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2013 Solid Waste Characterization Study Golden Refuse Disposal Site

Project No. C69.205

Prepared for

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EXECUTIVE SUMMARY

Characterization of solid waste provides important information about the composition of waste produced by residential, commercial, industrial and institutional sources and is a useful tool for waste management planning purposes. The Columbia Shuswap Regional District (CSRD) is responsible for managing solid waste within its boundaries, and recognizes the value of conducting a waste characterization study in assessing the effectiveness of the current solid waste management planning. Solid waste characterization studies provide information about the waste streams generated by residents, businesses, institutions and industry. The studies are useful for managing waste flows, and can help with the development and implementation of waste reduction strategies.

A waste characterization study to estimate the overall composition of waste generated at four refuse disposal sites located in the CSRD was undertaken from September 3rd to September 18th, 2013. This report summarizes the waste characterization results for the Golden Refuse Disposal Site (Golden RDS) which services approximately 7,000 residents in Golden and the surrounding area.

The Study was completed at the Golden RDS between September 4th and September 6th, 2013. A total of sixteen (16) waste samples, each weighing approximately 100 kg, were collected and analyzed. Each sample was classified according to one of the following sources: residential curbside, self-haul residential, industrial, commercial and institutional (ICI) or from a transfer station. All samples were weighed and sorted into twelve (12) primary categories, forty-six (46) secondary categories and fifty-nine (59) tertiary categories. The mass of each category was recorded and used to calculate the sample composition. The data was subjected to statistical analysis to determine the mean and standard deviations.

The primary category constituting the greatest mass was compostable organics with a mass percent representing 34.1% of the total waste sorted. RES Curb had the largest percentage of organic waste with 41.3%, followed by ICI with 33.3% and RES Self-haul with 26.4%. The next largest primary categories were plastic and paper, comprising a mean composition of 17.8%, followed by paper at 16.6%. Collectively, paper and organics make up over two-thirds of the waste delivered to the Golden RDS. RES Self-haul had the largest quantity of building materials such as carpet waste, and also the largest quantity of bulky objects.

The percentage of hazardous waste and electronic waste was from the ICI sector and was much higher than from any other waste sector. Specifically, 8.1% of waste from the ICI was reported as hazardous by-products, greater than the 0.9% to 2.6% range reported for all other waste sources. This included products from a building site such as caulking, aerosol cans, painting supplies and other sealants. Most of the electronic waste was made up of computers, printers, and audio equipment.

The waste composition for the RES Self-haul and ICI sectors shows a larger standard deviation for all primary waste categories than the RES Curb sector. The larger standard deviation reflects the more diverse sources of waste which can include household waste and renovation waste or bulky object clean up for the RES Self-haul sector, or restaurants, offices, schools and parks for the ICI sector. A large confidence interval does not necessarily indicate that the data is unreliable; instead it can indicate that the data from a particular sector is highly variable depending on the source, with different sub-sectors producing different types of waste.

NOTE TO THE READER

The samples collected and audited for this study are "snapshots" in time, meaning the reported quantities are estimates and only represent the conditions for the period of time in which they were collected. Seasonal and annual variability, weather, and other factors can affect the amount and composition of waste and recyclables generated by the various sectors at any given time.

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1 INTRODUCTION

TRI Environmental Consulting Inc. (TRI) was engaged by the Columbia Shuswap Regional District (CSRD) to undertake a Waste Characterization Study (the Study) to gain a better understanding of the characteristics of municipal and rural waste arriving at the Golden Refuse Disposal Site (RDS). The assessment of the overall composition of waste generated within the Golden waste shed was undertaken with samples collected at the Golden RDS. The disposal facility receives materials from the Town of Golden municipal collection services, outlying rural transfer station of Parson, the general public and commercial haulers.

The CSRD is responsible for managing solid waste within its boundaries, and recognizes the value of conducting a waste characterization study in assessing the effectiveness of the current solid waste management planning. Solid waste characterization studies provide information about the waste streams generated by residents, businesses, institutions and industry. The studies are useful for managing waste flows, and can help with the development and implementation of waste reduction strategies.

1.1 OBJECTIVE

The purpose of this Study was to gain an understanding of the composition of the municipal solid waste (MSW) within the CSRD's four waste sheds. Information obtained from this Study will be extrapolated to determine the overall waste composition for the Golden RDS. It will be used as a tool for Solid Waste Management planning, including determining any changes in the waste composition since the implementation of expanded stewardship programs in the region, and to identify the improvements and changes in recycling behaviour. This study can serve as a baseline for comparison and the methodology used was derived from the new draft "Waste Characterization Tool" developed by the Ministry of Environment in 2012. The methodology, as well as the terms and conditions for the Study, were described in the Request for Proposal dated July 30, 2013.

1.2 DEFINITIONS / TERMINOLOGY

During the waste composition analysis, the "as received" wet mass of the waste samples and compositions were recorded. In this report, "Study" refers to this waste characterization study, "hauler" refers to the vehicle delivering the waste, "load" refers to the total amount of waste contained in a hauler truck, "sample" refers to the portion of the load that was sorted and weighed, and "load source" refers to the origin of a specific sample. Refer to Appendix I for waste category definitions.

2 METHODOLOGY

2.1 DESIGN OF THE SAMPLING PROGRAM

The sampling program for the waste composition monitoring was based on industry accepted techniques [1,2,3] and previous experience gained by TRI, with modifications made according to the requirements of the present Study. The design of the sampling program was consistent with the proposal[4] prepared by TRI, which provided a work plan and a detailed waste source allocation list identifying the number of waste samples to be sorted by source category at the Golden RDS. Samples were completed from three different sources of municipal solid waste.

2.2 LOAD SOURCE AND SAMPLE ACQUISITION

Municipal waste received at the Golden RDS is classified as originating from one of the following four (4) sectors:

- Residential curbside collection (RES Curb)
- Transfer stations; (TS)
- Residential self-hauled (RES Self-haul)
- Industrial, Commercial, and Institutional (ICI)

In general, RES Curb, TS and ICI loads are sent directly to the landfill active face, while self-haul loads are delivered to a series of 50 yard bins for self-hauled drop-off. To obtain a sample from RES Curb, TS and ICI waste, a front-end loader collected a portion of the load that was dropped at the landfill face and brought it to the sort area. The sort supervisor confirmed the truck number and the source of a given load with the front-end loader operator and randomly selected samples from the dropped material. A ticket indicating the net mass of the load was collected from the scale house operator at the end of the project.

In order to safely sample self-haul residential waste, the scale house arranged for all self-haul loads to be dumped into one 50 yard container which was then transported to the landfill face where samples were collected by the sort supervisor. The sort supervisor randomly selected a sample from each self-haul load once permission to analyze the waste was obtained from the customer. The load mass was

[1] SENES Consultants Ltd., April 30, 1999. *Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada*, 39 pp.

[2] Ministry of Water Land and Air Protection (MWLAP), November, 2001. *Procedural Manual for Municipal Solid Waste Composition Analysis*.

[3] TRI Environmental Consulting Inc., May 14, 2012. Solid Waste Characterization Studies: Standardized Spreadsheet Tool for Assisting in the Planning, Execution and Reporting for Solid Waste Characterization Studies (Draft Version) prepared for the BC Ministry of Environment.

[4] TRI Environmental Consulting Inc., July 30, 2013. *Proposal to Undertake a Waste Characterization Study (RFP C69.105)*.

recorded at the scale house, and this information was obtained by the sort supervisor at the end of the project.

Every effort was made to randomly select loads for sampling; however at times when only a small number of vehicles were arriving at the facility, any available load was selected for sampling.

2.3 Waste Characterization Categories

The waste composition was achieved by grouping the waste into twelve (12) primary categories, forty-six (46) secondary categories and fifty-nine (59) tertiary categories. The primary categories included paper, plastics, compostable organics, non-compostable organics, metals, glass, building materials, electronic waste, household hazardous waste (HHW), household hygiene, bulky objects and fines. The secondary categories further divided the primary categories into materials that are commonly found in municipal waste. A tertiary categorization was used to further segregate the waste into more specific categories. In all, fifty-nine (59) categories of waste were used to systematically characterize the waste stream sampled in the Study.

The primary category 'Fines' was used for items that were aggregates of several categories of waste but were too small or indistinguishable to separate. The complete list of waste characterization categories is given in Appendix I.

2.4 Waste Sorting Methodology

Waste material from source loads was delivered by the truck operator or the loader operator to the waste sorting area. The waste pile was first visually inspected by the sort supervisor to confirm the source of waste and to ensure no cross contamination from other waste had occurred. Materials were randomly collected using 97 L plastic garbage cans from all sides of the waste pile to acquire the most representative sample. Large items in a sample were weighed directly on a calibrated electronic weigh scale and then discarded back onto the waste pile. The filled garbage cans were weighed to confirm 100 kg ± 5 kg of sample acquisition.

The sorting station was set up under a portable canopy tent to protect the samples from any added water content due to precipitation. The sorting was performed by two waste technicians and the sort supervisor. The technicians were trained in the sorting method to identify and segregate waste items into the various waste categories and place them in the appropriate categorized 26 L plastic bins. The bins were arranged around the sort table such that they were readily accessible. The sort supervisor watched for items placed into incorrect bins and assisted in categorizing unusual items. When possible, food waste in containers was separated and sorted accordingly. Items that contained multiple components that could not be separated, such as metal and plastic, were placed into bins representing the material with the highest weight content.

After the contents of the sample were sorted, each bin was weighed using the electronic scale and the data recorded on the waste categorization field sheet.

2.5 Health and Safety

TRI developed a Health and Safety Plan (HASP) specifically intended for the waste audit at each of the CSRDs refuse disposal sites to implement all safety measures on site. The sort supervisor and all waste technicians received health and safety training to manage hazards associated with sorting waste as well as site-specific hazards. All workers were required to have up-to-date tetanus shots. Sharp objects (*i.e.* straight razors, syringes and broken glass) in the waste presented a significant hazard which were occasionally hidden and mixed with other wastes. Tongs were used to sort through waste if medical waste or signs of sharps were identified in the samples. Syringes and needles were immediately placed in a medical waste container upon discovery.

The most important safety issue at the facilities was vehicular traffic. Visual contact with drivers was maintained when working around vehicles. Workers at the site were provided with appropriate personal protective equipment (PPE).

2.6 Data Analysis

Data analysis for the Study was performed at the TRI office. Raw data was entered into a British Columbia Ministry of Environment spreadsheet tool for facilitating waste characterization studies. The weighted mean compositions for all categories (primary, secondary, and tertiary) for each waste category and source were calculated for the waste. Standard deviations about the means were also determined. Additionally, TRI has employed basic statistical methods to derive quantitative information from the data. Appendix II contains a detailed description of the calculations used to arrive at the results presented in this report.

2.7 Quality Assurance and Quality Control Procedures

In addition to the methods described above, a quality control program was undertaken concurrently with the Study to ensure accurate results. The raw waste composition data was reviewed on a daily basis following the sorts. This review allowed the sort supervisor to determine if items had been omitted from the data sheets. All samples were weighed at the beginning before any sorting occurred, and then again at the end to ensure all material was accounted for. Also, office staff reviewed the accuracy of 100% of the data that was transcribed into spreadsheet format. The accuracy of all data was reviewed by calculating the difference between the sum of the sorted category masses and the unsorted sample mass. Data entry corrections were made as necessary for the samples exhibiting discrepancies greater than 5% of the unsorted sample mass.

3 RESULTS

The results of the analysis of the data collected in this Study are presented including the composition of waste from all sectors coming into the landfill by waste category, and a breakdown for each waste generating sector. This comparative approach allows for a better understanding of the total amount and type of waste coming into the landfill and the sectors that are generating the waste.

3.1 SAMPLE SOURCE AND DISTRIBUTION

During the Study a total of sixteen (16) waste samples were sorted between September 4 and September 6, 2013; comprising of four (4) RES Curb, three (3) ICI, and nine (9) RES Self-haul with a combined mass of 1,584 kg. The mean sample size was approximately 99 kg. The mean sample masses are consistent with the recommended sample size of 100 kg[5]. Selected photographs taken during the waste sorting operations are provided in Appendix III. A summary of the number of samples and the tonnages generated from different sources of waste is provided in Table 2.

Table 1: Number of Samples and Total Mass Sorted

Waste Source	Number of Samples Sorted	Total Mass Sorted (kg)	Total Waste Buried[5] (tonnes)
RES Curb	4	391.3	521
RES Self-haul	9	893.2	340
TS	0	0	95
ICI	3	299.8	1,997
Total	16	1,584	2,953

As Table 1 identifies, although approximately 3% of the total tonnage of buried waste originated from the transfer station sector, samples were not collected from the transfer station sector due to logistical reasons; otherwise, the number of samples sorted correlates with the waste source allocation requirements provided by the CSRD. All waste sorts were completed at the Golden RDS.

The CSRD provided information concerning the waste pickup schedule for various neighbourhoods in the Town of Golden. Sources of waste from distinct residential neighbourhoods and from the various self-hauled and commercial ICI waste sectors were identified.

3.2 WASTE COMPOSITION BY SECTOR

Table 2 presents the waste composition as a percentage of all categories for the RES Curb, RES Self-haul and ICI waste sectors. The average compositions are based on the tonnage each sector contributes to overall waste buried at Golden RDS. The calculation method is given in Appendix II. Note that all percentages in the following sections are of cumulative total sample weight content.

[5] RES Curbside, RES Self-haul and TS is the total waste buried from Jan.1 to Oct.1, 2013; ICI is total waste buried in 2012.

Table 2: Composition of Primary and Secondary Categories from All Sectors

Primary	Secondary	Tertiary	Average	RES Curb	RES Self-haul	ICI
PAPER		Subtotal	16.6%	15.5%	15.3%	17.2%
	Fine, computer, office		1.8%	2.2%	2.1%	1.6%
	OCC	Clean OCC	1.6%	0.3%	1.9%	2.1%
		Waxed and other non-recyclable OCC	0.8%	0.6%	0.1%	1.1%
	Boxboard		1.7%	3.0%	2.3%	1.1%
	Bound paper products (books)		0.7%	2.1%	1.6%	0.0%
	Beverage containers - Drink Box / Aseptic Containers (Tetra)	Dairy or Dairy Substitute	0.1%	0.2%	0.2%	0.1%
		Non-Dairy (refundable)	0.1%	0.2%	0.2%	0.1%
	Tissue / Paper Towels, other paper (food contaminated paper, paper plates, etc.)		9.7%	6.9%	7.0%	11.2%
PLASTIC		Subtotal	17.8%	21.5%	17.8%	16.5%
	Film		7.8%	8.4%	6.4%	7.9%
	Textiles	Clothing (natural fibers, blends, polyester, Gore-Tex, fleece, nylon, etc.)	2.4%	5.3%	2.2%	1.4%
	Rigid Beverage Containers	Deposit Containers (juice, pop, alcohol)	1.0%	0.4%	0.6%	1.2%
		Non-Deposit (milk/milk substitute)	1.2%	0.4%	0.1%	1.8%
	Rigid containers - All others	#1 PETE; #2 HDPE; #3 PVC; #4 LDPE; #5 PP; #6 Non-Foam/Foam; #7 Mixed Resin Plastic	3.3%	4.2%	3.6%	2.9%
	Other Plastics	Durable products, toys, etc.	2.1%	2.7%	4.9%	1.3%
COMPOSTABLE ORGANICS		Subtotal	34.1%	41.3%	26.4%	33.3%
	Yard and Garden	Small yard waste (leaves, branches, grass clippings	3.4%	7.7%	4.5%	1.6%
	Food Waste	Compostable (e.g. fruits, vegetables) Backyard Non-compostable (Meat, bones, breads, non-liquid dairy, fats)	18.1%	33.2%	21.3%	12.2%
	Clean Wood		12.6%	0.4%	0.7%	19.5%
NON COMPOSTABLE ORGANICS		Subtotal	4.1%	3.4%	2.4%	4.7%

	Treated/Painted Wood/Composite Wood		2.3%	0.3%	0.3%	3.4%
	Rubber		0.5%	0.4%	0.2%	0.6%
	Multiple/Composite organic materials (footwear, etc.)		1.3%	2.7%	1.8%	0.7%
METALS		Subtotal	5.8%	3.3%	4.5%	7.0%
	Beverage Containers	Alcoholic	0.1%	0.1%	0.2%	0.1%
		Non-alcoholic	0.2%	0.2%	0.3%	0.2%
	Food Containers, Trays or Foil Wraps		1.0%	1.9%	1.3%	0.6%
	Other Metals		4.5%	1.2%	2.6%	6.1%
GLASS		Subtotal	1.9%	2.6%	1.9%	1.6%
	Beverage containers	Refundable alcoholic	0.7%	0.1%	0.6%	1.0%
		Refundable non-alcoholic	0.2%	0.0%	0.1%	0.3%
		Non-refundable	0.0%	0.0%	0.0%	0.0%
	Food containers		0.5%	0.9%	0.6%	0.4%
	Other glass		0.5%	1.7%	0.6%	0.0%
BUILDING MATERIAL		Subtotal	3.5%	1.1%	15.5%	1.6%
	Gypsum/drywall, plaster		0.2%	0.1%	1.4%	0.0%
	Masonry (bricks, blocks, concrete, etc.)		0.0%	0.0%	0.1%	0.0%
	Rock, sand, dirt, ceramic, porcelain		0.0%	0.0%	0.1%	0.0%
	Rigid Asphalt Products		0.0%	0.0%	0.1%	0.0%
	Carpet Waste (and underlay)		3.0%	0.9%	12.7%	1.6%
	Other Inorganics (linoleum, etc.)		0.2%	0.1%	1.2%	0.0%
ELECTRONIC WASTE		Subtotal	5.1%	1.6%	2.3%	7.0%
	Computers and peripherals		2.3%	0.3%	0.0%	3.6%
	TV & Audio/video equipment		0.8%	0.1%	0.0%	1.2%
	Telephones & Equipment		0.1%	0.1%	0.0%	0.1%
	Small appliances & floor care appliances		0.2%	0.8%	0.4%	0.0%
	Electronic or electrical tools		0.8%	0.0%	0.5%	1.1%
	Electronic toys		0.0%	0.0%	0.2%	0.0%
	Lighting equipment and light bulbs		0.7%	0.1%	1.0%	0.8%
	Smoke/CO detectors		0.0%	0.0%	0.0%	0.0%
	Other e-waste		0.2%	0.1%	0.2%	0.2%
HOUSEHOLD HAZARDOUS (HHW)		Subtotal	5.7%	0.9%	2.6%	8.1%
	Batteries		0.1%	0.1%	0.3%	0.0%
	HHW (product &/or container)	Paint	0.8%	0.0%	0.6%	1.1%
		Fertilizers/Pesticides	0.1%	0.1%	0.2%	0.1%

		Automotive	0.3%	0.1%	1.1%	0.2%
		Pharmaceuticals	0.0%	0.1%	0.0%	0.0%
		Solvents	0.0%	0.0%	0.0%	0.0%
		Cosmetics	0.0%	0.0%	0.0%	0.0%
	Mercury Containing Items	Thermostats and switches	0.0%	0.0%	0.0%	0.0%
		Other (old thermometers)	0.0%	0.0%	0.0%	0.0%
	Other HHW		4.4%	0.5%	0.4%	6.7%
HOUSEHOLD HYGIENE		Subtotal	3.9%	8.2%	5.1%	2.1%
	Biological	Diapers, feminine hygiene products	3.4%	7.2%	3.3%	2.1%
		Pet Waste (kitty litter, dog waste)	0.5%	1.0%	1.8%	0.0%
BULKY OBJECTS		Subtotal	0.7%	0.0%	5.0%	0.0%
	Furniture		0.7%	0.0%	5.0%	0.0%
FINES		Subtotal	0.9%	0.6%	1.1%	0.9%

The primary category constituting the greatest mass was compostable organics with a mass percent representing 34.1% of the total waste sorted. RES Curb had the largest percentage of organic waste with 41.3%, followed by ICI with 33.3% and RES Self-haul with 26.4%. A large percentage of the organics in the ICI stream included clean wood. The next largest primary categories were plastic, comprising a mean composition of 17.8%, followed by paper at 16.6%. Collectively, paper and organics make up over half of the waste delivered to the Golden RDS. The ICI sector had the largest proportion of OCC at 2.1%, while the residential sector had up to 2.1% fine paper and 3.0 % boxboard. Compostable paper such as paper towels, paper plates, and tissues was the largest portion of the paper waste in all sectors accounting for 6.9% to 11.2 % of the paper stream. The compostable paper products, such as paper towels, are often heavy and wet as they absorb a large quantity of moisture from the waste stream and results of this study are presented on a mass basis.

The next largest waste constituents were metals comprising a mean composition of 5.8%, followed by household hazardous with a mean composition of 5.7%. Metals included items such as tin foil and other packaging materials, and metal tools such as a small step ladder. Household hazardous included items such a pesticides, oil containers, and building supplies such as caulking and other sealants. The remainder of the primary categories (*i.e.* non-compostable organics, electronic waste, glass, household hygiene, bulky objects and fines) each comprised approximately 5% or less of the total waste stream. The data is presented graphically in Figure 1 and Figure 2.

As can be seen in the Figure 1, RES Curb contributes the largest quantity of compostable organics in the total waste stream followed by the ICI sector. RES Self-Haul had the largest quantity of building materials such as carpet waste, and also the largest quantity of bulky objects. The percentage of hazardous waste and electronic waste was from the ICI sector and was much larger than from any other waste sector. Specifically, 8.1% of waste from the recycling transfer stations was reported as hazardous by-products, greater than the 0.9% to 2.6% range reported for all other waste sources. This included products from a building site such as caulking, aerosol cans, painting supplies and other sealants. Most of the electronic waste was made up of computers, printers, and audio equipment.

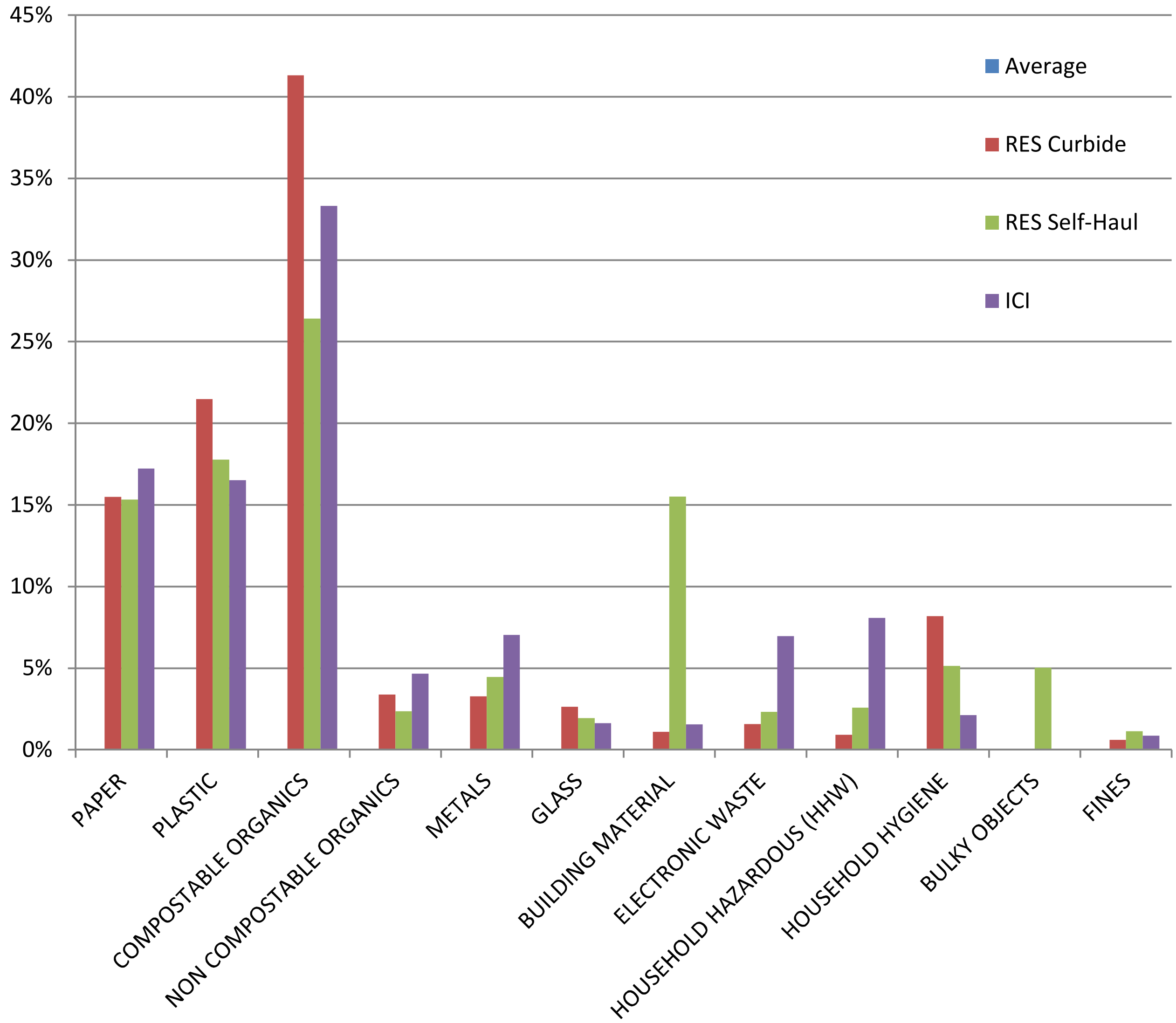

Figure 1: Overall Waste Composition by Sector and Primary Category Bar Graph

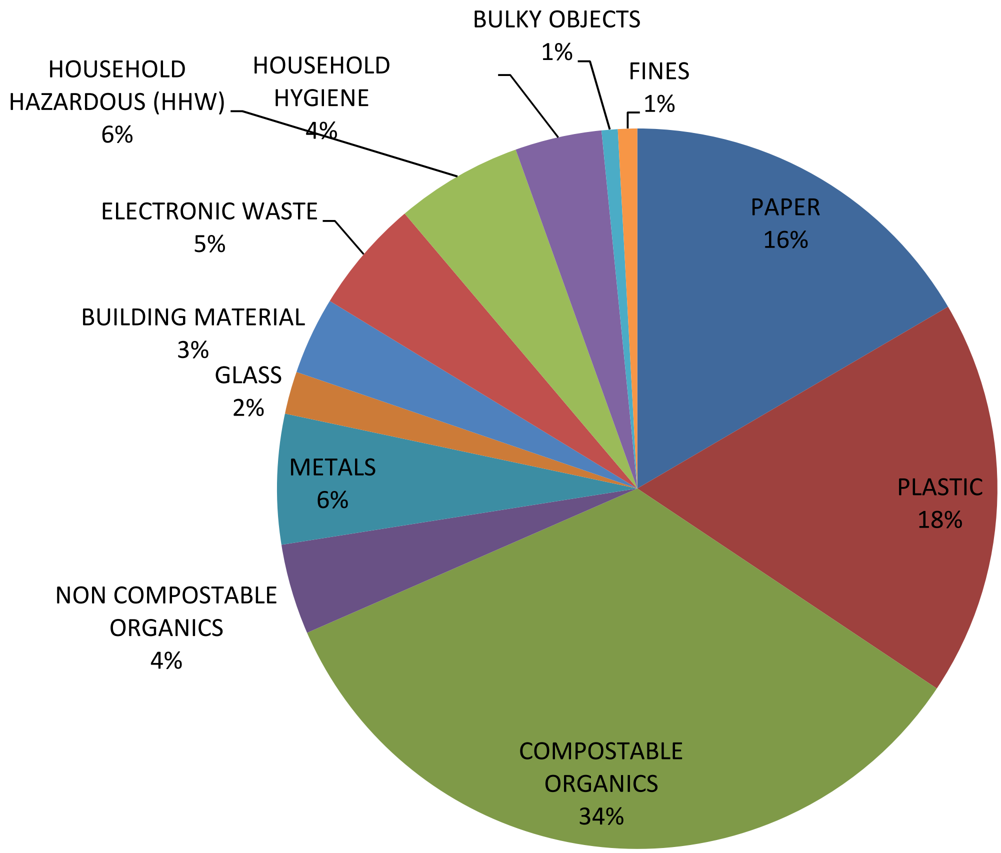

Figure 2: Overall Waste Composition Primary Category Pie Chart

3.2.1 Residential Curbside (RES Curb)

A total of four (4) waste samples were sorted from the RES Curb sector. The percent composition for primary waste categories identified in these samples is provided in Table 3.

The largest quantity of the RES Curb waste stream was compostable organics representing 41.3% of the total weight sampled. Out of the 41.3% compostable organic content, food waste represented 33.2%, yard and garden waste represented 7.7%, and the remainder was clean wood. Plastic comprised the second largest waste category at 21.5%, with 8.4% of that being plastic film, 5.3% being synthetic textile material, 4.2% rigid plastic containers, 0.4% was deposit bearing beverage containers, 0.4% was milk jugs, and the remainder was other durable plastic products.

Paper was the third largest category at 15.5%. This includes 6.9% compostable paper such as paper plates and napkins, 3.0% boxboard, 2.2% fine office paper, and 2.1 % bound paper products. Tetra packs, including deposit bearing beverage containers and milk containers, were 0.4% of the total waste stream.

It was noted by the sorting team that there was little electronic waste and household hazardous items in the RES Curb waste compared to the other waste sectors and other waste composition studies conducted in BC.

The waste composition for the RES Curb sector was relatively consistent throughout the samples and the standard deviation for each waste category is lower than the other waste sources. Typically, residential waste is more consistent and does not vary largely within the same area. The high standard deviation for the compostable organics was caused by the variable amount of yard waste in some of the waste samples. All samples would have a consistent amount of food waste; however, some samples would have a large quantity of yard waste, while others would have no yard waste, which leads to the larger standard deviation observed.

Table 3: Mean Primary Category Distribution for the RES Curb Sector

	Percent Total Mass	Standard Deviation
PAPER	15.5%	4.0%
PLASTIC	21.5%	2.7%
COMPOSTABLE ORGANICS	41.3%	8.0%
NON COMPOSTABLE ORGANICS	3.4%	2.2%
METALS	3.3%	1.6%
GLASS	2.6%	1.3%
BUILDING MATERIAL	1.1%	1.8%
ELECTRONIC WASTE	1.6%	1.7%
HOUSEHOLD HAZARDOUS (HHW)	0.9%	1.0%
HOUSEHOLD HYGIENE	8.2%	3.7%
BULKY OBJECTS	0.0%	0.0%
FINES	0.6%	0.9%
Total	100%	

3.2.2 Residential Self-Haul (RES Self-haul)

For this Study, a total of nine (9) waste samples were sorted from the RES Self-haul sector. The percent composition for primary waste categories identified in these samples is provided in Table 4.

The waste composition was more variable for the RES Self-haul sector; however there were occurrences of common trends in each of the samples sorted. Most samples were from residents who hauled all of their household waste, and one sample was from a building renovation. Compostable organics once again constituted the largest portion at 26.4%; however the large standard deviation suggests the high variability of organic waste as a constituent to the self-haul residential waste stream. Some samples included larger amounts of yard and garden waste and one self-haul sample was from a building renovation which contained no compostable organics. Building materials generated from renovation activities accounted for approximately 15.5%. Plastic was 17.8% and paper was 15.3 % of the waste sector. The breakdown was fairly similar to the RES Curb sector other than a slight increase in the amount of OCC.

There was a slight increase in the quantity of electronic waste and household hazardous waste compared to the RES Curb sector, and this included items such as small appliances, power tools, lights, oil containers and paint cans.

The standard deviation for the primary categories contributing significant quantities of waste within the RES Self-haul sector were generally larger than found for the RES Curb sector. The larger standard deviation reflects the more diverse sources of waste. RES Self-haul samples are variable, since activities such as construction, renovations and bulky object clean-up can generate many different types of waste along with the waste from residents who self-haul their kitchen and household waste.

Table 4: Mean Primary Category Distribution for the RES Self-haul Sector

	Percent Total Mass	Standard Deviation
PAPER	15.3%	6.6%
PLASTIC	17.8%	6.5%
COMPOSTABLE ORGANICS	26.4%	16.6%
NON COMPOSTABLE ORGANICS	2.4%	2.0%
METALS	4.5%	3.2%
GLASS	1.9%	1.1%
BUILDING MATERIAL	15.5%	33.0%
ELECTRONIC WASTE	2.3%	2.7%
HOUSEHOLD HAZARDOUS (HHW)	2.6%	2.5%
HOUSEHOLD HYGIENE	5.1%	4.9%
BULKY OBJECTS	5.0%	7.3%
FINES	1.1%	1.6%
Total	100.0%	

3.2.3 Industrial, Commercial and Institutional (ICI)

For this Study, a total of three (3) waste samples were sorted from the commercial ICI sector. The percent composition for primary waste categories identified in these samples is provided in Table 5.

Compostable organics made up the largest portion of the waste representing 33.3%. Clean wood and food waste were the main portions of the organic waste. Paper was the next largest portion of the waste stream at 17.2%, followed by plastic at 16.5%. Compostable paper was the largest portion of the paper stream, followed by fine paper, OCC and boxboard. Plastic film was the largest portion of the plastic waste stream and there was a larger portion of beverage containers which totaled 3%.

There was a larger portion of electronic waste and household hazardous waste which included products from a building site such as caulking, aerosol cans, painting supplies and other sealants. Most of the electronic waste was made up of computers, printers, and audio equipment.

The waste composition for the ICI sector shows a larger standard deviation for all primary waste categories than the residential sector. The larger standard deviations reflect the more diverse individual source sites. Specific sources identified in this sort included renovation materials from a gas station, a number of fast food restaurants, coffee shops, and a hardware store. Generally in ICI samples, the contents were variable, depending on the sample's origin as one ICI sample was often shown to have a vastly different waste composition compared to another, depending on the source of the load. In general, the ICI waste composition is highly variable overall as there are many different activities that occur in the ICI sector that generate varying types of waste.

Table 5: Mean Primary Category Distribution for the ICI Sector

	Percent Total Mass	Standard Deviation
PAPER	17.2%	14.8%
PLASTIC	16.5%	6.5%
COMPOSTABLE ORGANICS	33.3%	36.1%
NON COMPOSTABLE ORGANICS	4.7%	6.1%
METALS	7.0%	5.5%
GLASS	1.6%	1.8%
BUILDING MATERIAL	1.6%	1.5%
ELECTRONIC WASTE	7.0%	4.6%
HOUSEHOLD HAZARDOUS (HHW)	8.1%	11.4%
HOUSEHOLD HYGIENE	2.1%	3.5%
BULKY OBJECTS	0.0%	0.0%
FINES	0.9%	0.8%
Total	100.0%	

3.3 Limitations: Sources of Error

Small discrepancies between the total sample mass and the sum of the sorted category masses can occur at the end of sorting a sample. Sample material falling to the floor and changes in moisture content during the sort would result in a sorted category mass that was different than the total sample mass. Also, errors in the recording of field data are possible reasons for the sum of the category masses being different from the total sample mass. Such errors were minor, and are controlled by our QA/QC procedures for error checking the data.

To keep the waste composition tables and figures readable, percentages are rounded to the nearest tenth of a percent. Due to rounding in the data presented in the report, when added together the percentages may not exactly match the subtotals and totals shown, as the results were are not rounded in the Microsoft Excel data tables.

4 CONCLUSIONS

Analysis of the overall waste composition from all sectors coming into the Golden RDS demonstrates that compostable organics make up the largest portion of the waste at 34.1%. This includes yard and garden waste, food scraps and clean wood. Plastic and paper were second and third largest categories at 17.8% and 16.6% respectively. All other categories contributed less than 6% to the total quantity of waste going into the Golden RDS.

Electronic waste was found in all waste streams; however, the greatest quantity came from the ICI sector where 7.0% of the total mass sorted was electronic waste – 3 times more than the RES Self-haul sector. Most of the electronic items that were found are products that are covered by various EPR programs in BC including computers, audio equipment, small appliances and power tools, and lighting equipment. Other EPR items commonly identified included beverage containers of all types including paper, plastic and metal which totaled 1.5% of the overall waste stream, small household batteries, oil containers, and paint containers.

The primary and secondary category data was subjected to statistical analysis using the provincial waste characterization tool to determine the means and standard deviations of each of the categories. The standard deviations of waste within each of the primary categories calculations indicated a good consistency for the RES Curb samples. The waste composition for the RES Self-haul and ICI sectors shows a larger standard deviation for all primary waste categories than the RES Curb sector. Larger standard deviations are expected for the RES Self-haul and ICI sector because the primary sources can be vastly different. In addition, each delivery may contain waste from several primary sources, but the load is not necessarily well mixed. The standard deviations for a majority of the categories of the self-haul waste are large. However, this is due to having a significant number of the samples from the self-haul sector containing waste from only a few primary categories. A large confidence interval does not necessarily indicate that the data is unreliable; instead it can indicate that the data from a particular sector is highly variable depending on the source, with different sub-sectors producing different types of waste.

5 CLOSURE AND PROFESSIONAL STATEMENT

TRI Environmental Consulting Inc. prepared the foregoing report for the exclusive use and information of the Columbia Shuswap Regional District. The information and data were collected and compiled in accordance with the general level of care and skill normally exercised by environmental science and engineering professionals practicing under similar circumstances. During the preparation of this report, TRI has relied on reports, data, studies, specifications, documents and other information provided by others. TRI has taken care to verify the information provided where possible, but makes no warranty as to the accuracy of the reports, data, studies, specifications, documents and other information prepared by others and accepts no responsibility for information contained in them.

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Thank you for choosing TRI for this Project. Should you have questions concerning this report, or if you require additional information, please contact the undersigned at **(604) 436-3384.**

Sincerely,
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APPENDICES

APPENDIX I
WASTE CHARACTERIZATION CATEGORIES

Sample: ______________________________

Date: ______________ Time: ______________ Big bin Mass ______________

Small Bin Mass ______________

Hauler: ______________________________ Weather: ______________

Vehicle ID/Type: ______________________________ License: ______________ Project # C69.205

Load: SF Residential ____ Self-haul RES ____

Transfer Station ___ ICI (Commercial) ____

Source: ______________________________

Inbound hauler mass: ______________

Outbound hauler mass: ______________

Load mass: ______________

Sample mass (kg):

With bins ______________

Without bins ______________

Primary	Secondary	Tertiary	# of Big Bins	# of Small Bins	Sample Mass with Bins (kg)
Paper					
1	Fine, computer, office				
2	OCC	Clean OCC			
3		Waxed and other non-recyclable OCC			
4	Boxboard				
5	Bound paper products (books)				
6	Beverage containers - Drink Box / Aseptic Containers (Tetra)	Dairy or Dairy Substitute			
7		Non-Dairy (refundable)t			
8	Tissue / Paper Towels, other paper (food contaminated paper, paper plates, etc)				
Plastic					
9	Film				
10	Textiles	Clothing (natural fibers, blends, polyester, Gore-Tex, fleece, nylon, etc.)			
11	Rigid **Beverage** Containers	Deposit Containers (juice, pop, alcohol)			
12		Non-Deposit (milk/milk substitute)			
13	Rigid containers - All others	#1 PETE; #2 HDPE; #3 PVC; #4 LDPE; #5 PP; #6 Non-Foam/Foam; #7 Mixed Resin Plastic			
14	Other Plastics	Durable products, toys, etc.			
Compostable Organics					
15	Yard and Garden	Small yard waste (leaves, branches, grass clippings			
16	Food Waste	Backyard compostable (e.g. fruits, vegetables). Backyard Non-compostable (Meat, bones, breads, non-liquid dairy, fats)			
17	Clean Wood				
Non Compostable Organics					
18	Treated/Painted Wood/Composite				
19	Rubber				
20	Multiple / Composite organic materials (footwear, etc.)				
Metals					
21	Beverage Containers	Alcoholic			
22		Non-alcoholic			
23	Food Containers, Trays or Foil Wraps				
24	Other Metals				

Primary	Secondary	Tertiary	# of Big Bins	# of Small Bins	Sample Mass with Bins (kg)
Glass					
25	Beverage containers	Refundable alcoholic			
26		Refundable non-alcoholic			
27		Non-refundable			
28	Food containers				
29	Other glass				
Building Material					
30	Gypsum/drywall,plas				
31	Masonry (bricks, blocks, concrete, etc.)				
32	Rock,sand,dirt,ceramic, porcelain				
33	Rigid Asphalt Products				
34	Carpet Waste (and underlay)				
35	Other Inorganics (linoleum, etc.)				
Electronic Waste					
36	Computers and peripherals				
37	TV & Audio/video equipment				
38	Telephones & telecommunications Equipment				
39	Small appliances & floor care appliances				
40	Electronic or electrical tools				
41	Electronic toys				
42	Lighting equipment and light bulbs				
43	Smoke/CO detectors				
44	Other e-waste				
Household Hazardous (HHW)					
45	Batteries				
46	HHW (product &/or container)	Paint			
47		Fertilizers/Pesticides			
48		Automotive			
49		Pharmaceuticals			
50		Solvents			
51		Cosmetics			
52	Mercury Containing Items	Thermostats and switches			
53		Other (old thermometers)			
54	Other HHW				
Household Hygiene					
55	Biological	Diapers, femenine hygiene products			
56		Pet Waste (kitty litter, dog waste)			
Bulky Objects					
57	Furniture				
Fines					
58	Fines				

APPENDIX II
CALCULATION METHODOLOGY

Waste Composition Estimation

1. The weighted mean of a particular category or subcategory was calculated by first summing the weights of that particular category across all the samples.

2. Next, the weights of each sample were summed to obtain the total weight for all samples within that set (eg. Round 1 of SF-RES sector).

3. The weighted mean is finally calculated by dividing the first sum by the second.

This method was chosen to calculate the mean compositions because not every sample is exactly the same weight. This method ensures that the average gives more emphasis to those samples that contain a greater weight.

A simple illustration is provided for the sample calculation for the weighted mean of newsprint.

	RES-1	RES-2	RES-3	RES-4
Newsprint (weight)	2	1.5	1.4	3
Boxboard (weight)	1.1	2	3	1.2
Total Weight of Sample	3.1	3.5	4.4	4.2

Following Step 1, the sum is of the weights is taken across all samples of newsprint.

2 + 1.5 + 1.4 + 3 = **7.9**

Step 2 entails summing the total weights of each sample across all samples.

3.1+ 3.5 + 4.4 + 4.2 = **15.2**

Finally, the weighted mean of newsprint is calculated by dividing the two sums.

7.9 / 15.2 = **0.52**

Mathematically, the calculations of the weighted mean can be shown as follows:

Let

i represent an individual sample
j represent the waste category
k_{ij} represent the weight of waste category *j* in sample *i*
w_i represent the weight of sample *i*

Then,

Weight Mean of Waste Category $j = \Sigma_i k_{ij} / \Sigma_i w_i$

Standard Deviation Calculations

The non-biased standard deviation method was applied to the Study to estimate how much the waste in a particular category varies about the average from sample to sample.

1. All data was converted from weight in kilograms to percentage of sample weight. For example, Sample 1 has a total mass is 100.2 kg. Suppose 1.65 kg out of 100.2 kg consisted of Fine Office Paper then in terms of percentages, 1.65/100.2 or 1.65 percent of Sample 1 consisted of Fine Office Paper.

2. The non-biased, or "n-1" equation for standard deviation was then applied to the percentages of a particular waste category across all samples.

Using the above example, the weights are converted to percentages to obtain the following table.

	RES-1	RES-2	RES-3	RES-4
Newsprint (%)	65%	43%	32%	71%
Boxboard (%)	35%	57%	68%	29%
Total % of Sample	100%	100%	100%	100%

Then, applying the non-biased equation for standard deviation to newsprint,
(values 65%, 43%, 32%, and 71%) the standard deviation of newsprint is obtained to be 18.47%.

$SD_{newsprint}$ = sqrt((4((65%)^2 + (43%)^2 + (32%)^2 + (71%)^2) – (65% + 43% + 32% + 71%)^2) / 4(3)) = 18.34 %

Mathematically, the calculations of the standard deviation can be shown as follows:

$$SD_j = \sqrt{\frac{n \sum_i x_{ij}^2 - (\sum_i x_{ij})^2}{n(n-1)}}$$

Where *i* represents an individual sample
j represents the waste category
n is the number of samples
x_{ij} is the percentage waste in the waste category *j* of sample *i*

***Note**

The standard deviations for Primary Waste Categories were calculated by first calculating the standard deviations for Secondary Categories using the above method, and then summing those standard deviations to obtain standard deviations for the Primary Categories.

For the Study, the same methods for calculating weighted averages and standard deviations of waste categories in one particular facility have been extended to calculating weighted averages and standard deviations across data sets of an entire sector or round.

APPENDIX III
SELECTED SITE PHOTOS

Golden RDS Sorting Station

Load of Waste to be Sampled

Paper – Fine, Office, Computer

Paper – Tetra Beverage Containers

Paper – Soiled Paper

Paper – Clean OCC

Paper – Bound (books)

Plastic – Textiles

Plastics – Rigid Containers

Plastics – Rigid Beverage Containers

Plastics – Film

Plastics – Other (Durable, Toys, etc)


Compostable Organics – Yard and Garden


Compostable Organics – Food Waste


Compostable Organics – Clean Wood


Non-Compostable Organics


Metals – Food Containers, Trays, Foil

Metals – Beverage Containers

Glass – Other

Glass – Beverage Containers

Building Materials – Carpet Wastes

Building Materials – Soil Materials

Building Materials – Gypsum/Drywall/Plaster

Electronics - Computers

Electronics – Telephones

Electronics – Light Bulbs

HHW - Batteries

HHW - Automotive

Household Hygiene - Diapers

Bulky Objects - Furniture