British Columbia Industrial, Commercial and Institutional Packaging and Paper Products Baseline Report:

Waste Flows Study

CANADA PLASTICS PACT

Canada Plastics Pact Mission

The Canada Plastics Pact (CPP) is tackling plastic waste and pollution, as a multi-stakeholder, industry-led, cross-value chain collaboration platform. The CPP brings together Partners who are united behind a vision of creating a circular economy in Canada in which plastic waste is kept in the economy and out of the environment. It unites businesses, government, non-governmental organizations and other key actors in the local plastics value chain behind clear actionable targets for 2025. By aligning with the Ellen MacArthur Foundation's global Plastics Pact network and the New Plastics Economy's common vision of a circular economy for plastics, CPP Partners commit to fundamentally rethinking the way we design, use, and reuse plastic packaging. The Canada Plastics Pact is a member of the Ellen MacArthur Foundation's Global Plastics Pact network. It operates as an independent initiative of The Natural Step Canada, a national charity with over 25 years experience advancing science, innovation and strategic leadership aimed at fostering a strong and inclusive economy that thrives within nature's limits.

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Executive summary

The Canada Plastics Pact (CPP) is working to create a circular economy for plastic packaging. To support its work, CPP has established a Roadmap to 2025 for Circular Plastics[1]– that outlines key steps to reducing plastic waste in Canada. CPP recognizes that a first step towards achieving better plastic packaging management in Canada is documenting our country's current plastic packaging baseline and material flows, including its use in the context of other packaging materials.

The British Columbia (BC) Ministry of Environment and Climate Change Strategy (the Ministry) too is evaluating opportunities to better prevent and manage packaging waste, including establishing an action plan — i.e., Advancing Recycling in B.C. Extended Producer Responsibility Five-Year Action Plan — that will, among other objectives, evaluate opportunities to encourage improved circularity for industrial, commercial, and institutional (ICI) packaging and paper products (PPP).[2]

Project objective

The purpose of this project was to develop a defensible baseline for the amount of PPP that is generated and then subsequently either disposed, reused, or recycled by BC's ICI sector, and identify opportunities and barriers that might exist to better improve reuse or increase recycling of ICI PPP. This includes:

- pre-consumer PPP waste generated by manufacturing and retail sites; and
- post-consumer PPP waste generated in commercial, institutional, and light industrial settings, including the construction and demolition (C&D) and agricultural ICI sub-sectors.

It does not include pre-consumer by-products that are fed back into manufacturing processes and do not enter a waste stream.

This study was not designed to develop policy or program recommendations for the Government of British Columbia nor conduct an assessment of actions or pathways the government could take to improve ICI PPP management.

Approach

Data and information across a number of sources were collected, assessed, modelled, and cross referenced to ultimately triangulate a baseline value for the amount of ICI PPP that is disposed and collected for recycling across BC as whole, across BC 'zones', and across specific BC ICI sub-sectors.

[1] Canada Plastics Pact, 2021. Roadmap to 2025. A shared action plan to build a circular economy for plastics packaging. Available at: https://roadmap.plasticspact.ca/wp-content/uploads/2021/10/CPP_Roadmap_V1_Oct2021.pdf

[2] Government of British Columbia, 2021. Advancing Recycling in B.C. Extended Producer Responsibility Five-Year Action Plan 2021-2026. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/recycling/recycle/extended_producer_five_year_action_plan.pdf

The following ICI sub-sectors were included in the scope of work:

- Agriculture; Construction; Manufacturing; Trade (i.e., retail and wholesale); Administration and Office; Transportation and Warehousing; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; and Accommodation and Food Services.

Baseline: ICI PPP disposed in BC

Table E-01 provides an overview of the estimates for the total amount of ICI PPP disposed in BC as well as where the material was disposed by geographic distribution (i.e., BC zone). The percentage of overall PPP disposed from in-scope ICI entities is estimated to range from 225,000 - 326,000 tonnes per year and approximately 26% of all ICI waste disposed. The PPP disposed consists mainly of fibre and plastic in a relatively even proportion at approximately 12%, or over 100,000 tonnes per material per year. Metal and glass PPP are found less often in the disposal stream, at approximately 1-2% by weight. The amount of PPP disposed is highest in the Lower Mainland followed by the Vancouver Island and Coastal zones.

Table E-01: Overview of ICI PPP Disposed

	Regional District waste audits (Section 3)	**Industry waste audits (Section 4)**
Total ICI PPP disposed* (tonnes)	225,000	326,000
Proportion of ICI PPP in disposal stream by material		
PPP Fibre	12%	12%
PPP Plastic	12%	12%
PPP Metal	2%	1%
PPP Glass	1%	1%
Total	26%	26%
Distribution of ICI PPP in disposal stream by zone		
Vancouver Island and Coastal	19%	14%
Lower Mainland	50%	66%
Southern Interior	15%	12%
Kootenay	4%	2%
North Central	12%	6%
Total	**100%**	**100%**

** Rounded to the nearest thousand or for percentages rounded to the nearest 1 so may not add up*

The main ICI sub-sector contributors to PPP disposed in BC are Trade (i.e., retail and wholesale) and Food Services.

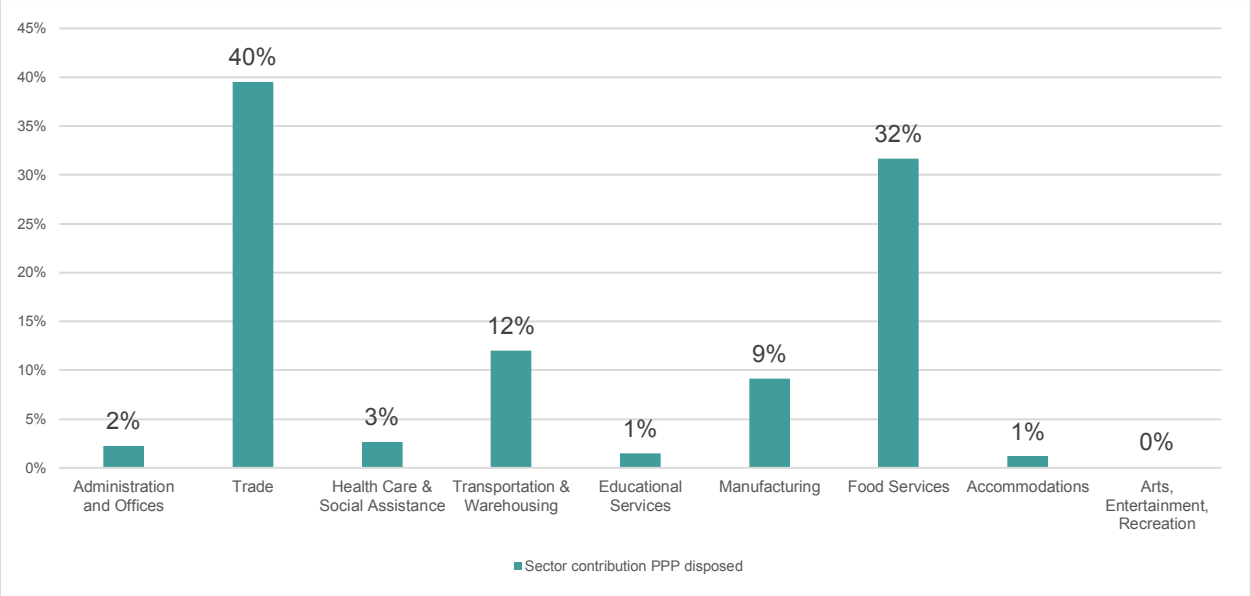

Figure E-01: Distribution of ICI PPP disposed, by sub-sector

Of the top ten ICI sub-sector contributors to PPP disposed in BC, which collectively contribute 84% of all PPP disposed, four are in the Lower Mainland and contribute 61% of all PPP disposed (i.e., Trade, Food Services, Transportation and Warehousing, and Manufacturing) (**Table E-02**).

Table E-02: Top ICI sub-sector contributors to ICI PPP disposed in BC

Sector	Zone	Total contribution to PPP disposed
Trade	Lower Mainland	25%
Food Services	Lower Mainland	21%
Transportation and Warehousing	Lower Mainland	9%
Manufacturing	Lower Mainland	6%
Trade	Vancouver Island and Coastal	6%
Trade	Southern Interior	6%
Food Services	Vancouver Island and Coastal	5%
Food Services	Southern Interior	3%
Trade	North Central	2%
Food Services	North Central	2%
Total		**84%**

Baseline: ICI PPP collected for recycling in BC

Table E-03 provides an overview of estimates for the amount of PPP collected for recycling from ICI sources in BC. While the estimates associated with collected for recycling vary more widely than disposed, industry intelligence coupled with the assessment of alternate data sources provides greater confidence in a BC baseline of PPP collected for recycling of between 200,000 – 300,000 tonnes. The variability of the collected for recycling estimates are driven by a number of factors, including fewer data sources compared to those collected for the disposal baseline assessment, a high percentage of waste audit data sources being received being from the Lower Mainland, and the knowledge that those companies that obtain waste audits are often doing so to improve upon existing recycling systems (i.e., companies without recycling systems rarely obtain waste audits). Many of these factors would lead to an 'over-estimate' of the amount of PPP collected for recycling.

Across BC, fibre materials are by far the most common ICI PPP material collected for recycling (66-96%), followed by plastics (5-18%).

Table E-03: Overview of ICI PPP collected for recycling

	Industry waste audit (i.e., Section 4)	**Service provider feedback (Section 5)**
Total ICI PPP collected for recycling* (tonnes)	517,000	150,000 - 250,000
% PPP Fibre	66 to 96% by sub-sector	90%
% PPP Plastic	5 to 18% by sub-sector	8%
% PPP Metal	0 to 12% by sub-sector	1.4%
% PPP Glass	0 to 18% by sub-sector	1.1%

** Rounded to the nearest thousand*

The main sub-sector contributors to ICI PPP collected for recycling are Trade, Transportation and Warehousing, Manufacturing, and Food services (**Figure E-02**).

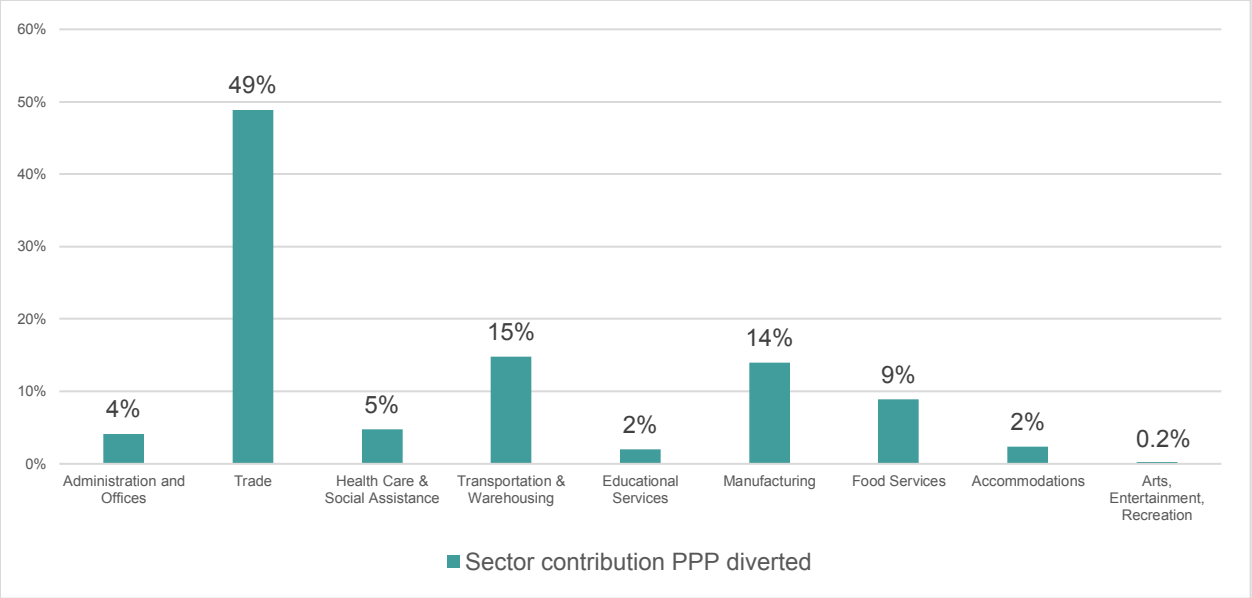

Figure E-02: Distribution of PPP collected for recycling, by sub-sector

Baseline: ICI PPP reuse in BC

A quantitative estimate for reuse could not be obtained, largely because reusable PPP is not considered nor tracked as 'waste' in waste audit data. Regardless, reuse systems have flourished, naturally, for decades, particularly where production facilities, distribution centres, and retail are all located locally (e.g., baked goods, dairy products, cold beverages, and produce). The interviews completed suggest there is a significant amount of reusable PPP being employed in the ICI sector, including for totes, pallets, crates, trays, and pressurized containers that account for hundreds of thousands of rotations per year.

Barriers to increasing ICI PPP reuse include logistics, ability to clean PPP, capitalization costs, and a lack of PPP standardization.

Acknowledgements

We thank all of the organizations that provided information to support the completion of this report. We are grateful to work in a sector with so many dedicated companies and individuals seeking to improve environmental and economic outcomes. While some companies asked to remain anonymous, we want to publicly acknowledge the support provided by the following organizations:

- British Columbia Used Oil Management Association
- British Columbia Product Stewardship Council
- Canadian Electrical Stewardship Association
- Canadian Tire Corporation, Limited
- Circular Innovation Council
- Cleanfarms
- Coast Waste Management Association
- Encorp Pacific Canada (Return-It)
- Dillon Consulting
- First Credit Union
- Fraser Health
- Green Circle Salons
- GreenStep Solutions
- London Drugs
- Metro Testing & Engineering
- MJ Waste Solutions Inc.
- Nelson Cares
- Oso Negro Coffee
- PepsiCo
- Providence Health Care
- Provincial Health Services Authority
- RecycleSmart
- Save-on-Foods
- Sea to Sky Removal
- S-Cubed Environmental
- Vancity
- Vancouver Coastal Health
- Waste Management Association of BC
- Western Dairy Council
- Zero Waste BC

To ensure maximum transparency, it should be noted that none of these organizations were permitted to review nor sanctioned the findings of this report prior to publication.

We are also grateful for the support provided by Metro Vancouver, which provided access to data and peer review, as well as British Columbia's Regional Districts and the many waste management service providers, which were instrumental in helping the project team understand the dynamics of waste generation and management across British Columbia's varying geographies and local conditions.

Finally, we thank and acknowledge the advice and guidance provided on data modelling and statistical analysis by Paul van der Werf, PhD, Adjunct Professor, Department of Geography and Ivey Business School, Western University.

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Key terms defined

Terms	Definition
Agricultural PPP	PPP generated by the agricultural sector, such as on-farm operations. It is a sub-set of ICI PPP.
Collected	End-of-life material retrieved from a generator for the purpose of recycling or disposal. In this report, material is either referred to as "collected for recycling" or "collected for disposal".
Construction and Demolition PPP (C&D PPP)	PPP generated by construction, renovation, and demolition activities and are currently not defined as residential PPP in BC's Recycling Regulation. C&D PPP is a component of ICI PPP. It excludes materials generated from land clearing.
Disposed	Material collected for disposal in a landfill or via waste-to-energy.
End-market	An organization that receives either sorted or re-processed material as feedstock for the manufacture of materials, substances, or products. For example: A pulp mill is usually an end-market because it would receive sorted fibre material (e.g., direct from a MRF), re-process it, and make new paper products. A plastics re-processor (recycler) is usually not an end-market because it would receive sorted material (e.g., direct from a MRF), re-process it into pellets or flakes, and then sell that material to an end-market that would manufacture new plastic products. A plastics re-processor could be an end-market it if manufactured plastics products post re-processing.
Generator	An ICI entity that places PPP in its waste stream.
Generated	PPP available for collection from an ICI generator.
Industrial, Commercial, and Institutional Sector (ICI)	Means any sites that that are not deemed to be part of the residential sector in BC's Recycling Regulation.
Industrial, Commercial, and Institutional PPP (ICI PPP)	PPP materials currently not defined as residential PPP in BC's Recycling Regulation. These include: industrial materials, which are generated by manufacturing, and primary and secondary industries, and are managed off-site from the manufacturing operation;

	commercial materials, which are generated by commercial operations, such as shopping centres, restaurants, offices, and others; and institutional materials that are generated by institutional facilities, such as schools, hospitals, government facilities, seniors' homes, universities, and others.[3] For clarity, industrial PPP also includes: construction and demolition PPP (C&D PPP), and agricultural PPP.
Material Recovery Facility (MRF)	A processing facility that sorts material for shipment to an end-market. A MRF is sometimes referred to as a 'processor'.
Ministry	Means the Government of British Columbia's Ministry of Environment and Climate Change Strategy.
Municipal solid waste (MSW)	"Refuse that originates from residential, commercial, institutional, demolition, land clearing or construction sources, or refuse specified by a director to be included in a waste management plan."[4]
Packaging	"A material, substance or object that is used to protect, contain or transport a commodity or product, or attached to a commodity or product or its container for the purpose of marketing or communicating information about the commodity or product."[5] The following list of materials are types of packaging: primary packaging; grouped packaging or secondary packaging; transportation, distribution, or tertiary packaging; service packaging; and packaging components and ancillary elements integrated into packaging.[6]
Paper (Fibre) Products	BC's Recycling Regulation defines "paper" as: paper of any description, including (a) flyers, (b) brochures, (c) booklets, (d) catalogues, (e) telephone directories, (f) newspapers, (g) magazines, (h) paper fibre, and (i) paper used for copying, writing or any other general use. Paper does not include (a) paper products that, by

[3] Change to: Adapted from Government of BC, June 2012. Solid Waste Generation in British Columbia 2010-2025 Forecast. Available at: https://www2.gov.bc.ca/assets/gov/data/statistics/nature-environment/solid_waste_generation_2010_2025.pdf
[4] Government of British Columbia. *Environmental Management Act*. Part 3 – Municipal Waste Management. (Current to June 1, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_03
[5] Government of British Columbia. *Environmental Management Act*. Part 1 – Introductory Provisions. (Current to June 1, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_01#section1.
[6] Adapted from: Recycle BC, 2019. Packaging and Paper Product Extended Producer Responsibility Plan Available at: https://recyclebc.ca/wp-content/uploads/2019/07/RecycleBCStewardshipPlan_16July2019.pdf

	virtue of their anticipated use, could become unsafe or unsanitary to recycle, or (b) bound reference books, literary books, and textbooks.[7]
Recyclable Material	BC's Environmental Management Act defines this as: "A product or substance that has been diverted from disposal, and satisfies at least one of the following criteria: (a) is organic material from residential, commercial, or institutional sources and is capable of being composted, or is being composted, at a site; (b) is managed as a marketable commodity with an established market by the owner or operator of a site (c) is being used in the manufacture of a new product that has an established market or is being processed as an intermediate stage of an existing manufacturing process; (d) has been identified as a recyclable material in a waste management plan; (e) is any other material prescribed by the Lieutenant Governor in Council, or the minister under section 22 [minister's regulations — codes of practice.] "[8]
Recycler / Re-processor	A facility that takes sorted recyclable material, processes it, and produces recycled raw materials (e.g., post-consumer resin) for use by an end-market.
Recycled	PPP that is re-processed into recycled raw materials that are incorporated into new products, materials, or substances whether for the original or other purposes. Re-processing might include conventional recycling activities or composting but excludes energy recovery.
Residential Sector	BC's Recycling Regulation defines the residential sector as: "Houses, apartments, condominiums, town homes and other premises in which persons reside but does not include institutional accommodations or visitor accommodations."[9]
Reuse	The use of durable products for multiple trips or rotations for periods that are typically longer than five years, before being disposed of or reaching the end of their useful lifespan. Reusable products are those that have low turnover rates, are captured after

[7] Government of British Columbia. *Recycling Regulation*. (Current to June 21, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/449_2004
[8] Government of British Columbia. *Environmental Management Act*. Part 1 − Introductory Provisions. (Current to June 1, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_01
[9] Government of British Columbia. *Recycling Regulation*. Definitions. (Current to June 21, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/449_2004

	each use, and are responsibly managed through the end of their useful life.[10]
Refill	"An operation by which packaging is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products (1) present on the market, enabling the packaging to be refilled. Source: ISO 18603:2013, Packaging and the environment -Reuse, modified (clarification note 1). Note: An auxiliary product is a product used to support the refilling/loading of reusable packaging. (…) An example of an auxiliary product is a detergent pouch used to refill a reusable container at home (ISO 18603). As per, ISO 18603, auxiliary products that are one-way products (i.e., designed to be used once) are not considered reusable packaging."[11]
Small or medium-sized enterprise (SME)	Enterprises with less than 500 employees.
Supplied	PPP provided to ICI entities in BC.
Waste Audit	This phrase is often used interchangeably with waste composition study. A waste audit is a detailed analysis of materials found in a particular waste stream (e.g., disposal, recycling, green bin).
Work Camp	Also called industrial camps, means "places where people are employed and accommodated onsite – such as camps supporting forestry, sawmills, mining, canneries, and oil and gas activities."[12]
Solid Waste Management Plan (SWMP)	A plan BC's Regional Districts are required to develop, as mandated by BC's Environmental Management Act.

[10] Definition was developed by adapting the Government of British Columbia's definition of 'short-use product': "Both packaging-like and single-use products are included if they would be ordinarily disposed of after a single use or short-term use, regardless of whether they could be re-used or not. This refers to products that are used and re-used for a short period of time, typically less than five years, before being disposed of or reaching the end of their useful lifespan. The intention of including these products is to ensure items with high turnover rates are captured and responsibly managed (p.3)." Source: Government of British Columbia, Ministry of Environment and Climate Change Strategy, 2020. 2020 Amendments to the Recycling Regulation. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/recycling/recycle/2020-06-29_explanatory_notes_to_reg_amendments.pdf

[11] Ellen MacArthur Foundation, 2021. The New Plastics Economy. Plastics Pact Network, Vision and Definitions. Available at: https://emf.thirdlight.com/link/yohiss18qn6m-rs0oo3/@/preview/1?o

[12] Government of British Columbia, n.d. Industrial camps. Available at: https://www2.gov.bc.ca/gov/content/health/keeping-bc-healthy-safe/industrial-camps.

Abbreviations

Terms	Definition
B2B	Business to business
B2C	Business to consumer
BC	British Columbia
CI	Confidence interval
C&D	Construction and demolition
CPP	Canada Plastics Pact
DRS	Deposit return system
EPR	Extended Producer Responsibility
EPS	Expanded polystyrene
FTE	Full time equivalent
HDPE	High-density polyethylene
IBC	Intermediate bulk container
ICI	Industrial, commercial, and institutional
Ministry	Ministry of Environment and Climate Change Strategy
MRF	Material recovery facility
MSW	Municipal solid waste
NAICS	North American Industry Classification System
n/a	Not available
n.d.	No data
OCC	Old corrugated cardboard or old corrugated carton. Both phrases refer to the same type of material.
PET	Polyethylene terephthalate
PP	Polypropylene
PPEC	Paperboard Packaging Environmental Council
PPP	Packaging and paper (fibre) products
PS	Polystyrene
SD	Standard deviation
SME	Small or medium-sized enterprise
SWMP	Solid Waste Management Plan

1. Background

The Canada Plastics Pact (CPP) is working to create a circular economy for plastic packaging. To support its work, CPP has established an unprecedented collaboration between companies, organizations, and governments across the entire plastics value chain to carry out an action plan –i.e., Roadmap to 2025 for Circular Plastics– that outlines key steps to reducing plastic waste in Canada.[13] CPP recognizes that a first step towards achieving better plastic packaging management in Canada is documenting our country's current plastic packaging baseline and material flows, including its use in the context of other packaging materials. The British Columbia (BC) Ministry of Environment and Climate Change Strategy (the Ministry) is an implementation partner of CPP.

The Ministry, too, is evaluating opportunities to better prevent and manage packaging waste, including:

- proposing regulatory interventions to prevent or restrict problematic plastic packaging and short-term use products;[14] and
- establishing an action plan – i.e., Advancing Recycling in B.C. Extended Producer Responsibility Five-Year Action Plan– to establish new extended producer responsibility (EPR) requirements for some end-of-life products and evaluate opportunities to encourage improved circularity for industrial, commercial, and institutional (ICI) packaging and paper products (PPP).[15]

Residentially generated PPP is already subject to EPR collection and recycling requirements under BC's *Recycling Regulation*. However, ICI PPP is not a designated material under the regulation; ICI PPP includes any PPP that is not generated by the residential sector (see **Key Terms Defined** for the definition of "ICI sector")."[16,17]

To support CPP's and the Ministry's joint goal of enabling actions that promote PPP circularity, the Ministry engaged CPP to collect and provide baseline information on the current state of ICI PPP end-of-life management (i.e., disposal, recycling, and reuse) in BC. Both CPP and the Ministry established the project scope, objectives, and budget. CPP engaged Policy Integrity to complete this work on their behalf.

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[13] Canada Plastics Pact, 2021. Roadmap to 2025. A shared action plan to build a circular economy for plastics packaging. Available at: https://roadmap.plasticspact.ca/wp-content/uploads/2021/10/CPP_Roadmap_V1_Oct2021.pdf

[14] Government of British Columbia, 2022. Preventing Single-Use and Plastic Waste in British Columbia: Intentions Paper. Available at: https://engage.gov.bc.ca/app/uploads/sites/752/2022/04/CleanBC_Single-Use-Plastics_Intentions-Paper.pdf

[15] Government of British Columbia, 2021. Advancing Recycling in B.C. Extended Producer Responsibility Five-Year Action Plan 2021-2026. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/recycling/recycle/extended_producer_five_year_action_plan.pdf

[16] Government of British Columbia. *Recycling Regulation*. Definitions. (Current to June 21, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/449_2004

[17] BC Ministry of Environment and Climate Change Strategy, Advancing Recycling in B.C.: Extended Producer Responsibility Five-Year Action Plan 2021-2026, 2021. Available at https://www2.gov.bc.ca/assets/gov/environment/waste-management/recycling/recycle/extended_producer_five_year_action_plan.pdf (viewed March 12, 2022).

This study was not designed to develop policy or program recommendations for the Government of British Columbia nor conduct an assessment of actions or pathways the government could take to improve ICI PPP management. While this project was focussed on developing an ICI PPP profile for BC, this project provides a foundational approach and methodology that could be replicated and scaled nationally.

2. Objective and scope

2.1. Project objective

The primary purpose of this project was to develop a defensible baseline for the amount of PPP that is generated in ICI waste streams and then subsequently either disposed (whether in landfill or by waste-to-energy), reused, or recycled by BC's ICI sector. This includes pre-consumer PPP generated by manufacturing and retail sites, and post-consumer PPP generated in commercial, institutional, and light industrial settings, including the construction and demolition (C&D) and agricultural ICI sub-sectors.

It is important to emphasize that this study was not designed to develop or assess policy or program recommendations to improve ICI PPP management in BC. This project was strictly designed to establish baseline for ICI PPP end-of-life management, as well as identifying any issues that might be hindering improved management (Figure 1). The BC Government plans to build on the findings of this report to undertake separate work related to identifying and implementing solutions to overcome issues and to improve ICI PPP management.

In this report, all mentions of "PPP" should be considered ICI PPP in BC unless otherwise stated.

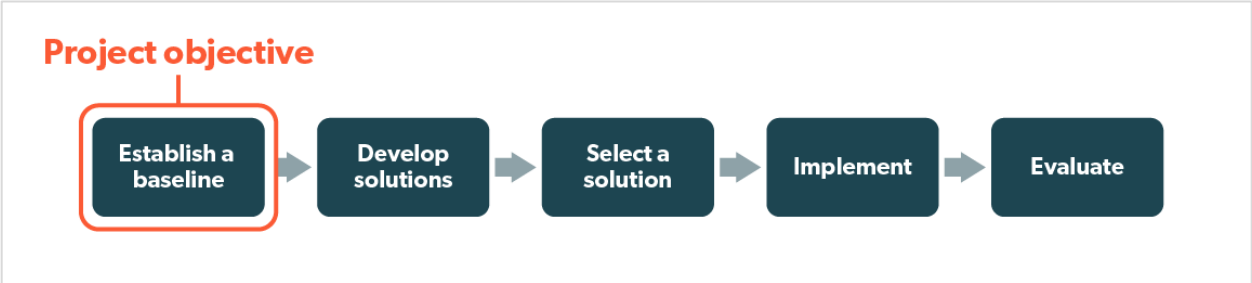

Figure 1: Project Objective

2.2. Project scope

This project was scoped to target those ICI sub-sectors for which PPP data are most readily available and that are generating the greatest amounts of PPP. Within each target sub-sector, effort was focused on businesses that are receiving 'conventional' waste disposal services from a waste management company (i.e., those that have bins or carts and are regularly serviced). In addition, while data are scarce, the Ministry also requested baseline data be sought for work camps, which support the resource sector (e.g., mining, oil, and gas). **Table 1** lists those ICI sub-sectors, by North American Industry Classification System (NAICS) Code, that were analyzed as part of this study.

Table 1: ICI Sub-Sectors Reviewed

NAICS Codes	Category
11 (111-112 only)	Agriculture, forestry, fishing, and hunting (i.e., agriculture only)
23	Construction
31-33	Manufacturing
41, 44-45	Trade (e.g., retail and grocery stores, malls)
48-49	Transportation and warehousing (e.g., airports, ferry, transit)
51-56, 81, 91	Administration and office[18]
61	Educational services (e.g., elementary, secondary, and post-secondary schools)
62	Health care and social assistance (e.g., hospitals, care homes)
72	Accommodation (e.g., hotels, motels, resorts, campgrounds) and Food Services (e.g., restaurants and catering)
71	Arts, entertainment, and recreation (e.g., museums, arenas)
n/a	Work camps

2.2.1. Out-of-scope activities

The following activities were deemed out-of-scope:

- resource extraction industries (e.g., mining, forestry), with the exception of related work camps, because waste audit data for these industries are largely unavailable and they are not believed to be large generators of PPP;[19] and
- litter, including ocean debris, because the generators of these materials are unknown and might not reside in BC.

2.3. Approach and methodology

This section provides an overview of:

- the sources of data sought and acquired;
- specifics on how PPP data were categorized and assessed;
- how Regional Districts were grouped into "zones" to enable comparisons and determine whether there were any significant differences in PPP disposed and collected for recycling across BC;
- how data from Regional Districts were collected and analyzed to establish an estimate of the PPP disposed by Regional District and by zone;

[18] The title "Administration and office" has been used for the purpose of brevity but includes the following NAICS categories: Information and cultural industries, Finance and insurance, Real estate and rental and leasing, Professional, scientific, and technical services, Management of companies and enterprises, Administrative and support, waste management and remediation services, Other services (except public administration), and Public administration.

[19] Workcamps, also known as industrial camps, are "places where people are employed and accommodated onsite – such as camps supporting forestry, sawmills, mining, canneries, and oil and gas activities". Government of British Columbia, n.d. Industrial camps. Available at: https://www2.gov.bc.ca/gov/content/health/keeping-bc-healthy-safe/industrial-camps#:~:text=The%20Ministry%20of%20Health%20provides%20policy%20support%20for,agriculture.%20B.C.%20has%20declared%20a%20state%20of%20emergency

- how waste audit data and information from individual businesses were collected, analyzed, and modelled to establish estimates of PPP disposed and collected for recycling by ICI sub-sector and by zone of BC;
- how service provider data and information were collected and assessed to establish an estimate of PPP collected for recycling and ultimately recycled; and
- how all of these data were collated, cross referenced, and ultimately used to triangulate a BC baseline for ICI PPP disposed and collected for recycling.

2.3.1. Overview and rationale for the approach taken

The approach needed to establish a baseline ICI PPP disposed and collected for recycling is fundamentally different than would be needed to set a baseline for residential PPP. Residential PPP has been the topic of significant study for decades –whether for data gathering, policy making, or program development. As a result, the literature available on residential PPP supply to market, waste generation, and end-of-life management is plentiful. There are already systems in place across most of Canada (i.e., those with regulated EPR /shared responsibility systems) to collect and report on the amount of residential PPP supplied (i.e., put into the marketplace), generated as waste and disposed as garbage, collected for recycling, and ultimately recycled (i.e., sold to an end-market for the manufacture of new goods).
In comparison, access to detailed and coherent datasets for ICI PPP generation and management in BC, as in the rest of Canada, is limited, and the PPP profile within the ICI sector (i.e., across ICI sub-sectors) and across jurisdictions (i.e., between provinces and across zones of a province) is heterogenous.[20] Specific issues to obtaining reliable ICI PPP datasets include:

- ICI waste is generally not collected by public bodies (e.g., municipalities). Instead, it tends to be collected by private waste management companies that compete in an open marketplace. Private companies guard their proprietary data because it affects their ability to compete. Therefore, far fewer public reports documenting the composition of ICI waste streams exist.
- Canada's provinces and territories have not yet implemented EPR PPP systems for the entire ICI sector, though components of the ICI sector might be included in residentially-focussed PPP systems (e.g., schools, nursing homes, retirement homes). In June 2022, Québec became the first province to regulate an EPR requirement for ICI PPP; however, this will take several years to fully implement. Therefore, "producers" (e.g., brand owners, retailers) do not have ready backend data systems in place to track their supply of PPP to the ICI sector and consider it proprietary. The lack of publicly available data inhibits researchers' ability to obtain a complete picture of the ICI PPP material supplied by producers into the marketplace.
- Much of the ICI PPP that is believed to be supplied to the market is business to business (B2B) PPP (i.e., pre-consumer PPP). B2B PPP is generally managed by different divisions of producers' companies than those that track and manage PPP supplied to the

[20] For example, 1. Environment and Climate Change, National Waste Characterization Report: The Composition of Canadian Residual Municipal Solid Waste, 2020. Available at https://publications.gc.ca/collections/collection_2020/eccc/en14/En14-405-2020-eng.pdf and 2) Canada Plastics Pact, Canada Plastics Pact Foundational Research and Study: Canadian Plastic Packaging Flows, 2021. Available at https://plasticspact.ca/wp-content/uploads/2021/10/CPP-Foundational-Research-on-Canadian-Plastics-Packaging-Flows-Might-2021-final.pdf

residential sector (i.e., consumer packaging). As a result, even if a producer could use their residential PPP data to estimate the amount of consumer-facing packaging that is put into the marketplace and sold into the ICI sector, they do not yet have data systems in place to provide a readily available estimate of B2B PPP generation and management.

- Unlike the homogeneity of the PPP composition in the residential sector, the PPP composition for the ICI sector is highly heterogenous. The types of activities being undertaken by the ICI sector are diverse resulting in unique PPP compositions across ICI sub-sectors (e.g., small coffee shops, food processing facilities, product manufacturers, hospitals). Even across similar types of businesses within an ICI sub-sector, there can be great heterogeneity depending on their business model. An individual business' PPP composition and management are affected by factors such as:
    - the business' geographic location and its distance from material markets;
    - the size of the business;
    - its customers' expectations;
    - the availability of local waste management services; and
    - the physical space available for it to manage materials on its property, whether indoors or outside.

To overcome the challenges of limited data sets and diverse PPP composition, this project built an ICI PPP baseline profile for BC by drawing on both quantitative and qualitative data from numerous existing sources. These data sets were analyzed and then cross checked to determine whether the results were consistent. When multiple data sources trend towards the same results, this enables more confidence in the results found. This approach is called triangulation and is illustrated in **Figure 2.** The approach allowed the project team to ensure a continual data checking loop to test the validity of our findings. While some of the data and information sources might have been weaker on their own, this approach allowed the project team to gain better confidence in the overall assessment.

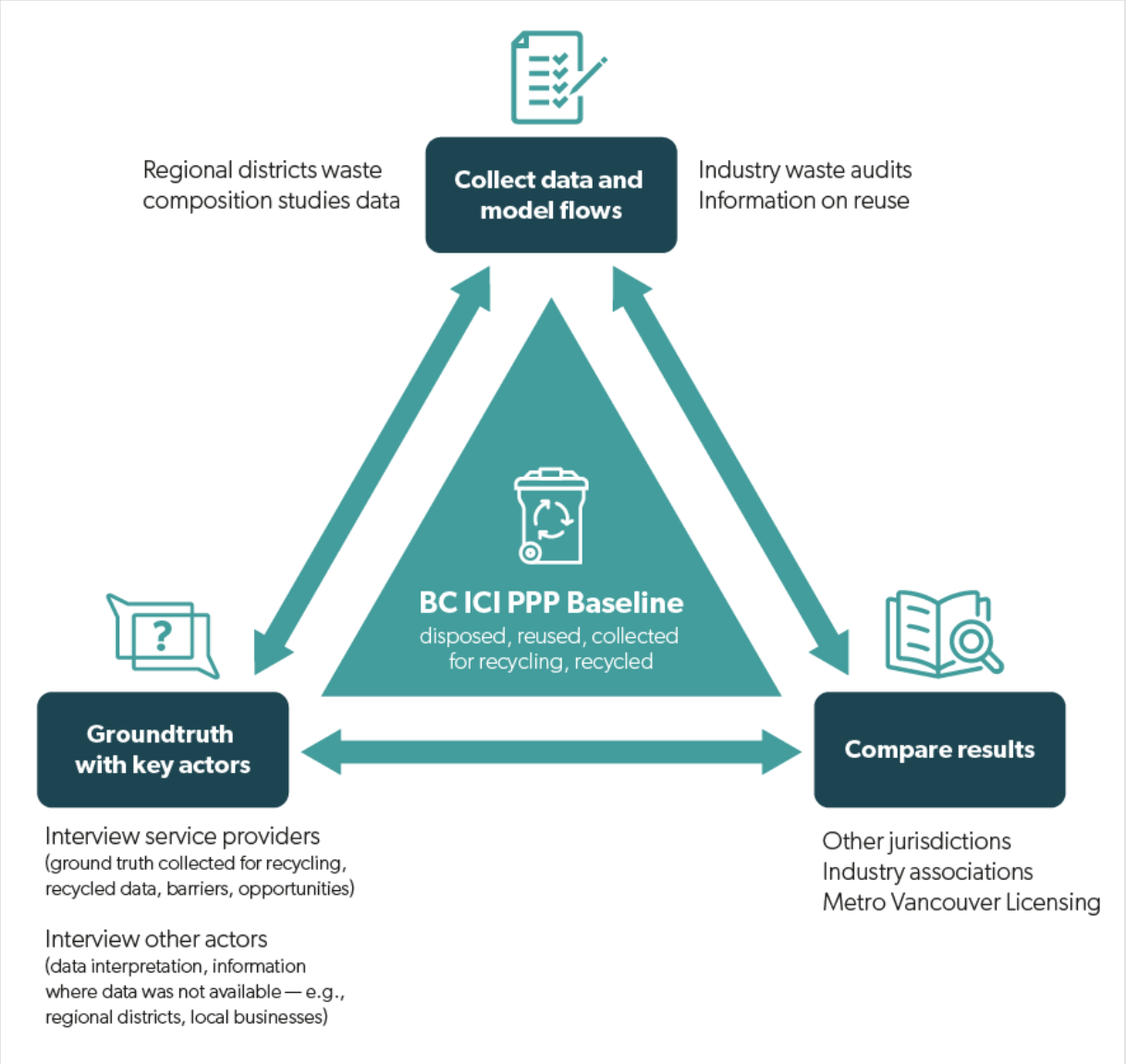

Figure 2: Triangulation of an ICI PPP Baseline for BC

2.3.2. Sources of data and information

More than 150 entities (i.e., businesses, associations, BC local and regional governments) were contacted for access to quantitative and qualitative data sources. Over 50 of these agreed to provide assistance. Many ICI entities required the project team to sign confidentiality agreements to ensure they were not identified in this research nor were any datasets attributable to them. There is a significant amount of concern that ICI PPP data attributable to specific companies could provide an indicator of their market share and result in anti-competitive effects.

Sources of the quantitative data gathered include:

- BC government data self-reported by Regional Districts (through Re-TRAC Connect);

- Regional District waste audits and Solid Waste Management Plans (SWMP);
- waste and recycling audit data from individual businesses across all targeted ICI sub-sectors;
- producer responsibility system operators that service the ICI sub-sector;
- agricultural data published by Cleanfarms;[21]
- Metro Vancouver solid waste facility licensing data;
- Data from research completed by the Paper and Paperboard Packaging Environmental Council;
- a BC dairy industry survey on reuse; and
- Statistics Canada's Waste Management Industry Survey.

Quantitative data were received for all NAICS codes.

The project team focused on collecting waste audit data from 2019 or earlier to ensure COVID-related issues impacting the ICI sector did not skew the baseline. However, given a lack of data sources, some data incorporated into the analysis are from 2020 and 2021.

Sources of qualitative data included over 50 interviews with individuals from the following organizations:

- Regional Districts waste management staff;
- EPR system operators;
- industry and environmental associations;
- haulers, sorting facilities (i.e., MRFs, which are sometimes called processors), and re-processors (i.e., makers of recycled raw materials, but some of which, like fibre mills, are also end-markets that manufacture products with recycled content from the recycled raw materials);
- C&D recycler;
- waste auditors; and
- businesses (e.g., coffee shop owner, a charity that used to haul ICI PPP, two banks, several grocery stores, several pharmacies, several goods retailers, a food manufacturer, a distribution centre operator, a government agency) to gain a better understanding of PPP waste generation and management at their sites.

2.3.3. PPP material categorization

Consolidating data related to PPP is challenging because of the variation in how data are captured by various sources. As a result, the PPP categories assessed for this project were streamlined from how they are typically reported in individual waste audits to allow for comparisons between data sources. This included grouping the discrete PPP categories reported into high-level groupings. **Table 2** provides the list of ICI PPP material categories and sub-categories that were assessed, and examples of materials in each sub-category.

[21] In 2021, Cleanfarms published "Agricultural Plastic Characterization and Management on Canadian Farms". Available at https://cleanfarms.ca/agricultural-plastic-characterization-and-management-on-canadian-farms/

Note: In BC, all designated ready-to-serve beverage containers are collected and managed by an EPR system (i.e., two separate programs), which operate using a deposit return system. Milk and milk substitute containers (with exceptions of products such as kefir, buttermilk, and drinkable yoghurt) were added to the system in 2022. These containers were included in the PPP categories assessed because the waste audits reviewed often do not separate these containers out as a separate waste stream (i.e., they are included in the plastic, glass, or metal streams) and the containers are present in the waste stream. However, overall, beverage containers contribute a relatively small portion (less than 1%) of the ICI PPP disposed and so their inclusion is assumed to be insignificant to the findings.

Table 2: Material categories and sub-categories reviewed

Categories	Sub-categories	Examples
Paper (Fibre)	OCC / Boxboard	Boxboard, cardboard, waxed OCC
	Mixed paper	Marketing and advertising mail, flyers, unaddressed mail, fine office fibre, envelopes, newsprint, fibre cups, plastic-lined fibre cups, magazines, telephone books, gable top containers, drink boxes, aseptic containers, unlined and lined plastic fibre take-out containers, fibre bags
	Non-PPP	Paper towels, books
Plastic	PET	PET, rigid cups, PET beverage containers
	HDPE	Some beverage containers, detergent bottles, pails, and buckets
	Film	Film, plastic bags, sandwich bags, freezer bags, beverage pouches, soft plastics
	Other	Containers and single-use plastic products (e.g., utensils, straws, disposable tableware) made from PP, PVC, or compostable plastics; rigid LDPE and PS (e.g., foam cups, takeout containers, and tableware); rigid PVC (e.g., blister pack), uncoded packaging.
	Non-PPP	Synthetic textiles, durable plastic
Metal	Non-Ferrous	Aluminum containers, foil trays, foil wrap
	Ferrous	Ferrous food containers, spiral-wound containers
	Non-PPP	Mixed metals, machine parts, construction metals, industrial metals, shelving
Glass	Glass	Glass beverage containers, glass food containers
	Non-PPP	Other glass and ceramics, windows

In addition, the project team assessed the incidence of reuse for durable and reusable PPP items (e.g., pallets, skids, bulk bags, drums, bulk containers, crates) through surveys and follow-up interviews. As these items are not typically placed in a disposal stream until the end of their useful life, quantitative data on their reuse, recycling, and disposal is not accurately captured in most waste and recycling audit data.

2.3.4. Regional District data ICI PPP characterization

Each Regional District self-reports the percentage of ICI waste that make up their waste stream, either through the Ministry's municipal solid waste disposal calculator (i.e., Re-TRAC Connect system) or in their Solid Waste Management Plan (SWMP) or waste audit (**Appendix A: Self-reported estimate of the relative proportion of residential, ICI, and C&D waste**). The self-reported data are not verified. Because of data irregularities or missing data, some data were adjusted from their self-reported data in the municipal solid waste disposal calculator. The data for Bulkley-Nechako were adjusted using data reported in their SWMP.[22] Data for Fraser Valley, Fraser-Fort George, and qathet were adjusted using their most recent waste audits. A self-reported estimate of the contribution of ICI to total municipal solid waste (MSW) was not available for Central Kootenay, East Kootenay, Kootenay Boundary,[23] Okanagan-Similkameen, or Sunshine Coast. In these cases, a weighted average of other Regional Districts was extrapolated to estimate ICI PPP in those Regional Districts.

Regional District waste audits were reviewed to assess whether ICI PPP was measured as a component of the total waste stream. Of the 27 Regional Districts, 20 had studies available that included an assessment of ICI PPP (**Appendix B: Regional District waste audits**). Of these, one (Kootenay Boundary, 2006) was outside the recommended 10-year planning period for Regional Districts and its data were found to be out-of-date. In general, the waste audits were highly varied in methodology, including the level of detail undertaken for each study.

Where waste audits were available, each was reviewed to calculate the proportion of ICI PPP fibre, PPP plastic, PPP metal, and PPP glass that were found in the overall waste stream. The percentage of PPP for each material was calculated by subtracting non-PPP data from the total reported for each material category:

Where audits of more than one landfill / data source / point in time were undertaken as part of a waste audit, a weighted average of the proportion of ICI PPP was calculated for the Regional District. The estimated percentage contribution of each ICI PPP material category for each Regional District was then multiplied by the estimated ICI tonnage for each Regional District to establish a rough estimate of the total tonnage of ICI PPP waste disposed.

To identify whether there were patterns in PPP generation by BC 'zone', the Regional Districts were grouped into five zones based on local government association affiliations as characterized by Union of BC Municipalities (UBCM): Kootenay, North Central, Lower Mainland, Southern Interior, and Vancouver Island and Coastal Communities (**Table 3**).[24] Squamish-

[22] Bulkley-Nechako's self-reported data did not identify an ICI contribution. A self-reported estimate was included in their SWMP.

[23] While there were data available for Kootenay Boundary, the most recent waste audit for Kootenay Boundary was completed in 2006, which was outside BC's recommended 10-year solid waste management planning horizon, and before the introduction of BC's residential PPP recycling system. As a result, this data was determined to be an unreliable representation of the current state of ICI PPP disposal.

[24] Union of BC Municipalities. Area Associations. (Current to June 21,2022). Available at: https://www.ubcm.ca/about-ubcm/area-associations

Lillooet is a member of both the Lower Mainland Local Government Association and the Southern Interior Local Government Association but is most often affiliated with the Lower Mainland. Sunshine Coast is a member of the Vancouver Island and Coastal zone by government association affiliation and from a waste perspective this grouping is logical as it is a region that is serviced by ferry access. However, according to Government of BC statistics, it is also a member of the Lower Mainland Economic Region.[25]

Table 3: Regional Districts by zones

Zones	Regional Districts
Kootenay	Central Kootenay East Kootenay Kootenay Boundary
Lower Mainland	Fraser Valley Metro-Vancouver Squamish-Lillooet
North Central	Bulkley-Nechako Cariboo North Coast Northern Rockies Regional Municipality Peace River Fraser-Fort George Kitimat-Stikine
Southern Interior	Central Okanagan Columbia-Shuswap North Okanagan Okanagan-Similkameen Thompson-Nicola
Vancouver Island and Coastal	Alberni-Clayoquot Capital Central Coast Comox-Strathcona Cowichan Valley Mount Waddington Nanaimo qathet Sunshine Coast

[25] Government of British Columbia. Census boundaries. (Current to June 21, 2022). Available at: https://www2.gov.bc.ca/gov/content/data/geographic-data-services/land-use/administrative-boundaries/census-boundaries

2.3.5. Industry waste audit data ICI PPP characterization

The project team contacted more than 120 entities that could have access to ICI waste audits across the targeted NAICS codes, including waste auditors, CPP members, industry associations, environmental organizations, universities and colleges, government departments and agencies, and EPR organizations. Each contact was sent an email that requested waste audit data, including a copy of a waste audit data collection sheet. Contacts without direct access to individual company waste audit data (e.g., associations, Regional Districts, municipalities) but whose members or ratepayers could have waste audit data were asked to relay information about the project to their constituents and encourage them to provide audit data to support the project.

Where the waste audit data received were challenging to understand, a representative from the ICI entity that provided the data were interviewed to gain a better understanding of the audit. Entities that provided waste audits did so on the basis that the audit data would be treated as confidential and aggregated with other like businesses to ensure the anonymity of the data source. The project team provided written assurance that it would not disclose the data of individual businesses to CPP, the Ministry, or any other entity, or people beyond specific members of the project team. Before providing data, many of the companies required the additional surety of signed confidentiality agreements to enable legal recourse if data were to be disclosed.

At the request of the Ministry, the project team started by gathering waste audit data exclusively from BC, which equated to 61% of the data ultimately used. For example, numerous retailers provided data for retail stores across Canada, but only BC-based stores were used wherever possible. While extensive outreach was undertaken, much of the waste audit data obtained in BC were from the Lower Mainland and Southern Interior Regions. Where data gaps existed, out-of-province data were used to supplement BC data. This included waste audit data from Ontario (35%), and Alberta and Québec (5%). There were no waste audits related to PPP available for construction sites, only one audit related to work camps, and very few audits for the transportation sector.

Consolidating the waste audit data were challenging as there is inconsistency in how waste audits are conducted and normalization factors are often not recorded as part of the audit report. In total, 350 usable waste audits of individual businesses were collected, analyzed, and modelled (**Table 4**)**.** Well over 100 waste audits were collected that could not be used because they could not be normalized to make them 'comparable' data sources. For example, audits were discarded if:

- they were lacking square footage or full time equivalent (FTE) data;
- it was unclear 'what' was audited –i.e., the whole business or facility or just part of it;
- the timeframe for the audit was unclear;
- the annual amount of waste disposed or collected for recycling was not available;
- PPP was not recorded by categories but instead was recorded as 'program recyclable material' or waste.

Most of the data collected were from 2019-2021, however some datapoints dated as far back as 2014.

The waste audit data collected included:

- generator information (e.g., type of business, number of FTEs);
- square footage of the facility;
- days the facility is open per year;
- tonnes of waste disposed and collected for recycling annually; and
- the percentage of various PPP categories/sub-categories in the waste disposal stream and the recycling stream (when available).

All data were aggregated to ensure individual ICI generator anonymity and categorized by two-digit NAICS codes.

It should be noted that many of the waste audits received included waste disposal data only. This is likely because waste audits are often undertaken to provide company operators with a better understanding of the amount of divertible wastes in the disposal stream (i.e., to inform opportunities to improve 'recycling'). An estimated 59% of the waste audits received (42% from BC), included usable PPP collected for recycling data. Most of the waste audit data collected did not include PPP that is reused (e.g., totes, bins, trays, skids, pallets). Information on reusable PPP is provided in **Section 4.5.**

Table 4: Overview of waste audit data collection, by sector

NAICS Codes	Category	Total waste audits	BC waste audits	Audits with recycling and disposal data
11	**Agriculture, forestry, fishing, and hunting**	Out of scope except 111-112		
111, 112	*Crop production, animal production and aquaculture*	*Cleanfarms data*		
23	**Construction**	**0**	**0**	**0**
31-33	**Manufacturing**	**67**	**38**	**57%**
41, 44-45	**Trade**	**64**	**35**	**54%**
41	*Wholesale trade*	*0*	*0*	*0*
44-45	*Retail trade*	*58*	*34*	*53%*
51-56, 81, 91	**Administration and office**	**81**	**57**	**61%**
48-49	**Transportation and warehousing**	**3**	**2**	**100%**
61	**Educational services**	**28**	**7**	**96%**
6111	*Elementary and Secondary Schools*	*10*	*0*	*100%*
6112, 6113	*Colleges and Universities*	*18*	*7*	*94%*
62	**Health care and social assistance**	**18**	**7**	**89%**
71	**Arts, entertainment, and recreation**	**18**	**10**	**83%**
72	**Accommodation and food services**	**71**	**52**	**42%**
722	*Food services*	*48*	*39*	*23%*
721	*Accommodation*	*23*	*13*	*87%*
	Total	**350**	**208**	**59%**

Post consolidation, the data were modelled to create an estimate of the weight of PPP and percentage of PPP, by material category (fibre, plastic, metal, glass) and sub-category (e.g., OCC) in the disposal and the collected for recycling streams for each targeted ICI sub-sector, as a whole (i.e., across all of BC), and for each BC zone. Estimates were calculated as follows:

- Statistics Canada 2021 FTE sub-sector data[26] was used and broken out by BC zone using the equivalent proportion of employment per zone as detailed in BC Stats employment and unemployment rates by development region.[27] The relative proportion between total number of employees and FTEs, by sub-sector, is similar.
- The waste audit data collected for each business was processed to generate an estimate of the kg disposed/collected for recycling per year per FTE (i.e., kg/FTE/year).
- The data for each business was then aggregated into the appropriate ICI sub-sector and averaged to generate an estimate of the average kg/FTE/year for each sub-sector.[28]
- Where an estimate of kg/FTE/year could not be calculated based on the available data, proxies were used:
    - For the Transportation and Warehousing sub-sector (i.e., NAICS 48-49), FTE data were not available. As a result, the estimates generated for the Trade sub-sector were used.
    - For the Education sub-sector (i.e., NAICS 61), waste audits regularly report the number of students rather than the number of FTEs contributing to the waste stream. As a result, students were used as a proxy of FTEs. A ratio of FTEs and students was developed and used to calculate kg/FTE/yr (i.e., where the FTEs were teachers and staff).
- To calculate an estimate of the weight disposed / collected for recycling across each ICI sub-sector for the whole of BC (i.e., kg/year/sub-sector):
    - The estimates of the average kg/FTE/year of PPP disposed and PPP collected for recycling were then multiplied by the number of FTEs in each sub-sector (i.e., as determined by the 2021 FTE sub-sector data from Statistics Canada.[29]
    - This value was then converted to tonnes/year.
- To calculate an estimate of the weight disposed/collected for recycling across each ICI sub-sector for each zone of BC (i.e., kg/year/sub-sector/zone):
    - The estimates of the average kg/FTE/year of PPP disposed and PPP collected for recycling were then multiplied by Statistics Canada BC employment data for each sub-sector for each BC zone (for zone breakdown see **Table 3**).[30]

Presentation of the data based on each of the sub-sector (**Section 4.3**) has been carefully considered to avoid misinterpretation while also providing enough information for future researchers to improve upon the results found. Normally, a confidence interval is calculated and provides an indicator to the reader of the confidence they should have in the results found. The more variable the data are, the wider the confidence interval is, and the less confidence a reader should typically have in the results. More data points could contribute to reducing the size of a confidence interval. However, as discussed in **Section 2.3.3**, the ICI sector and even ICI sub-sectors and divisions are naturally highly variable in terms of PPP generation, disposal, and

[26] Statistics Canada. Table 14-10-0202-01 Employment by industry, annual. Available at. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410020201.
[27] BC Stats. Employment and Unemployment Rates by Detailed NAICS Industry and Development Region. (Current to June 21, 2022). Available at: https://www2.gov.bc.ca/gov/content/data/statistics/business-industry-trade/number-of-businesses-and-employment-by-industry
[28] Employment by industry, annual. Available at: https://open.canada.ca/data/en/dataset/51490d9d-e071-4644-8b86-a351d1a48399
[29] Ibid.
[30] Ibid.

collection for recycling. This is due to many factors such as: the activities of individual businesses (e.g., a clothing store vs a grocery store), their individual waste management system choices, and the availability of waste management system options in their geographic location.

Because high variability is inherent in the ICI sector as a whole and within its sub-sectors simply due to the different business models employed, one should expect the data to have wider confidence intervals. As a result, the use of confidence intervals alone to assess the quality of data that is naturally highly variable is not wholly informative for the reader. However, it is still important to document the data variability and quality found in this study as a guide for future research to potentially improve upon the findings of this report.

To highlight which sub-sectors' data proved to be more variable, a 'variability rating' was provided that is based on a calculation of the confidence intervals both for PPP disposed and collected for recycling:

- Where the confidence interval was <70% a medium variability rating was provided.
- Where the confidence interval was between 70%-100%, a medium to high variability rating was provided.
- Where the confidence interval was >100%, a high variability rating was provided.

To be clear, in this case, the level of variability should not be construed good or bad. Highly variable data is likely just an indicator of the variability of business models within the sub-sector. Future research that focuses on specific business models could yield less variable results.

In addition to data variability, it's also important to provide a 'data availability rating' as an indicator of the number of waste audits used to inform the assessment of each ICI-sub-sector:

- Where there were 15 or fewer waste audits for a sub-sector, a low rating was provided.
- Where there were 16 - 40 waste audits for a sub-sector, a low to medium rating was provided.
- Where there were more than 40 waste audits for a sub-sector, a medium to high rating was provided.

The data availability rating could be an indicator of those ICI-sub-sectors that are conducting fewer waste audits or are less likely to voluntarily share the results of their waste audits.

2.3.6. Service provider data ICI PPP characterization

Service providers were contacted from across the province, including haulers (i.e., collection contractors), sorting facilities (i.e., MRF operators, sometimes called "processors"), and re-processors (recyclers, which sometimes are also "end-markets").[31] Each participant was first

[31] Note: In this report the term 'end-market' refers to an entity that manufactures new products from recycled content. A re-processor can be an end-market if it re-processes and manufacturers new products, which is common for paper mills.

sent an email, provided with a copy of a data collection sheet, and provided with the proposed questions to be addressed during an interview. Key questions addressed in each interview included:

- Do the preliminary estimates of PPP collected for recycling data modelled by the project team appear credible or reasonable?
- What is the estimated annual quantity of PPP collected for recycling in the province for the various ICI sub-sectors?

Of the 32 companies contacted, none of the companies responded in-writing to our request for data or information, but 26 agreed to be interviewed, and of these 24 were found to provide ICI services including:

- eight haulers;
- nine integrated hauler/MRFs (i.e., processors); and
- seven re-processors/ end-markets.

Of these:

- nine operate province-wide;
- six operate across the Lower Mainland zone;
- four operate across the Vancouver Island and Coastal zone;
- three operate in the North Central zone; and
- two operate across the interior (i.e., Kootenay and Southern Interior zones);

About 50% of the haulers and processors interviewed are integrated (i.e., offer both collection and processing services), while the rest provide only collection services or processing services.

Of the haulers and MRFs operating across BC, only five could be defined as having a "national presence" (i.e., GFL Environmental, Waste Connections, Waste Management, Emterra Environmental, and Cascades Recovery). The majority of BC's service providers (by number) are smaller regional and local companies.

2.4. Data limitations

Much of the data analyzed as part of this report were generously provided by Regional Districts, municipalities, businesses, waste consultants, and trade associations. While every effort was taken to assure the integrity of the data used, they were collected using various methodologies, different material classifications, and were collected and verified by the waste auditors with different levels of rigour.

Some of the information in this report is obtained from a small sub-sample of the businesses operating in BC and should be taken as a general guide about relative proportions and types of waste that are generated for disposal / collected for recycling. The waste audits received might not be proportionally representative of the businesses operating in BC (e.g., there might be proportionally more large businesses relative to the actual number of SMEs; there might be

more audits received from beverage processors than goods manufacturers; individual businesses within a specific sub-sector might generate and manage PPP differently than those reviewed), which could skew the results.

3. Regional District data ICI PPP characterization

3.1. Overview

British Columbia has 27 Regional Districts (**Figure 3, Table 5**) that report waste statistics into the Ministry's municipal solid waste disposal calculator.[32] The total reported waste disposed includes all waste disposed of within and transferred out of each Regional District. This includes waste from:

- residential sources; and
- institutional, commercial, and light industrial sources.
-

This includes some, but not all, C&D waste. Further, it does not include waste from First Nations, which is regulated federally, or waste that is not MSW,[33] such as hazardous waste, biomedical waste, agricultural waste, motor vehicles or components, waste from heavy industry, or contaminated soils.

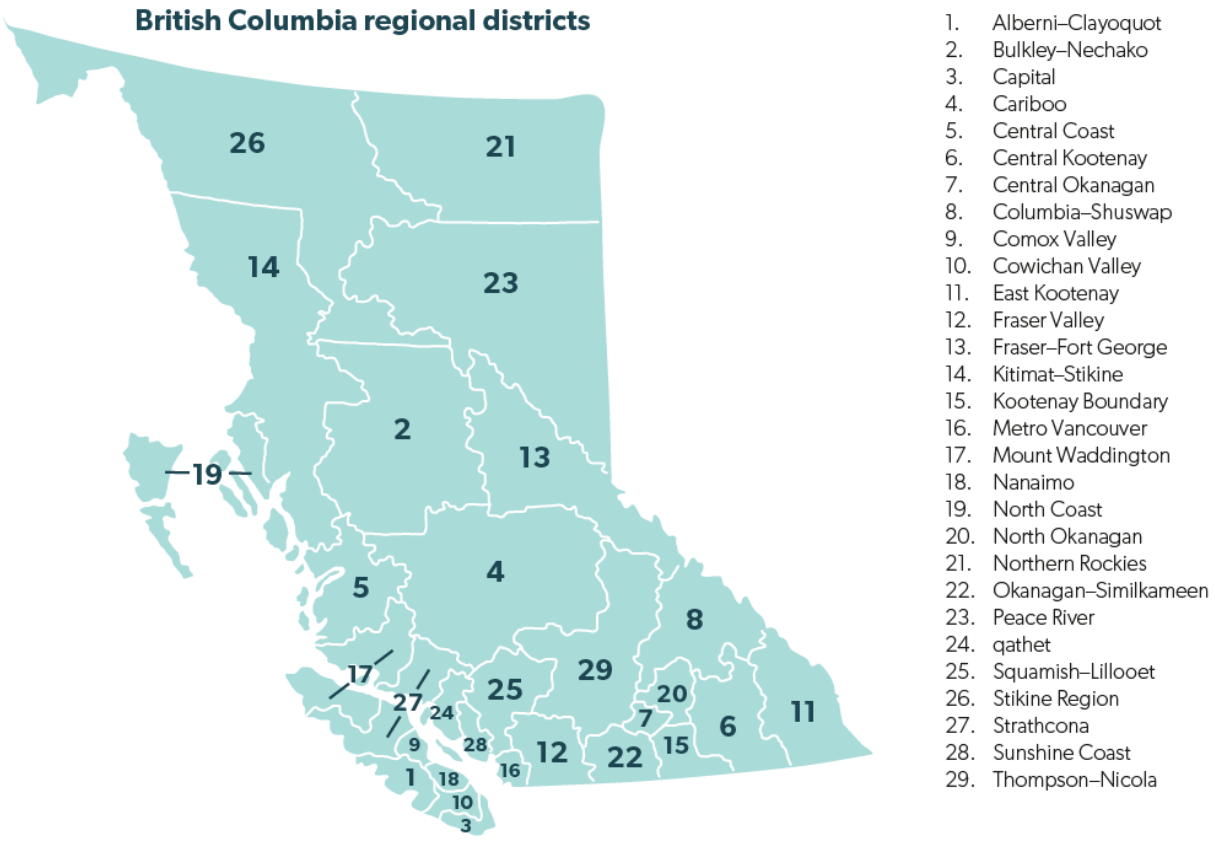

Figure 3: Map of British Columbia regional districts

[32] Government of British Columbia, 2016. A guide to solid waste management planning. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/garbage/swmp.pdf
[33] Government of British Columbia. Environmental Management Act (updated to May 25, 2022). Available at: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/03053_03

Table 5: Regional Districts

Regional District	Number on map, figure 3	Regional District	Number on map, figure 3
Kootenay Zone		**Southern Interior Zone**	
Central Kootenay	6	Central Okanagan	7
East Kootenay	11	Columbia-Shuswap	8
Kootenay Boundary	15	North Okanagan	20
Lower Mainland Zone		Okanagan-Similkameen	22
Fraser Valley	12	Thompson-Nicola	29
Metro Vancouver	16	**Vancouver Island and Coastal Zone**	
Squamish-Lillooet	25	Alberni-Clayoquot	1
North Central Zone		Capital	3
Bulkley-Nechako	2	Central Coast	5
Cariboo	4	Comox-Strathcona	9, 27 **see note*
Fraser-Fort George	13	Cowichan Valley	10
Kitimat-Stikine	14	Mount Waddington	17
North Coast	19	Nanaimo	18
Northern Rockies Regional Municipality	21	qathet	24
Peace River	23	Sunshine Coast	28
Stikine Region	26		

** These Regional Districts are combined because they jointly report their waste statistics to the Ministry and submit a joint SWMP.*

In 2019, which was the last full pre-pandemic year of waste disposal, BC disposed 2.6 million tonnes of MSW at an average of 501 kg/capita (**Appendix C: Regional District Waste Disposed**).[34] Across Regional Districts, the per capita waste disposed ranged from a low of 382 kg/capita (Capital and Central Coast) to a high of 867 kg/capita in Peace River. An estimate established using the 2019 self-reported Regional District data, waste audits, and SWMPs suggests that 932 thousand tonnes of ICI waste was disposed across BC, including 226 thousand tonnes of ICI PPP (**Appendix D: Regional District ICI Waste Disposed (Estimate)** and **Appendix E: Regional District ICI PPP Disposed (Estimate)**).

To encourage waste minimization and reduce the per capita MSW disposed, BC's *Environmental Management Act* requires its Regional Districts to develop and implement SWMPs that are reviewed and approved by the Minister.[35] The Ministry recommends the process for

[34] Data retrieved from Government of British Columbia Re-TRAC Connect system. Available at: https://connect.re-trac.com/
[35] Ministry of Environment, 2016. A Guide to Solid Waste Management Planning. Version 1.0. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/garbage/swmp.pdf)

implementing these plans includes: establishing an advisory committee, setting regional targets, reviewing the existing waste management system and identifying strategy options.[36] Public review and consultation on the plan is required, and the Ministry recommends the plans be renewed every 10 years. Municipalities within each Regional District are expected to support the plan but might implement enhanced recycling practices above and beyond that required by the Regional District.

To support their waste minimization goals, many Regional Districts have implemented disposal bans or financial incentives (**Appendix F: Regional District PPP disposal prohibitions or levies**). These measures support consumer use of regulated recycling systems operating under an extended producer responsibility (EPR) model and encourage ICI PPP recycling where no regulated system exists. In total, 15 of 27 Regional Districts have established disposal bans or financial incentives to encourage recycling of corrugated cardboard. At least six Regional Districts (i.e., Fraser Valley, Capital, Metro Vancouver, Central Okanagan, Kitimat-Stikine, Kootenay Boundary, and Nanaimo) also provide incentives to encourage the recycling of other PPP items, such as plastic containers and mixed paper.

3.2. ICI PPP characterization by regional district and BC zone

Province-wide, plastic and fibre make up the greatest proportion of PPP disposed at approximately 12% each; metal and glass make up relatively smaller proportions between 1-2% each. When the Regional Districts are grouped by zone, the estimates indicate that the Lower Mainland disposes the greatest proportion of PPP (30%) and the Southern Interior disposing the least PPP (24%) (**Figure 4, Table 6**).

There does not appear to be a significant difference between PPP disposed by BC zone. Disposal of PPP by zone varies from 24% in Kootenay and the Southern Interior to 30% in the Lower Mainland. Across Regional Districts, there does appear to be some difference in the amount of estimated PPP fibre, plastic, metal, and glass disposed. PPP disposed by Regional District varies from 18% (Nanaimo) to 33% (Squamish-Lillooet), with an average of 26% PPP disposed (**Table 6**). The Regional Districts vary highly in terms of population density from a high of 962 people/km^2 in Metro Vancouver to a low of 0.6 people/km^2 in the Northern Rockies. **Figure 5** provides an assessment of the confidence intervals for the total estimated ICI PPP disposed by zone.

[36] Ibid.

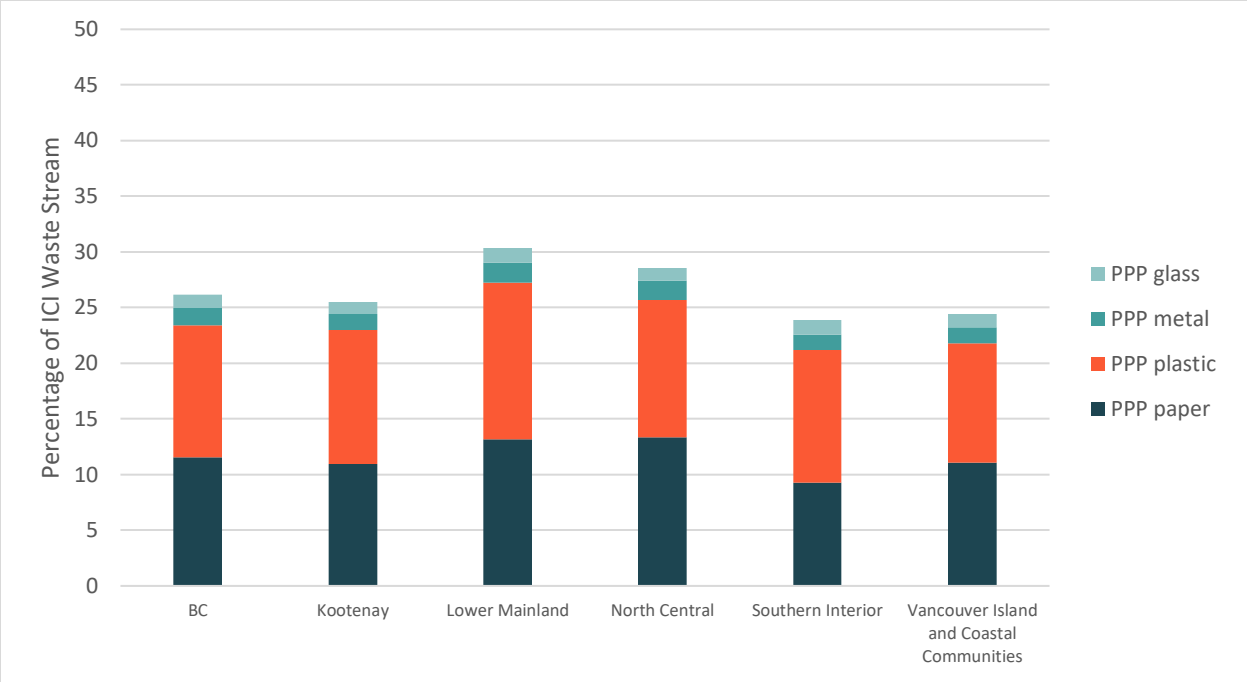

Figure 4: Average ICI PPP disposed by material stream and by zone

Table 6: Estimated proportion of ICI PPP disposed by regional district

Regional District	% of ICI disposal stream					Population density (per km²)[37]
	Fibre	Plastic	Metal	Glass	Total	
Kootenay	**11**	**12**	**1**	**1**	**24**	–
Central Kootenay	12	12	2	1	26	2.9
East Kootenay	10	13	1	1	25	2.4
Kootenay Boundary	12	12	2	1	26	4.2
Lower Mainland	**13**	**14**	**2**	**1**	**30**	–
Fraser Valley	17	18	3	1	38	25.5
Metro Vancouver	9	9	1	0	20	962.0
Squamish-Lillooet	13	16	2	3	33	3.0
North Central	**13**	**12**	**2**	**1**	**29**	–
Bulkley-Nechako	12	12	2	1	26	0.5
Cariboo	14	16	1	1	32	0.8
Fraser-Fort George	18	14	2	2	37	2.1
Kitimat-Stikine	10	11	2	1	24	0.4
North Coast	12	12	2	1	26	1.0

[37] City Population, 2021. Canada-British Columbia. Available at: http://citypopulation.de/en/canada/britishcolumbia/admin/

Northern Rockies Regional Municipality	12	12	2	1	26	0.1
Peace River	16	11	2	1	30	0.6
Southern Interior	**9**	**12**	**1**	**1**	**24**	–
Central Okanagan	8	12	2	2	24	79.0
Columbia-Shuswap	7	10	2	1	20	2.0
North Okanagan	11	16	0	2	29	12.5
Okanagan-Similkameen	7	12	2	2	23	9.0
Thompson-Nicola	13	10	1	0	25	3.3
Vancouver Island and Coastal	**11**	**11**	**2**	**1**	**25**	–
Alberni-Clayoquot	9	12	1	2	24	5.2
Capital	12	12	1	1	26	184.6
Central Coast	12	12	2	1	26	0.2
Comox-Strathcona	15	10	1	2	28	Comox: 44.0 Strathcona: 2.7
Cowichan Valley	9	13	2	1	25	26.5
Mount Waddington	12	12	2	1	26	0.6
Nanaimo	9	7	1	1	18	85.2
qathet	11.9	8	1	1	22	4.2
Sunshine Coast	12	12	2	1	26	9.0
British Columbia weighted average[38]	**12**	**12**	**2**	**1**	**26**	5.8

[38] This is a weighted average based on tonnes disposed.

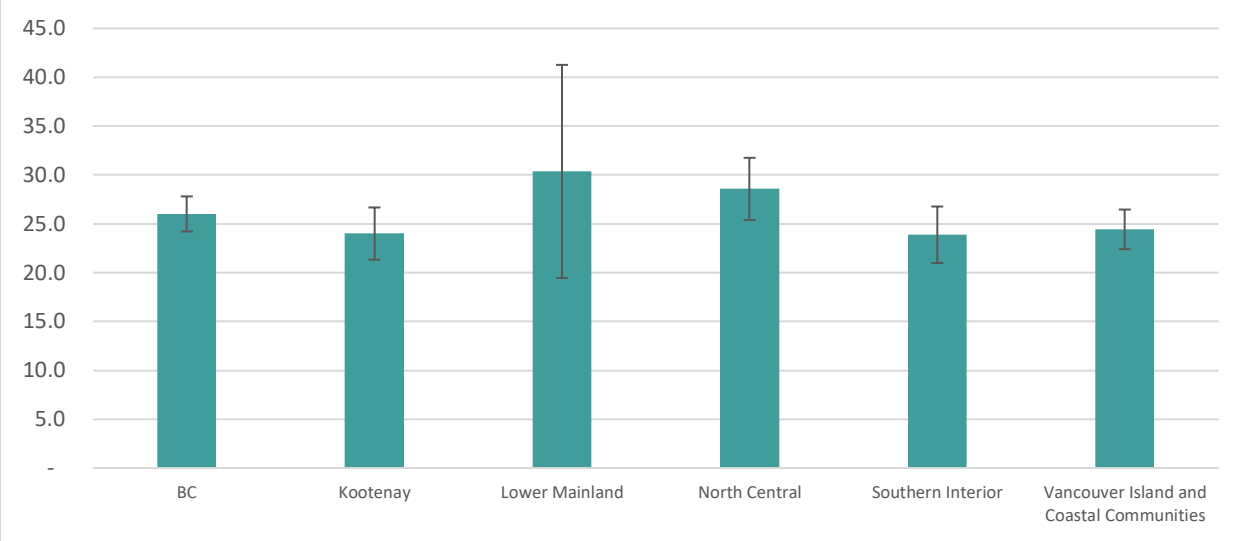

Figure 5: Average total ICI PPP disposed by zone with data confidence intervals

3.3. Key findings from ICI PPP characterization based on regional district data

Based on this data set, there does not seem to be a significant difference in PPP waste disposed across zones, which range from a high of 30% in the Lower Mainland zone to a low of 24% in the Kootenay and the Southern Interior zones.

The implementation of ICI disposal bans targeting PPP also do not seem to provide a significant difference. For example, the Lower Mainland communities Metro Vancouver and Fraser Valley have disposal bans targeting all ICI PPP, yet Metro Vancouver has the second lowest estimated proportion of ICI PPP in its waste stream (20%) and Fraser Valley has the highest proportion (38%). However, there was no assessment completed on the length of time the disposal bans have been in place nor the efficacy of their enforcement, as a result any conclusions on the effectiveness of disposal bans should be made with caution.

The data also do not show a significant correlation between population density and ICI PPP disposal. For example, Metro Vancouver and Capital Regional Districts have the highest population densities in BC by a significant margin (962 people/km^2 and 182 people/km^2 respectively), but Metro Vancouver has the second lowest proportion of ICI PPP disposed (20%) and Capital Regional District has 26% ICI PPP disposed.

The proportion of PPP assessed in BC's disposal stream (i.e., the average across all Regional Districts) was compared to similar assessments in other jurisdictions and found to be relatively consistent (**Table 7**). Note that few jurisdictions have undertaken similar assessments. While data comparisons of disposal streams between jurisdictions should be considered with caution as the recycling streams will impact the proportion of materials in the disposal streams, the results show a level of consistency, with the exception of the fibre stream that seems to be lower than in BC's disposal stream.

Table 7: Comparison of BC's estimated percentage of ICI PPP disposed with other jurisdictions

	British Columbia	Québec[39]	California[40]	Australia[41]
Date completed	2019	2019-2020	2014	2010-2011
PPP Fibre	12%	18%	27%	21%
PPP Plastic	12%	11%	2%	10%
PPP Metal	2%	1%	1%	3%
PPP Glass	1%	2%	2%	1%
Total PPP*	**26%**	**32%**	**31%**	**35%**

** Rounded to the nearest 1 so might not add up*

[39] RECYC-QUÉBEC, 2021. Étude de caractérisation à l'élimination 2019-2020. Available at: https://www.recyc-quebec.gouv.qc.ca/sites/default/files/documents/caracterisation-elimination2019-2020.pdf

[40] CalRecycle, 2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion, September 2015. Available at https://www2.calrecycle.ca.gov/WasteCharacterization/PubExtracts/2014/GenSummary.pdf

[41] Australian Government, 2013. A Study into Commercial and Industrial Waste and Recycling in Australia by Industry Division. Available at: https://www.awe.gov.au/sites/default/files/documents/commercial-industrial-waste.pdf

4. Industry waste audit data ICI PPP characterization

4.1. Overview

This section provides an overview of BC's ICI PPP waste characterization using industry waste audit data. Data is assessed by management stream (i.e., disposal and collected for recycling) and by ICI sub-sectors (based on NAICS codes). This section also provides a preliminary indication of which ICI sub-sectors generate the most PPP.

4.1.1. BC economic activity

Table 8 provides an overview of BC's economic sector activity by the number of FTEs. The number of FTEs provides a normalization factor by which to model the amount of PPP that might be disposed or collected for recycling by each sub-sectors, though this can vary based on local conditions.

The majority of FTEs are employed by the Administration and Office, Trade, and Heath Care and Social Assistance sub-sectors, which add up to approximately 60% of total employment. Transportation and Construction account for approximately 20%.

Table 8: BC economic activity based on percentage share of FTE[42]

NAICS codes	Category	Economic activity by share of FTE
51-56, 81, 91	**Administration and office**	**31%**
54	Professional, scientific, and technical services	9%
52-53	Finance, insurance, real estate, and leasing	6%
91	Public administration	5%
55-56	Business, building, and other support services	4%
81	Other services	4%
51	Information and cultural industries	3%
41, 44-45	**Trade**	**14%**
44-45	Retail trade	11%
41	Wholesale trade	3%
62	**Health care and social assistance**	**13%**
48-49	**Transportation and warehousing**	**10%**
48	Transportation	9%
49	Warehousing	<1%

[42] Statistics Canada. BC Employment by industry, annual, 2021. Available at Table 14-10-0202-01 Employment by industry, annual

23	**Construction**	**8%**
61	**Educational services**	**7%**
31-33	**Manufacturing**	**7%**
72	**Accommodation and food services**	**6%**
722	Food services	5%
721	Accommodation	1%
71	**Arts, entertainment, and recreation**	**2%**
111-112	**Crop production, animal production and aquaculture**	**<1%**
11, 21-22	**Out-of-scope**	**2%**
11	Agriculture (all 111-112), forestry, fishing, and hunting	<1%
21	Mining, quarrying and oil and gas extraction	1%
22	Utilities	<1%

The economic activity differs across the various zones in BC. Some zones have higher employment within certain ICI sub-sectors (**Table 9**). These differences in economic activity will cause differences in the types of PPP generated as well as how it might be managed at end-of-life (**Section 4.3**).

Table 9: BC economic activity, by economic region, based on percentage share of employees[43]

	Vancouver Island and Coastal	Lower Mainland	Southern Interior	Kootenay	North Central
Administration and Office	32%	32%	24%	21%	19%
Trade	14%	14%	16%	13%	16%
Health Care and Social Assistance	15%	11%	15%	15%	15%
Transportation and Warehousing	7%	11%	9%	2%	6%
Construction	8%	9%	10%	10%	10%
Educational Services	8%	7%	6%	8%	8%
Manufacturing	4%	6%	7%	8%	10%
Accommodation and Food Services	7%	7%	6%	7%	6%
Arts, Entertainment and Recreation	2%	3%	3%	4%	<0.0%
Agriculture and Other Out-of-Scope Sub-Sectors	3%	>1%	4%	12%	10%

[43] Government of BC. Number of Businesses and Employment by Industry, 2021. Available at https://www2.gov.bc.ca/gov/content/data/statistics/business-industry-trade/number-of-businesses-and-employment-by-industry

4.2. ICI PPP characterization by waste stream

PPP generation rates (i.e., disposal, collected for recycling, and reuse streams) are presented in this section. The methodology used for this analysis is described in **Section 2.3.5**.

4.2.1. Disposal stream

Figure 6 presents an overview of the percentage by weight of PPP, per material category, in the disposal stream. It illustrates the heterogeneity of the composition of PPP in disposal streams across the targeted ICI sub-sectors, especially for fibre and plastic. PPP in the disposal stream ranges from 10% (Health Care Facilities) to 36% (Food Service).

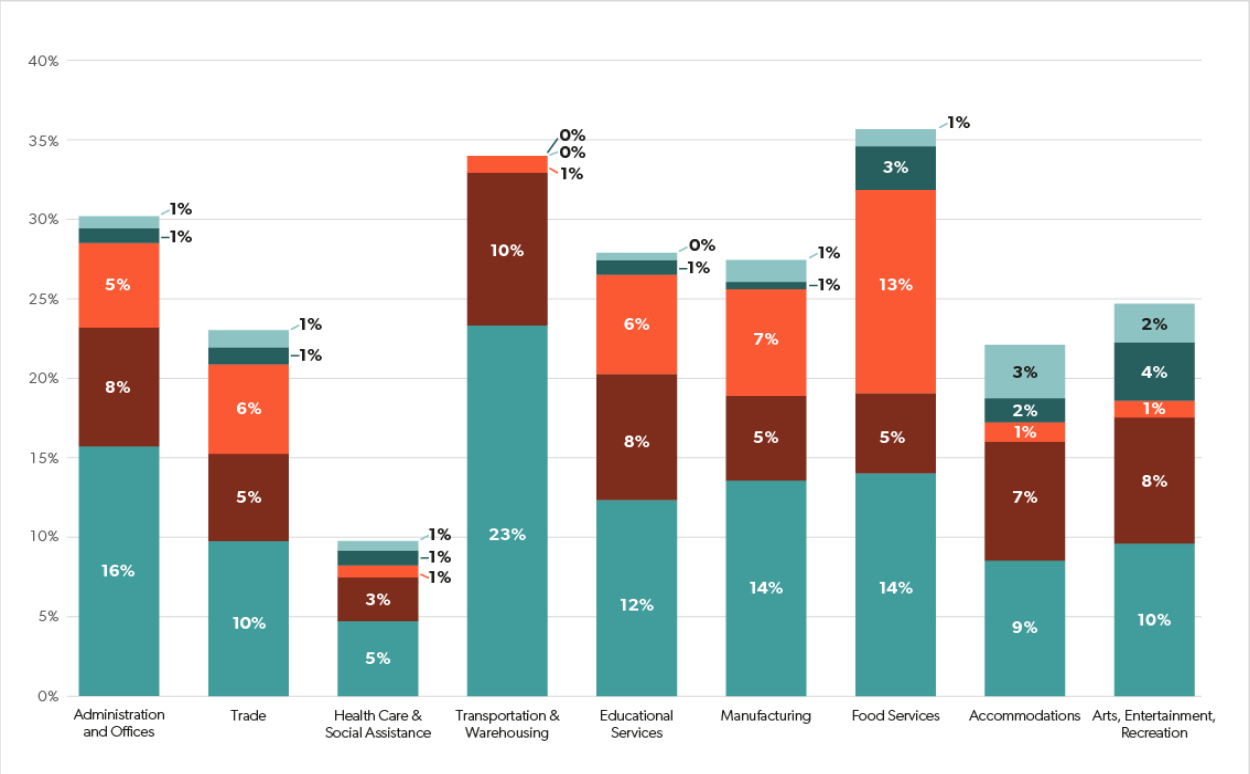

Figure 6: Overview of percentage of ICI PPP, by material, in the disposal stream

The types of PPP in the ICI disposal stream, across all sub-sectors, consist of almost an even mix of:

- fibres and plastic, which together make up approximately 90% of the PPP disposed; and
- metal and glass, which together make up approximately 10% of the PPP disposed.

These results are consistent with the RD characterization data (**Section 3**)

Although not shown in **Figure 6**, because it was out of scope, there is also a substantial amount of the waste disposed that consists in non-PPP materials (e.g., food waste, tissues and toweling,

durable goods). In some sectors, such as Health Care and Social Assistance, Educational Services and Manufacturing, non-PPP fibre, plastic, glass, and metal make up 50%, 63%, and 38% respectively of the disposal stream.

4.2.2. Collected for recycling stream

Of the industry waste audits collected for this project, approximately 59% (42% from BC) included usable PPP collected for recycling audit data. As stated in **Section 2.3.5.**, collected for recycling stream audits are not as common as disposal stream audits and are more difficult to analyze for several reasons:

- When an ICI entity does undertake waste audits, the scope of those audits tends to focus on better understanding the amount of recyclable materials in the disposal stream (i.e., garbage) so that the amount of recyclables disposed can be reduced.
- Waste audits of the disposal stream are easier to undertake because it only requires sorting one stream as compared to sorting multiple recycling streams, which is more costly.
- Recycling stream audits might not account for certain materials, such as deposit containers returned by staff or confidential paper removed for shredding. Several waste audits for office buildings explicitly did not include these materials.

As a result, confidence in the recycling stream waste audit data of this report is not as strong as the disposal stream waste audit data. Because of this uncertainty in the data, only the percentage PPP collected for recycling by material type is presented (**Table 10**).

Table 10: Proportion of PPP collected for recycling by material type

Facility type	Fibre	Rigid plastic	Flexible plastic	Metal	Glass
Manufacturing	74%	10%	5%	3%	9%
Retail trade	93%	4%	1%	1%	1%
Administration and offices	85%	9%	1%	2%	3%
Educational services	79%	15%	1%	3%	2%
Health Care and Social Assistance	66%	17%	3%	12%	2%
Arts, Entertainment, Recreation	69%	18%	1%	5%	7%
Accommodations	69%	10%	0%	3%	18%
Food services	79%	8%	1%	3%	9%
Transportation	96%	2%	3%	0%	0%
Weighted average	87%	6%	2%	2%	3%

In general, the most prevalent PPP collected for recycling is fibre, followed by plastic, with much smaller amounts of metal and glass. The dominance of fibre in the collected for recycling stream is consistent with the information gathered from service providers, which identified far fewer plastic, metal, and glass recycling activities underway**.** For sectors with a relatively high proportion of plastic, PET and other rigid packaging seem to be main types of plastic collected for recycling due to stronger and more established markets for these types of plastics.[44]

While fibre is the main PPP collected for recycling, there is important variability across the sub-sectors in the main type of fibre recycled (i.e., OCC or mixed paper). In almost all sub-sectors, a considerable amount of non-PPP fibre (e.g., paper towels) is also collected.

4.2.3. Total disposed and collected for recycling

It is estimated that BC generates approximately 847,710 tonnes of PPP annually of which 325,860 tonnes is disposed of and 516,850 tonnes is collected for recycling (**Table 11**).

Table 11: Estimate of PPP generated, disposed, and collected for recycling by ICI sub-sector based on industry waste audit data

ICI sub-sectors	Waste disposed	PPP generated	PPP disposed	PPP collected for recycling
	tonnes			
Manufacturing	235,680	101,890	29,520	72,370
Trade	286,530	380,600	127,820	252,780
Administration and offices	69,740	28,400	7,340	21,060
Educational services	18,300	17,510	7,340	10,170
Health Care and Social Assistance	97,160	33,180	8,670	24,510
Arts, Entertainment, Recreation	1,760	1,370	270	1,100
Accommodations	31,390	16,070	3,820	12,250
Food services	291,740	148,450	102,380	46,070
Transportation	86,760	115,240	38,700	76,540
Total	1,119,060	842,710	325,860	516,850

** Numbers rounded to the nearest 10*

For the disposal stream, the total waste disposed is, all things considered, similar between RD waste audits and the industry waste audits modelling (930,000 tonnes compared to 1.1 million tonnes respectively), as is the weighted average of the relative contribution by material type of PPP disposed (**Table 12**).

[44] Australian Government, 2013. A Study into Commercial and Industrial Waste and Recycling in Australia by Industry Division. Available at: https://www.awe.gov.au/sites/default/files/documents/commercial-industrial-waste.pdf

Table 12: Comparison of the Estimated Proportion of PPP Disposed by Data Source

Materials	PPP disposed (Estimate using industry waste audit data)	PPP disposed (Estimate using RD waste audit data)
Fibre	12%	12%
Plastic	12%	12%
Metal	1%	2%
Glass	1%	1%
TOTAL	26%	26%

** Numbers rounded to the nearest 1 so may not add up*

Figure 7 illustrates based on the industry waste audit data analysis the relative contribution of each sub-sector to BC's employment, PPP disposed, and PPP collected for recycling. This figure shows the largest contributors to PPP disposed are Trade and Food Services, and the largest contributors to PPP collected for recycling are Trade, Transportation and Manufacturing.

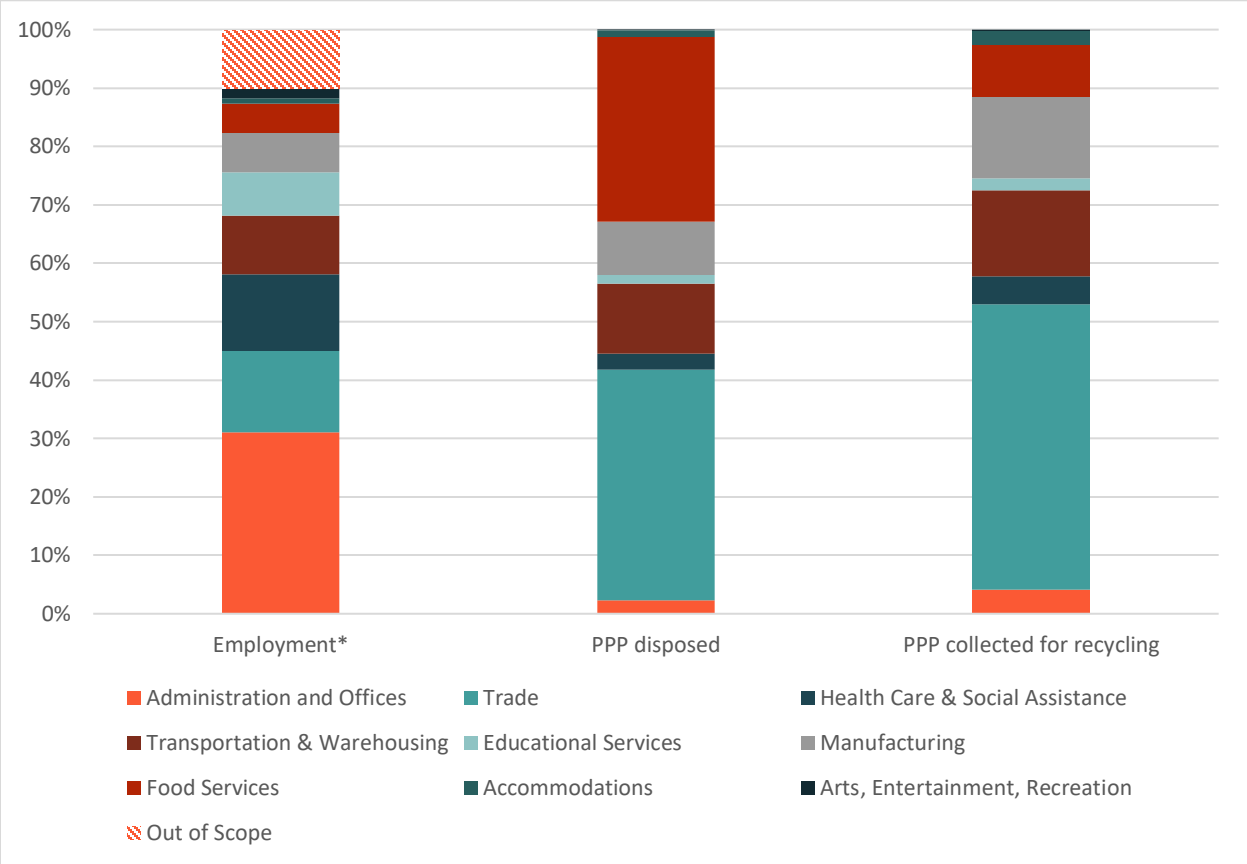

Figure 7: Relative contribution of ICI sub-sectors to employment, ICI PPP waste disposal, and collected for recycling in BC

**Note employment represents only 90% of total employment because some ICI sub-sectors were out-of-scope*

4.3. ICI PPP characterization by ICI sub-sector

This section provides an overview of the PPP disposed and collected for recycling across ICI sub-sectors. For each sub-sector or sub-division, the significance of its contribution to BC's overall ICI PPP disposed and collected for recycling and the significance of its contribution to each zone is assessed.

4.3.1. Administration and office

Overview

The Administration and Office sub-sector represents a grouping of ICI entities with similar office settings. See **Appendix G** for a list of the NAICS codes in this sub-sector and examples of the types of businesses they represent.

The Administration and Office sub-sector includes a grouping of NAICS sub-divisions that together make up the largest contributor to BC's employment, representing 682,000 FTEs or 28% of BC's total employment. **Table 13** provides an overview of the sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Administration and Office sub-sector is higher in the Lower Mainland and Vancouver Island and Coastal Areas compared with the other zones, accounting for over 30% of their employment.

Table 13: Administration and Office Employment in Relation to Total Employment

BC zone	Contribution of sub-sector to total zone employment
Vancouver Island and Coastal	31.6%
Lower Mainland	31.5%
Southern Interior	24.2%
Kootenay	21.2%
North Central	19.5%

This sub-sector also includes a large proportion of small and medium size enterprises (SMEs). According to Government of BC Stats, over 85% have 20 employees or less (with the exception of the public administration where the proportion is ~35%).[45]

Data analysis

Data variability PPP disposal	Low	**Medium**	High
Data variability PPP collected for recycling	Low	Medium	**High**
Data availability	Low	**Medium**	**High**

[45] Government of BC. Number of Businesses and Employment by Industry, 2021. Available at https://www2.gov.bc.ca/gov/content/data/statistics/business-industry-trade/number-of-businesses-and-employment-by-industry

Table 14 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is lower on a per FTE basis compared to other sub-sectors (**Appendix H**). There is also significantly more PPP collected for recycling compared to that collected for disposal in this sub-sector.

Table 14: Overview of disposed and collected for recycling audit data from administration and office

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
51-56, 81, 91	81	351	205,792	11	31

There are several factors that should be considered when reviewing the data from this sub-sector:

- The waste audits received for this sub-sector included large administration and office buildings, which might also contain some restaurant or small retail activities that cannot be easily separated in the waste audit data provided.
- The waste audits received for this sub-sector often did not clearly detail whether the paper data included the amount of confidential paper that was generated (i.e., paper collected by a separate company for secure disposal). As many of the entities within this sub-sector would use these services, the PPP generation particularly for mixed paper, might be underestimated.
- The impact of the pandemic on waste generation might be more acute for this sub-sector than others because it would have been easier for employees in this sub-sector to work from home than other sub-sectors where onsite employee presence could not be avoided (e.g., hospital, grocery store). While data were not available to quantify the relative number of employees that were able to work from home for this sub-sector compared to others, it is likely that more PPP materials that are typically generated by sub-sector were shifted to the residential sector.

Table 15 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. Although this sub-sector is a significant source of economic activity in the province, because of its low disposal rate per FTE, it is a low contributor to BC's overall PPP disposal. Only 2% of all PPP disposed in BC is estimated to come from administration and office activities.

Table 15: Contribution of administration and office PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	1.5%
Vancouver Island and Coastal	0.4%

Southern Interior	0.2%
North Central	0.1%
Kootenay	<0.0%

The economic activity for this sub-sector is clustered in the Lower Mainland and Vancouver Island and Coastal Areas; these regions account for 85% of the PPP disposed in this sub-sector.

PPP composition in the disposal and collected for recycling streams

In comparison to other sub-sectors, there is less heterogeneity in the composition of PPP materials disposed and collected for recycling in this sub-sector. However, some specific activities within this sub-sector could influence the composition of PPP in individual business' disposal and collected for recycling streams. For example, a scientific lab would likely generate more plastic PPP, while a publishing company might generate more newsprint material.

Fibre-based materials are the dominant PPP found in both the disposal and collected for recycling streams (**Figure 8** and **Figure 9**), which makes intuitive sense based on the type of work being undertaken.

- Mixed paper accounts for the largest proportion of the disposal stream. The amount of plastic PPP, including plastic film and other plastics, represents 13% of the disposal stream. The proportion of plastic PPP in the disposal stream for this sub-sector was higher than was observed in other jurisdictions reviewed (e.g., Australia, California, Québec). The higher proportion of plastic PPP might be related to:
    - when these studies were undertaken;
    - retail or food service activities that might be inadvertently captured in some of the waste audits undertaken (i.e., due to offices being co-located with retail or food services); and/or
    - what appears to be a lack of robust plastic collection systems for this sub-sector (**Section 5**).

- Fibre-based material also accounts for the largest portion of material collected for recycling. Of that collected, there is almost an equal amount of OCC and mixed paper collected. However, as noted previously, the amount of mixed paper collected for recycling could be higher than reported here as it appears that not all waste audit data received included confidential paper that is managed by shredding companies. Regardless, there appears to be a robust collection system in place for fibre-based PPP (**Section 5**). The amount of plastic, glass, and metal PPP collected for recycling might also be slightly higher than is reported here as the waste audit data obtained usually did not capture deposit bearing beverage containers that are taken back by staff for redemption.

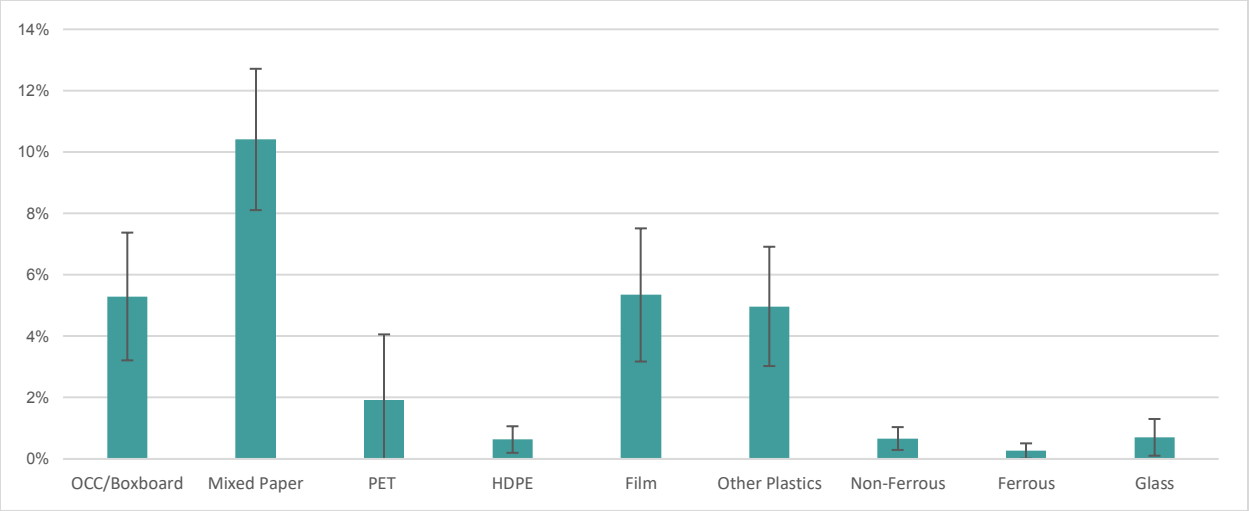

Figure 8: Proportion of PPP in the administration and office disposal stream

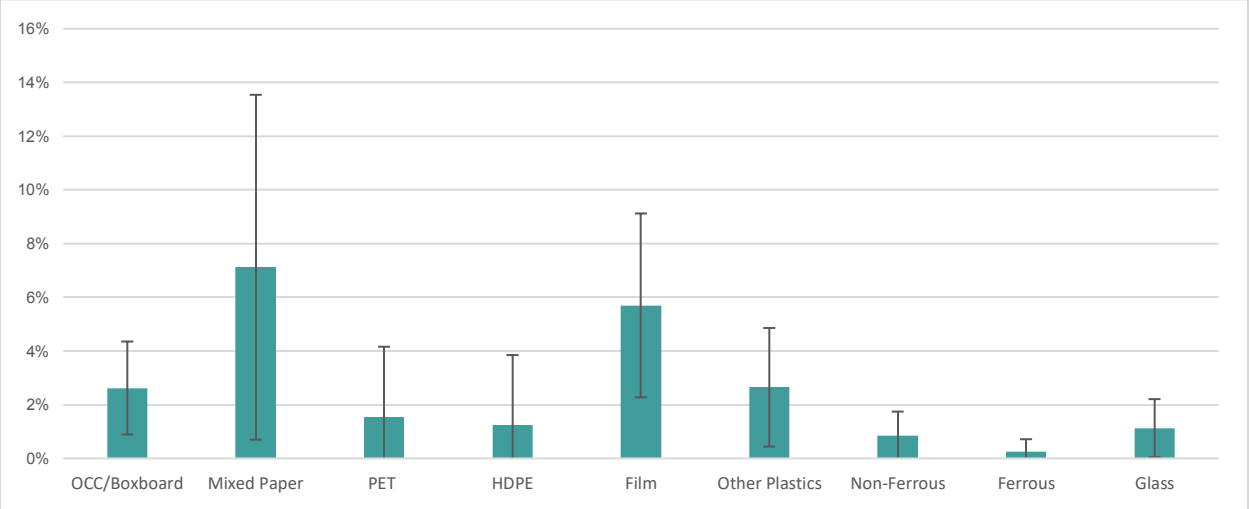

Figure 9: Proportion of PPP in the administration and office collected for recycling stream

4.3.2. Trade (e.g., retail and wholesale)

Overview

The Trade sub-sector includes entities involved in wholesale and retail trade. See **Appendix G** for a list of the NAICS codes in this sub-sector and examples of the types of businesses they represent.

The Trade sub-sector makes up the second largest contributor to BC's employment, representing 271,000 FTEs or 15% of all BC employment. **Table 16** provides an overview of the Trade sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Trade sub-sector is relatively similar across each of the BC zones.

Table 16: Trade employment in relation to total employment

BC zone	Contribution of sub-sector to total zone employment
Southern Interior	15.9%
North Central	15.5%
Lower Mainland	14.4%
Vancouver Island and Coastal	13.9%
Kootenay	13.1%

According to Government of BC Stats, almost 25% of all retail employees work in food and beverage stores, while health and personal care stores, clothing stores, and general merchandise stores each account for 10% of the employees.[46]

Data analysis

Data variability PPP disposal	Low	Medium	**High**
Data variability PPP collected for recycling	Low	Medium	**High**
Data availability	Low	**Medium**	**High**

Table 17 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is the highest on a per FTE basis compared to other sub-sectors (**Appendix H**). There is also significantly more PPP collected for recycling compared to that collected for disposal in this sub-sector.

Table 17: Overview of disposed and collected for recycling audit data from trade

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
41, 44-45	58	215	238,528	339	670

There is considerable variation in the waste audit disposal and recycling information received for this sub-sector (e.g., PPP composition and management practices). This is likely reflective of the diversity of activities being undertaken by this sub-sector, which includes major differences in the merchandise being sold (e.g., perishable as compared to non-perishable) and the size and format of businesses (e.g., malls, big box stores, small retailers).

[46] Ibid.

This sub-sector is by far the most significant contributor to BC's PPP waste disposal, based on its higher disposal rate per FTE and its importance to the economy. Based on an assessment of waste audit data it accounts for 40% of all ICI PPP disposed in BC.

Table 18 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. The high disposal rate per FTE in this sub-sector coupled with the large contribution this sub-sector to overall BC's overall employment results in this sub-sector being a major contributor to BC's PPP disposal.

Table 18: Contribution of trade PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	25%
Southern Interior	6%
Vancouver Island and Coastal	6%
North Central	2%
Kootenay	1%

PPP composition in the disposal and collected for recycling streams

As illustrated in Figure 10 plastic film and mixed paper comprise the majority of the PPP in the disposal stream, with OCC and other plastics each representing less than 3% each. Of all PPP generated by this sub-sector, OCC is, by far, the material most often collected for recycling. Although not well reflected in **Figure 11**, a number of larger entities that provided data for this sub-sector were managing significant volumes of certain plastics –such as film, polystyrene, HDPE, and PET– in their collected for recycling streams.

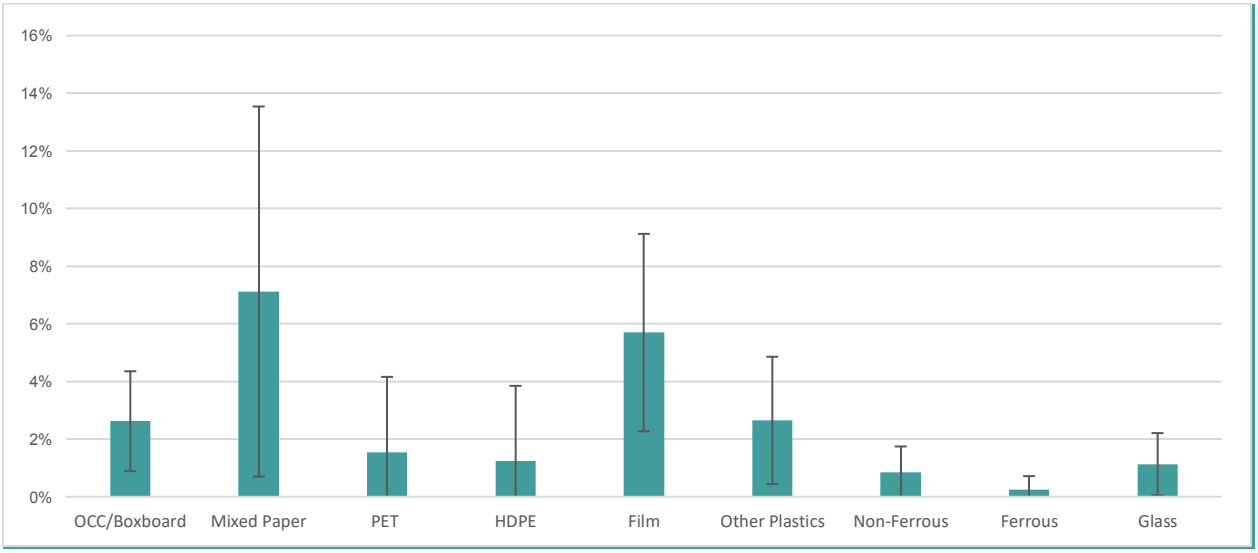

Figure 10: Proportion of PPP in the trade disposal stream

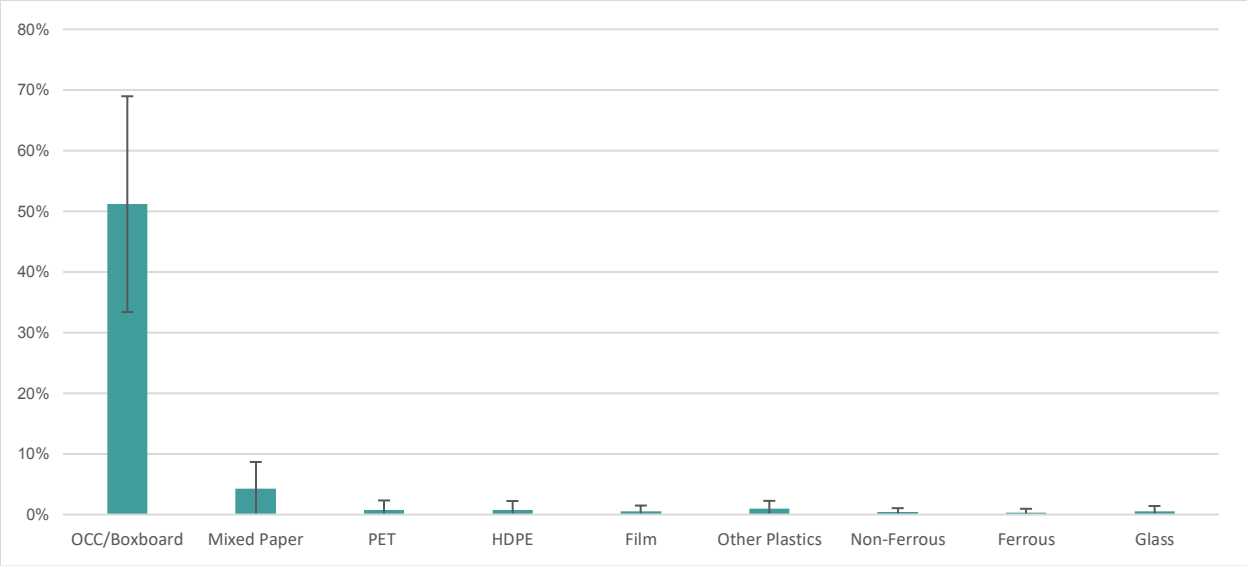

Figure 11: Proportion of PPP in the trade collected for recycling stream

One interviewee provided average waste data for their BC grocery stores (**Figure 12**). Their data show that 95% of their inorganic recyclables stream is OCC. They stated that OCC might not get 'caught' in waste audit reports because it is managed as a separate and profitable commodity stream and that it is collected by their service provider almost daily because of the sheer volume of OCC generated (i.e., OCC is put straight into a trailer that is picked up by a hauler). They stated they fill one 53-foot trailer with OCC per day.

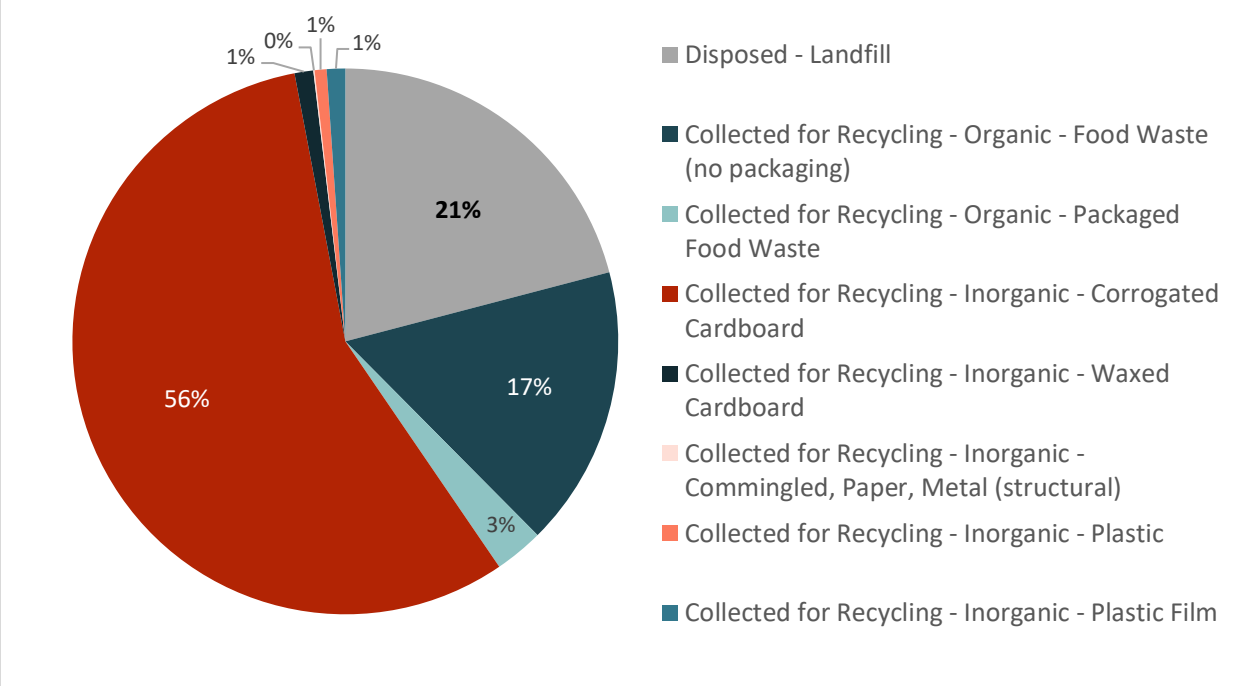

Figure 12: Example of grocery store waste stream composition (2021)

4.3.3. Health care and social assistance

Overview

The Health Care and Social Assistance sub-sector is comprised of entities primarily engaged in providing health care diagnosis and treatment, residential care for medical and social reasons, and social assistance, such as counselling, welfare, child protection, community housing and food services, vocational rehabilitation, and childcare. The sub-sector includes hospitals, but also ambulatory health care services and residential care facilities. The types of activities can be very different, which might influence the results. See **Appendix G** for a list of the NAICS codes in this sub-sector.

The sub-sector accounts for approximately 299,000 FTEs or about 13% of BC's total employment. **Table 19** provides an overview of this sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Health Care and Social Assistance sub-sector is relatively similar across four of the five BC zones, with lower employment activity in the Lower Mainland zone.

Table 19: Health care and social assistance employment in relation to total employment by BC zones

BC zone	Contribution of sub-sector to total zone employment
Southern Interior	14.9%
Vancouver Island and Coastal	14.9%
North Central	14.6%
Kootenay	14.5%
Lower Mainland	10.8%

Data analysis

Data variability PPP disposal	Low	Medium	**High**
Data variability PPP collected for recycling	Low	Medium	**High**
Data availability	**Low**	**Medium**	High

Table 20 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The amount of PPP disposed and collected for recycling is moderate on a per FTE basis compared to other sub-sectors (**Appendix H**). There is also significantly more PPP collected for recycling compared to that collected for disposal in this sub-sector.

Table 20: Overview of disposed and collected for recycling audit data from health care and social assistance

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
62	18	1,206	608,667	28.98	81.95

There are several factors to consider when reviewing the data from this sub-sector:

- There is a great deal of variation in the disposal and collected for recycling composition data received for this sub-sector. This is likely due to the heterogeneity of the activities undertaken by individual businesses in this sub-sector. For example,
    - Waste streams are known to vary significantly in facilities where food services are provided compared to those where food services are not provided.
    - An analysis of the Québec healthcare system showed there is a difference according to the type of facilities audited. For instance, there is much more printed paper generated in hospitals (12% of the total generated) compared to senior housing (6% of the total generated).[47] Senior housing has a waste composition more similar to residential sector than a hospital.
- The categorization of PPP and non-PPP materials might not be captured consistently in the waste audits completed for this sub-sector compared to other sub-sectors. In health care facilities, there is a significant quantity of non-PPP products (i.e., paper towel, oxygen mask tubing). In some waste audits these items are recorded as PPP materials, which could skew the analysis of the data. Other recycling programs (e.g., needles and medical products) could also influence analysis of the data for collected for recycling stream.

Based on an assessment of waste audit data, the sub-sector accounts for approximately 3% of all ICI PPP disposed in BC.

Table 21 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. Although this sub-sector is a moderate source of economic activity in the province, because of its lower disposal rate per FTE, it is a low contributor to BC's overall PPP disposal.

Table 21: contribution of health care and social assistance PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	1.5%
Vancouver Island and Coastal	0.5%
Southern Interior	0.4%
North Central	0.2%
Kootenay	0.1%

[47] SSE, 2022. Fiche matière Papier. Available at: https://gmr.synergiesanteenvironnement.org/papier/ (in French)

PPP composition in the disposal and collected for recycling streams

The results of the analysis show this sub-sector is not a significant generator of PPP for the disposal stream as compared to other sub-sectors (10% compared to 25-30%). As illustrated in **Figure 13** and **Figure 14,** fibre-based materials are the largest proportion of PPP in both the disposal and collected for recycling streams. However, there is also a notable amount of plastics in both streams as well.

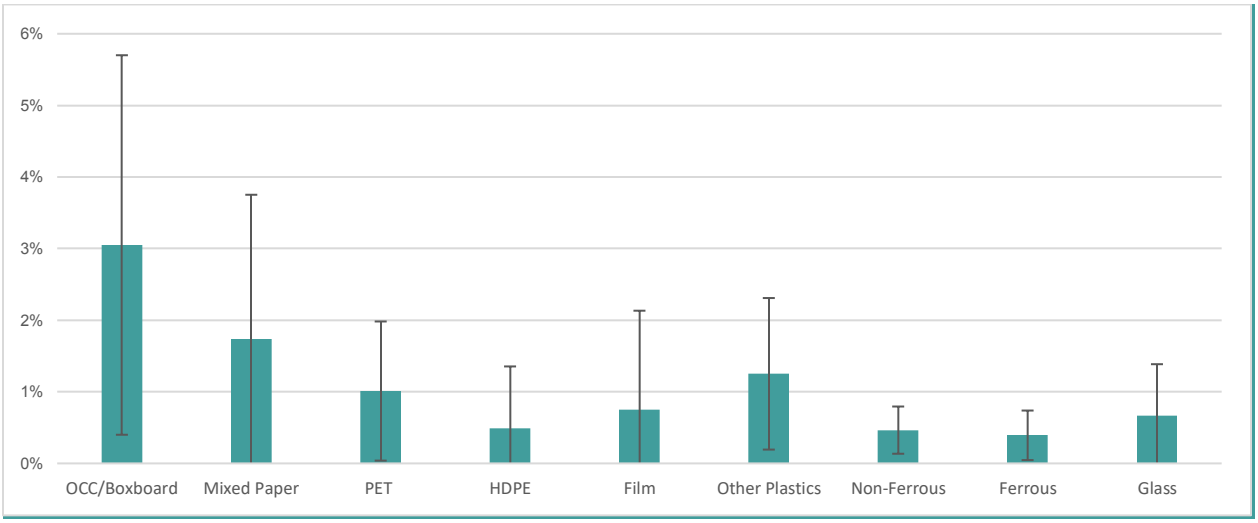

Figure 13: Proportion of PPP in the health care and social assistance disposal stream

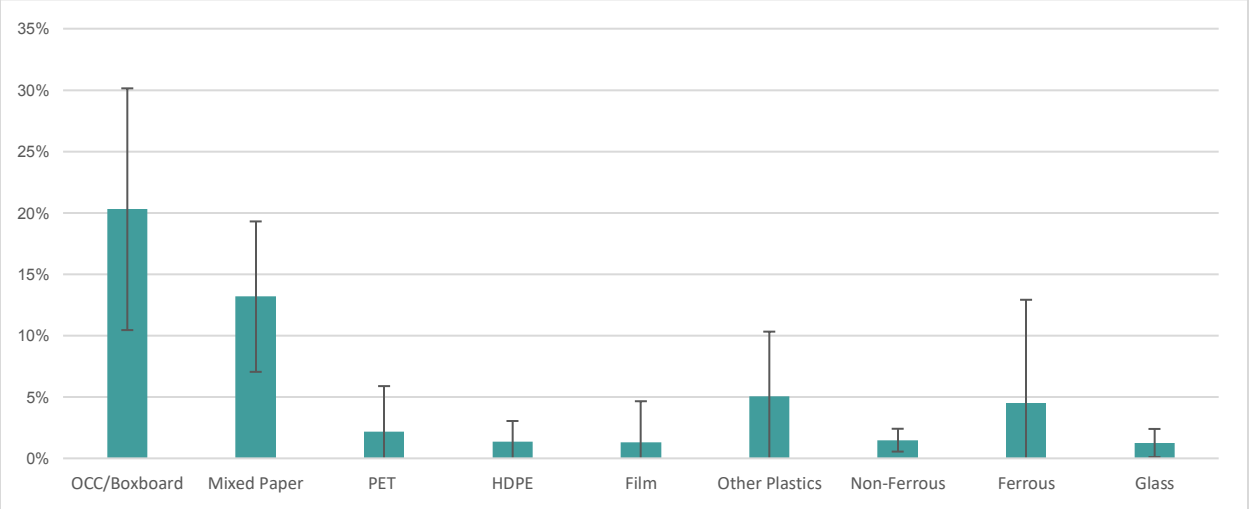

Figure 14: Proportion of PPP in the health care and social assistance collected for recycling stream

A Québec study provides some insight into the types of plastics generated by hospitals. It showed that polyolefins (#2, #4 and #5) compose most of the hospital plastic PPP generated (**Table 22**).[48] This is consistent with the data obtained in the waste audits received for

[48] SSE, 2016. Récupération des plastiques hospitaliers. Available at: https://gmr.synergiesanteenvironnement.org/projets-pilotes/ (in French)

this study. Hospital polyolefin packaging includes PP trays, as well as HDPE and PP bottles, which are used to contain detergent or medical product.

It is worthwhile to note PVC is an important plastic resin used in the Health Care system, especially in hospitals. According to the Vinyl Institute, PVC is used for oxygen masks, oxygen mask tubing, and intravenous fluid bags.[49] Intravenous fluid bags could be considered and managed as packaging, and when co-collected in a single stream recycling system along with other plastics is a contaminant that can disrupt the recycling of other plastics resins. Therefore, it is preferable to collect PVC packaging separately to avoid contaminating the other plastic recycling streams.

Table 22: Results from plastic audit undertaken in three hospitals in Québec

Plastic (PPP and non-PPP)	Average
Unidentified plastics	28%
PP(#5)	23%
HDPE (#2)	20%
PVC (#3)	15%
PS (#6)	6%
PET (#1)	5%
LDPE (#4)	3%
Other Plastics (#7)	1%

4.3.4. Transportation and warehousing

Overview

The Transportation and Warehousing sub-sector includes entities primarily engaged in transporting passengers and goods (e.g., trucking, transit, rail, water, air, and pipeline), warehousing and storing goods, and providing services to these establishments. This sub-sector includes couriers. See **Appendix G** for a list of the NAICS codes in this sub-sector.

BC's Transportation and Warehousing sub-sector accounts for approximately 93,591 FTEs or about 10% of the workforce. **Table 23** provides an overview of the sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Transportation and Warehousing sub-sector is higher in the Lower Mainland and Southern Interior zones, with significantly lower in the other zones.

[49] Vinyl Institute, 2020. Medical PVC Recycling Pilot Program. Available at: https://www.vinylinstituteofcanada.com/medical-pvc-recycling-pilot-program-pvc-123/

Table 23: Transportation and Warehousing Employment in Relation to Total Employment by BC Zone

BC zone	Contribution of sub-sector to total zone employment
Lower Mainland	11.3%
Southern Interior	9.4%
Vancouver Island and Coastal	7.0%
North Central	6.5%
Kootenay	2.5%

Data analysis

Data variability PPP disposal	Low	**Medium**	**High**
Data variability PPP collected for recycling	Low	**Medium**	**High**
Data availability	**Low**	Medium	High

Waste audit results were particularly weak for this sub-sector. Data were received from a few Transportation and Warehouse entities, but normalizing factors and annual generation numbers were problematic. As a result, Trade was used as a proxy. Based on this proxy, 12% of all PPP disposed in BC comes from Transportation and Warehousing.

Table 24 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. The Lower Mainland is the largest generator of PPP in this sub-sector, which is not surprising given the amount of economic activity in this area. The high disposal rate per FTE in this sub-sector coupled with the moderate contribution of this sub-sector to BC's overall employment results in this sub-sector being a larger contributor to BC's PPP disposal.

Table 24: Contribution of transportation and warehousing PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	8.8%
Vancouver Island and Coastal	1.4%
Southern Interior	1.3%
North Central	0.4%
Kootenay	0.1%

PPP composition in the disposal and collected for recycling streams

As illustrated by **Figure 15** mixed paper comprises the majority of the PPP in the disposal stream at 20%, with OCC contributing approximately 3%, and other plastics contributing almost 10%. Of all PPP generated by this sub-sector, mixed paper is the material most often collected for recycling (**Figure 16**).

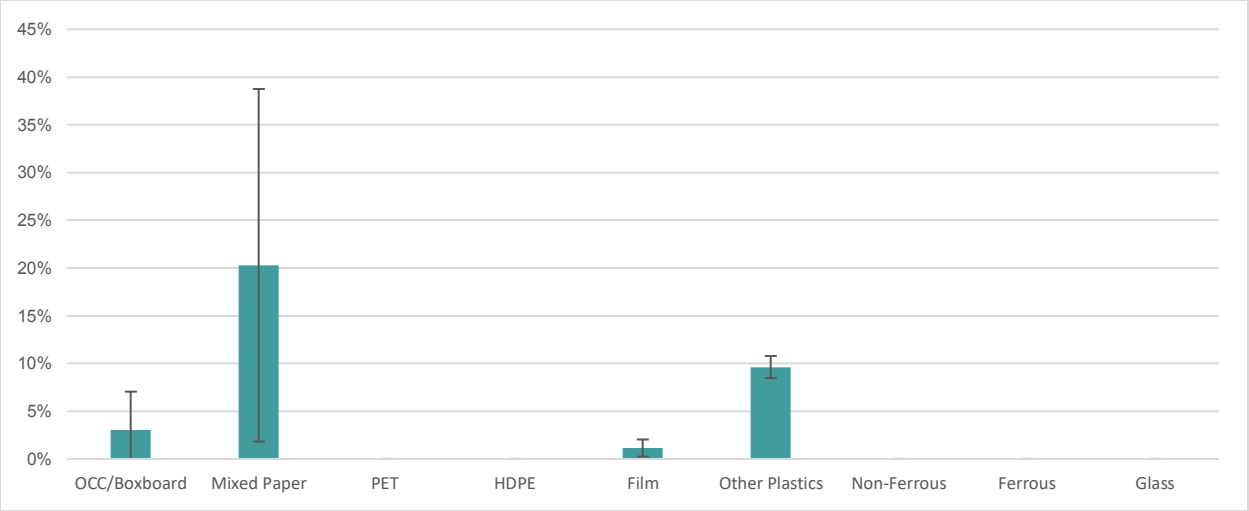

Figure 15: Proportion of PPP in the transportation and warehousing disposal stream

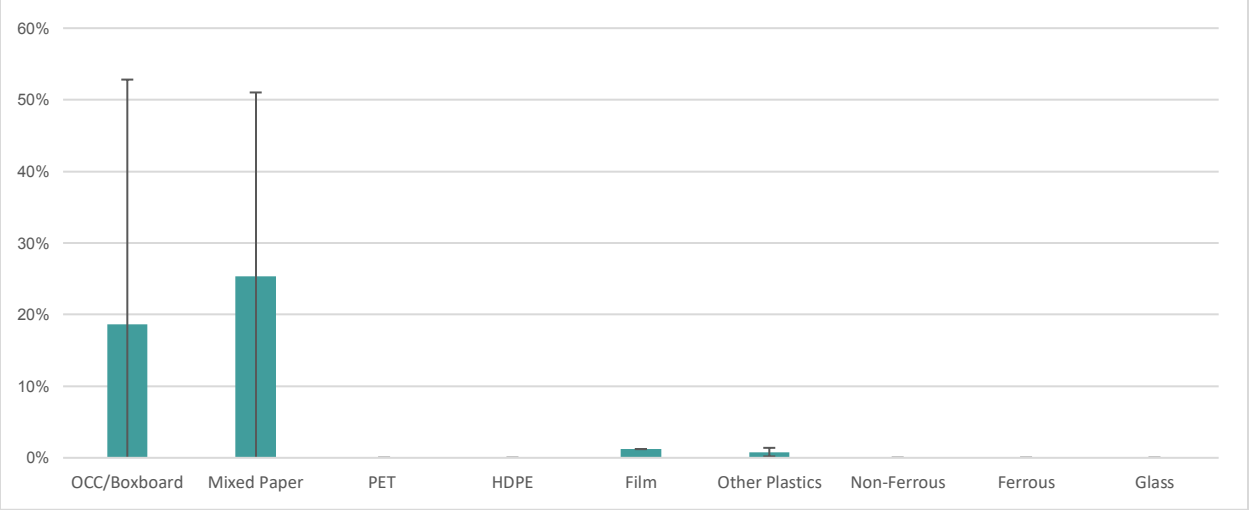

Figure 16: Proportion of PPP in the transportation and warehousing collected for recycling stream

4.3.5. Educational services

Overview

The Educational Services sub-sector include entities primarily engaged in providing instruction and training in a wide variety of subjects. This instruction and training are provided at specialized establishments, such as elementary and secondary schools, post-secondary institutions (e.g., colleges, universities), and training centres. See **Appendix G** for a list of the NAICS codes in this sub-sector.

This sub-sector accounts for approximately 170,000 FTEs or about 7% of the workforce. **Table 25** provides an overview of the sub-sector's employment in relation to total employment in

each of the five BC zones. Employment in the Educational Services sub-sector is relatively similar across each of the BC zones.

Table 25: Education services employment in relation to total employment by BC zone

BC zone	Contribution of sub-sector to total zone employment
Vancouver Island and Coastal	8.4%
Kootenay	8.0%
North Central	7.6%
Lower Mainland	6.6%
Southern Interior	6.0%

Data analysis

Data variability PPP disposal	Low	**Medium**	High
Data variability PPP collected for recycling	Low	**Medium**	High
Data availability	**Low**	**Medium**	High

Table 26 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is lower on a per FTE basis compared to other sub-sectors (**Appendix H**). There is also significantly more PPP collected for recycling compared to that collected for disposal in this sub-sector.

Table 26: Overview of disposed and collected for recycling audit data from educational services

NAICS	Division	Number of waste audits	Students / Facility	Average facility size (ft^2)	PPP disposed (kg/student/yr)	PPP collected for recycling (kg/student/yr)
61	Elementary schools	4	299	n/a	6.12	16.03
61	Secondary schools	6	866	n/a	4.12	4.81
61	Post-secondary schools	18	14,095	335,559	9.13	20.08

There are several factors to consider when reviewing the data from this sub-sector:

- Some organizations have focused educational programs for recycling of packaging (e.g., EcoSchools Canada, Encorp Pacific, Carton Council of Canada). The effort to engage students and staff in the 3Rs (e.g., reduce, reuse, recycle) can also influence an entity's overall waste management.
- Whether a school has a cafeteria can impact PPP composition and management.

- Some schools might also require packaging from lunches to be taken home or might have a separate system to collect containers that bear a refundable deposit.

Table 27 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. As the sub-sector makes up a relatively smaller amount of economic activity in the province, and the disposal rate per FTE is low, it is a low contributor to PPP waste generation.

Table 27: Contribution of educational services PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	0.9%
Vancouver Island and Coastal	0.3%
North Central	0.1%
Southern Interior	0.1%
Kootenay	<0.1%

PPP composition in the disposal and collected for recycling streams

Similar to the Administration and Office sub-sector, there is less variation in the composition of PPP materials disposed and collected for recycling in the Educational Services sub-sector than other sub-sectors. However, the individual activities of businesses within this sub-sector could influence the composition of PPP in the disposal and collected for recycling streams. For example, a scientific lab or a cafeteria at a college or university could likely generate more plastic PPP.

Fibre-based materials are the dominant form of PPP found in both the disposal and collected for recycling streams (**Figure 17** and **Figure 18**), which is makes intuitive sense based on the type of activities being undertaken in educational facilities. Mixed paper accounts for the largest proportion of the disposal and collected for recycling streams. The amount of plastic PPP represents 14% of total materials disposed, mainly driven by film PPP and other plastic PPP. The proportion of plastic PPP in the disposal stream for this sub-sector is higher than in the other jurisdictions reviewed (e.g., Australia). This might be related to the time periods in which these studies were undertaken or that waste composition is different between jurisdictions.

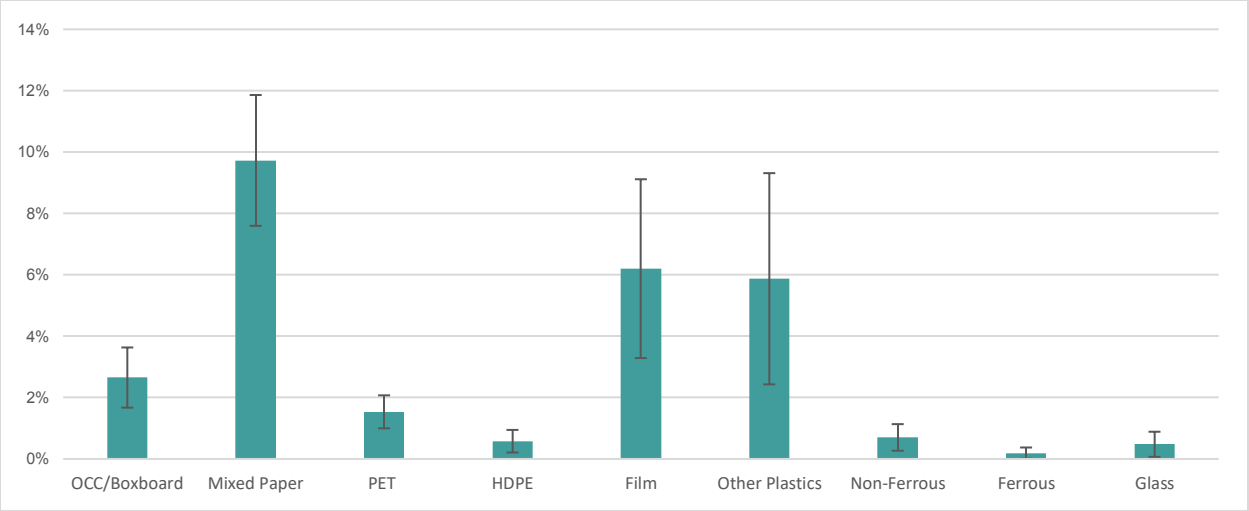

Figure 17: Proportion of PPP in the educational service disposal stream

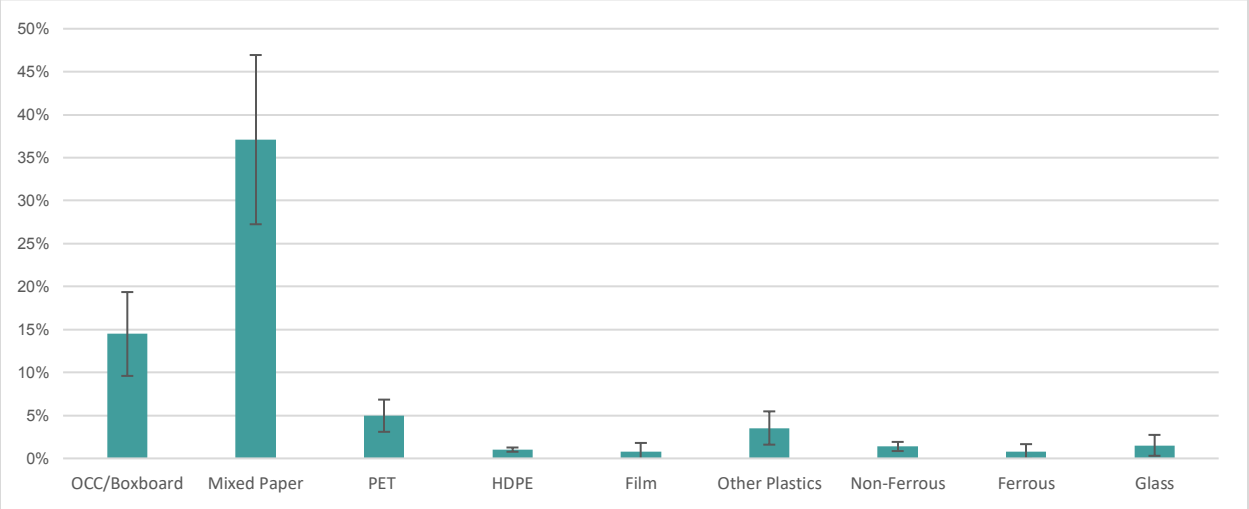

Figure 18: Proportion of PPP in the educational service collected for recycling stream

4.3.6. Manufacturing

Overview

The Manufacturing sub-sector includes entities primarily engaged in the chemical, mechanical or physical transformation of materials or substances into new products. See **Appendix G** for a list of the NAICS codes in this sub-sector.

According to Government of BC Stats, 57% of the manufacturing sub-sector is dedicated to durables goods and 43% to non-durable goods. The two main contributors to this sub-sector are wood and fibre product manufacturing (20% of all manufacturing activities) and food manufacturing (16% of all manufacturing activities).[50] It is not clear whether these types of

[50] Ibid.

manufacturers are reflected proportionally in the modelling completed for this report as waste audit data collected did not identify the type of manufacturer.

This sub-sector accounts for approximately 150,000 FTEs or about 6% of the provincial workforce. **Table 28** provides an overview of the sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Manufacturing sub-sector is highest in the North Central and Kootenay zones.

Table 28: Manufacturing employment in relation to total employment by BC zone

BC zone	Contribution of sub-sector to total zone employment
North Central	10.0%
Kootenay	7.6%
Southern Interior	6.8%
Lower Mainland	6.3%
Vancouver Island and Coastal	4.3%

Data analysis

Data variability PPP disposal	Low	**Medium**	High
Data variability PPP collected for recycling	Low	Medium	**High**
Data availability	Low	**Medium**	**High**

Table 29 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is high on a per FTE basis compared to other sub-sectors (**Appendix H**). There is also significantly more PPP collected for recycling compared to that collected for disposal in this sub-sector.

Table 29: Overview of disposed and collected for recycling audit data from manufacturing

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
31-33	67	227	124,648	194	475

When reviewing the data from this sub-sector it is important to consider that there could be significant differences in the amount and type of PPP that manufacturers generate based on what they manufacture: i.e., whether they are a food or beverage processor, equipment manufacturer, or goods manufacturer.

Table 30 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. Although this sub-sector has a higher disposal rate per FTE, it is a lower source

of economic activity in the province, and as a result is a lower contributor to BC's overall PPP disposal.

Table 30: Contribution of manufacturing PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	5.9%
Southern Interior	1.1%
Vancouver Island and Coastal	1.0%
North Central	0.8%
Kootenay	0.3%

PPP composition in the disposal and collected for recycling streams

Mixed paper and transportation type packaging (plastic film and OCC) compose the majority of the PPP in the disposal and diversion stream (**Figure 19** and **Figure 20**).

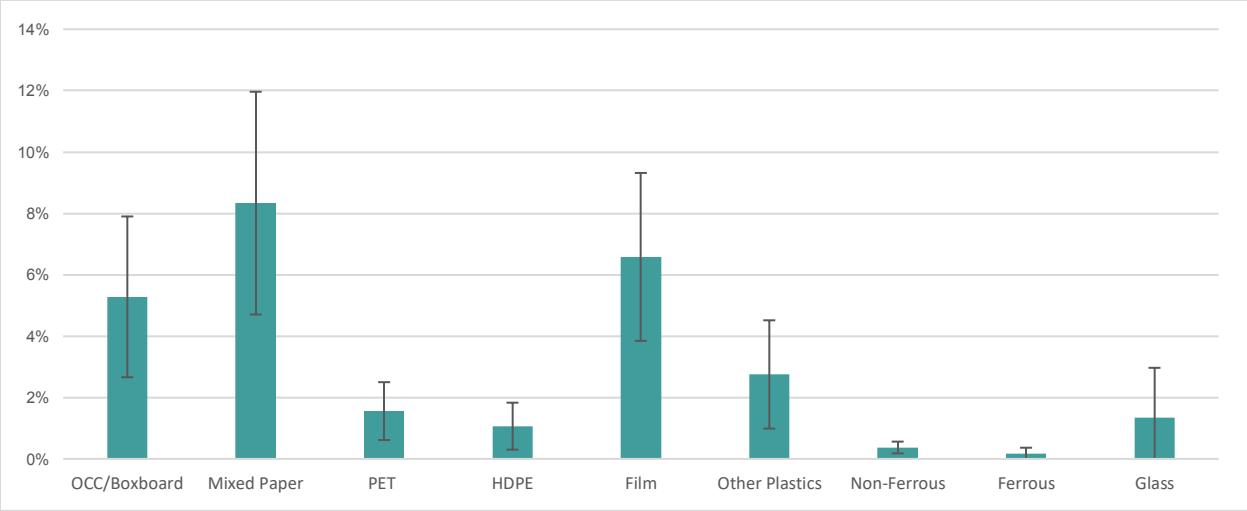

Figure 19: Proportion of PPP in the manufacturing disposal stream

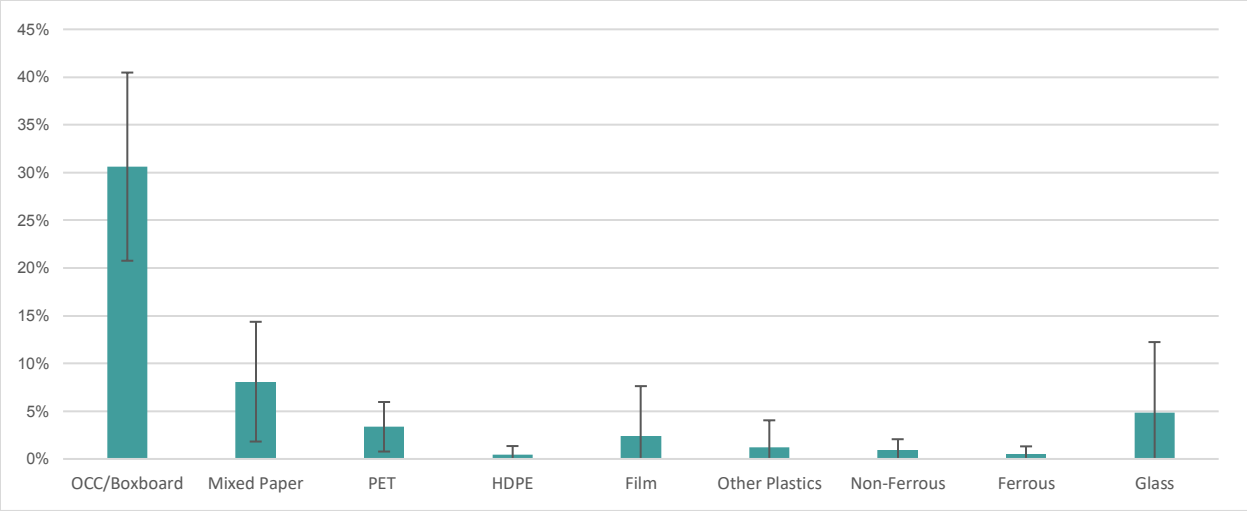

Figure 20: Proportion of PPP in the manufacturing collected for recycling stream

4.3.7. Accommodation and food services

Accommodations: Overview

The Accommodations sub-sector includes entities primarily engaged in providing short-term lodging for travellers, vacationers, and others (e.g., hotels, motels, resorts, recreational camps, seasonal trailer parks). In addition to lodging, a range of other services might be provided (e.g., food, recreation). See **Appendix G** for a list of the NAICS codes in this sub-sector.

The sub-sector accounts for approximately 55,348 FTEs or just over 1% of the workforce. **Table 31** provides an overview of the sub-sector employment in relation to total employment in each of the different zones in BC.

Table 31: Accommodations employment in relation to total employment by BC zone

BC zone	Total sub-sector employment by BC zone
Vancouver Island and Coastal	1.5%
Kootenay	1.3%
Southern Interior	1.0%
Lower Mainland	0.9%
North Central	<0.1%

Accommodations: Data analysis

Data variability PPP disposal	Low	**Medium**	High
Data variability PPP collected for recycling	Low	**Medium**	**High**
Data availability	Low	**Medium**	**High**

Table 32 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is moderate on a per FTE basis compared to other sub-sectors (**Appendix H**). There is also significantly more PPP collected for recycling compared to that collected for disposal in this sub-sector.

There are several factors to consider when reviewing the data from this sub-sector:

- It was not clear in the waste audit data received as to whether the management of deposit bearing beverage containers were captured or not. As many of the entities within this sub-sector would use deposit bearing containers, the PPP generation might be underestimated.
- Based on discussions with industry experts, this sub-sector often deals with more highly contaminated material in the collected for recycling stream (e.g., food contaminated packaging, consumers improperly sorting waste and recyclables).

Table 32: Overview of disposed and collected for recycling audit data from accommodations sub-sector

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
721	23	150	102,083	69.09	221.31

Table 33 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. While the amount of PPP disposed is moderate per FTE compared to other sub-sectors, the overall employees working within this sub-sector is low. As a result, approximately 1% of all PPP disposed in BC comes from the Accommodations sub-sector.

Table 33: Contribution of accommodations PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed in BC
Lower Mainland	0.7%
Vancouver Island and Coastal	0.3%
Southern Interior	0.1%
Kootenay	<0.1%
North Central	<0.1%

PPP composition in the disposal and collected for recycling streams

According to the data, 22% of the total disposal stream for the sub-sector is PPP, a similar proportion of fibre and plastic based PPP (**Figure 21**). There is also a significant proportion of glass in the disposal stream, compared to other sectors.

The plastic data are consistent with a report[51] completed by WRAP UK and the UK Plastic Pact on this sub-sector. In those facilities:

- Almost 60% of plastic generated is PET (e.g., beverages) and HDPE (e.g., detergents) bottles.
- Almost 20% of plastic generated is plastic film.

Given the prevalence of plastic beverage bottles, it is not surprising to find a relatively high proportion of glass bottles as well. Most of the materials collected for recycling in this sub-sector are fibre-based, most specifically OCC.

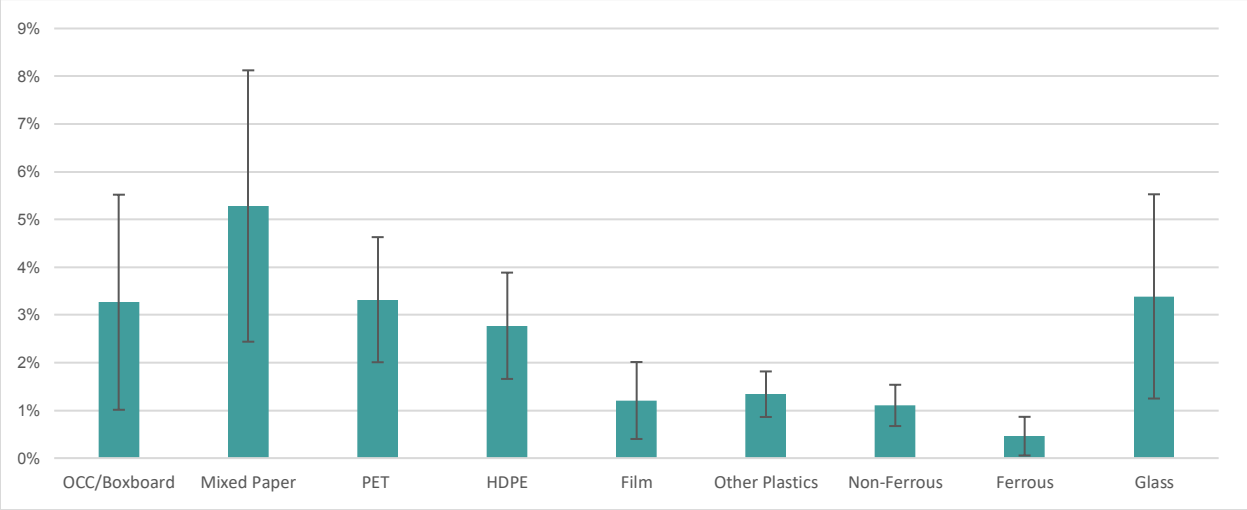

Figure 21: Proportion of PPP in the accommodation disposal stream

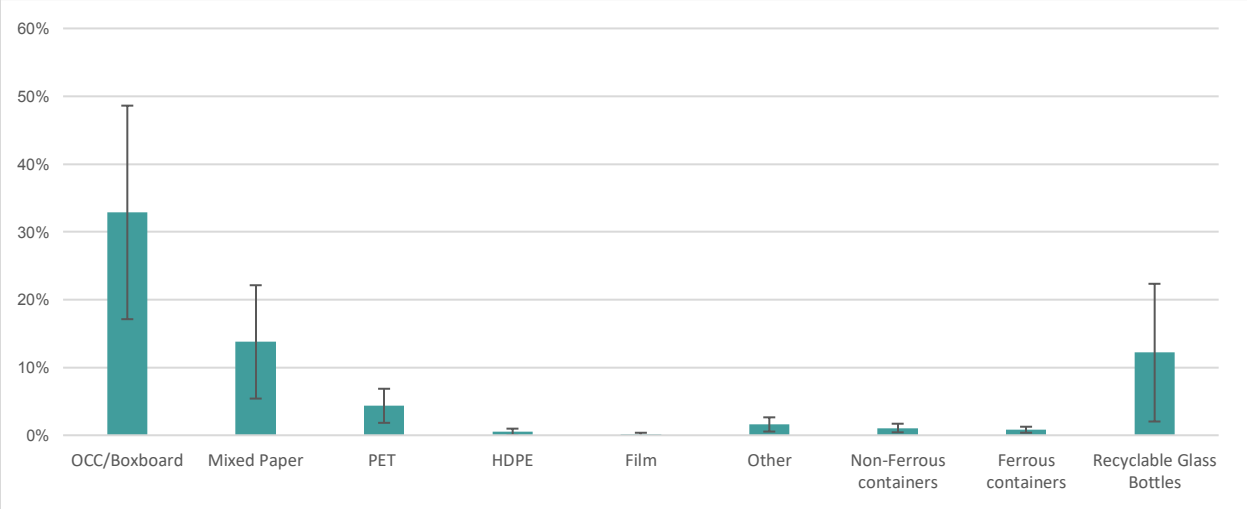

Figure 22: Proportion of PPP in the accommodation collected for recycling stream

[51] WRAP, August 2018. Plastic Flow 2015: Plastic Packaging Flow Data Report. Available at: https://wrap.org.uk/sites/default/files/2020-11/WRAP-PlasticFlow%202025%20Plastic%20Packaging%20Flow%20Data%20Report_0.pdf

Food Services: Overview

The food services sub-sector includes entities that prepare food for immediate consumption on or off the premises. Examples include full-service sit-in restaurants, quick service restaurants, cafeterias, bars, taverns, caterers, and mobile food trucks. It does not include meals that occur within other establishments such as hotels, amusement and recreation parks, theatres, unless they are leased food service locations (e.g., airports, malls, hotels). See **Appendix G** for a list of the NAICS codes in this sub-sector.

The sub-sector represents approximately 170,000 FTEs or only 5% of BC's overall employment. **Table 34** provides an overview of the sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Food Services sub-sector is relatively similar across each of the BC zones.

Table 34: Accommodation and food services employment in relation to total employment by BC zone

BC zone	Contribution of sub-sector to total zone employment
North Central	6.0%
Lower Mainland	5.9%
Vancouver Island and Coastal	5.8%
Kootenay	5.4%
Southern Interior	5.2%

Food Services: Data analysis

Data variability PPP disposal	Low	**Medium**	High
Data variability PPP collected for recycling	**Low**	Medium	High
Data availability	Low	**Medium**	**High**

Table 35 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is high on a per FTE basis compared to other sub-sectors (**Appendix H**). There is significantly less PPP that is being collected for recycling compared to that collected for disposal in this sub-sector.

Table 35: Overview of disposed and collected for recycling data from food services sub-sector

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
722	48	100	n/a	606	273

There are several factors to consider when reviewing the data from this sub-sector:

- It was not clear in all of the waste audit data received as to whether the management of deposit return containers were captured or not. As many of the entities within this sub-sector would use deposit bearing containers, the PPP generation results might be underestimated.
- Based on discussion with industry experts, this sub-sector often deals with more highly contaminated PPP in the collected for recycling stream (e.g., food contaminated packaging, consumers improperly sorting waste and recyclables).
- There can be significant variation in access to recycling systems across businesses in this sub-sector (e.g., a restaurant located in a mall with access to recycling streams will have different opportunities than a small restaurant not surrounded by other businesses and with minimal storage).

Table 36 shows there are important differences between the PPP generation between fast-food restaurants and sit-in restaurants based on study conducted in Québec.[52] In fast-food restaurants, the proportion of fibre will be significantly higher than in sit-in restaurants, because meals are served in fibre-packaging (boxes, fibre wrap, etc.). Sit-in restaurants may generate more glass containers than in quick serve restaurants as they serve alcohol more often.

Table 36: Comparison of material generation according to the type of food services facility (based on Québec data)

Type	Fibre	Plastic	Metal	Glass
Sit-in	11.9%	4.8%	2.2%	11.9%
Quick Serve	23.9%	7.8%	0.6%	1.5%

Table 37 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. Based on its high disposal rate per FTE and moderate level of employment in BC, this sub-sector is a substantial contributor to PPP waste disposal, representing almost 32% of total PPP disposed. The Lower Mainland area is the largest contributor of PPP disposal.

Table 37: Contribution of food services PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	20.9%
Vancouver Island and Coastal	4.9%
Southern Interior	3.2%
North Central	1.8%
Kootenay	0.8%

[52] RECYC-QUÉBEC and Éco Entreprises Québec, 2009. Caractérisation des matières résiduelles du sous-secteur commercial. Available at: https://www.recyc-Québec.gouv.qc.ca/sites/default/files/documents/caracterisation-secteur-commercial-08-09.pdf (in French)

PPP composition in the disposal and recycling stream

Figure 23 shows a high proportion of the PPP in the disposal stream is plastic film and mixed paper. The PPP materials in the disposal stream were generally comparable to the PPP disposed in California and Australia[53]. However, the proportion of plastics seems much higher in this study compared to others, driven by an ~13% plastic film PPP. This might be partially due to the age of these other studies and/or the composition is different in Canada.

The majority of materials collected for recycling are fibre-based PPP (**Figure 24)**. Glass and plastic PPP represent an equal amount of the collected for recycling stream at 4% and metal PPP represents only 1%.

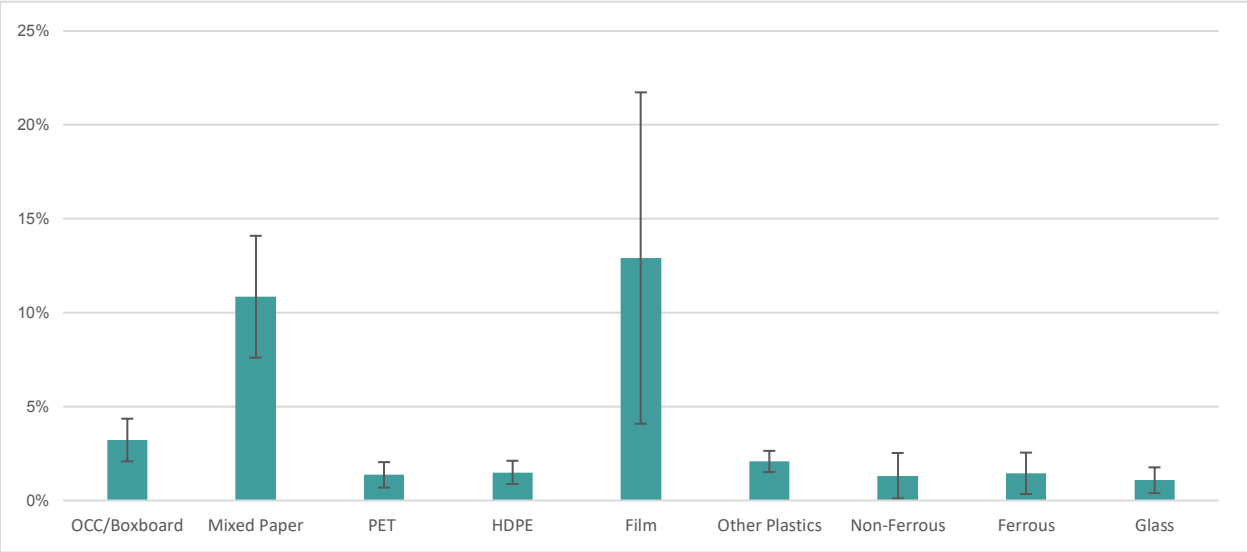

Figure 23: Proportion of PPP in the food services disposal stream

[53] Australian Government, 2013. A Study into Commercial and Industrial Waste and Recycling in Australia by Industry Division. Available at: https://www.awe.gov.au/sites/default/files/documents/commercial-industrial-waste.pdf

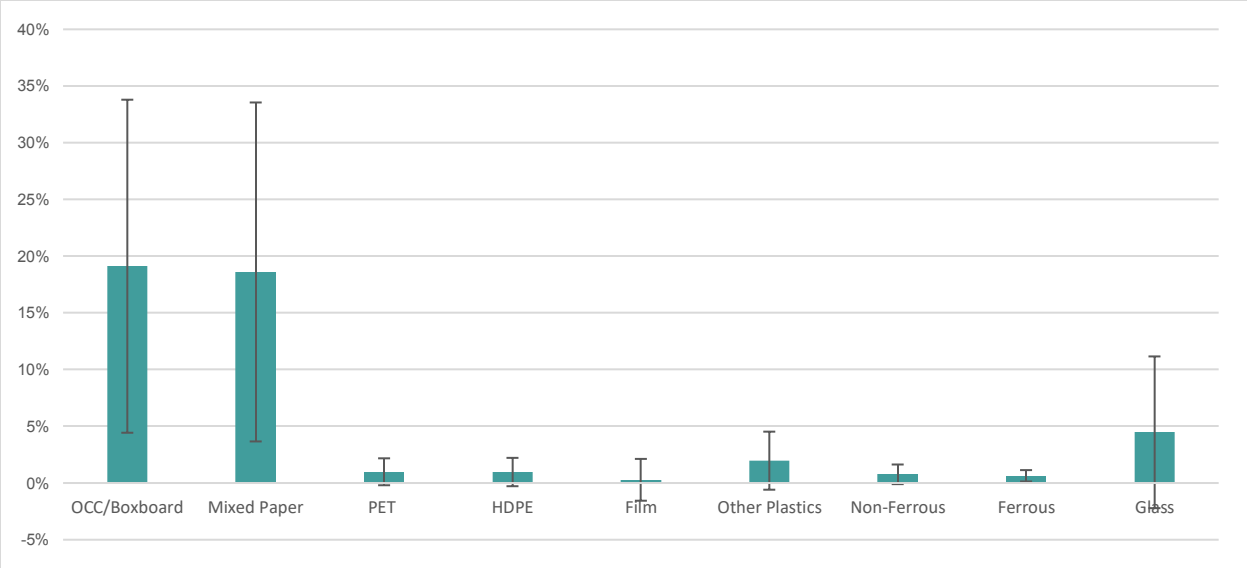

Figure 24: Proportion of PPP in the food services collected for recycling stream

4.3.8. Arts, entertainment, and recreation

Overview

The Arts, Entertainment, and Recreation sub-sector includes entitles primarily engaged in operating facilities or providing services to meet the cultural, entertainment and recreational interests of their patrons (e.g., theatres, sports venues, museums, zoos). See **Appendix G** for a list of the NAICS codes in this sub-sector.

This is the smallest sub-sector reviewed representing approximately 37,000 FTEs or 2% BC's workforce.

The need to consider the seasonality of this sub-sector is discussed below. **Table 38** provides an overview of the sub-sector's employment in relation to total employment in each of the five BC zones. Employment in the Arts, Entertainment, and Recreation sub-sector is relatively similar across each of the BC zones, with the exception of the North Central area, which has very little employment in this sub-sector.

While some activities are permanent, there is a wide range of cultural activities within this sub-sector that only occur at specified periods of the year, for example certain outdoors activities.

Table 38: Arts, entertainment, recreation employment in relation to total employment by BC zone

BC zone	Contribution of sub-sector to total zone employment
Kootenay	3.9%
Lower Mainland	2.8%
Southern Interior	2.7%

Vancouver Island and Coastal	2.2%
North Central	<0.1%

Data analysis

Data variability PPP disposal	Low	**Medium**	**High**
Data variability PPP collected for recycling	Low	Medium	**High**
Data availability	**Low**	**Medium**	High

Table 39 provides the number of waste audits modelled for this sub-sector, as well as the average number of FTEs, the average square footage of the sites audited, and the average kg/FTE PPP disposed and collected for recycling. The PPP disposed and collected for recycling is lower on a per FTE basis compared to other sub-sectors (**Appendix H**). There is significantly more PPP that is being collected for recycling compared to that collected for disposal in this sub-sector.

Table 39: Overview of disposed and collected for recycling audit data from arts, entertainment, recreation sub-sector

NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
71	18	507	75,762	7.19	29.26

There are several factors to consider when reviewing the data from this sub-sector:

- The data in this sub-sector will be highly variable given:
  - The type of event or activity (i.e., concert, art gallery, sports event, corporate event).
  - The size of the activity (i.e., number of attendees).
  - The venue associated with the activity (i.e., outdoor festival, theatre).
  - The type of consumption that is allowed (e.g., alcohol, food).
- Moreover, the seasonality of the activities, and therefore the waste production, needs to be considered in a waste management perspective.

Table 40 provides an estimate of this sub-sector's PPP contribution to the total ICI PPP disposed in the province. Given the low employment in this sub-sector and the low PPP disposal rate per FTE, it is a low contributor to PPP waste generation. Under 0.1% of all PPP disposed in BC comes from this sub-sector.

Table 40: Contribution of arts, entertainment, recreation PPP to total ICI PPP disposed in BC

BC zone	Proportion of PPP disposed
Lower Mainland	0.06%
Southern Interior	0.01%

Vancouver Island and Coastal	0.01%
Kootenay	<0.01%
North Central	<0.01%

PPP composition in the disposal and collected for recycling streams

Similar to other sectors, the largest proportion of PPP is fibre-based PPP in both the disposal and collected for recycling streams (**Figure 25** and **Figure 26)**. Mixed paper is the largest contributor to the amount of PPP disposed. However, there is also similar amounts of OCC and mixed paper collected for recycling. In comparison, PET makes up a larger portion of the collected recycling streams (10%) in this sub-sector as compared to other sub-sectors.

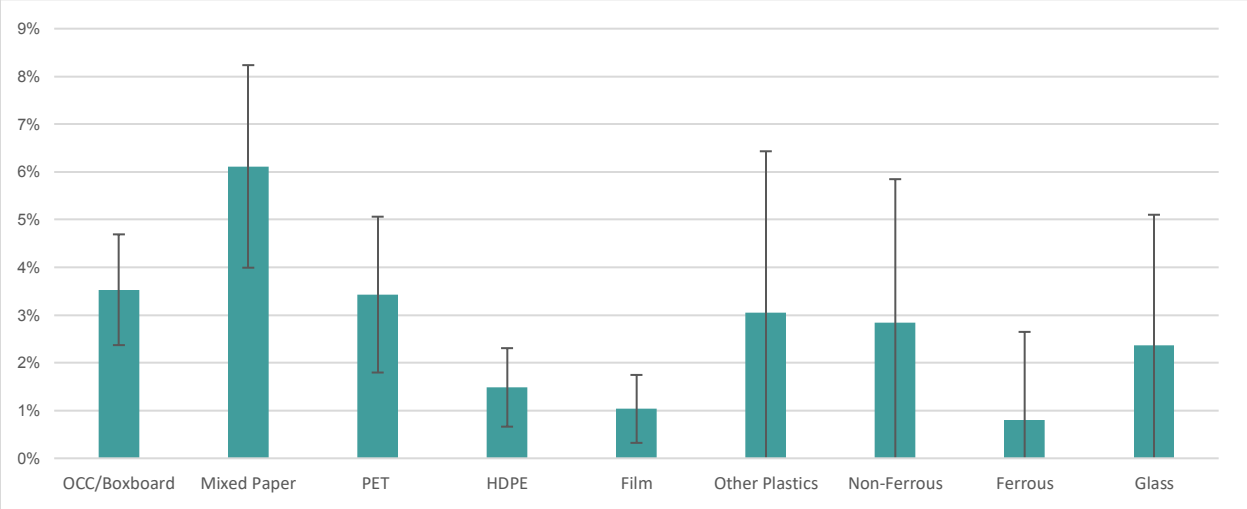

Figure 25: Proportion of PPP in the arts, entertainment, recreation disposal stream

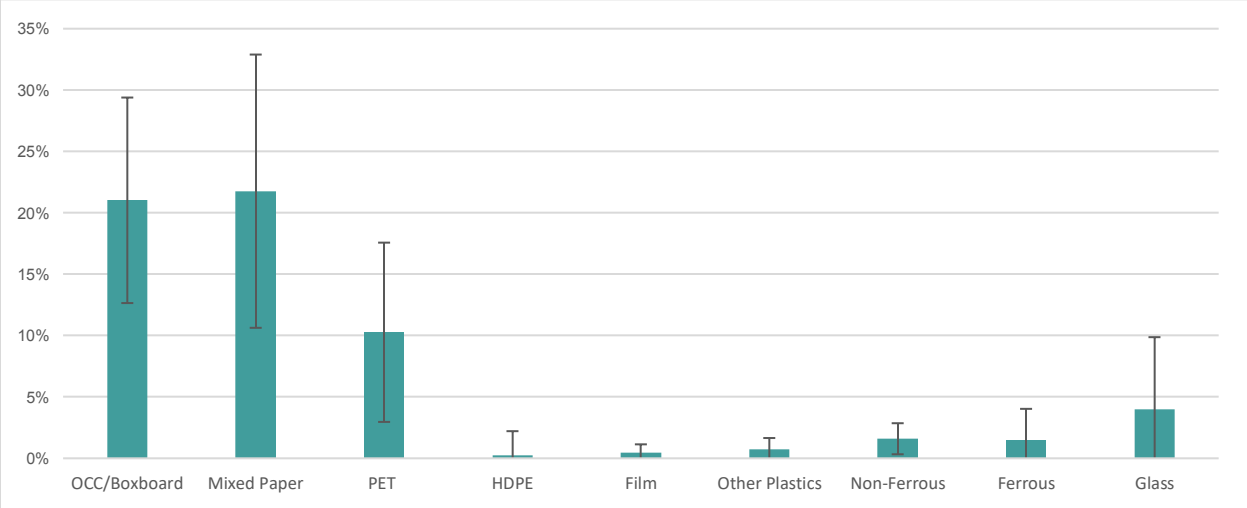

Figure 26: Proportion of PPP in the arts, entertainment, recreation collected for recycling stream

4.4. Other ICI PPP characterization

4.4.1. Agriculture

Overview

The Agriculture sub-sector includes entities such as:

- farms, orchards, groves, greenhouses, and nurseries, primarily engaged in growing crops, plants, vines, trees, and their seeds (excluding those engaged in forestry operations); and
- ranches, farms, and feedlots, primarily engaged in raising animals, producing animal products, and fattening animals.

The Agricultural sub-sector is one of the smallest sub-sectors reviewed for this report representing approximately 26,800 FTEs or about 1% BC's workforce. Based on the annual revenue, crop production, and animal production are of relatively equal size in the province (**Table 41**).

Table 41: BC sub-sector agriculture revenue

Sub-sector	Revenue (2019)
Crop production (111)	$1.81B
Animal production (112)	$1.61B

Data analysis

From the outset of the project, the objective was to leverage the existing and recent waste characterization analysis undertaken by Cleanfarms to inform on the amount of PPP in the disposal and collected for recycling streams.[54]

Table 42 provides a summary of the data and information provided through the Cleanfarms report on the amount of PPP in both the disposal and collected for recycling streams. With an estimated 4,236 tonnes of plastic PPP produced annually (an amount which is mainly disposed), it is estimated at around 1% of all PPP disposed in BC.

Table 42: Overview of disposed and collected for recycling audit data from agriculture

NAICS	Number of agricultural employees	PPP disposed	PPP recycled	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP collected for recycling (kg/FTE/yr)
111-112	26,800[55]	4,168 MT	68 MT	n/a	156	3

[54] Cleanfarms, 2021. Agricultural Plastics Characterization and Management on Canadian Farms. Available at: https://cleanfarms.ca/wp-content/uploads/2021/08/Project-Building-a-Canada-Wide-Zero-Plastic-Waste-Strategy-for-Agriculture.pdf

[55] Government of British Columbia, January 2022. Fast Stats: British Columbia's Agriculture, Food and Seafood Sector. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/statistics/industry-and-sector-profiles/fast-stats/fast_stats_2019.pdf

Figure 27 provides a summary of the proportion of PPP by material type. Cleanfarms has a collection program in place for HDPE containers used for pesticides and fertilizers. LLDPE and LDPE from bale wrap, roof film, mulch film and bags account for half of the plastic generated by this sub-sector. According to Cleanfarms, there are few collection programs for these materials.

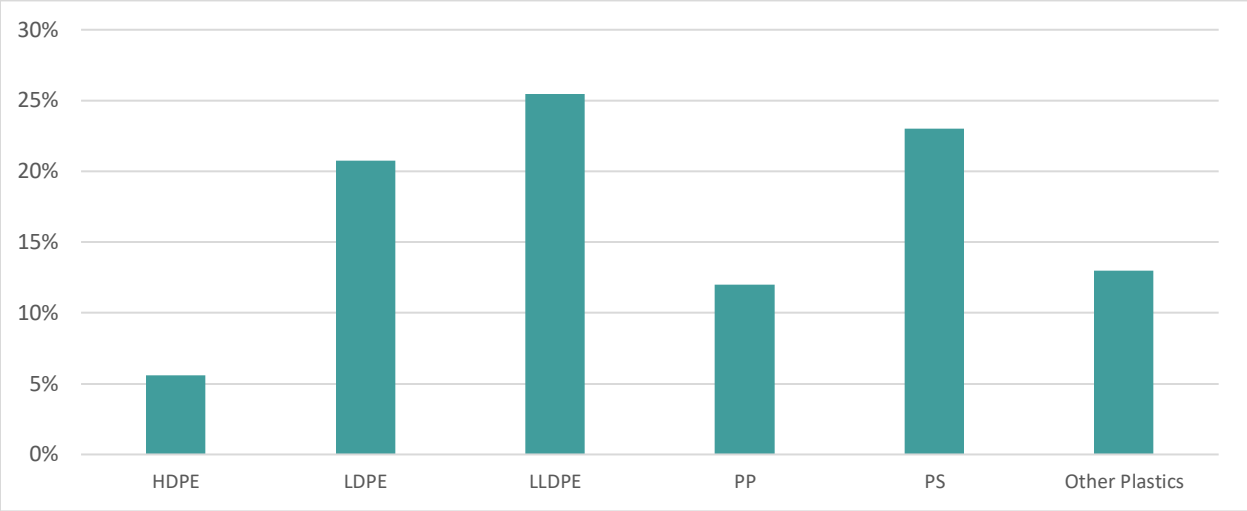

Figure 27: Proportion of plastic PPP by type generated in agriculture

4.4.2. Construction

Overview

The Construction sub-sector includes entities primarily engaged in constructing, repairing, and renovating buildings and engineering works, and in subdividing and developing land.

BC's Construction sub-sector accounts for approximately 170,000 FTEs or about 8% of BC's workforce. **Table 43** provides an overview of the sub-sector's employment in relation to total employment in each of the five BC zones. The employment of this sub-sector is a relatively consistent contributor to overall employment across the province.

Table 43: construction employment in relation to total employment by BC zone

BC zone	Contribution of sub-sector to total zone employment
Kootenay	10.5%
North Central	10.1%
Southern Interior	10.1%
Lower Mainland	8.6%
Vancouver Island and Coastal	8.1%

Data analysis

No waste audit data were obtained for this sub-sector and as a result per FTE or per square footage PPP disposal numbers cannot be generated. Anecdotal data were provided by two C&D recyclers in BC. The data provided by these entities was similar to a recent characterization study undertaken by RECYC-QUÉBEC (**Figure 28**).[56] C&D recyclers confirmed that about 5% by weight of the PPP was fibre-based, and approximately 2% by weight was plastic but this included both PPP (e.g., film, pails and buckets) and durable non-PPP plastics. For examples of the types of plastic PPP found on C&D sites see **Figure 29 – 34.**

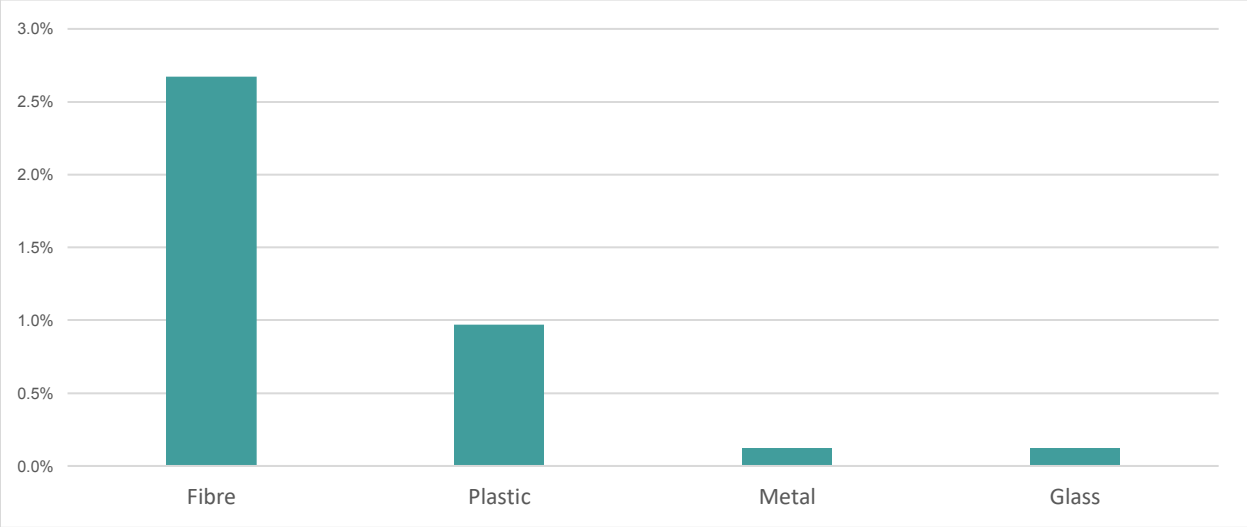

Figure 28: Proportion of C&D PPP disposed in Québec's waste stream

[56] RECYC-QUÉBEC, 2021. Étude de caractérisation à l'élimination 2019-2020. Available at: https://www.recyc-Québec.gouv.qc.ca/sites/default/files/documents/caracterisation-elimination2019-2020.pdf (in French)

Figure 29: White banding

Figure 30: Foam

Figure 31: Plastic separators

Figure 32: Foam

Figure 33: Film plastic

Figure 34: Green banding

Interviewees emphasized there is less activity related recycling C&D plastics (as opposed to other C&D materials like OCC) as it represents a low volume overall, and can often highly contaminated (e.g., a bucket of sealant or mortar with residuals that cannot be easily removed).

4.4.3. Work camps

Work camps (i.e., industrial camps) are locations where people are employed and accommodated onsite, and are commonly used in the forestry, mining, and oil and gas sectors. The operation of workcamps is regulated under the *Public Health Act* and *Industrial Camps*

Regulation[57] and the guidelines for waste management are outlined in *Industrial Camps: Waste Authorizations and Best Practices*.[58] The Ministry does not have current statistics on the number of workcamps operating across BC. In 2012, the Ministry of Health estimated that there were 1,809 possible camps, but could not determine which were active, scheduled for future development, or retired and further stated that estimate did not include smaller, more transient camps (e.g., exploration, silviculture).[59] The Ministry estimates there are in excess of 10,000 people living in BC workcamps in 2022.

Workcamps are considered part of the ICI sector and recyclables produced by workcamps are not managed by BC's regulated residential PPP system. Workcamp operators are not required to conduct waste audits nor meet any reuse or recycling targets. As a result, workcamp audit data are scarce. Anecdotally, some Regional Districts report workcamp 'waste' to be a stressor on their waste management systems and that the waste streams are 'similar' to residential waste (i.e., the waste generated by day-to-day living).

Only one waste audit was found for workcamp waste, which was conducted for Peace River Regional District. [60] This report confirmed that workcamp waste tended to resemble residential waste rather than waste from the ICI sector, and this characterization was "primarily due to the high proportion of compostable organics (18.0%), fibre (18.0%), and plastic (10.4%)."[61]

Data from the waste audit was reviewed to assess the amount of PPP plastic, fibre, metal, and glass that were contributors to the work camp waste stream. **Table 44** provides estimates of identifiable PPP from this stream.

Table 44: Proportion of PPP in the work camp disposal stream

Work camp waste audit results	Proportion of PPP
PPP Fibre	6.9%
PPP Plastic	14.3%
PPP Metal	1.3%
PPP Glass	0.4%

If we assume that an average stable population of 10,000 people live in workcamps across BC at any given time (whether people enter or exit the workcamps) and we assume the waste they

[57] Government of British Columbia, n.d. Industrial camps. Available at: https://www2.gov.bc.ca/gov/content/health/keeping-bc-healthy-safe/industrial-camps#:~:text=The%20Ministry%20of%20Health%20provides%20policy%20support%20for,agriculture.%20B.C.%20has%20declared%20a%20state%20of%20emergency
[58] Ministry of Environment and Climate Change Strategy, 2018. Waste authorizations and best practices. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/mwr/workcampsfs.pdf
[59] Ministry of Health, 2012. Part 1: Understanding the State of Industrial Camps in Northern BC: A Background Fibre. Available at: In health, men face poorer outcomes than women across a range of key indicators (northernhealth.ca)
[60] Tetra Tech, 2018. Four season waste composition study. Available at: https://prrd.bc.ca/wp-content/uploads/page/plans-and-strategies/Four-Season-Report_IFU062918.pdf
[61] Ibid. Tetra Tech, 2018. S. 4.2.4.

produce from day-to-day living is the same as other BC residents (500.8 kg/capita), then these workers would dispose 5,008 tonnes of waste per year at workcamps across BC.

4.5. Reuse in business-to-business packaging

Reusable packaging is made from durable items intended for longer terms uses. In the ICI sector reusable PPP is not considered 'packaging' but instead is considered an 'asset' that has been invested in and needs to be managed. Reusable packaging is included in this report for two reasons:

1. Reusable packaging is one method to reduce the need for single-use packaging disposal and collection for recycling, and therefore the status of and barriers to reusable packaging are of interest.
2. Reusable packaging must be disposed at end-of-life and should be properly managed.

ICI business-to-business (B2B) packaging is fundamentally different than business-to-consumer packaging. Consumer packaging is designed to encourage a consumer sale through visual and functional cues. B2B packaging serves much different functions, such as, protection of goods during transportation to a site (e.g., pallets, shrink wrap), the ability for large quantities to be broken down into smaller portions at distribution centres for shipment to multiple retail locations (e.g., totes), and even for pre-loaded displays for use by retail clients (e.g., seasonal candy displays, or cosmetic displays). These types of B2B packaging remain in the ICI sub-sector are not ever meant to be in the possession of a residential consumer.

This simplified relationship more easily enables closed loop systems, where new products and packaging are delivered to a location and the delivery trucks are re-loaded with used packaging that is then backhauled to potentially be cleaned and used again. These types of systems are common in the transit of both perishable and non-perishable goods to retail operations (e.g., between producers, distribution centres, and retail stores). These systems can be more economical or practical than alternative disposable systems, however the overall cost will depend on how logistics are arranged between the producer, distribution centre, and the retail store.

Reuse systems have flourished, naturally, for decades, particularly where production facilities, distribution centres, and retailers are all located locally (e.g., baked goods, dairy products, cold beverages, and produce). Other examples of common reuse systems include those for pallets and shipping containers that have been standardized across global supply chains.

However, the very fact that reuse systems evolved due to economic or practical drivers (i.e., and not as a result of corporate social responsibility goals) has meant that reusable items were never 'considered' PPP by ICI users; they are considered an asset like any other tangible business asset, and so very little practical data exists on their 'environmental performance' (e.g., number of trips or rotations, or how many disposable alternatives those items replaced).

During our interviews, ICI waste generators were asked about reusable PPP. Most interviewees acknowledged that reuse was part of their system but did not quantify the number of uses or rotations. They were able to qualitatively describe the benefits and barriers to increased reuse.

Some reusable business-to-consumer (B2C) PPP was also identified, including beverage containers (e.g., beer bottles, kegs) and gas cylinders (e.g., propane, acetylene, oxygen, helium). However, reusable consumer packaging was deemed to be less prevalent than B2B packaging. Similar to B2B reuse systems, B2C reuse systems tend to be present where production facilities, distribution centres, and retailers were all located locally.

4.5.1. Reusable ICI PPP

Types of reusable PPP commonly used in the ICI sub-sector include:

- totes (e.g., smaller totes with flip lips sometimes called ‘re-packs’);
- pallets;
- plastic and metal drums;
- super sacs;
- crates (e.g., milk crate);
- trays (e.g., bread, beverage containers, 4L milk jugs);
- beverage containers (e.g., beer bottles, kegs);
- gas cylinders (e.g., propane, acetylene, oxygen, helium);
- drums;
- intermediate bulk containers (for liquid storage) (**Figure 35**).

Figure 35: Examples of reusable ICI PPP

4.5.2. Reuse facilitators

ICI interviewees were asked about how they facilitated reuse within their systems. In general, there are three major pathways for reuse.

1. An investment is made by a company for a reusable container/item within a closed loop B2B operation (e.g., distribution centre to retailer). For example, distribution centres receive large quantities of items from manufacturers, break apart large loads, and repackage items into smaller loads for shipment to specific retailers or for storage. In these circumstances, smaller plastic reusable 'totes' are often used for repacking. In these B2B interactions, there is a natural 'backhaul' system available where delivery trucks transporting items from distribution centres for drop off at retail can collect empty reusable PPP items from the retailer at the same time for return to the distribution centres. Because an investment has been made, reusable items are repaired where possible and discarded when they reach end-of-life.

   One interviewee reported they have 50,000 totes in circulation, with approximately 2,500 loaded and shipped to retail stores each day, totalling approximately 780,000 uses each year. The lifespan of this kind of tote is approximately 10 years barring unexpected damage.

2. Items are rented (e.g., pallets acquired on a pay-by-use screen) as part of a shared pool of rentable resources used across the ICI sub-sector.

   One interviewee reported that their vendors ship them approximately 160,000 "CHEP brand" pallets per year, they reuse approximately 65,000 of these in their own B2B operations (i.e., shipping goods from their distribution centres to retail stores), return approximately 85,000 pallets to CHEP per year, and approximately 10,000 are tied up in transit or storage. These pay-by-use pallets supplement their own internal reusable stock of 275,000 pallets per year.

3. A deposit return system (DRS) is applied to the item (e.g., crates, intermediate bulk container totes). This model is more common in 'short' supply chains -i.e., vendor supplies an item directly to a retailer.

This is a common model in the dairy and bakery industries where a DRS system is applied by the vendor (e.g., a dairy manufacturer) to a highly valuable reusable PPP item (e.g., a milk crate), and a credit is provided to a retailer upon the return of the item to the vendor.

One interviewee reported they have 10,000 crates in circulation, with approximately a 25% loss each year mostly due to customers not returning the crates for reuse. The average lifespan of this kind of crate is 5-7 years, however this is mostly due to customers not returning the milk crates (despite a deposit being paid) and using them for other uses.

Another interviewee reported their dairy 'cases' have a lifespan of 10 years or 80,000 – 200,000 rotations and carry a deposit of $3.00, and their 4L milk jug trays have a lifespan 7 years or 1,500 rotations and carry a deposit of $3.00.

4.6. Key findings from ICI characterization based on industry waste audit data

It's important to reiterate that the results provided in this section results are based on the 350 waste audits and interviews with representatives with ICI entities. While there is a high level of confidence that the waste audit data received are representative of waste audits completed (i.e., because they were supplied by a variety of companies that undertake waste audits) there is a lower level of confidence that they are fully representative of all ICI generators. It seems likely, although not supported by empirical evidence, that ICI waste generators that undertake waste audits are more likely to be those that pay closer attention to waste generation and more likely to have recycling and food and organic waste diversion programs. This information is a general indication of tends given the level of variability in the activities of ICI entities. All efforts have been taken by the project team to ensure the accuracy of the results, but it is important to understand the limitation posed by a lack of data.

In general, the results of this study show that composition, quantities, and management of ICI PPP is much more variable than residential PPP. Residential PPP generation and disposal tends to be relatively homogeneous regardless of where it's generated (i.e., whether in single-family homes or multi-family residential buildings) and, in general, residential PPP can be collected and processed in a similar manner regardless of its source.

ICI PPP composition and quantity varies significantly by its source (i.e., individual generator and ICI sub-sector) depending on:

- the sophistication of the waste management planning of individual businesses;
- the outputs of different types and sizes of businesses within an ICI sub-sector; and
- the outputs of different types of businesses across ICI sub-sectors.

For example, a beverage manufacturer is generating different types of PPP (e.g., material composition and formats of packaging) than a quick serve restaurant and, each would be serviced in a much different manner by a waste management company (e.g., container type,

collection method). Even within sub-sub-sectors, significant differences exist – a store that sells clothing will manage different types of packaging than a store that sells chocolate.

4.7. Service provider estimate of ICI PPP collected and processed

Service providers would not provide detailed data on estimates of PPP collected for recycling or ultimately recycled either because they consider this information to be commercially sensitive or simply because they did not have the data requested in an easily accessible form. However, they were willing to provide a broad estimate of the quantity of ICI PPP collected, sorted, and sent to a re-processor based on industry expertise. Overall, their responses varied ranging from an estimate of 150,000 – 400,000 tonnes per year. However, it's our assessment that those with the greatest depth of industry knowledge agreed to an estimate of 150,000 – 250,000 tonnes per year of ICI PPP collected for recycling and delivered to a re-processor.

4.7.1. Service Provider estimate

Most interviewees agreed that ICI PPP fibre recycling is strong province-wide, especially for OCC, but that non-fibre PPP recycling programs are limited, particularly outside the urban areas.

Table 45 provides a calculation of ICI PPP processed based on the interviewees' estimated relative proportion of each PPP material stream collected for recycling in the ICI sector and what that proportion would equate to based on 200,000 tonnes ICI PPP collected for recycling per year.

Table 45: ICI PPP collected for recycling, by material type

Material type	Service Provider estimated PPP collected for recycling in BC's ICI sector	
	Estimated proportion of ICI PPP stream (%)	The proportion of tonnes ICI PPP collected
Plastic (all)	**8%**	**12,000 – 20,000**
Rigid Plastic	37.5% of plastic	4,500 – 7,500
Film	62.5% of plastic	7,500 – 12,500
Fibre (total)	**90%**	**135,000 – 225,000**
Fibre – OCC	80% of fibre	108,000 – 180,000
Fibre – Mixed Paper	20% of fibre	27,000 – 45,000
Metal	**1%**	**1,500 – 2,500**
Glass	**1%**	**1,500 – 2,500**
Total	**100%**	**150,000 – 250,000**

While service providers would not provide actual data, two other sources of information combined with industry intelligence were used in an attempt to provide rough verification of their broad estimates and the estimates developed for PPP generation in Section 4, including

data from the Paper and Paperboard Packaging Environmental Council (PPEC) and Metro Vancouver (**Section 4.2.1** and **Section 4.2.2)**

The PPEC and Metro Vancouver assessment suggests that between 200,000 and 400,000 tonnes of PPP are collected, sorted, and collected for recycling each year. However, when this estimate was shared with interviewees, most agreed that based on their professional judgement that this was an 'over-estimate' and that the total PPP collected is closer to 200,000 tonnes across BC. Service providers' rationale was that most of the PPP collection routes are in the Lower Mainland and Vancouver Island and there are very few collection routes in the other regions. It should be noted that they might not be accounting for materials that might not be collected for recycling but might be lost before they make it a processor or re-processor (Figure 36).

4.7.2. PPEC assessment

As established in **Section 4.2.2**, OCC makes up the majority of PPP collected for recycling across the province. Other common recycling systems, (e.g., office fibre collection or regulated recycling systems like deposit return systems for beverage containers) provide for minor collection opportunities compared to the amount of OCC being collected.

PPEC estimates that 75% of all BC's ICI fibre products are collected, sorted, and sent to re-processors / end markets (i.e., fibre mills) .[62] The project team was not able to verify PPEC's 75% estimate because the organization has not provided the detailed collected and generated data to support the claim. However, according to another industry expert, the 75% collection performance (i.e., capture rate) is similar to other adjacent jurisdictions along the West Coast. [63]

In **Section 3**, analysis of the Regional District data suggested that approximately 103,500 tonnes of fibre are disposed annually. If we assume that number is correct, then PPEC's estimate of 75% collection would mean that approximately 310,000 tonnes of PPP fibre is collected, processed, and sent to an end-market for recycling in BC's ICI sector (**Table 46**). This would suggest that 414,000 tonnes of PPP fibre are generated annually.

Table 46: Estimated collected fibres from BC's ICI sector based on PPEC assessment

Status	Estimated quantities
Generated	414,000 MT
Collected for Recycling	310,500 MT
Disposed	103,500 MT
Collected rate	75%

[62] Paper and Paperboard Packaging Environmental Council, 2020. Recycling Regulation Policy Intentions Fibre. (*Unpublished*).
[63] Personal communication. Bill Moore from Moore and Associates, a recognized industry fiber recycling expert in the U.S. (March 20th, 2022)

4.7.3. Metro Van licensing assessment

Metro Vancouver licences privately operated solid waste facilities under a regulatory program managed by its Parks and Environment Department, Environmental Regulatory and Enforcement Services.[64] As a condition of their license/operating permit, Metro Vancouver requires MRF operators to submit electronic, quarterly reports on the quantities and types of recyclable material that are received and shipped.

Metro Vancouver provided a summary of the data it received from 40 of its licenced solid waste facilities. Of these, 17 accept PPP materials from residential sources, ICI sources, or both. Although the data set does include residential tonnes and has some inputting errors, it is possible to "correct" the data with industry knowledge, validation with downstream processors, and residential material categories. An assessment of these data show that approximately 180,000 tonnes of PPP is collected in Metro Vancouver alone and almost 90% of this is fibre (**Table 47**). However, this is likely an over-estimate given ICI entities in the Lower Mainland that have greater access to processing capacity and markets as compared to other zones in the BC.

These data are only from the Metro Vancouver area, which represents around 60% of BC's economic activity based on employment numbers. When these data are extrapolated to all of BC, it would suggest that around 300,000 tonnes of PPP materials would be collected across BC from the ICI sector.

Table 47: Estimated collected PPP from BC's ICI sector based on Metro Vancouver licensing data

Materials	Collected (tonnes)
OCC	148,456
Other Fibre	10,804
Metal	509
Glass	2,579
Rigid Plastic	16,704
Film Plastic	Unknown
TOTAL	**179,054**

4.7.4. Processing markets

BC benefits from the availability of local processing capacity and more importantly strong, sustainable re-processors / end-markets. BC is home to one of the largest plastics processors in North America, Merlin Plastics, which sorts and re-processes a wide range of rigid and film

[64] Metro Vancouver, n.d. Solid Waste Licencing Program. Available at: http://www.metrovancouver.org/services/Permits-regulations-enforcement/solid-waste/Pages/default.aspx

plastics. BC is also home to specialty or niche recyclers such as Interone Plastics, which processes polystyrene, and CKF Inc. that produce molded fiber from newsprint scrap.

BC also benefits from a geographic location with access to domestic and international markets for a broad range of ICI PPP materials. For example, the US Pacific Northwest has several mills that consistently use brown fibre grades such as OCC. Although relatively small, these mills have consistent appetites for recycled fiber materials. Moreover, offshore export markets remain strong for a variety of high-grade fibre materials.

There is a need to consider a yield loss of the process, which is mainly due to contamination. In the case of ICI however, this yield loss could be considered marginal for materials such as fibre, glass, and metal. Material tends to only be collected when there is an economic value added (i.e., developed market and a cost-effective sortation process). **Table 48** provides an evaluation of the loss and the potential contaminant found when PPP material types are collected in separated streams.

Table 48: Potential yield losses from source separated PPP

Material	Potential contaminant	Yield loss estimation
Fibre	Waxed cardboard, tape, foam, and shrink wrap	<2 %[65]
Glass	Labels, caps and overcaps, ceramics	<1%[66]
Metal	Labels	marginal[67]

Plastic PPP, however, is not necessarily collected separately, except for deposit containers. Based on the information from downstream processors gathered for the CPP Foundational research on Canadian Plastic Packaging Flow, **Table 49** provides the estimated potential yield loss for mixed plastics.[68]

Table 49: potential yield losses from mixed plastic PPP

Material	Low yield loss	High yield loss
PET and HDPE collected through deposit program	15%	20%
HDPE, PP, Tubs & Lids, PS	15%	25%

[65] Based on the specifications of post-commercial and post-industrial recovered fibre (e.g., Double sorted OCC #12; Sorted Clean News #58) presented by the Institute of Scrap Recycling Industries (ISRI). Available at: https://www.isri.org/recycling-commodities-old/scrap-specifications-circular

[66] Based on discussion with glass recyclers during the Québec Innovative Glass Work Plan (2016-2019) and the briefs tables from 2M Resources during the committee « Order of initiative – The issues of recycling and local recovery of glass ». Available at: http://www.assnat.qc.ca/en/travaux-parlementaires/commissions/CTE/mandats/Mandat-41019/memoires-deposes.html

[67] Organic materials (label, food residue) will burn during the recycling process.

[68] Canada Plastics Pact, 2021. Canada Plastics Pact Foundational Research and Study: Canadian Plastic Packaging Flows. Available at: https://plasticspact.ca/wp-content/uploads/2021/10/CPP-Foundational-Research-on-Canadian-Plastics-Packaging-Flows-Might-2021-final.pdf

5. BC's ICI PPP disposal and collected for recycling baseline

Material management of PPP waste streams flow from the generator to be picked up by the haulers, then to sorting facilities (i.e., MRFs or processors), and lastly to re-processors (recycling facility or 'end market'), although residual losses can occur along the entire value chain (**Figure 36**).

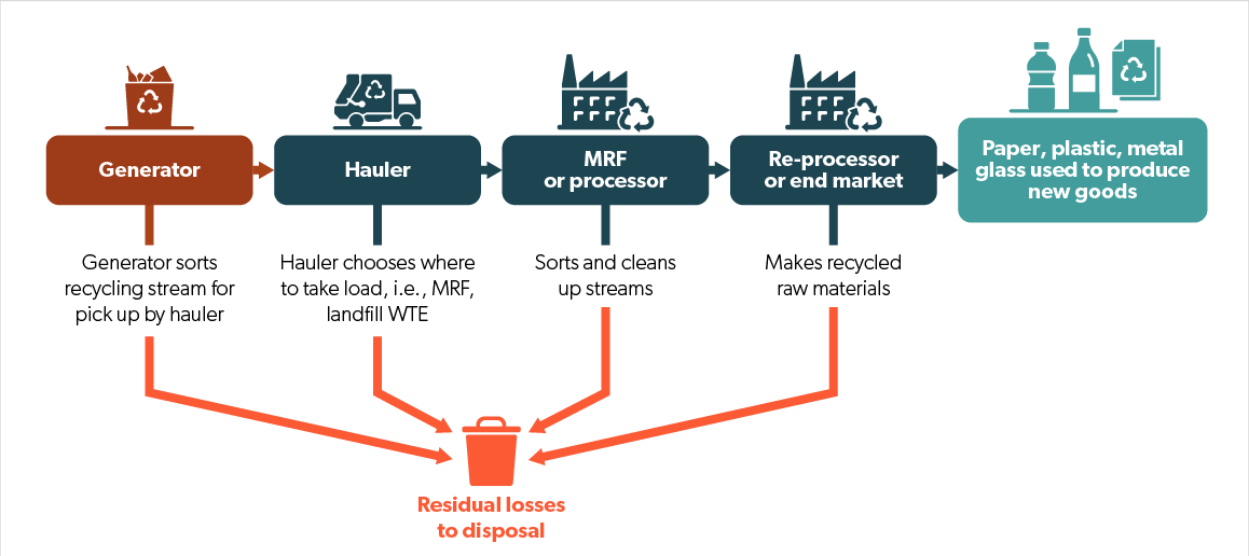

Figure 36: Flow of materials from generator through final processing.

Neither the Government of British Columbia nor the Government of Canada monitor or report on ICI PPP supply, generation, disposal, recycling, or reuse, and BC's ICI sector is neither required to report on PPP supplied into the market nor to conduct waste audits on its onsite end-of-life management.

There isn't a readily available, comprehensive source of information that describes the amount of ICI PPP generated in BC nor how it is managed at end- of-life. As a result, this report sought to assess BC's ICI PPP baseline using the various incomplete sources of data that do exist (i.e., RD waste audits, existing industry waste audits and industry intelligence, and service provider intelligence) that when assessed in tandem and compared provide a reasonable and defensible approach to estimating BC's ICI PPP baseline.

This report highlights how there are different approaches to assessing the amount of ICI PPP that is disposed and collected for recycling in BC. All of these data sources have challenges and do not provide a complete picture of ICI PPP. However, when these sources are reviewed together, a clearer picture begins to emerge, and this report is able to provide BC with its first baseline estimate of BC ICI PPP disposal and collected for recycling. There was sufficient quantitative data available to support the development of quantitative estimates.

Two separate estimates were made of PPP disposal (e.g., RD waste audit data, industry waste audit data across all target sub-sectors) with a significant agreement. For PPP collected for recycling, multiple estimates were made (e.g., industry waste audit data across all target sub-sectors, raw and extrapolated data from relevant BC reports, service provider data), which together resulted in an imperfect but reasonable level of agreement.

There are well established recycling activities of ICI PPP in BC, especially for fibre and to a lesser extent for plastic. As well, there is a reasonable level of reuse occurring particularly in certain sub-sectors. With that stated, a significant amount of PPP, particularly fibre and plastic PPP are being disposed. While the trade sub-sector is a major contributor to PPP recycling activities, it and the food services division contribute the majority of PPP that is sent to disposal. Certain barriers and gaps within BC (e.g., informational, economic, logistical, infrastructure related, policy related) that are leading these PPP materials to end up in the disposal stream.

BC has five technologically sophisticated, larger scale MRFs in operation; all are located in the Lower Mainland. These are facilities and equipment capable of separating commingled PPP materials (i.e., Merlin Plastics, GFL Environmental, Emterra Environmental, Cascades Recovery, and Urban Impact). There are an additional 15-20 facilities that exist across the province, that are 'push and bale' facilities, where material is dropped on the floor of a MRF, contaminants removed manually, pushed onto a conveyor, and then baled. However, these facilities typically only accept clean, source separated PPP materials because they do not have advanced or mechanical sortation abilities.

To develop a fuller and more comprehensive understanding of BC ICI PPP requires generating and acquiring additional data and using this to bolster the data used in this report.

5.1. Baseline for ICI PPP disposed

Table 50 provides a comparison of the data related to PPP disposed in the two datasets assessed. There is approximately a 30% – 45% difference for the total for ICI waste disposed and the total PPP disposed between the two datasets assessed. Note: the total amount of ICI waste that is estimated to be disposed by the both the Regional District and the Industry Waste Audit data assessments fall below Statistics Canada's estimate of non-residential waste disposed in its 2018 Statistics Canada Waste Management Industry Survey, which was 1.7 million tonnes.[69] This could be, in part, due to Statistics Canada including data from landfills or other disposal facilities not managed by Regional Districts.

Some differences also exist in the two datasets in the percentage of materials being disposed by zone. These differences could be the result of a number of factors, including:

- Some ICI waste, including PPP being disposed of in landfills not operated by the Regional Districts;

[69] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

- Differences in how waste audit work was undertaken (e.g., classification, sample size, removal of contamination from PPP); and
- Greater representation of some of the out-of-scope ICI sub-sectors (e.g., mining, forestry) in certain zones.

The percentage of overall PPP disposed from in-scope ICI entities appears to be in the range between 225,000 – 326,000 tonnes per year. The PPP that is disposed consists mainly of fibre and plastic in a relatively even proportion at approximately 12%, or over 100,000 tonnes per material per year. Metal and glass PPP are found less often in the disposal stream, at approximately 1–2%.

Table 50: Comparison of ICI PPP disposed in BC

	Regional Districts waste audits (Section 3)	Industry waste audits (Section 4)	Statistics Canada WMIS (2018)
Total ICI waste disposed* (tonnes)	932,000	1,191,000	1,727,000
Total ICI PPP disposed*	225,000	326,000	n/a
Proportion of PPP in ICI disposal stream	26%	26%	n/a
PPP Fibre	12%	12%	n/a
PPP Plastic	12%	12%	n/a
PPP Metal	2%	1%	n/a
PPP Glass	1%	1%	n/a
Distribution of ICI PPP disposed by zone			
Vancouver Island and Coastal	19%	14%	n/a
Lower Mainland	50%	66%	n/a
Southern Interior	15%	12%	n/a
Kootenay	4%	2%	n/a
North Central	12%	6%	n/a

** Rounded to the nearest thousand or for percentages rounded to the nearest 1 so may not add up*

Based on the assessment completed in (**Section 4**) the main contributors to disposed ICI PPP are (**Figure 37**):

- Trade; and
- Food services.

It is important to emphasize that parts of the retail sector also have some of the highest rates of ICI PPP collected for recycling.

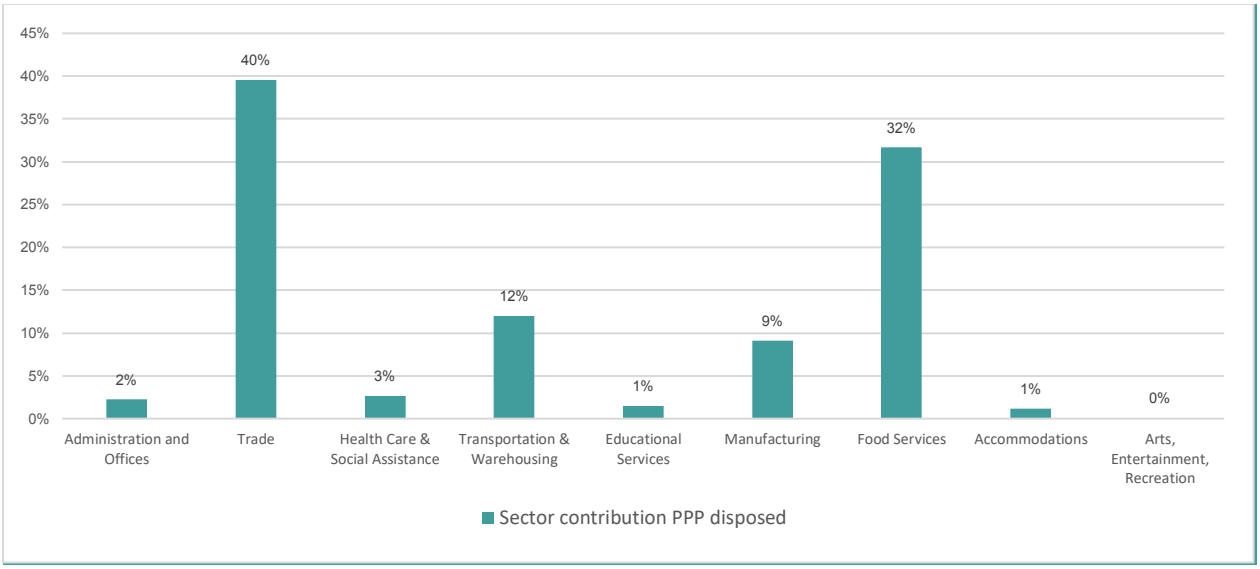

Figure 37: ICI PPP collected for disposal, by sub-sector

An assessment was also undertaken to assess which sectors generated the highest disposal rates by zone. **Table 51** provides a list of the top ten sub-sector contributors, by zone contributing to PPP disposed in BC.

Table 51: Top sub-sector contributors to ICI PPP disposed in BC

Sector	Zone	Total contribution to ICI PPP disposed
Trade	Lower Mainland	25%
Food Services	Lower Mainland	21%
Transportation and Warehousing	Lower Mainland	9%
Manufacturing	Lower Mainland	6%
Trade	Vancouver Island and Coastal	6%
Trade	Southern Interior	6%
Food Services	Vancouver Island and Coastal	5%
Food Services	Southern Interior	3%
Trade	North Central	2%
Food Services	North Central	2%
Total		**84%**

5.2. Baseline for ICI PPP collected for recycling

Table 52 provides a comparison of the data related to PPP collected for recycling based on multiple sources. There is a substantial difference between various assessments undertaken as

part of this work in their estimation of the amount of PPP that is collected for recycling in BC (**Section 4**) Overall, a narrow estimate of the amount of ICI PPP collected for recycling remains elusive. According to the various calculations and analysis, it could vary from 150,000 tonnes – 517,000 tonnes, which is a significantly wide range. There are numerous reasons for this potential range:

- The high-end estimate (industry waste audit – **Section 4**):
  - modelled using a less robust dataset than disposal;
  - most of the data came from ICI entities in the Lower Mainland and Southern Interior which have greater access to markets and whose data could have skewed the results; and
  - waste audits more likely to be completed by ICI entities with more focus on recycling.
- The mid-level estimate (Metro Vancouver Licencing – **Section 4**):
  - are modelled based on ICI entities in the Lower Mainland that have greater access to markets which could have skewed the numbers.
- The low-end estimate is based on industry experts that:
  - might not know all the outlets for where ICI PPP is sent; and
  - might not be accounting for ICI PPP that are collected for recycling but disposed at the hauler stage due to contamination issues, a lack of end markets, operator error, operational issues with the processor.

Table 52: Comparison of ICI PPP collected for recycling in BC

	Industry waste audit (Section 4)	Service provider feedback (Section 5)	Metro Vancouver licensing (Section 5)	PPEC data (Section 5)
Total ICI PPP collected for recycling*	517,000	150,000 - 250,000	300,000	311,000 *only fibre-based PPP
Percentage of ICI PPP by material type collected for recycling				
% PPP Fibre	66% to 96% by sub-sector	90%	89%	n/a
% PPP Plastic	5% to 18% by sub-sector	8%	9%	n/a
% PPP Metal	0% to 12% by sub-sector	1.4%	<1%	n/a
% PPP Glass	0% to 18% by sub-sector	1.1%	<1%	n/a

** Rounded to the nearest thousand*

It is likely that the amount of PPP collected for recycling lies more in the range of 200,000 to 300,000 tonnes based on extensive industry feedback and comparison to other provinces such as Ontario and Québec. This range does also seem to align with materials reported as recycled within the 2018 Statistics Canada Waste Industry Survey, which stated that based on the material categories associated with PPP (e.g., paper fibres, glass, ferrous metals, copper and

aluminum, gable top and aseptic containers, plastics), the total amount of materials recycled is approximately 600,000 tonnes but would include non-PPP materials.[70]

Regardless, it is clear that there is a functioning recycling market, particularly for fibre-based ICI PPP, which is the majority of PPP that is currently being collected for recycling.

Based on an assessment (**Figure 38**), completed in **Section 5,** the main contributors to PPP collected for recycling are:

- Trade;
- Transportation and Warehousing;
- Manufacturing; and
- Food services.

It is important to emphasize that some of these ICI entities also had some of the higher PPP disposal numbers.

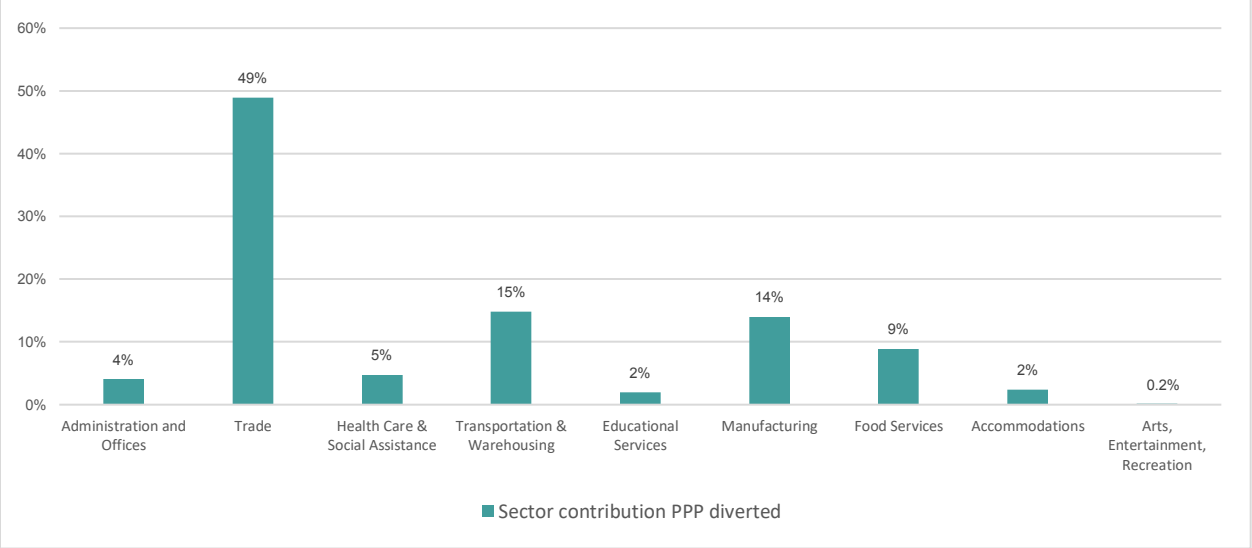

Figure 38: ICI PPP collected for recycling contribution, by sub-sector

[70] Statistics Canada. Table 38-10-0138-01 Waste materials diverted, by type and by source

Appendix A: Self-reported estimate of the relative proportion of residential, ICI, and C&D waste

Regional District	% Residential	% ICI	% C&D
Alberni-Clayoquot	47	34	18
Bulkley-Nechako	42	40	18
Capital	42	42	16
Cariboo	40	40	20
Central Coast	70	20	10
Central Kootenay	n.d.	n.d.	n.d.
Central Okanagan	26	37	37
Columbia Shuswap	30	50	20
Comox Valley (Strathcona)	32	49	17
Cowichan Valley	28	42	18
East Kootenay	n.d.	n.d.	n.d.
Fraser-Fort George	38	44	17
Fraser Valley	38	61	2
Kitimat Stikine	35	47	18
Kootenay Boundary	n.d.	n.d.	n.d.
Metro Vancouver	37	30	33
Mount Waddington	36	30	34
Nanaimo	27	67	6
North Coast	70	20	
North Okanagan	55	39	6
Northern Rockies	57	19	24
Okanagan-Similkameen	n.d.	n.d.	n.d.
Peace River	23	48	29
qathet	53	26	21
Squamish-Lillooet	30	38	12
Sunshine Coast	n.d.	n.d.	n.d.
Thompson Nicola	50	30	20
Weighted Average	**40**	**40**	**19**

Appendix B: Regional District waste audits

Regional District	Auditor and Audit Year
Alberni-Clayoquot	Dillon Consulting, 2019
Bulkley-Nechako	No waste audit available
Capital	Tetra Tech Canada, 2016
Cariboo	Tetra Tech Canada, 2019
Central Coast	No waste audits available.
Central Kootenay	No waste audits available.
Central Okanagan	Tetra Tech Canada, 2020-2021
Columbia-Shuswap	Tetra Tech Canada (Golden Refuse Landfill) 2018 Dillon Consulting (Salmon Arm Landfill), 2021
Comox-Strathcona	AET, 2017
Cowichan Valley	Tetra Tech Canada, 2017
East Kootenay	Sperling Hansen Associates, 2018
Fraser Valley	Tri Environmental Consulting, 2016
Fraser-Fort George	Tri Environmental Consulting, 2018
Kitimat-Stikine	Tetra Tech, 2017
Kootenay Boundary	Tri Environmental Consulting, 2006 (data out of 10-year planning cycle)
Metro Vancouver	Metro Testing, 2020
Mount Waddington	No waste audits available.
Nanaimo	Maura Walker and Associates, 2012
North Coast	No waste audits available.
North Okanagan	Tri Environmental Consulting, 2012
Northern Rockies Regional Municipality	GHD Group, 2016 (No ICI waste audit data, residential waste only)
Okanagan-Similkameen	Tetra Tech Canada, 2020
Peace River	Tetra Tech Canada, 2018
qathet	Let's Talk Trash, 2021 and Maura Walker & Associates and Let's Talk Trash, 2021
Squamish-Lillooet	Tetra Tech Canada (Regional District), 2020 Tetra Tech (Whistler), 2019
Sunshine Coast	No waste audits available.
Thompson-Nicola	Tetra Tech, 2021 (Thompson-Nicola) Tetra Tech, 2021 (Kamloops)

Appendix C: Regional District waste disposed

Data in the following table was provided by the Ministry. Disposal tonnes are self-reported by Regional Districts to the Ministry as part of their annual reporting.

Member	Zone	Year	2019 Per Capita Disposal (kg/capita)	2019 Total Disposal (tonnes)	2019 Population
Alberni-Clayoquot	Vancouver Island and Coastal Communities	2019	589.7	22,250	37,731
Bulkley-Nechako	North Central	2019	555.04	24,249	43,689
Capital	Vancouver Island and Coastal Communities	2019	382.37	160,027	418,511
Cariboo	North Central	2019	630.92	41,297.57	65,456
Central Coast	Vancouver Island and Coastal Communities	2019	382.81	1,372	3,584
Central Kootenay	Kootenay	2019	465.73	29,486	63,311
Central Okanagan	Southern Interior	2019	672.85	146,152.27	217,214
Columbia Shuswap	Southern Interior	2019	748.72	41,796	55,823
Comox Valley (Strathcona)	Vancouver Island and Coastal Communities	2019	536.26	65,268	121,710
Cowichan Valley	Vancouver Island and Coastal Communities	2019	389.98	35,272.92	90,448
East Kootenay	Kootenay	2019	556.08	44,238.57	79,555
Fraser Valley	Lower Mainland	2019	424.3	140,670.04	331,533
Fraser-Fort George	Northern	2019	772.95	79,916.5	103,392
Kitimat Stikine	Northern	2019	589.63	23,083.9	39,150
Kootenay Boundary	Kootenay	2019	541.48	18,102.62	33,432
Metro Vancouver	Lower Mainland	2019	482.66	1,299,005	2,691,343
Mount Waddington	Vancouver Island and Coastal	2019	665.38	7,763	11,667
Nanaimo	Vancouver Island and Coastal	2019	388.79	66,079.54	169,960
North Coast	North Central	2019	628.03	12,122.84	19,303
North Okanagan	Southern Interior	2019	505.38	45,921.15	90,865
Northern Rockies	North Central	2019	397.26	1,968.8	4,956
Okanagan-Similkameen	Southern Interior	2019	564.65	49,873	88,326
Peace River	North Central	2019	867.42	58,013.32	66,880
qathet	Vancouver Island and Coastal Communities	2019	491.75	10,377	21,102
Squamish-Lillooet	Lower Mainland	2019	434.24	29,971.32	69,020
Sunshine Coast	Vancouver Island and Coastal Communities	2019	426.38	13,563	31,810
Thompson Nicola	Southern Interior	2019	645.87	94,359	146,096
Total			**500.83**	**2,562,199.36**	**5,115,867**

Appendix D: Regional District ICI waste disposed (estimate)

Regional District	Zone	Population	Total waste disposed (tonnes)	ICI disposed (%)	ICI disposed (%) with weighted averages	ICI waste disposed (tonnes)	kg/capita disposed	Data source
Based on 2019 data								
Alberni-Clayoquot	Vancouver Island and Coastal	37,731	22,250	34	34	7,565	340	Ministry data
Bulkley-Nechako	North Central	43,689	24,249	40	40	9,700	400	SWMP
Capital	Vancouver Island and Coastal	418,511	160,027	42	42	67,211	420	Ministry data
Cariboo	North Central	65,456	41,298	40	40	16,519	400	Ministry data
Central Coast	Vancouver Island and Coastal	3,584	1,372	20	20	274	200	Ministry data
Central Kootenay	Kootenay	63,311	29,486	n.d.	38	11,177	379	weighted average
Central Okanagan	Southern Interior	217,214	146,152	37	37	54,076	370	Ministry data
Columbia Shuswap	Southern Interior	55,823	41,796	50	50	20,898	500	Ministry data
Comox Valley (Strathcona)	Vancouver Island and Coastal	121,710	65,268	47.7	48	31,133	477	Ministry data
Cowichan Valley	Vancouver Island and Coastal	90,448	35,273	42	42	14,815	420	Ministry data
East Kootenay	Kootenay	79,555	44,239	n.d.	38	16,769	379	weighted average
Fraser Valley	Lower Mainland	331,533	140,670	44	44	61,895	440	weighted average
Fraser-Fort George	Northern	103,392	79,917	60.65	61	48,469	607	weighted average
Kitimat Stikine	Northern	39,150	23,084	47	47	10,849	470	Ministry data
Kootenay Boundary	Kootenay	33,432	18,103	n.d.	38	6,862	379	weighted average
Metro Vancouver	Lower Mainland	2,691,343	1,299,005	30	30	389,702	300	Ministry data
Mount Waddington	Vancouver Island and Coastal	11,667	7,763	30	30	2,329	300	Ministry data
Nanaimo	Vancouver Island and Coastal	169,960	66,080	67	67	44,273	670	Ministry data
North Coast	North Central	19,303	12,123	20	20	2,425	200	Ministry data
North Okanagan	Southern Interior	90,865	45,921	38.5	39	17,680	385	Ministry data
Northern Rockies	North Central	4,956	1,969	19	19	374	190	Ministry data
Okanagan-Similkameen	Southern Interior	88,326	49,873	n.d.	38	18,904	379	weighted average
Peace River	North Central	66,880	58,013	48	48	27,846	480	Ministry data
qathet	Vancouver Island and Coastal	21,102	10,377	51	51	5,292	510	weighted average
Squamish-Lillooet	Lower Mainland	69,020	29,971	38	38	11,389	380	Ministry data
Sunshine Coast	Vancouver Island and Coastal	31,810	13,563	n.d.	38	5,141	379	weighted average
Thompson Nicola	Southern Interior	146,096	94,359	30	30	28,308	300	Ministry data
Average				38				
Weighted average					39			
Total		5,115,867	2,562,199			931,875		

Appendix E: Regional District ICI PPP disposed (estimate)

Regional District	Total	Fibre	Plastic	Metal	Glass	PPP
	ICI tonnes/year disposed based on 2019 data					
Kootenay						
Central Kootenay	11,177	1,285	1,285	201	134	2,906
East Kootenay	16,769	1,660	2,180	117	168	4,125
Kootenay Boundary	6,862	642	796	652	87	2,177
Lower Mainland						
Fraser Valley	61,895	10,658	10,900	1,591	495	23,644
Metro-Vancouver	389,702	36,632	35,463	2,728	1,559	76,381
Squamish-Lillooet	11,389	1,461	1,781	234	315	3,790
North Central						
Bulkley-Nechako	9,700	1,115	1,115	175	116	2,522
Cariboo	16,519	2,341	2,557	182	122	5,202
Fraser-Fort George	48,469	8,807	6,984	1,091	780	17,662
Kitimat-Stikine	10,849	1,085	1,226	195	119	2,626
North Coast	2,425	279	279	44	29	630
Northern Rockies Regional Municipality	374	43	43	7	4	97
Peace River	27,846	4,570	3,039	407	291	8,307
Southern Interior						
Central Okanagan	54,076	4,284	6,326	1,002	1,149	12,760
Columbia-Shuswap	20,898	1,421	2,058	397	219	4,096
North Okanagan	17,680	1,939	2,853	25	256	5,074
Okanagan-Similkameen	18,904	1,399	2,193	397	321	4,310

Thompson-Nicola	28,308	3,793	2,887	226	85	6,992
Vancouver Island and Coastal						
Alberni-Clayoquot	7,565	671	900	83	123	1,778
Capital	67,211	7,864	8,267	739	336	17,206
Central Coast	274	32	32	5	3	71
Comox-Strathcona	31,133	4,714	3,135	415	552	8,816
Cowichan Valley	14,815	1,259	1,956	311	148	3,674
Mount Waddington	2,329	268	268	42	28	606
Nanaimo	44,273	4,073	2,878	310	531	7,792
qathet	5,292	627	410	71	58	1,167
Sunshine Coast	5,141	591	591	93	62	1,337
Total	**931,875**	**103,513**	**102,403**	**11,739**	**8,094**	**225,748**

Appendix F: Regional District PPP disposal prohibitions or levies

Regional District	Prohibited PPP	Levies where noted
Alberni-Clayoquot[71]	Corrugated cardboard	
Bulkley-Nechako[72]	n/a	
Capital[73]	n/a	Levy: Additional fees for loads that contain corrugated cardboard, mixed paper, glass containers, film plastic, polystyrene, polycoat containers.
Cariboo[74]	n/a	Levy: Additional fees for loads that contain greater than 10% combined weight of recyclable PPP.
Central Coast[75]	Corrugated cardboard Paint cans Gas cylinders	
Central Kootenay[76]	Gas cylinders	Levy: Additional fees for loads that contain greater than 10% combined weight of recyclable PPP.
Central Okanagan[77]	Corrugated cardboard Boxboard Other recyclables (fibre, plastic, tin)	Levy: Additional fees for loads that contain these materials.
Columbia-Shuswap[78]	n/a	
Comox Valley[79]	Corrugated cardboard Household recyclables	
Cowichan Valley[80]	Gas cylinders	

[71] Regional District of Alberni-Clayoquot. Bylaw No. R1029 - A Bylaw to Provide for the Regulation of Recycling, Solid Waste Disposal and Tipping Fees at the Alberni Valley Landfill (Schedule C). Available at https://www.acrd.bc.ca/dms/documents/bylaws/regulatory-bylaws/r1029.pdf.

[72] Regional District of Bulkley-Nechako. Bylaw No. 1879 – Solid Waste Management Facility Bylaw and User Fee Amendment, 2019. Available at https://www.rdbn.bc.ca/application/files/4716/1058/2947/RDBN_bylaw1879_user_fees_amendment_2020.pdf.

[73] Capital Regional District. Bylaw No. 3881 – Hartland Landfill Tipping and Regulation Bylaw No. 6, 2013. Available at https://www.crd.bc.ca/docs/default-source/crd-document-library/bylaws/solidwastehartlandlandfillssitransferstationscompostingfacilities/3881---hartland-landfill-tipping-fee-and-regulation-bylaw-no-6-2013B.pdf?sfvrsn=4.

[74] Cariboo Regional District. Bylaw No. 5355 - A bylaw of the Cariboo Regional District, in the Province of British Columbia, to amend the established fees and charges for the South Cariboo Landfill.

[75] Central Coast Regional District. Facilities and Programs - Thorsen Creek Waste and Recycling Centre (TCWRC). Available at https://www.ccrd.ca/services/solid-waste-recycling/facilities-programs.

[76] Regional District of Central Kootenay. Bylaw. No. 2803, 2021. Available at https://www.rdck.ca/assets/Government/Bylaws/Resource~Recovery/2826-AMD-2803_RDCK_RR_Facilities_Consolidated.pdf#search=%22landfill%22.

[77] Regional District of Central Okanagan. Bylaw No. 1253, 2021. Available at https://www.rdco.com/en/your-government/resources/Bylaws/1253-Solid-Waste-Mgmt-Regulation-Bylaw--Consolidated-October-2021.pdf.

[78] Columbia-Shuswap Regional District. Bylaw No. 5835, 2021. Available at https://www.csrd.bc.ca/sites/default/files/BL5835%2C%202021%20CSRD%20Solid%20Waste%20Disposal%20Tipping%20Fee%20and%20Regulation_0.pdf.

[79] Comox Valley Regional District Bylaw No. 170. Available at https://www.comoxvalleyrd.ca/sites/default/files/uploads/bylaws/170_solid_waste_fees_consolidated.pdf.

[80] Cowichan Valley Regional District. Bylaw No. 2108. Available at https://www.cvrd.ca/DocumentCenter/View/101968/Bylaw-2108-Con-2020-.

East Kootenay[81]	n/a	Levy: Additional fees for loads that contain materials accepted for recycling (e.g., corrugated cardboard[82]).
Fraser Valley[83]	Fibre packaging (e.g., corrugated cardboard) Fibre container Plastic containers Metal items Printed fibre Film plastic Glass	
Fraser-Fort George[84]	Steel and plastic drums	
Kitimat-Stikine[85]	Corrugated cardboard Fibre products Rigid plastic containers Polycoat containers Aseptic cartons Metal packaging	
Kootenay Boundary[86]	Beverage containers Gas cylinders Corrugated cardboard Metal containers Mixed paper Newspaper Plastic containers	
Metro Vancouver[87]	Beverage containers Corrugated cardboard Metal, glass, plastic (PET, HDPE, LDPE, or PP) containers Recyclable fibre	* Also have levies
Mount Waddington[88]	Corrugated cardboard	

[81] Regional District of East Kootenay. Bylaw No. 1573. Available at https://www.rdek.bc.ca/web/regulartorybylaws/1573elkvalleyreg.pdf.
[82] Regional District of East Kootenay does not accept waxed or food/grease soiled cardboard for recycling. These must be disposed. Source: Regional District East Kootenay, 2021. Columbia Valley Recycling Guide -They Yellow Bins. Available at: https://ehq-production-canada.s3.ca-central-1.amazonaws.com/eafbfa9ccd226fb6396f15f1f31eced97d9c6f3c/original/1608586270/20.12.21_Recycling_Guide_Columbia_Valley.pdf_c84394c1068fc1834d7df31dece8796e?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIBJCUKKD4ZO4WUUA%2F20220529%2Fca-central-1%2Fs3%2Faws4_request&X-Amz-Date=20220529T211753Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=1cec32aca0d66d076b9fdc07ae3f085ef054af665ab7798b59414dfab5e9d36f
[83] Fraser Valley Regional District. Bylaw No. 1495, 2018. Available at https://www.fvrd.ca/assets/Government/Documents/Bylaws/Other/Bylaw%20No.%201495,%202018%20Regional%20Solid%20Waste%20Removal%20Regulations.PDF.
[84] Regional District of Fraser-Fort George. Prohibited Materials. Available at http://www.rdffg.bc.ca/services/environment/solid-waste-management/landfills/prohibited-materials.
[85] Regional District of Kitimat-Stikine. Bylaw No. 674. Available at https://cdn5-hosted.civiclive.com/UserFiles/Servers/Server_12415106/File/Government/Bylaws%20&%20Policies/Terrace%20Area%20Solid%20Waste%20and%20Recycling%20Collection%20Service%20Rates%20and%20Regulations%20Bylaw%20No.%20674,%202016.pdf.
[86] Regional District of Kootenay Boundary. Bylaw No. 1719. Available at https://rdkb.com/Portals/0/Administration/Documents/Bylaws/Bylaw1719-SolidWasteManagement.pdf?ver=2020-10-16-142726-100.
[87] Metro Vancouver. Bylaw No. 306, 2017. Available at http://www.metrovancouver.org/boards/Bylaws1/GVSDD_306.pdf.
[88] Regional District of Mount Waddington. Bylaw No. 919. Available at http://www.rdmw.bc.ca/media/Bylaw%20No.%20919%20Amend%207-Mile%20Solid%20Waste%20Disposal%20Bylaw.pdf.

Nanaimo[89]	Gas cylinders Corrugated cardboard Recyclable fibre Recyclable plastic containers Metal	
North Coast	n/a	
North Okanagan[90]	n/a	
Northern Rockies	n/a	
Okanagan-Similkameen[91]	n/a	
Peace River[92]	Corrugated cardboard	
qathet[93]	Gas cylinders Corrugated cardboard Recyclable fibre	
Squamish-Lillooet[94]	n/a	
Sunshine Coast[95]	n/a	
Thompson Nicola[96]	Corrugated cardboard	

[89] Regional District of Nanaimo. Bylaw No. 1784. Available at https://www.rdn.bc.ca/sites/default/files/inline-files/1784%20%28Consolidated%20up%20to%20.02%29.pdf.
[90] Regional District of North Okanagan. Bylaw No. 2832, 2019. Available at https://www.rdno.ca/sites/default/files/2021-10/Municipal%20Solid%20Waste%20Management%20Bylaw.pdf.
[91] Regional District of Okanagan-Similkameen. Bylaw No. 2925, 2021. Available at https://www.rdos.bc.ca/assets/bylaws/leg-services/RDOS/2021/BL2925.pdf.
[92] Regional District of Peace River. Bylaw No. 2065, 2013. Available at https://prrd.bc.ca/wp-content/uploads/bylaws/solid-waste-regulation-bylaw/BL_2065_SWReg_Fees-Consolidated_Feb-2022.pdf.
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[94] Squamish-Lillooet Regional District. Bylaw No. 1299, 2013. Available at https://www.slrd.bc.ca/sites/default/files/bylaws/pdf/2016%20Pemberton%20Facilities%20Rates%20and%20Charges%20Regulation%20Bylaw%201299-2013%20Consolidated.pdf.
[95] Sunshine Coast Regional District. Bylaw No. 405. Available at https://www.scrd.ca/files/File/Administration/Bylaws/405%20Sanitary%20Landfill%20Site%20-%20Consolidated%20to%20405.24%20%28effective%202021-AUG-01%20to%20Present%29.pdf.
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Appendix G: ICI sub-sectors, divisions, and NAICS codes

ICI Sub-Sector	Division	NAICS	Example
Administration & Office	Information and cultural industries	51	Entities primarily engaged in producing and distributing information and cultural products (e.g., publishers, motion picture and sound recording industry, telecommunications, data processing.
	Finance and insurance	52	Entities primarily engaged in financial transactions or in facilitating financial transactions.
	Real estate, and rental and leasing	53	Entities primarily engaged in renting, leasing, or otherwise allowing the use of tangible or intangible assets.
	Professional, scientific, and technical services	54	Entities primarily engaged in activities in which human capital is the major input. These establishments make the knowledge and skills of their employees available, often on an assignment basis.
	Management companies and enterprises	55	Entities primarily engaged in managing companies and enterprises and/or holding the securities or financial assets of companies and enterprises, for the purpose of owning a controlling interest in them and/or influencing their management decisions.
	Administrative and support, waste management and remediation services	56	Entities primarily engaged in activities that support the day-to-day operations of other organizations or those primarily engaged in waste management activities.
	Other services	81	Entities that are not included in other sub-sectors and range from laundry and funeral services to advocacy groups and repair shops.
	Public administration	91	Entities primarily engaged in activities of a governmental nature (e.g., legislative, taxation, public order, and safety administration of programs).
Trade	Wholesale Trade	41	Entities distributing merchandise in large quantities to retailers and institutional clients.
	Retail Trade	44-45	Entities primarily engaged in the distribution of merchandise, both through operating brick-and-mortar stores (e.g., grocers, retail goods, convenience) and those that interact with customers through a different means (e.g., vending machine, online sales, catalogues).

Health Care and Social Assistance	n/a	62	Is comprised of entities primarily engaged in providing health care diagnosis and treatment, residential care for medical and social reasons, and social assistance, such as counselling, welfare, child protection, community housing and food services, vocational rehabilitation, and childcare. The sub-sector includes hospitals, but also ambulatory health care services and residential care facilities.
Transportation and Warehousing	n/a	48-49	Entities primarily engaged in transporting passengers and goods (e.g., trucking, transit, rail, water, air, and pipeline), warehousing and storing goods, and providing services to these establishments. This sub-sector includes couriers.
Educational Services	n/a	61, 6111-6113	Entities primarily engaged in providing instruction and training in a wide variety of subjects. This instruction and training are provided at specialized establishments, such as elementary and secondary schools, post-secondary institutions (e.g., colleges, universities), and training centres.
Manufacturing	n/a	31-33	Entities primarily engaged in the chemical, mechanical or physical transformation of materials or substances into new products.
Accommodation and Food Services	Food Services	722	Entities that prepare food for immediate consumption on or off the premises. Examples include full-service sit-in restaurants, quick service restaurants, cafeterias, bars, taverns, caterers, and mobile food trucks. It does not include meals that occur within other establishments such as hotels, amusement and recreation parks, theatres, unless they are leased food service locations (e.g., airports, malls, hotels).
	Accommodation	721	Entities primarily engaged in providing short-term lodging for travellers, vacationers, and others (e.g., hotels, motels, resorts, recreational camps, seasonal trailer parks). In addition to lodging, a range of other services might be provided (e.g., food, recreation).
Arts, Entertainment, Recreation	n/a	71	Entitles primarily engaged in operating facilities or providing services to meet the cultural, entertainment and recreational interests of their patrons (e.g., theatres, sports venues, museums, zoos).
Agriculture, forestry, fishing, and hunting	Crop production, animal production and aquaculture	11 111 112	Entities, such as: farms, orchards, groves, greenhouses, and nurseries, primarily engaged in growing crops, plants, vines, trees, and their seeds (excluding those engaged in forestry operations), ranches, farms, and feedlots, primarily engaged in raising animals, producing animal products, and fattening animals.
Construction	n/a	23	Entities primarily engaged in constructing, repairing, and renovating buildings and engineering works, and in subdividing and developing land.

Appendix H: Disposed and collected for recycling sub-sector audit data

Sub-Sector	NAICS	Number of waste audits	FTE / Facility	Average facility size (ft^2)	PPP disposed (kg/FTE/yr)	PPP Collected for recycling (kg/FTE/yr)
Administration & Office	51-56 81, 91	81	351	205,792	11	31
Trade	41, 44-45	58	215	238,528	339	670
Health Care and Social Assistance	62	18	1,206	608,667	28.98	81.95
Transportation and Warehousing	Modelling based on Trade subsector, but composition altered based on 2 transportation audits					
Education	61					
Elementary schools	61	4	299	n/a	6.12	16.03
Secondary schools	61	8	866	n/a	4.12	4.81
Post-secondary schools	61	18	14,095	335,559	9.13	20.08
Manufacturing	31-33	67	227	124,648	194	475
Food Services	722	48	100	n/a	606.13	272.79
Accommodation	721	23	150	102,083	69.09	221.31
Arts, Entertainment, Recreation	71	18	507	75,762	7.19	29.26