Sustainability Through an Inclusive Lens (STIL) increasing the accessibility of multi-stream waste disposal systems – A research report[1]

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Introduction

In response to the climate crisis many municipalities are setting ambitious greenhouse gas reduction goals and taking significant climate actions. As municipalities shape a sustainable future, it is important, however, that this is a future where everybody belongs. Therefore, considerations of equity and accessibility are important aspects in municipal climate action. An increasing number of innovations are emerging to support municipalities in integrating accessibility into their sustainability projects, including the focus of this report, the WasteFinder system developed by Sustainability Through an Inclusive Lens (STIL) Solutions.

STIL is a social enterprise that aims to enable and empower individuals with vision loss to participate in sustainability-focused initiatives, particularly independent waste disposal and management. STIL designed WasteFinder – a tactile and visual information system that is installed on the ground adjacent to waste disposal units and assists persons with vision loss to dispose of their waste independently and correctly. The City of Kitchener purchased and installed three WasteFinder systems at the Kitchener Market in 2021. The Viessman Centre for Engagement and Research in Sustainability (VERiS) at Wilfrid Laurier University received a SSHRC Partnership Engage Grant in partnership with STIL to evaluate an early implementation of this system and the Kitchener Market was selected as a suitable case study. Market patrons/community members were surveyed pre- and post installation to gauge their perception of accessibility and sustainability features at the market, including potential barriers to proper waste sorting and disposal. In addition, pre-post focus groups and waste-audits were conducted. The purpose of this report is to explore how the WasteFinder system impacts the ability of persons with vision loss (and other disabilities) to participate in proper waste sorting and disposal as well as how the system impacted other market patrons' awareness and waste sorting behaviour.

In this report, we will first address the current state of accessibility in sustainable policy among municipalities, providing additional context on STIL and the implementation context within the City of Kitchener. Then, we will provide a detailed overview of the current study, including explanations of the surveys, focus groups, and waste audits that were conducted. Finally, we will discuss the findings of the study as they relate to this specific implementation context, as well as the intersection between accessibility and sustainability in municipal actions more broadly. We will conclude with specific recommendations based on our findings.

Accessibility in the Context of Sustainability

Overview of Municipal Sustainability Efforts

As of February 1st, 2022, 2,071 jurisdictions in 38 countries have declared a climate emergency. (Aidt, 2022). Responding to the climate emergency requires significant planning and action from all levels of government, including municipalities. Municipalities are in a unique position to respond to the climate crisis by enhancing community resilience due to their jurisdiction over many public services that affect citizens' quality of life (Philip & Cohen, 2020). Further, municipalities play an important role in greenhouse gas emissions reduction, controlling approximately 40% of Canada's greenhouse gas emissions through sectors such as transportation, waste, and land use/zoning regulations (Guyadeen et al., 2019; Philip & Cohen, 2020).

Municipalities across Canada (and the world) are developing community and/or corporate climate action plans (CAPs) intended to roadmap the policies, programs, and institutional changes required at the municipal level to sufficiently respond to the climate emergency (Guyadeen et al., 2019; Schrock et al., 2015). CAPs focus on both mitigation (that is, reducing greenhouse has emissions, such as

cutting waste management-related emissions) and adaptation (that is, preparing for and adjusting to expected climate change, such as building infrastructure to prevent flooding due to rising sea levels) (Boswell et al., 2012; Davoudi et al., 2009). Specific actions in these plans relate to high efficiency housing, zero-carbon buildings, renewable energy, local community grids, waste diversion, among others.

Actions pertaining to waste diversion, the focus of this report, are important because the decomposition of organic waste in landfills results in methane emissions, which is more damaging to our atmosphere and climate than carbon dioxide (ClimateActionWR, 2021). Actions within municipal CAPs focused on waste diversion and proper waste disposal can help reduce the amount of residential and corporate/commercial waste in local public landfills, thus reducing greenhouse gas emissions, and responding to the climate emergency.

The Equity Deficit

As municipalities continue to invest in the development and implementation of ambitious CAPs, there is growing recognition that these plans should not (unintentionally or otherwise) contribute to an equity deficit whereby the benefits and burdens of climate actions are unequally distributed and inequalities exacerbated (Agyeman & Evans, 2003; Rice et al., 2019; Russo et al., 2016; Schrock et al., 2015). Growing research confirms there is an equity deficit in climate planning which affects marginalized groups such as those with disabilities; these individuals often cite inaccessibility of built and social environments, which lead to difficulty performing everyday tasks (Jensen & Nielsen, 2001). For example, a policy aimed to discourage driving by restricting parking space may lead to difficulty/exclusion/discrimination for people with disabilities that rely on individual automobiles (see Salkeld, 2019). Moreover, the design of many public waste disposal and recycling units poses a barrier to waste sorting and disposal for people with vision loss and other disabilities (Jensen & Nielsen, 2001).

In consideration of the equity deficit, there is a need to move towards 'just sustainabilities' – that is, a "better quality of life for all, now and into the future, in a just and equitable manner, whilst living within the limits of supporting ecosystems" (Agyeman & Evans, 2003, p. 5). A move towards just sustainabilities will remove barriers that lead to inaccessibility and disability discrimination and ensure disability concerns are a core consideration of public policy. This would also align with Goal 11 of the UN Sustainable Development Goals, which encourages member states to "provide universal access to safe, inclusive and accessible green and public spaces…in particular for…people with disabilities" (United Nations, 2019).

Current Knowledge About Accessibility and Sustainability

The inaccessibility of built and social environments relates to Western architecture's tendency towards 'ableist' or 'ablebodiedness' constructs, in which design and construction decisions usually reflect the 'average' person, or people with greater physical abilities, thus neglecting individuals with disabilities (Jensen & Nielsen, 2001; Lim, 2004). Universal Design (UD) has emerged from research in disability studies as an important strategy for improving accessibility, promoting designs that accommodate and are sensitive to a wide range of individual abilities and needs (Lid & Solvang, 2016). In the context of waste sorting and disposal, this may include reconsidering the height, width, and depth of receptacles, as well as their openings or lids (see Jensen & Nielsen, 2001).

The intersection of accessibility and sustainability is an emerging field of study, especially in the context of municipal climate actions. A study of the UK's sustainability policies found that they fail to address disability equality – a multi-dimensional understanding of equality, combined with a social-relational understanding of disability – and called for the inclusion of the growing population of persons

with disabilities in sustainability discussions and design of sustainability activities (Salkeld, 2016). Similarly, failures have been observed in the Malaysian context (Yiing et al, 2013). Canadian research that empirically investigates this cross-section is very limited. There has been no research in the Canadian context that looked specifically at the accessibility of waste sorting stations.

STIL (Sustainability Through an Inclusive Lens)

History

STIL Solutions is a social enterprise that "enables and empowers individuals of all abilities and experiences to independently and effectively dispose of waste in public spaces." (STIL Solutions, n.d.). With guiding values of accessibility, boldness, care, collaboration, and sustainability, STIL aims to address the intersection of sustainability and accessibility, enabling all community members to participate in sustainability efforts (STIL Solutions, n.d.).

After losing her vision, STIL Solutions CEO, Hillary Scanlon, took a course at Wilfrid Laurier University titled 'Perspectives on Sustainability', which encouraged her to research accessible sustainability. Soon after, she received a grant from the university enabling her to carry out research on more inclusive and accessible waste management. With collaboration among several supporters including the Canadian National Institute for the Blind and Laurier's Accessible Learning Centre, STIL Solutions was able to grow. STIL Solutions provides products and services (e.g., the WasteFinder system) that facilitate the inclusion of individuals with vision loss in sustainable practices and initiatives (STIL Solutions, n.d.).

WasteFinder System

The WasteFinder system is designed to assist individuals with vision loss to sort their waste conveniently and independently in public spaces. This system utilizes an arrangement of tiles placed in front of a waste disposal unit to indicate that a waste unit is close by and differentiate among each waste stream; the raised tiles provide tactile information that can be felt underfoot, eliminating the need to touch the waste bins to distinguish between streams of waste. The tiles also provide additional visual information through colours and shapes, further distinguishing the different waste streams (see Image 1; STIL Solutions, n.d.).

The vicinity indicators are light blue tiles with small, raised triangles. Directly in front of the bins are stream indicators, which identify each waste stream with unique colours and large raised shapes. A large dark blue tile indicates the recycling stream, a black square tile indicates landfill, and a green circular tile indicates organics/compost (see Image 2; STIL Solutions, n.d.).

Image 1

Image 2

The Implementation Context

Kitchener is a mid-size city in Southern Ontario, Canada. It is one of the top-20 fastest-growing cities in North America, a high-tech industry centre, recognized for their leadership in public engagement, climate action planning, stormwater management, and community well-being. Kitchener has been at the forefront of previous municipal innovations and is known for its forward-thinking leadership. They recently completed a Corporate Climate Action Plan (https://www.kitchener.ca/en/resourcesGeneral/Documents/DSD_Kitcheners_Corporate_Climate_Action_Plan.pdf), and also contributed to the Region of Waterloo's Community Climate Adaptation Plan (https://www.regionofwaterloo.ca/en/living-here/resources/Environment/Community-Climate-Adaptation-Plan---Full-ACCESS.pdf) and the recently released TransformWR Community Climate Action Plan (https://climateactionwr.ca/wp-content/uploads/2021/07/Final-TransformWR-Stragegy.pdf). The latter has a strong emphasis on the intersectionality of environmental sustainability and equity and accessibility as reflected in the overall goal of thriving for a "transition to an equitable, prosperous, resilient low carbon community. The City is also "committed to building an inclusive community and providing an accessible environment where all individuals have access to the City's services, facilities open spaces and programs in a way that respects the dignity and independence of people with disabilities" (https://www.kitchener.ca/en/accessibility.aspx).

The Kitchener Market, operated by the City of Kitchener, is a popular local vending, dining, and community space and one of the oldest operating markets in Canada (in operation of over 150 years). The market is located in the center of the city and is accessible by bus, light rail transit, bike, and cars, with parking available in the bottom of the market hall, including designated spaces for people with physical disabilities. There are two main levels, which are accessible through stairs and elevators. The bottom level is the main vending space while the second level includes a variety of takeout food vendors, a large dining area, and an event space.

Overview of Current Study

The City of Kitchener partnered with STIL Solutions to install three WasteFinder systems on the upper dining level of the Market. The research team, in collaboration with STIL Solutions and the City of Kitchener, set out to better understand the relationship between disability and participation in sustainability at the Kitchener Market and the possible effect that WasteFinder may have on perceptions of and participation in sustainability practices, including the intersection of sustainability with accessibility. To do so, the study used an exploratory sequential mixed methods research design, including surveys, focus groups and waste audits pre- and post- installation of three WasteFinder systems. The main objectives of this research were to (1) explore the factors that promote and/or hinder participation in waste diversion in a public space and (2) assess the impact of the WasteFinder System on participation and perceptions of sustainability, inclusivity, accessibility.

Participants of this study were Kitchener Market patrons and vendors, 18+ years of age. Survey participants were invited to participate in person by researchers at the market or scanned a QR code to complete the online survey at another time. Participants were asked to leave their contact info if they wished to be contacted for the focus group or future phases of the research (e.g., post-installation survey and focus group).

Surveys

Pre-installation survey questions aimed to establish a baseline level of awareness and understanding of accessibility and inclusion of sustainability practices at the Kitchener Market. Pre-survey data collection occurred online via Qualtrics, an online survey data collection platform, from

August 7th, 2021 to September 9th, 2021 and in person on two Market days (August 7th, 2021 and August 14th, 2021).

Post-installation questions aimed to compare awareness and understanding of accessibility and inclusion post-installation of WasteFinder and assess participants' experience with the WasteFinder system. Post-survey data collection occurred online via Qualtrics from October 30, 2021 to November 17th, 2021 and in person on two Market days (October 30th, 2021 and November 6th, 2021). Paper survey data were manually entered into Qualtrics by a trained research assistant.

Focus Groups

The pre-installation focus group occurred on September 2, 2021 and aimed to gain a richer understanding of participants' experience of accessibility and inclusivity of sustainability at the Kitchener Market.

The post-installation focus group occurred on November 2, 2021 and aimed to compare participants experience with accessibility and sustainability following the installation of WasteFinder. Focus groups were recorded and transcribed to text for analysis.

Waste Audits

Waste audits were conducted pre- and post-installation of the WasteFinder system. Pre-installation waste audits aimed to establish a baseline level of waste disposal practices at the Market and post-installation waste audit aimed to measure the possible impact that WasteFinder has on waste disposal practices.

On each of the in-person data collection days at the Market, all waste bags used in the waste bins were labeled according to each of the four Region of Waterloo waste streams (Mixed Paper, Garbage, Compost, Glass, Metals and Plastics). On the Tuesday following each of the in-person survey data collection days (Pre-installation: August 10th and 17th, 2021; post-installation: November 9th, 2021), custodial staff left the labeled waste bags in the Market waste room for the research team to access. Luggage scales were used to measure the weight of the waste. Each labeled waste bag was weighed, then sorted into each of the four streams, then weighed again according to each stream. Weight was measured in pounds (lbs).

WasteFinder and the accompanying signage (informational poster explaining WasteFinder and instructions for each waste stream) were installed sequentially from August to October 2021:

- August 17th, 2021
- October 16th, 2021
- October 19th, 2021

All research methods were reviewed and approved by the Wilfrid Laurier University Research Ethics Board (#6518) and conducted by trained research assistants.

Findings

Survey Respondents

The sample primarily consisted of visitors and a few vendors at the Kitchener Market. Potential participants were approached by student research assistants near the upstairs dining area at the market before the WasteFinder was installed (in August, 2021), and after its installation (in November, 2021). Individuals were asked to complete a paper or online survey about their perception of accessibility and sustainability in the market, as well as their ability to engage in sustainable practices, such as sorting and disposing of waste at the market. A total of 182 unique individuals completed the survey prior to the installation of the WasteFinder systems (*n=106*) or after their installation (*n=78*). Only two (2) participants answered the survey at both timepoints, resulting in 184 survey responses completed by 182 unique respondents.

Table 1: Age of Survey Respondents

	Frequency	Valid Percent[1]
18-24	28	15.6
25-39	68	37.8
40-59	43	23.9
60+	41	22.8
No response	2	
Total	**182**	**100%**

Most respondents were young adults 25-39 (37.8%), followed closely by older adults 40-59 (23.9%) and adults 60+ (22.8%; see Table 1 for more details). Most respondents described themselves as regular visitors of the market (53.6%), with intermittent patrons being the next largest group (31.8%; see Table 2 for more details). Of the 176 respondents who reported on their English abilities, approximately 75% described themselves as Native English speakers. These demographic variables were relatively comparable across both pre-installation and post-installation surveys, with a slightly higher percentage of Native English speakers in the post-installation sample.

Table 2: Market Patron Status

	Frequency	Valid Percent
Regular visitor	96	53.6
Intermittent visitor	57	31.8
First-time visitor	23	12.8
Vendor	3	1.7
No response	3	
Total	**182**	**100%**

Approximately 10% of respondents who disclosed their ability/disability status (*n=177*) identified as a person with a disability, while approximately 90% did not (see Figure 1). In the pre-WasteFinder installation survey (*n=101*), eight respondents (7.9%) identified as having a disability, while the other 93 (92.1%) did not; five respondents did not disclose their ability/disability status. In the post-WasteFinder installation survey (*n=78*), 10 respondents (13.2%) identified as a person with a disability, and the other 66 (86.8) did not.

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[1] The percentage of data with missing cases excluded.

Sustainability and Accessibility

A key goal of the survey was to understand perceptions of the market's accessibility services and features. Marketgoers were asked if they perceived the market as accessible and inclusive to anyone who may visit; in the post-installation survey (*n=77*), 59.8% of respondents said 'Yes' or 'Definitely yes'. For a related but slightly different question in the pre-installation survey (*n=106*), 39.6% of respondents said 'Yes' or 'Definitely yes' – however, this figure could be due to the specific language used in the pre-installation survey, which was

Figure 1: Do you identify as an individual with a disability?

18 — Yes
159 — No

altered for clarity in the post-installation survey.[2] Overall, many respondents found the market accessible, and many identified specific market features that promote accessibility including multiple elevators, ramps, handrails, automatic doors, and spaciousness.
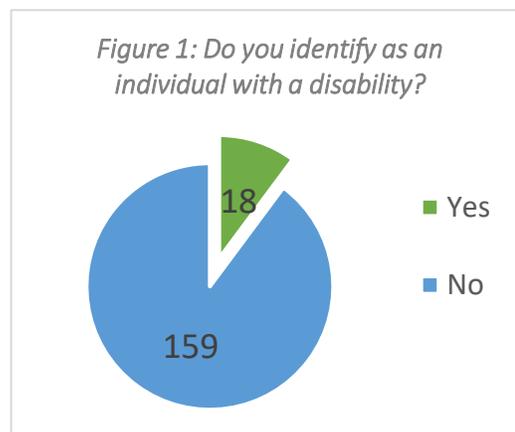
It is important to note, however, that respondents' perceptions and experiences of accessibility were contextualized by the ease at which they are able to access and participate fully in the space. While some participants listed the above features as promoting accessibility at the market, others described a more nuanced experience of these same market features. For example, several respondents noted the elevators can be difficult to find, and often have long wait times. In another example, one respondent noted the non-automatic doors were quite heavy (i.e., may be difficult for those with disabilities to open/close independently). While the spaciousness of the market was described positively by one participant, others noted the space can become crowded and difficult to navigate. Specific recommendations to increase accessibility at the market are detailed in the *Discussion* section.

> *"We have elevators, which are great for wheeled travel, but we have no way finding system for the blind/visually impaired." – Pre-installation survey participant*

The survey also asked respondents about the most notable sustainability features at the market. The most noted feature both pre- and post- WasteFinder installation was the waste disposal units (*n=39 and 32, pre- and post-installation respectively*). Other features include purchasing local, organic foods (*n=4 and 5, pre- and post-installation, respectively*), producing less waste while grocery shopping (*n=6 and 7, pre- and post-installation, respectively*), the market operating an open-air facility *(n=3 pre-installation, sampled during summer months)* and conveniently accessed by multiple modes of travel (e.g., walking, biking, transit; *n=7 post-installation*). Specific recommendations to increase sustainability at the market (while also taking into account accessibility recommendations) are also detailed in the *Discussion* section.

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[2] The pre-installation survey (n=106) posed the question "In your opinion, to what degree has the Kitchener Market met Ontario's commitment to create an accessible Ontario, as well as promoting accessibility and equitable access to services and facilities?". It is possible that the phrase 'Ontario's commitment to create an accessible Ontario' left many respondents uncertain about the standards to which we were referring, as suggested by the 46.2% of respondents who answered 'Neutral/not sure'. We addressed this by changing the wording of the question in the post-installation survey (n=77); "In your opinion, do you feel the Kitchener Market is equally accessible and inclusive to anyone that may visit the Market", to which fewer respondents said 'Neutral/not sure' (25%).

Experiences with WasteFinder

Of the 78 surveys that were collected post-WasteFinder installation, 34 respondents confirmed they saw and/or interacted with a WasteFinder system. A large majority of these respondents (75.8%; see Table 3) described the WasteFinder as easy to use. Several respondents noted specific features of the WasteFinder that made it easy to use, including its colour-coded

Table 3: WasteFinder Ease-of-use

	Frequency	Valid Percent
Easy	25	75.8
Neither easy nor difficult	6	18.2
Difficult	2	6.1
No response	1	

system, the floor tiles themselves, and the use of additional visual cues/illustrations (i.e., the posters with pictures posted by the waste disposal units). 50% of the respondents who interacted with the WasteFinder system reported it influenced how they sort their waste (*n=34*). One respondent said they felt the WasteFinder "*Forces individuals to sort their waste, become more aware.*"
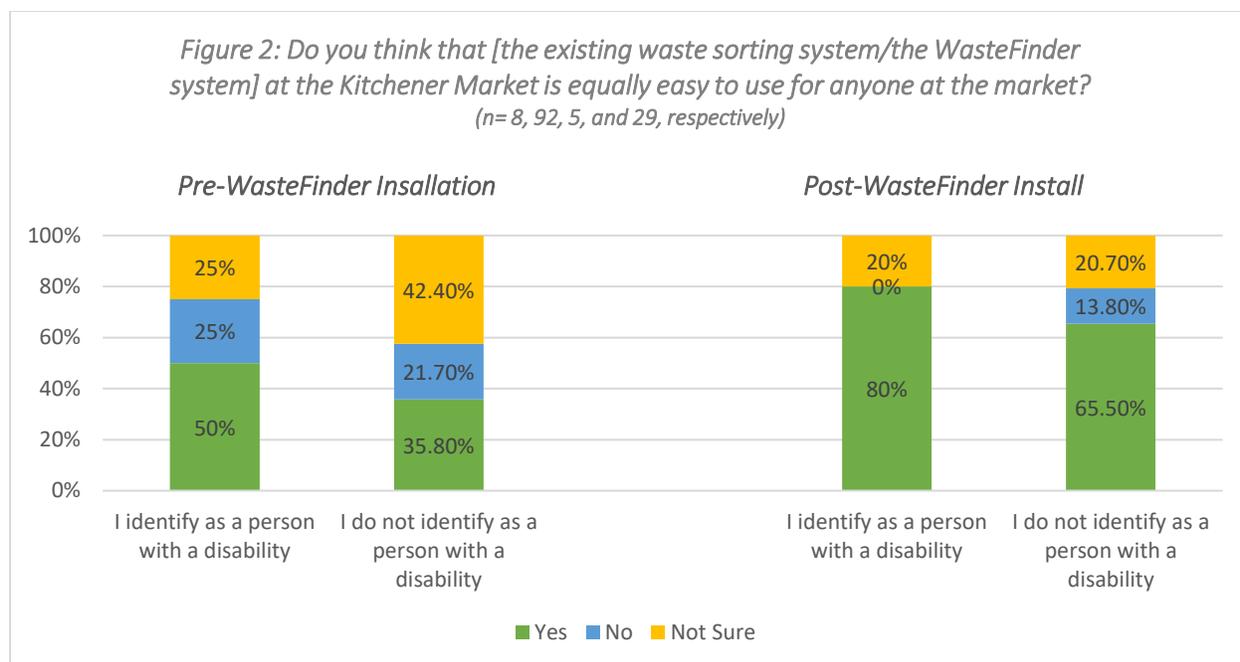
While WasteFinder was generally easy to use, participants noted that there was still *"[c]onfusion over what materials can be put into different receptacles*". Several respondents noted there was not sufficient instructional signage to support them in effectively sorting their waste, and noted issues with existing signage (e.g., "too small, not posted in convenient locations"). Participants also noted that the bins were too high for people in wheelchairs and were difficult to find. Further challenges to sorting waste are discussed in the subsequent section.

Impact of WasteFinder

As previously mentioned, the majority (75.8%, *n=33*) of respondents who interacted with the WasteFinder described it as easy to use, and 50% (*n=34*) indicated that it influenced how they sorted their waste. Additional findings suggest that WasteFinder is generally perceived as accessible; 80% of respondents with a disability, and 65.5% of respondents without a disability (*n=34*) agreed that WasteFinder was '*equally easy to use for anyone that may visit the market'*, compared to 50% of respondents with a disability, and 35.8% of respondents without a disability who agreed with this statement prior to the installation of WasteFinder (*n=104*). This is demonstrated in Figure 2, and this finding was true for respondents who identified as a person with a disability, as well as those who did not identify as a person with a disability.

Figure 2: Do you think that [the existing waste sorting system/the WasteFinder system] at the Kitchener Market is equally easy to use for anyone at the market?
(n= 8, 92, 5, and 29, respectively)

Our findings suggest that the WasteFinder system reduced common barriers to sorting and disposing of waste among respondents with diverse abilities. While only about 10% of all respondents identified as a person with a disability, approximately 25% all of respondents said they experience challenges when sorting their waste both the pre-installation (25.5%, *n=106*) and post-installation (24.7%, *n=77*). While these percentages are comparable, the qualitative survey data suggests the frequency at which common barriers were mentioned was reduced post-installation. For example, pre-WasteFinder installation, several participants commented that they had difficulty finding the waste bins (*n=7*), or that they were concerned about the waste sorting and disposal systems available (*n=10*). One pre-installation survey participant noted "*The [lack of] availability of compost and recycle bins*" as a challenge. Following the installation of WasteFinder, there were fewer comments about difficulty finding the bins (*n=2*) and the limited availability of receptacles (*n=5*). Taken together, these findings might suggest the WasteFinder system reduced commonly perceived barriers to sorting and disposing of waste among many respondents.

A common barrier to sorting and disposing of waste in both the pre-installation (*n=8*) and post-installation (*n=10*) surveys was insufficient instructional signage to assist in the proper sorting of waste. The size and location of existing signage was noted as a limitation; one post-installation survey participant said, "Pictures [are] small & confusing, a written list would be better for me". Specific recommendations to improve waste sorting and disposal signage are detailed in the *Discussion* section.

Waste Audits – Pre and Post

Finally, a series of pre- and post-installation waste audits were conducted to assess the level of improvement in proper waste sorting/disposal that may be attributed to the WasteFinder system. The objective of the waste audits was to measure the weight and composition of each waste stream at each of the three waste units pre- and post-installation of the WasteFinder system. The first two waste audits established the baseline weight and composition of each of the four waste streams prior to the installation of WasteFinder. The third waste audit measured the weight and composition of the four waste streams following the installation of WasteFinder.

Audit Scope & Method

The waste audit included three separate waste units (Unit A, Unit B, and Unit C) located on the upper level of the Kitchener Market. Each unit contained four separate compartments for each of the following streams:

1. Recycling (Mixed Paper, Cardboard)
2. Garbage
3. Compost
4. Recycling (Glass, Metal, Plastics, Containers)

The scope of the materials audited were mainly daily single-use consumer products, including food waste, food containers, paper, packaging, etc. All waste collected for the purposes of the waste audit were included.
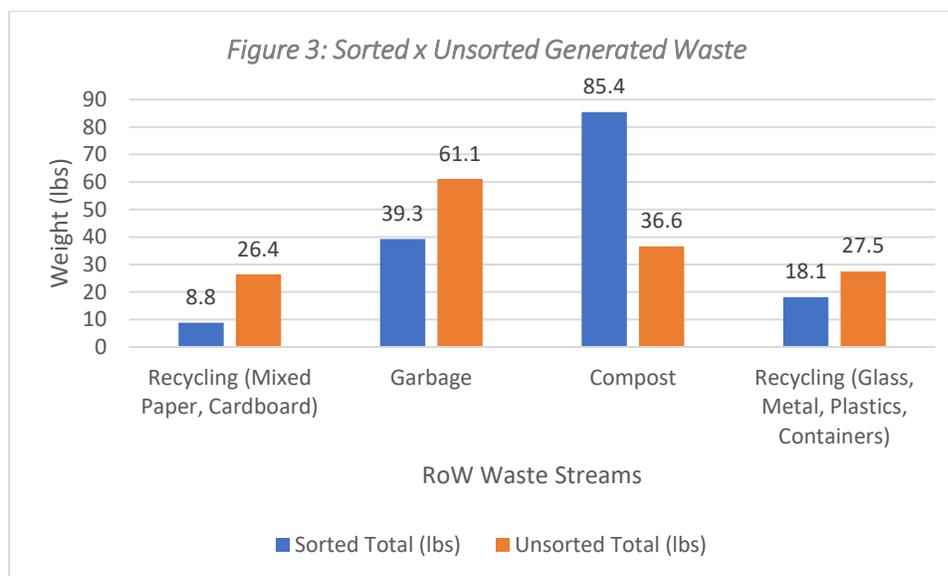
On the Tuesday following each of the selected time points, custodial staff left the labeled waste bags in the Market waste room for the research team to access. Luggage scales were used to measure the weight of the waste. Each labeled waste bag was weighed, then sorted into each of the four streams, then weighed again according to each stream. Weight was measured in pounds (lbs). The identification of waste streams follows the Region of Waterloo standard.

Waste Generated at the Kitchener Market

A total of 151.6 pounds of waste was generated at the Kitchener Market over the three data collection days. Table 4 and Figure 3 below display the distribution of weight across each waste stream before and after waste was sorted. All calculations presented in this report are based on the weight of the unsorted waste streams, that is, before the research team intervened. Note that the findings presented below are not statistically significant and should be considered with caution.

Table 4: Waste generated at the Kitchener Market

RoW Waste Stream	Unsorted Total (lbs)	Sorted Total (lbs)
Recycling (Mixed Paper, Cardboard)	26.4	8.8
Garbage	61.1	39.3
Compost	36.6	85.4
Recycling (Glass, Metal, Plastics, Containers)	27.5	18.1
Grand Total	**151.6**	**151.6**

Figure 3: Sorted x Unsorted Generated Waste

Weight (lbs) — RoW Waste Streams

- Recycling (Mixed Paper, Cardboard): Sorted Total 8.8, Unsorted Total 26.4
- Garbage: Sorted Total 39.3, Unsorted Total 61.1
- Compost: Sorted Total 85.4, Unsorted Total 36.6
- Recycling (Glass, Metal, Plastics, Containers): Sorted Total 18.1, Unsorted Total 27.5

Legend: Sorted Total (lbs), Unsorted Total (lbs)

Diversion Rates Across Waves

The Diversion Rate is the proportion by mass of all waste diverted from disposal (i.e., landfill or incineration) to the total weight of all waste material generated, expressed as a percentage (BOMA, n.d.).

Figure 4 below displays some variability in diversion rates pre- and post-installation of the WasteFinder system. The waste audit found an increased rate of compost materials diverted from landfill (26.17% diversion rate relative to 21.59% pre-installation) and a decreased rate of recycling materials diverted from landfill (30.98% diversion rate relative to 39.98% pre-installation).

Figure 4: Diversion Rate Pre-Post

Percentage Weight — Diversion Rate

- Recycling: Pre (W0+W1) 39.26%, Post (W2) 30.98%
- Compost: Pre (W0+W1) 21.59%, Post (W2) 26.17%
- Recycling & Compost: Pre (W0+W1) 60.85%, Post (W2) 57.14%

Legend: Pre (W0+W1), Post (W2)
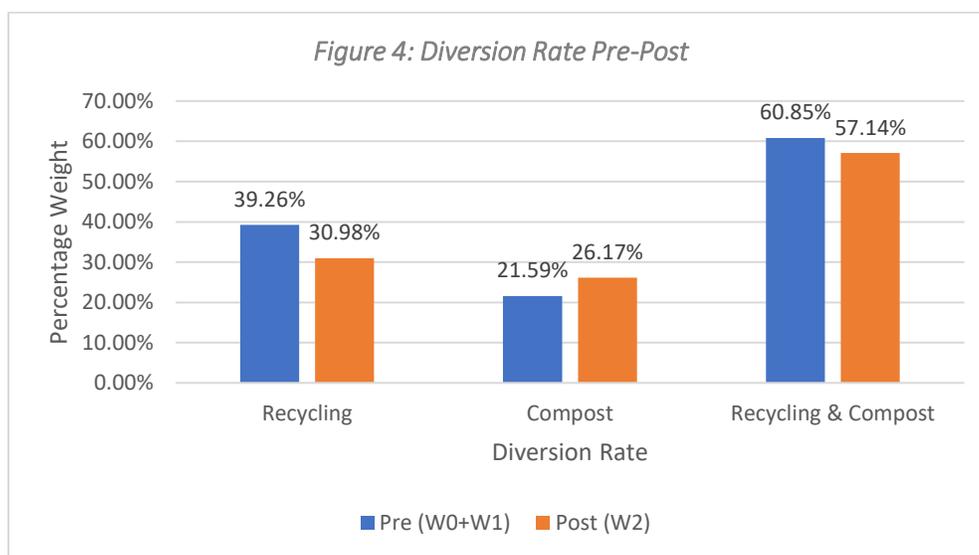
Contamination Rates Across Waves

The Contamination Rate is the proportion of materials found in waste stream in which that material does not belong (e.g., organic material in the recycling bin; BOMA, n.d.).

The waste audit found increased contamination rates of both recycling and compost systems post-installation of the WasteFinder System. Following installation, contamination of the recycling

stream was 66.50% relative to 55.2% pre-installation, and contamination of the compost stream was 16.67% relative to 4.41% pre-installation, as seen in Figure 5 below.

Figure 5: Contamination Rate Pre-Post
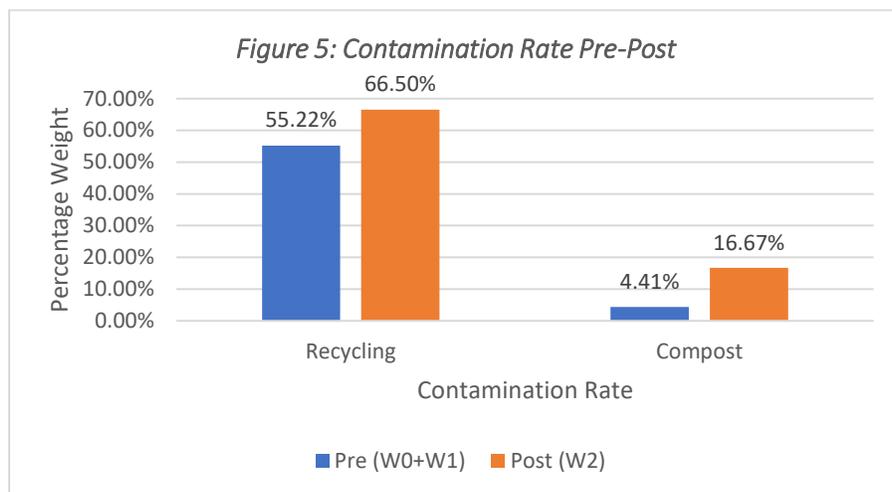
Capture Rates Across Waves

The Capture Rate is the proportion by mass of all waste currently diverted from disposal (i.e., landfill or incineration) to the total mass of all waste material that could have been diverted (e.g., total weight of properly recycled waste to the total weight of all recyclable materials; BOMA, n.d.)

The waste audit found comparative capture rates for both recycling and compost streams pre- and post-installation of the WasteFinder system. See Figure 6 below.

Figure 6: Capture Rate Pre-Post
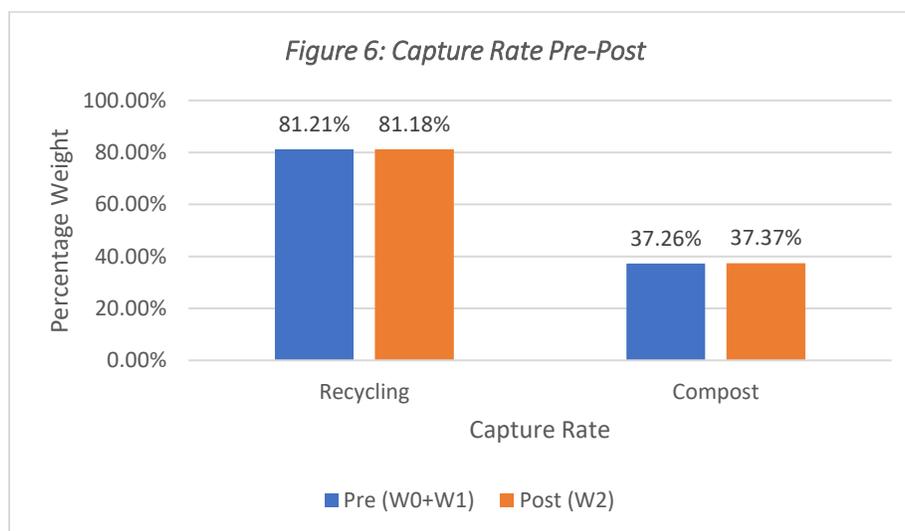
Discussion

Accessible Sorting/Disposal of Waste and WasteFinder

Our findings suggest that overall, respondents found Kitchener Market to be accessible, noting key accessibility features such as ramps and multiple elevators; however, most of our sample did not identify as having a disability and several respondents noted accessibility features for which qualitative survey data suggests a more nuanced experience of accessibility. Thus, our findings do not suggest that the space is objectively accessible since individuals' perceptions of accessibility were dependent on their

ability to access and participate fully in the space. People with disabilities have a unique awareness of the accessibility of the market. Conclusions drawn about the accessibility of a space should come from the full participation of individuals with diverse abilities to truly understand the factors that support or hinder the participation of all communities.

While the majority of those who interacted with the WasteFinder system found it easy to use, approximately half of the sample stated that it influenced how they sort their waste. Respondents liked the visual cues that WasteFinder provided, including the colour-coded tiles and how it acted as an overall nudge to sort waste. Overall, the WasteFinder was perceived to be accessible by most respondents, however the vast majority of respondents did not identify as having a disability. That said, our findings might also suggest that the WasteFinder reduced common barriers to sorting and disposing waste among many respondents regardless of their self-reported ability/disability status.

Many respondents also noted that there was not sufficient instructional signage to support them in effectively sorting their waste. Diversion rates of both recycling and compost were negligible both pre- and post-installation of the WasteFinder; further, capture rates of both recycling and compost were virtually the same pre- and post-installation, and contamination of both streams increased following the installation of the WasteFinder. However, it is important to note that waste streams can easily become contaminated as a result of the improper disposal of a single item (e.g., a half full takeout coffee cup disposed of in the mixed paper bin). This one incorrectly sorted item can contaminate the entire bin of recyclable paper. Taken together, these findings suggest that WasteFinder did not have a significant impact on waste sorting practices at the market. However, this finding should be taken into consideration with the implementation context: only one waste audit was conducted post-installation (relative to two pre-installation) and the installation of WasteFinder and accompanying informational pieces occurred sequentially. As such, there was likely not sufficient intervention/installation time before the post-installation audit. Overall, for WasteFinder to be successful, implementation should include a thorough instructional piece and information campaign (e.g., clear signage on what does and does not go in the bin) to ensure that users are able to sort their waste easily and effectively. This is discussed in more detail below.

Based on our findings, we recommend placing more multi-stream waste disposal systems around the market. It is recommended that additional accessibility concerns are considered with the selection and placement of these waste systems, including providing sufficient space around the receptacle, a lower height at which to dispose of waste (i.e., for patrons in wheelchairs, children), adequately sized openings for placing waste into the bins, and keeping them in permanent locations. Further, it is recommended that sufficient signage is installed around all waste disposal units to assist marketgoers in properly sorting their waste. Based on the survey responses, adequate signage would be large, with both images and text/writing (perhaps in multiple languages) indicating where common waste items do and do not go. The signage should also be at eye-level – noting that there may be more than one common eye-level. Additional signage/wayfinding indicating the location of the bins would also likely be beneficial. These recommendations are supported by key findings from this report – specifically comments from marketgoers.

Further, we recommend improvements that could be made to future installations of the WasteFinder systems. We recommend implementing/installing all WasteFinders in each location at the same time and pairing the install with sufficient instructional signage as described above. We also recommend finding permanent locations for the waste disposal systems, so that bins can be reliably accessed by users. Furthermore, we recommend pairing the installation with a sufficient educational campaign to those involved in the operation of the facility (e.g., bringing all facility staff, volunteers,

vendors, executives, etc., onboard to ensure efficient implementation and operation of the WasteFinder).

More broadly, our findings support an overall recommendation to continue embracing solutions that make sustainability practices accessible for all. Specifically, we suggest implementing way-finding strips to make navigation easier for marketgoers with diverse abilities. We also recommend offering reduced capacity hours for marketgoers who identify as a person with a disability, and/or senior citizens.

Sustainability

Based on survey responses, recommendations pertaining to sustainability include more reminders/encouragement for marketgoers to bring their own reusable bags, as well as encouraging vendors to only use sustainable packaging. Further, marketgoers may respond positively to the option of reusable plates/cutlery that can be washed at the market by patrons or staff. Along a similar vein, one respondent recommended a reusable container program, where the market provides containers for taking home food that could subsequently be exchanged at the market for a clean one.

Limitations and Conclusion

As with all research, this study was not without limitations. First, the sample of marketgoers who knowingly interacted with a WasteFinder system was quite limited; less than half of all post-installation survey respondents indicated that they interacted with WasteFinder. Another limitation is that only approximately 10% of our overall sample identified as a person with a disability (in comparison to 20.8% of Region of Waterloo population, according to a census of the metropolitan area; Statistics Canada, 2019), and that we do not have further details on how their disability status may or may not impact their ability to properly sort of and dispose of waste or engage in other sustainable practices. Another important consideration is the unique historical context in which the WasteFinder systems were installed. This research was conducted in the middle of the COVID-19 pandemic. This had multiple significant impacts on the research. First, the recurring adjustments needed to deal with the changing public health requirements made it difficult to make the installation of the WasteFinder System a priority for the market staff. While the staff were very supportive of the research activities, there were limitations regarding the installation of the WasteFinder (e.g., a sequential installation; very limited educational campaign, limited ability to monitor the current location of the wastebins relative to the tiles). Further, research activities had to be delayed multiple times due to the public health requirements both at the market and at Laurier. Also, the WasteFinder systems were installed in the main upstairs dining area of the market, which was restricted during the time of the data collection (it was sectioned off with tables with the requirement to show proof of vaccination to pass into the dining area). This will likely have altered how some market patrons use and navigate the market and who entered the areas with the WasteFinder systems installed. The health risks related to the pandemic may also have prevented some people with disabilities to go to the market during that time. Given these challenges, we are very thankful to the City of Kitchener and the market staff for allowing us to conduct this research and for their support throughout the research process.

In conclusion, this research report ultimately suggests the City of Kitchener continues to embrace solutions that make sustainable practices and a sustainable future more accessible and inclusive for all community members. This is aligned with their overall commitment and leadership in regard to integrating considerations of equity and accessibility into their climate action and sustainability planning. The WasteFinder System seems to be a practical solution that supports the City in these efforts, which not only makes the waste sorting more accessible for people with visual impairments but also has a positive impact on other market patrons and vendors.

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Appendix A – Responses to question about Kitchener Market

Both pre- and post- installation surveys posed the following question: *"If you have any other thoughts about sustainability and/or accessibility at the Kitchener market, please feel free to share them here. We will make sure to share these with the manager of the market."*

Of the 182 unique participants that took part in the survey, 8 (4.4%) answered this question. Their suggestions are in the table below:

10041	"I question the value of this survey given the uncertainty about what was meant by sustainability and the questions i have about the ability of people without disability to prove responses that are meaningful. I feel my time has been wasted."
10040	"Maybe set up a station that sells reusable mugs and if you use that mug at any market stand you get a discount. And people could return them to be cleaned and handed a new one."
gad11	"Get rid of plastic… No more plastic utensils, packaging and plastic bags"
ncj11	"I'd love to see sustainability through waste reduction taken to the next level. For example, replace all single use plate and cutlery with a system of washable items used by all vendors. Perhaps a third party could provide this service."
nkm44	"Possibly elevators in the market if they don't already exist"
rka55	"I bring my own containers, knife & fork mug etc."
tkm99	"Parking is a huge problem at the Market"
ykf99	"Fruit and vegetable vendors use more paper or ask for reusable bags"