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2016 Solid Waste Stream Composition Study

PREPARED BY:

TETRA TECH

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Acknowledgements

The project team would like to thank all the staff from Hartland landfill and the Capital Regional District for their participation in the Waste Composition Study and their cooperation to make the sorting and field work safe and successful. The project team would like to thank the following individuals who were part of the field team who completed the waste sorting including:

- Laurie Taylor;
- Jasmine Lowther;
- Ronn Stevenson; and
- Shovana Shrestha.

EXECUTIVE SUMMARY

Tetra Tech EBA Inc. (Tetra Tech) was retained by the Capital Regional District (CRD) to conduct the 2016 Solid Waste Stream Composition Study. The waste composition sorting was conducted from September to October 2016 at the Hartland Landfill (Hartland).

The objective of the study was to produce a solid waste stream composition profile for the entire waste stream entering Hartland from the identified sectors including:

- Single family residential (SF),
- Multi-family residential (MF),
- Garbage that is self-hauled to the public drop-off bins at the landfill (bins);
- Industrial, commercial, and institutional (ICI); and
- Construction, Renovation and Demolition (CR&D).

Garbage samples were sorted into 15 primary categories, and a total of 89 material subcategories. In collaboration with the study, the Stewardship Association of British Columbia (SABC) entered into a contract with Tetra Tech to complete sorting of the garbage into an additional 159 categories to detail Extended Producer Responsibility (EPR) materials. In total, 107 samples were analyzed for the study.

The results for each material stream, along with the combined (SF, MF, ICI, bins, and CR&D) weighted average primary material composition results are presented in Section 3.0 of this report. The largest component of the overall garbage arriving at Hartland landfill was compostable organics (21.2%), followed by wood and wood products (17.0%), paper (15.4%), and plastic (14.3%). Wood and wood products were primarily identified in the bins and CR&D waste streams.

Based on the total weight of garbage (135,000 tonnes) estimated to be disposed of at Hartland in 2016, and the total estimated population of 378,232 the total waste generation rate is 357 kg/capita in the CRD. Using the waste composition data collected in this study and the waste generation data, the total waste disposed per capita per year by material stream was calculated. This includes approximately 75 kg of organics per capita, followed by 61 kg of wood and wood products, 55 kg of paper and paperboard and 51 kg of plastics. Of the total 75 kg/capita of organics, 35.8 kg/capita was identified as avoidable food waste, 24.8 kg/capita was unavoidable and backyard compostable, 5.7 kg/capita was donatable, 4.6 kg/capita was yard and garden waste, and 3.2 kg/capita was unavoidable and non-backyard compostable.

A historical comparison of the waste composition, and waste disposal per capita by primary material category from 2001 to 2016 is provided in this report. This information can be used to help evaluate how waste reduction and diversion programs are affecting the quantity and proportion of materials disposed at Hartland. Historical data was obtained from the previous Waste Composition reports and the historic data from 2001, 2004, and 2010 was reorganized to reflect the new category alignments used in 2016.

Trends observed from this study include:

- From 2010 to 2016, the percentage of organics in the waste composition decreased by 6.6%. The change in the waste generation rate for organics shows a significant drop of 45 kg/capita from 120 kg/capita in 2010 to 75 kg/capita in 2016. The decrease is due to the implementation and uptake in usage of organics diversion programs in the region.

- The only material to have increased in waste generation compared to all other years since 2001 was wood and wood products, now representing 61 kg/capita. This is primarily wood from construction, renovation and demolition activities. All other primary materials have either stayed consistent or have decreased in the overall weight arriving at Hartland.
- From 2010 to 2016, the percentage of paper in the waste composition decreased by 0.1%, however the total change in the waste generation rate for paper shows a drop of 12 kg/capita from 67 kg/capita in 2010 to 55 kg/capita in 2016. Over the past five years, there has been a decrease in the total quantity of paper used (for example less newspapers). This along with improved performance of recycling programs likely accounts for the change.
- From 2010 to 2016, the percentage of plastic in the waste composition increased by 1.8%. However the change in the waste generation rate for plastic shows a drop of 3 kg/capita from 54 kg/capita in 2010 to 51 kg/capita in 2016. This is due to a decrease in the total amount of waste generated in the region. The improved performance in recycling programs and types of materials accepted likely accounts for the change.
- The total amount of textiles has been relatively consistent since 2001, fluctuating between 15 and 23 kg/capita and a total of 21 kg/capita calculated in 2016.
- The total amount of all other materials are slightly lower than, or relatively consistent compared to previous years, and is within the expected variation of the results for the study from year to year.

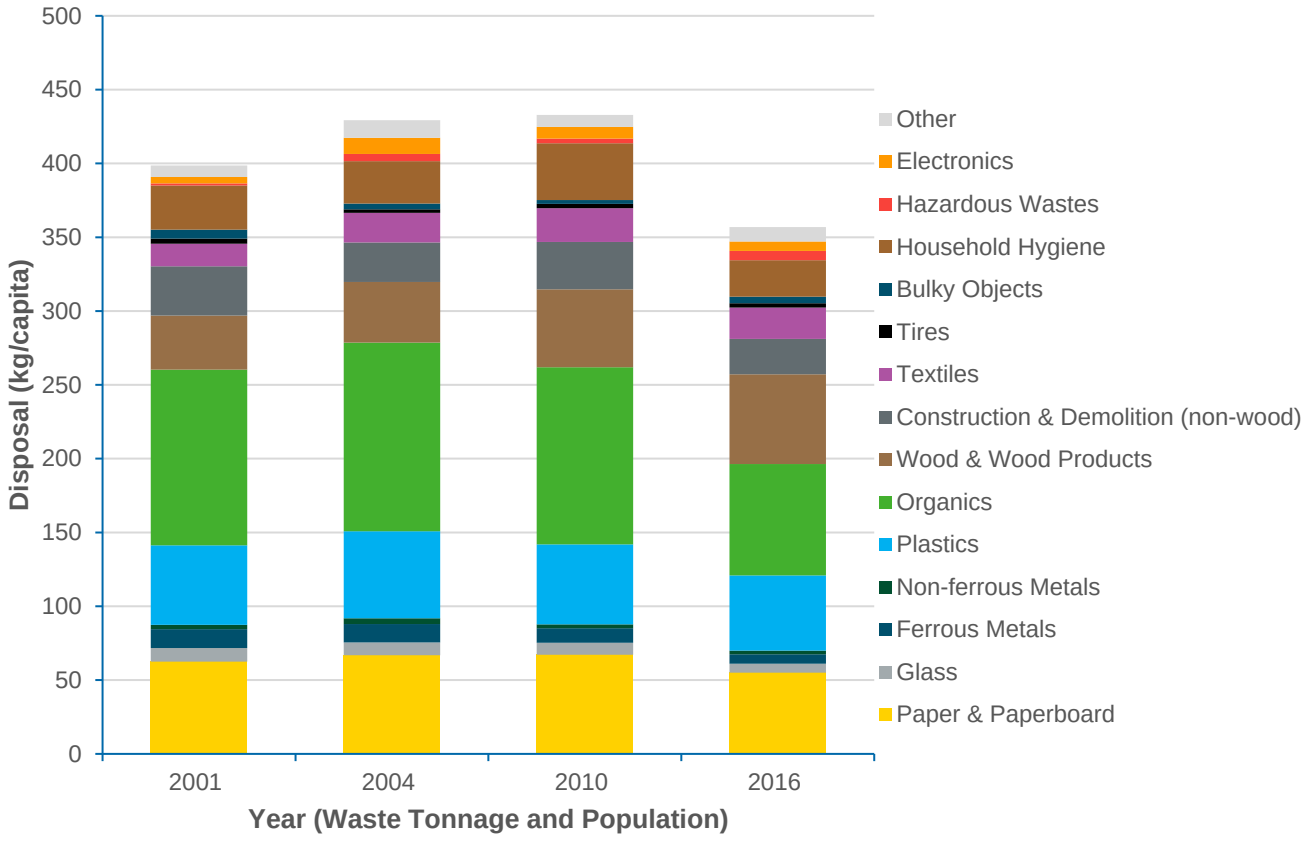

Figure A: Disposal per Capita at Hartland – Historical Comparison (2001-2016)

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ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
CR&D	Construction, Renovation and Demolition
EPR	Extended Producer Responsibility
HDPE	High Density Polyethylene (#2 plastic, rigid container and flexible film)
ICI	Industrial, Commercial and Institutional
LDPE	Low-density Polyethylene (#4 plastic, rigid items and flexible film)
MF	Multi-Family Residential
MSW	Municipal Solid Waste
N	Number of Samples
PETE	Polyethylene Terephthalate (#1, rigid bottles and thermoforms)
PP	Polypropylene (#5 rigid container)
PPP	Packaging and Printed Paper
PS	Polystyrene (#6 rigid and expanded)
PVC	Polyvinyl Chloride (#3 rigid container)
RSD	Relative Standard Deviation
SABC	Stewardship Association of British Columbia
SF	Single Family Residential

Terminology	Definition
Hauler	Vehicle delivering the waste
Load	Amount of waste contained in a hauler truck
Load Source	Origin of a specific sample
Sample	Portion of the load that was sorted and weighed

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Capital Regional District and their agents. Tetra Tech EBA Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Capital Regional District, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA Inc.'s Services Agreement. Tetra Tech's General Conditions are provided in Appendix A of this report.

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. Even with combined educational, regulatory and financial initiatives the reader should not assume that it is necessarily easy, practical, or economical to recover a substantial portion of a disposed material from a mixed waste stream or at its source.

1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech) was retained by the Capital Regional District (CRD) to conduct the 2016 Solid Waste Stream Composition Study. The waste composition sorting was conducted from September to October 2016 at the Hartland Landfill (Hartland). This report discusses the methodology employed for the composition auditing and provides the results and analysis from the sort broken down by each sector, and as a regional average. Using available waste generation data for each sector, the waste disposal per capita was calculated for the material categories, and the results were compared to previous waste composition studies.

1.1 BACKGROUND

The CRD is the regional government for 13 municipalities and 3 electoral areas on southern Vancouver Island and the nearby Gulf Islands, serving more than 378,000 citizens. There are 22 First Nations whose traditional territories span portions of the region, with 11 of those Nations holding reserve lands throughout the capital region. The CRD is responsible for solid waste disposal in the region.

The CRD commissions a waste composition study approximately every five years to determine the sources and composition (by weight) of municipal solid waste (MSW) disposed at the region's landfill. Previous studies were completed in 1990, 1996, 2001, 2004, and 2009/2010. Since the last waste composition study was completed in 2009/2010, new programs such as the packaging and printed paper (PPP) extended producer responsibility (EPR) program, additional EPR programs for electronics, the 2015 CRD kitchen scraps ban, and every-other-week garbage collection has significantly changed how residents manage their solid waste. Now that these practices are the new norm, the CRD is in a position to understand which materials are still being disposed and which sectors are the greatest contributors. This will enable the CRD to determine where resources should be directed in the future to achieve their waste diversion goals.

Hartland is owned and operated by the CRD and is located about 14 km northwest of Victoria. In 2015, a total of 130,442 tonnes of garbage was disposed in the Capital Region as tracked in the BC waste disposal calculator, including 112,442 tonnes at Hartland, and 18,000 tonnes at the Tervita Highwest landfill. In 2009 when the last waste composition study was being completed at total of 160,093 tonnes of garbage was disposed in the CRD including 153,263 tonnes at Hartland, and 6,830 tonnes at the Tervita Highwest landfill. In 2015, there were 29,651 fewer tonnes of garbage disposed than in 2009.

In 2016, the amount of garbage (specially construction and demolition waste) arriving at Hartland increased primarily due to the temporary closure of the Tervita Highwest Landfill Site that accepted construction and demolition waste as capital improvements are taking place at the site in 2016. Waste materials from demolition projects are classified as controlled waste due to health and safety concerns for staff from materials such as asbestos that may be present, and a hazardous materials survey and controlled waste disposal permit is required before the load will be accepted for disposal at Hartland. This waste composition study included all materials that arrived at the active face of the landfill, and excluded materials that are classified as controlled waste and are disposed of in designated trenches at the landfill.

1.2 SCOPE OF WORK

The scope of work for the 2016 Solid Waste Stream Composition Study includes sorting municipal solid waste (MSW) that arrives at Hartland from the following waste generating sectors:

- Single family residential (SF),

- Multi-family residential (MF),
- Garbage that is self-hauled to the public drop-off bins at the landfill (bins);
- Industrial, commercial, and institutional (ICI); and
- Construction, Renovation and Demolition (CR&D).

The aim of the study is to produce solid waste stream composition profiles for the entire waste stream entering Hartland, along with a waste stream composition profile for waste arriving from identified sectors. Garbage samples were sorted into 15 primary categories, and a total of 89 material subcategories. In collaboration with the study, the Stewardship Association of British Columbia (SABC) entered into a contract with Tetra Tech to complete sorting of the garbage into an additional 159 categories to detail EPR materials in the waste stream and this data was made available to the CRD as part of the agreement.

2.0 METHODOLOGY

This section reviews the components of the study, provides an overview of how waste was collected and sampled, and outlines other key factors and considerations for the study. Sampling and sorting was conducted in accordance with the methodology set out in the Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada (Canadian Council of Ministers of Environment 1999). Detailed category descriptions are included in Appendix A.

2.1 NUMBER OF SAMPLES

Tetra Tech prepared a sampling framework and protocol customized for this study, working from data completeness, scheduling, safety, and budgetary perspectives. The study took place over four consecutive weeks, as previous studies that were completed in different seasons did not show any significant seasonal variability in the waste composition. For the previous waste composition studies, it was assumed that garbage arriving at Hartland was evenly distributed between ICI and the SF residential sectors, with 50% of the waste assumed to be from each sector. For the 2016 study, the amount of waste arriving from each sector was estimated using the available data for the tonnage arriving from identified single family service routes and the tonnage data available for bins. This data was extrapolated based on the total number of households serviced, and the existing number of multi-family households to come up with the new estimates that are presented in Table 1.

Table 1: Samples Completed by Sector

Sector	Proportion of Garbage Arriving at Hartland (2016)[1]	Total
Sorting Dates (2016)		**September 12 – October 7**
SF	25%	27
MF	13%	10
Bins	5%	12
ICI	41%	38
CR&D	16%	20
Total	**100%**	**107**

[1]Values are estimated based on available data for bins, and extrapolated from identified single family service routes.

The total number of samples from each sector was chosen by taking into account the total proportion of garbage that has been historically received from each sector in the region, through discussions with CRD staff about the increased quantities of CR&D loads arriving at Hartland in 2016 due to the temporary closure of the Tervita Highwest landfill, and the overall variation of the waste stream expected for each sector. This resulted in fewer samples from the SF sector given less sample variation, and additional samples for the bins, ICI and CR&D sectors as those sectors have more variability in the waste composition.

To obtain the desired number of samples from each sector, vehicles were selected at random as they arrived at Hartland for MF, ICI and CR&D samples. For SF samples, a list of targeted SF collection routes was prepared prior to commencement of the sampling period to ensure samples were from a distribution of a majority of the municipalities in the CRD. The number of SF samples from each municipality was determined based on the total amount of waste that was estimated to be generated for each municipality.

In total, 107 samples were analyzed for the study. For SF households, a total of 27 garbage samples were collected from 12 municipalities and electoral areas in the CRD. For MF households, a total of 10 samples were completed, originating from 6 municipalities. A total of 38 ICI samples were completed from a selection of haulers originating from around the region.

2.2 SAMPLING CATEGORIES

Garbage samples were sorted into 15 primary categories, and a total of 89 material subcategories. Some categories were changed from the previous waste composition studies to better align with the categories in the BC provincial waste characterization tool. Specific category changes from the previous waste composition studies included:

- Many EPR categories such as paint, beverage containers were combined for the CRD waste composition to reflect how the products are managed by EPR stewards. Further sorting of these materials was conducted through a contract with SABC.
- The addition of specific subcategories for the identification of food waste as avoidable, donatable or unavoidable. In this study, avoidable food waste refers to foods that could have been eaten such as plate scraping, fruits and vegetables, meats, etc. Unavoidable food waste refers to waste arising from food or drink preparation that is not edible under normal situations, like bones, egg shells, and tea bags.
- The elimination of the composite products primary category.
- The addition of a new bulky objects primary category that included furniture that was historically in the composite products primary category, and the movement of large metal appliances (white goods) that was historically in the ferrous metals primary category.
- The addition of a household hygiene primary category which included:
  - Disposable diapers (previously classified under composite products primary category);
  - Cat litter (previously classified under “other” primary category);
  - Animal feces (previously classified under organic waste primary category); and
  - Other hygiene protects – This included hygiene products (sanitary napkins, tampons) that was previously classified under the paper primary category, and other personal hygiene products such as cotton balls, Q-tips and dental floss that were previously classified under other composites or other waste primary categories.

Please see Appendix A for a description of all categories. Additionally garbage was further sorted into 159 categories to detail EPR materials in the waste stream.

2.3 LOAD IDENTIFICATION AND SAMPLE SELECTION

Sample collection was completed with the assistance of Hartland staff and the loader operator, and sorting was completed by a Tetra Tech site supervisor, along with waste sorters who were trained on safety and material sorting procedures prior to the fieldwork. Personal protective equipment was used by staff according to the specifications of Tetra Tech's Health and Safety Plan, which factored in special requirements for working at Hartland. Safety meetings were conducted daily to emphasize key concerns including how to handle material hazards such as sharps or hazardous materials, safe lifting of garbage bags, and working around vehicles.

The Tetra Tech site supervisor worked closely with Hartland staff to coordinate identification and selection of the loads to be sampled as they arrived with minimal interruption of daily operations. Select sample photographs can be found in Appendix C.

A copy of the sampling plan was reviewed with Hartland staff each day to determine what samples were needed based on known truck arrival schedules. As the sorting team completed a sample, or as selected loads for sampling arrived at Hartland, the Hartland staff would confirm with the hauler the source of the load to determine if it was suitable for sampling. A copy of the truck identification and selection procedure for each waste sector is included in Appendix B. The hauler would be directed to empty the load on the side of the landfill face. For SF, MF and ICI samples which were hand sorted, the Hartland staff would be in radio communication with the loader operator to ensure one loader bucket of material that was approximately 200 kg to 300 kg in weight on average was randomly collected from the load, and delivered to the sorting area for manual sorting following the method described in Section 2.4.1. For bin and CR&D samples, which were visually audited as the garbage is primarily large items that are difficult to manually lift and weigh, the Hartland staff would be in radio communication with the loader operator to ensure the load was spread out to ensure all contents were visible in the load. Tetra Tech staff would then be brought to the area to perform a visual audit as described in Section 2.4.2

2.4 SAMPLE SORTING

The SF, MF and ICI samples were manually sorted, and CR&D and bin samples were primarily visually audited.

2.4.1 Manual Sorting

After a portion of a load was brought to the sorting area by the loader operator, the source of the load would be recorded and the scale ticket for the sample was obtained and brought to the sorting area by Hartland staff. The field team assisted the supervisor in collecting a sample which consisted of 100 kg of garbage using a rough grid pattern to minimize potential bias. The sample was photographed and pre-weighed prior to sorting. The materials were then sorted into bins.

At the end of the sample sorting, each categorized bin was weighed and the bin tare weight was subtracted to obtain the net sample weight. Select photographs of the process can be found in Appendix C.

2.4.2 Visual Audits

Tetra Tech's methodology for the visual audit was based on CalRecycle's "Method of Visual Characterization of Disposal Waste from Construction and Demolition Activities."[1] This method is used for samples that consist of primary large and heavy items that cannot be safely hand sorted.

[1] CalRecycle. October 2006. Method of Visual Characterization of Disposed Waste from Construction and Demolition Activities. Prepared under contract by Cascadia Consulting Group.

Prior to visual auditing, the load was spread apart by an excavator to ensure that all material types were visible. Both the field supervisor and field assistant visually estimated the contents of the load by volume percentage. This was accomplished by first estimating the amount of material by primary categories, and then further estimating the amount of materials within the primary category. Estimates derived by each person were compared to determine acceptability and were adjusted until consensus is reached. Select photographs of the process can be found in Appendix D.

For the bin samples, two samples that were primarily black garbage bags were manually sorted and the ten samples were visually audited. For the visual audits, if black garbage bags were in the load, they would be cut open if easily and safely accessible to view the contents, otherwise they were included as a category in other waste. Two bin samples that were primarily black garbage bags were hand sorted and added to the data set to ensure the overall data includes the proportionate representation from the garbage that was bagged and put into the bins.

2.5 DATA ANALYSIS AND STATISTICAL EVALUATION

Data was compiled electronically throughout the course of the field work for garbage that was manually sorted, and data was manually recorded on clipboards for visual audits. Data collection logs and scale tickets (if applicable) were reviewed daily to ensure accuracy. Quality assurance and quality control methods were then employed for accuracy including ensuring the difference between pre-sorting weights of each sample with the calculated final sample weight after sorting was within an acceptable margin of accuracy.

The average was calculated using a weighted mean for each waste sector and material category. The data for the manual sorting is weight based and does not take into account the volume of the material. Therefore heavier dense objects such as kitty litter can represented a small portion of the volume of a waste stream, but can represent a larger portion of the calculated waste composition; whereas light bulky objects such as plastic film that represent a larger volume, but do not have a large weight associated with the material can represent a large volume of the waste stream, but have a relatively large smaller portion of the calculated waste composition.

Standard deviations were calculated for primary material categories by waste sector to evaluate the results. These parameters were determined using waste composition percentages to normalize the data set, as each sample can have a different total sample weight. A large standard deviation does not necessarily indicate that the data is unreliable; instead it could indicate that the data from a particular sector is highly variable depending on the source, with different institutions or businesses producing different composition of waste.

3.0 WASTE COMPOSITION RESULTS

The waste composition results are reported as weighted average percentages by primary material category in the following sections. Weighted average percentages were calculated by combining all sample data for each sector. A summary of the results for all 89 material categories is included in Table A at the end of the report. Select photographs from the field auditing are included in Appendix C and Appendix D.

3.1 RESIDENTIAL

Residential waste targeted both single family collection routes which have curbside service, and multi-family garbage collected by haulers from dumpsters at apartment buildings and condos.

3.1.1 Single Family Residential

Figure 1 presents the weighted average primary material composition for SF residential garbage. The largest component of the garbage was compostable organics (28.2%), followed by household hygiene (15.9%), paper (14.8%), and plastic (14.8%). Compostable organics mainly comprised food waste (26.1%), of which 13.5% of food was avoidable and 9.7% was unavoidable and backyard compostable. A total of 1.7% of the food waste was identified as being debatable in its current form. The largest component of household hygiene waste diapers (6.6%), followed by cat litter (4.5%) animal feces (2.9%) and other hygiene products (1.9%). The largest component of paper was other paper (primarily compostable paper such as napkins, paper plates, and food soiled paper) at 6.4% followed by paper packaging (2.8%) and printed paper (1.5%). The largest portion of plastic was plastic film packaging (3.5%), followed by durable plastic products (3.3%).

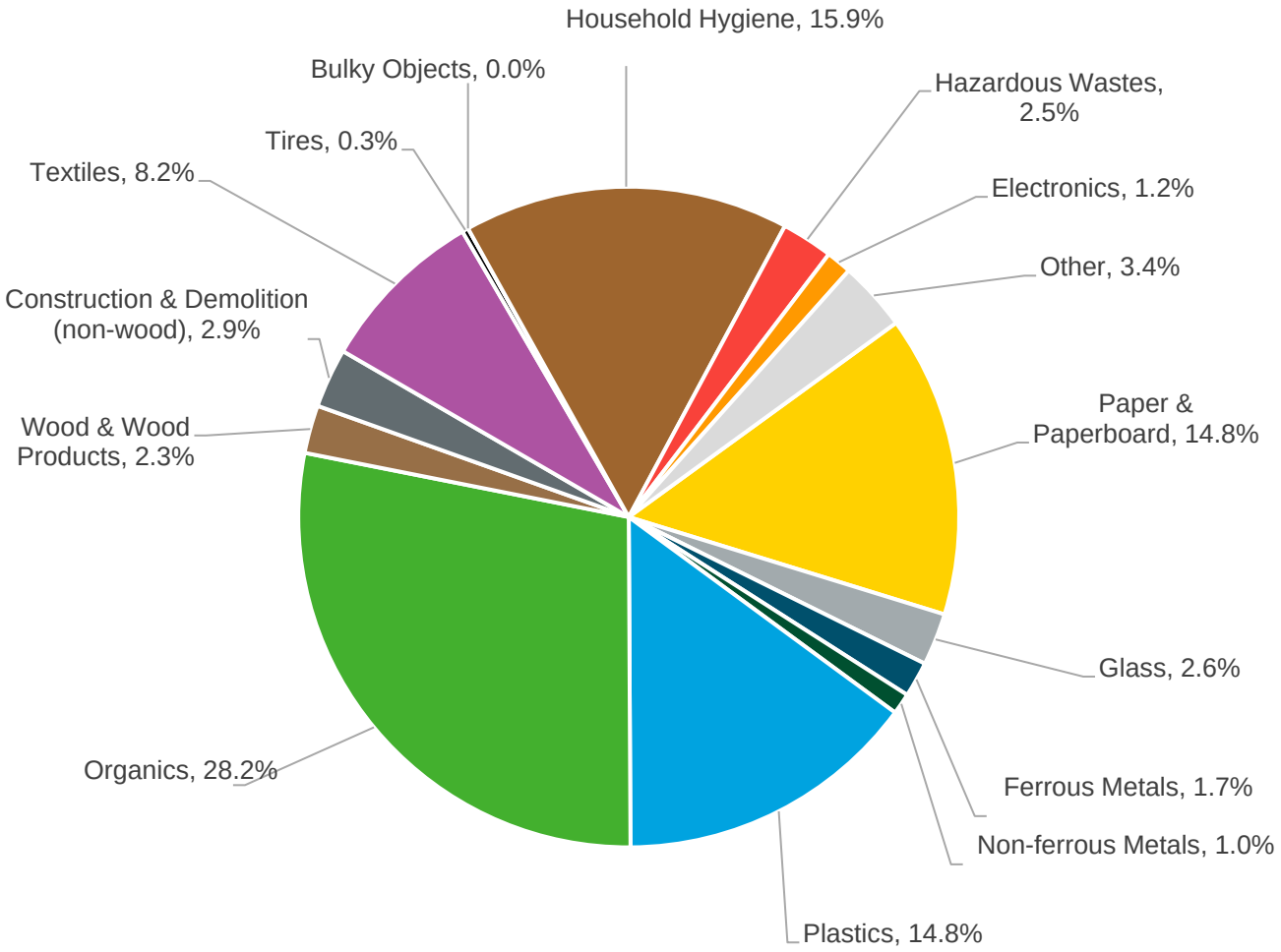

Figure 1: Primary Category Composition – Single Family Residential Garbage (N=27)

3.1.2 Multi-Family Residential

Figure 2 presents the weighted average primary material composition for MF residential garbage. The largest component of the garbage was compostable organics (31.1%), followed by paper (16.2%), plastic (15.5%), and household hygiene (11.5%). Compostable organics mainly comprised food waste (28.4%), of which 12.2% of food was avoidable and 11.3% was unavoidable and backyard compostable. A total of 2.9% of the food waste was identified as being debatable in its current form. The largest component of paper was other paper (primarily compostable paper such as napkins, paper plates, and food soiled paper) at 6.0% followed by paper packaging (2.7%), other paper (2.0%) and 1.1 % of both corrugated cardboard and newsprint, and 1.0% paper packaging for liquids. The largest portion of plastic was durable plastic products (4.5%) followed by rigid plastic containers (2.5%) and film packaging (2%). The fourth largest portion of the garbage stream was household hygiene (11.5%) which consisted primarily of diapers (6.5%) followed by cat litter (2.3%) animal feces (1.5%) and other hygiene products (1.1%).

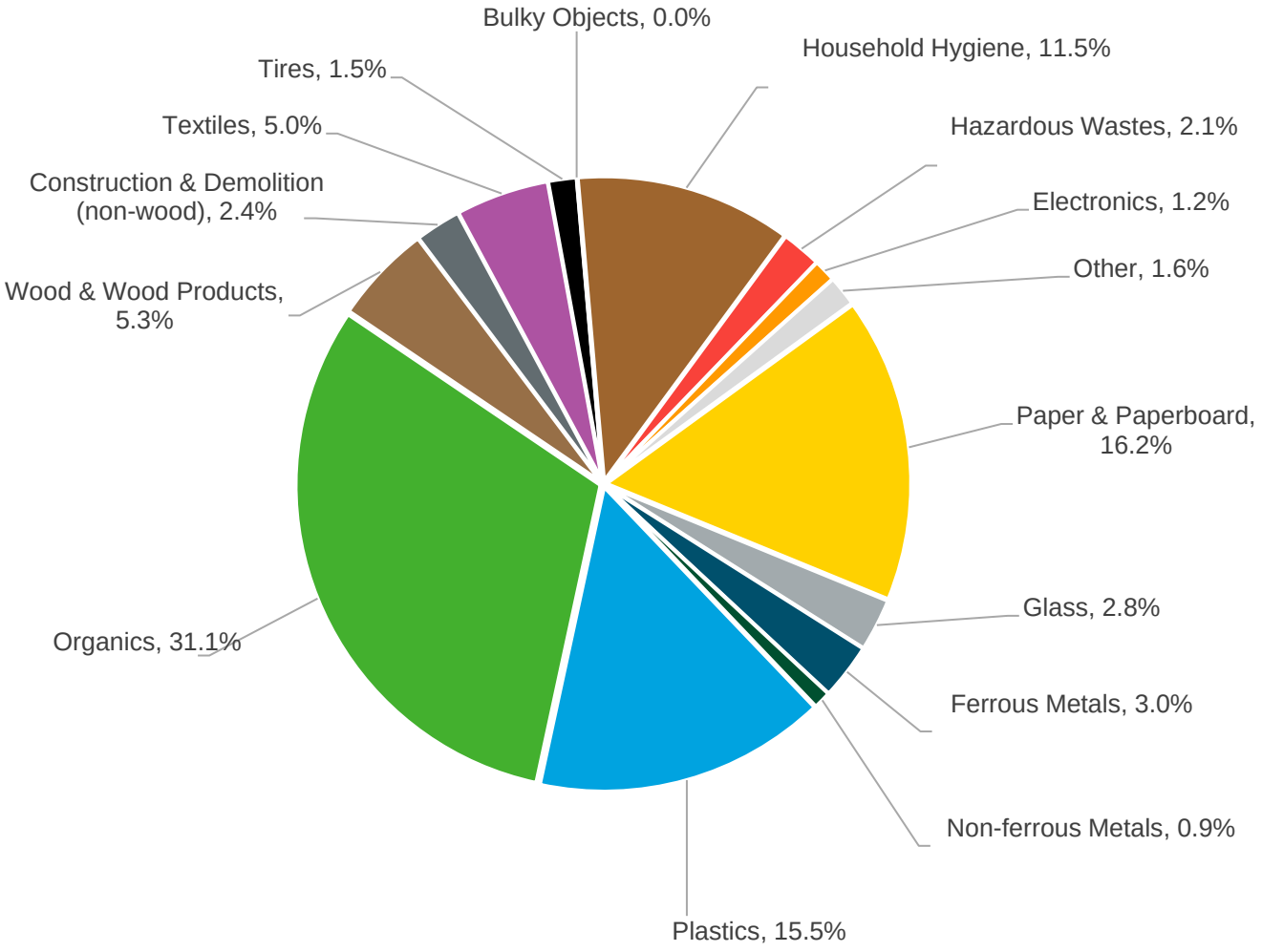

Figure 2: Primary Category Composition – Multi-family Residential Garbage (N=10)

3.1.3 Summary of Residential Results

The results for both residential sectors are summarized in Table 2 along with the standard deviation for each primary category. Table A following the report includes detailed data for all material categories.

Table 2: Waste Composition for Single Family and Multi-Family Sectors

Primary Category	Single Family		Multi-family	
	Weighted Average (N=27)[1]	Standard Deviation (+/-)	**Weighted Average (N=10)[1]**	Standard Deviation (+/-)
Paper and Paperboard	**14.8%**	4%	**16.2%**	4%
Glass	**2.6%**	2%	**2.8%**	2%
Ferrous Metals	**1.7%**	2%	**3.0%**	2%
Non-ferrous Metals	**1.0%**	1%	**0.9%**	1%
Plastics	**14.8%**	5%	**15.5%**	4%
Organics	**28.2%**	9%	**31.1%**	7%
Wood and Wood Products	**2.3%**	4%	**5.3%**	8%
Construction and Demolition (non-wood)	**2.9%**	6%	**2.4%**	3%
Textiles	**8.2%**	5%	**5.0%**	3%
Tires	**0.3%**	0%	**1.5%**	2%
Bulky Objects	**<0.1%**	-	**<0.1%**	-
Household Hygiene	**15.9%**	8%	**11.5%**	11%
Hazardous Wastes	**2.5%**	2%	**2.1%**	2%
Electronics	**1.2%**	2%	**1.2%**	1%
Other	**3.4%**	2%	**1.6%**	1%

[1]N = number of samples completed for the sector

The standard deviation for each material category were low, indicating that there was good consistency to the data. The largest difference in the waste composition was the larger quantity of household hygiene items in the SF garbage. This was primarily more animal feces and cat litter. The proportion of diapers was the same for both SF and MF sectors. Garbage from the multi-family buildings had slightly higher amounts of paper, metals, plastics and organics. These items were observed to be typical recallable items such as newsprint, cardboard and plastic containers. Other notable difference were the larger amount of textiles in the SF garbage, and the larger amount of wood products (primarily wood furniture) in the MF garbage.

3.2 INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL

Figure 3 presents the weighted average primary material composition for the ICI garbage. The largest component of the garbage was compostable organics (23.3%), followed by paper (22.9%), plastic (17.6%), wood (8.2%) and textiles (7.2%). Compostable organics mainly comprised food waste (22.0%), of which 12.2% of food was avoidable and 7.0% was unavoidable and backyard compostable. A total of 1.9% of the food waste was identified as being debatable in its current form. The second largest category was paper (22.9%) which included compostable soiled paper (8.3%), paper packaging (3.0%), printed paper (2.8%) and corrugated cardboard (2.8%), other paper (2.6%) and paper packaging for liquids (2.3%). Plastics (17.6%) included durable plastic products (5.3%), film packaging (2.9%), other film (2.4%), #2 and #4 film packaging (2.3%) along with other categories making up the remainder. Wood included treated wood (6.5%) followed by wood furniture (0.7%) and clean wood (0.6%).

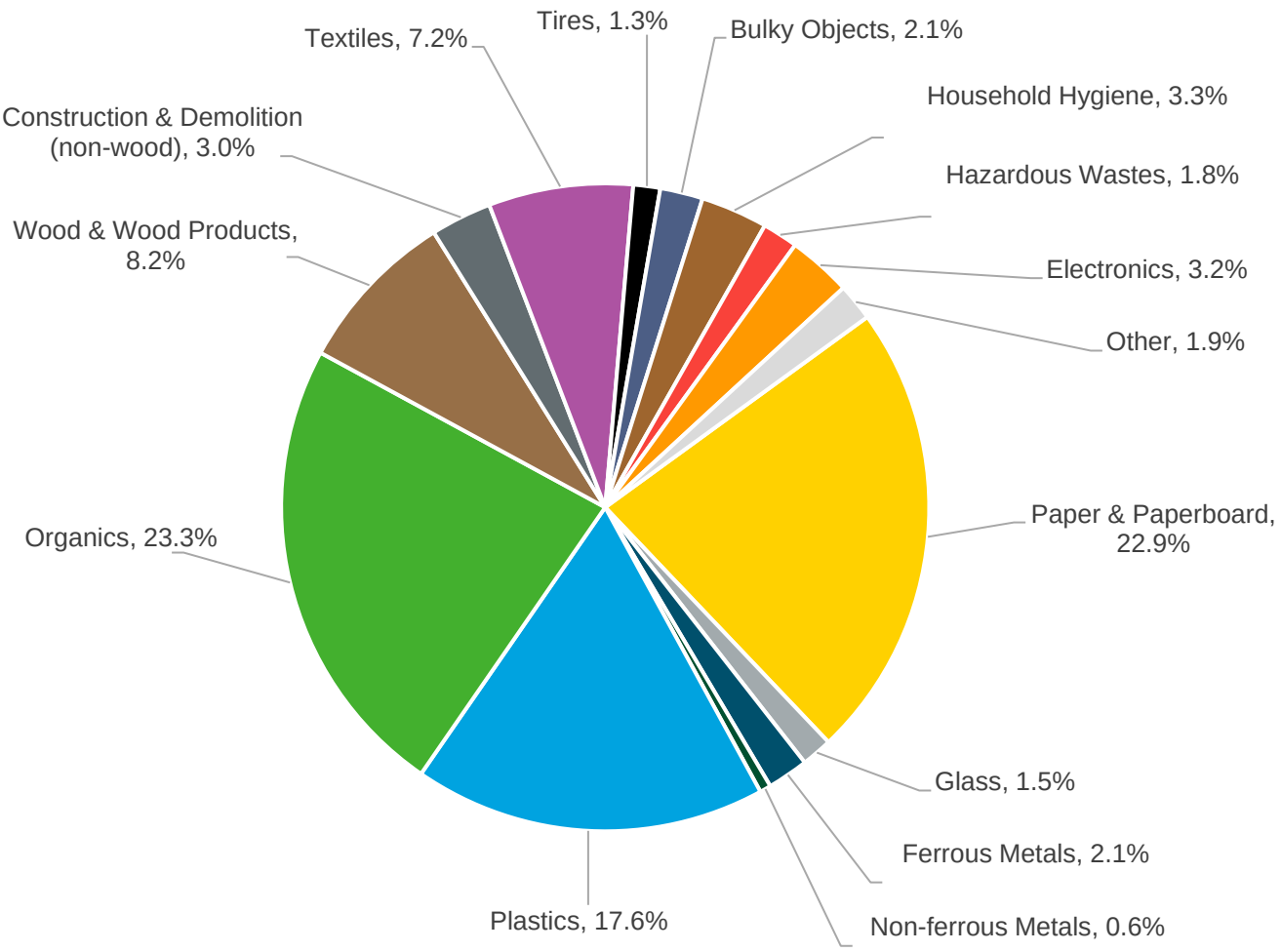

Figure 3: Primary Category Composition – Industrial, Commercial and Institutional Garbage (N=38)

Table 3 summarizes the average primary material results, along with the standard deviation for each primary category. Table A following the report includes detailed data for all material categories.

Table 3: Waste Composition for Industrial, Commercial, and Institutional Sector

Primary Category	Industrial, Commercial, and Intuitional	
	Weighted Average (N=38)[1]	Standard Deviation (+/-)
Paper and Paperboard	**22.9%**	13%
Glass	**1.5%**	4%
Ferrous Metals	**2.1%**	3%
Non-ferrous Metals	**0.6%**	0%
Plastics	**17.6%**	6%
Organics	**23.3%**	15%
Wood and Wood Products	**8.2%**	13%
Construction and Demolition (non-wood)	**3.0%**	6%
Textiles	**7.2%**	9%
Tires	**1.3%**	2%
Bulky Objects	**2.1%**	6%
Household Hygiene	**3.3%**	6%
Hazardous Wastes	**1.8%**	3%
Electronics	**3.2%**	6%
Other	**1.9%**	2%

[1]N = number of samples completed for the sector

The data for paper and paperboard, plastics and organics has the lowest relative standard deviations. These categories are the most common occurring in the garbage and it is expected that they would have the lowest standard deviation. The standard deviations for paper and organics reflects the nature of the loads that were sampled, where some samples would have a large amount of paper and organics as their source was from a restaurant or grocery store, whereas other samples would have very little organics as the source could be a manufacturing or repair facility. The standard deviation are highest for items that were not consistently found in each sample such as glass, bulky objects and electronics.

3.3 BINS (SELF-HAUL AND DROP-OFF AT HARTLAND)

Figure 4 presents the weighted average of primary material categories for "bins" or self-haul garbage. The bin garbage can be representative of waste from any garage that is self-hauled by residents and small commercial loads to the drop-off depot area at Hartland. It was assumed that 50% of the garbage in the bins originates from residential sources, and 50% of the garbage in the bins originates from ICI sources. The largest component of the garbage was wood and wood products (43.4%), followed by construction and demolition (13.3%), other (10.0%), plastic (9.4%) and organics (8.4%). Wood and wood products consisted of treated wood (19.7%), wood furniture (7.6%), painted wood (5.8%), pallets/skids (4.4%), wood shingles (3.1%), plywood/particle board (2.5%) and clean wood (0.6%). Construction and demolition materials included carpet (5.5%), flooring (1.8%) and smaller amounts of shingles, roofing, drywall, insulation and other CR&D waste. Other waste was primarily from black garbage bags that could not be cut open due to access constraints when visual auditing; however, two bin samples that were primarily black garbage bags were hand sorted and added to the data set to provide an indication of the data that could be included as a representative amount of garbage that was bagged in the bins. The identified organics and household hygiene items were primarily identified in the black bagged garbage in the bins.

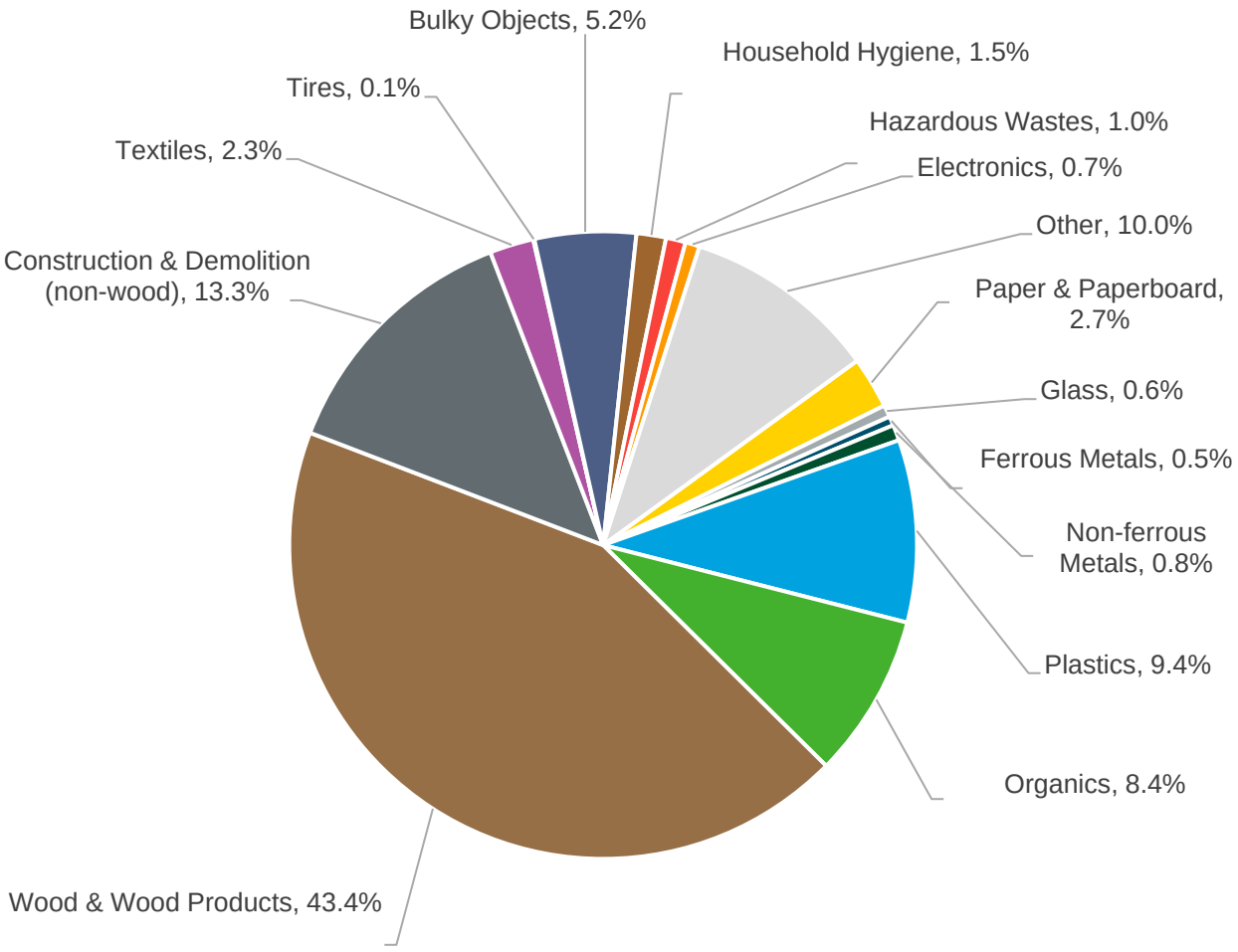

Figure 4: Primary Category Composition – Bins Garbage (N=12)

Table 4 summarizes the average primary material results, along with the standard deviation for each primary category. Table A following the report includes detailed data for all material categories.

Table 4: Waste Composition for Bins

Primary Category	Bins	
	Weighted Average (N=12)[1]	Standard Deviation (+/-)
Paper and Paperboard	**2.7%**	5%
Glass	**0.6%**	1%
Ferrous Metals	**0.5%**	0%
Non-ferrous Metals	**0.8%**	1%
Plastics	**9.4%**	6%
Organics	**8.4%**	16%
Wood and Wood Products	**43.4%**	26%
Construction and Demolition (non-wood)	**13.3%**	13%
Textiles	**2.3%**	1%
Tires	**0.1%**	0%
Bulky Objects	**5.2%**	6%
Household Hygiene	**1.5%**	4%
Hazardous Wastes	**1.0%**	1%
Electronics	**0.7%**	1%
Other	**10.0%**	6%

[1]N = number of samples completed for the sector

The data for wood, plastics, textiles, metals, and construction and demolition materials had the lowest relative standard deviations. These items were consistently found in a majority of the samples. Overall the standard deviations are high for the remainder of the categories as these items were not found consistently in each sample.

3.4 CONSTRUCTION AND DEMOLITION

Figure 5 presents the weighted average of primary material categories for the CR&D garbage. The CR&D were identified as large loads that arrived that were primarily building materials. The largest component of the garbage was wood and wood products (63.9%), followed by construction and demolition (23.6%), and plastic (5.5%). Wood and wood products consisted of treated wood (28.5%), pallets/skids (10.9%), painted wood (8.2%), plywood/particle board (6.9%), wood shingles (6.3%), clean wood (2.9%), and wood furniture (0.2%). Construction and demolition materials included asphalt singles (14%), roofing felt (3.9%), insulation (3.6%) and small amounts of flooring, drywall and other CR&D waste. Plastic consisted of a mixture of other film, durable plastic products, film packaging and small amounts of bags, expanded polystyrene, and containers.

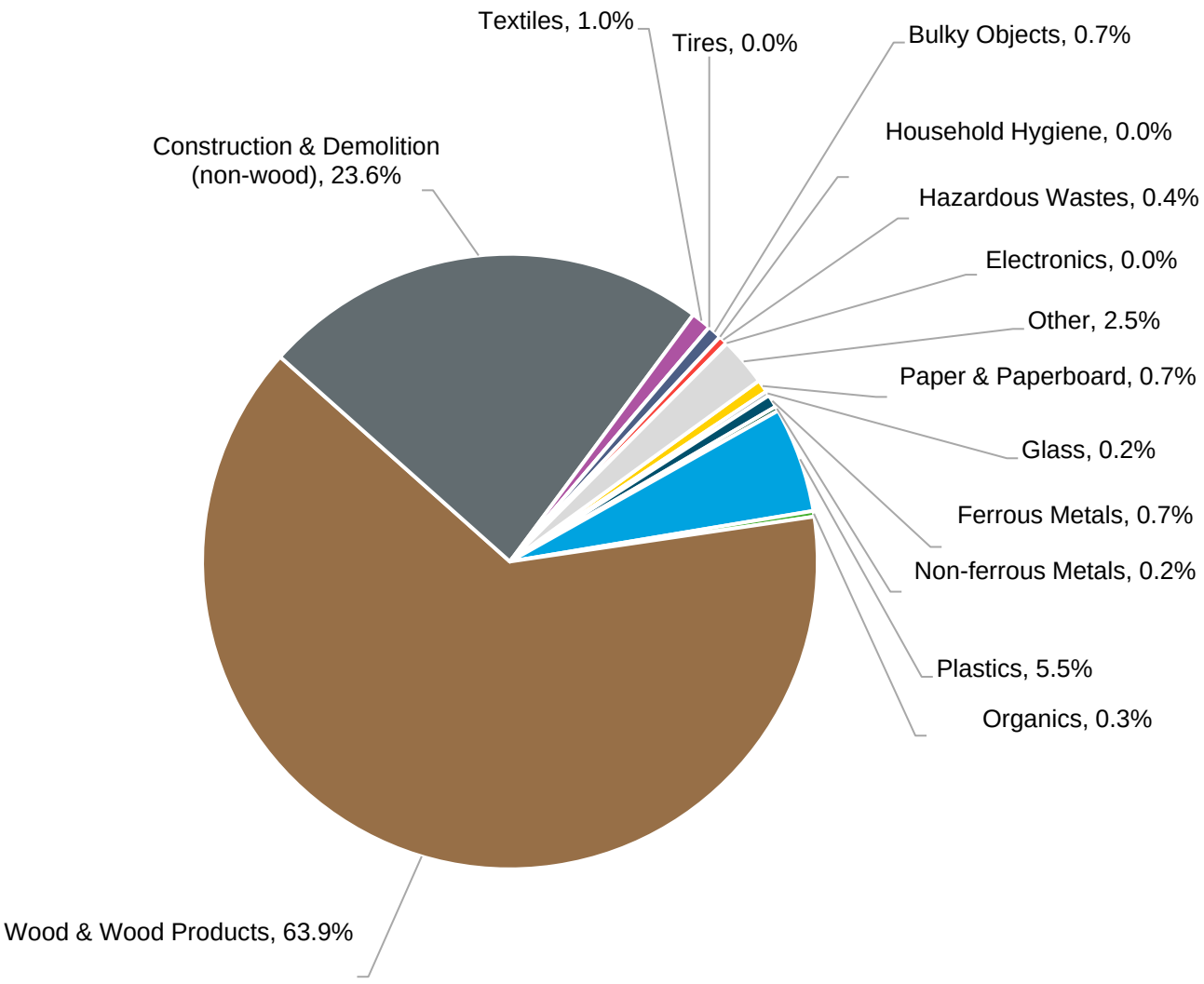

Figure 5: Primary Category Composition – Construction, Renovation and Demolition (N=20)

Table 5 summarizes the average primary material results, along with the standard deviation for each primary category. Table A following the report includes detailed data for all material categories.

Table 5: Waste Composition for Construction, Renovation and Demolition

Primary Category	Construction, Renovation and Demolition	
	Weighted Average (N=20)[1]	Standard Deviation (+/-)
Paper and Paperboard	**0.7%**	1%
Glass	**0.2%**	1%
Ferrous Metals	**0.7%**	1%
Non-ferrous Metals	**0.2%**	1%
Plastics	**5.5%**	8%
Organics	**0.3%**	1%
Wood and Wood Products	**63.9%**	36%
Construction and Demolition (non-wood)	**23.6%**	35%
Textiles	**1.0%**	3%
Tires	**<0.1%**	-
Bulky Objects	**0.7%**	3%
Household Hygiene	**<0.1%**	-
Hazardous Wastes	**0.4%**	1%
Electronics	**<0.1%**	0%
Other	**2.5%**	5%

[1]N = number of samples completed for the sector

The data for wood and wood products has the lowest relative standard deviation. Wood was the most common material identified in each sample. All other materials did not occur consistently and have higher standard deviations. The standard deviations are quite high as loads were from a large variety of construction, renovation and demolition projects and this reflects the large variability in the type of materials that arrive at Hartland for this waste sector.

3.5 COMBINED WASTE COMPOSITION RESULTS

The combined (SF, MF, ICI, bins, and CR&D) weighted average primary material composition results are presented on Figure 6. The largest component of the garbage was compostable organics (21.1%), followed by wood and wood products (17%), paper (15.4%), and plastic (14.3%). Organics were comprised of avoidable food waste (10.0%) followed by unavoidable backyard compostable food scrap (7.0%), donatable food (1.6%) and yard waste (1.3%). It is important to note that 5.8% of the garbage was identified as compostable food soiled paper that can go into the food scraps program. Paper also consisted of paper packaging (2.4%), printed paper (1.7%) corrugated cardboard (1.5%), other paper (1.6%) and liquid paper packaging (1.3%). Wood and wood products were primarily identified in the Bins and CR&D waste streams and included treated wood (8.7%), painted wood (1.8%), pallets (2%), wood furniture (1.4%) plywood and particle board (1.3%) and other wood such as wood shingles and clean wood.

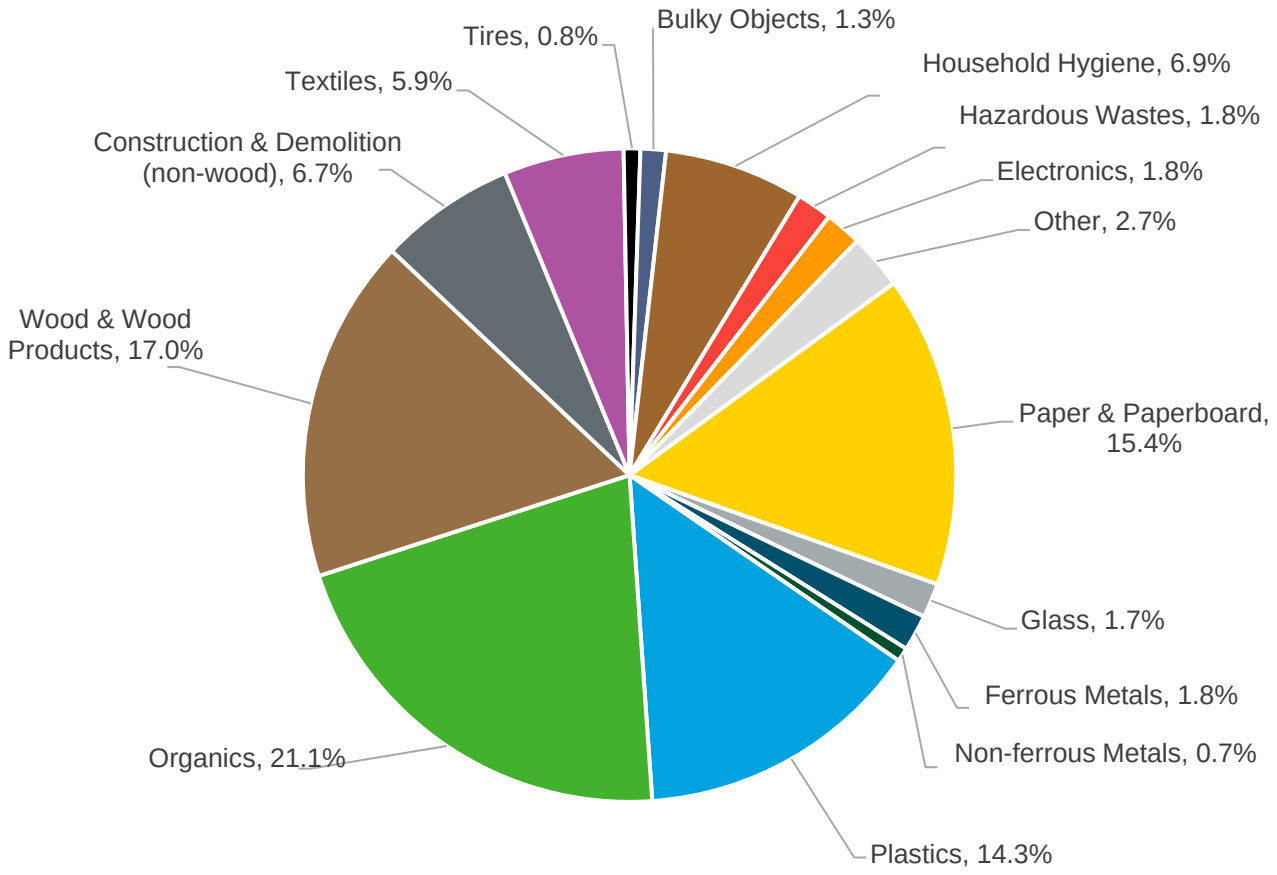

Figure 6: Primary Category Composition – Overall Regional Weighted Average

Table 6 summarizes the average primary material results for each sector, along with the calculated overall average for waste arriving at Hartland. Table A following the report includes detailed data for all material categories. The overall average was calculated by taking into account the total amount of waste that arrives at Hartland for each waste stream in 2015 as summarized in Table 1 in Section 2.0 of the report.

Table 6: Waste Composition Results by Sector and Overall Hartland Average

Primary Category	SF	MF	ICI	Bins	CR&D	Sector Weighted Average
Weighting	**0.25**	**0.13**	**0.41**	**0.05**	**0.16**	
Paper and Paperboard	14.8%	16.2%	22.9%	2.7%	0.7%	**15.4%**
Glass	2.6%	2.8%	1.5%	0.6%	0.2%	**1.7%**
Ferrous Metals	1.7%	3.0%	2.1%	0.5%	0.7%	**1.8%**
Non-ferrous Metals	1.0%	0.9%	0.6%	0.8%	0.2%	**0.7%**
Plastics	14.8%	15.5%	17.6%	9.4%	5.5%	**14.3%**
Organics	28.2%	31.1%	23.3%	8.4%	0.3%	**21.1%**
Wood and Wood Products	2.3%	5.3%	8.2%	43.4%	63.9%	**17.0%**
Construction and Demolition (non-wood)	2.9%	2.4%	3.0%	13.3%	23.6%	**6.7%**
Textiles	8.2%	5.0%	7.2%	2.3%	1.0%	**5.9%**
Tires	0.3%	1.5%	1.3%	0.1%	<0.1%	**0.8%**
Bulky Objects	0.0%	0.0%	2.1%	5.2%	0.7%	**1.3%**
Household Hygiene	15.9%	11.5%	3.3%	1.5%	<0.1%	**6.9%**
Hazardous Wastes	2.5%	2.1%	1.8%	1.0%	0.4%	**1.8%**
Electronics	1.2%	1.2%	3.2%	0.7%	<0.1%	**1.8%**
Other	3.4%	1.6%	1.9%	10.0%	2.5%	**2.7%**

[1]Weighting is the proportion of waste that each sector contributes to the overall total amount of waste arriving at Hartland landfill.

3.5.1 Statistical Evaluation

The residential samples from both the SF and MF sectors had the lowest amount of variation calculated, with standard deviations for primary material categories ranging from 1 to 11%. Within these sectors, the paper and paperboard, plastic, and organic waste categories consistently have the lowest relative standard deviation as these material types occurred consistently in most samples and have the lowest overall variation from sample to sample. Material categories such as electronics, wood, and construction and demolition materials had the highest variation for the SF and MF sectors as these materials did not occur consistently from sample to sample and have a high variability. Sample from the ICI sector had larger standard deviations compared to the residential sector indicating that there was more variation in composition from sample to sample. This is expected as there is a large variety of types of Industrial, Commercial, and Institutional facilities that make up the results for this sector. The bins samples had a larger amount of variability, however the results for metals, plastics, wood, textiles and construction materials have lower relative standard deviations as the materials were identified in most samples. The results from the CR&D sector had the highest relative standard deviations of all the sectors included in the study. The large variation are due to the variability in the types of users and sources of these materials, and the only material that has a lower variation is wood products as this occurred in most samples. Overall the statistical evaluation indicates that the results for the SF, MF, ICI and bins sectors are within expected ranges. The CR&D sector for all material categories other that wood products has higher variation and additional sampling would be required to improve the variation in the results and confirm the variability in this sector.

3.6 WASTE DISPOSAL PER CAPITA

In 2016, it is estimated that a total of 135,000 tonnes of waste will be disposed of at Hartland landfill as additional CR&D waste is being sent to the Hartland while the Tervita Highest landfill is closed. In 2015, the estimated population in the CRD was 378,232. The waste generation rate per capita and the waste disposal rate for each category was calculated and is summarized in Table 7. The waste disposal rate is calculated by taking the overall average waste composition, and multiplying by the total amount of waste generated. For the waste generation rate, the amount of waste generated is then divided by the total population of the region.

Table 7: Overall Waste Composition and Generation at Hartland

Primary Category	Overall Waste Composition		
	Composition (%)	2016 Estimated Waste Generation (kg/person/year)	2016 Estimated Waste Disposal Rate (tonnes/year to landfill)
Paper and Paperboard	15.4%	55	20,826
Glass	1.7%	6	2,299
Ferrous Metals	1.8%	6	2,417
Non-ferrous Metals	0.7%	2	930
Plastics	14.3%	51	19,282
Organics	21.1%	75	28,503
Wood and Wood Products	17.0%	61	22,997
Construction and Demolition (non-wood)	6.7%	24	9,087
Textiles	5.9%	21	8,018
Tires	0.8%	3	1,114
Bulky Objects	1.3%	4	1,697
Household Hygiene	6.9%	25	9,337
Hazardous Wastes	1.8%	6	2,366
Electronics	1.8%	6	2,447
Other	2.7%	10	3,681
Total (Estimated) 2016		357	135,000

Based on the total weight of garbage (135,000 Tones) estimated to be disposed of at Hartland in 2016, and the total estimated population of 378,232 the total waste generation rate is 357 kg/capita. Using the waste composition data, this calculates to approximately 75 kg of organics per person per year, followed by 61 kg of wood and wood products, 55 kg of paper and paperboard and 51 kg of plastics. Of the total 75 kg/capita of organics, 35.8 kg/capita was identified as avoidable food waste, 24.8 kg/capita was unavoidable and backyard compostable, 5.7 kg/capita was donatable, 4.6 kg/capita was yard and garden waste, and 3.2 kg/capita was unavoidable and non-backyard compostable.

3.7 HISTORICAL COMPARISON

A historical comparison of the waste composition, and waste disposal per capita by primary material category from 2001 to 2016 is provided in the following tables and graphs. This information can be used to help evaluate how waste reduction and diversion programs are affecting the quantity and proportion of materials disposed at Hartland. Historical data was obtained from the previous Waste Composition Reports and the historic data from 2001, 2004 and 2010 was reorganized to reflect the new category alignments used in 2016.

Waste composition results are presented as the relative percentages of each material in the garbage, with all categories adding up to total 100%. A pie chart is commonly used to present an overview of waste composition by primary material category. Waste composition studies reveal one moment in time (a snapshot). One study does not directly indicate progress in reduction or re-use or recycling of materials. Comparison to repeated studies over several years using the same approach are used to determine the changing patterns or trends in the waste composition. Waste generation is the total quantity of waste produced, and that is ultimately managed at Hartland landfill each year. The analysis combining both the quantity and composition allows for detailed analysis of changes in the quantities of total materials that are being disposed in the garbage over time, and can be visually represented with bar charts showing both the changing composition and waste generation simultaneously.

Table 8 presents the comparison of the overall composition from the 2010 study and this study.

Table 8: Comparison to Historic Waste Composition at Hartland

Primary Category	2009/2010[1]	2016	Change (2016-2010)
	Weighted Average % Composition		
Paper and Paperboard	15.5%	15.4%	-0.1%
Glass	1.9%	1.7%	-0.2%
Ferrous Metals	2.3%	1.8%	-0.5%
Non-ferrous Metals	0.6%	0.7%	+0.1%
Plastics	12.5%	14.3%	+1.8%
Organics	27.7%	21.1%	-6.6%
Wood and Wood Products	12.2%	17.0%	+4.8%
Construction and Demolition (non-wood)	7.4%	6.7%	-0.7%
Textiles	5.3%	5.9%	+0.7%
Tires	0.7%	0.8%	+0.1%
Bulky Objects	0.6%	1.3%	+1.3%
Household Hygiene	8.9%	6.9%	-2.0%
Hazardous Wastes	0.7%	1.8%	+1.0%
Electronics	1.8%	1.8%	0.0%
Other	1.9%	2.7%	+0.8%

[1] The categories from the 2009/2010 waste composition study were reorganized and recalculated to allow for direct comparison with the 2016 results

The most significant difference in the waste composition is a decrease of 6.6% in organic waste, and an increase of 4.8% in wood and wood products, compared to the 2010 results. All other changes were +/- 2% or less. There have been some minor changes in categories for each study, and some items that would have been classified as other, are now separated into bulky objects.

To further evaluate the change in the waste arriving at Hartland, the waste composition results were used to calculate the waste generation rates for each primary material category and are outlined in Table 9. Data going back to 2001 was available and is included in Table 9, and shown on Figure 7.

Table 9: Comparison to Historic Waste Generation Rates at Hartland

Primary Category	2001[1]	2004[1]	2009/2010[1,2]	2016
	kg/capita			
Paper and Paperboard	62	67	67	55
Glass	9	9	8	6
Ferrous Metals	13	12	10	6
Non-ferrous Metals	3	4	3	2
Plastics	54	59	54	51
Organics	119	128	120	75
Wood and Wood Products	37	41	53	61
Construction and Demolition (non-wood)	33	27	32	24
Textiles	15	20	23	21
Tires	3	2	3	3
Bulky Objects	6	4	3	4
Household Hygiene	30	29	38	25
Hazardous Wastes	1	5	3	6
Electronics	4	11	8	6
Other	8	12	8	10
Waste Generation (kg/capita)	399	429	433	357

[1] The categories from the 2001, 2004, and 2009/2010 waste composition study were reorganized and recalculated to allow for direct comparison with the 2016 results.
[2] The 2009/2010 kg/capita was recalculated to include the tonnage of waste that arrived at the Tervita Highwest landfill. No tonnage data is available for Tervita Highest landfill in 2001 and 2004.

Trends observed in the per capita waste disposal include:

- From 2010 to 2016, the percentage of organics in the waste composition decreased by 6.6%. The change in the waste generation rate for organics shows a significant drop of 45 kg/capita from 120 kg/capita in 2010 to 75 kg/capita in 2016. The decrease is due to the implementation and uptake in usage of organics diversion programs in the region.
- The only material to have increased in waste generation compared to all other years since 2001 was wood and wood products, now representing 61 kg/capita. This is primarily wood from construction, renovation and

demolition activities. All other primary materials have either stayed consistent or have decreased in the overall weight arriving at Hartland.

- From 2010 to 2016, the percentage of paper in the waste composition decreased by 0.1%, however the total change in the waste generation rate for paper shows a drop of 12 kg/capita from 67 kg/capita in 2010 to 55 kg/capita in 2016. Over the past five years, there has been a decrease in the total quantity of paper used (for example less newspapers). This along with improved performance of recycling programs likely accounts for the change.
- From 2010 to 2016, the percentage of plastic in the waste composition increased by 1.8%. However the change in the waste generation rate for plastic shows a drop of 3 kg/capita from 54 kg/capita in 2010 to 51 kg/capita in 2016. This is due to a decrease in the total amount of waste generated in the CRD. The improved performance in recycling programs and types of materials accepted likely accounts for the change.
- The total amount of textiles has been relatively consistent since 2001, fluctuating between 15 and 23 kg/capita and a total of 21 kg/capita calculated in 2016.
- The total amount of all other materials are slightly lower than, or relatively consistent compared to previous years, and is within the expected variation of the results for the study from year to year.

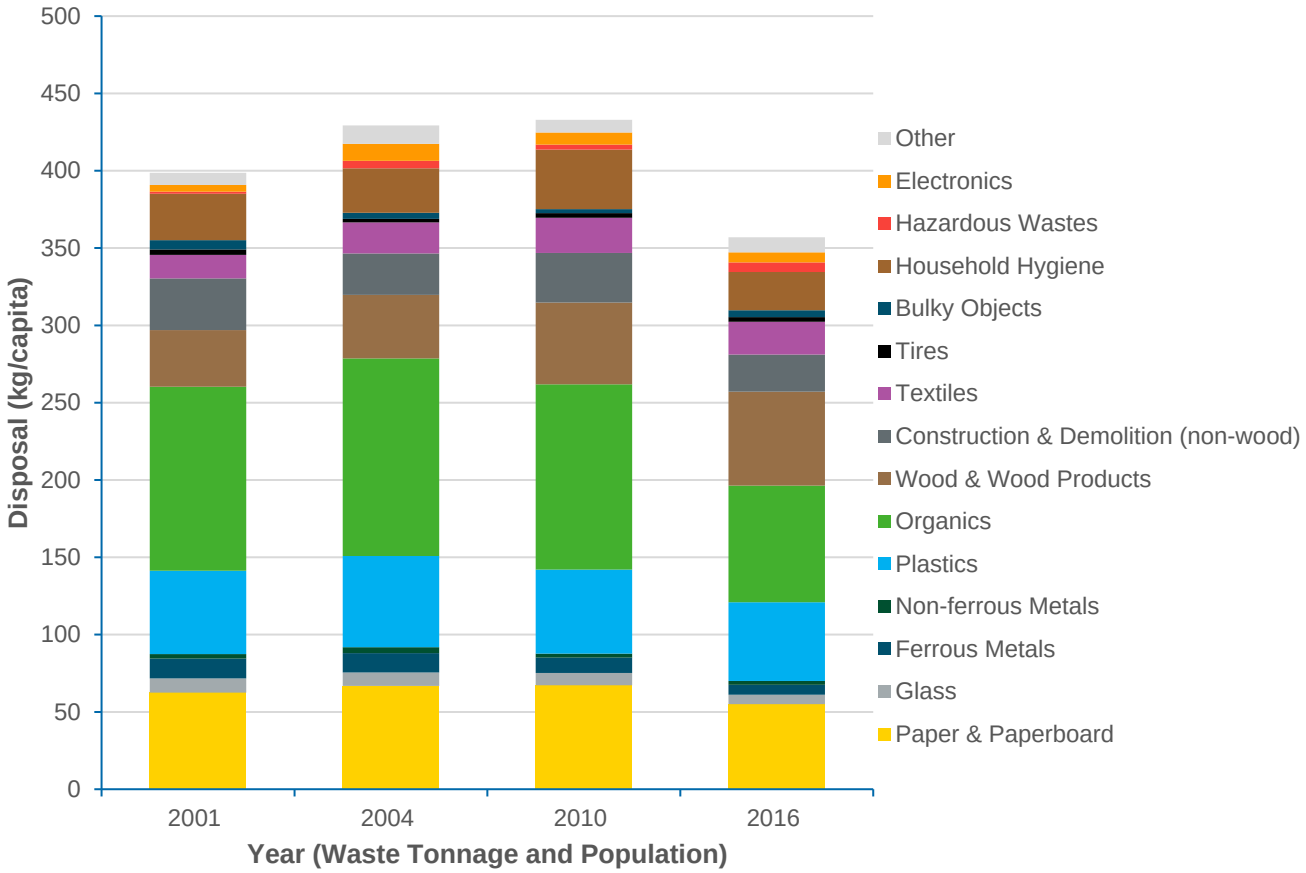

Figure 7: Disposal per Capita at Hartland – Historical Comparison (2001-2016)

3.8 PRODUCT STEWARD MATERIAL CATEGORY SUMMARY

As part of the study, materials were further sorted into 159 EPR categories for the SABC for samples that were manually sorted. A summary of the overall stewardship data is included in Table 10.

Overall the largest amount of material in the garage is PPP. This accounts for between 12% and 17% of the total waste stream. Overall the quantity of electronics was the largest in the ICI stream at 1.2%, compared to 0.8% and 0.9% in the SF and MF stream. The total quantity of beverage containers includes all deposit bearing beverage containers that are paper, plastic, glass or metal, and totaled 1.0% in the SF stream, 1.9% in the MF stream and 1.5% of the ICI waste stream. In total there was approximately 1585 beverage containers counted and separated during the study. Other commonly identified items were single use and rechargeable batteries, paint containers and electronics.

Table 10: Summary of Product Steward Materials in the Garbage

Primary Category	SF	MF	ICI
Non-EPR Products (All other garbage)	84.1%	80.4%	78.9%
Packaging	11.0%	13.2%	15.3%
Printed Paper	1.7%	2.7%	2.0%
Electronics	0.8%	0.9%	1.2%
Appliances / Tools	0.3%	0.3%	0.8%
Beverage Containers	1.0%	1.9%	1.5%
Paint / Solvents / Pesticides / Gasoline	0.9%	0.4%	0.2%
Medications	0.2%	0.1%	<0.1%
Batteries	0.1%	0.1%	0.1%
Tires	<0.1%	<0.1%	0.1%
Oil and Antifreeze	<0.1%	<0.1%	<0.1%
Alarms / Thermostats	<0.1%	<0.1%	<0.1%
Total	**100%**	**100%**	**100%**

4.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

Prepared by:
Melissa Nielsen, E.I.T.
Project Engineer
Solid Waste Practice
Direct Line: 604.317.8276
Melissa.Nielsen@tetratech.com

Prepared by/Reviewed by:
Avery Gottfried, ME, P.Eng.
Solid Waste Planning Engineer
Solid Waste Practice
Direct Line: 604.830.6989
Avery.Gottfried@tetratech.com

Reviewed by:
Wilbert Yang, P.Eng
Senior Waste Management Engineer
Solid Waste Practice
Direct Line: 604.608.8648
Wilbert.Yang@tetratech.com

/bvb/sy

TABLES

Table A: Waste Composition Results – All Categories by Sector and Overall Average

	Category	SF	MF	ICI	Bins	CR&D	Average	kg/ capita
	Category 1: Paper and Paperboard							
1	Newsprint	0.8%	1.1%	0.6%	0.1%	0.0%	0.6%	2.1
2	Printed Paper	1.5%	1.4%	2.8%	0.3%	0.0%	1.7%	6.2
3	Corrugated Cardboard	0.8%	1.1%	2.8%	0.5%	0.1%	1.5%	5.5
4	Paper packaging - dry goods	2.9%	2.7%	3.0%	0.5%	0.2%	2.4%	8.4
5	Paper packaging - liquids	0.7%	1.0%	2.3%	0.1%	0.3%	1.3%	4.7
6	Paper Beverage Containers - deposit	0.1%	0.4%	0.1%	0.0%	0.0%	0.1%	0.5
7	Books	0.4%	0.5%	0.3%	0.0%	0.0%	0.3%	1.1
8	Other paper (non-recyclable)	1.2%	2.0%	2.6%	0.1%	0.1%	1.6%	5.9
9	Soiled paper (compostable)	6.4%	6.0%	8.3%	1.1%	0.0%	5.8%	20.8
	Subtotal	**14.8%**	**16.2%**	**22.9%**	**2.7%**	**0.7%**	**15.4%**	**55.1**
	Category 2: Glass							
10	Glass beverage containers - deposit	0.3%	0.7%	0.2%	0.2%	0.0%	0.3%	1.1
11	Glass containers - bottles and jars	0.8%	1.1%	0.3%	0.2%	0.0%	0.4%	1.6
12	Other Glass and Ceramics	1.5%	1.0%	1.0%	0.3%	0.2%	1.0%	3.4
	Subtotal	**2.6%**	**2.8%**	**1.5%**	**0.6%**	**0.2%**	**1.7%**	**6.1**
	Category 3: Ferrous Metals							
13	Ferrous metal beverage containers - deposit	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1
14	Food containers	0.5%	0.5%	0.5%	0.0%	0.0%	0.4%	1.4
15	Other ferrous metals	1.2%	2.5%	1.5%	0.4%	0.6%	1.4%	4.9
	Subtotal	**1.7%**	**3.0%**	**2.1%**	**0.5%**	**0.7%**	**1.8%**	**6.4**
	Category 4: Non-ferrous Metals							
16	Non-ferrous beverage containers - deposit	0.1%	0.2%	0.1%	0.1%	0.0%	0.1%	0.4
17	Food containers & foil	0.7%	0.4%	0.3%	0.1%	0.0%	0.4%	1.3
18	Other non-ferrous metals	0.3%	0.3%	0.1%	0.6%	0.2%	0.2%	0.8
	Subtotal	**1.0%**	**0.9%**	**0.6%**	**0.8%**	**0.2%**	**0.7%**	**2.5**
	Category 5: Plastics							
19	Plastic beverage containers – deposit	0.2%	0.2%	0.4%	0.0%	0.1%	0.3%	0.9
20	Plastic containers – bottles & jugs - non deposit	1.0%	1.2%	1.0%	0.1%	0.0%	0.8%	2.9
21	Rigid plastic containers (incl. lids) – non expanded polystyrene	1.3%	2.5%	2.0%	0.2%	0.0%	1.5%	5.3

	Category	SF	MF	ICI	Bins	CR&D	Average	kg/ capita
22	Rigid plastic containers (incl. lids) – expanded PS (White)	0.9%	0.7%	0.5%	0.2%	0.0%	0.5%	1.8
23	Packaging – expanded polystyrene	0.3%	0.1%	0.4%	0.8%	0.8%	0.4%	1.5
24	Film packaging – retail & grocery bags	1.5%	1.0%	0.5%	0.2%	0.2%	0.8%	2.7
25	Film packaging - #2 & #4 polyethylene film	1.9%	1.7%	2.3%	0.4%	0.1%	1.6%	5.9
26	Film packaging – (PETE, PVC, LDPE Stretch and PP Films, Multi)	3.5%	2.0%	2.8%	2.0%	1.6%	2.7%	9.5
27	Other film packaging	1.0%	1.6%	2.4%	1.7%	1.5%	1.8%	6.4
28	Durable plastic products	3.3%	4.5%	5.3%	3.8%	1.1%	3.9%	14.0
29	Compostable plastics	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
	Subtotal	**14.8%**	**15.5%**	**17.6%**	**9.4%**	**5.5%**	**14.3%**	**51.0**
	Category 6: Organics							
30	Food waste – backyard compostable (unavoidable)	9.7%	11.3%	7.0%	3.7%	0.0%	7.0%	24.8
31	Food waste – non-backyard compostable (unavoidable)	1.2%	2.0%	0.9%	0.1%	0.0%	0.9%	3.2
32	Food waste – avoidable	13.5%	12.2%	12.2%	1.3%	0.0%	10.0%	35.8
33	Food waste – donatable	1.7%	2.9%	1.9%	0.1%	0.0%	1.6%	5.7
34	Food waste – fats, oil and grease	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
35	Yard & garden waste	1.9%	2.0%	1.2%	0.6%	0.2%	1.3%	4.6
36	Other organic waste	0.2%	0.7%	0.1%	2.6%	0.0%	0.3%	1.2
	Subtotal	**28.2%**	**31.1%**	**23.3%**	**8.4%**	**0.3%**	**21.1%**	**75.4**
	Category 7: Wood & Wood Products							
37	Pallets/skids	0.0%	0.0%	0.0%	4.4%	10.9%	2.0%	7.0
38	Wood shingles	0.0%	0.0%	0.0%	3.1%	6.3%	1.2%	4.1
39	Wood furniture	0.4%	4.3%	0.7%	7.6%	0.2%	1.4%	4.9
40	Clean wood	0.4%	0.1%	0.6%	0.3%	2.9%	0.9%	3.1
41	Other wood – treated	1.4%	0.7%	6.5%	19.7%	28.5%	8.7%	30.9
42	Other wood - painted	0.0%	0.0%	0.4%	5.8%	8.2%	1.8%	6.3
43	Plywood/particle board	0.0%	0.2%	0.0%	2.5%	6.9%	1.3%	4.5
	Subtotal	**2.3%**	**5.3%**	**8.2%**	**43.4%**	**63.9%**	**17.0%**	**60.8**

	Category	SF	MF	ICI	Bins	CR&D	Average	kg/capita
	Category 8: Construction and Demolition (non-wood)							
44	Drywall	0.2%	0.1%	0.1%	0.6%	0.5%	0.2%	0.8
45	Asphalt shingles	0.0%	0.0%	0.2%	0.4%	14.0%	2.4%	8.4
46	Roofing Felt	0.0%	0.0%	0.0%	0.4%	3.9%	0.6%	2.3
47	Flooring – carpet & underlay	1.6%	1.3%	0.6%	5.5%	0.4%	1.2%	4.2
48	Flooring – vinyl, tile and other	0.3%	0.6%	0.2%	1.8%	0.0%	0.3%	1.1
49	Insulation – fibreglass, foam, vermiculite, other	0.3%	0.0%	0.3%	0.9%	3.6%	0.8%	3.0
50	Masonry	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1
51	Stucco/plaster	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
52	Rock/sand/dirt	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.2
53	Other C&D waste	0.4%	0.4%	1.4%	3.8%	1.1%	1.1%	3.9
	Subtotal	**2.9%**	**2.4%**	**3.0%**	**13.3%**	**23.6%**	**6.7%**	**24.0**
	Category 9: Textiles							
54	Clothing	3.2%	2.0%	2.7%	0.3%	0.0%	2.2%	7.9
55	Footwear	1.3%	0.7%	0.7%	0.2%	0.0%	0.7%	2.6
56	Other textiles	3.8%	2.3%	3.7%	1.7%	1.0%	3.0%	10.8
	Subtotal	**8.2%**	**5.0%**	**7.2%**	**2.3%**	**1.0%**	**5.9%**	**21.2**
	Category 10: Tires							
57	Vehicle tires	0.0%	0.4%	0.3%	0.0%	0.0%	0.2%	0.6
58	Other rubber products	0.3%	1.1%	1.1%	0.1%	0.0%	0.7%	2.4
	Subtotal	**0.3%**	**1.5%**	**1.3%**	**0.1%**	**0.0%**	**0.8%**	**2.9**
	Category 11: Bulky Objects							
59	Furniture	0.0%	0.0%	1.7%	3.4%	0.0%	0.9%	3.1
60	Mattresses & Box springs	0.0%	0.0%	0.3%	1.8%	0.7%	0.3%	1.2
61	Large appliances	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.2
	Subtotal	**0.0%**	**0.0%**	**2.1%**	**5.2%**	**0.7%**	**1.3%**	**4.5**
	Category 12: Household Hygiene							
62	Disposable diapers	6.6%	6.5%	1.6%	1.2%	0.0%	3.2%	11.5
63	Cat litter	4.5%	2.3%	0.8%	0.0%	0.0%	1.8%	6.3
64	Animal feces	2.9%	1.5%	0.1%	0.1%	0.0%	1.0%	3.4
65	Other hygiene products	1.9%	1.1%	0.9%	0.3%	0.0%	1.0%	3.5
	Subtotal	**15.9%**	**11.5%**	**3.3%**	**1.5%**	**0.0%**	**6.9%**	**24.7**

	Category	SF	MF	ICI	Bins	CR&D	Average	kg/capita
	Category 13: Hazardous Wastes							
66	Light bulbs, tubes & ballasts	0.2%	0.8%	0.2%	0.3%	0.0%	0.3%	1.0
67	Batteries – automotive	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
68	Batteries – household	0.2%	0.2%	0.1%	0.0%	0.0%	0.1%	0.3
69	Oil and antifreeze	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.2
70	EPR paints & containers (latex and oil)	0.7%	0.5%	0.5%	0.4%	0.1%	0.5%	1.7
71	EPR solvents & pesticides	0.1%	0.0%	0.1%	0.2%	0.2%	0.1%	0.3
72	Non EPR paints & containers	0.2%	0.0%	0.1%	0.0%	0.0%	0.1%	0.3
73	Non EPR solvents & pesticides	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
74	Pharmaceuticals, including containers	0.2%	0.1%	0.1%	0.0%	0.0%	0.1%	0.3
75	Needles & sharps	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
76	Other empty aerosol cans	0.2%	0.2%	0.1%	0.0%	0.0%	0.1%	0.3
77	Non-hazardous / non-EPR	0.3%	0.2%	0.3%	0.0%	0.0%	0.2%	0.8
78	Other materials	0.4%	0.1%	0.3%	0.1%	0.1%	0.3%	0.9
	Subtotal	**2.5%**	**2.1%**	**1.8%**	**1.0%**	**0.4%**	**1.8%**	**6.3**
	Category 14: Electronics							
79	TV & audio/video equipment	0.2%	0.1%	0.5%	0.1%	0.0%	0.3%	1.0
80	Computers & peripherals	0.4%	0.0%	0.4%	0.0%	0.0%	0.3%	1.0
81	Telephones & answering machines	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
82	Cell phones	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
83	Electronic/electrical instruments (incl. toys)	0.4%	0.3%	0.9%	0.2%	0.0%	0.5%	1.9
84	Alarms & Thermostats	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
85	Heating & cooling products	0.0%	0.0%	0.1%	0.2%	0.0%	0.1%	0.2
86	Small appliances & power tools	0.3%	0.4%	1.1%	0.2%	0.0%	0.6%	2.1
87	Outdoor power equipment	0.0%	0.4%	0.0%	0.0%	0.0%	0.1%	0.2
	Subtotal	**1.2%**	**1.2%**	**3.2%**	**0.7%**	**0.0%**	**1.8%**	**6.5**
	Category 15: Other							
88	Non distinct fines	3.4%	1.6%	1.9%	0.3%	0.0%	1.8%	6.5
89	Soot/Ash	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0
-	Black Bags (Visual Audits Only)	-	-	-	9.8%	2.5%	0.9%	3.2
	Subtotal	**3.4%**	**1.6%**	**1.9%**	**10.0%**	**2.5%**	**2.7%**	**9.7**
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**356.9**

APPENDIX A

GARBAGE SORTING CATEGORIES

	Category 1: Paper and Paperboard	
1	Newsprint	Newsprint
2	Printed paper	Telephone books Magazines and mixed recyclable paper Fine paper
3	Corrugated cardboard	Corrugated cardboard Pizza boxes
4	Paper packaging – dry goods	Boxboard Brown Kraft paper, including bags
5	Paper packaging - liquids	Paper cups Gabletop cartons – milk and milk substitutes Aseptic boxes – milk and milk substitutes
6	Paper beverage containers - deposit	Gabletop cartons – juice and other Aseptic boxes – juice and other
7	Books	Books (hard and soft cover)
8	Other paper (non-recyclable)	Other paper (non-recyclable/non compostable) Waxed corrugated cardboard
9	Soiled paper (compostable)	Tissue paper, paper towels, napkins
	Category 2: Glass	
10	Glass beverage containers – deposit	Beverage containers – alcoholic Beverage containers – non alcoholic
11	Glass containers (bottles and jars)	Food containers Other glass containers
12	Other glass and ceramics	Plates, cups, mirrors
	Category 3: Ferrous Metals	
13	Ferrous metal beverage containers – deposit	Beverage containers - alcoholic Beverage containers – non alcoholic
14	Food containers	Food containers
15	Other ferrous metals	Other ferrous metals
	Category 4: Non-ferrous Metals	
16	Non-ferrous beverage containers – deposit	Beverage containers - alcoholic Beverage containers – non alcoholic
17	Food containers and foil	Food containers Aluminum trays and foil
18	Other non-ferrous metals	Other non-ferrous metals

	Category 5: Plastics	
19	Plastic beverage containers – deposit	Bottles/jugs #1 - deposit Other bottles/jugs - deposit
20	Plastic containers – bottles and jugs – non deposit	#1 – dish soap, cooking oil #2 – milk jugs #2 – other (shampoo, etc.) #3 – (lotions, soap) #4,5,7 – ketchup, etc.
21	Rigid plastic containers (incl. lids) – non expanded polystyrene	#1 food take out (McD etc) #1 other food containers (deli etc.) #6 rigid take out (clear cups, trays) #6 rigid packaging – Rxbottles, seed trays #5 wide mouth food take out (deli) Other rigid containers and lids – ice cream, yogurt All other (blister package, plant pots, deodorant) Large pails and lids
22	Rigid plastic containers (incl. lids) – expanded polystyrene (White)	#6 form take out (clam shells, etc.) #6 form packaging – meat trays etc.
23	Packaging – expanded polystyrene	Foam cushion packaging
24	Film packaging – retail and grocery bags	Empty/clean and re-used as a garbage bag/kitchen catcher
25	Film packaging - #2 and #4 polyethylene film	Stretchy plastic films
26	Film packaging – (PETE, PVC, LDPE Stretch and PP Films, Multi-laminated plastic packaging)	Non-stretchy plastic films
27	Other film packaging	Kitchen catchers, garbage bags, cling wraps Laminates, Commercial wrap
28	Durable plastic products	Non packaging (VCR tapes, CDs, toys, lawn chairs) Vinyl siding
29	Compostable plastics	Food ware, bags
	Category 6: Organics	
30	Food waste – backyard compostable (unavoidable)	Fruit and vegetable peelings, carrot tops, egg shells, tea bags.
31	Food waste – non-backyard compostable (unavoidable)	Waste from food/drink preparation that is not edible (bones, cartilage, etc.)
32	Food waste – avoidable	Leftovers, plate scrapings, usable fruit and vegetables, baked goods, candy, stacks, condiments, whole meats.
33	Food waste – donatable	Food waste that is **not past** the expiration date, unused ready made, whole meats/fish, baked goods, deli, liquids (like oil in package)
34	Food waste – fats, oil and grease	Brown and yellow fats, oil and grease
35	Yard and garden waste	Grass, leaves, branches < 3 inches diameter
36	Other organic waste	Other organic waste
	Category 7: Wood and Wood Products	
37	Pallets/skids	
38	Wood shingles	
39	Wood furniture	>80% wood
40	Clean wood	
41	Other wood – treated	Stained and/or treated (creosote or CCA)

42	Other wood – painted	Painted only - opaque paint
43	Plywood/particle board	
	Category 8: Construction and Demolition Material (non-wood)	
44	Drywall	
45	Asphalt shingles	
46	Roofing felt	
47	Flooring – carpet and underlay	
48	Flooring – vinyl, tile and other	Include comment about what type
49	Insulation – fibreglass, foam, vermiculite, other	Include comment about what type
50	Masonry	
51	Stucco/plaster	
52	Rock/sand/dirt	
53	Other C&D waste	
	Category 9: Textiles	
54	Clothing	
55	Footwear	Leather, cloth, no rubber
56	Other textiles	Blankets, sheets etc.
	Category 10: Tires	
57	Vehicle tires	
58	Other rubber products	
	Category 11: Bulky Objects	
59	Furniture	Furniture - composite
60	Mattresses and box springs	
61	Large appliances	
	Category 12: Household Hygiene	
62	Disposable diapers	Child, adult
63	Cat litter	
64	Animal feces	
65	Other hygiene products	Feminine hygiene products, cotton balls, dental floss, Q-tips, etc.
	Category 13: Hazardous Wastes	
66	Light bulbs, tubes and ballasts	Fluorescent lighting – CFL bulbs, tubes, ballasts
67	Batteries – automotive	Lead acid batteries
68	Batteries – household	Rechargeable and non-rechargeable
69	Oil and antifreeze	Lubricating oil, incl. containers Empty oil containers Oil filters Antifreeze, incl. containers
70	EPR paints and containers (latex and oil based)	Latex paint, incl. containers (PCA) Empty latex paint containers (PCA) Oil based paint, incl. containers (PCA) Empty oil based paint containers (PCA) Paint in aerosol cans (PCA) Paint – empty aerosol cans (PCA)

71	EPR solvents and pesticides, including containers	Solvents incl. containers (<10 l) PCA Solvents – empty containers (PCA) Pesticides incl. containers (PCA) Pesticides – empty containers (PCA)
72	Non EPR paints and containers, including containers	Paint – (non-PCA) incl. containers Paint – (non PCA) containers Paint – aerosol cans (non PCA) Paint – empty aerosol cans (non PCA)
73	Non EPR solvents and pesticides, including containers	Solvents incl. containers (non PCA) Solvents – empty containers (non PCA) Pesticides incl. containers (non-PCA) Pesticides – empty containers (non PCA)
74	Pharmaceuticals, including containers	
75	Needles and sharps	
76	Other empty aerosol cans	
77	HHW - Non-hazardous / non-EPR	Windex, Draino, Armorall, Fertilizers, other relatively benign household cleaners / products
78	Other HW	Record individually
	Category 14: Electronics	
79	TV and audio/video equipment	Display Devices (monitors/TVs) , Vehicle audio/video, home audio/video, Personal/portable audio/video
80	Computers and peripherals	Computers, desktop computer printers, copiers, faxes, computer scanners, computer peripherals (keyboards, mice)
81	Telephones and answering machines	Non-cell phones and answering machines
82	Cell phones	Cell phones, PDAs, pagers
83	Electronic or electrical instruments/equipment (incl. toys)	
84	Alarms and thermostats	
85	Heating and cooling products	Commercial
86	Small appliances and power tools	
87	Outdoor power equipment	
	Category 15: Other	
88	Non distinct fines	
89	Soot/Ash	

APPENDIX B

TRUCK IDENTIFICATION AND SELECTION

Source	Source Definition for Truck Identification and Sampling Collection Method
Single Family Residential (SF)	**Definition** Large municipal or contracted private haulers with loads from curbside residential garbage routes. Primarily detached single-family, duplex, triplex, and fourplex homes, where each residential unit has their own garbage container. **Sample Collection** Haulers identified to meet the definition above were asked to be sampled randomly.
Multi-family Residential (MF)	**Definition** Private paid account haulers with loads collected from dumpsters into front loading hauling trucks or roll-off compactor bins from primarily residential garbage pick-up routes. Primarily apartments and condominiums with five or more units. Waste is collected from dumpsters, or roll-off compactor bins. **Sample Collection** Haulers identified through random selection and interview of the waste hauler at the landfill. If the hauler indicated the load was primarily > (greater than) 25% mixed source, the load was not sampled, if the hauler indicated the load was “mostly residential” >75% the driver was instructed to deliver a sample and the site supervisor confirmed if a MF sample could be obtained with no ICI contamination.
Industrial, Commercial, Institutional (ICI)	**Definition** Load > 1,500 kg. Large paid account haulers for commercial businesses, institutions and industries. **Sample Collection** Haulers identified by random selection at the landfill. If primarily >25% mixed source the load was not sampled, if the load was “commercial or mostly commercial” >75% the driver was instructed to deliver a sample and the site supervisor confirmed if a ICI sample could be obtained.
Self-haul to Public Drop-off (Bins)	**Definition** All loads directed to the Heartland Bin area. Generally these loads are loads with gross vehicle weight < (less than) 5,500 kg, small pick-up trucks or small vehicles with trailers. These loads are Non-account residential AND non-account commercial drop-off. **Sample Collection** Samples collected from the bins are they are brought to the active face of the landfill.
Construction Renovation and Demolition (CR&D)	**Definition** Open top roll-off bins or hydraulic dumping trucks and trailers. Loads are primarily large, heavy or bulky items, no bagged municipal waste **Sample Collection** Loads are identified and once unloaded, the pile is spread out to a thickness of 1 m so all contents can be seen visually. Loads are then visually audited.

APPENDIX C

MANUAL SORTING SELECT PHOTOGRAPHS

Photo 1: Hartland Landfill Active Face (Viewed from Waste Sorting Area)

Photo 2: Truck Identified for Sampling - Hauler Unloading

Photo 3: Loader Operator Transferring a Waste Sample to the Sorting Area

Photo 4: Waste Sorting Area

Photo 5: Collection of a Sample from the Waste Dumped by the Loader Operator

Photo 6: Waste Sorting Area and Field Team

Photo 7: Sample Photograph Prior to Sample Collection and Sorting

Photo 8: Deposit Bearing Beverage Containers Accumulated Throughout the Study

Photo 9: Electronics Accumulated Throughout the Study

Photo 10: Category 83 – Cell Phone (with lithium battery)

Photo 11: Category 33 - 32 – Food Waste - Avoidable

Photo 12: Category 5 – Paper Packaging - Liquids

Photo 13: Category 20 – Plastic Containers – Bottles and Jugs

Photo 14: Category 4 – Paper Packaging – Dry Goods

Photo 15: Category 26 and 25 – Film Packaging – Retail and Grocery Bag – Re-used as garbage bag/kitchen catcher (Left) and empty/clean (Right)

Photo 16: Category 27a – Film Packaging #2 and #4 (Stretch Plastic Film)

APPENDIX D

VISUAL AUDIT SELECT PHOTOGRAPHS

Photo 1: Visual Auditing – CR&D-18

Photo 2: CR&D - 06

Photo 3: CR&D-07

Photo 4: CR&D-08

Photo 5: Visual Auditing - Bin -07

Photo 6: Bin -04

Photo 7: Bin - 05

Photo 8: Bin - 05

Photo 9: CR&D-19 – Ceiling Tiles and Inslulation

Photo 10: CR&D – 19 – Flooring Tiles

Photo 11: Bin – 09 – Some Yard Waste Identified

Photo 12: Bin -11

APPENDIX E

TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.1 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

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Making a difference...together

Tetra Tech
Suite 1000 - 10th Floor,
885 Dunsmuir Street
VANCOUVER, BC V6C 1N5
p. 604.685.0275

TETRA TECH