

UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Zero Waste Design Strategies in Multi Unit Residential Buildings

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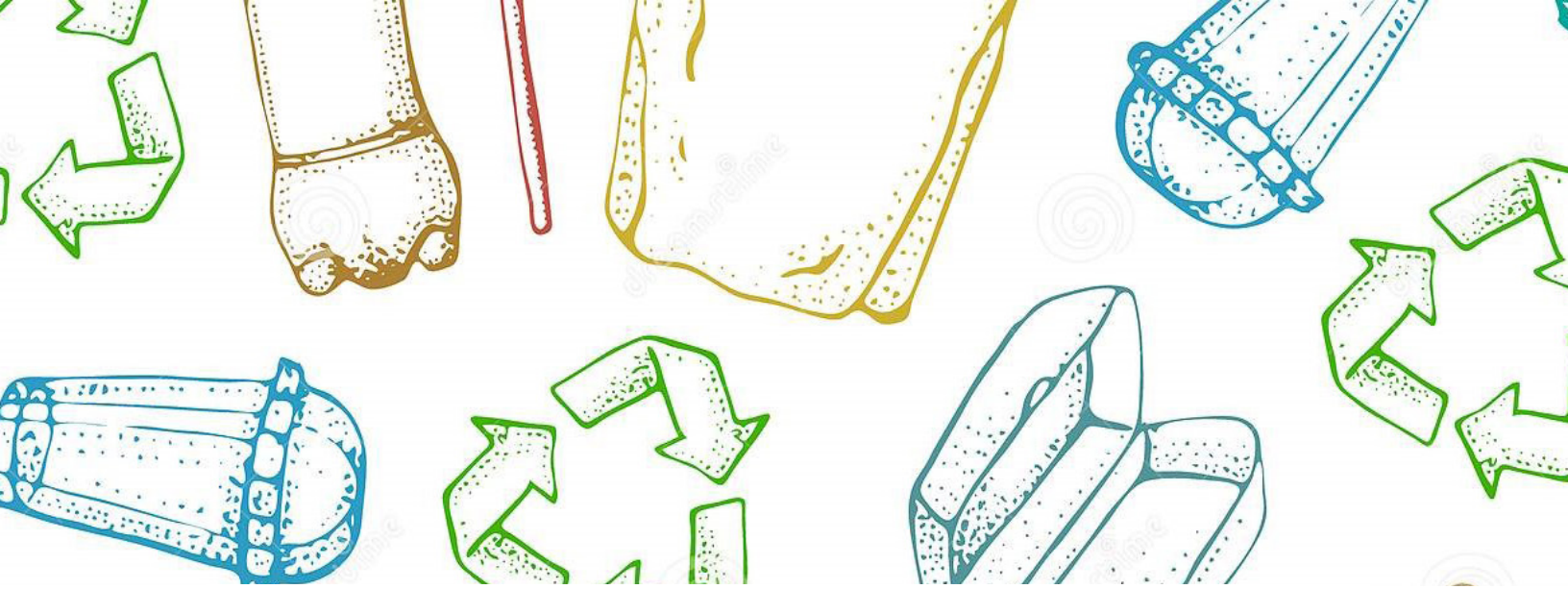
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Zero Waste Design Strategies in Multi-Unit Residential Buildings

Capstone Professional Report
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October 2019



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01

Introduction

Zero Waste and Multi-Unit Residential Buildings

According to Metro Vancouver reports, waste diversion¹ rates are the lowest among multi-unit residential buildings (MURBs). In 2017, residents in MURBs diverted only 31% of compostable organics, paper, and other recyclable materials from the landfill. This diversion rate decreased from the previous year by 2%. This is in contrast to a 64% diversion rate among single-unit residential buildings.²

As more of our population continues to live in dense, urban settings, how can we address low diversion rates in MURBs? How can design modifications be implemented throughout these buildings in a way that facilitates recycling behaviours?

Waste disposal and recycling is a part of our every day lives. However, it is not something that most

people spend a lot of time thinking about or take time to do. The way our buildings are designed can greatly impact our willingness and desire to take more or less time disposing of our waste into its various streams. Building design can either facilitate or discourage recycling behaviours among residents. Despite knowing that design informs behaviours, we so rarely see an apartment building's disposal system on its amenity list.³

Between consumption and waste collection, there are many small decisions that go into how we dispose of the items that we no longer find useful. Those decisions are informed by our knowledge of waste systems, convenience, time, values, and building design. So what if the design of our buildings made it so that our decision to place something in the recycling bin, organics bin, textile

1 Waste diversion refers to the percentage of household solid waste that is recycled and composted. This is in contrast to a reduction in waste disposed which refers to a reduction of the amount of material disposed to landfill and incinerator.

2 Metro Vancouver (2018), Metro Vancouver Recycling and Solid Waste Management 2017 Report.

3 McKeough, T. (2018), Trash disposal needs design?, *NY Times*.

bin, electronics bin, donation bin, or garbage bin was easier based on the way we incorporate our waste systems into the design of our buildings?

The design of buildings and cities are crucial in achieving zero waste targets.⁴ Encouraging zero waste in MURBs is a priority for the University of British Columbia (UBC) as they shift toward becoming a zero-waste community. UBC's Zero Waste Action Plan defines zero waste as both a guiding principle and aspirational target where "all unwanted products and materials will be treated as resources that can be used again, resulting in virtually zero garbage."⁵

Similarly, the City of Vancouver's Zero Waste 2040 Strategy also prioritizes the transition towards becoming a zero waste community. This transition requires residents, businesses, and visitors to think differently about everything that is being both consumed and disposed of. To achieve its targets, consumers are encouraged to not only participate in existing recycling and organics programs which helps divert materials from landfills and incinerators, but they are encouraged to avoid and reduce waste while keeping materials in circulation for as long as possible.⁶

Both these strategies define zero waste as a hierarchy that involves avoidance, reduction, recycling, and lastly disposal.

This project identifies best practices and zero waste design strategies that can be implemented

in MURBs and improve waste diversion rates. But, accurate separation of materials into their appropriate waste stream is only a small part of the solution towards zero waste. More significantly, decreasing the amount of overall waste that is produced relies on changing consumer behaviours and the use and reuse of products.⁷ Therefore, this project also highlights initiatives that can be implemented to facilitate the reuse and exchange of household items through zero waste design strategies.

This report pulls from a growing body of literature that examines the barriers to participating in recycling programs and zero waste design strategies that may be implemented to address those barriers. It applies zero waste design strategies to facilitate recycling behaviours among residents in Faculty and Staff Housing with findings that are also applicable to student housing.



SOURCE: CITY OF VANCOUVER (2018) ZERO WASTE 2040.

4 AIA New York (2017). Zero Waste Design Guidelines: Design Strategies and Case Studies for a Zero Waste City.
5 Campus + Community Planning (2014). UBC Vancouver campus zero waste action plan, p. 5.
6 City of Vancouver (2018), Zero Waste 2040.
7 Ibid.

Literature Review

In order to recommend what design modifications may be implemented in MURBs, a review of relevant literature was completed. The areas of research studied include:

- Barriers that may discourage residents from participating in recycling and organics programs in MURBs; and
- Zero waste design strategies that can be implemented.

Barriers

Several authors have noted the importance of focusing waste diversion efforts on residents living in MURBs. Klemky suggests that the combined high population density and low waste diversion rate for MURBs provides impetus to understand waste behaviours and implement strategies that will encourage better diversion habits.⁸ Similarly, Lakhan states that “increased diversion in multi residential buildings represents a significant opportunity for the province to increase diversion in a sector that has traditionally been considered a laggard.”⁹ Further to this point, DiGiacomo argues that efforts should be focused on “identifying best practices for pro-environmental behaviour in high-density buildings.”¹⁰ Within the context of university campuses where a large majority of students,

faculty, and staff live in multi residential buildings and work or study in the institutional buildings, targeting waste behaviours among residents is a priority.

Implementing zero waste design strategies in MURBs is one way that may help municipalities and other governing bodies like UBC meet waste reduction and diversion targets. However, addressing low diversion rates in MURBs can be difficult. Klemky states that:

Waste management in MURBs can be complicated given the number of variables involved such as occupants’ physical ability to divert waste, understanding of program requirements and available space for sorting and storage in apartments and as such, it is difficult for buildings to achieve high waste diversion rates. Numerous waste behaviour studies have identified convenience as one of the most important factors when it comes to achieving high waste diversion. In addition, it is difficult to identify individual violators of program requirements or material bans in order to correct behaviours, therefore mandatory programs have little influence on MURBs recycling rates.¹¹

This quotation describes three barriers that may prevent participation in waste diversion

8 Klemky, D. B. (2017), *Achieving zero waste in multi-unit residential buildings*, p. 32.

9 Lakhan, C. (2016). *Out of sight, out of mind: Issues and obstacles to recycling in Ontario’s multi residential*

10 DiGiacomo, A., Wu, D. W. L., Lenkic, P., Fraser, B., Zhao, J., & Kingstone, A. (2018). *Convenience improves composting and recycling rates in high-density residential buildings*. *Journal of Environmental Planning and Management*, 61(2), p. 310.

11 Klemky, D. B. (2017), p. 32.

programs: a lack of convenience, unclear signage, and anonymity. These barriers contribute to high contamination rates in MURBs.

Convenience is the largest category and describes many other barriers such as a lack of space (either in-unit or in the central waste and recycling room) to store and sort waste into its various streams; the distance required to transport materials from individual units to the central waste room; overflowing bins; as well as the absence of bins.

Unclear signage can make it difficult for residents, especially those new to a building or disposal program, to identify what goes where regardless of their willingness or desire to recycle their materials as best they can. Overflowing bins or an absence of bins can also cause further confusion and frustration without proper signage.

Anonymity and a lack of personal responsibility to sort and separate all waste into its various streams is often worsened by other barriers previously mentioned.

There are two key elements involved in successful waste sorting: participation in recycling and composting programs and accuracy to avoid contamination of different waste streams. Zelenika states that “incorrect sorting leads to critical contamination of the waste streams which results in all the bin’s contents going to the landfill, cancelling out the positive intent of participation.”¹² In order to ensure that residents are both participating in these programs and sorting their waste accurately, they need to be given the tools to succeed. These

tools can be implemented in the design of our buildings and through engagement with tenants.

Designing Zero Waste in Multi Residential Buildings

Throughout this research, the *Zero Waste Design Guidelines: Design Strategies and Case Studies for a Zero Waste City* were frequently referenced to understand how the design of buildings and cities are crucial in achieving zero waste targets. These guidelines were compiled as a tool for those involved in the planning, construction, and management of buildings, streets, and neighbourhoods. The strategies presented in the guidelines can be incorporated into new and existing buildings to improve how waste management systems are functioning in a way that maximizes the potential of achieving zero waste objectives.¹³

According to the guidelines, waste management plans involve four stages: tenant disposal and separation, the movement of recyclables and waste to central storage, waste storage, and waste collection. Zero waste design strategies in these buildings should fit into the existing waste management plan where household waste is transported from individual units to a central waste and recycling storage room.

12 Zelenika, I (2017). University Neighbourhoods Association Multi Unit Residential Building Waste Behavioural Research, p. 6.

13 AIA New York (2017).

The guidelines suggest that best practice strategies for building design fall into four broad categories. They are:

1. Planning for materials flow through a building;
2. Making waste separation easier;
3. Reducing material consumption through programming decisions; and
4. Reducing the volume of waste.

Design modifications, as recommended in the final section of this report, will fall into the first three of these categories.

Planning for materials flow through a building

Buildings should be designed for those who serve the building (property management staff, maintenance staff, waste haulers) as well as those the building serves (residents and visitors). When buildings are designed to improve the experiences of both these groups, it has been found that waste programs are more successful. The following strategies should be considered:

- **Determine waste streams and quantities.** Ensure that the central waste storage space accommodates the required number of waste containers (as determined by the Metro Vancouver Specifications for Recycling and Garbage Amenities). Space should also be somewhat flexible as waste streams and waste demands change over time.
- **Plan a route.** As tenants are required to transport their household waste from their

units to the central waste room, it is important to consider the distance that residents have to travel, the method (stairs or elevator), and how residents carry waste (bags, containers, cart, trolley). While the physical distance and method cannot necessarily change, the way residents carry their waste can.

- **Design storage space.** Well-designed storage spaces are proven to increase diversion. Within central waste storage rooms, consider ventilation, lighting, drainage, layout, and signage.
- **Plan for collection.** Consider how waste haulers can access the space and individual containers, and consider the type of containers being used.
- **Consider staff procedures.** Some residential buildings have staff that help maintain central waste rooms through regular cleaning and bin placement. Ensure staff needs are considered.¹⁴

Making waste separation easier

Waste diversion strategies help to maximize the proportion of materials being diverted from landfills and incinerators. Higher diversion rates are closely related to a user's awareness of recycling and organics programs and convenience of using the system. Education is shown to reinforce participation in these programs and accuracy. The following strategies should be considered:

- **Provide equal convenience disposal.** Residents should have equal access to recycling, organics, and garbage disposal opportunities. Consider

14 AIA New York (2017), p 86-97.

co-locating all streams to ensure one stream is not more convenient to use (which may consequently lead to lower diversion rates).

- **Provide clear visual cues and signage.** Most residents only spend a few moments deciding which bin to dispose of their waste. Visual cues and signage are shown to reduce contamination rates and increase diversion. Signage and information should consider visual cues that can be read quickly. Consider coordinating colour with its respective waste stream.
- **Provide opportunities for feedback.** Consider providing visual feedback to residents in the form of newsletters or poster updates that demonstrate the change in behaviours. This may encourage residents to continue participating in recycling and organics programs.
- **Develop awareness and education programs.** As residents move from different residential buildings, it is important to communicate how the waste system in your particular building works. Consider combining signage, visual cues, and feedback with awareness programs to ensure that residents understand the program.
- **Design for occupancy.** Residential buildings produce different types of waste than commercial or institutional buildings. Consider the types of waste (beyond recycling and organics) that residents produce (such as textiles, batteries, electronics, small appliances, soft plastics, etc.) and consider contracting additional waste collectors or charitable organizations to collect those items and reduce

dumping.¹⁵

Reducing material consumption through programming decisions

Shifting towards a zero waste community requires more actions than planning for disposal and increasing waste diversion. The following strategies should be considered:

- **Provide shared assets and services.** In zero waste communities, sharing resources, equipment, and services is key to reducing waste. Consider what types of household items and services can be shared among residents (toys in a shared playroom, weights in a gym, books in a shared reading room, tools, vacuums, etc).
- **Facilitate donation and reuse.** The reuse of items is a key strategy on the waste hierarchy to reduce waste. Consider how areas within a residential building or neighbourhood can facilitate the reuse of unwanted items, consider organizing an online platform to facilitate discussions between neighbours, and consider organizing recurring events where residents can collectively exchange goods.¹⁶

15 AIA New York (2017), p 97-104.

16 Ibid, p. 105-110.

02 Research Background

Purpose and General Methodology

UBC Properties Trust, which manages Faculty and Staff housing, aims to reduce the waste generated by residents living in MURBs. However, due to their diverse resident demographic, they wish to gain information on how best to target waste reduction efforts. This requires identifying what barriers exist that may discourage residents from participating fully in waste sorting and disposal programs and recommending modifications that make it easier for residents to sort and separate their waste. This research asks:

How can UBC Properties Trust implement zero waste design strategies in MURBs to facilitate participation in recycling and organics programs, and ultimately, increase waste diversion?

This project is intended to provide UBC Properties Trust management teams with a better understanding of the barriers that make it challenging for residents to sort and separate their household waste. By identifying these barriers, it is hoped that MURBs can be designed in a way that makes it easier for residents to sort and separate their waste and ultimately, reduce the amount

waste that is being sent to landfills and incinerators.

The objectives of this research are to:

1. Review relevant literature regarding barriers and zero waste design strategies;
2. Understand how tenants experience waste rooms;
3. Identify precedent modifications that have been implemented other multi residential buildings; and
4. Propose modifications that can be implemented in residential buildings across UBC.

To achieve these objectives, this research uses several different qualitative methods including a literature review, qualitative survey, interviews, and observational site visits.

Generally, this research occurred in three phases: first, gaining an understanding of waste diversion barriers and practices in MURBs; second, learning how other MURBs are addressing low diversion rates through design modifications that are implemented to the central waste and recycling room as well as throughout the building; third, summarizing

and recommending what modifications can be implemented in MURBs at UBC.

The first phase of research involved completing a literature review, residential survey, and site visits. The literature review analyzed different areas of research that examine the barriers that may discourage residents from participating in recycling and organics programs in MURBs as well as zero waste design strategies that can be implemented within different building typologies.

To contextualize these findings within the context of Faculty and Staff housing in Wesbrook Village, a qualitative survey was distributed through email to residents in five buildings via UBC Properties Trust listserv on April 30th, 2019. The survey remained open until May 22nd, 2019. A total of 77 residents participated in the survey. The intent of the survey was to understand the specific barriers that tenants experience when sorting and disposing of their household waste into the various streams and to identify possible modifications that can be implemented to facilitate recycling behaviours. These responses were analyzed and compared to the findings in the literature review. This comparative analysis provided a better grasp of the specific barriers faculty and staff face when sorting and disposing of their waste into the various streams and what solutions may address these barriers.

Five Faculty and Staff buildings were identified as study sites: Webber House, Cypress House, Pine House, Magnolia House, and Dahlia House. These residential buildings were chosen based on REAP sustainability level, date of tenancy, and

building typology.¹⁷ Note that a central waste room is shared between Cypress House, Pine House, Magnolia House, and Dahlia House. Site visits were also conducted to gather observational data about the central waste and recycling rooms.

The second phase of research involved identifying precedent zero waste design strategies that can be implemented in recycling rooms in other MURBs. Interviews with development managers and building residents provided greater insight into what design modifications have been implemented and how these modifications benefit both residents and property management staff. The analysis of these precedent designs informed the design principles and suggested modifications that can be implemented in existing and future residential buildings at UBC.

The final step of the project involved recommending design modifications to waste systems in existing and new residential buildings at UBC. Modifications generally fall into the three categories outlined in the *Zero Waste Design Guidelines*, as summarized in the literature review. These recommendations can be applied to both Faculty and Staff residences as well as student housing. However, further research may be required to compare the barriers to participation in recycling program between these two demographics.

17 Building typology of all study sites is one where residents are required to transport their household waste to a central recycling area at or below grade which is stored until collected by contracted waste haulers.

03

Research Context

Waste and Recycling Room Requirements

UBC residential buildings are subject to specific requirements as described in UBC's Residential Environmental Assessment Program (REAP 3.0 and 3.1) as well as Metro Vancouver's Technical Specifications for Recycling and Garbage Amenities.

REAP 3.0 and 3.1

At UBC, new residential buildings are being built in accordance with REAP 3.0 and 3.1 requirements for garbage and recycling spaces. These standards focus on the size and design of spaces as well as occupant access.¹⁸¹⁹

The program requires mandatory collection of recyclable materials including paper, plastic, glass, and metal and of compost with the intent to facilitate recycling and composting and reduce the

amount of waste sent to landfills.

Optional credits can also be achieved with the installation of in-unit recycling and organics containers as well as providing sustainability education. The program provides credit for the installation of a separation and collection systems in each unit to facilitate sorting and separation. The option to provide space and a system for in-unit recycling separation recognizes that the decision to sort recyclable materials and organics occurs at a household level and can be facilitated through the installation of in-suite containers. Credits are also available if a homeowner's manual is developed to inform residents of sustainable behaviours and proper use of the waste disposal system.

18 University of British Columbia (n.d.), Residential environmental assessment program (REAP 3.0).

19 University of British Columbia (2018), Residential environmental assessment program (REAP 3.1).

Metro Vancouver’s Technical Specifications for Recycling and Waste Rooms

Metro Vancouver’s technical specifications ensure that recycling and garbage storage spaces in MURBs are both sufficient and accessible for residents. For new construction MURBs, they specify the size, location, design, temporary storage area, loading area, vehicle access route, and occupant access. The sections most relevant to this research are the size, location, design, and occupant access.²⁰

The minimum size of centralized garbage and recycling storage space is determined to ensure that there is sufficient space for the number of bins that will allow residents to dispose of their waste.²¹ Within the centralized garbage and recycling storage space, there is also a minimum size allocated specifically for recycling storage. In new MURBs construction, the centralized recycling and storage space also includes additional flex space for reusable or recyclable materials that may be added to collection over time.²² The number of recycling and garbage bins required in MURBs can be estimated using Metro Vancouver guides.

The location of centralized garbage and recycling storage must be located adjacent to one another, must be either at ground level or no more than one level below grade, and must be in a location that minimizes noise and odour impacts to neighbours

and residents in the building.

The design of garbage and recycling storage space should be configured in a way that all bins are individually accessible, must have adequate ventilation to minimize odours, must be sufficiently secure to minimize pest and wildlife access, must be protected from unauthorized entrance, and have sufficient lighting for safety.

The centralized garbage and recycling room must be accessible to residents of all mobility abilities, and the distance for residents to reach the recycling area must be similar to the distance for residents to reach the garbage area.

Working beyond recycling requirements

Beyond these requirements, there is an appetite from staff at Campus and Community Planning to implement zero waste design strategies in MURBs to not only address low diversion rates, but to foster a culture of zero waste through waste avoidance and reduction. These zero waste design strategies can be implemented in new residential buildings and monitored to test their successes and challenges.

20 Metro Vancouver (2015b), Technical specifications for recycling and garbage amenities in multi-family and commercial developments.

21 Metro Vancouver (2015a), Guide to estimate the recycling and garbage bins required in a multi-unit building.

22 The minimum size of centralized garbage and recycling storage space is determined through the following formula: $(0.31 \text{ m}^2 \times \text{number of housing units}) + 8 \text{ m}^2$. The minimum size of centralized recycling storage space is determined through the following formula: $(0.16 \text{ m}^2 \times \text{number of housing units}) + 5 \text{ m}^2$. The required size for a flex space is equal to an additional 50% of the recycling storage space.

Study Sites



WESBROOK VILLAGE
NEIGHBOURHOOD MAP

1 Webber House

Building type: 6-storey building with 1-, 2-, 3-, 4-bedroom units (3-bedroom units as primary type)

Number of units: 36

Sustainability rating: REAP Gold

Completion date: Spring 2017

2 Cypress House

Building type: 6-storey building with 1-, 2-, 3-, and 4- bedroom apartments

Number of units: 82

Sustainability rating: REAP Gold

Completion date: Spring 2018

3 Pine House

Building type: 6-storey building with 1-, 2-, 3-, and 4- bedroom apartments

Number of units: 93

Sustainability rating: REAP Gold

Completion date: Spring 2018

4 Dahlia House

Building type: 4-storey building with 1-, 2-, and 3-bedrooms units

Number of units: 60

Sustainability rating: REAP Gold

Completion date: July 2012

5 Magnolia House

Building type: 4-storey building with 1-, 2-, and 3-bedrooms units

Number of units: 47

Sustainability rating: REAP Gold

Completion date: July 2012

Building Typology

In this building typology (illustrated below), residents sort their household waste in their units and bring waste to the central waste and recycling storage area, located either at grade or one level below grade. This building typology is very common in multi residential buildings. All five study sites follow this building typology, with four of the five sites (Cypress, Pine, Magnolia, and Dahlia) sharing one central waste and recycling room in the underground shared parkade located centrally between the buildings. Entrance to the waste rooms is accessible only by fob.

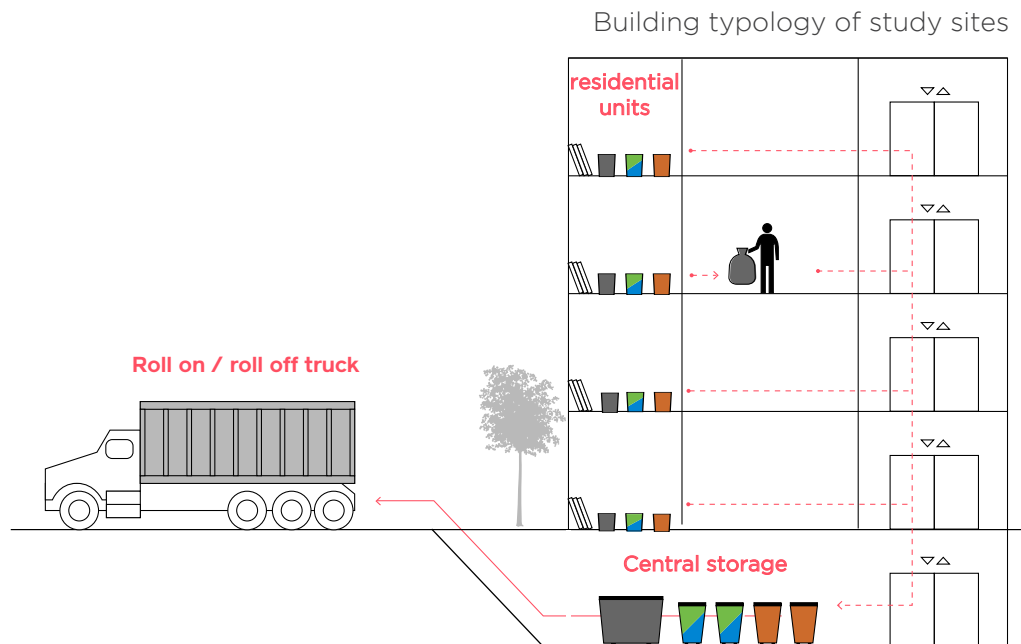
According to the *Zero Waste Design Guidelines*, buildings with a centrally located waste and recycling room have various advantages and disadvantages.

Advantages:

- Efficient use of space as floor space is not required on each floor or in each unit
- Residents not required to set out waste on particular schedule
- Central location for all waste streams
- Low maintenance for building staff

Disadvantages:

- Inconvenient for residents who may not frequently carry waste to central location
- Distance and other physical challenges for residents transporting waste
- Anonymity and lack of responsibility to sort recycling and organics accurately
- Odours and lack of cleanliness if poorly ventilated and not frequently maintained or cleaned



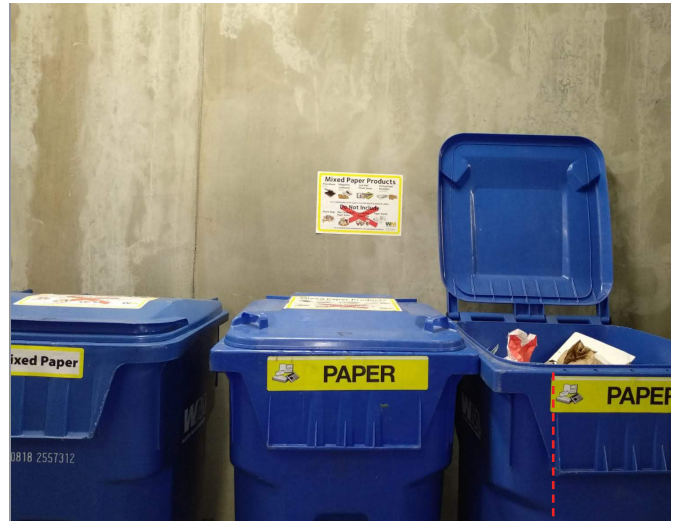
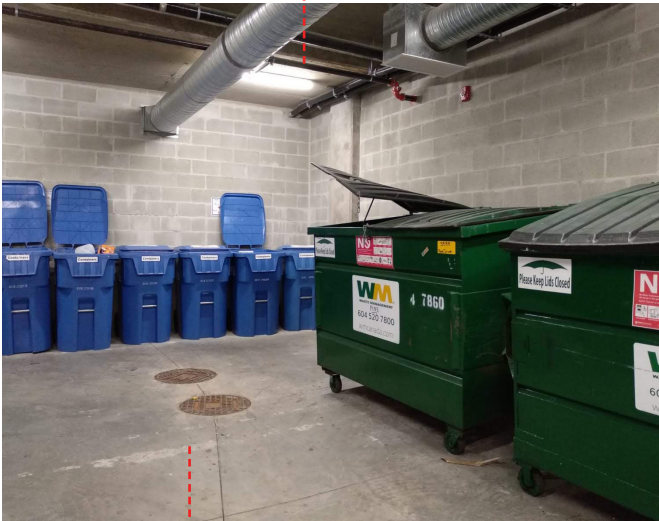
SOURCE: ADAPTED FROM AIA NEW YORK (2017).

Resident Experiences

THEME	KEY FINDINGS	DISCUSSION
CONVENIENCE	<ul style="list-style-type: none"> 73% of respondents live more than two floors away from the central waste and recycling room 27% of respondents identified that distance between their unit and the central waste and recycling room is a barrier to participating in recycling programs 	<p>We know that distance and convenience are commonly cited as the main barriers to participation in recycling and organics programs, therefore modifications should not be focused only on central waste and recycling rooms but on facilitating the movements of recyclables and other waste from individual units to the waste room.</p>
AWARENESS	<ul style="list-style-type: none"> 39% of respondents identified that unclear signage and not understanding what goes where is a barrier. The majority of respondents have lived in their respective buildings for less than one year. Of the 77 respondents, 47% have lived in their building for less than one year, 32% have lived in their building between one to two years, 13% have lived in their building between two and five years, and 8% have lived in their building for more than five years. 	<p>With so many new residents moving into these buildings – many of whom who may be unfamiliar with the waste system – education, signage, and other communication materials should be clear, consistent, and readily available for reference to all residents.</p> <p>Visually useful signage and door-to-door interactions with residents can help reduce contamination of recycling and organics bins and increase participation for organics and recycling programs overall. However, signage and door-to-door interactions alone do not reduce contamination.</p>
WILLINGNESS	<ul style="list-style-type: none"> Most respondents actively participate in recycling and organics programs in their buildings. Approximately 90% of respondents stated that they almost always or always separate materials from different recycling streams (paper, containers, and glass); approximately 95% of respondents almost always or always separate recyclable materials from the garbage stream; and approximately 85% of respondents almost always or always separate organic materials from the garbage stream. 	<p>This finding demonstrates that most residents are committed to recycling. Assuming that residents are willing to sort and separate their waste into the various recycling and organics streams but waste diversion rates are still low in MURBs, then this indicates that there are other barriers that are preventing residents from actually sorting and separating their waste in the central room.</p>
OTHER	<ul style="list-style-type: none"> Some other barriers mentioned are: overflowing or insufficient bins (83%), uncleanliness (61%), lack of space to sort and separate waste in waste room and in units (31%), and absence of bins (25%). 	<p>Many of these barriers can be addressed through maintenance and minor design modifications to the central waste room and in units.</p>

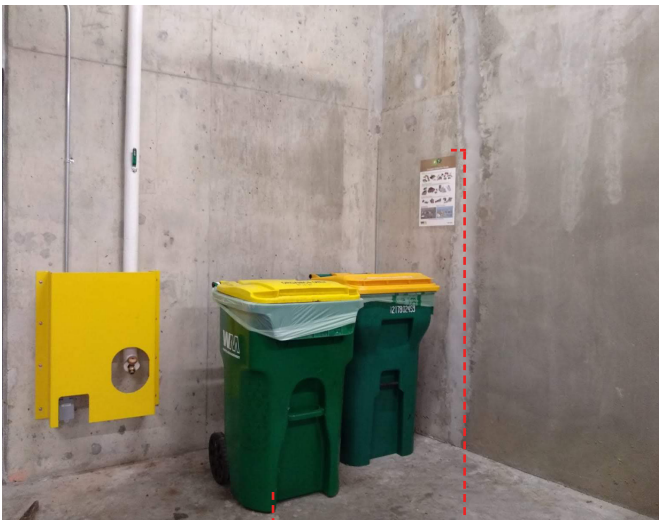
Existing Conditions

moderately lit and ventilated

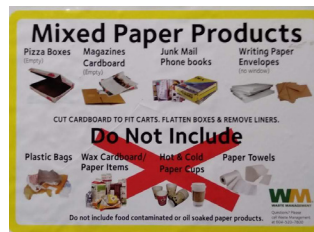


drains do not collect waste water properly

overflowing bins



bins spatially unorganized



limited, small, difficult to read, and unclear signage

04 Precedent Recycling and Sorting Rooms

Bentall Properties, multiple locations

Bentall Properties develops and manages rental buildings, such as Hull Estates which is a 26-storey rental building located in the Beltline neighbourhood in Calgary. Despite its height, the building does not include garbage or recycling chutes. The central waste and recycling storage room features brightly painted coloured walls and additional bins for clothing and electronics. The building also provides extensive education materials for residents upon tenancy.

Concert Properties, multiple locations

Concert Properties develops and manages a range of residential, office, and industrial properties which feature expanded recycling programs since 2011 to reduce the volume of waste. Many waste and recycling storage rooms are located in the underground parkade and include brightly painted coloured walls that coordinate with the various waste streams, stainless steel tables for sorting, lighting, ventilation, and drainage that exceeds minimums building codes, as well as an extensive engagement materials.

Athlete's Village Housing Co-operative, Vancouver

First Avenue Athlete's Village Housing Co-operative is a five-storey building with rental 84 units. It is a LEED Gold building with sustainability features like green roofs and passive building design. The waste and recycling room is located in the underground parkade and exceeds the minimum requirements for organics and recycling bins. Other zero waste strategies include composting program on the green rooftop, shared items in common spaces, and regular exchange events.

Quayside Village Cohousing, North Vancouver

Quayside Village Cohousing is a 3-storey building including 18 owned residential units with one rental unit. The building features many sustainable elements including a grey water recycling system, composting system, and extensive recycling program managed by residents. The waste and recycling storage spaces are located separately, with the recycling storage room located in the first level parade and the organics and waste bin located in the shared garden.

Bentall Properties

MULTIPLE LOCATIONS

brightly painted walls



additional waste streams respond to a common type of household waste



organized bin placement



visual cues correspond to bins

sufficient number of bins minimizes possibility of overfilling

“People will use the textile donation and recycling if it is made available.”

Bentall Properties management staff recognize that in order for residents to participate and accurately dispose of their waste, residents should be provided with the tools to succeed which include ongoing education and awareness, streamlined signage, and in-unit recycling and compost bins.

Recycling infrastructure

The central waste and recycling room is designed to quickly communicate different waste streams by painting the walls, posting visual signage on the walls to indicate what goes where, and ensuring that all bins are properly labeled.

Additional bins that are provided include ones for clothing and textiles, light bulbs, electronic, Styrofoam, batteries, and plastic bags. Through partnerships with charitable organizations to coordinate the collection of textiles and other organizations for the remaining bins, residents are able to recycle common household items that are often discarded when residents do not have the time to donate or discard of them properly. It was found that people will use textile and other bins if they are available because it means that it is one less trip somewhere else.

All residents are provided with recycling totes

and organics containers at move-in to ensure they have the necessary containers to sort waste in their units.

Engagement

Residents are provided with informative materials and education at move-in to ensure that they are aware of what goes where. Additionally, posters and emails are sent out monthly which include any updates to the recycling system, improvements, or challenges that management staff may identify. This ongoing line of communication helps to remind residents of any changes and also provide an outlet if they have any questions or concerns.

Implementation and management

Management staff are responsible for routine cleaning which helps minimize odours and reduce any fallen items on the ground.²³

23 V. Pankratz, personal communication, July 26, 2019.

Concert Properties

MULTIPLE LOCATIONS



“We wanted to change how the room felt and was regarded by users.”

Recycling Infrastructure

The ‘garbage room’ was renamed to ‘recycling room’ so that when they arrive at the recycling room, the first thing they think about is recycling.

Colours are used to quickly communicate different waste streams by coordinating the colours of the bins to match sections on the walls and the signage provided above the bins, and in the recycling guide. Coordinating colours made it easier for residents to sort their waste into the various streams and also made it easier for waste haulers to place the correct bins in the same spot after they’re emptied.

A stainless steel table allows residents to place any items down and sort them into the various streams without having to place their belongings on the ground. Stainless steel is easy to clean by management staff.

The garbage bin is placed at the back of the room so that residents must pass all the recycling containers first. The number of garbage bins was also reduced.

The recycling room also features increased ventilation, lighting, and drainage requirements to ensure that the room is bright, would minimize odours, and that any spills would drain properly.

Every unit is equipped with compost containers and an under-the-sink recycle sorting system with 2-3 containers.

Engagement

A guide was developed and distributed to all residents, is provided upon tenancy, and is hung for reference in the central waste and recycling room. It is written in seven different languages – the most common languages that residents identified as speaking.

Implementation and management

Improving recycling infrastructure and developing a more robust engagement program, the management team was able to change how the room felt and was regarded by users. Ongoing education and information sharing was noted as being important to maintain compliance. And regular maintenance of the recycling room to keep it clean and welcoming helped ensure residents would continue to participate in the program.

Concert Properties management teams witnessed waste diversion rates massively increase from the typical 30-40% seen in MURBs to 70-80% within one year of monitoring.²⁴

24 J. Meads, personal communication, July 25, 2019.

Athlete's Village Housing Co-operative

VANCOUVER, BC

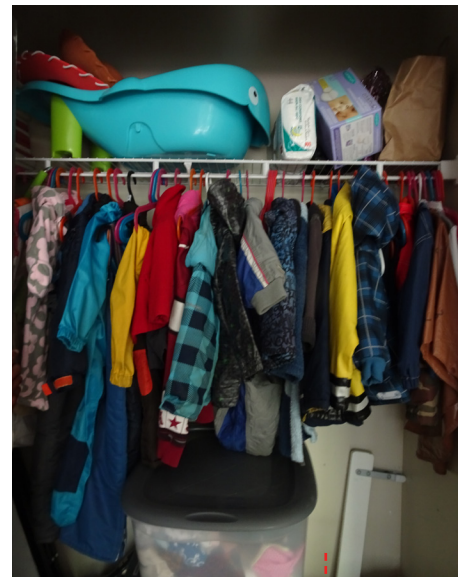
must pass recycling bins first

standard signage

compactor



textile recycling and donation



clothing swap closet and shared lounge with bookshelf and toy storage provides opportunity for reuse and sharing



communal lounge area used for events and workshops

“The culture of sustainability has always been a part of the housing coop.”

Recycling infrastructure

Additional bins provided include ones for the donation or recycling of clothing and textiles; bottles and cans deposits are collected with part of the revenue returning to the co-op; an area for soft plastics that is informally collected by residents; additional containers for organics and paper during holiday season to accommodate waste fluctuations; and a second composting system on the rooftop used in the community gardens. Occasional junk removal is also organized to avoid the dumping of household items. A garbage compactor which helps to minimize odours.

Signage on bins and walls is minimal and remains an ongoing barrier to accurate sorting.

Ongoing tidying and maintenance is done by members of the co-op which contributes to a greater sense of ownership of residential waste: if one resident doesn't sort their waste accurately, then that burden often lands on another member in the co-op to correct those errors.

Items are shared in spaces such as the communal kitchen and lounge with books, toys, and a clothing swap closet.

Engagement

25 R. James, personal communication, August 6, 2019.

Members of the co-op are very engaged in sustainability initiatives throughout the building with many opportunities to participate, ask questions, and improve the recycling program. A recycling committee acts as a resource if residents have questions, implements program changes, and organizes reuse and sharing events. A Facebook page also provides a space for updates, questions, feedback, and exchange or sale of items. Occasional recycling workshops are held in the lobby where many residents can stop by.

Over time the culture of waste within the co-op has shifted from one of recycling to one of waste avoidance and reduction. This cultural shift is facilitated largely through the efforts of the recycling committee and the range of opportunities for reuse.

Implementation and management

Implementation and management of the recycling program is undertaken by resident committees where the decisions are made collectively. Community-oriented decision making allows the recycling and other programs to accommodate residents' needs through additional infrastructure and events.²⁵

Quayside Village Cohousing

NORTH VANCOUVER, BC

in-unit recycling stations make transportation of recyclables easier



three-tier composting system for gardening

only one garbage bin for entire building!



city collected compost



voluntary recycling system indicating recyclable material, where materials are dropped-off for recycling, and who is responsible for transporting materials when full

city collected recycling

“Everything can be recycled, it’s just a matter of bringing it to the right place.”

Recycling infrastructure

Two organics bins are collected by a contractor and are located in the garden area. In addition to these bins, there are two three-tier composting systems which are used for soil in the community gardens and green spaces. One garbage bin is also located here and services the entire building.

The recycling room is organized into several rows of small bins that collect household items that are not commonly collected by waste haulers. Bins are labelled with the item that is being collected, where the item is brought, and who is responsible for transporting those recyclables to the appropriate organization. This system illustrates that everything can be recycled, it’s just a matter of bringing it to the right place.

Some of these bins collect textiles, light bulbs, batteries, various types of soft plastics Nespresso coffee pods, printer ink, pens, bicycle tubes, packing peanuts, hangers, Styrofoam, and many many others.

Some units also feature in-unit recycling sorting stations. These are installed by the owner.

Engagement

Residents are highly engaged and informed

of the recycling system. Residents understand what happens to their waste once it leaves their home. This creates a sense of ownership and responsibility to dispose of all items accurately. By providing such specific recycling options, it reinforces that if materials are not sorted properly, then it will end up in the landfill. This sentiment increases individual ownership and responsibility to recycle items accurately.

Most of the education is communicated by neighbours and in co-op meetings. Asking for help is easy as each recycling bin is voluntarily assigned to a resident.

Implementation and management

The implementation and management of the recycling program is taken on by members of the co-op, many of whom are long-term residents. The recycling room was organized by a few individuals who took the initiative to identify different categories of recycling and implement a voluntary system where different members of the co-op are responsible for bringing those materials to the correct organization.

Three-tier composting system is also managed by a few residents.²⁶

26 C. Kelley, personal communication, August 19, 2019.

05

Discussion

Recycling infrastructure and participation

Recycling infrastructure facilitates residents' ability to participate in recycling programs. All residential buildings already include recycling infrastructure in the form of recycling rooms. However, design modifications to existing recycling infrastructure can improve residents' experiences while participating in these programs.

Recycling infrastructure can include the number of bins provided in the recycling storage room, in-unit recycling stations, countertop organics bins, and recycling stations in common spaces. Recycling infrastructure should also cater the types of waste that residents are producing. As we learned in all four case studies, modifications to recycling infrastructure increases waste diversion rates and improves resident experiences. Both these property management teams expanded their recycling program in response to the types of waste that residents produce.

However, it is not enough to design a well-organized, brightly lit, and clean recycling and sorting room as those modifications only facilitate

how waste is being transported out of the unit. Nor is it enough to only provide a recycling and organics station in individual units as this assumes residents are not producing waste in shared spaces like outdoor courtyards, communal reading rooms, lobbies, rooftop, and other shared amenity spaces.

Recycling infrastructure unsuccessfully only facilitates waste diversion. Residents should also be provided with the opportunity to engage in other forms of zero waste activities like reuse and sharing.

When we look more broadly at zero waste infrastructure, which includes the recycling infrastructure described above, we can explore what other modifications may be implemented to facilitate waste avoidance and reduction. Athlete's Village Housing Co-operative is an example of the successful implementation of zero waste infrastructure in common spaces like the kitchen and lounge which include a clothing swap closet, library, and playroom. These spaces provide the opportunity for residents to avoid and reduce waste through reuse and sharing. Zero waste infrastructure provides opportunities for residents to engage in waste avoidance, reduction, and recycling.

Engagement and ownership

When residents understand where their waste is going, they take greater responsibility and ownership of the waste they produce and how it is disposed. While improving zero waste infrastructure allows residents to participate in avoidance, reduction, and recycling programs, ongoing engagement is needed to communicate the value of these behaviours. Engagement can take the form of recycling guides, clear signage and visual cues, as well as feedback or updates. Engagement increases accuracy in waste sorting behaviours as well as increased sense of responsibility. It also provides opportunities to learn, ask questions, and improve.

Findings from the four case studies revealed that there are a number of ways to engage residents. However, engagement will look different depending on the buildings' tenant profile.

In residential buildings where the average tenancy is shorter (less than two years), it is important to engage residents as soon as they move in to ensure that they understand the recycling program of that particular building. Clear visual cues are also important as they act as easy reminders to minimize confusion. Additionally, updates regarding changes to the recycling program and improvements in waste diversion rates should be communicated to increase compliance. These engagement techniques proved successful in both Concert and Bentall Properties. Engagement in these two buildings occurred from the property management team.

In residential buildings where the average tenancy is longer (more than two years), residents are more likely to be actively engaged and committed to the

building's recycling system as they can see how their behaviours have made a difference. Residents in Athlete's Village Housing Co-operative are very engaged because their sustainability concerns are addressed in meetings and solutions are implemented by members of the co-op. Residents in Quayside Village Cohousing also similarly engaged in zero waste initiatives because it is clear where their waste is going once it leaves their hands. Unlike the other two case studies, engagement in these two buildings is developed and implemented by residents, either through committees or in smaller groups. Both of these buildings also used online platforms to communicate any changes, updates, events, or workshops.

While all four case studies may communicate and engage residents differently, the key finding is that when residents understand how their recycling behaviours have positive environmental and social impacts, they are likely to take greater responsibility and ownership of their recycling behaviours and comply to programs. Regular communication and feedback are shown to maintain compliance, increase ownership, and normalizes reduction and recycling behaviours.

Implementation and ongoing management

The implementation and ongoing management of waste avoidance, reduction, and recycling programs is crucial to the success of recycling programs. Regardless of who is implementing these programs - either property management teams or resident committees in the case of housing co-ops - these programs should be designed to facilitate residents' opportunities to

engage in reuse, exchange, sharing, and recycling in their building. The formation of a recycling or sustainability committee is one way that allows residents to advocate for the changes they would like to see implemented in recycling programs and provides an additional channel of communication between residents and management.

Towards a culture of zero waste

With the implementation of zero waste infrastructure and engagement programs, some residents are changing how they think about waste.

In Concert Properties, renaming the central storage room to recycling room changed the way that residents approached the sorting and disposal of their various waste streams. This mental shift was also reinforced by designing a storage room that was inviting and clean.

In both Concert and Bentall Properties, the expansion of recycling containers provided residents with the opportunity to dispose of many recyclable items with the same convenience as disposing of other waste.

In Athlete's Village Co-operative Housing, a culture of sustainability had always existed as the building itself features many sustainable designs including a green roof and composting system. This case study illustrates that when sustainable design strategies are implemented into a building prior to tenancy, it is easier for tenants to participate and foster this culture. As previously above, there has been a shift in the culture from one of recycling to one of avoidance and reduction. This cultural shift is fostered through the availability of various items for reuse in shared spaces like the lounge and

clothing swap closet, and the many events that are organized by members of the co-op to exchange goods, host workshops, and share items.

In Quayside Village Cohousing, the extensive recycling program, which originated with a few keen residents, has fostered a culture of zero waste because residents are able to understand where all their waste goes after it is removed from the recycling room through the labelling system in the recycling room.

Zero waste design modifications, such as those detailed in the case studies above and those recommended in the following section, may help contribute to developing a culture of zero waste in MURBs by facilitating waste avoidance, reduction, and recycling behaviours.

06

Zero Waste Design Strategies

Rationale

Results from the in-depth analysis of four multi-unit residential buildings illustrate a range of zero waste design strategies that can be implemented in multi residential buildings. They illustrate several different strategies that can be implemented in the central storage area, in units, and in common or shared spaces. Some of these strategies focused more on increasing waste diversion while others focused more on waste avoidance and reduction.

Most MURBs, both new construction and existing, can be improved with some modification to units,

common areas, amenity spaces, and the central waste and recycling storage area. The following tables list zero waste design modifications that are easily implementable, potentially implementable, and difficult to implement. A legend is provided below each table.

Where modifications can be made, they should be implemented with consideration of the following zero waste design principles.

Pleasant, convenient, and easy to understand

Recycling and storage infrastructure should be convenient, easy to understand, and pleasant. Improved recycling infrastructure and robust recycling awareness materials are required to achieve this principle.

Flexible

Recycling rooms should be designed in a way that allows them to change over time as waste streams are either reduced or expanded and as recycling demands change. By designing a space that anticipates change, there is more opportunity for property managers and residents to express the need for additional recycling streams.

Designed for occupancy

Residential buildings have different recycling demands than commercial or institutional buildings. Ensure recycling streams consider who is producing different types of waste.

Holistic

We produce waste everywhere we go and in most activities we do. Zero waste design should respond to the types of waste that residents produce, how waste is sorted in units, how it is transported, how it is separated in the recycling storage area, and finally how it is collected.

Suggested Modifications

1.0 Planning for materials flow through a building

	Existing buildings	Future buildings	Faculty/Staff	Student
1.1 Determine waste streams and quantities	x	x	x	x
Include, at minimum, the number of recycling and waste containers as specified in the Metro Vancouver Technical Specifications for Recycling and Garbage Amenities.	x	x	x	x
Ensure central waste and recycling room is flexible to accommodate additional bins (if overflowing) or different bins (textiles, batteries, soft plastics, etc) if requested.	x	x	x	x
Replace large garbage bin with smaller bins. Only keep one garbage bin in the central storage room with back ups stored away. If garbage bin fills up, have staff add one of the back up bins to the main storage area for use.	x	x	x	x
1.2 Plan a route	x	x	x	x
Ensure all routes to the central storage area are universally accessible.	x	x	x	x
Install in-unit recycling stations to make it easier to transport recyclables.	x	x	x	x
Provide a shared trolley to residents on upper floors to facilitate transportation of recyclables to central storage area.	x	x	x	x
1.3 Design storage space	x	x	x	x
Paint walls to correspond with colours used in signage.	x	x	x	x
Ensure signage and visual cues are clearly visible even when lids are open.	x	x	x	x
Upgrade lighting, ventilation, and floor drainage requirements to maximize safety, minimize odours, and increase overall cleanliness.	x	x	x	x
Place a stainless steel table in storage space for residents to put their containers down when sorting waste into various streams.	x	x	x	x
Ensure all bins are easily accessible with no obstructions and ensure lids are left open as they can be difficult to lift.	x	x	x	x
Place similar bins in close proximity to one another (for example, place paper bins next to cardboard bins).	x	x	x	x
Place garbage bin at rear of storage area.	x	x	x	x
1.4 Plan for collection	x	x	x	x
Follow Metro Vancouver Technical Specifications to ensure access by waste haulers.	x	x	x	x
If bins are consistently overflowing, order additional bins or increase frequency of collection.	x		x	x
After bins are emptied by waste haulers, ensure they are placed into their original location, as indicated through increased signage and painted walls.	x	x	x	x
1.5 Consider staff procedures	x	x	x	x
If additional recycling and organics bins are added to shared spaces, ensure staff time is allocated to transport the contents of those bins to the central storage area for collection.	x	x	x	x
Ensure staff are routinely maintaining and cleaning the central storage room.	x	x	x	x
Establish procedure to contact waste haulers if bins are damaged or missing.	x	x	x	x



DIFFICULT TO IMPLEMENT



POTENTIALLY IMPLEMENTABLE



EASILY IMPLEMENTABLE

2.0 Making waste separation easier

	Existing buildings	Future buildings	Faculty/ Staff	Student
2.1 Provide equal convenience disposal	x	x	x	x
Design in-unit recycling and organics sorting stations.		x	x	x
Provide recycling and organics containers in all shared spaces, recognizing that residents do not only produce waste in their units.		x	x	x
Co-locate recycling, organics, and waste containers in central storage area.		x	x	x
2.2 Provide clear visual cues and signage	x	x	x	x
Rename the 'waste and recycling storage room' to 'recycling storage room.'	x	x	x	x
Paint the walls in the central waste room to correspond with colours of signage.	x	x	x	x
Consider ordering waste bins that are the same colour as the walls and signage.	x	x	x	x
Ensure visual cues are consistent on bin labels, walls, and any educational materials.	x	x	x	x
Correspond signage colours and images. Either with signage used by UBC Sustainability (as many residents living may already be familiar with on-campus sorting streams) or with Metro Vancouver .	x	x	x	x
2.3 Provide opportunities for feedback	x	x	x	x
In existing buildings, provide residents with updates on waste diversion rates after any design modifications are implemented to reinforce recycling behaviour changes and increase individual sense of responsibility.	x		x	x
In new buildings, provide residents with periodic updates on waste diversion rates to reinforce recycling behaviours and increase individual sense of responsibility.		x	x	x
2.4 Develop awareness and education programs	x	x	x	x
Develop a recycling guide in multiple languages.	x	x	x	x
Provide a copy of the recycling guide in the central storage area, elevators, lobby, and online for easy access.	x	x	x	x
Combine signage, visual cues, and feedback into awareness programs.	x	x	x	x
Establish an online platform where residents can ask questions, post updates, and communicate changes to the recycling program to increase visibility of recycling.	x	x	x	x
Establish a zero waste or recycling committee that can advocate for additional bins, donation bins, or events to accommodate the types of waste being produced. Committee can also serve as a resource where residents can ask questions.	x	x	x	x
2.5 Design for occupancy	x	x	x	x
Consider contracting different organizations to collect different types of waste. For example, Big Brother Big Sister is an organization that collects textile donations and recycling.	x	x	x	x
If smaller recyclable items (such as batteries, soft plastics, pens) cannot be contracted for collection, consider working closely with the University Neighbourhood Association (UNA) and the Green Depot to organize pick-up of waste items that are not collected in residential buildings. See list of accepted items and recyclables.	x	x	x	x

 DIFFICULT TO IMPLEMENT

 POTENTIALLY IMPLEMENTABLE

 EASILY IMPLEMENTABLE

3.0 Reducing material consumption through programming decisions

	Existing buildings	Future buildings	Faculty/Staff	Student
3.1 Provide shared assets and services	x	x	x	x
In shared spaces such as lounges, offices, and kitchen areas, provide shelves, containers, and hangers that can be used to establish a clothing swap closet, shared bookshelf, share toys, and an area for household items to be placed for someone else's use.	x	x	x	x
Consider opportunities for expanding waste streams like yard composting where residents can manage and use their compost for gardening. This is likely to be more effective and cared for in buildings with longer term residents.	x	x	x	x
3.2 Facilitate donation and reuse	x	x	x	x
Designate space where residents can store bulky household items.	x	x	x	x
Organize events where residents can exchange goods that complement existing events offered through the UNA like clothing fix-it events, clothing swaps, and community yard sales.	x	x	x	x
In student housing, organize these events to correspond with different times of the year like the beginning and end of a semester.	x	x		x
Establish an online platform where residents can post items for sale or reuse.	x	x	x	x

DIFFICULT TO IMPLEMENT
 x POTENTIALLY IMPLEMENTABLE
 x EASILY IMPLEMENTABLE

Summary of modifications

The list of suggested modifications above can be implemented in both existing and future buildings, as well as in Faculty and Staff housing and in student housing buildings. Nearly all the modifications are implementable in different housing types and can replace or improve an existing waste disposal system. Modifications should be implemented to achieve a building's desired outcome.

Zero waste design strategies that plan for material flow through a building will help increase participation in recycling programs. Zero waste

design strategies that plan for material flow and make waste separation easier will increase participation in recycling programs and increase accuracy of recyclable materials sorted into their appropriate stream. Zero waste design strategies that plan for material flow, make waste separation easier, and reduce material consumption through programming decisions will foster a culture of zero waste that incorporates values of waste avoidance, reduction, and recycling.

Further Recommendations

To encourage property developers to implement these zero waste design strategies in the future development and operation of MURBs, some modifications may be added to the UBC REAP program requirements. Consider the following:

Performance category: sustainable sites (SS):

SS 1.2 - recycling and compost separation in shared or common spaces (optional)

Requirement: Provide a space and system for simplified separation and collection of recycling and compostables in all shared or common spaces.

Intent: To facilitate recycling and composting in order to reduce the amount of waste sent to landfills.

Rationale: Tenants produce waste in many areas throughout residential buildings, including shared common spaces like lounges, kitchens, outdoor play and cooking areas, and rooftop gardens or amenity spaces. Making it easier to recycle or compost materials than to throw them away through the thoughtful design and placement of multi-stream recycling and organics collection in these areas can make waste separation easier.

Submission: Building Permit

Points: 2

Performance category: sustainable sites (SS):

SSM9 - tenant education (mandatory)

Requirement: Provide tenant education materials or guide to describe the recycling and organics program upon tenancy. This guide should be written in multiple languages and should also include visual cues that are consistent with other signage used in the waste program and sorting spaces.

Intent: To inform and educate residents of the recycling and organics program upon move-in to help residents understand what goes where.

Rationale: Because different buildings and public places use varied waste management and sorting systems, it is important for residents to understand the recycling and organics program within their specific residential building. When residents understand what goes where, they are more likely to participate in these programs and accurately dispose of their waste into the appropriate waste stream.

Note: if recycling and organics program is changed or updated to include additional streams, these updates should be added to the guide and clearly communicated to all existing residents.

Submission: Building and Occupancy Permits

Implications for property managers, residents, and UBC community

Zero waste design strategies impact a range of decisions that are made at the point of a building's design and construction, throughout its ongoing management, and in habitual actions that residents make when buying, using, and disposing household items. The implementation of zero waste design strategies has implications for many different stakeholders.

Property managers

- Implement, maintain, and monitor zero waste design strategies. While some strategies may require additional cost, such as arranging for overflowing bins to be collected more frequently or providing additional bins for other recycling streams, there is a proven benefit to many design modifications such as lower contamination rates of recycling streams and increased waste diversion rates which may offset cost.
- Coordinate zero waste design modifications with waste haulers and other organizations to ensure that all streams are being collected and recycled properly.
- Communicate requirements of recycling program with residents through education materials, feedback, and updates to reinforce recycling behaviours and maintain compliance.
- Respond to residents' recycling needs.
- Maintain recycling system.

Residents

- Actively participate in recycling and diversion programs. Reference recycling guides when sorting waste.
- Understand the various waste streams to ensure accurate sorting and separation of waste.
- Advocate for modifications to the recycling program to better response to their waste habits.
- In residential buildings where recycling committees may be established or regular reuse events are organized, residents engage with their neighbours and participate in zero waste culture.

UBC community

- Require minimum standards for recycling infrastructure in residential buildings.
- Implement zero waste design strategies which may contribute to UBC's zero waste targets.
- Modifications may encourage a gradual shift away from recycling and more towards avoidance and reduction, fostering a zero waste community.
- In the medium- to long-term, zero waste design strategies may become normalized and implemented in all new buildings if shown to increase waste diversion rates and foster waste avoidance and reduction behaviours. Requires ongoing monitoring.

07

Conclusion

Throughout this report, results have indicated that residents in Faculty and Staff Housing have identified convenience and awareness as the main barriers that make it difficult for them to participate in recycling programs. While most respondents expressed a desire to participate in these programs, some lacked the tools to sort and separate their waste successfully.

Through an analysis of precedent recycling rooms in MURBs, it was found that improving zero waste infrastructure encourages residents to participate in recycling systems while engagement and communication provides residents with a greater sense of ownership and responsibility for their waste.

To facilitate recycling behaviours and participation in recycling or reuse programs, a wide range of zero waste design strategies can be implemented, either by property management teams or by residents. These modifications should be made throughout the building - in central recycling and sorting rooms, in common and shared spaces, and in units. By implementing these modifications throughout the building instead of exclusively focusing efforts in the central recycling and sorting room, recycling behaviours are facilitated as residents are able to

participate where they produce waste, in the way they transport their waste, and in the way they sort their waste for collection.

Ultimately, these modifications should be implemented in a way that creates a pleasant, convenient, and easily understandable recycling program, that is flexible to accommodate changing recycling streams, that is designed for occupancy, and that is holistic.

Next Steps

Future work may involve developing design guidelines and operational guidelines that describe how the recommendations from this report can be implemented throughout MURBs. These guidelines could be used to supplement the REAP requirements.

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