



2002 Oregon Solid Waste Characterization and Composition



Oregon Solid Waste Characterization and Composition

2002

prepared by:

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co-sponsors:

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City of Eugene
Marion County**

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Cover: Sky Valley Associates weighs out nearly 100 pounds of food waste from Sample 874, collected from a residential rear-load garbage truck from Portland on December 3, 2002.

Oregon Solid Waste Characterization and Composition

2002

More than 2,700,000 tons of municipal solid waste were generated in Oregon and then disposed in landfills or solid waste burning facilities in 2002. Most of these wastes were disposed in Oregon, with only about 19,000 tons being exported to other states for disposal. Additionally, another 970,000 tons of industrial waste, rubble, contaminated soils, and other special wastes were generated and disposed in Oregon. Oregon also imported about 1,300,000 tons of municipal solid waste and 170,000 tons of industrial and other waste from other states, giving an overall total of more than 5 million tons of waste buried in landfills or burned.

This report provides information on the quantity and composition of the solid waste generated in Oregon, concentrating on municipal solid wastes. It is based primarily on a waste composition study jointly funded by the Oregon Department of Environmental Quality (DEQ), Metro, Marion County, and the City of Eugene, along with disposal quantification information reported to the study sponsors by disposal sites throughout the state. Sky Valley Associates of Monroe, Washington, and Oregon City, Oregon, carried out the fieldwork using methodology jointly developed by DEQ, Sky Valley Associates, and previous contractors. Disposal site operators and solid waste collection companies also provided extensive information and assistance for the study. DEQ carried out the analysis of waste composition and quantification data and produced the final report.

This report includes the following:

- The tons of solid waste disposed in Oregon or generated in Oregon and disposed out-of-state, by source and by type of disposal facility.
- The composition of municipal solid waste disposed, based on a traditional field waste composition study that involved collecting and sorting 844 samples of solid waste collected from 55 disposal sites in 25 counties throughout calendar year 2002. This composition is referred to as "field" composition or "dirty, wet" composition, as materials sorted in the field are often wet or contaminated with other materials that are impractical to separate under field sorting conditions.
- The results of contamination analysis of selected samples taken from the field composition work, designed to remove the effects of contamination and absorption of water from wet waste or external water into dry wastes. This was done to better estimate the "clean, dry" weight of each type of waste as generated in Oregon. This analysis was referred to in past studies as "detailed sample analysis."
- Comparisons of the results of this study to four previous studies conducted by DEQ since 1992, and by Metro in the greater Portland area in 1993/94, each conducted using similar methodology to the field composition portion of this study.
- Comparisons of the composition of municipal wastes disposed to the composition of materials recovered in Oregon for recycling, composting, or energy recovery, based on the 2002 Oregon Material Recovery Survey conducted and published by DEQ:
(<http://www.deq.state.or.us/wmc/solwaste/documents/2002MRSReport.pdf>) .

Quantity of Waste Disposed

The tonnages reported in Table 1 are based on reports to DEQ by disposal sites and waste exporters in Oregon. They include waste disposed of in permitted landfills as well as Oregon's only waste-to-energy facility and a waste incinerator. A limited amount of septage sludge spread on land under DEQ solid waste

permits is included, but agricultural wastes, treated sewage sludge, and paper mill sludge applied to land for beneficial purposes are not included.

Table 1. Tons of Solid Waste Disposed in Oregon or Exported from Oregon in 2002

	Municipal Solid Waste Landfills	Municipal Burners/ Incinerators	Industrial Solid Waste Landfills	Thermal Treatment Plants	Sludge Lagoon/ Spreading Sites	Solid Waste Exported Out-of-state	Total
Oregon-generated wastes							
Municipal waste****	2,514,524	201,301	12,326			19,324	2,747,475
Alternative daily cover**	94,071						94,071
Asbestos	5,895		25,000			2	30,897
Contaminated soils**	222,368			45,494		9,927	277,789
Inerts - other soil	16,399		37,592			4,676	58,667
Septage sludge	5,589				19,610		25,198
Industrial & other wastes	316,320	6,065	174,851			17,286	514,522
Total Oregon waste	3,175,165	207,367	249,769	45,494	19,610	51,215	3,748,620
Out-of-state generated wastes							
Municipal & unspecified wastes	1,423,270	140	17,703				1,441,113
Alternative daily cover**	42,579						42,579
Asbestos	1,789						1,789
Contaminated soils**	246,704						246,704
Total out-of-state	1,714,342	140	17,703	-	-	-	1,732,185
Total generated and/or disposed in Oregon	4,889,507	207,507	267,472	45,494	19,610	51,215	5,480,804
Total disposed in Oregon	4,889,507	207,507	267,472	45,494	19,610		5,429,590

* Tires disposed at the Crook County tire landfill.

** Petroleum-contaminated soil is included under "contaminated soils" even when used as daily cover.

*** Includes 466 tons of exported waste not reported to DEQ but reported to Washington Department of Ecology, plus 189.5 tons of tires that were inadvertently left off the 2002 Oregon Material Recovery Survey report

**** The 2002 Oregon material recovery survey reported 2,723,365 tons of municipal waste disposed. The numbers published here differ due to the following:

- 24,227 tons of waste that were burned in the Marion County Energy Recovery Facility were counted as recovered material under ORS459A.010 in the material recovery survey, but counted as disposed here.
- 976 tons of industrial sand inadvertently counted as municipal waste in the material recovery survey, but as inert material here.
- 343 tons of industrial waste that Lane County double-reported both as municipal and industrial waste at Glenwood and Short Mountain. This has been corrected here.
- 189.5 tons of tires shipped to the Roosevelt landfill that were inadvertently omitted from the material recovery survey
- 466 tons of exported MSW not reported to DEQ but reported received by landfill in other states.

Composition: Field Sampling at Municipal Solid Waste Disposal Sites

Current Study in Relationship to Previous Studies:

DEQ has conducted three earlier composition studies using the same general methodology as the current study. These studies were conducted in 1992/93, in 1994/95, 1998, and in 2000. The first two covered all areas of Oregon outside the three Portland Metro-area counties. Metro conducted a similar study in 1993/94 using the same methodology as DEQ, and joined with DEQ in conducting all studies starting in 1998. There have been minor changes in categories used over the years, mostly involving splitting a single category into two or more subcategories. Also, contamination analysis (detailed sample analysis) was not done in the DEQ 1992/93 study or the Metro 1993/94 study. Metro also did two previous studies, in 1986/87 and 1989/90. However, the material categories used in these earlier studies do not match closely with the later studies, making comparisons difficult.

This study is the second half of a combined 2000/2002 waste composition study. As with all sampling studies, the precision of the results depends on the number of samples collected. DEQ normally aims for a level of precision such that for common materials like newspaper or plastic containers, we can estimate the tonnage being disposed to within plus or minus ten percent (at the 90% confidence level). Based on data from past studies, it takes roughly 600 samples to achieve this level of precision. However, doing a 600-sample study every two years is fairly expensive. To conserve money, DEQ and Metro decided to divide the study into two 2-year periods, and collect roughly half the samples during each period. A 300-sample "half-study" should achieve a precision level of roughly plus or minus 14% for disposal tonnage of some common materials, while the combined 2000/2002 results, based on 600 samples, should achieve a plus or minus 10% precision. For the 2002 part of the study, DEQ collected 300 disposal site samples statewide, of which 74 were from the Metro tri-county area. Metro funded an additional 225 Metro-area samples, bringing the Metro total up to 300 samples. In addition, DEQ funded 50 samples of residual waste from mixed solid waste processing facilities, and Metro funded an additional 16 samples from these facilities. Marion County and the City of Eugene also joined in the 2002 study, paying for sufficient numbers of field samples to achieve at least 150 samples within each of their jurisdictions. These extra samples also helped increase the precision of the statewide composition estimates developed in this study.

Methodology:

Field sampling at disposal sites involves selecting unbiased, representative loads of waste, pulling a sample weighing about 200 pounds (100 kg) from each load, and sorting the sample into different material categories. Each material category is then weighed and disposed or recycled.

A brief outline of the methodology is included below. Appendices B and C give the details of the methodology used in this study, and Appendix D gives definitions for the 84 material categories used.

Geographic Areas and Waste Substreams Sampled

In each of the 4 targeted areas for waste composition (Metro, Marion County, Eugene, and "rest of Oregon"), samples were collected from a large number of disposal sites in a manner that was representative of the overall waste disposed in each area. Results for Marion County and the City of Eugene have been analyzed separately and published as supplements to the overall 2002 study, but in this report their results are combined with results from other parts of Oregon outside the Metro area, and are not reported separately.

Within each geographic area, waste samples were selected from eight "waste substreams":

- Residential route garbage trucks. At least 90% of the waste on the truck is from single-family or multifamily residences.
- Commercial route garbage trucks. At least 90% of the waste on the truck is from businesses.
- Mixed route garbage trucks. Contains a mixture of residential and commercial wastes. Frequently the residential waste is mainly from apartments or other multifamily residences, since apartments often have large garbage containers that are serviced by the commercial route trucks.
- Compacting drop boxes. Commonly used by individual grocery stores, malls, or other retail operations.
- Loose drop boxes. Commonly used for construction and demolition and for "yard-cleaning" activities.
- Self-haul. Any wastes hauled directly to the transfer station or landfill by the person or business that generated the waste.
- Mixed Solid Waste Processing Facility (MSWPF) residual wastes. These are the wastes left over for disposal after recoverable materials have been removed at the facility.
- Special Purpose Landfills, as described below.

Most of the samples were collected either at general-purpose landfills or at transfer stations that ship all their waste to general purpose landfills. However, in the Metro area and the Willamette Valley, significant amounts of waste are taken to limited-purpose landfills. These landfills are prohibited from accepting food and other putrescible wastes, and thus should differ significantly in waste composition from samples taken from waste bound to a general-purpose landfill. In the Metro region, wastes arriving at limited purpose landfills were divided into two waste substreams:

- Hauler loads (mainly loose drop boxes) going to special-purpose landfills, and
- Self-haul loads going to special purpose landfills.

In the rest of the state, very few mixed-waste hauler loads are taken to special purpose landfills, so a single waste substream was designated for all (mainly self-haul) loads.

With the exception of the MSWPF samples and samples from Marion County transfer stations that collect only self-haul waste, loads arriving in transfer trailers were not sampled. In areas where significant amounts of waste pass through transfer stations on their way to final disposal, sampling was done directly at the transfer stations rather than from the transfer trailers arriving at the landfill. This was done to distinguish individual wastes from the individual substreams listed above. For MSWPFs however, it seemed more appropriate to sample the residual waste going to disposal after recoverable materials had been removed, rather than the waste arriving at the facility. For the Marion County transfer stations, some "high-recoverable" waste is first taken to a processing facility where recoverable materials are removed, so sampling had to be done instead at the point where the waste was transferred to the Marion County Energy Recovery Facility in order to accurately represent the waste being disposed.

Table 2 shows the total number of samples collected and sorted for each geographic area and for each waste substream.

Table 2 Number of Composition Samples Collected in 2002, by Waste Substream.

Waste substream	Metro	Marion County	City of Eugene	Rest of Oregon	Total
Residential Routes	52	28	38	24	142
Commercial Routes	33	16	18	20	87
Mixed Routes	43	22	16	20	101
Compacting Drop Boxes	30	16	4	11	61
Loose Drop Boxes	43	21	4	30	98
Self-Haul	49	38	63	71	221
MSWPF residue	50	8	8	0	66
Hauler: Limited Purpose LF	22	0	0	0	22
Self-Haul: Limited Purpose LF	27	9	10	0	46
Total	349	158	161	176	844

Within each geographic area, the number of samples collected from each waste substream depended on two factors:

- The absolute quantity of waste disposed from each substream, and
- The expected variability of waste in the substream, based on past composition studies.

Some waste streams such as residential garbage truck wastes are fairly homogeneous from load to load. In contrast, loose drop box loads and self-haul loads can be highly variable. Frequently, drop box and self haul loads might consist mainly of just a few materials. Whole loads of just roofing, gypsum wallboard, and yard debris are fairly common, while other loads might contain just residential garbage (from people without garbage collection service) or a variety of materials from cleaning out a storage room, a back yard, or an office space. To obtain a more precise estimate of overall waste composition, these highly variable waste substreams must be "oversampled" relative to their total proportion of the waste disposed.

Analysis by Waste Substream

To determine the overall composition of waste statewide and in the different geographic areas, the following method was used to combine data from the samples taken in different areas, from different waste substreams, in different seasons:

Step 1. The tonnage of waste disposed during 2002 was determined for each geographic area, waste substream, and season. Data on waste by geographic area and by season were directly available based on reports by disposal sites to DEQ. In many cases, waste quantities by substream were available from disposal transaction data at larger landfills, but in other cases estimates had to be made based on information from disposal sites and garbage collection companies.

Step 2. The absolute tonnage for each area/waste substream/season was divided by the total tonnage disposed, giving the percentage of waste disposed in each of the above categories. The tonnages are given in Appendix A table A1.

Step 3. The average composition for each area/waste substream/quarter was calculated by averaging the composition of samples taken from that area/waste substream/quarter.

Step 4. The overall composition of sampled waste was determined by taking a weighted average of the compositions calculated in step 3 above, using the percentages determined in step 2 above as the weighting factors.

Four material-specific waste streams were not included in sampling in this study, since the composition of these specific streams is already known. Largest of these is 27,379 tons of shredded and oversized tires landfilled at a number of sites in and out of Oregon during 2002. Second-largest is 3,847 tons of gypsum wallboard delivered in 2002 to the Browns Island Landfill in Marion County. The other two material-specific waste streams were medical waste and dead animals. Generally, the composition results presented in tables in this report do not include these material-specific waste streams, unless specified in the table.

Contamination Analysis

Materials that are relatively clean and dry when first thrown into a garbage can may not end up that way by the time they reach the disposal site. Compacting garbage trucks compress the different wastes together, causing wet food waste to become absorbed in or smeared onto other types of waste, making it difficult to separate and identify individual wastes. In addition, external moisture such as rain water can get into the waste, making the absorbent materials heavier than they were when first disposed.

The purpose of contamination analysis is to better estimate the "clean, as generated" weight of materials being disposed, as opposed to the "dirty, wet" weight of materials as weighed in the field waste composition sorting. Forty field samples were randomly selected for contamination analysis. After these samples were sorted at the disposal sites, the individual sorted materials were bagged and brought back to a facility where each bag of material was carefully re-sorted to remove and weigh contaminants, further cleaned and air-dried, and re-weighed. This allowed us to estimate, for each separate "target" material sorted in the field:

- The amount of water that had been absorbed into the material,
- The amount of other material contaminating each "target" material, and
- The amount of each "target" material that ends up as a contaminant in other sorted material categories due either to adherence of the materials or sorting error.

For rigid plastic containers, an additional 108 samples were selected for contamination analysis, resulting in about one-quarter of all field samples having contamination analysis done for plastic containers. Special attention was given to these containers for two reasons:

- We wanted more precise information on rigid plastic containers for better estimating the recycling rate for these types of plastics as specified under Oregon Revised Statutes 459A.657.
- Detailed samples of rigid plastic containers were further sorted by resin type and by container type (bottle versus tub/pail) - a level of detail that is difficult to accurately determine in field sorting.

A complete description of the methodology used for contamination analysis is given in Appendix C. This appendix includes a description of how the sorting and processing of samples was done, how the data were analyzed, a discussion of the precision of the results, and an analysis of the optimal amount of effort to be devoted to field sorting of samples versus contamination analysis in order to maximize the overall precision of the results.

To our knowledge, no other disposal site waste composition study has undertaken and published similar contamination analysis. Results from the three most recent Oregon studies show just how important such contamination analysis can be in determining the overall amount of materials disposed. For example, based on field data alone for rigid plastic containers in the current study, the estimated amount of plastic containers disposed from Oregon sources in 2002 was 45,945 tons, with a 90% confidence interval ranging from 43,200 tons to 49,000 tons. Contamination analysis showed that more than 20% of those tons were contaminants such as lids, product residue in the container, and water. After removing these contaminants, the estimated amount of plastic containers being disposed drops to 35,808 tons, with a 90% confidence interval of 33,600 tons to 38,300 tons. The result is that significantly fewer rigid plastic containers are being disposed in Oregon each year than the amount that would have been estimated if the Oregon studies only involved the field-sorting of waste at disposal sites

Beverage Container / Oil Filter / Fluorescent Light Counts

In addition to weighing materials, we also counted beverage containers by beverage type and by container material type (glass, plastic, aluminum, and steel). Only bottles and cans were counted. Open cups and paper cartons (including aseptic containers and milk cartons) were not counted. We used these data to determine the average number of containers of each type disposed per ton of waste. Multiplying the total tons of waste disposed from Oregon by the containers per ton gives an estimate of the absolute number of Oregon beverage containers and other counted items that end up in landfills and other disposal sites.

Discarded oil filters, fluorescent light bulbs, and compact fluorescent lights were also counted in the same manner, so the number of these items being disposed could also be estimated.

Results: 2002 Composition Study

This report presents three main types of results:

1) Field sorting results. The field data results are best used for comparing Oregon results with results in other jurisdictions. In addition, field data are the easiest to use for statistically comparing results of the current composition study to early studies conducted by DEQ and Metro. There were not enough contamination analysis samples collected to allow for separate contamination correction factors to be calculated for different waste substreams, geographic areas, or seasons. Thus, comparisons between these groups can only be done using the field data results.

2) Contamination-analysis-corrected results. These are the best results to use for determining the amount of material that might have been recycled had it been kept clean and in recyclable condition.

3) Absolute tonnage of materials disposed. These results are produced by multiplying the contamination-analysis-corrected results (expressed as a percentage) by the total tonnage of mixed wastes

disposed from Oregon. Single-material wastes disposed, such as tires and gypsum wallboard, are then added to the results. In addition, some transfer stations report pulling a small amount of recyclable materials such as cardboard from mixed waste received. Since our waste samples were collected for sorting before any such separating of recyclable materials occurred at these transfer stations, the tonnage pulled for recycling was subtracted from the total estimated tonnage disposed.

The results are presented in a series of large tables in Appendix A of this report. The tables in Appendix A include the following:

Table A1. Tonnage of waste disposed in 2002 by substream, geography, and season.

Table A2. Oregon 2002 waste composition statewide results: field results, contamination correction factors, and contamination-corrected results.

Table A3. Tonnage of each material disposed statewide from Oregon in 2002 (contamination-corrected tons by extrapolation, single-material disposal/recovery, and total tons disposed).

Table A4. Disposal and recovery of selected material from Oregon in 2002.

Table A5. Comparing 2002 composition for Metro and for the rest of Oregon (field data).

Table A6. 2002 Composition of waste substreams (field data).

Table A7. Confidence intervals for composition of waste substreams (field data).

Table A8. Changes in Oregon statewide field data composition since 1994.

Table A9. Changes in Metro waste composition since 1993/94 (field data).

Table A10. Changes in waste composition outside the Metro area since 1992/93 (field data).

Table A11. Metro 2002 composition of waste substreams (field data).

Table A12. Metro 2002 confidence intervals of waste substreams (field data).

Table A13. Metro 2002 field and contamination-corrected composition results.

Table A14. Metro 2002 tonnage of each material disposed (contamination-corrected tons by extrapolation, single-material material disposal/recovery, and total tons disposed).

Table A15. Rest of Oregon 2002 composition of waste substreams (field data).

Table A16. Rest of Oregon 2002 confidence intervals for waste substreams (field data).

Table A17. Beverage container counts: Oregon 1998, 2000, and 2002.

Table A18. Beverage Containers Disposed in Millions: Oregon 1998, 2000, and 2002.

Presentation and Discussion of Results - by Material Category

Paper

One of the more encouraging findings of this study is the continued drop in paper disposal over the last decade - particularly for some of the grades of paper that are easily recycled. Figure 1 shows paper disposal and recovery per person for 1993 through 2002. Paper recovery numbers are from the annual Oregon Material Recovery Survey, while disposal is based on all Oregon waste composition studies to date. For years when no waste composition study was done, an average composition was calculated based on the most recent studies before and after that year, adjusted by the total weight disposed in that year. As can be seen, total paper generation has been fairly constant since 1993, but recovery has steadily risen and disposal has steadily fallen on a per-capita basis.

Figure 1. Paper Recovery and Disposal Per Capita

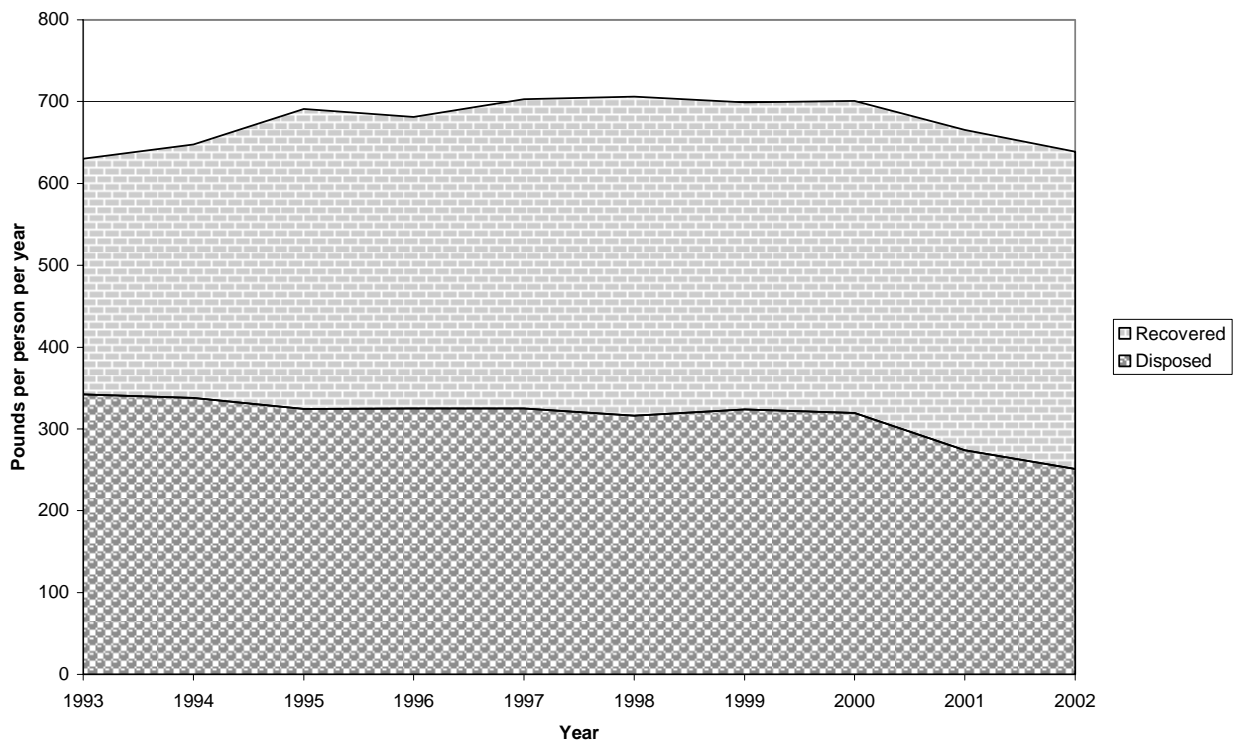


Table 3 shows the results of field sort results over time for all statewide studies, with the 1993/95 results combining DEQ's 1994-95 study with Metro's 1993-94 study. In both the Metro area and the rest of the state, corrugated cardboard and recyclable paper in general make up a significantly smaller portion of the waste stream in 2002 than they did in earlier studies. The decline in disposal has been matched by an increase in recycling of the material, as demonstrated by the annual Oregon Material Recovery Survey conducted by DEQ. Table 4 gives recovery survey results for various paper grades since 1992, as published in the 2002 Oregon Material Recovery Survey Report.

Table 3. Recent Waste Composition Results for Paper (field sort data)

	Percent 1993/95	Percent 1998	Percent 2000	Percent 2002
TOTAL PAPER	27.35	24.35	23.10	20.62
Paper Packaging	12.79	11.98	9.57	9.09
Cardboard/Brown Bags	6.49	5.45	3.69	3.23
Low Grade Packaging Paper	2.86	2.85	2.25	2.10
Bleached Polycoated Boxboard	0.39	0.42	0.54	0.43
Non-Recyclable Pkg. Paper	1.80	1.54	1.37	1.42
Mixed Paper / Materials	1.26	1.73	1.73	1.91
Other Paper	14.56	12.37	13.53	11.53
Newspaper	2.77	2.16	2.79	2.17
Magazines	1.55	1.36	1.47	1.27
Hi Grade Paper	1.89	1.60	1.83	1.75
Hardcover Books	0.24	0.16	0.28	0.11
Other Low-Grade Paper	4.11	3.74	2.85	2.35
Other Non-recyclable Paper	4.01	3.33	4.30	3.88
<i>Low-grade Recyc. Paper combined</i>	<i>7.60</i>	<i>7.18</i>	<i>5.92</i>	<i>4.99</i>
<i>Nonrecyclable Paper combined</i>	<i>7.06</i>	<i>6.59</i>	<i>7.40</i>	<i>7.21</i>

Table 4. Recovery of Paper Grades in Oregon 1992-2002. Data are from the 2002 Oregon Material Recovery Survey Report.

Material Type	1992 Tons	1994 Tons	1996 Tons	1998 Tons	2000 Tons	2001 Tons	2002 Tons
Cardboard/Kraft Paper	204,729	251,559	304,093	321,501	310,776	332,876	381,027
High-Grade Paper	67,077	35,401	49,298	69,449	54,358	62,185	41,659
Newspaper & Magazines	141,427	155,822	158,662	180,356	195,483	203,021	211,082
Mixed Scrap Paper	24,012	40,570	66,108	81,230	94,440	81,418	46,203
Total Papers	437,245	483,352	578,161	652,536	655,057	679,499	679,971

Because of increased commingling of papers in recycling collection, it is no longer possible to separate out the tonnage of different paper grades as accurately as was done in the past. Thus, grades such as newspaper and magazines have had to be combined in Table 4, since the two materials are often collected, marketed, and utilized combined together, giving no separate source of information for quantifying the amount of newspaper separately from the amount of magazines. Also, it is possible that some of the material being marketed now as either cardboard or newspaper was marketed a few years ago as either high-grade paper or mixed scrap paper.

Although corrugated cardboard disposal was significantly reduced, it still remains a large component of the waste stream. More than 70,000 tons of clean, dry corrugated cardboard are disposed each year as of 2002.

Newspaper disposal in 2002 fell back to 1998 levels as a percentage of the waste stream, significantly below disposal levels in early years. Disposal in 2000 had been higher than either 1998 or 2002, for unknown reasons.

No single substream stands out as having much greater quantities of corrugated cardboard disposed than others. Compacting drop boxes showed the largest percentages of cardboard (6%) followed by commercial and mixed routes each at about 4%, but residential routes, self haul, loose drop boxes and even MSWPF residual wastes still contained about 2-3% cardboard each.

Table 5. Paper in Different Waste Substreams - 2002 Statewide (field sort data - in percent)

	Garbage Route Trucks			Drop Boxes		Self-haul	MSWPF
	RES	COM	MIX	Compacting	Loose		
TOTAL PAPER	25.23	30.95	26.49	29.27	15.93	8.73	10.82
Paper Packaging	8.80	12.49	11.12	17.29	8.77	4.65	5.36
Cardboard/Brown Bags	2.30	4.40	3.85	6.02	3.38	2.40	1.85
Low Grade Packaging	2.69	3.00	2.46	3.12	1.59	0.83	1.75
Bleached Polycoats	0.56	0.83	0.66	0.36	0.35	0.07	0.09
Nonrecyc. Packaging	1.08	2.20	2.04	5.04	1.16	0.20	0.29
Mixed Paper / Materials	2.15	2.05	2.11	2.76	2.30	1.17	1.37
Other Paper	16.44	18.47	15.36	11.98	7.16	4.08	5.46
Newspaper	3.19	3.28	3.36	2.08	0.92	0.84	0.69
Magazines	2.45	1.63	1.49	0.85	0.19	0.68	0.57
Hi Grade Paper	1.79	3.53	2.22	1.54	1.50	0.62	1.33
Hardcover Books	0.11	0.06	0.19	0.10	0.05	0.12	0.11
Low Grade Paper	3.49	3.46	2.56	1.82	2.51	0.95	1.04
Other Nonrecyc. Paper	5.40	6.51	5.54	5.58	1.99	0.86	1.72
Low-grade Recyc. Paper combined	6.86	7.35	5.87	5.40	4.50	1.97	2.99
Nonrecyclable Paper combined	8.64	10.76	9.68	13.37	5.44	2.22	3.39

Plastic

Following a slight decline in 2000, plastics disposal and total generation resumed increasing as it had in earlier studies. Figure 2 shows total disposal and recovery per person since 1993.

Figure 2. Plastic Recovery and Disposal Per Capita

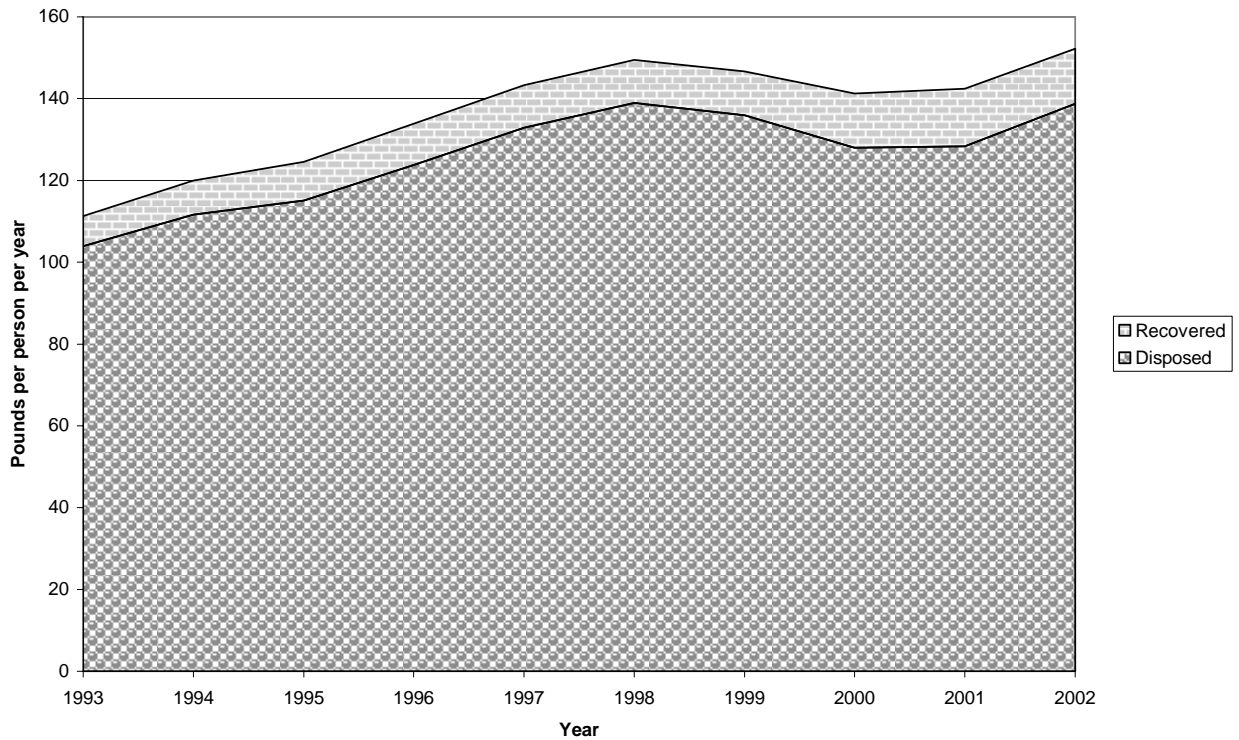


Table 6: Recent Waste Composition Results for Plastics (field sort data - in percent)

	Percent 1993/95	Percent 1998	Percent 2000	Percent 2002
TOTAL PLASTICS	8.84	10.45	9.70	10.95
Plastic Packaging	3.71	5.33	5.23	5.65
Rigid Plastic Containers	1.11	1.34	1.51	1.67
Other Plastic Packaging	2.60	3.99	3.71	3.98
Plastic Products	5.13	5.12	4.47	5.29
Film plastic combined	4.29	4.55	4.32	4.87

Table 7. Recovery of Plastics in Oregon 1992-2002. Data are from the 2002 Oregon Material Recovery Survey Report.

Material Type	1992 Tons	1994 Tons	1996 Tons	1998 Tons	2000 Tons	2001 Tons	2002 Tons
Total plastic recovered	9,520	15,048	16,338	17,933	24,222	24,380	23,647

Table 8. Composition of Plastics 2002 Statewide by Waste Substream (field sort data - in percent)

	Garbage Route Trucks			Drop Boxes		Self-haul	MSWPF
	RES	COM	MIX	Compacting	Loose		
TOTAL PLASTICS	11.99	12.96	12.45	17.88	9.80	6.76	9.41
Plastic Packaging	7.62	7.71	7.11	9.00	4.35	2.00	3.30
Rigid Plastic Containers	2.65	2.13	2.15	2.37	1.06	0.63	0.46
Other Plastic Packaging	4.97	5.57	4.95	6.63	3.30	1.37	2.84
Plastic Products	4.37	5.26	5.35	8.88	5.45	4.76	6.11
Film plastic combined	5.98	7.15	6.04	7.80	3.86	1.70	3.80

The only large difference in plastics composition between waste substreams is that plastic packaging was much lower in self-haul wastes than in all other wastes substreams, particularly for film plastic and for other rigid plastic packaging. Also, rigid plastic containers were highest in waste from residential route garbage trucks, and lowest in loose drop boxes and self-haul wastes. As in the past, film plastics were particularly high in compacting drop boxes, often used by retail stores, but were nearly as high in 2002 in both residential and commercial route garbage trucks.

Rigid plastic containers were not sorted by resin type in the field, but one-fourth of the waste samples that contained rigid plastic containers were brought back to a facility for detailed analysis as part of contamination estimation. These samples were sorted both by resin type and by whether they were bottles (blow-molded) or tubs/pails (usually injection-molded). Table 9 gives the percentage of rigid plastic containers that were each resin/container type, both as a percentage of the total solid waste and as a percentage of all rigid plastic containers.

Table 9. Rigid Plastic Containers by Resin and Container Type Statewide 2002 (Clean, Dry Weights from Detailed Sample Analysis - in percent)

	As % of solid waste			As % of rigid plastic containers		
	Bottle	Tub	Total	Bottle	Tub	Total
1 PET	0.3800	0.1011	0.4811	29.12	7.74	36.86
1 HDPE	0.3121	0.0758	0.3879	23.91	5.81	29.72
3 PVC	0.0188	0.0091	0.0279	1.44	0.70	2.14
4 LDPE	0.0012		0.0012	0.09		0.09
5 PP	0.0096	0.0711	0.0807	0.74	5.44	6.18
6 PS (not foam)	0.0007	0.1089	0.1096	0.05	8.34	8.39
6 PS (PS foam)		0.0827	0.0827		6.34	6.34
7 Other	0.0107	0.0056	0.0164	0.82	0.43	1.25
U Unknown	0.0028	0.1149	0.1177	0.21	8.80	9.02
Total	0.7360	0.5691	1.3052	56.39	43.61	100.00

Construction/Demolition/Remodel

Of the 120 loose drop box loads sorted as part of the 2002 study, 25, or 21%, were identified as coming from construction or demolition (C&D) sites or projects. Similarly, of the 229 "self-haul" loads directly sampled in this study (excluding 38 Marion County samples that were collected from transfer trailers), 88, or 38%, were identified as being from C&D sites or projects. Table 10 shows the average composition of these loads, including only selected materials often associated with these types of activities.

Table 10. Composition of Wastes from Construction/Demolition Loads (2002 Field Sort Data - Statewide - in percent, with 2000 results shown for comparison)

Material	Loose Drop Boxes	Self Haul Loads	Combined 2002	Combined 2000
Cardboard/Brown Bags	4.76	1.36	2.11	4.00
Rigid Plastic Products	1.39	1.10	1.16	1.51
Untreated Lumber	8.77	7.97	8.15	13.96
Clean "Hog Fuel" Lumber	4.23	7.91	7.09	4.06
Painted Lumber	4.72	2.88	3.29	2.63
Chemically-treated Lumber	0.04	1.90	1.49	1.96
Wood Pallets / Crates	10.23	1.17	3.17	3.36
Mixed Wood / Materials	2.72	3.37	3.23	1.96
Carpet	1.30	1.70	1.61	1.84
Roofing / Tarpaper	9.05	21.97	19.11	18.42
Flat Window Glass	0.10	0.08	0.08	0.19
Other Ferrous Metal	4.64	2.46	2.94	4.68
Rock / Concrete / Brick	4.67	8.14	7.37	3.88
Gypsum Wallboard OLD	8.40	4.31	5.21	6.42
Gypsum Wallboard NEW	13.44	13.33	13.36	10.94
Fiberglass Insulation	0.34	2.17	1.76	1.53
Other Inorganics	6.18	4.25	4.68	2.61
Total: Above Selected Materials	84.98	86.06	85.82	83.95

Some materials such as cardboard and rigid plastic products are generated by many activities in addition to construction and demolition, but other materials like gypsum wallboard, asphalt roofing, and insulation come almost solely from C&D activities.

Table 11 shows the overall composition of the different waste substreams for selected C&D materials. Although small amounts of C&D wastes may be collected by regular route garbage trucks, the large majority of these materials are brought to disposal sites by garbage haulers using loose drop boxes, or by construction firms as "self-haul" loads using a variety of trucks. Mixed solid waste processing facilities (MSWPFs) also receive substantial amounts of construction debris. Significant amounts of wood, scrap metal, and cardboard are pulled from the construction debris at MSWPFs, and the residual is sent off for disposal.

Table 11. C&D Materials in Different Waste Substreams: 2002 Statewide (field sort data in percent)

Material	Garbage Route Trucks			Drop Boxes		Self-haul	MSWPF
	RES	COM	MIX	Compacting	Loose		
Cardboard/Brown Bags	2.30	4.40	3.85	6.02	3.38	2.40	1.85
Rigid Plastic Products	1.38	1.82	2.04	3.23	2.93	2.37	2.41
Wood (all types combined)	1.76	3.67	3.87	3.66	20.17	15.91	12.50
Untreated Lumber	0.46	1.13	0.90	0.45	4.17	3.90	2.79
Clean "Hog Fuel" Lumber	0.27	0.35	0.51	0.04	2.34	3.57	1.59
Painted Lumber	0.35	0.30	0.23	0.13	2.13	2.77	1.00
Chem. Treated Lumber	0.21	0.11	0.05	0.00	0.08	1.32	0.00
Wood Pallets / Crates	0.14	0.24	0.73	1.16	6.18	0.65	0.72
Mixed Wood / Materials	0.17	1.16	1.16	1.64	4.30	2.63	5.84
Carpet	0.63	0.32	1.92	0.60	2.46	2.68	8.82
Roofing / Tarpaper	0.07	0.41	0.08	0.00	4.15	11.18	9.25
Flat Window Glass	0.13	0.02	0.10	0.08	0.08	0.85	0.10
Other Ferrous Metal	0.55	1.82	1.28	1.97	4.19	1.74	1.83
Rock / Concrete / Brick	1.34	0.89	0.45	0.13	3.62	5.56	5.28
Gypsum wallboard (total)	0.09	0.49	0.33	0.11	6.42	13.05	10.15
Gypsum Wallboard OLD	0.09	0.34	0.12	0.09	2.88	5.29	8.33
Gypsum Wallboard NEW	0.00	0.15	0.21	0.02	3.54	7.76	1.82
Fiberglass Insulation	0.00	0.08	0.03	0.00	0.26	2.17	0.55
Other Inorganics	0.75	1.19	0.82	0.58	3.90	3.29	8.47
Total of C&D Materials	8.84	14.72	14.49	16.13	50.59	60.11	60.66

Table 12. C&D Materials in Recent Oregon Waste Composition Studies (field sort data - in percent)

	1993-95*	1998 Statewide		2000 Statewide		2002 Statewide	
	Percent	Percent	(90% Conf. Int.)	Percent	(90% Conf. Int.)	Percent	(90% Conf. Int.)
Cardboard/Brown Bags	6.49	5.45	(5.15 - 5.77)	3.69	(3.38 - 4.02)	3.23	(2.93 - 3.55)
Rigid Plastic Products	1.88	2.26	(2.03 - 2.49)	1.74	(1.48 - 2.00)	2.16	(1.83 - 2.49)
Wood - all types combined	9.09	11.18	(10.37 - 12.05)	8.81	(7.78 - 9.89)	8.72	(7.75 - 9.73)
Clean lumber & hog fuel	5.33	4.74	(4.26 - 5.22)	4.57	(3.84 - 5.34)	3.45	(2.87 - 4.04)
Painted & Treated lumber	1.19	2.63	(2.29 - 3.00)	1.54	(1.20 - 1.90)	1.53	(1.10 - 2.04)
Wood Pallets / Crates	0.86	1.40	(1.15 - 1.66)	1.23	(0.92 - 1.61)	1.19	(0.86 - 1.51)
Mixed Wood / Materials	0.50	1.24	(0.96 - 1.60)	0.54	(0.38 - 0.73)	1.98	(1.57 - 2.46)
Carpet	1.23	2.84	(2.45 - 3.30)	1.46	(1.19 - 1.74)	1.97	(1.48 - 2.58)
Roofing / Tarpaper	3.44	2.85	(2.34 - 3.39)	2.94	(2.23 - 3.75)	3.81	(2.84 - 4.80)
Flat Window Glass	0.31	0.51	(0.34 - 0.71)	0.13	(0.09 - 0.18)	0.27	(0.08 - 0.60)
Other Ferrous Metal	2.69	2.23	(2.01 - 2.46)	2.43	(2.07 - 2.87)	1.74	(1.45 - 2.05)
Rock / Concrete / Brick	1.93	1.74	(1.36 - 2.10)	3.02	(2.34 - 3.82)	2.57	(1.89 - 3.27)
Gypsum wallboard	2.70	3.46	(2.96 - 3.97)	3.83	(3.09 - 4.66)	4.65	(3.64 - 5.69)
Fiberglass Insulation	0.55	0.29	(0.22 - 0.36)	0.49	(0.26 - 0.73)	0.60	(0.17 - 1.08)
Other Inorganics	2.01	1.89	(1.54 - 2.26)	1.73	(1.31 - 2.15)	2.25	(1.80 - 2.80)
Total of C&D materials	31.16	33.64		29.44		31.41	
Oregon Housing Starts**	22,500	26,700		19,800		21,900	

*Combines DEQ 1994/95 study with Metro 1993/94 study

**Source: <http://www.oea.das.state.or.us/DAS/OEA/docs/economic/other-annual.xls> (1993-95 value is the average for the three years)

There has been a very close correlation between construction activities, as measured by housing starts in Oregon, and the total percentage of construction and demolition materials in the waste stream. Oregon experienced a recession in 2000, and housing starts were lower in 2000 than they had been since 1993. 2000 was also a year that had the lowest levels of construction waste in the waste stream, and also was a year in which the tons of waste disposed actually declined from the previous year. The drop in construction waste was probably a major factor in the overall decline in disposal. However, waste tonnage continued to decline sharply through 2001 although housing starts started increasing again that year. Both housing starts and total disposal increased again in 2002.

Figure 3 shows combined recovery and disposal for the combined total of most of the materials shown in Tables 10 - 12. Figure 3 does not include scrap metal, as the Oregon Material Recovery Survey does not include scrap metal that is generated in most construction and demolition activities, as directed by Oregon state law. Figure 3 also does not include cardboard, as the vast majority of recovered cardboard comes from activities unrelated to construction.

Figure 3. Selected Construction Materials Recovery and Disposal Per Capita



Yard Debris

"Yard debris" was defined in this study to include natural vegetative material such as grass, leaves, flowers, weeds, branches, and stumps.

In the Metro area, nearly all cities and counties have instituted strong yard debris collection, composting, and reduction programs. Many of the Metro programs started in the early 90s before the Metro 1993/94 composition study was completed. Portland, the largest jurisdiction in the Metro area, began a monthly curbside yard debris collection program in 1992 and expanded it to a bi-weekly program in 1993/94. A number of other jurisdictions began weekly yard debris collection in the early 1990s also.

Yard debris results for 2002 seem to present a puzzle. It appears that the amount of yard debris in the waste stream has been holding steady or even increasing in recent years, in spite of greater collection programs.

In the past, yard debris decreased regularly - particularly in the Portland Metro area (see Table 13). Studies done for Metro in 1985/86 and 1989/90 showed yard debris as making up 10% or more of solid waste. Studies done since 1993 show yard debris as dropping to under 5 percent. There was a slight increase in yard debris in 2000 and 2002 as compared to 1998 in the Metro area, but this increase is not statistically significant, meaning that the difference could be due just to the randomness of sampling. Overall, the 2002 yard debris disposal is still significantly less than the disposal rate from 1990 and before. The decline in yard debris disposal appears closely linked to the implementation of collection and home composting programs discussed above.

Although some cities and counties in other parts of Oregon have good programs, many jurisdictions have not taken significant steps in this regard. Yard debris outside the Portland Metro area is significantly higher than yard debris in the Metro area. However, new programs are being implemented in the rest of the state. Significant amounts of yard debris have been collected in curbside programs in Marion and Polk counties starting in 1998. By 2002, curbside programs started in parts of Lane, Yamhill, and Jackson Counties. Parts of Benton and Linn Counties have had programs operating for many years. Very little yard debris collection occurred outside the Metro area in 1992, so the decline in yard debris in the 1994/95 study and the 1998 study outside the Metro area seems consistent with implementation of the new collection programs. While collections programs have strongly increased in recent years, yard debris disposal has also risen, to the point where the 2002 yard debris disposal percentage outside the Metro area is no longer significantly less than the 1992/93 disposal percentage.

Table 15 demonstrates the increase in yard debris collection statewide as determined by DEQ's annual material survey. In addition, many jurisdictions have been promoting home composting, "grasscycling" (allowing grass clippings to remain on the lawn), and other waste prevention methods. These programs do not add to the numbers in the material recovery survey, but should result in further reductions in disposal.

Table 13. Changes in Yard Debris in the Portland Metro Region: (field sort data - in percent)

Material	Metro 1986/87	Metro 1989/90	Metro 1993/94	Metro 1998	Metro 2000	Metro 2002
Yard Debris	10.50	11.31	5.10	3.76	4.49	4.46
Leaves & Grass			3.46	2.83	2.95	3.40
Small Prunings under 2"			1.31	0.68	0.94	0.93
Limbs (>2"), trunks, stumps			0.33	0.17	0.61	0.17

Table 14. Changes in Yard Debris outside the Portland Metro Region (field sort data - in percent)

Material	Oregon Outside of Metro 1992/93	Oregon Outside of Metro 1994/95	Oregon Outside of Metro 1998	Oregon Outside of Metro 2000	Oregon Outside of Metro 2002
Yard Debris	9.42	5.80	5.86	7.05	8.19
Leaves & Grass	6.58	4.81	4.40	5.47	7.02
Small Prunings under 2"	2.46	0.90	1.14	0.92	0.75
Limbs (>2"), Trunks, Stumps	0.38	0.10	0.23	0.65	0.42

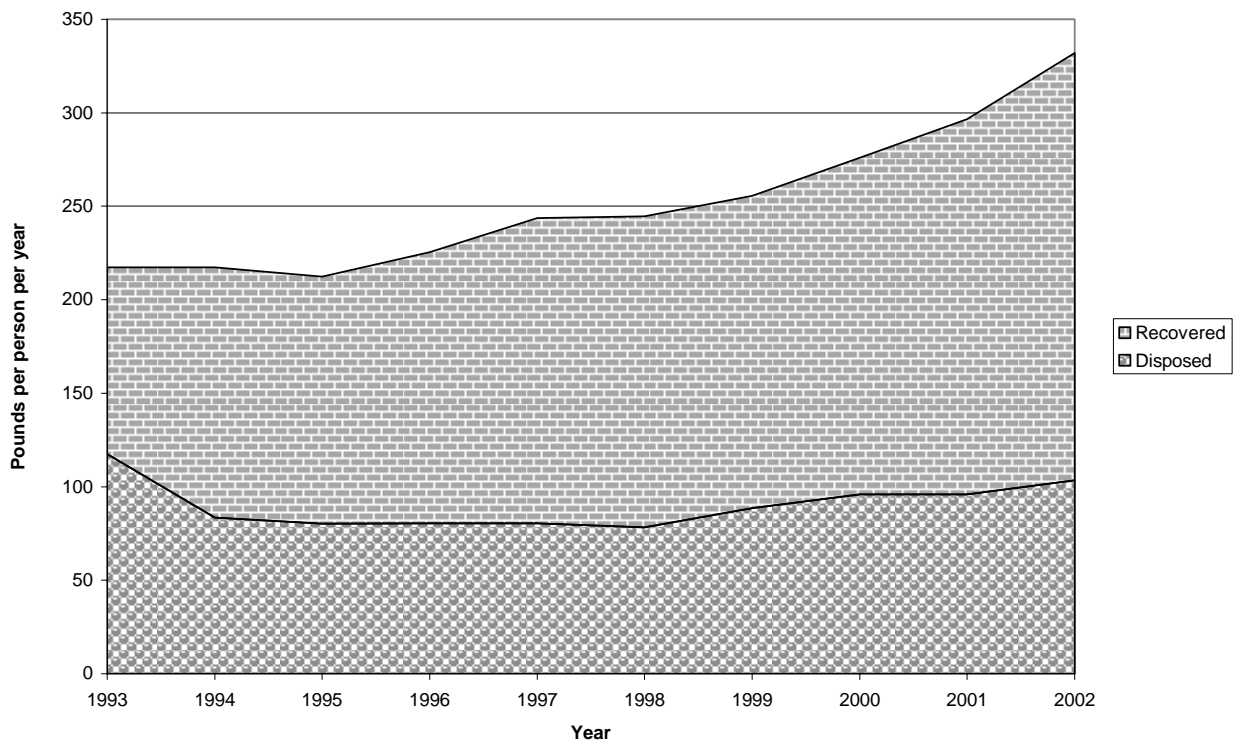
Table 15. Recovery of Yard Debris in Oregon 1993-2002. Data are from the 2002 Oregon Material Recovery Survey Report.

Material Type	1993 Tons	1994 Tons	1995 Tons	1996 Tons	1997 Tons	1998 Tons	1999 Tons	2000 Tons	2001 Tons	2002 Tons
Yard Debris	152,589	208,722	210,240	235,562	269,620	278,750	283,440	309,407	348,472	400,174

Figure 3 shows the overall yard debris collected for disposal and recycling (composting or energy recovery) since 1993. Note that total generation has increased steadily since the mid-90s. The new yard debris collection and composting programs have almost certainly contributed to the apparent increase in generation. When new yard debris services are offered, some of the yard debris collected is material that used to be disposed as garbage, but other collected materials includes yard debris that used to be burned in burn piles, or that previously was left to decompose in place. Materials that are burned in backyards or left to decompose in place are not measured, but the material then becomes measured when it is diverted into a collection program.

Different types of yard debris are generated in different manners. Grass, leaves, and weeds are generated in relatively small volumes through roughly weekly grass mowing or yard cleanup activities. Leaves and grass can be easily set out regularly either in the garbage can for disposal or in a special container for collection and composting. In contrast, larger prunings, such as limbs and trunks, are generated on a much more sporadic basis, such as annual hedge shearings, removal of whole trees, or cleanup of limbs following major storms. These large limbs are usually generated in quantities too large to allow them to be easily put out for disposal or composting collection.

Figure 4. Yard Debris Recovery and Disposal Per Capita



Because of this difference in how types of yard debris are generated, they are often disposed of differently. Grass and leaves that are not home-composted or collected as part of a yard debris collection program commonly end up in garbage cans and are collected by residential route garbage trucks. Limbs, on the other hand, are too bulky to fit in a garbage can and are not easily prepared for yard debris collection. Thus, piles of limbs and branches are much more likely to be disposed of by being taken directly to a landfill or transfer station as part of a self-haul load, or put into a large drop box which is then taken off for disposal. Large quantities of leaves and grass may also be taken to disposal sites either by self-haul or in a drop box. Large limbs, on the other hand, rarely appear in garbage route trucks, although on some occasions a pile of yard debris including limbs may be set out next to a garbage can to be collected for disposal.

In previous years, as demonstrated by the data from 1998 and 2000 in Table 16 below, the trends described above were clearly evident in the waste composition results. In 2002, two loads sampled from residential route trucks had significant amounts of large limbs in the randomly-selected material. Of the 142 residential route trucks loads sorted in 2002, only 5 had any large limbs present, and in 3 of those the limbs made up less than 1 percent of the load weight. However, 2 route trucks from the lower Willamette Valley had heavy limbs in their samples, making up 16% and 12% of the weight of each sample. Also, for unknown reasons, self haul and loose drop box loads contained fewer large limbs than in previous years, and also higher amounts of leaves and grass.

Table 16. Yard Debris in Different Waste Substreams Statewide 2002 (field sort data - in percent)

Material	Garbage Route Trucks			Drop Boxes		Self-haul	MSWPF
	RES	COM	MIX	Compacting	Loose		
2002 Yard Debris	9.17	5.57	6.78	4.09	4.57	7.34	3.18
2002 Leaves / Grass	7.82	4.18	5.46	3.79	4.02	5.96	2.90
2002 Small Prunings under 2"	0.84	1.18	1.20	0.30	0.29	0.93	0.27
2002 Large Prunings over 2"	0.50	0.22	0.12	0.00	0.25	0.24	0.01
2002 Stumps	0.02	0.00	0.00	0.00	0.00	0.20	0.00
2000 Yard Debris	11.18	4.76	4.92	1.54	5.08	4.58	3.76
2000 Leaves / Grass	10.37	2.82	4.09	1.51	1.95	2.45	2.62
2000 Small Prunings under 2"	0.71	1.09	0.81	0.03	1.43	1.24	0.26
2000 Large Prunings over 2"	0.10	0.86	0.02	0.00	0.76	0.38	0.87
2000 Stumps	0.00	0.00	0.00	0.00	0.95	0.51	0.00
1998 Yard Debris	7.50	3.66	4.19	1.41	3.91	6.35	2.03
1998 Leaves / Grass	6.16	2.74	3.48	1.26	2.88	4.24	0.83
1998 Small Prunings under 2"	1.30	0.72	0.63	0.15	0.64	1.42	0.77
1998 Large Prunings over 2"	0.04	0.17	0.08	0.00	0.35	0.45	0.16
1998 Stumps	0.01	0.04	0.00	0.00	0.03	0.25	0.27

Food Waste and Other Compostables

At 15.60% in 2002, food waste is again the largest single component of Oregon's municipal solid waste stream. This section looks at food waste in conjunction with other potentially compostable wastes, to provide information that may be useful for combined compostables collection.

"Compostables" include any of the organic materials that could be composted, such as food waste, paper, wood (excluding treated wood), disposable diapers, pet litter, and other miscellaneous organics. However, many of these materials would not be good in a composting program, either because they are much more valuable when recycled, or because they commonly contain significant contaminants that would lower the

value of the compost produced. "Compost - target" as used in the following tables, includes only those materials most likely to be included in an organics collection program, including some non-recyclable paper (mainly paper tissue/towels), food waste, yard debris, clean wood (untreated) and a few other organic materials. Appendix D includes a complete list of materials designated as "compostable" or "compost-target".

The amount of food being disposed has remained fairly consistently at about 16%, and there has been no general difference between food disposal from the Metro area as compared to the rest of the state. Disposal of target compostables has declined slightly since 1993, mainly due to reduction in yard debris being disposed. Total compostables has shown an even greater decline, due to the reduction in disposal of paper since 1993.

Table 17. Food Waste and Other Compostables in Recent Oregon Waste Composition Studies (field sort data - in percent)

Material	Percent 1993/95	Percent 1998	Percent 2000	Percent 2002
Food Waste	16.62	14.30	16.22	15.60
All Compostables	59.96	55.13	56.94	52.94
Compostables - target	33.96	30.73	32.73	31.04

Food waste is much more common in residential and other garbage route trucks than it is in self-haul loads, loose drop boxes, or residuals wastes from MSWPFs (which generally will not accept food-contaminated waste). Food also makes up a large component of the waste in compacting drop boxes, since these are often used by the retail grocery industry (see Table 18). Other compostables also are more common in garbage route trucks than in loose drop boxes or self-haul waste, since paper tends to be more common in these same waste substreams. However, there is significant wood and yard debris in loose drop boxes and self-haul waste, which constitute most of the compostable material in those waste streams.

Table 18. Food Wastes and Other Compostables in Different Waste Substreams Statewide 2002 (field sort data - in percent)

Material	Garbage Route Trucks			Drop Boxes		Self-haul	MSWPF
	RES	COM	MIX	Compacting	Loose		
Food Waste	24.56	22.70	22.48	23.90	6.63	4.28	2.04
All Compostables	70.46	65.36	65.66	60.66	42.52	32.03	22.95
Compostables - target	41.28	37.95	38.54	36.05	25.06	19.16	11.93

Computers and Electronics

Prior to 1998, computers and most electronic devices were lumped together into a single category called "small appliances." Beginning in 1998, this category was split into three groups:

- Computers, printers, monitors, and their component parts.
- Other "brown goods." Small appliances with significant electronic components, such as TVs, radios, telephones, microwaves, and stereos.
- Non-electronic small appliances, including fans, hair blowers, can openers, kitchen blenders. Note - these may contain small electronic components such as digital readouts and controls, and often will have electric motors, but do not have significant amounts of circuit-board electronics.

Because of concern about the amount of lead in cathode ray tube type computer monitors and televisions, the first two categories were further split in 2002. Computer monitors of the cathode ray tube type were separated from other computer and printer equipment, including flat-screen monitors. Similarly, "Other Brown Goods" was split with televisions and other equipment with cathode ray tubes separated from radios, microwaves, stereos, and non-cathode-ray-tube electronic equipment.

The 2000 Waste Composition Study noted a large increase in the disposal of computers and other electronic devices in that year, but also cautioned that the magnitude of the increase might not be as large as it at first appears, because of the low precision of the estimates as demonstrated by the large confidence interval associated with each estimate. Unlike common regularly-disposed materials such as most papers and plastics, computers and electronics are highly variable items in the waste stream. Many samples have no computers or electronics at all, while a small minority of samples have substantial weights of computers or electronics. For example, in 2000 only 38 of 591 samples had any pieces of computer equipment. Only 8 samples contributed more than half the weight of computers making up the 2000 results. Considering the random nature of sample selection, the results could have been quite different if any of those eight samples had not been selected, or conversely, if a few more samples high in computers had been randomly selected.

Results from 2002 back up that caution. The best estimate of the amount of electronics being disposed in 2002 still exceeded the levels disposed in 1998, but the difference was not as large. The 2002 numbers were lower than 2000 numbers, but the difference was not statistically significant. Both the 2000 and 2002 disposal percentages were significantly higher than the 1998 disposal percentage for computers (just barely in the case of the 2002 number), but the 2002 disposal percentage for brown goods was not significantly higher than the 1998 percentage.

A number of studies have documented that many times computers, televisions, and other major electronic items are not immediately disposed when they become broken or obsolete. Instead, these items are often stored temporarily in attics, closets, and basements. This is especially true for computers, where the original computer system might have cost a couple thousand dollars and still be operational, even though it is slow and obsolete by current standards. The low disposal of electronics in 1998 and before might in large part be due to this stockpiling. Evidently 2000 was a year in which many computers moved out of the storage areas and into disposal.

Table 19. Computers and Electronic Appliances (Statewide - field data)

	1998		2000		2002	
	Percent	(90% conf int.)	Percent	(90% conf int.)	Percent	(90% conf int.)
Computers	0.25%	(0.13 - 0.37%)	0.68%	(0.43 - 0.99%)	0.56%	(0.34 - 0.82%)
Computers excluding CRT* Monitors					0.32%	(0.18 - 0.49%)
CRT-type Monitors					0.24%	(0.11 - 0.39%)
Brown Goods	0.44%	(0.30 - 0.62%)	0.98%	(0.66 - 1.34%)	0.71%	(0.47 - 0.96%)
TVs and other CRTs					0.43%	(0.22 - 0.64%)
Other Brown Goods excluding CRTs					0.28%	(0.18 - 0.40%)
Small Appliances-non electronic	0.46%	(0.37 - 0.54%)	0.56%	(0.39 - 0.74%)	0.64%	(0.48 - 0.83%)

*CRT = Cathode Ray Tube

Table 20 presents the same information as Table 19, except that the results of contamination analysis are used instead of the field data, and results are extrapolated to statewide tonnage. For big, distinct, non-absorbent items like computers and brown goods, contamination levels in sorting are very low, and so contamination correction factors are usually zero or close to zero.

The year 2000 was the first year in which the Oregon Material Recovery Survey had any electronics recycling reported. Since 2000, the tonnage of electronics recycled has grown, but the total collected for recycling is still just a small percentage of the total tonnage of electronics being generated as waste. The recovery tonnage is shown in table 22. However, the numbers reported in table 22 underestimate the total

electronics recovered as some components of electronics recycling are reported as scrap metal or other materials.

Table 20. Computers and Electronic Appliances (Statewide tonnage, with contamination analysis adjustments)

	1998		2000		2002	
	Percent	(90% conf int.)	Percent	(90% conf int.)	Tons	(90% conf int.)
Computers	6,615	(3,400 - 9,800)	18,803	(11,907 - 27,532)	15,341	(9,293 - 22,497)
Computers excluding CRT* Monitors					8,841	(4,908 - 13,575)
CRT-type Monitors					6,501	(3,128 - 10,808)
Brown Goods	11,748	(8,000 - 16,400)	26,933	(17,782 - 36,906)	19,473	(12,968 - 26,474)
TVs and other CRTs					11,689	(5,958 - 17,461)
Other Brown Goods excluding CRTs					7,784	(4,990 - 10,964)
Small Appliances-non electronic	12,097	(9,800 - 14,300)	15,441	(11,100 - 19,992)	17,561	(13,051 - 22,638)

*CRT = Cathode Ray Tube

Table 21. Recovery of Electronics 2000-2002. Data are from the 2002 Oregon Material Recovery Survey Report. No electronics recovery was reported to DEQ prior to 2000.

Material Type	2000 Tons	2001 Tons	2002 Tons
Electronics (Computers & Brown Goods)	617	1,640	2,216

Beverage Containers

As in past DEQ and Metro studies, beverage containers were both counted and weighed. Separate counts were made by beverage type (beer, soft drink, juice, wine, wine cooler, liquor, water, other) and by container material type (plastic, glass, aluminum, steel). For beer and soft drink, deposit containers were recorded separately from no-deposit (out-of-state) containers. "Soft drink" as used here includes sparkling water and other non-alcoholic carbonated beverages in containers that have deposits under Oregon law. "Beer" includes malt coolers that also have deposits.

Results of counts were analyzed in much the same way as results of weights, but the results for counts are reported as containers per average ton of waste rather than as a percentage. This allows a simple extrapolation of the total number of beverage containers disposed statewide by multiplying the containers per ton figure by the total tons of waste disposed in 2002 (2,743,561 tons, excluding single-material waste streams that were not sampled as part of this study - see Table A1 in Appendix A).

Table 22 shows the number of beverage containers disposed per ton of Oregon waste disposed in both 2000 and 2002. Table 23 uses the extrapolation described above to estimate the total number of containers from Oregon that were disposed in 2000 and 2002, reported in millions of containers. Tables A17 and A18 in Appendix A give the same results as Tables 22 and 23, but also show statistical confidence intervals.

Table 22 Beverage Containers Disposed per Ton of Solid Waste - 2000 and 2002 Oregon Statewide

Year	Beverage*	Plastic	Glass	Aluminum	Steel (tin)	Total
2002	Beer & Malt Cooler: Deposit	0.07	10.81	15.23		26.11
2002	Beer & Malt Cooler: No deposit		0.12	0.08		0.20
2002	Soft Drink: Deposit	16.77	1.51	44.19		62.46
2002	Soft Drink: No deposit	0.07	0.13	0.09		0.29
2002	Milk	17.81	0.01			17.82
2002	Juice/Sports/Tea/Other	22.61	9.67	10.80	4.91	47.99
2002	Water	28.16	0.15			28.32
2002	Liquor	1.09	2.55			3.64
2002	Wine & Wine Cooler		4.07			4.07
2002	Subtotal: Deposit	16.84	12.31	59.41	0.00	88.56
2002	Subtotal: No deposit	69.74	16.70	10.97	4.91	102.33
2002	Total	86.58	29.02	70.38	4.91	190.89
2000	Beer & Malt Cooler: Deposit	0.38	8.14	15.97		24.49
2000	Beer & Malt Cooler: No deposit	0.73	0.02	0.04		0.78
2000	Soft Drink: Deposit	14.63	1.46	41.90		57.99
2000	Soft Drink: No deposit	0.13	0.11	0.07		0.31
2000	Milk	18.36	0.18			18.54
2000	Juice/Sports/Tea/Other	19.46	13.54	9.60	5.34	47.93
2000	Water	16.86	0.14			17.00
2000	Liquor	0.94	2.26			3.20
2000	Wine & Wine Cooler		4.90			4.90
2000	Subtotal: Deposit	15.01	9.60	57.87	0.00	82.49
2000	Subtotal: No deposit	56.48	21.15	9.70	5.34	92.67
2000	Total	71.49	30.75	67.58	5.34	175.16

* A very small percentage of aluminum cans were not recorded by beverage type in the 2000 study. In tables 22 and 23, these unidentified cans were allocated into beverage categories in proportion to known aluminum cans. Appendix tables A17 and A18 from the 2000 study show the numbers for unidentified aluminum cans.

As can be seen in Table 23, an estimated 243 million deposit beverage containers ended up being disposed in 2002. DEQ has independently estimated that about 1.4 billion beer and soft drink containers were sold in Oregon in 2002. Thus, the containers disposed represent about 17% of the total deposit containers sold in 2002. This disposal rate is substantially less than the disposal rate for beverage containers in states that do not have deposit legislation. According to the "Multi-Stakeholder Recovery Project" report by Business and Environmentalists Allied for Recycling (BEAR), the disposal rate for beverage containers in non-deposit states is about 72%. The BEAR report is available at the following web site: <http://www.globalgreen.org/BEAR/Projects/FinalReport.pdf>. DEQ does not have good sales figures for the other beverages listed in Tables 22 and 23, but based on national sales numbers the number of other beverage containers sold is substantially less than the number of beer and soft drink (deposit) containers.

Table 23. Beverage Containers Disposed from Oregon in 2000 and 2002 (in millions of containers)

Year	Beverage*	Plastic	Glass	Aluminum	Steel (tin)	Total
2002	Beer & Malt Cooler: Deposit	0.2	29.7	41.8		71.6
2002	Beer & Malt Cooler: No deposit		0.3	0.2		0.5
2002	Soft Drink: Deposit	46.0	4.1	121.2		171.4
2002	Soft Drink: No deposit	0.2	0.4	0.2		0.8
2002	Milk	48.9	0.0			48.9
2002	Juice/Sports/Tea/Other	62.0	26.5	29.6	13.5	131.7
2002	Water	77.3	0.4			77.7
2002	Liquor	3.0	7.0			10.0
2002	Wine & Wine Cooler		11.2			11.2
2002	Subtotal: Deposit	46.2	33.8	163.0	0.0	243.0
2002	Subtotal: No deposit	191.3	45.8	30.1	13.5	280.7
2002	Total	237.5	79.6	193.1	13.5	523.7
2000	Beer & Malt Cooler: Deposit	1.0	22.5	44.1		67.7
2000	Beer & Malt Cooler: No deposit	2.0	0.1	0.1		2.2
2000	Soft Drink: Deposit	40.4	4.0	115.8		160.2
2000	Soft Drink: No deposit	0.4	0.3	0.2		0.9
2000	Milk	50.7	0.5			51.2
2000	Juice/Sports/Tea/Other	53.8	37.4	26.5	14.8	132.5
2000	Water	46.6	0.4			47.0
2000	Liquor	2.6	6.2			8.8
2000	Wine & Wine Cooler		13.5			13.5
2000	Subtotal: Deposit	41.5	26.5	159.9	0.0	227.9
2000	Subtotal: No deposit	156.1	58.4	26.8	14.8	256.1
2000	Total	197.6	85.0	186.7	14.8	484.0

* See note for Table 22.

Changes in beverage container disposal.

Tables A17 and A18 in Appendix A give full comparisons of beverage container counts for the current study compared to 1998. Table 24 below show weight data for categories that contain beverage containers. Note however that many rigid plastic containers and most tinned food cans are not beverage containers.

Table 24. Percent Composition by Weight: Categories Containing Beverage Containers. Oregon Statewide (field sort data not including contamination corrections).

	Percent 1993-95	Percent 1998	90% confidence interval	Percent 2000	90% confidence interval	Percent 2002	90% confidence interval
Rigid Plastic Containers	1.11	1.34	(1.28 - 1.41)	1.51	(1.40 - 1.64)	1.67	(1.58 - 1.78)
Deposit Beverage Bottles	0.14	0.23	(0.20 - 0.27)	0.28	(0.24 - 0.33)	0.37	(0.30 - 0.44)
Other Clear Glass Bottles	0.85	0.50	(0.46 - 0.54)	0.55	(0.48 - 0.62)	0.44	(0.38 - 0.49)
Other Colored Glass Bottles	0.43	0.30	(0.26 - 0.33)	0.28	(0.22 - 0.34)	0.28	(0.23 - 0.33)
Aluminum Beverage Cans	0.13*	0.11	(0.10 - 0.12)	0.13	(0.12 - 0.15)	0.13	(0.12 - 0.15)
Tin Food Cans	1.15	0.90	(0.84 - 0.96)	0.91	(0.83 - 0.99)	0.79	(0.72 - 0.86)

*Excludes one sample with extremely high aluminum can counts that originated out-of-state. Confidence intervals are not available for the combined 1993-95 studies.

These results show that deposit glass bottles and aluminum cans are relatively scarce in Oregon's garbage, but there has been an increase in disposal of these containers over the past few years. The 17% disposal rate for beer and soft drink containers in 2002 compares to 16% in 2000 and 12.5% in 1998 and less than 10% in previous studies. There has also been a decline in other glass bottle disposal over the last decade, but this is probably due in large part to a conversion from glass to plastic for many types of bottles.

Tires

Except for bicycle tires and tires from vehicles not driven on roadways such as large tractor tires, most whole tires are banned from landfilling in Oregon by state law. In order to be landfilled, the tires must first be cut into pieces as specified by Oregon Administrative Rule 340-064-0052. Since 1997, two Oregon landfills have been accepting and chipping tires for disposal. In addition, other processors chip and dispose of whole tires or substantial portions of the tires. The tires or chips arriving at the landfills come in whole loads of tires only, and were not sampled as part of the waste composition study.

Because disposal of whole tires is banned, very few tires come to landfills and transfer stations in mixed loads. We did not record whether the tires being disposed were whole tires, or were other unregulated tire material such as bicycle tires or innertubes. However, based on weight, 8 samples (of the 844 collected in the study) had enough tire rubber present to possibly contain whole tires. These samples contain between 20 and 54 pounds of tire rubber, and thus probably consisted of one or two passenger tires each. Another 10 samples had small amounts of tire rubber - between 1 and 18 pounds. These were most likely bicycle or other small non-road tires, innertubes, or pieces of tire tread. The remaining 826 samples had no measurable tire rubber.

For consistency, this report analyzed tires in the same manner as other materials. Based on that analysis, tires made up 0.12% of the waste stream sampled, but because of the high variability between samples, the 90% confidence interval was very broad - between 0.06% to 0.19%. This works out to between 1,700 and 5,200 tons of tires being disposed excluding the single-material disposal of tires. In fact though, it is highly likely that many of these tires are pulled out of the waste before being disposed at the landfill. The tires would then be sent to a processor and probably chipped and disposed as a single-stream disposal of tires. If this is the case, adding the estimate of tire disposal based on sampling to the reported single-stream disposal of tires probably will double-count most of the tire tonnage estimated by sampling.

Landfills generally report to DEQ the total tons of tires or tire chips they accept for disposal, plus DEQ surveys tire and other recyclers as part of conducting the Oregon Material Recovery Survey each year. Table 25 gives the results of the disposal reporting and the recovery survey.

The disposal numbers in Table 25 do not include any of the tonnage estimates based on the waste composition study. Based on the above discussion, DEQ believes that less than 1000 tons per year of tires, including bicycle and other small tires, are being disposed each year mixed with other solid waste. Including this tonnage would slightly reduce the recovery rate reported in Table 25.

Two major sets of adjustments have been made to the disposal totals. First, the two landfills with tire chippers originally had reported almost all of their tires received as coming from Oregon. Closer examination showed that in fact most of the tires were coming from tire stores outside of Oregon. DEQ obtained information from the tire store chain on how many tires came from Oregon versus other states, and used this to adjust the Oregon tire disposal numbers at those landfills. Second, in earlier years the residue from tire processing operations was considered to be an industrial waste, and was not counted toward the total municipal waste disposed. This residue consisted of the belts and other parts of the tire that were not considered easily recyclable, often with substantial amounts of tire rubber attached. However, by 1998 it became obvious that tire processors were grinding whole tires for disposal, and much

more than just non-recyclable residue was being disposed. Since that time DEQ has classified all tire chips and residue as being a counting municipal waste when disposed. For the purpose of calculating recovery rates, both processing waste and chipping of whole tires are counted in the total disposed tonnage.

Table 25: Tire Disposal and Recycling as a Single Material Stream
(results based on reporting with adjustments, not sampling)

Year	Disposed total	Recovered Total	Generated Total	Recovery Rate	Original Disposal Reported	Original Disposal Excluded as Residue
1992	N.A.	23,370	N.A.		N.A.	4,497
1993	6,375	31,553	37,928	83%	1,152	5,223
1994	8,704	25,406	34,110	74%	710	7,994
1995	9,382	31,262*	40,644	77%	943	8,439
1996	12,598	24,360**	36,958	66%	448	12,150
1997	38,136	21,477	59,613	36%	33,825	4,311
1998	51,378	20,782	72,160	29%	49,971	1,407
1999	47,281	22,804	70,085	33%	47,281	0
2000	35,241	16,419	51,660	32%	35,241	0
2001	33,386	17,251	50,636	34%	33,386	0
2002	27,190	23,423	50,613	46%	27,190	0

* Originally reported as 45,185 tons in the 1995 Oregon Material Recovery Survey report. DEQ now believes that 13,923 tons of this was a mistaken double-count.

** May be low by a few thousand tons due to the failure of a tire end-user to report.

In Table 25, tires are counted as disposed or recycled in the year when they are actually processed. In many cases, the tires might have been sitting in a tire storage site for years before finally being processed. The high disposal and generation rates for 1997-1999 reflect the cleanup and processing of tires from one huge tire storage site in Eastern Oregon that had millions of tires.

Overall, the trend showed by Table 25 for tire recovery has been negative. Both tire disposal and generation have been increasing, while tire recovery has been steadily decreasing over the last decade. Part of this was probably due to markets being overwhelmed with tires from a major pile cleanup from 1997 to 1999 and the loss of a major tire-derived fuel market in 1997. However, there has been a slight reversal recently, with recovery increasing and disposal decreasing in 2001 and 2002.

Recovery Rate Summary

Table 26 summarizes Oregon recovery rates for selected materials by comparing the results of the Oregon waste composition studies to results from the annual Oregon Material Recovery Surveys. Because the waste composition study looks at material categories in more detail than are reported in the material recovery survey, it is not possible to match the categories in each report on a one-to-one basis. In addition, the increase in collection and recycling of commingled materials has made it more difficult to match categories. For example, in earlier years, newspaper and magazines were generally recycled as separate grades. Now, many of the newspaper grades include magazines, and often substantial amounts of office paper is also included in with newspaper grades and mixed scrap paper grades. The decline in high-grade paper recycling rates since 1998 is probably more associated with high-grade papers being included in other paper categories, particularly newsprint, than with any real decrease in recycling.

Table 26: Recovery Rates for Selected Materials Statewide 1994-2002.

	2002 Tons Disposed	2002 Tons Recovered	2002 Total Tons Generated	2002 Oregon recovery percent	2000 Oregon recovery percent	1998 Oregon recovery percent	1994 Oregon recovery percent
Paper (Total)	440,077	679,971	1,120,048	60.7%	54.4%	55.3%	47.7%
Cardboard/Kraft	71,252	381,027	452,279	84.2%	78.1%	72.9%	66.5%
Newspaper & Magazines	77,854	211,082	288,936	69.9%	69.9%	68.8%	62.4%
High Grade Paper	45,261	41,659	86,920	47.9%	53.2%	63.1%	40.5%
Low Grade Paper	115,885	46,203	162,089	28.5%	39.8%	35.2%	21.7%
Non-recyclable paper	129,825	-	129,825	0.0%	0.0%	0.0%	0.0%
All Plastic (total)	243,047	23,647	266,694	8.9%	9.9%	7.1%	7.9%
Rigid Plastic Containers	35,808	13,396	49,204	27.2%	29.4%	29.4%	30.7%
Film Plastic	88,951	6,724	95,675	7.0%	4.6%	2.2%	2.5%
All Other Plastic	118,288	3,527	121,815	2.9%	4.2%	2.9%	1.7%
Food & Grease	450,846	45,144	495,990	9.1%	5.9%	6.6%	6.1%
Yard Debris	181,443	398,822	580,266	68.7%	65.3%	68.0%	61.5%
Wood	221,441	386,053	607,494	63.5%	62.4%	53.5%	42.7%
Container Glass	41,890	90,475	132,366	68.4%	64.8%	63.8%	56.6%
All Other Glass	21,318	4,621	25,939	17.8%	9.4%	2.6%	6.5%
Electronics	34,814	2,216	37,030	6.0%	1.3%	0.0%	0.0%
Scrap Metal (excl. electronics)*	155,404	262,390	417,794	62.8%	51.7%	44.8%	25.9%
Carpet	52,817	540	53,357	1.0%	2.7%	0.4%	0.0%
Textiles	44,337	4,527	48,864	9.3%	7.6%	7.3%	0.0%
Asphalt Roofing	104,601	13,459	118,061	11.4%	23.7%	7.3%	0.0%
Gypsum	130,989	3,781	134,770	2.8%	4.5%	7.8%	9.6%
Vehicle Tires**	27,190	23,327	50,516	46.2%	31.8%	28.8%	74.5%
All Other	596,607	85,423	682,030	12.5%	7.7%	7.5%	11.6%
Total	2,746,821	2,024,398	4,771,219	42.4%	38.9%	37.3%	32.6%

* Based on an exemption in state law, much commercial scrap metal recycling is not reported to DEQ. Low recovery of scrap metal in 1994 compared to later years is probably related more to how scrap metal dealers chose to report tonnages, rather than real changes in recovery rates.

** Includes only vehicle tires collected and disposed as a separate material. Bicycle and other small tires and any vehicle tires that may be illegally disposed as mixed solid waste are included in the "all other materials" category.

Most materials have either held steady or shown increases in recycling rates since 1994. Increases in recovery in even long-time recycled materials such as the paper categories is reflective of increased promotion of recycling by the recyclers, garbage collectors, governments, and businesses in Oregon. The only exceptions to the trend are vehicle tires, rigid plastic containers, and gypsum wallboard. Vehicle tire recovery declined sharply in the mid-90s due to the discontinuation of a major market for tire derived fuel and an increase in generation due to a major tire cleanup, but has begun to increase again since 1998. Rigid plastic container recovery has showed a slow decline since 1995 as documented in the 2002/2004 rigid plastic container recycling rate report (<http://www.deq.state.or.us/wmc/solwaste/rpc2004.html>), Gypsum wallboard recycling has dwindled with closure of facilities, most recently in 2001. Asphalt roofing recycling began in Oregon after 1994 but declined sharply in 2002 with the closure of a major facility in Portland.

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