CAPITAL REGIONAL DISTRICT

SOLID WASTE STREAM ANALYSIS

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EXECUTIVE SUMMARY

Between April 23 - May 17 and July 26 - August 16, 1990, 27.5 tonnes of CRD refuse was sorted, at the Hartland Avenue landfill, into 36 different categories. The sample size was 0.1% of the 26,800 tonnes delivered during the sorting period. Samples were taken volumetrically, in proportion to the recorded scale weights of the previous year, for each type of customer.

Samples were taken by first mixing the selected load with a backhoe and then picking a visually representative portion of the load. Samples were sorted into garbage cans and weighed on a beam scale. Bulky items (chairs, couches, mattresses), white goods (stoves, freezers, refrigerators, hot water tanks) and tires were counted in Phase II of the program. Weights were obtained from the scalehouse for controlled wastes, stumps and brush, and demolition debris.

The average of the results for the two phases are shown on the table on the following page.

A calculation was done to illustrate the differences between commercial refuse and residential refuse. While the calculation has some limitations, the findings are felt to be reasonable.

For major resource recovery or energy recovery the CRD refuse can be categorized by the following percentages.

Combustible	79%
Compostable	62%
Refuse derived fuel	38%

The existing curbside and depot recycling program is removing the following approximate percentages of recoverable items from the total waste stream and from the residential waste stream.

	Total Waste Stream	Residential Waste Stream
Newspaper	29 - 68%	47 - 87%
Glass	43%	54%
Cans	24%	34%
All Items	31 - 52%	47 - 68%

The percentage breakdown of refuse information from this study is in reasonable agreement with results from other studies. More garden waste was found in the spring than in the summer which is consistent with expected seasonal variation in refuse composition.

It is estimated that about 100 tonnes per year (including the weight of the containers) of household hazardous wastes in plastic, glass or metal containers enters the landfill. An additional 2900 tonnes per year of empty household hazardous materials containers enter the landfill. About 660 tonnes per year of other hazardous materials (batteries, cleaning compounds, detergents, insecticides, etc.) also enter the landfill.

It is estimated that between 900 and 1500 hypodermic needles are discarded each day.

SOLID WASTE STREAM ANALYSIS

Item No.	Component	Average Per Cent	Approximate Annual Tonnes
1	Combustible - compostable	20.86	41700
2	Garden waste	10.16	20300
3	Food waste	8.81	17600
4	Non-combustibles	8.08	16200
5	Contaminated corrugated	7.42	14800
6	Other plastic	6.19	12400
7	Other ferrous metal	4.74	9500
8	Combustibles - non-compostable	4.70	9400
9	Polyethylene	3.94	7900
10	Clean wood	3.88	7800
11	Glass food & beverage containers	2.44	4900
12	Clean newspaper	1.60	3200
13	Textiles	1.52	3000
14	Controlled wastes	1.52	3000
15	Clean corrugated	1.44	2900
16	Stumps, brush	1.30	2600
17	Other clean paper	1.20	2400
18	Disposable diapers	1.16	2300
19	Tin cans	1.07	2100
20	Clean multi-material paper	1.02	2000
21	Rubber	0.94	1900
22	Other non-ferrous metal	0.78	1600
23	Ferrous cans with hazardous	0.78	1600
24	Plastic containers with hazardous	0.66	1300
25	Clean magazines	0.41	800
26	Bulky materials	0.38	800
27	Other glass	0.38	800
28	White goods	0.34	700
29	Other hazardous materials	0.34	700
30	Other clean white paper	0.32	600
31	Rubber tires	0.25	500
32	Aluminum food & beverage cans	0.23	450
33	Clean envelopes	0.20	400
34	Clear, rigid plastic bottles	0.20	400
35	Treated wood	0.19	400
36	Demolition debris	0.14	300
37	White & colored rigid plastic bottles	0.08	150
38	Leather	0.08	150
39	Medical, dental, syringes, etc	0.08	150
40	Clean colored bond paper	0.06	100
41	Glass containers with hazardous	0.06	100
42	PET bottles	0.05	100
TOTAL		100.00	200000

CHAPTER 1 - INTRODUCTION

In June, 1989, Cameron Advisory Services Ltd. was requested to prepare a cost estimate for a solid waste stream analysis which would:

1. Quantify materials being delivered to the Hartland Avenue landfill so that the Regional District will be able to determine those materials which can be added to its current recycling program, and

2. Quantify those materials being delivered to the Hartland Avenue landfill which are household hazardous wastes (HHW).

On March 9, 1990, Cameron Advisory Services Ltd. was requested to carry out the waste stream analysis.

In the original proposal, refuse would have been separated into 31 different categories. This was expanded to 36 categories when the project was undertaken.

Refuse was sorted in two phases. Phase I took place between April 23 and May 17, 1990 and Phase II between July 26 and August 16, 1990. A crew of five people plus one supervisor performed the task of refuse sorting. Invaluable assistance was provided by the Capital Regional District (CRD) staff at Hartland Avenue.

CHAPTER 2 - METHODOLOGY

In the original proposal, refuse was to have been selected from 7 different types of delivery vehicle (urban residential, rural residential, urban private drop-off, rural private drop-off, urban commercial, rural commercial and institutional). Based on a statistical approach developed by Carruth and Klee (U. S. Public Health Service), a total sample size of 16800 lbs would have been adequate to give an estimate within 2 per cent at a 90% confidence level. Unfortunately, the delivery vehicles contained mixed household, apartment and commercial refuse and no clear distinction between rural and urban garbage was possible. A different approach was then taken.

Data was obtained from the CRD on the monthly charges to account customers for the months of April and May, 1989. From this an accurate tonnage was obtained for each of these account customers. The total cash transactions at the landfill, for the months of April and May 1989, were used to calculate the tonnage of refuse delivered by cash customers. This calculation gave a total tonnage which was in reasonable agreement with the total scaled refuse for these months.

The percentage of total monthly refuse, by weight, was then determined for each of the account customers and for the cash customers. Discussions were held with the staff responsible for handling the cash customers to determine the distribution of cash customers delivering to the landfill itself and those delivering to the containers located near the weigh scales. The latter comprise small vehicles such as pickup trucks, cars with trailers and cars. As samples had to be collected on a volumetric basis, a sample volume was calculated for each of the account customers and for the cash customers. A list was then prepared so that the supervisor would be able to obtain reasonably representative samples.

For the larger account customers (BFI and Laidlaw, for example) samples were taken on different days of the week and from the different types of vehicles used (front loading trucks, roll-off container trucks and stationary packer container trucks).

For samples from the containers near the scale house, the assistance of the CRD spotters was used. The spotters were asked to have the container to be sampled filled with "representative" refuse.

Once the vehicle to be sampled from was selected, the full load was dumped in an area separate from the working face. A rubber-tired backhoe was used to visually mix the load to make the various components as evenly distributed as possible. After mixing, a sample of the appropriate volume was taken using the backhoe's clam-shell bucket. The sample was then taken to the sorting table.

The various components were placed into conventional plastic household garbage cans. Because of the volume occupied, contaminated corrugated cardboard was placed in a large wooden storage container. All of the plastic garbage cans were scaled using a beam scale calibrated to the nearest 0.25 lbs.

Large objects were handled in two different ways. Stumps, brush, demolition debris and controlled wastes (largely asbestos) are scaled separately at the landfill so accurate data were available.

In Phase I, only an estimate of the numbers of bulky materials (chairs, mattresses, sofas) and white goods (stoves, refrigerators, freezers, hot water tanks) delivered to the containers near the scale house was obtained from the spotters. To get a more accurate picture, the spotters were asked to provide a count of bulky goods and white goods in

Phase II. The count in Phase II showed that the estimates in Phase I were not very accurate. The data from Phase II were therefore used for both Phase I and Phase II.

In Phase I the quantity of rubber tires being delivered to the site was based upon a study carried out in 1984 for the Provincial Ministry of Environment. The count taken in Phase II showed this to be invalid. The tire count from Phase II was therefore used for both Phases I and II.

CHAPTER 3 - RESULTS

3.1 Introduction

In Phase I, a total of 34,837.25 lbs (15.8 tonnes) of refuse was sampled over a period of 25 calendar days (17 sorting days) for a sorting rate of 54.6 lbs per person per hour. During this time, 15,371 tonnes was delivered to the landfill.

In Phase II, a total of 25,734.25 lbs (11.7 tonnes) was sampled over a period of 22 calendar days (15 sorting days) for a sorting rate of 45.2 lb per person per hour. During this period, 11,439 tonnes of refuse was delivered to the landfill.

3.2 General Comparison With Other Studies

An idea of how the average results from Phases I and II compare with other findings is shown in Table 1. In Table 1, the values for newspaper, metals and glass have been corrected to include materials collected in the CRD curbside program.

TABLE 1 - SOLID WASTE PERCENTAGE SUMMARY

Component	This Survey 1990	Bird & Hale 1979	Tchobanoglous 1977
Paper & cardboard	35.91	37.80	28 - 60
Food	8.32	17.42	6 - 26
Garden	12.14	7.28	0 - 20
Ferrous metal	7.26	7.20	3 - 12
Non-ferrous metal	0.95	0.48	0 - 1
Glass	4.37	7.78	4 - 16
Textiles, rubber, leather	2.64	4.99	0 - 8
Plastics	12.94	5.42	2 - 8
Wood	5.99	5.19	1 - 4
Non-combustibles	9.48	6.44	0 - 10
TOTAL	100.00	100.00	

3.3 Detailed Results of This Survey

The detailed results from the survey carried out are presented in Table 2 and arranged in descending order of the averages for Phases I and II.

The percentage figures in Table 2 have been adjusted to take into account the counts and scaled masses for rubber tires, bulky materials, white goods, demolition materials, controlled wastes and stumps and brush.

SOME NOTES OF CAUTION MUST BE OBSERVED WHEN INTERPRETING THE DATA IN ALL TABLES IN THIS REPORT.

1. The samples represent two periods, late spring and summer. Other seasons of the year are therefore not represented.

2. The samples were taken volumetrically. At the conclusion of the study, a weight calculation showed that some inadvertent biases had occurred.

3. No sampling was done on Saturdays.

TABLE 2 - SOLID WASTE STREAM ANALYSIS

Item No.	Component	Per Cent Spring	Per Cent Summer	Per Cent Change	Average Per Cent
1	Combustible - compostable	22.77	18.96	- 17	20.86
2	Garden waste	12.52	7.80	- 38	10.16
3	Food waste	9.14	8.47	- 7	8.81
4	Non-combustibles	8.71	7.46	- 14	8.08
5	Contaminated corrugated*	5.68	9.15	+ 61	7.42
6	Other plastic	5.54	6.84	+ 23	6.19
7	Other ferrous metal	4.97	4.52	- 9	4.74
8	Combustibles - non-compostable	3.57	5.82	+ 63	4.70
9	Polyethylene	3.31	4.57	+ 38	3.94
10	Clean wood	3.65	4.12	+ 13	3.88
11	Glass food & beverage containers	2.57	2.32	- 10	2.44
12	Clean newspaper	1.48	1.72	+ 16	1.60
13	Textiles	1.71	1.33	- 22	1.52
14	Controlled wastes*	1.00	2.03	+103	1.52
15	Clean corrugated	0.72	2.15	+199	1.44
16	Stumps, brush	1.38	1.23	- 11	1.30
17	Other clean paper	0.96	1.45	+ 51	1.20
18	Disposable diapers	1.06	1.27	+ 20	1.16
19	Tin cans	1.17	0.97	- 17	1.07
20	Clean multi-material paper*	0.91	1.12	+ 23	1.02
21	Rubber*	1.07	0.82	- 23	0.94
22	Other non-ferrous metal	0.78	0.78	0	0.78
23	Ferrous cans with hazardous	0.82	0.73	- 11	0.78
24	Plastic containers with hazardous	0.62	0.69	+ 11	0.66
25	Clean magazines	0.40	0.42	+ 5	0.41
26	Bulky materials	0.38	0.38	NA	0.38
27	Other glass	0.39	0.36	- 8	0.38
28	White goods	0.34	0.34	NA	0.34
29	Other hazardous materials*	0.10	0.57	+470	0.34
30	Other clean white paper	0.54	0.11	- 80	0.32
31	Rubber tires	0.25	0.25	NA	0.25
32	Aluminum food & beverage cans	0.17	0.29	+ 71	0.23
33	Clean envelopes	0.27	0.14	- 48	0.20
34	Clear, rigid plastic bottles	0.18	0.23	+ 28	0.20
35	Treated wood*	0.13	0.25	+ 92	0.19
36	Demolition debris	0.27	0.02	- 93	0.14
37	White & colored rigid plastic bottles	0.11	0.04	- 64	0.08
38	Leather	0.08	0.07	- 13	0.08
39	Medical, dental, syringes, etc*	0.07	0.08	+ 14	0.08
40	Clean colored bond paper	0.12	0.00	-100	0.06
41	Glass containers with hazardous	0.04	0.08	+100	0.06
42	PET bottles*	0.05	0.05	0	0.05
TOTAL		100.00	100.00		100.00

NA Not applicable because data obtained during Phase II was applied to Phase I.

* A brief description of these categories is on the following page.

Contaminated corrugated - contaminated with dirt, food, oil or grease.

Controlled wastes - mostly asbestos. Also includes sewage sludges, septic tank sludges, condemned foods, dead animals, bulky materials (exceeding 1.5 cubic m in size), water containing oil, sand, gravel or other non-hazardous solids. All such wastes are handled using special precautions and separate dumping areas at the landfill.

Clean multi-material paper - envelopes with plastic windows, bubble packs, magazines with staples, telephone books.

Rubber - bicycle tires, fan belts, mats, hoses, seals, bicycle tubes.

Treated wood - wood treated with wood preservatives such as creosote, cuprinol, zinc naphthanate.

Medical, dental, syringes, etc. One sample contained rubber gloves and masks from a dental office. A total of 40 syringes (apparently diabetic syringes) was found during sampling in Phase I and 21 syringes in Phase II. Four bags of medical laboratory blood tubes and other miscellaneous materials such as swabs were found in one sample. One of these bags was marked as being autoclavable, the remaining three bags were not. About 15 lbs of medical wastes including tablets, gloves, one syringe, a pump and two bottles of chemical solutions came from one hospital. Dental cleaning powder, dental masks, dental molds, pipettes, plastic tubing and ophthalmic solution were also found.

PET bottles - polyethylene terphthalate bottles - usually large, green or clear plastic bottles for beverages such as 7-Up, Coke, Sprite, Pepsi-cola.

Household hazardous wastes are those as defined in "Hazardous Wastes From Homes", Enterprise for Education Inc., Santa Monica, California, 1986. ISBN 0-934653-07-0. A listing which was given to each of the sorters is included as Appendix B.

Further Breakdown of Categories - To provide an understanding of both the complexity of garbage and the nature of the various categories, the survey was expanded upon. This was done in Phase I by making random, visual observations of the makeup of the various categories. In Phase II, random samples were taken and the weights of the various components determined. The percentages thus determined are shown in Tables A-1 through A-16 in Appendix A. The categories are:

Combustible - compostable	Table A-1
Non-combustibles	Table A-2
Other plastic	Table A-3
Other ferrous metal	Table A-4
Combustible - non-compostable	Table A-5
Polyethylene	Table A-6
Glass food & beverage containers	Table A-7
Other clean paper	Table A-8
Other non-ferrous metal	Table A-9
Ferrous containers with hazardous waste	Table A-10
Plastic containers with hazardous waste	Table A-11
Other glass	Table A-12
Other hazardous materials	Table A-13
Aluminum food & beverage containers	Table A-14
Clear, rigid plastic bottles	Table A-15
Glass containers with hazardous waste	Table A-16

3.4 Residential vs Commercial Refuse

As previously mentioned, because of the mixed loads brought in by the various vehicles, it was not possible to obtain a tonnage breakdown for urban and rural refuse. It was also not possible to determine a tonnage breakdown between commercial and residential refuse for the same reason. A further complication was that refuse from apartment buildings is considered to be commercial refuse by the collection vehicle drivers. To gain some appreciation of the differences between residential refuse and commercial plus apartment refuse, data was taken from those vehicles which were reported to contain either, 100% residential or, 100% commercial plus apartment refuse. The percentage breakdowns are presented in Table 3. The data represent 26 samples of commercial plus apartment refuse and 28 samples of residential refuse.

Table 3 also shows a commercial with no apartment column. This is based upon the assumption that disposable diapers in the commercial plus apartment column come only from apartments. The commercial with no apartment column was normalized by (1) subtracting the per cent of the residential item multiplied by the ratio of disposable diapers in commercial plus apartments to those in residential for each commercial plus apartment item. In step (2), the commercial with no apartment column was then corrected to give a total of 100%. For example, for combustible-compostables:

Step (1) $22.252 - (0.657 \times 19.760)/2.259 = 22.252 - 5.747 = 16.505$

Step (2) $16.505 / (1 - 0.657/2.259) = 23.27$

TABLE 3 - RESIDENTIAL AND COMMERCIAL REFUSE PERCENTAGES

Item No.	Component*	Residential Per Cent	Commercial Including Apartments Per Cent	Commercial Excluding Apartments Per Cent
1	Combustible - compostable	19.760	22.252	23.27
2	Garden waste	18.155	5.128	-0.22
3	Food waste	10.848	8.768	7.92
4	Non-combustibles	7.713	8.490	8.81
5	Contaminated corrugated	3.017	10.567	13.66
6	Other plastic	5.680	7.376	8.07
7	Other ferrous metal	5.359	5.244	5.20
8	Combustibles - non-compostable	4.994	4.937	4.91
9	Polyethylene	3.540	3.884	4.02
10	Clean wood	2.759	4.927	5.82
11	Glass food & beverage containers	2.953	1.915	1.49
12	Clean newspaper	1.050	1.817	2.13
13	Textiles	1.567	1.763	1.84
15	Clean corrugated	0.703	2.424	3.13
17	Other clean paper	0.800	1.571	1.89
18	Disposable diapers	2.259	0.657	0.00
19	Tin cans	1.334	0.977	0.83
20	Clean multi-material paper	0.992	1.265	1.38
21	Rubber	0.876	1.182	1.31
22	Other non-ferrous metal	1.021	0.707	0.58
23	Ferrous cans with hazardous	1.550	0.563	0.16
24	Plastic containers with hazardous	0.889	0.480	0.30
25	Clean magazines	0.503	0.400	0.36
27	Other glass	0.468	0.295	0.22
29	Other hazardous materials	0.207	0.104	0.06
30	Other clean white paper	0.071	0.804	1.11
32	Aluminum food & beverage cans	0.199	0.273	0.31
33	Clean envelopes	0.107	0.332	0.42
34	Clear, rigid plastic bottles	0.287	0.115	0.04
35	Treated wood	0.058	0.450	0.61
37	White & colored rigid plastic bottles	0.057	0.130	0.16
38	Leather	0.094	0.052	0.04
39	Medical, dental, syringes, etc	0.016	0.086	0.11
40	Clean colored bond paper	0.003	0.003	0.01
41	Glass containers with hazardous	0.074	0.015	0.00
42	PET bottles	0.037	0.047	0.05
TOTAL		100.000	100.000	100.00

* Items 14, 16, 26, 28, 31 and 36 (stumps, brush, bulky materials, controlled wastes, white goods, demolition debris and rubber tires) are not included as they are not applicable in the context of this table.

3.5 Major Recycle or Energy Recovery Possibilities

For three major alternative disposal or resource recovery options, the refuse in the CRD can be categorized as compostable, combustible or suitable for production of a refuse derived fuel (RDF). The percentages are shown in Table 4. Compostables include putrescible organics and wood wastes and all paper forms. Combustibles include all organic materials. RDF includes all paper and plastic in sheet form (i.e. no plastic containers or fabricated plastic shapes).

TABLE 4 - TOTAL COMPOSTABLE, COMBUSTIBLE AND RDF MATERIALS

	All Refuse	Residential Only	Commercial No Apartments
	%	%	%
Compostable	62	61	61
Combustible	79	79	83
RDF	38	31	52

3.6 Effect of Curbside Collection Program

The effect of the present curbside collection program is based upon an extrapolation of the data for recyclables collected during the months of April and July, 1990. A total of 9157 tonnes per year would be collected if the April rate of collection is valid for an entire year and 11015 tonnes per year if the July rate is used. The rate of waste production for Phase I was 212068 tonnes per year and for Phase II, 188442 tonnes per year. The curbside collection program was therefore reducing the total waste stream by 4.1% during Phase I and by 5.5% during Phase II.

If it is assumed that the split between residential and the commercial with no apartments tonnage is 50% each, then the curbside recycling program is having the effect shown in Table 5.

TABLE 5 - PERCENTAGE REMOVAL OF RECOVERABLE MATERIAL

Item	% Removed of Item Recoverable in Residential Waste Stream		% Removed of Item Recoverable in Total Waste Stream	
	Spring	Summer	Spring	Summer
Newspaper	86	87 (47)	66	68 (29)
Glass	48	54	31	43
Cans	29	34	18	24
ALL ITEMS	64	68 (47)	40	52 (31)

For glass and cans, in Table 5, the percentage figures are considered to be reasonably accurate because glass and metal food and beverage containers are readily easily identifiable so that they could be sorted into their single respective categories. The percentage for newspaper is probably high because some newspaper was contaminated and sorted into the combustible-compostable category. The bracketed figures for

summer (Phase II) are corrected based upon the percentage of contaminated newspaper scaled in the combustible-compostable category in Phase II.

CHAPTER 4 - DISCUSSION OF RESULTS

4.1 Comparison of Results With Other Studies

In Table 1 on page 4, the Tchobanoglous data are U. S. data including a significant proportion of data from California. The Bird & Hale data were determined at the Hartland Avenue landfill, the Victoria transfer station and the Vancouver Burns Bog landfill between October 1976 and September 1977. It would be expected that the Bird & Hale data would be more consistent with this survey than the Tchobanoglous data.

The significant differences between this survey and the Bird & Hale data are in the food, garden, non-ferrous metal, glass, textile, rubber and leather, plastics and non-combustible categories.

Bird & Hale did not segregate food wastes per se. Their category was "putrescible" waste which, for example, could include grass clippings.

In this survey, garden wastes reflect the late spring and early summer. It is to be expected that the results would be greater than results from sampling over the entire year.

If the food and garden wastes categories are combined for each of the two surveys, this survey shows a total of 20.46% while Bird & Hale's survey shows 24.7%. Part of the difference is explainable by the fact that Bird & Hale did not include construction and demolition debris. Adding these materials would reduce Bird and Hale's numbers for all other categories.

While the absolute difference between the two surveys for non-ferrous metal is about 100% the relative difference is 0.47%. This is relatively minor.

The total of the categories for glass, textiles, rubber, leather and plastics is 19.95% for this survey and 18.19% for Bird & Hale. The specific differences in the three categories are considered to be the significantly greater use of plastics, particularly in the area of food and beverage containers. Plastics have also supplanted many leather and rubber items.

As previously discussed, the Bird & Hale survey did not include construction and demolition debris. This is part of the reason for the difference for non-combustibles between the two surveys.

With the exception of plastics and wood, the data from this survey fall within the ranges given by Tchobanoglous. As discussed, the use of plastics has been increasing over the years. One might expect that wood wastes might form a greater percentage of the waste stream in a region which has a major forestry resource base.

Based on data from at least two other surveys, the data gathered in this survey is considered to be a reasonable reflection of the make-up of the solid waste stream for the period during which samples were taken.

4.2 Variation Between Sampling Periods

It is considered reasonable to expect that the disposable diaper category would remain consistent between April and August. If this is reasonable, then the increase of 20% for this category would be attributable to sampling error. This is consistent with calculations made by Bird & Hale. Bird & Hale show a standard error of about 17% for

an item comprising 38% of the waste stream and a standard error of over 100% for an item comprising 0.4% of the waste stream.

From Table 2 on page 5, the significant changes, for the major categories, are garden wastes (Item 2), corrugated cardboard (Items 5 and 15), combustible - non-compostables (Item 8), polyethylene (Item 9), controlled wastes (Item 14) and other clean paper (Item 17).

For garden wastes, a reduction from late spring to mid-summer is not surprising.

It seems reasonable that an increase in corrugated cardboard would be related to increased sales of packaged consumer products. The increase in total corrugated cardboard (from 6.4% to 11.3%) may therefore be partially due to tourism related activities in the summer. While other factors may contribute to the difference, no other explanation can be offered.

The increase in combustible - non-compostable materials may be due to an increase in reconstruction and home renovation activities during the summer.

The increase in polyethylene (mostly plastic in flexible sheet form), may be due to increased construction and home renovation as well as increased consumption of consumer products during the summer.

The difference in controlled wastes, which are scaled at the landfill, is a true reflection of seasonal variation.

The increase in other clean paper, of which a large percentage is office paper, is surprising when one considers that office activities are usually reduced in the summertime. The increase in this category may therefore be due to sample error.

The other significant difference is that for other hazardous materials. This category is a good example of how sample error increases when the percentage of the item is small. In Phase II, one large wet cell battery was found. This made up 63% of the total sample weight. If this battery had not been found, the percentage for other hazardous materials would have remained essentially unchanged.

With the exception of corrugated cardboard, polyethylene and other clean paper, the differences between the two sampling periods, for the major categories, can be explained by either seasonal variation or by the standard error inherent in sampling approximately 0.1% of the waste stream.

4.3 Residential and Commercial Refuse Percentages

Table 3 on page 8 shows a column for "commercial refuse not including apartments". This was based upon a calculation which assumed that disposable diapers would not come from conventional commercial sources. Inherent in this calculation was the assumption that refuse from apartments and from houses is the same. This, of course, is not true. However, the commercial with no apartments percentages are considered to be a better representation of commercial refuse than are the percentages shown in the commercial with apartments column in Table 3.

The percentage changes after normalizing, for garden waste (Item 2), corrugated cardboard (Items 5 and 15), the household hazardous waste categories (Items 23, 24, 29 and 41) and the medical, dental category (Item 39) tend to support the validity of the calculation.

4.4 Household Hazardous Materials

Items 23, 24, 29 and 41 represent about 2 per cent of the waste stream or about 4000 tonnes per year. This figure is misleading because of the containers themselves. In Phase I, the sorting crew had been advised not to open or shake any containers which they suspected of containing hazardous wastes. The crew felt, however, that the number of containers which contained significant quantities of hazardous material was very low.

In Phase II the crew was asked to confirm, without taking undue risk, whether or not the containers for the household hazardous waste categories were empty, partially full or full.

It was found that all glass containers were empty. A total of 4 items in the ferrous container with hazardous and 6 items in the plastic container with hazardous were either full or partially full. These items were an oil filter containing oil, aerosol cans, paint thinner, hair products, bubble bath and mouthwash.

The total weight of these items, including the containers, was 3.5% of the sample or about 0.05% of the total waste stream. On this basis, household hazardous materials, including their containers, would amount to about 100 tonnes per year. The other hazardous category is additional to this

4.5 Medical, Dental, Syringes

Extrapolation from the sample taken indicates that between about 900 and 1500 hypodermic needles are thrown in the garbage each day. This does represent some hazard to the collectors and could represent a hazard to sorters if a large scale hand separation system were put in place.

The material received from the dental offices and the ophthalmic offices did not appear to be of significant concern.

The autoclaved material should pose no problem although there is some concern today that autoclaving is not adequate to ensure complete destruction of bacterial spores and viruses when significant quantities of materials are autoclaved together.

4.6 Major Resource or Energy Recovery

The Provincial Government has established a goal of 50% reduction in refuse being landfilled by the year 2000. This will probably require that some sort of major technology will have to be applied to the waste stream. As shown in Table 4 on page 9, incineration or composting of a large percentage of the waste stream would be able to meet the 50% goal. Large scale composting appears to have the possibility of reducing the waste stream by about 60%.

4.7 Effect of Existing Curbside and Depot Program

As shown in Table 5 on page 9, assuming that residential garbage comprises 50% of the waste stream, the current recycling program appears to be removing about 47 to 68 per cent of the recoverable, newspaper, glass and cans in the residential waste stream. This represents about 31 to 52% of these recoverable items in the total waste stream.

The percentage recovery for cans is less than that of either newspaper or glass. This is probably a reflection of the slightly more difficult requirements for preparation of cans for recycling than are the requirements for newspaper and glass.

APPENDIX A

Further Breakdown of Categories From TABLE 2

IT IS VERY IMPORTANT TO RECOGNIZE THAT SOME OF THESE VALUES ARE BASED ON VISUAL OBSERVATIONS. ALL SAMPLES WERE TAKEN RANDOMLY. IN SOME CASES THE SAMPLE SIZES WERE SMALL. THE RESULTS SHOULD NOT BE USED FOR DETAILED EXTRAPOLATION.

TABLE A-1 - COMBUSTIBLE - COMPOSTABLE

(Item 1 from Table 2 - 20.86% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Contaminated paper	34.5	7.20
Cardboard packaging	26.5	5.52
Brown paper bags	6.4	1.34
Milk cartons	5.4	1.13
Miscellaneous small materials	27.2	5.67
TOTAL	100.0	20.86

Contaminated paper - all types of paper contaminated with food wastes, dirt, oil & grease.

Cardboard packaging - non-corrugated cardboard such as cereal boxes, shoe boxes & file folders.

Miscellaneous small materials - materials which were so small that an inordinate amount of time would have been required to separate into other categories - such as small bits of paper, grass, coffee grounds & traces of food.

TABLE A-2 - NON-COMBUSTIBLES

(Item 4 from Table 2 - 8.08% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Gypsum	28.8	2.33
Asphalt shingles	23.8	1.92
Concrete	23.6	1.91
Fiberglass insulation	8.8	0.71
Tar & gravel roofing	6.3	0.51
Rocks	3.4	0.27
Tile roofing	2.6	0.21
Ceramics	2.5	0.20
Dirt	0.2	0.02
TOTAL	100.0	8.08

TABLE A-3 - OTHER PLASTIC

(Item 6 from Table 2 - 6.19% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Carpeting	46.1	2.853
Styrofoam food containers	9.6	0.594
Styrofoam packaging	4.0	0.248
Buckets	3.5	0.217
Food packaging	3.3	0.204
Appliances	2.4	0.149
Couch	2.3	0.142
Rope	2.0	0.124
Tarpaulin	1.6	0.099
Lids	1.4	0.087
TV set	1.3	0.080
Plastic bed sheeting	1.3	0.080
Hose	1.1	0.068
Cassette case	1.1	0.068
Swimming pool	1.0	0.062
Strapping	0.8	0.050
Astroturf	0.7	0.043
Carpet underlay	0.7	0.043
Pillow	0.6	0.037
Pipe	0.5	0.031
School binders	0.5	0.031
Flower pots	0.5	0.031
Styrofoam cups	0.3	0.019
Frisbee	0.3	0.019
Wrapping	0.3	0.019
Christmas ornaments	0.3	0.019
Nylon stockings	0.3	0.019
Vacuum cleaner hose	0.3	0.019
Fence	0.3	0.019
Hangers	0.3	0.019
Toilet seat	0.2	0.012
Tupperware	0.2	0.012
Straws	0.2	0.012
Potato sacks	0.1	0.006
Easter egg basket	0.1	0.006
Car seat cover	0.1	0.006
Plates	0.1	0.006
Toilet seat cover	0.1	0.006
Siding	0.1	0.006
Gloves	0.1	0.006
Miscellaneous	10.0	0.619
TOTAL	100.0	6.190

Miscellaneous - such as suitcases, television cover, dinghy, Christmas tree, purse, car bumper, toys, belts, plastic trim, filters and foam stuffing.

Food packaging - potato chip bags and the like.

TABLE A-4 - OTHER FERROUS METAL

(Item 7 from Table 2 - 4.74% of waste stream)

PART 1 of Table A-4 represents the analysis from Phase I. There were too many items in this category in Phase II to get accurate weights within a reasonable time. PART 2 of Table A-4 therefore simply lists the items found.

PART 1 - Phase I

Component	Per cent of sample	Per cent of waste stream
Sheet metal	35.7	1.69
Heat & chimney ducting	11.9	0.57
Car parts	10.4	0.49
Siding	9.4	0.45
Strapping	7.6	0.36
Metal studs	6.3	0.30
Wheelbarrow	3.6	0.17
35 mm film containers	2.9	0.14
Chicken wire	2.4	0.11
Exhaust pipe	2.3	0.11
Pots and pans	1.5	0.07
Shopping cart	1.1	0.05
Bicycle parts	1.1	0.05
Wire	0.7	0.03
Curtain rods	0.2	0.01
Miscellaneous	2.9	0.14
TOTAL	100.0	4.74

Miscellaneous - car seat, come-along, rotary clothesline, shelving, pipes, bed spring, hot water tank, fencing, lawn sprinkler, air ducts.

PART 2 - Phase II

Stove parts	Muffler	Chair	Drain pipe
Sheet metal	Cable	Wash basin	Barrel
Camp stove	Shovel	Bike parts	Vacuum cleaner
Fence	Funnel	Struts	Closet rail
Beaters	Coat hangers	Bolts	Machine parts
Oven grill	Car parts	Garbage can	Television parts
Radio	Coffee pot	Iron	Plates
Strapping	Gate	Cooler	Bumper
Vent pipe	Gas tank	Fire extinguisher	Camera parts
Pipe	Paint dispenser	Garbage can lid	Spring
Tire rims	Barbecue grill	Odometer	Brake shoe
Gear	Steel wool	Licence plate	Air filter
Sign	Tail pipe	Lawn mower parts	Phonograph
Kettle	Bread box	Stove door	Baby stroller

TABLE A-5 - COMBUSTIBLE - NON-COMPOSTABLE

(Item 8 from Table 2 - 4.70% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Painted wood, particle board	69.1	3.25
Ceiling panels	8.1	0.38
Tetra-packs	7.6	0.36
Shoes	4.5	0.21
Carbon paper	3.5	0.16
Food packaging	2.2	0.10
Ironing board	0.8	0.04
Air filter	0.4	0.02
Mop	0.3	0.01
Photographs	0.2	0.01
Knapsack	0.1	0.01
Miscellaneous	3.2	0.15
TOTAL	100.0	4.70

Tetra-packs - wine and juice containers made of plastic and cardboard.

TABLE A-6 - POLYETHYLENE

(Item 9 from Table 2 - 3.94% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Store bags	12.5	0.49
Black garbage bags	13.1	0.52
Other	74.4	2.93
TOTAL	100.0	3.94

Store bags - plastic bags from grocery chains, drug stores.

TABLE A-7 - GLASS FOOD & BEVERAGE CONTAINERS

(Item 11 from Table 2 - 2.44% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Liquor bottles	41.6	1.02
Food containers	32.7	0.80
Pop, juice containers	25.7	0.62
TOTAL	100.0	2.44
Clear (flint)	58.4	1.43
Green	26.8	0.65
Brown	14.8	0.36
TOTAL	100.0	2.44

TABLE A-8 - OTHER CLEAN PAPER

(Item 17 from Table 2 - 1.20% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Office paper	55.7	0.67
Computer paper	8.6	0.11
Shredded paper	7.6	0.09
Advertising	7.5	0.09
Stationery	1.9	0.02
Miscellaneous	18.7	0.22
TOTAL	100.0	1.20

TABLE A-9 - OTHER NON-FERROUS METAL

(Item 22 from Table 2 - 0.78% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Aluminum foil	36.3	0.283
Aluminum strips	10.0	0.078
Lawn chairs	9.9	0.077
Dinner trays	9.2	0.072
Copper pipe	8.5	0.066
Aluminum pipe	7.9	0.062
Copper wire	4.5	0.035
Coffee container	2.0	0.016
Tray legs	2.0	0.016
Aluminum rails	1.4	0.011
Thermos	1.3	0.010
Lids	1.0	0.008
Siding	0.8	0.006
Ski poles	0.7	0.005
Bucket	0.7	0.005
Sprinkler head	0.6	0.005
Strapping	0.5	0.004
Weed eater	0.3	0.002
Miscellaneous	2.4	0.019
TOTAL	100.0	0.780

TABLE A-10 - FERROUS CONTAINERS WITH HOUSEHOLD HAZARDOUS WASTES

(Item 23 from Table 2 - 0.78% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Paint	31.0	0.241
Aerosol cans	31.0	0.241
Propane cylinder	17.7	0.138
Oil filters	6.3	0.049
Metal preservative	3.1	0.024
Oil cans	3.0	0.023
Hair spray	2.0	0.016
Paint thinner	1.3	0.010
Oil treatment	1.1	0.009
Insecticide	1.0	0.008
Unknown	0.9	0.007
Shoe polish	0.7	0.006
Car cleaner	0.6	0.005
Acetone	0.2	0.002
Turpentine	0.1	0.001
TOTAL	100.0	0.780

TABLE A-11 - PLASTIC CONTAINERS WITH HOUSEHOLD HAZARDOUS WASTES

(Item 24 from Table 2 - 0.66% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Oil	29.0	0.191
Detergent	14.8	0.098
Miscellaneous cleaners	13.2	0.087
Shampoo	10.4	0.069
Bleach	5.9	0.039
Softener	3.5	0.023
Hair products	2.6	0.017
Mouthwash	1.3	0.009
Steering fluid	1.3	0.008
Paint thinner	1.2	0.008
Lipstick, nail polish	1.1	0.007
Medicine	0.9	0.006
Armorall	0.7	0.005
Ointment	0.5	0.003
Contact cement	0.4	0.003
Wax	0.4	0.003
Fiberglass resin	0.3	0.002
Copier ink	0.3	0.002
Unknown	0.3	0.002
Lysol	0.2	0.001
Varsol	0.1	0.001
Transmission fluid	0.1	0.001
Bubble bath	0.1	0.001
Car treatment	0.1	0.001
Ammonia	0.1	0.001
Disinfectant	0.1	0.001
Gas treatment	0.1	0.001
Miscellaneous	11.0	0.070
TOTAL	100.0	0.660

TABLE A-12 - OTHER GLASS

(Item 27 from Table 2 - 0.38% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Windows	72.9	0.277
Mirrors	12.5	0.048
Light bulbs	8.1	0.031
Plate glass	6.1	0.023
Drinking glasses	0.4	0.001
TOTAL	100.0	0.380

TABLE A-13 - OTHER HAZARDOUS

(Item 29 from Table 2 - 0.34% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Automobile battery	63.1	0.214
Cleaning compounds	13.7	0.047
Deer carcass	12.6	0.043
Caulking	4.7	0.016
Household batteries	2.5	0.009
Detergent	1.2	0.004
Dry bleach	1.0	0.003
Slug bait	0.8	0.002
Carbon dioxide capsule	0.2	0.001
Ointment	0.2	0.001
TOTAL	100.0	0.340

TABLE A-14 - ALUMINUM FOOD & BEVERAGE CONTAINERS

(Item 32 from Table 2 - 0.23% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Pop cans	63.0	0.145
Beer cans	37.0	0.085
TOTAL	100.0	0.230

TABLE A-15 - CLEAR, RIGID PLASTIC BOTTLES

(Item 34 from Table 2 - 0.20% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Milk containers	49.8	0.101
Food containers	20.7	0.042
Miscellaneous beverage containers	13.1	0.026
Mineral water	4.2	0.008
Vegetable oil	4.0	0.008
Liquor bottles	3.2	0.006
Juice containers	3.2	0.006
Vinegar	1.1	0.002
Mouthwash	0.7	0.001
TOTAL	100.0	0.200

TABLE A-16 - GLASS CONTAINERS WITH HOUSEHOLD HAZARDOUS WASTES

(Item 41 from Table 2 - 0.06% of waste stream)

Component	Per cent of sample	Per cent of waste stream
Diazanon	32.0	0.019
Nail polish	28.0	0.017
Medicine	16.0	0.010
Glue	8.0	0.005
Disinfectant	8.0	0.005
Oil	4.0	0.002
Perfume	4.0	0.002
TOTAL	100.0	0.060

APPENDIX B

Listing of Household Hazardous Wastes

HOUSEHOLD HAZARDOUS WASTE CATEGORIES

AUTOMOTIVE SUPPLIES -

A. Motor oil, lubricating oil, automatic transmission fluid, kerosene, lamp oil, diesel fuel, brake fluid.
B. Antifreeze.
C. Gasoline.
D. Automobile battery.
E. Windshield washer concentrate.
F. Engine degreaser, carburetor cleaner, car wax and polish.
G. Auto body filler.

PAINTING AND DECORATING SUPPLIES -

A. Latex based paint.
B. Oil based paint, alkyd enamel, epoxy enamel, varnish.
C. Synthetic auto enamel, model airplane paint.
D. Paint thinner, turpentine, mineral spirits.
E. Paint stripper.
F. Brush cleaners with TSP.
G. Brush cleaners with solvents.

BUILDING AND WOODWORKING SUPPLIES -

A. Mercury batteries.
B. Fluorescent lamp ballast.
C. Smoke detectors (ionization type).
D. Wood preservatives.
E. Wood treated with preservatives.
F. Glues and cements with solvents other than water.
G. Asbestos.

GARDEN SUPPLIES -

A. Insecticide.
B. Soil fumigants, worm killers.
C. Fungicides.
D. Weed killer, herbicides, vegetation killer.
E. Molluscicide, snail and slug poison.
F. Rat, mouse, gopher poison.

CLEANERS -

A. Septic tank degreasers, cesspool cleaner with organic solvents.
B. Rust remover, aluminum cleaner.

SWIMMING POOL SUPPLIES -

A. Pool acid.

PETS, HOBBIES, TOYS -

A. Flea powder.
B. Chemistry sets.
C. Ammunition, primer, powder.
D. Gun cleaning solvent.
E. Antistatic brushes.
F. Photographic chemicals.
G. Photographic solutions.
H. Ceramic glazes.
I. Artists' oils, acrylics.
J. Artists' mediums, thinners, fixatives.
K. Rubber cement thinner.
L. Fiberglass resins, epoxy resins.
M. Aerosol cans.
N. Batteries.

FOOD -

A. Extracts such as vanilla & peppermint.
B. Hard liquor.

HOUSECLEANING SUPPLIES -

A. Lye, oven cleaner and drain cleaner with sodium hydroxide.
B. Rug cleaner with solvents, furniture polish with petroleum distillate, floor polish for wood floors with solvent.
C. Metal polish with petroleum distillates.
D. Cleaners containing ammonia.
E. Aerosol cans.

LAUNDRY SUPPLIES -

A. Chlorine bleach.
B. Spot remover, dry cleaning solvent for clothing.
C. Moth balls, moth flakes.

MISCELLANEOUS -

A. Lighter fluid.
B. Shoe polish with petroleum distillates.
C. Shoe dye.

FROM THE BATHROOM -

A. Infectious wastes.

MEDICAL SUPPLIES

A. Expired prescriptions, other medicine.
B. Shampoo for head lice containing lindane.
C. Mercury
D. Hearing aid batteries.
E. Rubbing alcohol.

COSMETICS -

A. Waving lotion in home permanents, relaxer in hair straighteners, depilatory, cuticle remover with sodium or potassium hydroxide, or thioglycolate.
B. Perfume, cologne, after shave, pre-shave for electric razors.
C. Nail polish.
D. Nail polish remover.

CLEANERS -

A. Tub, tile and shower stall cleaners.
B. Disinfectant.
C. Toilet bowl cleaner.