records)

Category	Total Disposed (tons)	Percent (%)	Excluding C&D (%)
Total FY 05 Landfill Deliveries	1,173,887	100%	1,073,992
Residential	541,232	*46%*	*50%*
Commercial	491,016	*42%*	*46%*
Construction and Demolition	99,895	*9%*	*NA*
Industrial	27,742	*2%*	*3%*
Government/Institutional	14,002	*1%*	*1%*

The revised estimates for non-residential deliveries to DSWA landfills were combined with deliveries of Delaware waste to the Waste Management/DRPI landfill, and with reported deliveries to out-of state disposal facilities of Delaware waste to calculate the denominator of the recycling rate calculation (Table 2).

Table 2 -Total Non-Residential Waste Disposed By Delaware Generators by Waste Type *(Tons, 2005)*

DISPOSAL	
DSWA Landfills	***2005 Totals (tons)***
Commercial Waste	491,016
Construction and Demolition	99,895
Industrial Solid Waste	27,742
Government/Institutional	14,002
DRPI Landfill	
Construction and Demolition	112,500
Other Disposal Facilities	
Commercial Waste	9,755
Construction and Demolition	41,543
Industrial Solid Waste	2,286
All Facilities:	
Commercial Waste	500,771
Construction and Demolition	253,938
Industrial Solid Waste	30,028
Government/Institutional	14,002
Total Disposed:	**798,739**

Verifying the Numerator: Amounts Recycled

Included Waste Types

This assessment concentrates on solid wastes only. No gaseous or liquid wastes are included, although solid residuals from the treatment of liquid and gaseous wastes are included to the extent that the materials are beneficially reused or recycled, and can be quantified (see below).

Both infectious wastes and Sub-title C (of RCRA) hazardous wastes are excluded, although DSM did attempt to include conditionally exempt waste streams, or "universal wastes" such as:

- Waste oil;
- Oil filters;
- Dry cell batteries (i.e. nickel cadmium);
- Lead acid batteries;
- Electronic wastes such as computer monitors, hard drives and related components; and,
- Mercury containing wastes such as fluorescent tubes and electronic switches (to the degree that they can be quantified at the processing stage).

Potential for Off-Site Disposal

Only those materials which would be disposed off-site if they were not beneficially reused or recycled, and therefore could potentially be delivered to a DSWA landfill, are included in the assessment. Examples include:

- Dairy manure, which is typically applied on adjacent agricultural fields for its nutrient value, is excluded, but excess poultry litter, which is generated in such large quantities that all of it cannot be applied on adjacent agricultural fields without increasing nutrient releases to ground and surface waters, is included.[3]
- Wood chips and stumps that are disposed on site are excluded while wood waste, including trees and stumps, that must be removed from the site is included.[4]
- Plastic wastes reused on-site in a manufacturing process are excluded, but plastic wastes sent off-site for reclamation are included.
- Pallets that are reused on-site are excluded, but pallets that are shipped off-site for reuse or rebuilding are included.

Import and Export

In all cases the assessment ***excludes*** solid wastes that are being imported to Delaware for either recycling or disposal. This includes construction and demolition (C&D) wastes that are generated in Pennsylvania or New Jersey but delivered to the Waste Management/DRPI landfill in New Castle County for disposal. This also includes petroleum contaminated soils imported from New Jersey (or other states) for thermal treatment at the Clean Earth facility in Wilmington, and scrap steel generated outside of Delaware but delivered to CitiSteel for feedstock.

Similarly, the study ***includes*** quantities of material generated in Delaware but exported for disposal or for recycling. For example, solid waste that is hauled out of state for disposal (to the degree it can be tracked and quantified) as well as recycled materials (e.g., paper and cardboard)

[3] Only that portion of poultry litter which is not applied to adjacent agricultural lands is included.
[4] Quantities reported in the 2004 Yard Waste report completed by DSM for DSWA.

backhauled or transported from large generators in Delaware directly to out-of-state warehouses or recyclers are included (e.g., grocery stores that backhaul cardboard to an out-of-state, central distribution facility for processing, or printing facilities that generate large amounts of scrap paper that broker directly to an out-of-state facility).

Material Categories

Based on the Scoping Study conducted by DSM to determine how to approach this analysis, and the definitions of included wastes described above, the material categories listed below were included in the study. Figure 1 then allocates each material category to "commercial", "industrial" or "construction and demolition" waste streams, which can then be used to estimate overall recycling rates by waste stream based on the waste categories reported by DSWA. It should be noted here that in some cases a material might be included in more than one waste stream category depending on the generator type. In addition, especially for food processing and other agricultural wastes, the decision to allocate these wastes to the "industrial" category has been made only because DSWA does not separately break out agricultural wastes.

- Asphalt
- Agricultural wastes
- Brick
- Concrete
- Contaminated soils (with the limitations described in "potential for off-site disposal")
- Construction and Demolition Wastes (including metal, painted and pressure treated woods, unpainted wood, gypsum, asphalt shingles, rubble)
- Commercial Wastes, include the following major categories:
    - *Office (including paper from government offices, large corporate headquarters and major office complexes);*
    - *Retail (including corrugated containers from "big box" department stores and small shops);*
    - *Restaurant (including grease and deposit beverage containers);*
    - *Automotive (including tires, scrap metal, junk automobiles, batteries); and*
    - *Groceries/Supermarkets.*
- Fly and bottom ash
- Food processing wastes (e.g., poultry processing wastes)
- Scrap metal (including white goods and scrap vehicles)
- Other industrial byproduct wastes that are recovered or disposed
- Waste water treatment plant sludge that is land applied or composted
- Other wastes (e.g., electronics, carpet, bulky goods, pallets, textiles, universal wastes)

Figure 1 – Classification of Material Categories by Waste Type

Materials/Categories	Commercial	Industrial	Construction & Demolition
Asphalt			x
Agricultural Wastes		x	
Brick			x
Concrete			x
Contaminated Soils		x	
Construction & Demolition Debris			x
Commercial Wastes			
Office	x		
Retail	x		
Restaurant	x		
Automotive	x	x	
Grocery/Supermarket	x		
Fly and Bottom Ash		x	
Food Processing Wastes (including poultry processing)		x	
Scrap Metals		x	
Other Industrial Byproduct Wastes		x	
Waste Water Treatment Plant Sludge		x	
Other Wastes (e.g., electronics, carpet, pallets textiles)	x	x	

Survey Approach

The primary methodology used was to identify all of the major processors, buyers, and/or end users of each material listed above, and then contact each firm to request data on total quantities collected from Delaware generators.

This survey was augmented by contacting many of the largest generators of recyclable material in the State to verify where their recyclable material was being sent. This provided contact names, and in many cases cell phone numbers and an "in" to the brokers/end users. It also provided a check against double counting.

Contacting the generators also provided information on the delivery of recyclables to out-of-state central warehouses. This is especially critical for corrugated containers because many of the national and regional chains (e.g., Wal-Mart, Acme, Safeway) organize backhauling of baled corrugated from their retail stores to a central warehouse, rather than relying on local waste haulers or paper brokers. Therefore, recycling of corrugated containers would be under-counted if the survey only relied on reports from waste haulers and paper brokers.[5]

Finally, existing data from State agencies was also utilized. This was especially the case for waste water treatment plant sludge that is being land applied, and for excess poultry litter which must be managed off-site. In the case of waste water treatment plant sludge (bio-solids), a DNREC permit, with annual reporting on quantities is required. In the case of excess poultry litter, the Delaware Nutrient Management Commission provides cost sharing for transport, and will help

[5] In all cases DSM offered survey respondents an opportunity to request that the data be kept confidential. As such, for some materials, data on quantities by individual firms will not be available to DSWA.

with locating alternative uses of the material, and maintains an up-to-date tally of quantities being beneficially reused off-site.

A more detailed description of the data gathering approach and the recycling process, if any, is described below for each material.

Asphalt: Waste asphalt is generated from repaving of public and private roadways, as well as from parking lots and driveways. There are a number of cases when it is necessary to remove the top course(s) of asphalt prior to repaving. Examples include locations where the surface of the roadway must be kept at a certain level below an overpass, to reduce the need for fill on the shoulder of the roadway, or because the existing top course is significantly deteriorated or rutted. This material can be used both as input to new asphalt, and as road base material. Under current Delaware DOT specifications, old asphalt can only represent up to 15 percent of the input into the new asphalt mix. As such, there is typically excess asphalt that must be used as road base, even though the asphalt paving contractors would prefer to use higher percentages of used asphalt in their paving because it would reduce their costs by saving energy and petroleum.

DSM met with the Executive Director of the *Delaware Asphalt Paving Association* and the larger contractors involved in asphalt production and road construction. This included site visits to several asphalt plants with grinding operations. In almost all cases, DSM received calendar year weigh data of incoming asphalt. Smaller contractors were contacted by telephone and provided estimates of quantities recovered and reused last year.

Agricultural Wastes: Agricultural wastes are typically applied to the land for their nutrient value. However, deteriorating water quality in the Delaware and Chesapeake river basins, combined with larger farms and concentrated animal feeding, have led to the need to reduce nitrogen and phosphorous loadings to soils and adjacent ground and surface waters. In 1999 Delaware passed the Nutrient Management Law which, among other provisions, requires mandatory nutrient management standards for farmers and golf courses. The net result is that larger farms with concentrated feeding (primarily large poultry farms) can no longer apply all of the poultry litter on adjacent lands without exceeding the nutrient management standards.[6] The excess poultry litter must therefore be hauled off-site and utilized on other lands, or in some other manner. Alternative uses include mushroom farming, commercial fertilizer production, and hauling to other areas of Delaware or adjacent states where crop production can utilize the nutrients. Data are available from the Delaware Nutrient Management Commission on the quantities of poultry litter and other agricultural wastes that are being hauled off-site for alternative uses.

Agricultural Processing Wastes: Delaware has a large poultry processing industry, with three large firms (Perdue, Mountaire and Allen Farms) operating five poultry processing facilities. These facilities generate significant quantities of offal, meat, bone, blood and feathers which must be disposed of. This material has value and is all being converted to such products as pet food and fertilizer. DSM met with representatives of two of the three firms and they agreed to provide data on quantities as long as the data were aggregated and the reported data on individual facilities kept confidential. The third firm was contacted by telephone[7].

Automotive Wastes: Automotive wastes include the byproducts from operating cars and trucks, such as oil filters, waste oil and waste antifreeze as well as lead acid batteries and tires. DSM confirmed oil filter recycling totals from DSWA (which are ultimately sent to CitiSteel for feedstock) and obtained figures on waste oil recovery from some but nor all oil recovery vendors

[6] Calculations of maximum nutrient loadings are made based on soil type and expected uptake by the agricultural crop on which the nutrients are applied.

[7] DSM is still waiting to receive quantities from two of the five plants. Until these quantities are reported to DSM the data from the three reporting plants has been extrapolated to estimate total processing wastes.

operating in the state (which goes to a variety of end uses including fuel). DSM also surveyed by telephone vendors of lead acid batteries to confirm statewide totals and one regional smelter to confirm lead recycling processes. Finally DSM surveyed the two largest tire recyclers – Magnus and Emanuel Tire – to confirm 2005 total quantities recovered. End uses for tires recovered were found to be mainly landscaping and drainage products but a small percentage of tires did go to tire derived fuel in 2005. It is likely that data on tire recycling underestimates total quantities because tires that are recapped are not included.

Commercial Waste: The commercial waste stream includes a number of materials that are traditionally recycled. For this reason, a significant amount of time was spent during this analysis attempting to better understand recovery of corrugated containers, office paper, packaging, food waste, beverage containers and other segments of the commercial waste stream. This involved meetings with many recycling facility owners as well as large generators. To gain access to business owners and representatives of the financial service industry, where cold calling is most difficult, DSM met with the Delaware Chamber of Commerce to obtain contact names and telephone numbers, and used these to begin the search for the correct person at each of the large generators who could provide information on what was being recycled and where it was going. These contacts also provided DSM with an "in" to the large brokers who were handling this material because DSM was able to both obtain a cell phone number of the contact, as well as use the generator contact name. Sectors where DSM did the most research included:

- ***Government offices***, and large employers in the banking, finance and insurance industry such as Bank of America/MBNA and BlueCross Blue Shield;
- ***Distributors***, such as Amazon and NKS (malt beverages);
- ***Retailers***, including Wal-Mart and Lowe's and other "big box" department stores such as Target and Costco, as well as major chains located in Delaware such as Happy Harry's drugstores;
- ***Restaurants***, where DSM interviewed representatives of some of the large restaurant chains to obtain data on corrugated container recycling and contact information on the rendering facility taking the grease; and,
- ***Groceries/Supermarkets***, including most of the major supermarket chains such as Acme/Albertson's, Giant Foods/Super Fresh, and Shop-Rite.

Concrete: Demolition of concrete buildings, foundations, and roadways results in large quantities of concrete which must be disposed of. Large contractors, as well as the major asphalt pavers and road construction firms have grinders that crush and grind this concrete, remove the metals, and produce an aggregate for road construction. These grinding operations are located at several fixed locations throughout the state. In addition, the larger contractors have mobile equipment that can set up for operation at a large job. DSM met with all of the largest contractors with grinding operations and obtained weigh data or estimates of last year's throughput.

Contaminated Soils: Soils contaminated with petroleum products or other potentially hazardous wastes are either treated on-site through aeration and biological degradation, or if too highly contaminated, removed off site for further treatment so that the land can be redeveloped. Clean Earth operates a large soil treatment facility in New Castle County which thermally treats contaminated soils. Clean Earth provided DSM with the estimated quantity of Delaware soils

treated at this facility in 2004 and this was aggregated with additional quantities reported from industries not using Clean Earth.

Construction and Demolition (C&D) Wastes: C&D wastes results from new construction, renovations or deconstruction of building and housing. DSM did not attempt to segregate residential (new home) from commercial construction waste as no data on incoming quantities is characterized in this way. The composition of C&D waste generally includes painted and pressure treated wood, unpainted wood, gypsum or wallboard, asphalt shingles, rubble, insulation, metals and corrugated. A number of these materials are potentially recyclable.

DSM interviewed contractors in person, and by telephone about construction and demolition recovery and disposal.

Fly and Bottom Ash: Bottom ash is the residue remaining in the bottom of the combustion chamber after the combustion of fuel or waste, while fly ash are the particles removed from gases by use of electrostatic precipitators or fabric filters prior to the release from the stack. Fly ash is often used in cement production, but in Delaware both fly and bottom ash have been used to stabilize boisolids from Wilmington's wastewater treatment facility. The resultant mix has been used as a landfill cover material at DSWA facilities.

Food Processing Wastes: As discussed above, DSM surveyed poultry processors to determine the quantity of poultry waste recovered for beneficial use. Data were also obtained from DNREC on quantities of waste water treatment sludge from other food processors in Delaware.

Food Waste recovered includes expired and waste meats from grocery stores and food trapped in collected oil and grease. The former is recovered and used in feed and the latter sent for organics composting out of state. DSM did not identify any fruit or vegetable waste separation by large retailers or restaurants for composting.

Scrap Metal: Scrap metal recovery was quantified mostly through on-site surveys with scrap metal businesses in Delaware and by some telephone surveys to confirm quantities reported to DSWA. DSM also surveyed CitiSteel to determine incoming quantities from Delaware sources.

While there are many scrap metals dealers in Delaware, most of the light iron (including white goods) is sent out of state for shredding by the scrap metal brokers, with some of the shredded material then used by CitiSteel in Delaware.

Two scrap metal dealers interviewed by DSM suggested a different classification for reporting metal recycling based on how it is sold. These categories would be *light iron* (which includes appliances), *heavy iron* and *high value metals* (such as copper, brass, etc). The current classifications used by DSWA can lead to double counting of white goods, which are included in light iron. While DSM believes there is merit to this approach, it was decided to continue to use the classifications for metals recovered that DSWA has used in the past.

These are:

Scrap autos (defined as Special Solid Waste by DNREC) are the weight of automobile crushed for scrap or sent for crushing after removal of fluids and some usable parts. This

number is under-reported by DSM because one very large generator would not provide data for this study.

Ferrous metals are derived from iron or steel and include products such as appliances, furniture, containers, and packaging (steel drums and barrels).

Non-ferrous metals are those metals or alloys that are relatively free of iron. They are nonmagnetic metals such as aluminum, lead, and copper, and products made from these non-ferrous metals include containers, packaging, appliances, furniture, electronic equipment and aluminum foil.

Appliances are generally made of a light iron and could be classified as either ferrous or nonferrous metal depending on the particular appliances.

Aluminum is a subset of non-ferrous metals

Other Industrial Byproducts: These include non hazardous solid waste that was sent out of state for disposal as well as metals and steelmaking slag. DSM surveyed most of the major manufacturers in the state, including ten members of the Chemical Manufacturing Association, General Motors, Daimler Chrysler, the Dover Post, the News Journal (of Wilmington), Dover Litho, Print Pak and several smaller printers.

Waste Water Treatment Plant Sludge: These are typically referred to as biosolids, which are land applied or composted. Figures were obtained from DNREC on dry tons, and then corrected to wet tons based on the moisture content reported.

Other Wastes: This category is a catch-all for all other materials that are being recovered, such as electronics, carpet waste, pallets, textiles, and universal waste such as fluorescents containing mercury. DSM attempted to survey the major recyclers of textiles, pallets and carpet, however did not contact all processors and therefore the numbers are underreported. DSM surveyed only a few recyclers of electronics and fluorescents, and believes that the quantities reported for these materials are severely underreported. However, even if all recyclers reported, the quantities would still be relatively small compared to the large quantities of other materials reported in this assessment.

Study Limitations

The methodology used for this analysis, which counts all activity and tracks material flow, is more likely to under report than over report recycling activity. This is because DSM's approach ensured almost no double counting, since the flow of material was tracked from almost all generators to processors and/or to end markets. Therefore, the downfall of this methodology is that unless all generators and brokers participate, some material will be missed. For example, corrugated may be slightly under reported since two major grocery store chains did not participate in the survey – Save-A-Lot and Safeway – representing a total of ten grocery stores that may jointly recycle another 2500 tons of corrugated.

Industrial waste disposed may also be under reported because not all industrial firms participated in the survey. This waste is likely to be non-hazardous solid waste shipped out of state to secure landfills or energy recovery because of future liability concerns.

Finally, it is important to note that DSM was charged with finding and reporting on all materials reused or recycled in Delaware without regard to whether these materials should or should not be included in any recycling rate calculation. For this reason, each material is reported separately, allowing decision makers to determine what the recycling rate is based on what materials are included and excluded. However, in all cases, the methodology is the same – any solid material that could go to landfill if it were not reused or recycled is included. In almost all cases this material is not going to landfill because it either has value, or it is less costly to reuse or recycle than it would be to landfill the material.

Results

Table 3 below presents estimated quantities of materials recovered for recycling or beneficial use by major material category in calendar year 2005.

Table 3 - Non-Residential Materials Recovery By Material Type *(Tons, 2005)*

RECOVERY	
	Estimated for 2005
Paper	***(tons)***
OCC	44,620
ONP	8,736
MOP	14,903
Subtotal:	**68,259**
Packaging	
Glass	3,749
Shrink Wrap	179
Mixed Plastics	2,231
Al/Steel Cans	116
Pallets	7,062
Subtotal:	**13,338**
Metals	
Scrap Autos	11,885
White Goods	8,950
Ferrous	58,173
Non-ferrous	4,203
All other	3,081
Subtotal:	**86,291**

RECOVERY (continued)	(tons)
Construction & Demolition	
Asphalt	478,165
Concrete	485,414
Wood (e.g. stumps and limbs)	28,490
Soils	101,933
Stones	4,457
Mixed Construction Waste	188
Carpet	66
Subtotal:	**1,098,714**
Ag and Food Wastes	
Poultry Waste (extrapolated)	350,835
Sludge	9,445
Poultry Litter	61,774
Food Processing	9750
Fats, Oil, Grease	3,560
Food Waste	10,694
Subtotal:	**446,058**
Vehicle Waste	
Tires and Rubber	7,239
Antifreeze	27
Waste Oil	1,047
Oil Filters	614
Lead Acid Batteries	1,435
Subtotal:	**10,363**
Special Wastes	
Textiles	1,753
Waste Oil	3
Electronics	1,539
Florescent Bulbs	43
Subtotal:	**3,338**
Industrial Waste Recovery	
Mixed Plastics	209
Biosolids (Wet Tons)	63,723
Bottom Ash (VLF)	145,788
Slag	80,000
Subtotal:	**289,720**
Total Recovered:	**2,016,081**

Figure 2 graphically illustrates the major components of the commercial and industrial waste stream that were recovered for recycling or beneficial use by major material category, using the figures from Table 3.

Figure 2 – Quantities Recovered By Major Material Category

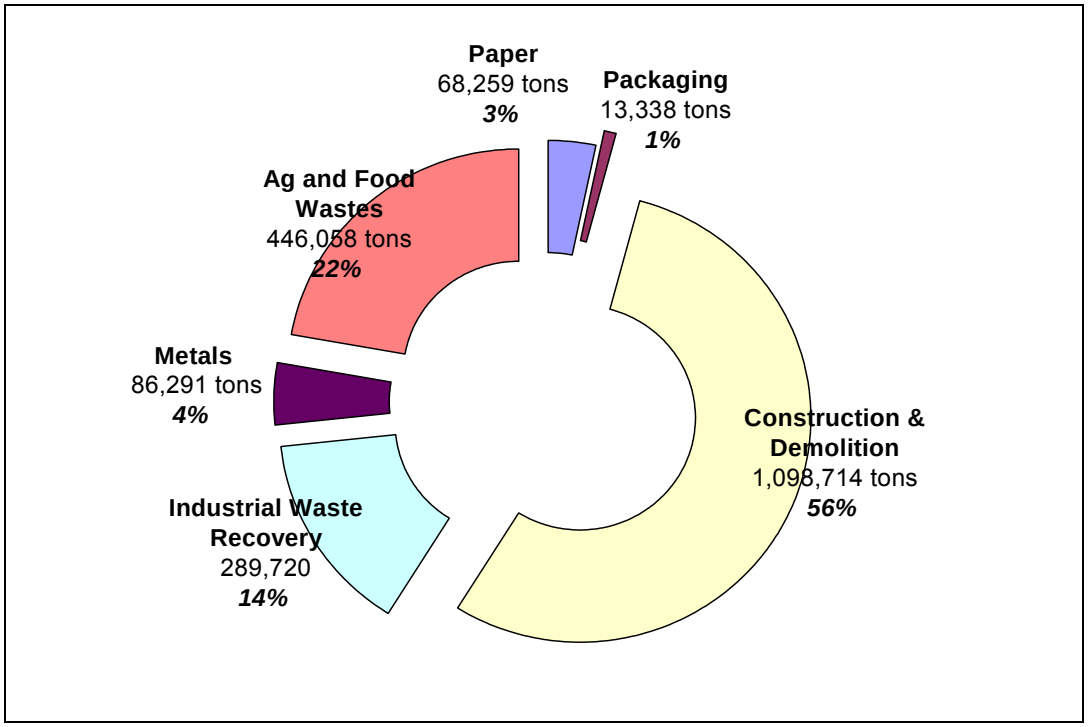

Table 4 presents estimated recycling rates for all commercial and industrial (C&I) waste, for construction and demolition (C&D) waste and for all other C&I waste, excluding C&D waste, using the data presented in Table 2 (the denominator) and Table 3 (the numerator). Note that the high rate for C&D waste is almost wholly attributed to the high recovery rate for asphalt and concrete.

Table 4 - **Recycling Rate Calculations**
By Major Waste Categories

CALCULATIONS	
	(tons)
All Non-Residential Waste	
Total Recycled/Recovered	2,016,081
Total Disposal	798,739
Recovery Rate:	***72%***
C&D Waste	
Recovered	1,098,714
Disposed	253,938
Recovery Rate:	**81%**
All Other C&I Waste	
Recovered	917,367
Disposed	544,801
Recovery Rate:	**63%**

Table 5 presents estimated recycling rates for all wastes generated in Delaware, including residential and yard waste, and the commercial and industrial wastes analyzed as part of this report. Data on residential waste and recovery were originally reported to DSWA in November, 2004.

Table 5 - **Recycling Rate, All Waste Categories (2005)**

	Residential Waste *(tons)*	***C&D Waste*** *(tons)*	***All Other C&I Waste*** *(tons)*	**Total Waste** (tons)
Total Recycled/Recovered	76,766	1,098,714	917,380	2,092,860
Total Disposal	541,232	253,938	544,801	1,339,971
Recovery Rate:	***12%***	***81%***	***63%***	***61%***

Comparison with Franklin Associates Report

Because the Franklin Associates Report (*Assessment of Delaware Solid Waste Discard in 2000 and the Potential for Recycling of Materials, September 2002)* was the last attempt to estimate commercial recycling rates for Delaware, a brief summary of the issues associated with a comparison of the Franklin data and the DSM data is included here.

Difference in Included Waste Streams

Franklin Associates includes only *municipal solid waste* (based on the US EPA definition) and construction and demolition waste. Franklin Associates *excludes*:

- Industrial and food processing wastes;
- Municipal sludge;
- Combustion ash;
- Junk automobiles; and,
- Trees and brush from non-residential sources.

By contrast, DSM has included *all non-hazardous wastes* that could be disposed of at a DSWA landfill. For example, municipal sludge can be disposed of at a DSWA landfill if it is at least 20 percent solids, and a small portion is landfilled because it is cheaper than alternative beneficial reuse options. Similarly, most agricultural processing waste is recovered for alternative uses, but small quantities are delivered to DSWA landfills.

For this reason, the overall recycling rates reported by DSM can not be compared with the Franklin Associates data. In addition, there are significant differences in the methodologies employed in estimating both the denominator and the numerator, as summarized below.

Denominator

There are few states in the United States where almost all wastes are disposed of at state (or authority) controlled facilities[8]. DSM was able to obtain detailed data on residential and commercial deliveries to the three DSWA landfills as well as accurate data on deliveries of Delaware waste to the one private landfill in Delaware, and to the two out-of-state disposal

[8] Rhode Island is the most similar to Delaware with most waste generated within the State disposed of at a single landfill owned by the Rhode Island Resource Recovery Corporation.

options. By contrast, Franklin Associates was forced to rely on national waste generation coefficients, by employment category, to estimate total commercial waste generation by material type. This allowed Franklin Associates to estimate recycling rates by material category, but the level of accuracy was less than the accuracy of the DSM data aggregated across all material categories.

Numerator

Delaware is a relatively small state with a tight knit business community. As a consequence, DSM was able to develop reasonably accurate recovery rates through on-site surveys of the majority of brokers and end-users in Delaware; essentially building from the "bottom up" to develop total recovery by material category. This also allowed DSM to avoid double counting of materials and to account only for Delaware material.

DSM was also able to survey most of the large generators to account for material generated in Delaware, but recycled outside of Delaware. For example, many of the large retailers bale corrugated and back-haul it to their central warehouses. This material was accounted for by interviewing the warehouse managers for the large retail chains.

To the best of our knowledge, this type of detailed survey of the vast majority of brokers and generators is unique, and should result in relatively accurate estimates of recovery by major material categories.

In contrast, Franklin Associates estimated recovery through a combination of national recycling rate coefficients applied to Delaware employment or other surrogate data, combined with telephone surveys of Delaware generators. This is the standard methodology used to prepare national recycling rate estimates. However, when attempts are made to disaggregate to the state level, errors are introduced which reduce the accuracy. In addition, the use of surveys of generators is likely to result in double counting, because it does not account for in-state transfer to brokers who may have already reported some of the same material.

The end result is that the Franklin Associates methodology is more likely to *overestimate* materials recovery, and the DSM methodology is more likely to *underestimate* material recovery, especially in cases where some brokers/end users were not willing to participate in the study.