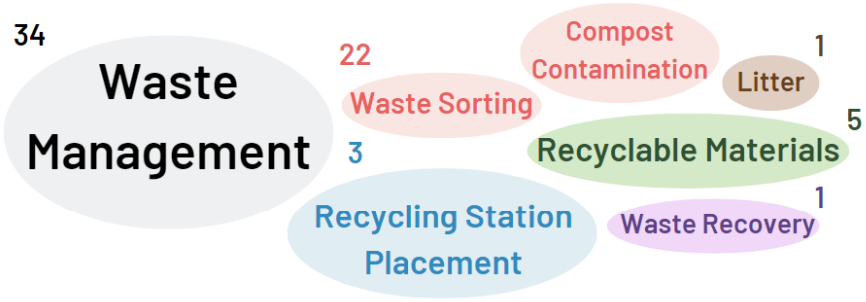
Backgrounder: Waste Management

Overview

Number of reports[1] on waste management since the 2014 ZWAP, as of Jul 16, 2024: **34**.

The topic of waste management includes sub-topics related to waste sorting, new recyclable materials, waste recovery and contamination.



Waste Sorting

Number of reports on waste sorting as of Jul 16, 2024: 20

Key findings

Summary

- Contamination in UBC compost bins is high, generally above the threshold required by the UBC in-vessel composter[2]; contaminated bins cannot be composted and instead are sent to the landfill (Goodeve et al., 2016)
- Most compost contaminants fall into 6 categories, in order of prevalence: paper coffee cups, plastic cutlery, food waste with packaging, plastic containers and cups, plastic bags, and plastic cup lids (Crolla et al., 2018).
- UBC bin users have identified ways in which Sort It Out stations can be improved. These include clearer signage, higher (i.e., more visible) placement of signage, 3D display boxes, and more bins (Crolla et al., 2018).
- Specific items often lead to confusion. Problematic items include plastic cutlery, compostable food containers, and composite items (e.g., paper pastry bags with plastic lining) (Crolla et al., 2018; Goodeve et al., 2016)
- A key problem is that food service ware varies across food outlets and cannot be disposed of in consistent fashion, leading to incorrect sorting (Crolla et al., 2018; Goodeve et al., 2016)

[1] Method: filtering in "list of reports" excel spreadsheet. 34 reports classified as relating to "waste management".

[2] The UBC in-vessel composter was shut down in January 2022. All food waste is currently taken to an off-campus recycler. It is unclear if the 5% contamination threshold is still required.

- Locations with especially high contamination of compost include the Nest, "Central" (i.e., retailers around the bus loop on University Boulevard), University Village, Vanier Dining Hall, Totem Dining Hall, Orchard Commons Dining Hall (Crolla et al., 2018)
- 3D display boxes show some evidence of improving waste sorting accuracy. However, steps must be taken to increase visibility of displays given that only 44% of surveyed students actually used the 3D display boxes (Fu et al., 2016)
- Other promising behavioural cue-based interventions include the use of bin lids, mirrors and messages/reminders ("Do you sort your waste?") (Cheung et al., 2015; De Cesare et al., 2015)
- In student/family residences, door-to-door canvassing can be an effective means of increasing participation and reducing contamination in compost and other recycling streams (Zelenika, 2018)

Status of waste sorting at UBC: waste audits

A few reports have conducted waste audits to describe the state of waste sorting at UBC (Crolla et al., 2018; Goodeve et al., 2016; Cheng, 2016).

All reports identified an **abundance of contaminants** in UBC sorting bins. In 2013, an audit of the Wesbrook building by TRI Environmental Consulting Inc. found that paper, recyclable containers, and the compost stream were 46%, 39% and 21% contaminated, respectively (Cheng, 2016). Major contaminants in the paper stream included **recyclable plastic film** and **soiled paper**. Major recycling contaminants included **food waste with non-compostable packaging**, **compostable food waste**, and **recyclable plastic films**. Major compost stream contaminants included **deposit glass beverage containers**, **food waste with non-compostable packaging**, **recyclable plastic films**, and **non-compostable paper cups** (Cheng, 2016)[3]. Further, waste audits of the Student Union Building by student-led Common Energy found that, in 2014, only 50% of waste was sorted correctly, with food scraps representing the largest category of incorrectly sorted waste (Cheng, 2016). In 2015, the audit was repeated and only 39% of waste was correctly sorted. Commonly missorted items included **coffee cups**, **chopsticks**, **portion-packed sauces**, **expanded polystyrene**, **plastic cutlery** (with and without a recycling sign), **food scraps**, **soup bowls**, **sushi containers** and **soft plastics** (Cheng, 2016).

In 2016, 8 outdoor compost bins had an average daily contamination rate of 10% (Goodeve et al., 2016), above the recommended threshold of 5%[4]. These contaminants were largely dominated by three major groups: **plastic cutlery**, **recyclable coffee cups**, and **recyclable food containers** (Goodeve et al., 2016). Another 2016 report found that the average percentage of correctly sorted items across 10+ Sort It Out stations was 63% (Cheng,

[3] See "Towards Achieving Zero Waste at UBC: Food Service Ware" by Cheng (2016) in the SEEDS Sustainability Library for additional 2013 waste audits referenced in the paper; results are omitted here due to limited space.
[4] This threshold is based on what the UBC in-vessel composter can manage, which is 5% contamination on a daily basis (Goodeve et al., 2016).

2016). The most commonly missorted items included **coffee cups, coffee cup lids, coffee cup sleeves, paper sleeves, compostable take-out containers, chequered food wrapping paper, compostable Nature bowls, recyclable Nature bowl lids** and **soiled napkins;** 98% of these items originated on campus (Cheng, 2016). In 2018, 57% of compost contaminants were non-conforming contaminants[5], and 81% of contaminants fell into 6 major categories (Crolla et al., 2018): **paper coffee cups** (21%), **plastic cutlery** (17%), **food waste with packaging** (15%), **plastic containers and cups** (15%), **plastic bags** (9%), and **plastic cup lids** (4%) (Crolla et al., 2018). Of these, plastic cutlery, food waste with packaging, and plastic containers and cups were non-conforming items.

These reports highlight a number of recurring item categories: **recyclable coffee cup components (lids, sleeves, cups)**, **plastic cutlery**, **recyclable/compostable food container components**, **soft plastics**, **food scraps**, and **packaging with food scraps**.

Campus-goer perspectives on waste sorting: attitudes and barriers

In terms of attitudes around waste sorting, UBC bin users appear to **compost for moral/environmental reasons**, including sustainable lifestyle (96%), reduced amount of waste to landfill (78%), and positive environmental impact (69%) (Goodeve et al., 2016). However, bin users seem to have a limited understanding of what waste sorting entails (Goodeve et al., 2016; Charles et al., 2019).

When asked about the functionality of UBC's Sort It Out campaign survey respondents had mixed feedback, saying that the stations were easy to use (43%) and had clear signage (39%), yet 22% found the stations **confusing** (Goodeve et al., 2016). When asked about improvements, students indicated that Sort It Out Stations could benefit from **better signage, higher placement of signage, and 3D displays** to clarify sorting for the user (Goodeve et al., 2016). Also, when asked the question, "What, if anything, would encourage you to compost at UBC?", 35% of respondents recommended **more bins on campus** (Goodeve et al., 2016).

Two reports have noted **confusion over sorting of specific items**. In 2016, 28% of respondents did not know how to sort **compostable food containers**, with 21% choosing to recycle them instead of composting (Goodeve et al., 2016). In 2018, the most **commonly missorted item was plastic cutlery**, likely due to **confusing signage** (i.e., recyclables signage states that plastics belong in the recycling bin, leading users to sort plastic cutlery accordingly—but this is not true of all plastics). **Composite items** were also problematic, especially items **consisting of paper and plastic (e.g., paper pastry bags with plastic lining)**, due to plastic components such as lining being easy to miss (Crolla et al., 2018). A central issue identified in both reports was that **food packaging**

[5] Non-conforming contaminants are items that cannot be recycled if sorted into another bin; they must be put in the garbage. Conforming contaminants are items that can be recycled but belong in a different bin.

items vary across food outlets and cannot be sorted in a standardized/consistent manner (Goodeve et al., 2016; Crolla et al., 2018).

A 2019 report examined waste sorting in the Meekinson Arts Student Space (MASS) specifically (Charles et al., 2019). When asked if there were any potential barriers to disposing of waste efficiently, the majority of respondents (29%) stated that there were **not enough bins,** the **bins were too small** (26%), and there was **no clear signage** (19%). There were also concerns regarding the location of bins in MASS. Preferred approaches to improving waste sorting included improving the cleanliness of the space, providing an e-waste disposal program, providing better sorting bins (e.g., larger) and clearer signage (Charles et al., 2019).

High-contamination locations on campus

Three reports identified problematic areas with particularly high contamination on campus. In 2016, the most polluted bin was located near the **Triple O's on Main Mall and Agriculture Boulevard**, with an average daily contamination rate of 16% (Goodeve et al., 2016). Five locations were found to be over the in-vessel composter threshold (i.e., 5% contamination): **The Trolley Bus Loop, Triple O's on Main Mall, The UBC Fountain on Main Mall near the Biology Building, Forestry and Sauder School of Business**. The bin with the least contamination was located near the Earth Sciences Building with an average daily contamination rate of 6% (Goodeve et al.,2016). Another 2016 report identified the **Nest**, **Vanier Residence Dining Hall** and **The Sauder Exchange Café** as problematic sites with percentage of correctly sorted items under 50% (Cheng, 2016). In 2018, the top 5 buildings with highest compost contamination were **the Nest, Central, University Village, Vanier Dining Hall, Totem Dining Hall,** and **Orchard Commons Dining Hall** (Crolla et al., 2018). The authors attributed contamination primarily to confusion arising from variability in food packaging for similar food items from different outlets. They suggested that food outlets within 100-meter buffers of contamination hotspots may be important contributors to contamination (see figure below; Crolla et al., 2018).

Figure taken from Crolla et al. (2018).

Individual business and food service ware

A 2016 report investigated food materials and packaging at food vendors across campus (Cheng, 2016). **"Unmarked" disposable materials** like unmarked plastic cutlery, unmarked straws, unmarked plastic soup bowl lids, unmarked plastic sleeves, plastic bags and unmarked plastic stir sticks were identified at several locations—importantly, unmarked items are likely to cause confusion at sorting stations. Locations that carried unmarked materials included UBC food services like Mercante, Sauder café, and Totem Residence Dining Hall, AMS vendors like the Delly, Palate, Qoola, and independent outlets like Tim Hortons and Great Dane (Cheng, 2016).

Additionally, some independently run locations don't have bins that align with UBC's Sort It Out program (e.g., Starbucks on east mall and agronomy, Tim Horton's in forest sciences, QOOLA in the nest, and Uppercase/Lowercase/Flip Side/Delly in the nest) (Cheng, 2016).

3D display boxes as visual aids to improve sorting accuracy

A number of studies have investigated the effect of **3D display boxes** on waste sorting behaviour (Talbot et al., 2019; Foster, 2016; Cho et al., 2019; Morgan et al., 2016). 3D display boxes are placed directly above waste bins and contain physical examples of items that belong in each bin.

Results are mixed; some reports have shown that **3D display boxes can improve waste sorting** at Sort It Out stations on campus. In 2015-2016, reports found that 3D display boxes improved the percentage of correctly sorted pizza plates and napkins (n = 593 sorted items; Foster, 2016), and reduced contamination in the recycling stream (n = 100 participants; Fu et al., 2016). A 2018-2019 report identified improvements in peoples' average accuracy of sorting and average number of items correctly sorted, especially for garbage and paper streams (n = 986 participants; Talbot et al., 2019). Other reports have **found no evidence that 3D display boxes affect sorting behaviour** (sample size not given ; Cho et al., 2019; n = 1115 participants; Morgan et al., 2016). Possible reasons for null findings included 1) the time of day evaluated coincided with peak busyness (Cho et al., 2019), 2) the short time period evaluated (e.g., 1 week; Cho et al., 2019), 3) the method of measuring contamination levels (e.g., counting missorted items based on a phone picture; Cho et al., 2019, Morgan et al., 2016), the possibility of one or a few people skewing results by mis-sorting a large number of items (Morgan et al., 2016).

Other studies have explored how users engage with Sort It Out stations, signage and visual aids. 2016 reports noted the following prevalent behaviours: 1) no attempt to sort the waste, placing waste directly in the garbage (Foster, 2016), 2) peering into the bins for guidance (Foster, 2016; Cheng, 2016), 3) not noticing 3D display boxes at all (Foster, 2016), 4) incorrect sorting triggered by full bins (Cheng, 2016), and 5) appearing to be in a hurry, on a

phone or otherwise distracted (Cheng, 2016). Another 2016 report found that **only 44% of surveyed students actually used the 3D display boxes** when sorting their waste (Fu et al., 2016). However, when surveyed, students felt that **improvements in signage, higher placement of signs,** and **3D display boxes** would improve composting at UBC (Goodeve et al., 2016).

Other behavioural interventions to improve sorting accuracy

A number of reports have investigated other methods to improve waste sorting behaviour (Cheung et al., 2015; De Cesare et al., 2015; Zelenika, 2018).

A study from 2014-2015 found that **mirrors and messages** (e.g., "do you sort your waste?") placed above Sort It Out stations both resulted in **improved accuracy of waste sorting** (Cheung et al., 2015).

A 2015 report found that the presence or absence of a **lid on waste bins can impact how effectively users sort their waste** (De Cesare et al., 2015). Specifically, lids on all bins at sorting stations force users to consider where their waste should go, leading to improved waste sorting (72% of study participants sorted effectively in the "lid" condition); effective sorting decreases dramatically when the garbage bin has no lid, especially for people with weak pro-environmental attitudes (51% of participants sorted effectively in the "no garbage lid" condition; De Cesare et al., 2015).

A 2018 report investigated the effect of different interventions on participation and contamination in recycling streams in Multi-Unit Residential Buildings on campus (Zelenika, 2018). Interventions included: 1) basic signage (i.e., basic information for item sorting), 2) signage designed by metro Vancouver to emphasize that food is not garbage, 3) psychology-informed signage that used pictures to display correct item-sorting, and 4) a door-to-door canvassing intervention where residents were reminded to sort waste, could ask questions and were handed a pamphlet that included key information like no plastic bags in any bins, and a QR code for an educational waste sorting game. **Door-to-door canvassing was most effective** at decreasing contamination in compost and recycling streams specifically, and also at increasing participation in the compost stream (Zelenika, 2018). Signage was generally ineffective, aside from the psychology-informed signage, which significantly decreased contamination in the recycling stream.

One important finding was that "food isn't garbage" posters led to **increases in participation and contamination** in the compost stream, because people were motivated to act but not fully informed on appropriate waste sorting (Zelenika, 2018). This shows that motivational strategies on their own, without education, can lead to higher rates of contamination.

Recommendations

🔴 Recommendation not met 🟠 Partially met 🟢 Well met

Visual behavioural techniques to improve waste sorting accuracy

- **Fill 3D displays boxes above all Sort It Out bins** on campus to clarify where items belong (Talbot et al., 2019; Apostolidis et al., 2023; Foster, 2016; Shory et al., 2017). [Status: the Nest has a 'best practice' of filling the clear display cases above the bins with physical examples of products permitted, but display cases are not always used (e.g., some display cases are half filled, some are completely empty)] 🟡
- **Introduce signs and mirrors above bins** to improve sorting accuracy. Messages might be simple reminders to sort, e.g., "Do you sort your waste?" (Cheung et al., 2015). [Status: not implemented] 🔴
- **Contents of 3D display boxes should be updated** and changed frequently, once a week or every other week (Morgan et al., 2016). [Status: most 3D display boxes are currently unused] 🔴
- **Design of 3D display boxes should be reconsidered** because the current boxes are fragile and inflexible (Foster, 2016). [Status: not clear if design has been changed since 2016] ⚪
- **Minimize number of posters** at Sort It Out stations to reduce "information overload"; remove unnecessary signage like "talking bins" labels (Pilat et al., 2019; Apostolidis et al., 2023). [Status: still need to assess] 🟡
- Use **visual cues to attract attention to 3D display boxes** so people actually use them to inform their sorting (e.g., motion-detected light, or colourful, attention-grabbing cues) (Fu et al., 2016). [Status: no visual cues beyond the display boxes themselves are being used] 🔴
- UBC should include **lids on all sorting stations** across campus, especially "priority buildings" with low sorting accuracy (De Cesare et al., 2015). [Status: lids are not consistently used at Sort It Out stations] 🔴

Creating supportive infrastructure for good waste sorting behaviour

UBC residential buildings (e.g., Marine Drive Towers, MURBS[6] like Hawthorne Greene and Esse)

- Residential buildings should **provide paper compost bags** to residents and have the cost be included in the residence fees (Lee et al., 2019). [Status: difficult to assess] ○
- Residential buildings should **install compost bins on each floor,** instead of using one bin per building (Lee et al., 2019; Wearmouth et al., 2019). [Status: not yet undertaken. In preliminary talks to try this in some buildings] 🔴
- Residential buildings should **supply each unit with the 4 different types of bins** that are present in the common waste sorting room, because residents are unlikely to sort through their single bin before disposing of its contents (Morgan et al., 2016). [Status: varies by building, e.g., Ponderosa Commons has multiple bins per suite but not clear how many and what kinds] 🟡
- Residential bins in common waste sorting rooms should **be labelled with their weight when empty** to make it easier to quantify contents in future studies (Morgan et al., 2016). [Status: difficult to assess] ○
- Place a **"plastic bags only" bin next to compost** to reduce contamination of plastic bags in the compost bins (Wearmouth et al., 2019). [Status: difficult to assess] ○
- **Improve convenience, ease of process**: all bins placed together in the same room, similar bins placed together (e.g., cardboard next to paper, compost next to garbage to throw away any plastic bags) (Zelenika, 2018). [Status: difficult to assess] ○
- Ensure **bin lids are consistently open and flipped** all the way over, and push bins against the wall to avoid covering any signage. Ideally, all lids should be open to avoid overstocking of open bins (Zelenika, 2018). Note: this conflicts with the recommendation under "Visual behavioural techniques to improve waste sorting accuracy" but this recommendation is specifically about residential buildings. [Status: difficult to assess] ○
- Provide residents with **free or discounted recycling and composting materials** to entice participation: small recycling and compost bins, bin-liners, etc. (Zelenika, 2019). [Status: difficult to assess] ○
- **Incorporate zero waste norms and practices** within the building events (e.g., make every event zero waste, organize clothing/household item donation drives, discuss recycling participation in strata meetings) (Zelenika, 2018). [Status: difficult to assess] ○

[6] MURBS stands for Multi-unit residential buildings.

- All rooms should have **relevant signage displayed above bins** (signage obtained from waste hauler websites, UNA or UBC sustainability office); do periodic checks for missing or damaged signage (Zelenika, 2018). [Status: difficult to assess] ○
- **Provide verbal and written information about waste sorting** to existing and new tenants, including why it is important (e.g., bylaw policy, resource efficiency and being a part of Vancouver culture), and info on correct item sorting (Zelenika, 2018). [Status: difficult to assess] ○
- **Communicate with waste haulers to identify bin issues** (e.g., broken, insufficient, dirty or sticky) and which bins should be replaced (Zelenika, 2018). [Status: difficult to assess] ○
- Conduct **contamination checks to identify commonly missorted materials;** communicate this with tenants through internal channels, letters, meetings, elevator flyers, message boards). Focus on a few key items instead of all items at once (Zelenika, 2018). [Status: difficult to assess] ○
- UBC should continue **working closely with MURB through Zero Waste Committees** to share best practices, support and resources (Zelenika, 2018). [Status: difficult to assess] ○
- **Provide alternative recycling streams** for household items that don't fit traditional bins, e.g., batteries, kitchenware, e-waste, soft plastics) (Zelenika, 2018). [Status: difficult to assess] ○
- Advertise reuse programs in the community or partner with organizations to pick up items/donations (Zelenika, 2018). [Status: unknown] ○
- **Educate leaders on campus**, such as Residence Advisors (RAs), on the impacts of landfills and contamination and encourage them to disseminate this information to their residents (Goodeve et al., 2016). [Status: unknown] ○

UBC AMS Nest

- **Standardize all waste materials** provided by food establishments in the Nest, in order to minimize confusion around which materials go in which bins (Talbot et al., 2019). [Status: The Zero Waste Foodware Strategy does provide "acceptable" and "non-acceptable" items for businesses across campus. AMS-owned outlets in the nest have standardized materials. However, a campus-wide requirement does not currently exist] ●

Sort It Out stations

- Ensure **waste bin design (e.g., color) is consistent** across campus and lines up with regional standards that people are used to (Apostolidis et al., 2023; Cheng, 2016). [Status: waste bin design across campus for Sort It Out stations is fairly consistent. Colours do not align with Vancouver on-street recycling colours] ●

- Introduce a **food-court style, manned waste sorting station** in the Nest. This will create more jobs and is a more effective way to increase sorting accuracy (Cho et al., 2019). [Status: Sort It Out stations are currently not manned]
- Clear and explicit differentiation of compostable and recyclable items in terms of bins and item-labels (Goodeve et al., 2016). [Status: bin signage provided by UBC Sustainability does make the distinction clear, whether all items are explicitly labelled is difficult to assess]
- Recommended improvements for MASS bins: 1) **introduce Type A Bins** to accommodate the volume of waste produced in MASS, reduce the chance of overflowing trash, increase the pick-up frequency, and enhance the aesthetic of the building while also increasing the bins' visibility, 2) include **visual aids like 3D display boxes** (Charles et al., 2019). [Status: difficult to assess]
- Replace single garbage cans with the Sort It Out equivalent bin; further, food services with single bins should eventually provide additional bins in alignment with UBC Sort It Out. Specific outlets include Starbucks (east mall and agronomy), Tim Horton's (Forest sciences), QOOLA (nest), Uppercase, Lowercase, Flip Side and the Delly in the nest (Cheng, 2016).
  [Status: difficult to assess if all single bins have been replaced]
- Waste sorting staff should be trained to empty bins more frequently during peak hours due to overflowing (Cheng, 2016). [Status: difficult to assess]

Educational initiatives to improve knowledge of good waste sorting

- **Create educational content** for students to improve waste sorting. Ideas include 1) educational videos on waste sorting to be played at Imagine Day, on TV screens in the Nest, or at sorting stations (Talbot et al., 2019; Chang et al., 2015; Crolla et al., 2018; Cheng, 2016), 2) online educational games that focus on commonly missorted items, with preferably a "learning" and "testing" phase built into the gameplay (Morgan et al., 2016), 3) an interactive app (e.g., Waste Wizard from City of Vancouver) to look up items and determine which sorting stream they belong to (Cheng, 2016), 4) a Waste Disposal Education Program that explains the importance of recycling, the sustainability plans of UBC, and recycling facts through posters in high-visibility areas (e.g., washroom doors and walls, bus stops) (Cheung et al., 2015)
  [Status: UBC sustainability has created 1) an educational waste sorting video, 2) the Sort It Out educational game, 3) the A-Z Recyclepedia, which allows users to see where common items belong in the waste sorting stream. These resources are available on the UBC Sustainability website: https://sustain.ubc.ca/resources/campus-guides/sort-it-out. Unclear if a formal

Waste Disposal Education Program exists, and whether or not educational videos have been played on Nest TV screens]

- Provide **educational information regarding plastic bags disposal** to students living in residence (Wearmouth et al., 2019). [Status: difficult to assess]
- Create an **awareness campaign** for waste sorting in the MASS; first steps would include mass distribution of posters and infographics. Leverage existing UBC resources to do so, e.g., **recruit talented design and arts students** to create informative and relevant waste management posters. Display posters on community bulletin boards, above or around sorting bins, in the Arts Undergraduate Society office space, near the microwave, in the kitchen space, and near vending machines. Outside of the MASS space, post infographics throughout the Buchanan building, and in relevant UBC spaces more broadly, e.g., other faculty student spaces and campus libraries. Ensure posters are centered around equity, diversity, and inclusion (Charles et al., 2019). [Status: Not clear if an awareness campaign has been pursued]

Requirements for businesses and food services

- **Make a set of "food service policies"** to mandate that vendors use compostable/recyclable food service ware that is compatible with campus and regional processing system. This policy framework would include 1) disposable food service ware procurement guidelines[7], 2) a system for testing and documenting current and prospective products to ensure they are compatible with local in-vessel composter, 3) technical guidelines to ensure in-house waste sorting aligns with Sort It Out, and 4) the authority for Campus and Community Planning to request that businesses stop using certain food service ware and or in-house disposal bins (Cheng, 2016). [Status: The Zero Waste Food Ware Strategy (2020) highlights accepted and non-accepted food materials and recycling guidelines (a separate guideline document also exists). Testing for the in-vessel composter is no longer relevant since the composter was shut down. Adherence rates to UBC guidelines are not known]
- **Standardize packaging at UBC food outlets**—all outlets should follow UBC Food Service Ware guidelines (Crolla et al., 2018). Relatedly, food services should **reduce the amount of food ware types**, **increase the amount of compostable items**, and **share product-specific information** to identify similar food ware items across businesses (Cheng, 2016). [Status: The Zero Waste Food Ware Strategy requires businesses to use "accepted" item categories (e.g., recyclable plastic cups), to what extent businesses use precisely the same items is unknown]

[7] See appendix for detailed guidelines.

- UBC should **make compostable packaging mandatory** (Apostolidis et al., 2023). [Status: the Zero Waste Food Ware Strategy requires compostable fibre containers]
- UBC should **phase out** certain materials including 1) **biodegradable and compostable plastics** (Cheng, 2016), 2) **coffee cup sleeves** (Cheng, 2016), 3) **straws** (Cheng, 2016), and 4) **plastic bags** (replaced with paper bags) (Cheng, 2016). [Status: The Zero Waste Food Ware Strategy prohibits plastic bags, compostable or biodegradable plastic straws but not cup sleeves]
- **Ensure waste management staff receive training** and maintain separation of garbage, compost and recycling when emptying bins (Chang et al., 2015; Cheng, 2016). [Status: not clear if training is required]
- Current and prospective food services should **implement reusable food ware** (Cheng, 2016). [Status: The Zero Waste Food Strategy requires limited engagement with reusables (e.g., accepting reusable containers from customers]
- UBC Food Services, the AMS and independently run food services should share product-specific information and **consolidate which items are purchased by vendors across the main campus** (Cheng, 2016). [Status: group buying opportunities exist (led by Campus and Community Planning) but are not mandatory]

Testing, monitoring, and documentation

- Campus and Community Planning should develop a **standard operating procedure to test, document, and ensure compatibility** of current and prospective compostable products with the in-vessel composter on South Campus. The SOP should define who would run the tests, outline training required, identify how many samples are needed for testing, the length of the test period, and define criteria of acceptability. Training should be provided to ensure tests are done consistently (Cheng, 2016). [Status: the in-vessel composter was shut down so this recommendation is no longer relevant]
- UBC and Campus and Community Planning **should monitor and evaluate waste management** by 1) keeping track of commonly incorrectly sorted items, 2) assessing quality of compost generated by the in-vessel composter, and 3) identifying which items are worsening the compost quality (Cheng, 2016). [Status: unclear if a consistent monitoring program exists]
- Create an **online data management system to document the data management process.** The following documents should be stored: **current policies** (food service ware procurement guidelines, food service policies, campus sorting guide, technical guidelines regarding Sort It Out stations – should be available online for general public to access), **non-compost-ability reports** (reports provided to food service management to notify them that certain problem

items should not be purchased and explain why), **waste composition audit reports and progress reports** (detail UBC's performance in reducing waste, describe overall diversion rates, composition of contaminants, identify modifications needed), **inventory lists from all food service locations** (to keep track of costs and food service ware needs, and inform Campus and Community Planning of how much and what types of food service ware are entering UBC waste system monthly and yearly) (Cheng, 2016). [Status: Current policies and reports are available online but unclear if a central repository exists]

Further research

Research on signage

- Explore effectiveness of different types of signage including "saliency messages", "collective efficacy", and "optimized displays" (Apostolidis et al., 2023) [Status: no reports have assessed a comprehensive range of signage]
- Explore the effect of "contamination-specific" tags (providing positive or negative feedback on the previous weeks' contamination levels) in combination with the "illusion of being watched" (e.g., eyes on posters) on waste sorting accuracy and contamination in residential buildings (Shory et al., 2017). [Status: No reports have assessed this specifically]
- Future research on visual interventions for improving waste sorting should **use the "sort it" poster and have limited and consistent signage** (Pilat et al., 2019) [Status: no reports have used the "sort it" poster specifically]
- Determine if stickers for better waste sorting are **more effective in a particular location** (e.g., directly on bins or on the wall) (Shory et al., 2017). [Status: no reports have assessed this]
- Explore the **use of "descriptive norms" (and other nudging strategies) in signage** directed at improving waste sorting (e.g., "others are all doing the same thing!"; Shory et al., 2017; Charles et al., 2019). [Status: no reports have further assessed this]
- Conduct more research on the **effect of informing people that they are on camera** as they sort waste, with posters of varying tone, from positive (e.g., "Smile you're on camera!") to aggressive (e.g., "Waste Sorting Accuracy is Monitored and Evaluated in this Area"); ensure posters are large and highly visible (Kwan et al., 2019) [Status: no other reports have assessed this]

Research on other techniques for improving waste sorting

- Explore **stationing people at Sort It Out stations** to help with waste sorting (Apostolidis et al., 2023). [Status: No reports have assessed this]

- Explore the effect of **all possible bin orders** on waste sorting accuracy (Chang et al., 2015) [Status: No reports have assessed all possible bin orders]
- Further explore the potential for plants and other "natural" stimuli to positively impact waste sorting behaviour (Baek et al., 2015). [Status: No reports have assessed this]

Research on 3D display boxes

- Explore methods for **increasing visibility of 3D display boxes** (e.g., white backdrop) (Foster, 2016). [Status: no reports have assessed this]
- Future research should determine whether **3D display boxes are better than signage** that explains which item belongs where, and whether most users rely on the display boxes or signage to inform their sorting (Fu et al., 2016). [Status: 3D display boxes have been found to improve sorting accuracy above the standard Sort It Out signage]

Other future research recommendations

- Determine which waste streams are especially difficult for people to sort correctly (Chang et al., 2015). [Status: Waste audits have determined the amount of contamination per waste stream and reports have identified confusing items]
- Identify the **food retailers distributing confusing items**, including plastic cutlery and composite packaging items—starting with major locations of concern and nearby vendors: the Nest, Vanier dining hall, Central, University Village, Orchard Commons Dining Hall (Crolla et al., 2018). [Status: some reports have identified potentially confusing vendors, although none have confirmed this experimentally. Zero Waste Food Ware Strategy has prioritized compostable items and likely reduced some confusion by narrowing the range of permitted food ware]
- More research needed to **study effective interventions in Multi-Unit Residential Buildings**. Future studies should ensure the following: one (or several) buildings in the control condition, comparison of effects on each individual building in the study, ensure interventions have the same period, and allow 2-3 weeks post intervention to go into the next intervention strategy, more rigorous contamination inspection of bins (Zelenika, 2018). [Status: No reports have examined MURBS since the initial report by Zelenika (2018)]
- More research needed to understand how to prevent **specific contamination issues like plastic bags and Styrofoam** in compost or recyclables bin (Zelenika, 2018). [Status: Some reports have assessed strategies for dealing with plastic bag contamination like a "plastic bags only bin", and The Zero Waste Food Ware Strategy has since restricted the use of these items]

- More research needed to determine if bin users are more confused by items and inconsistency in packaging or the designs of the bins themselves (Goodeve et al., 2016). [Status: No reports have examined this specifically]
- Research needed to assess waste management in the Meekison Arts Students Space (Charles et al., 2019). [Status: No reports have since examined this]

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Appendix A

A summary of procurement guidelines suggested in Cheng (2016).

Disposable food service ware procurement guidelines should be a revision of the current UBC Food Service Ware Guideline (2015-2016). The guidelines should specify **preferred**, **acceptable** and **avoid** items for drink ware (hot drink cups, hot drink lids, cold drink cups and containers, cold drink cup lids), food ware (bowls, bowl lids, food take-out containers, plates, boxes and trays, paper wrappers and sleeves), cutlery (forks/knives/spoons, chopsticks), and miscellaneous disposable items (straws, stir sticks, napkins, bags). The guidelines should include notes on which brands and products are preferred, along with pictures by Campus and Community Planning.

UBC should adopt guidelines in "appendix H" of Cheng (2016) which contain all necessary info, summarized here: all products should 1) be already in use on campus, 2) include symbols for each item that represent which stream it should be sorted into, 3) should explain why certain products are not appropriate for UBC's waste management stream. Final guidelines should be distributed to all service providers and posted online for transparency.

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Cheng, A. (2016). Towards Achieving Zero Waste at UBC: Food Service Ware. Vancouver: UBC SEEDS Sustainability Library.