EFFECTIVE PLACEMENT AND DESIGN OF THE FOUR-BIN WASTE DISPOSAL SYSTEM IN LOBBY AND CLASSROOM AREAS AT DALHOUSIE UNIVERSITY

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1.0 EXECUTIVE SUMMARY

Dalhousie University currently diverts 60% of its waste from landfills, but in order to improve the University's sustainability, a goal of 75% waste diversion has been set (Dalhousie University Office of Sustainability, n.d.). To assist with this goal of waste diversion, this study aims to examine the role of bin placement and signage in improving separation of waste. In order to evaluate student and custodial staff perspectives and attitudes about the waste management system at Dalhousie, written surveys were administered. Based on recommendations from surveys and the clients of this project, waste audits were completed in the Goldberg Computer Science Building and the Chemistry Building. One lobby and one classroom from each building were selected, and audits were conducted before and after changes were made to the location and signage. It was found that the organic and paper streams had the least amount of contamination while the recyclables and garbage had the greatest amount of contamination. After the changes were made to the four-bin systems, the most improved diversion was seen in recyclables. For Dalhousie University to reach its targets in waste diversion, it is recommended that more research should be completed.

2.0 INTRODUCTION

2.1 *Background and Research Importance*

The production of waste is becoming an important environmental issue throughout the world as waste generation increases proportionately with population and urbanization (Idris, Inanc, & Hassan, 2004). Rapid development, and lifestyle changes in many growing cities have resulted in the change of waste composition from primarily organic materials, to plastic, paper and complex packaging materials (Idris, Inanc, & Hassan, 2004). In addition, the increasing human population and consumption rate results in large amounts of waste being disposed into existing landfills and creates a need for more landfills to be constructed (Allan, et al., 2011). Not only do increased amounts of waste lead to more land being used for landfills and waste disposal sites, but these landfills also have negative environmental implications. When waste products, such as paper, food, and other biodegradable products, break down in landfills, large amounts of methane gas are produced, which contributes to global warming. Other greenhouse gases are associated with the burning of plastics and textiles in incinerators, and with the collection and transportation of waste to disposal sites (Allan, et al., 2011; Kallman, 2008). Also, landfills are often known to contain toxic chemicals, which can contaminate adjacent land, posing threats to humans, as well as other organisms that inhabit the area (Allan, et al., 2011). Chemicals produced in the degradation of waste can also leak into aquifers and contaminate groundwater (Kallman, 2008).

Previous studies have described waste minimization to be one of the fundamental principles of sustainability (Henson, et al., 2007), therefore it is important to study different methods that attempt to reduce waste and divert materials that could otherwise be recycled or composted, from landfills. Not only does the diversion of waste lessen negative environmental impacts, but it can also result in the reduction of costs incurred through the garbage disposal process (Toronto Solid Waste Management Services, 2011). Both landfills and recycling facilities charge fees for transportation and also often include a surcharge for weight, therefore, the minimization of the weight of wastes transported to landfills can decrease disposal costs (Ellis, 2011). A study displaying such a decrease in disposal costs was conducted in 2003 at the Massachusetts Institute of Technology. A waste audit was conducted in a dorm, an academic office building, and the Student Center at MIT, and found that 470 of 675 pounds (approximately 70%) of audited trash were actually recyclable. The results showed that by recycling 40% of its

trash, it would be possible for MIT to save up to $100,000 per year (Allan, et al., 2011; MITnews, 2003).

The issues of recycling and waste minimization/diversion are relevant to Dalhousie University as Dalhousie is a significant contributor to the waste produced within the Halifax Regional Municipality (Allan, et al., 2011). Sustainability is a growing concern in many universities, and many schools are implementing programs to promote sustainability on campus through the Greening the Campus movement. In 2006, a study was conducted at Dalhousie that evaluated the efficiency of the recycling program at the time. An audit was performed in several buildings throughout campus, such as the Life Sciences Centre (LSC), the Killam Library, the Student Union Building (SUB), the engineering buildings on Sexton Campus, and the Dentistry building. This study discovered that inefficiency of the recycling system was primarily a result of lack of knowledge, unclear labels, scarcity, and lack of access to recycling bins (Brooks, et al., 2006). A 2008 audit recorded contamination levels of the four-bin systems in the Henry Hicks, Tupper, and McNabb buildings, and found that coffee cups, napkins, tissues and cardboard were the most commonly misplaced items. Also, an audit in the LSC in 2009 reported large amounts of organic contamination (Allan, et al., 2011).

Currently Dalhousie diverts 60% of its waste and has a target to divert up to 75% (Dalhousie University Office of Sustainability, n.d). A multi-stream recycling system is in use, and when fully implemented in some buildings on campus, it has shown improvements in waste diversion. The multi-stream recycling system consists of four bins that contain organics, paper and cardboard, recyclables, and waste. These bins have been labeled with signage explaining what types of wastes belong in each bin and they have color-coded lids (Dalhousie University Office of Sustainability, n.d.). This is consistent with the suggestions of Toronto's Solid waste Management Services (2011), which state that an effective waste disposal area should consist of properly color-coded bins for each waste stream, with clearly labeled bins and proper signage that effectively communicates waste diversion information to the public. For education regarding waste management on campus, Dalhousie also provides a student and employee guide to waste management, and incorporates waste sorting activities into orientation week (Dalhousie University Office of Sustainability, n.d.).

Although Dalhousie has already undertaken several measures to improve its recycling system, there is still room for further improvement to reach the goal of 75% waste diversion. Previous research projects at Dalhousie have looked at related issues, such as increasing waste

diversion in laboratories, compliance to the four-bin system in the Killam Library, and evaluating three- and four-bin systems on campus, however, more research must be done to examine the effects of bin placement on waste diversion. Facilities management at Dalhousie has also expressed interest in implementing a system with smaller organics bins (Hill, pers. comm.). Currently, organics bins are the same size as garbage and recycling bins, although the volume of organics collected is often much less than that of the other bins. Since organics bins must be emptied more frequently due to odor, and to prevent attracting insects, smaller bins would reduce the amount of plastic wasted due to the disposal of only partially full organics bags.

In a project prepared for Waste Diversion Ontario, Stantec Consulting Ltd. (2009) indicates that the strategic placement of recycling bins is one of the best practices for open space recycling. The placement and layout of recycling bins is a major factor in promoting waste diversion. One useful tool in determining the best location to place bins is often identifying high traffic areas, or areas that involve activities that are likely to generate a significant volume of waste or litter. Open spaces that are located near densely-populated areas often capture more recyclable materials, and the placement of bins in areas where people expect to find them also contributes to increasing waste diversion. Stantec Consulting Ltd (2009) also notes that bins should be paired, which can be done by placing recycling bins next to garbage bins. This is consistent with other research noting that eliminating individual garbage bins and using primarily multi-unit systems can decrease the amount of garbage waste from 85% to 25%, and can decrease the overall rates of contamination in multi-unit systems (Allan, et al., 2011). The New South Wales Recycling Advisory Unit has also stated that the most effective waste disposal systems include conveniently located bins, clear signage, color-coding, side-by- side bins, and no garbage bins standing alone (Stantec Consulting Ltd., 2009).

A littering behavior study in 2001 in Australia noted that people are more likely to deposit waste in the proper receptacle if the bin is located within 3.5 meters of them. Another previous study done in Australia found that even after the implementation of three-bin systems in a food court, there were still high levels of contamination due to insufficient and confusing signage. Improved signage resulted in the diversion of 44% of waste in the food court (Stantec Consulting Ltd., 2009).

This particular research project intends to examine the effects of bin placement on waste diversion rates in select areas of two buildings on campus: the Goldberg Computer Science building, and the Chemistry building. This study aims to determine optimal locations for the

placement of four-bin waste disposal systems, as well as to determine optimal signage for waste disposal sites. Bin design will also be taken into consideration. Overall, this research hopes to contribute to the development of a standard system for bin placement on campus that increases waste diversion and helps Dalhousie to reach its goal of 75% of waste diverted.

2.2 *Research Problem*

As mentioned earlier, previous studies conducted at Dalhousie University that focused on waste diversion, as well as concerns expressed by our client, Carla Hill from Facilities Management, identified that there is room for improvement in waste diversion at Dalhousie (Allan, et al., 2011; Brooks, et al., 2006; Hill, pers. comm.). The main problem outlined is that waste is being improperly sorted into the wrong streams. For example, items that belong in the organics stream may be thrown into the garbage stream. This means that efforts to divert waste into separate streams, using the four-bin system at Dalhousie, create problems of waste stream contamination.

The research outlined in this report aims to decrease waste contamination and increase waste diversion by improving the placement and design of the four-bin systems in the Goldberg Computer Science Building and Chemistry Building at Dalhousie University. Four waste audits were conducted before and after changes were implemented in order to measure the change in waste contamination in the four waste streams, which would indicate if there was reduced contamination and increased waste diversion. A classroom and lobby were chosen at both the Goldberg Computer Science Building and at the Chemistry Building, for a total of four audit locations. The basis for improving the location of the four-bin systems was to place them in a visible area where there was high traffic, as this was found to increase waste diversion in previous research (Stantec Consulting Ltd., 2009). Furthermore, if they were not already so placed, the bins were ordered in the Paper Recycling Organics Garbage (PROG) alignment, which was indicated as the standard four-bin order at Dalhousie by our client, Carla Hill. Single garbage bins were removed from classrooms, as previous research indicated that doing so would increase waste diversion (Allan, et al., 2011). The signage above the bins was improved by placing a detailed list of what waste items belong in each stream. New signs were also placed inside classrooms asking students to dispose of their waste at the four-bin systems located outside the classrooms. To gain additional knowledge on the problem of waste contamination, questionnaires were conducted with students and custodians to gain more insight on the topic.

The results of this research can gain insight into how Dalhousie can improve their four-bin system in order to increase waste diversion as well as decrease waste contamination.

2.3 *Research Question and Objectives*

The research question for this study is: Does the placement and design of the four-bin system improve waste diversion and decrease waste stream contamination in classrooms and lobbies at the Goldberg Computer Science Building and Chemistry Building?

The following objectives were outlined for this study:

1. Conduct surveys with students using questionnaires to discover if students know how to properly sort their waste, why they may not choose to use the four-bin system, and how they think the system could be improved

2. Conduct surveys with custodial staff using questionnaires to discover their thoughts on the current four-bin system and any ideas they may have on improving the four-bin system to increase diversion and decrease contamination

3. Use the survey results to help identify locations for the four-bin systems that make them clearly visible and that are situated in high traffic areas, then measure the change in waste contamination before and after moving the four-bin systems to these new locations

4. Implement new signs that will include lists of waste items and which streams they belong in, as well as signs that will encourage students to dispose of waste in the four-bin systems instead of single garbage bins, then measure the change in waste contamination before and after posting these new signs

2.4 *Relation of Project to Greening the Campus Initiative*

This research study is contributing to the Greening the Campus Initiative by exploring the topic of waste diversion, which ultimately leads to waste reduction. By reducing waste generated on campus, less waste will be disposed of at landfills, which can have severe environmental impacts as discussed earlier. Waste diversion is one way that Dalhousie can reduce its ecological footprint and move towards becoming a more sustainable institution.

The research from this study can help establish standards for four-bin system location and signage design that will generate optimal waste diversion and decreased contamination amongst waste streams. Such standards can help Dalhousie reach its goal of 75% waste diversion as targeted by the Office of Sustainability. This research can also help initiate the implementation of standards on other aspects of the four-bin system, such as bin size, color, and lid design. By examining waste diversion in this study it is hoped that an interest in this area of sustainability is sparked and that further such research will be conducted at Dalhousie. With more research and work towards a more sustainable campus, Dalhousie can take full part in the Greening the Campus Initiative, and can become an exemplary sustainable institution.

3.0 RESEARCH METHODS

To accurately assess optimal bin placement and design, both qualitative and quantitative methods were used. Students and custodial staff were surveyed, and audits were completed before and after changes to location and signage design were made.

3.1 *Surveys*

First, in order to determine student awareness and suggestions about the four-bin waste management system at Dalhousie, a written survey was conducted on a volunteer basis. One-page surveys were handed out to students sitting in the Atrium at the Killam Library (Appendix 1). In total, 24 surveys were completed. Results were compiled and organized in Microsoft Excel. In addition, a written survey was administered to custodial staff (Appendix 2). Surveys were given to Gary Gaudet, a custodial supervisor with Facilities Management in the LSC custodial office. He distributed the surveys to his staff; in total 23 surveys were completed. The results from these custodial surveys were also organized into Microsoft Excel.

After the results from the surveys were compiled, areas of concern and main problems with the existing system were identified based on qualitative and quantitative questions answered by students and custodial staff. Guided by the group Mentor, Rebecca McNeil, the scope of the study was narrowed to lobby and classroom areas in two buildings on campus. The group's clients, Carla Hill and Chad Hiscock, suggested that the study should focus on the Goldberg Computer Science Building and the Chemistry Building.

3.2 *Waste Audits*

Quantitative analysis was then used. It was decided that a waste audit of the existing four-bin systems be completed in Chemistry Classroom 125 and the first floor lobby near the back entrance from the Dunn Parking Lot, and the Computer Science Room 127 and Main Floor Lobby by the stairs. To coordinate the audits, Custodial Managers Gary Gaudet, from the Chemistry Building, and Joanne Marion, from the Computer Science Building, were contacted. Based on the custodial schedules given by Gary and Joanne, waste audits were scheduled to ensure 24 hours of garbage collection prior to the audit. In the Computer Science Building, the first audit was completed on Thursday, March 22 at 2:30pm, and in the Chemistry Building, the first audit was completed on Friday, 23 at 8:30am.

The total content of each waste stream was weighed. The particular waste stream was then sorted on plastic sheets into the four different streams. Each stream was weighed individually, which allowed the percent contamination of each stream to be determined. While doing this, protective eyewear was worn, as well as protective suits and gloves. Each group member had a consistent role in the waste audit process. One student recorded the weights, one student weighed the waste, two students separated the waste, and one student assisted all positions. This ensured consistency throughout the process. The results of the first waste audit were compiled from each location into Microsoft Excel in order to better analyze the data.

After the waste audits were completed in these locations, better locations were determined for the bins. In the Computer Science Building, it was determined that the bins were already placed in optimal locations; therefore, the location of the bins was not changed. However, the order of the bins was changed to be in the Paper, Recycling, Organics, Garbage order mentioned above. In the Chemistry Lobby, the bins were hidden behind chairs, and were not visible to students and staff walking by. With the advice and approval of the custodial staff in the Chemistry Building, a better location for the bins was determined. They were moved across the hall, beside the entrance to the first floor Chemistry Laboratory. In addition, single garbage bins were removed from Chemistry 125 and Computer Science 127. As previous studies indicated, having only a four-bin system available, and removing single garbage bins increased waste diversion (Allan, et al., 2011). Signs were also developed and placed in Chemistry 125 and Computer Science 127 indicating that there was a four-bin system just outside the classroom (Appendix 3; Figure 9). Also, signs were added above the four-bin systems identifying which

items go in which bins. The sign placed above the bins is one that Dalhousie uses in their waste management efforts (Appendix 3; Figure 10).

After the signs were added and bins were moved in the four locations, Gary Gaudet and Joanne Marion were contacted in order to ensure the changes made would remain until the second audit was completed.

The second audits were completed on Tuesday March 27 at 2:30pm in Computer Science and on Wednesday March 28 at 8:30am in the Chemistry Building. The audits were completed at the same time in each building in order to have consistency with the amount of waste collected. By completing audits in the Chemistry on a Friday and a Wednesday, and in Computer Science on a Thursday and a Tuesday, the classes would be similar. Again, each group member performed the same task during the second audit to ensure consistency. Each stream of waste was weighed, and then placed onto a plastic bag, sorted properly, then weighed again. Percent contamination was calculated by dividing the weight of contamination in each stream by the total weight of contents originally in the stream. The data was then organized into Microsoft Excel, which allowed us to visualize the results and identify improvements.

3.3 *Limitations and Delimitations*

According to Baron (2008) limitations are factors of the research project that are out of the control of the researchers which may affect the results or interpretation of the results. Time was a limiting factor in this project. Approximately three months were given to carry out the literature review, the methods and to analyze the results and form conclusions. Thus, the before and after waste audits in the Chemistry and Computer Science buildings were performed within a short period of time. To determine a more accurate percentage of contamination and waste diversion in the four-bin systems in these buildings, more time would have been needed to allow more time between the two waste audits for individuals to adjust to the changes.

Limitations are not always apparent at the beginning of the research project and tend to appear throughout the course of it (Baron 2008). There were many limitations that did not present themselves until 2-3 months into the project, perhaps impairing the results. A major restraint to this project was the possibility of a DFA strike at Dalhousie University. This would have resulted in classes at Dalhousie being cancelled for the duration of the strike. The presence of a strike would have had drastic effects on the waste audits, as students would not be using the

four-bin systems in these buildings as often as during regularly scheduled classes. The status of the potential strike was not known until March 11, 2012. All waste audits and changes that were anticipated to be made on the locations and signage of the four-bin system were postponed until the status of the strike was known. This, in turn, left a very short period of time for the waste audits and improvements to be completed. In addition to the waste audits being affected by a potential strike, the surveys were also altered. On the date the student surveys were completed, March 9, 2012, many students from Dalhousie University may have arranged to leave campus or even Halifax, and the population of students at the Killam Library was not as large as it would normally have been had there not been the potential of a strike.

When performing the waste audits, it was unclear how many people would need to be contacted in order for the audits to be accurate and successful. Miscommunication throughout the waste audits was a constraining factor. One of the clients for this project, Carla Hill, provided the names of custodial managers to contact for both the Chemistry Building, (Gary Gaudet) and the Computer Science building (Joanne Marion). These individuals were both contacted and informed of the plans for the improvements and changes of the four-bin systems in both the classrooms and lobbies. Both individuals agreed to have the waste in the four-bin systems remain uncollected for 24 hours prior to the times planned for the audits. When the waste was collected during the audits, minimal waste was found in some of four-bin systems, which may have been due to lack of communication between the custodial managers, and custodial staff working the night and morning shifts. It would have been more beneficial to perform waste audits with more waste collected to obtain a more accurate percentage of diversion in these areas.

Initially, the desired lobby in the Chemistry building was the second floor lobby. When Gary Gaudet was approached with proposed changes for the Chemistry building, the student investigators were informed the permission of the Chemistry Department was required to place a four-bin system in this location. Unfortunately, when the Chemistry Department was approached, they were adamant that they did not want a four-bin system in the lobby because it is not aesthetically pleasing. This limitation interfered with the ideas proposed as it was believed to be an optimal location for placement in the Chemistry Building.

Also, the scale that was used to weigh waste provided values in only kilograms and pounds, and only showed two decimal places; therefore, any weight of contaminants that did not show up on the scale (under 10 g) was considered insignificant.

Another limitation to this research project was the inability of the entire group to meet at the same time. As the student investigators are third year university students, in different departments with heavy course loads, it was difficult finding times where the entire group could meet. This had implications for when the surveys and waste audits were completed. This limitation is one that could not be overcome.

In spite of the limitations, the surveys and waste audits were still accomplished and results obtained. These results have allowed conclusions to be drawn and recommendations to be made in order to improve the four-bin systems in the Chemistry and Computer Science Buildings at Dalhousie. This research contributes towards reaching Dalhousie's goal of having 75% of its waste diverted from the landfill.

Delimitations can be described as factors of the research project that can be controlled and help to identify the scope of the research (Baron 2008). It would have been valuable for Dalhousie University if a standard location, design and signage for the four-bin system was created for all of the desired areas of campus. These included hallways, kitchen areas, lobbies/foyers, offices, classrooms, labs (teaching and research), and meeting rooms. Due to the amount of time allotted for this research project, the scope of the project was deliberately narrowed to focus on one classroom and one lobby in both the Chemistry and Computer Science buildings at Dalhousie. These two buildings were chosen based on the interests of the clients for this research project, Carla Hill and Chad Hiscock. It is possible to obtain a standardized bin location and design for the other areas of campus mentioned above, but more time would be required to give precise recommendations for changes. This is something that could be explored in future research.

3.4 *Reliability and Validity*

This research project has aimed to create both internal and external validity. Internal validity occurs when the findings of the research project correctly represent reality (Hoepfl, 1997). This has been achieved in the experimental design through setting goals and questions, and demonstrating how the manipulation of one factor can have an effect on another. In the lobby of the Chemistry building, this was done by attempting to control all factors except for changing the location of the four-bin system and the signage. In the classroom this was done by removing the single garbage bin from the classroom and adding signs informing students of the

four-bin system just outside. In the Computer Science lobby, this was done by changing the order of the four-bins in the system to PROG as recommended by the client, Carla Hill, and adding improved signage above the bins. The after-audits showed whether changes had any effect on each stream contamination. The garbage was sorted and weighed by the same two individuals to keep it consistent, and the recording was done by the same individual as well. Thus, the group was able to conclude whether or not the independent variable (the changes to the four-bin systems) had an effect on the dependent variable (waste diversion in the four streams) without compromising internal validity.

External validity is the capacity to generalize the results and conclusions drawn in different locations or on different populations (Hoepfl, 1997). External validity in this project was attained through providing a detailed account in the methods section of how the research was conducted. It was outlined how the surveys and waste audits were completed including the times and locations, equipment used, and actions performed by the investigators. This would allow readers to carry out similar projects in other locations or on other populations, perhaps at different universities, and obtain comparable results and inferences.

For a research project to be considered reliable, the results must be the same every time the particular process is performed (Handley, n.d.). Such reliability was strived for in this research project by ensuring the same two individuals sorted the waste and placed it on the scale. This allowed for minimal confusion on which items goes in each stream such as what is considered "recycling" or "organic". The scale was always tared to zero. The recorder was also the same individual for each audit performed. This individual recorded all of the weights to the same decimal place in grams, and entered the data into an Excel spreadsheet to ensure consistency.

While achieving reliability and validity were important goals in this research project, they may have been compromised since the waste audits were not carried out on the same day of the week. Due to the time constraints mentioned in Section 3.3, it was necessary that the before and after audits were conducted in the span of a week since the results needed to be analyzed and the report written. This may have damaged the reliability and validity of the results since different students use the buildings on different days of the week. Students have different behaviours when it comes to sorting their waste so a more accurate representation of the population of these buildings would have been achieved through keeping the days of the week consistent. If the days of the week for completing the audit had been kept consistent, the classes in these areas

would likely be the same, and this would have kept the student population in these areas similar throughout the audits.

4.0 RESULTS

4.1 *Survey Results*

The results from the student survey indicated that the majority of students (75%) were aware of the four-bin waste disposal system that is currently in place. Also, through answering a simple scenario question, which asked what waste stream they would place an apple core in, the students appeared to have a good basic knowledge of the four-bin system, as 96% answered the question correctly. To address the issue of bin placement, we asked how far students would be willing to walk to properly dispose of a plastic bottle in the recyclables stream. The results indicated that 48% would keep the bottle with them until they saw an appropriate recycling container, whereas 39% would only go as far as within the room or building, and 13% would throw the bottle in the nearest garbage can. Of the students surveyed, 30% indicated that they do not always use the four-bin system because they cannot locate one every time they need it. Also, over half the students (58%) stated that they are often confused about what goes in which bin, although many students stated that they find the current signs helpful to sort their waste. Additional comments and recommendations indicated that students would like to see more bins, as well as clearer signs on the bins.

The results from the custodial staff surveys showed that the majority (83%) of the staff found the current four-bin system to be effective in increasing waste diversion. When asked which factors regarding the four-bin system could be improved, the majority of staff answered with signage and bin location, which fit perfectly within the scope this study. Similar to the student survey, additional comments indicated that bigger signs should be used, and that there should be more bins. The majority (83%) of the survey staff also indicated that they thought students leaving garbage on the desks/tables/ground etc. in classrooms was an issue. Other recommendations received from the custodial staff suggested the waste management system for offices on campus should be improved.

4.2 *Audit Results*

Through conducting the waste audits, it appeared that the recyclables and garbage streams were the most contaminated in general. Garbage was a major contaminant in other waste streams, whereas organics were the primary contaminant in garbage streams. The organics and paper streams had minimal contamination in all of the audits conducted. It was also noted during the audits that many of the bins had minimal waste contents.

The first audit, which was conducted outside Classroom 127 in the Goldberg Computer Science Building, prior to changes in bin placement and design, showed the garbage stream was the only contaminated waste stream, and two-thirds of the garbage contents by weight were contaminants (Figure 1).

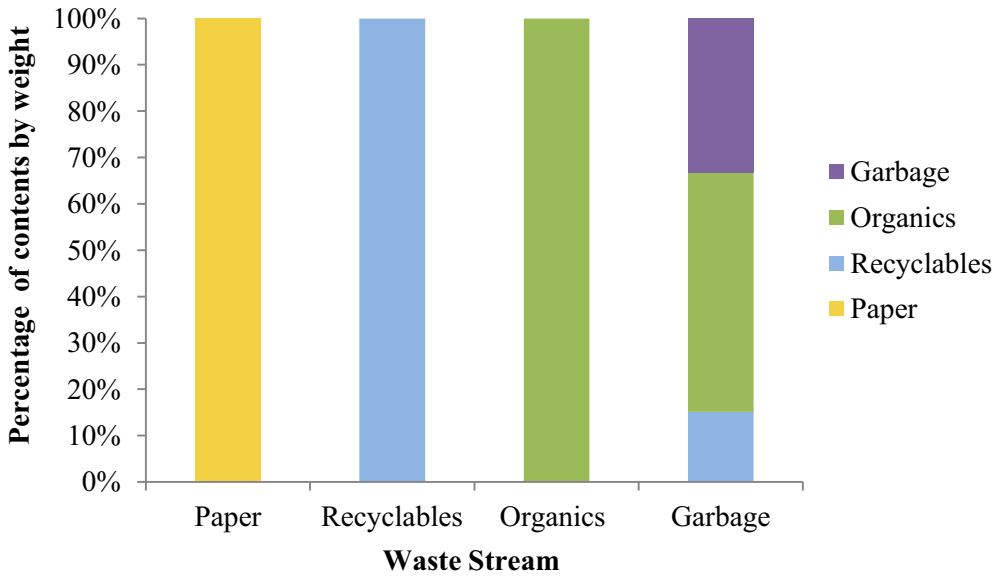

Figure 1. Percentage of each type of waste in the waste streams of the four-bin system located outside Classroom 127 in the Goldberg Computer Science building, based on an audit conducted on Thursday, March 22, 2012, at 2:30 pm. All contents that do not match the identified waste stream are considered to be contaminants.

The first audit at the lobby of the Computer Science building showed that both the garbage and recycling streams had significant amounts of contamination. The garbage bin had approximately 75% contamination, primarily by organics (Figure 2).

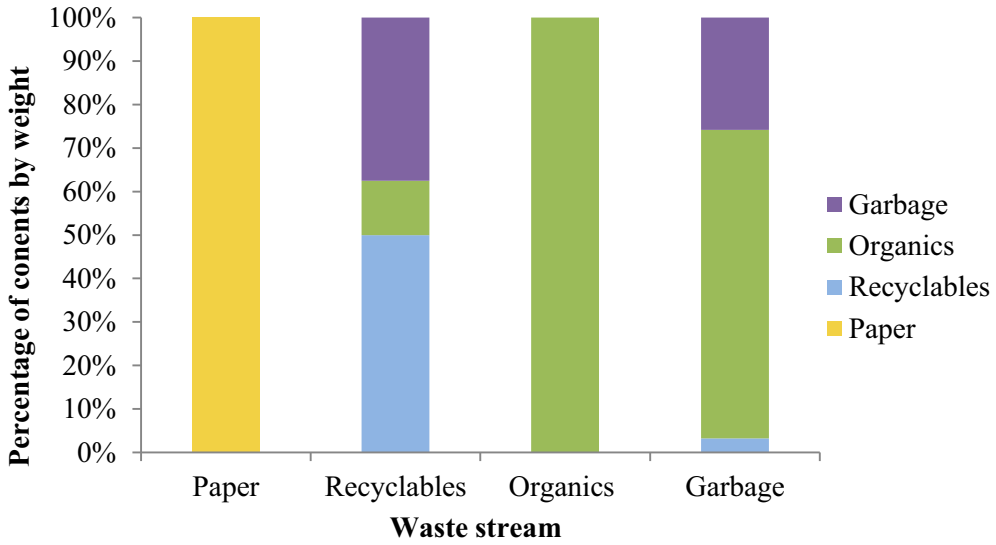

Figure 2. Percentage of each type of waste in the waste streams of the four-bin system located in the main floor lobby in the Goldberg Computer Science building, based on an audit conducted on Thursday, March 22, 2012, at 2:30 pm. All contents that do not match the identified waste stream are considered to be contaminants.

The audit conducted outside Chemistry Classroom 125 prior to placement and design changes showed minimal contamination in any of the waste streams, with less than 10% contamination in each of the recyclables and garbage streams (Figure 3). There was also negligible (<10g) contamination in the paper stream.

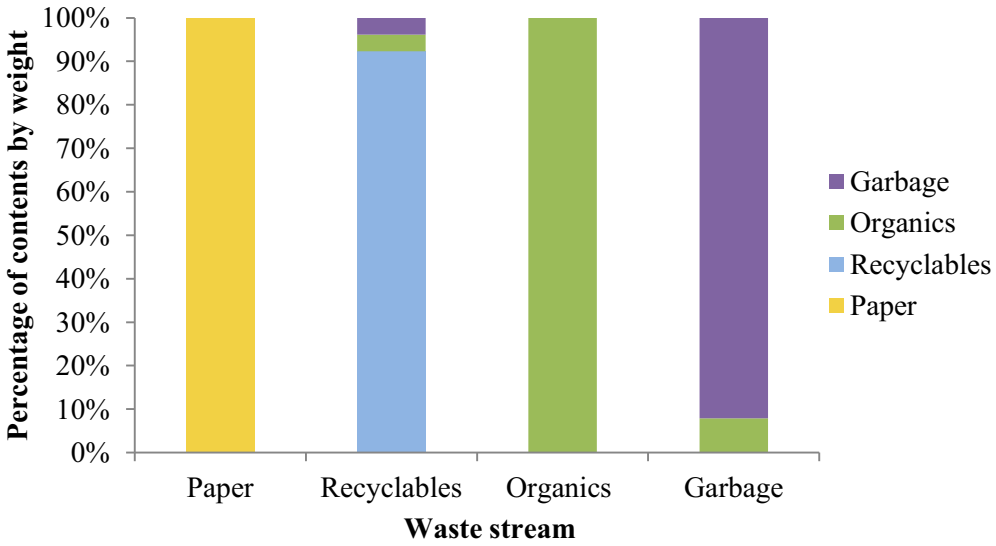

Figure 3. Percentage of each type of waste in the waste streams of the four-bin system located outside Classroom 125 in the Chemistry Building, based on an audit conducted on Friday, March 23, 2012, at 8:30 am. All contents that do not match the identified waste stream are considered to be contaminants.

The first audit conducted in the lobby of the Chemistry building showed contamination in the recyclables, organics, and garbage streams (Figure 4). The paper stream also contained negligible (<10g) contamination from garbage.

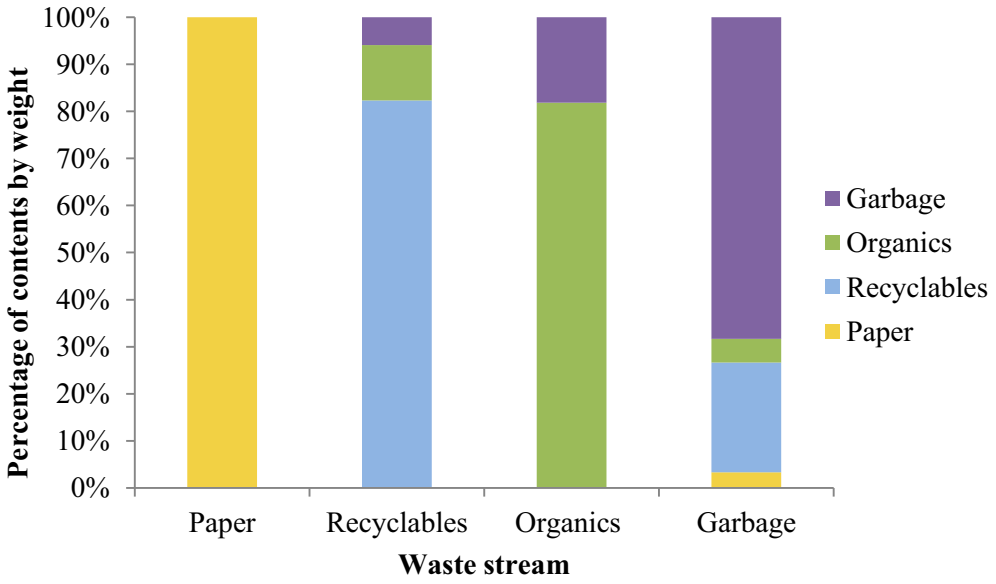

Figure 4. Percentage of each type of waste in the waste streams of the four-bin system located in a first floor lobby in the Chemistry Building, based on an audit conducted on Friday, March 23, 2012, at 8:30 am. All contents that do not match the identified waste stream are considered to be contaminants.

After implementing changes to the bin placement as well as the signage, improvements in the percentage of contamination in some bins was observed, although some bins did not show an improvement at all. Most improvements occurred in the Computer Science building. Recyclables was the most improved waste stream overall. The second audit in the classroom in the Computer Science building showed an improvement in the contamination of the garbage stream, although there was a slight increase in contamination in the recyclables stream (Figure 5).

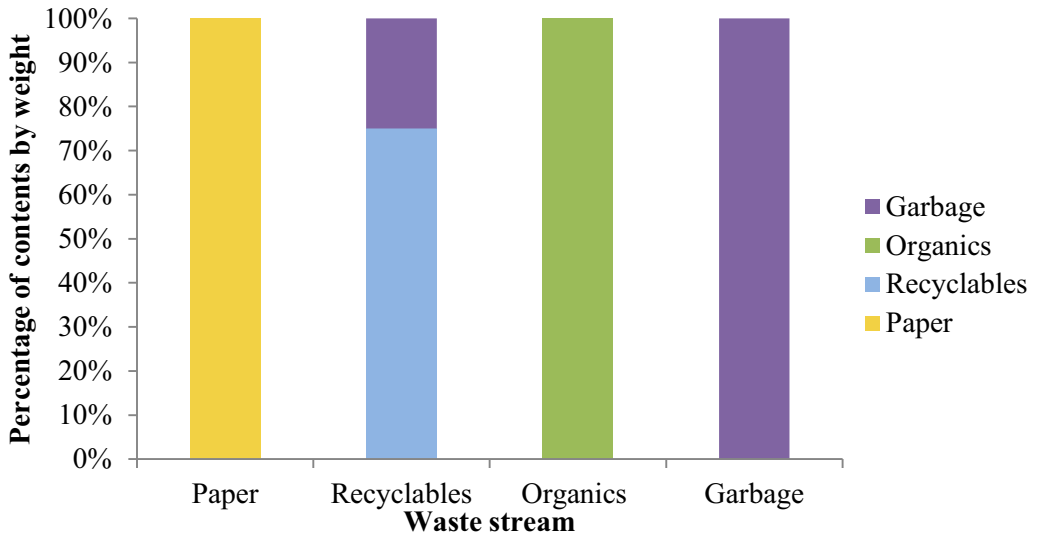

Figure 5. Percentage of each type of waste in the waste streams of the four-bin system located outside Classroom 127 in the Goldberg Computer Science building after implementing bin placement and design changes (Tuesday, March 27, 2012, at 2:30 pm). All contents that do not match the identified waste stream are considered to be contaminants.

After changes were made in the lobby of the Computer Science building, there were improvements in percentage contamination of the recyclables stream, and the garbage stream, as the percentage of garbage that was properly placed in the bin increased from 26% to 44%. The composition of the contaminations in the second lobby audit was different, however, changing from primarily organics to a mixture of paper and recyclables (Figure 6).

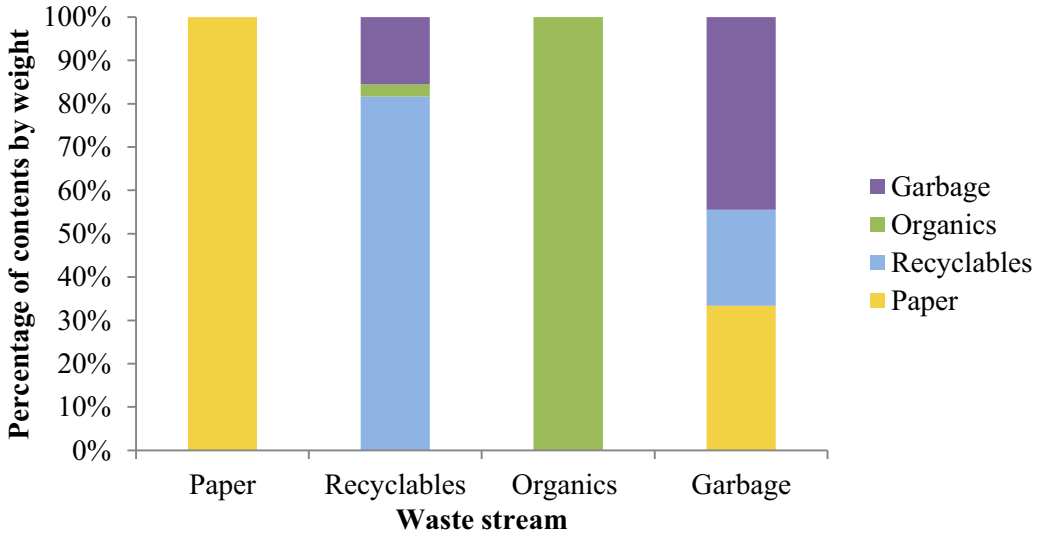

Figure 6. Percentage of each type of waste in the waste streams of the four-bin system located in the main floor lobby in the Goldberg Computer Science building after implementing placement and design changes (Tuesday, March 27, 2012, at 2:30 pm). All contents that do not match the identified waste stream are considered to be contaminants.

In the Chemistry building, the second audit outside the classroom showed an increase in the contamination of the garbage, as well as the paper streams, although there was an improvement in the contamination of the recyclables stream (Figure 7).

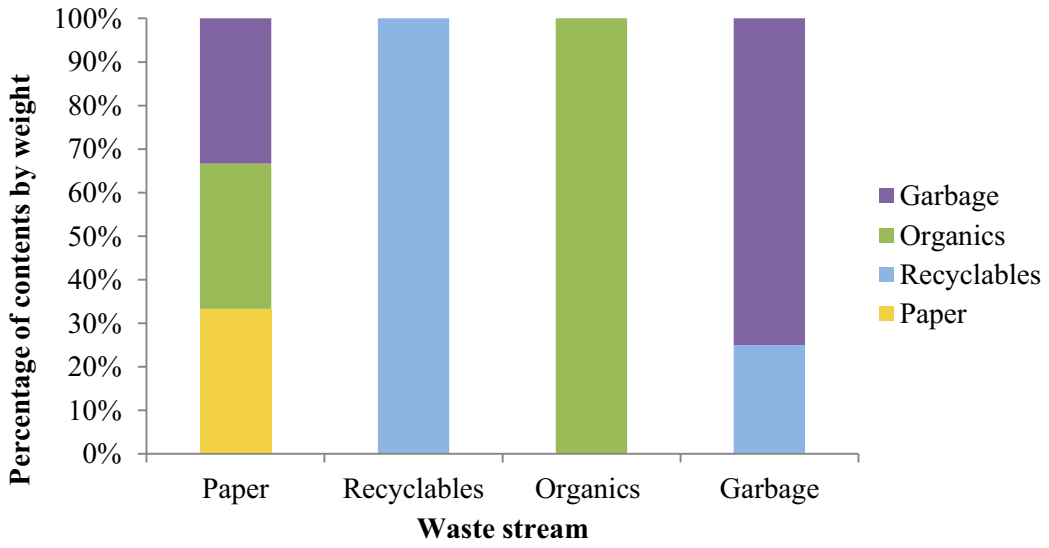

Figure 7. Percentage of each type of waste in the waste streams of the four-bin system located outside Classroom 125 in the Chemistry Building after implementing placement and design changes (Wednesday, March 28, 2012, at 8:30 am). All contents that do not match the identified waste stream are considered to be contaminants.

In the Chemistry lobby, the contamination of garbage stayed approximately the same, and the other streams showed a decline in waste diversion, with the exception of the recyclables stream. The composition of the contamination in the garbage bin also changed to be composed of entirely organics (Figure 8).

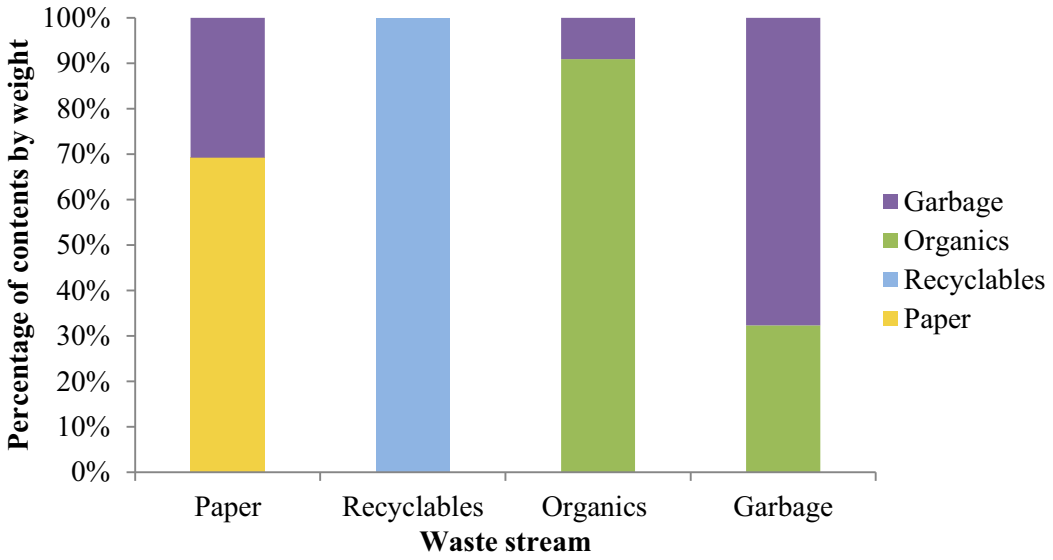

Figure 8. Percentage of each type of waste in the waste streams of the four-bin system located in a first floor lobby in the Chemistry Building after implementing placement and design changes (Wednesday, March 28, 2012, at 8:30 am). All contents that do not match the identified waste stream are considered to be contaminants.

5.0 DISCUSSION

5.1 Overview of Significant Findings

The results from the student and custodial surveys indicated that an issue with the four-bin system is the location and limited number of bins. Another issue outlined was that of signage design, as the signs are not big enough, according to the custodial staff, and sometimes difficult to understand, as indicated by student responses.

Improvements in waste diversion were observed as a decrease in contamination in a particular waste stream. These improvements were observed for particular streams in the after audits, which were conducted after changes were made to location and signage design. In the Computer Science classroom a decrease in contamination was found in the garbage stream. In the Computer Science lobby, a decrease in contamination was also observed in the garbage stream as well as the recyclables stream.

In the Chemistry Building classroom a decrease in contamination in the recyclables stream was observed. In the Chemistry Building lobby a decrease in contamination was also observed for the recyclables stream.

Overall, the after audits conducted in the Computer Science showed the most improvements, with the recyclables being the most improved waste stream in both buildings.

5.2 *Research in Light of Existing Studies*

A study conducted in 2008 by former ENVS/SUST 3502 students yielded similar results to our study. They conducted waste audits in the Killam Library and Student Union Building. This research found that there were high levels of contamination in the garbage (Carty, et al., 2008), which is consistent with results in our study. They found that the majority of the items in the trash belonged in the organics stream. They also discovered that recyclables were not always properly sorted and were often placed into the wrong stream. Their survey results indicated that students were often confused about which stream was appropriate for their waste. Our study had similar findings in that organics were identified to be the primary contaminant in garbage bins. As well, approximately half of the students surveyed were sometimes confused about where to put their waste. Additional feedback from our surveys indicated that students wanted improved signage on the bins and an increase in the numbers of bins around campus, and that the students' biggest barrier to using the bins was the difficulty of locating them

A previous study presented garbage audit results from 2008-2011 (Dalhousie University Office of Sustainability, 2011). This research focused on a residence and academic building. It was found that in both Risley Hall and the Rowe Management Building, the garbage and organics streams had the highest contamination rates.

Our findings indicated that the garbage stream was the most contaminated, which is similar to the audits that were previously discussed. When we interviewed the custodial staff, they agreed that improved signage and bin placement would help to improve the waste management system. Findings from this study showed improvements in some areas after implementing changes to bin placement and design. These improvements could be attributed to the fact that the improved signage and bin location does play a role in promoting waste diversion. Previous studies have stated that the strategic placement of bins, as well as clear signage are important factors to consider when attempting to increase rates of waste diversion (Stantec Consulting Ltd., 2009). Although improvements were not consistent with all streams of waste in all areas, our findings suggest that with further research over a longer period of time, bin placement and design can play a significant role in waste diversion, as suggested in other literature.

In conclusion, there is ample evidence to suggest that there is still much work to be done in terms of bin placement, as well as creating new signage that will help individuals to easily understand which items belong in which bins.

5.3 *Implications of the Research*

Overall, this study showed some improvements in waste diversion as a result of changing bin location, as well as implementing improved signage. Further research should attempt to examine the effects of these factors on waste reduction and diversion. With further research in this subject area, Dalhousie could potentially determine a standard for bin placement, design, and signage that results in optimal waste diversion rates.

This study suggests that bin location and design is a strategic action to consider when looking to improve waste diversion. Changing the location of bins is a simple and inexpensive way to increase diversion. In addition, implementing clearer signage is also a relatively inexpensive way to improve the existing system.

As previous studies have described waste minimization to be one of the fundamental principles of sustainability (Henson, et al., 2007), it is important to study different methods that attempt to reduce waste and divert materials that could otherwise be recycled or composted. Not only does the diversion of waste lessen negative environmental impacts, but it can also result in the reduction of costs incurred through the garbage disposal process (Toronto Solid Waste Management Services, 2011).

6.0 CONCLUSION

6.1 *Recommendations for Actions*

Although it would be ideal to have a standard four-bin system location, design, size, and signage created for each of the two areas this report focused on (lobby and classroom), this is difficult to create with different circumstances in every building. Different buildings have different designs and layouts, which makes it challenging to apply a standard to all buildings on campus. Also, the lobbies in the Computer Science and Chemistry buildings have a different population of students using them every day. Students from diverse departments may have different behaviours and actions when disposing their waste. Time also has an influence; if

students are in a rush when passing by the four-bin systems, they are less likely to take time to sort their waste. There are many factors that manipulate how often and why students and staff sort their waste properly so it is difficult to account for everything.

Regardless of whether the four-bin system is in an optimal location, in a proper arrangement (PROG) with extensive signage, there could still be contamination in the four streams, not due to the characteristics of the bins, but the people who use the bins. To find the optimal location of the four-bin system in each of these locations, more attempts need to be made in changing the placement the four-bin system around and observing what effect this has on waste diversion. As well, making the signage more detailed in each attempt could help to decrease contamination.

More accurate recommendations could be made when many more tests have been done in these specific lobbies and classrooms of the Chemistry and Computer Science buildings. Until then, it is recommended that Dalhousie place the four-bin systems in high traffic areas where the bins will be visible. In the Chemistry Building lobby (first floor near the back entrance of the Dunn Parking Lot), waste diversion could be improved if the four-bin system was moved from behind the leather chairs (low visibility) to the location seen in Appendix 3 (Figure 11). This new location, along with the improved signage used and an optimal arrangement (PROG), makes the bins more visible and accessible to individuals passing by. Removing the single garbage bins from Chemistry Room 125 and Computer Science Room 127 and adding additional signage of where the nearest bins are located (Appendix 3, Figure 10) could help to motivate students to hold onto their waste. Finally, changing the order of the bins in the Computer Science lobby (Level 2, closest to the stairs) and adding improved signage could also increase diversion (Appendix 3, Figure 12).

It is strongly suggested that more research be done to find the optimal location for the four-bin system in each lobby and classroom on campus. It is important that the four-bin system be placed in areas of high visibility, high traffic, and contain all the information necessary for individuals to sort their waste properly. The waste categories of HRM are constantly changing and the current four-bin systems in place do not have proper signage indicating which stream to place many of the materials found on campus. Items such as waxy food wrappings and Tim Horton's bags often get mistaken for Paper Recycling when in fact they are both garbage. It would be beneficial to have signage including materials that are commonly sold on campus.

It has been shown that individuals spend on average less than five seconds viewing signage in place for waste management (Stantec Consulting Limited, 2009). This suggests that improved signage needs to be simple, contain graphics and depict what goes in each stream of waste. There are many techniques for signage that have been used in efforts to increase waste diversion. Some of these include using a minimal amount of text, using symbols whenever possible instead of text (important for multilingual areas), and identifying items that usually stem confusion (coffee cups) (Stantec Consulting Limited, 2009). It is important to note that Dalhousie houses a community which welcomes diverse cultures from around the globe; therefore, it is important that this be taken into consideration when creating improved signage.

There are three very important influences that Dalhousie can use to its advantage to increase waste diversion. This includes increasing visibility and improving location of four-bin systems to ensure they are in high traffic areas, creating a standard order for all bins on campus– Paper, Recycling, Organic, Garbage (PROG), and lastly improving signage on or near the four-bin systems to have available for individuals who are not aware of how to properly sort their waste.

6.2 *Recommendations for Further Research*

From the combination of the student and custodial staff surveys and the before and after waste audits carried out in the Goldberg Computer Science and Chemistry buildings at Dalhousie University, some improvements have been recommended to improve the waste diversion in these particular areas on campus based on the results obtained. It is necessary for further research in order to explore the area of waste diversion at Dalhousie University in both lobby and classroom areas, as well as other areas and buildings.

It would benefit Dalhousie if more research was conducted identifying how changes and improvements in bin location, design, and signage increased waste diversion. Longer waste audits should be performed in the classrooms and lobbies of these two buildings and more surveys should be conducted to determine what would motivate students and staff to change their behaviours. Having long-term waste audit results could help to optimize existing four-bin systems rather than purchasing new unnecessary bins. In order for Dalhousie to achieve its targeted 75% waste diversion rate to increase sustainability on campus, further research in

buildings such as the Life Sciences Center and Tupper Building, which currently lack appropriate waste management systems, is necessary.

Based on the student surveys, it was found that a lot of students suggested they could either not find the proper four-bin system when they needed one, or they did not know how to properly sort their waste. It would be beneficial for Dalhousie to create a policy requiring that in every first year class, students are given a guest lecture on waste and waste management on Dalhousie campus and in Halifax Regional Municipality, as many students come from different locations outside of Nova Scotia. This is a global issue, and an idea as simple as this could leave a lifelong impression on students, perhaps changing their habits. It would also be important to examine educational initiatives to motivate students and staff to change their behaviours when properly sorting their waste on campus and in their everyday lives. This could potentially increase sustainability on a campus-wide scale. More must be conducted regarding human behaviour, so that it can be determined why people do not take the time to properly sort their waste. This cognitive research could help to establish ways to encourage people to sort their waste.

It is crucial that further research regarding the waste management systems at Dalhousie be performed. Not only would these opportunities of research promote sustainability on Dalhousie's campus, but they may also provide ideas for other universities or communities. There is a need for global change on the issue of waste diversion and overconsumption. Individuals turn to academic institutions such as Dalhousie University for leadership and innovation in many areas of research. Dalhousie should use this privilege to attempt to create a societal change in thoughts and behaviours regarding waste disposal and more sustainable lifestyles. This could reduce an enormous amount of waste even in the local community. Actions and innovation are needed to create global change which is crucial to sustain the Earth for future generations and wildlife.

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8.0 ACKNOWLEDGEMENTS

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Chad Hiscock, Waste Management Projects Officer, Office of Sustainability
Gary Gaudet, Facilities Management Supervisor
Joanne Marion, Facilities Management Supervisor
Student and custodial staff survey participants

9.0 APPENDICES

APPENDIX 1: STUDENT SURVEY

Student Survey: Four-bin System at Dalhousie

*The four-bin waste disposal system at Dalhousie includes the Garbage, Recyclables, Paper/Cardboard and Organic bins that are grouped together around campus.

Are you aware of the waste management system at Dalhousie (ie. The four-bin system)?

a) Yes
b) No

If you had an apple core, which stream of waste would you place it in?

a) Garbage
b) Organics Bin
c) Recyclables
d) Whichever is closest to me

If there was only a garbage can beside you and you had a plastic bottle, how far would you walk to place it in the Recyclable Bin?

a) I would throw it in the garbage bin
b) Across the Room
c) Somewhere within the same building
d) I would keep it with me until I saw a Recycling Bin
e) Other: _____

If you do not use the four-bin system, why is this?

a) I always use the four-bin system
b) I don't know how to properly separate my waste into the bins
c) I cannot find one when I need it
d) Unmotivated

Are you ever confused about which items go in which bin?

a) Yes
b) No
c) I haven't noticed

Do you find the signs on the bins are easy to understand to help you separate waste?

a) Yes
b) No
c) I don't use them
d) I haven't noticed

Do you have any comments/recommendations for ways we can improve the waste management system at Dalhousie?

APPENDIX 2: CUSTODIAL STAFF SURVEY

Custodial Staff Survey: Four-bin System at Dalhousie

*The four-bin waste disposal system at Dalhousie includes the Garbage, Recyclables, Paper/Cardboard and Organic bins that are grouped together around campus.

Do you find the current four-bin system to be effective for waste diversion?

a) Yes
b) No
c) I don't know

What factors about the four-bin system listed do you think could be improved?

a) Signage
b) Location/placement of bins
c) Bin design
d) Other: (Please specify) _____

Do you think that reducing the size of the organics bin would be an improvement to the current system?

a) Yes
b) No

Why? _____

Do you think students leaving their garbage on the desks, ground, tables, etc. is common at Dalhousie?

a) Yes
b) No

Explain: (ie. where is this a problem?)

_____

Do you have any suggestions for improvements?

_____

APPENDIX 3: IMPROVEMENTS

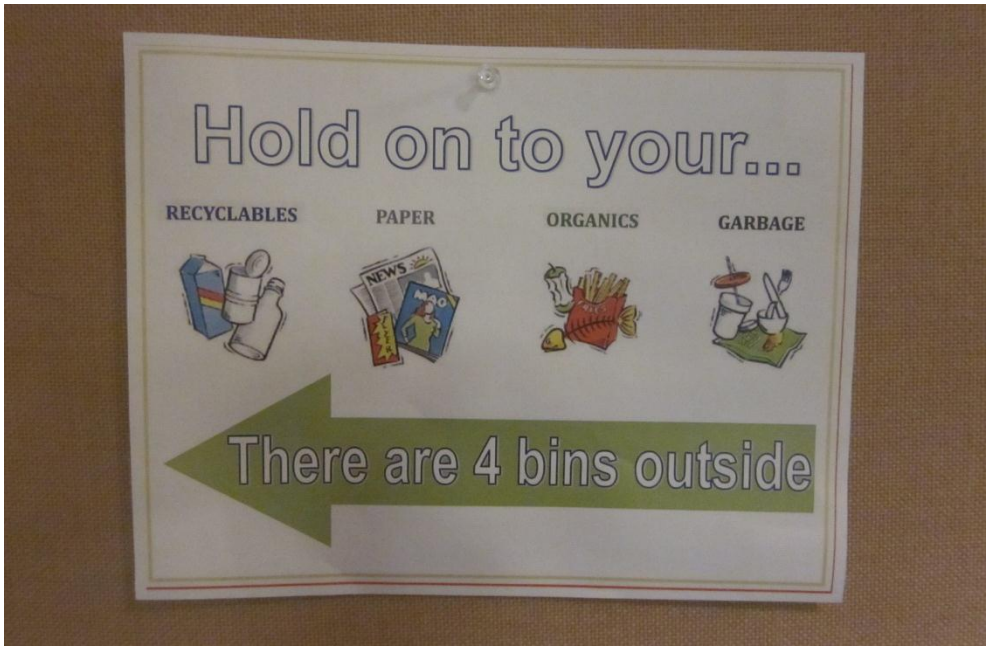

Figure 9. Photograph of sign placed in Classroom 125 in Chemistry Building and Classroom 127 in Computer Science Building, indicating that four-bin system is outside.

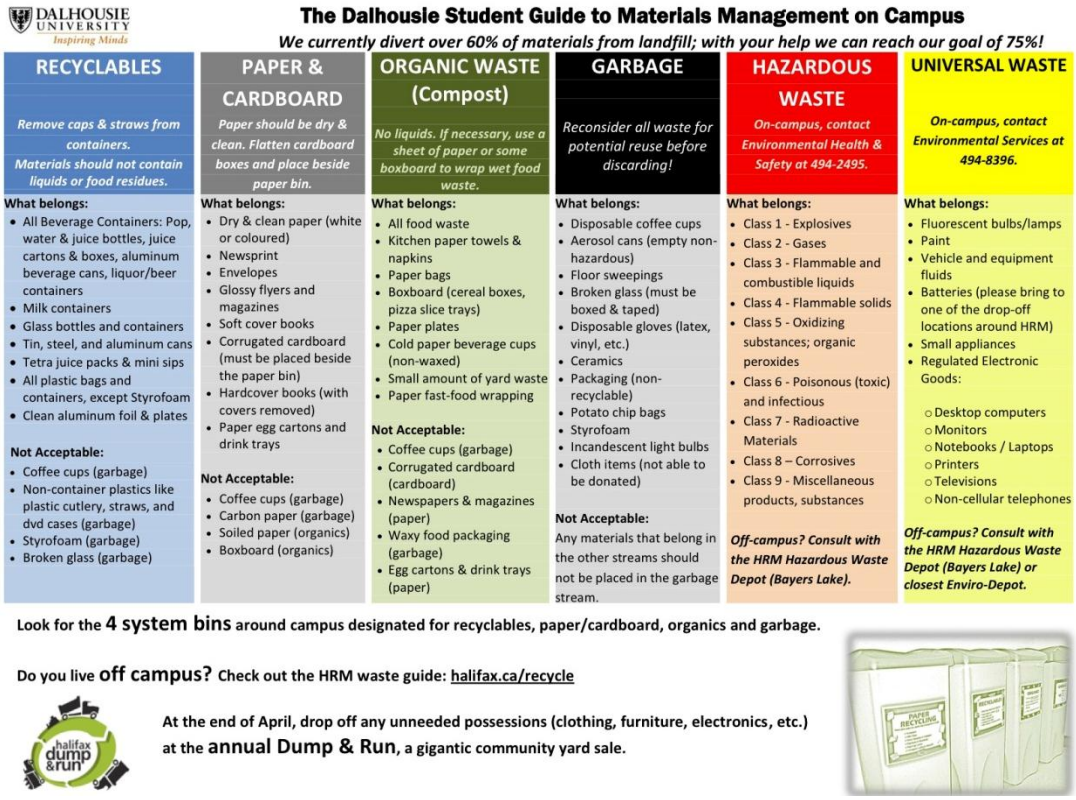

Figure 10. Photograph of sign placed above each four-bin system in both Chemistry and Computer Science buildings depicting which items belong in each stream of waste.

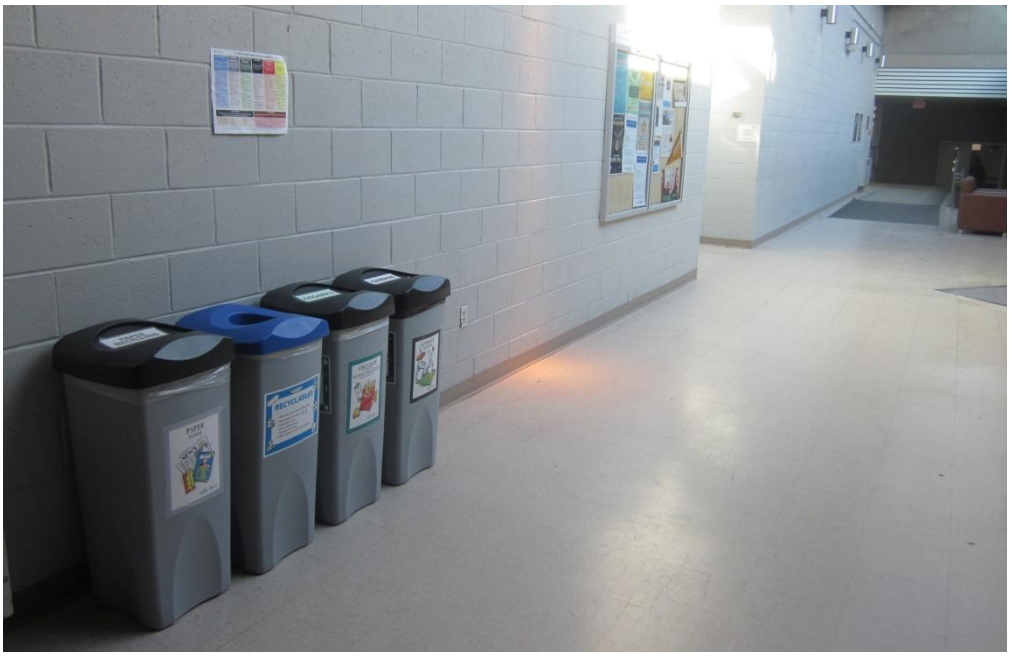

Figure 11. Photograph of improved location and signage of the four-bin system in the Chemistry Lobby.

Figure 12. Photograph of improved order and signage of the four-bin system in Computer Science Lobby.

APPENDIX 4: ETHICS PROPOSAL

ENVIRONMENTAL SCIENCE PROGRAM
FACULTY OF SCIENCE
DALHOUSIE UNIVERSITY

APPLICATION FOR ETHICS REVIEW OF RESEARCH INVOLVING HUMAN PARTICIPANTS
UNDERGRADUATE THESES AND IN NON-THESIS COURSE PROJECTS

GENERAL INFORMATION

1. Title of Project: Effective Placement and Design of the Four-Bin Waste Disposal System in Lobby and Classroom Areas at Dalhousie University

2. Faculty Supervisor(s): Rochelle Owen **Department:** Environmental Science and Sustainability
E-mail: rjowen@dal.ca

3. Student Investigator(s):	**Department:**	**E-mail:**	**Phone:**
Jillian Arany	Marine Biology	jl246747@dal.ca	902-293-6435
Alyssa Boivin	Environmental Science	al533703@dal.ca	902-880-0269
Samantha Halloran	Environmental Science	sm337305@dal.ca	902-789-9134
Joanna Poltarowicz	Environmental Science	jn288718@dal.ca	902-401-2016
Angie Ricketts	Environmental Science	an754532@dal.ca	902-293-1383

4. Level of Project: Non-thesis Course Project [X] Undergraduate [ ] Graduate [ ]
Specify course and number: ENVS/SUST 3502: Campus as a Living Lab

5. a. Indicate the anticipated commencement date for this project: March 8, 2012
b. Indicate the anticipated completion date for this project: April 13, 2012

SUMMARY OF PROPOSED RESEARCH

1. Purpose and Rationale for Proposed Research: *Briefly describe the purpose (objectives) and rationale of the proposed project and include any hypothesis(es)/research questions to be investigated*

Objectives:

- To find the best signage for the four- bin system in the Computer Science and Chemistry buildings
- To find the best location for the four- bin system outside of a classroom and in the foyer/lobby of the Computer Science and Chemistry buildings
- To determine if there is an improvement in the contamination when a single garbage bin is replaced with a four- bin system outside of a classroom

- To survey custodial staff and students to find out the reasons for contamination, their ideas for improvements for the waste disposal program at Dalhousie, and any issues they may see with the current system

Rationale:
This particular research project intends to examine the effects of bin placement on waste diversion rates in select areas of two buildings on campus: the Goldberg Computer Science building, and the Chemistry building. This study aims to determine optimal locations for the placement of four-bin waste disposal systems, as well as to determine optimal signage for waste disposal sites.

Hypothesis:
We hypothesize that when areas outside classrooms and in lobbies have a four-bin system that is properly labeled and placed in an easily noticeable location, the contamination rate will decrease.

Research question:
Does the placement and design of the four-bin system improve waste diversion and decrease waste stream contamination in classrooms and lobbies in the Goldberg Computer Science Building and the Chemistry Building at Dalhousie University?

2. Methodology/Procedures
a. ***Which of the following procedures will be used? Provide a copy of all materials to be used in this study****.*
[ ] Survey(s) or questionnaire(s) (mail-back)
[X] Survey(s) or questionnaire(s) (in person)
[ ] Computer-administered task(s) or survey(s)]
[ ] Interview(s) (in person)
[ ] Interview(s) (by telephone)
[ ] Focus group(s)
[ ] Audio taping
[ ] Videotaping
[X] Analysis of secondary data (no involvement with human participants)
[ ] Unobtrusive observations
[ ] Other, specify _____

b*. **Provide a brief, sequential description of the procedures to be used in this study**. **For studies involving multiple procedures or sessions, the use of a flow chart is recommended.***

Literature → First Meeting with client → Background research → Preliminary proposal due → Survey (students) → Survey (Custodial staff) → Waste audit (before changes) → Audit (after changes) → Analysis of data → Recommendations

3. Participants Involved in the Study: ***Indicate who will be recruited as potential participants in this study.***

Dalhousie Participants:
[X] Undergraduate students
[X] Graduate students
[X] Faculty and/or staff

Non-Dal Participants:
[ ] Adolescents
[ ] Adults
[ ] Seniors
[ ] Vulnerable population* (e.g. Nursing Homes, Correctional Facilities)

** Applicant will be required to submit ethics application to appropriate Dalhousie Research Ethics Board*

b. ***Describe the potential participants in this study including group affiliation, gender, age range and any other special characteristics. If only one gender is to be recruited, provide a justification for this.***

Potential participants for the survey we wish to distribute are male or female Dalhousie students, most likely in their undergraduate. Their age range could vary as Dalhousie has a selection of students, but the majority will most likely between the ages of 17-30 years old. We are also surveying custodial staff who are employed by Facilities Management who could be male or female but likely with a higher age range than students.

c. ***How many participants are expected to be involved in this study?*** 20-100

4. Recruitment Process and Study Location

a. ***From what source(s) will the potential participants be recruited?***
[X] Dalhousie University undergraduate and/or graduate classes
[X] Other Dalhousie sources (specify) **Custodial Staff**
[ ] Local School Boards*
[ ] Halifax Community
[ ] Agencies
[ ] Businesses, Industries, Professions
[ ] Health care settings*
[ ] Other, specify (e.g. mailing lists) _____ *

Applicant may also require ethics approval from relevant authority, e.g. school board, hospital administration, etc.

b. ***Identify who will recruit potential participants and describe the recruitment process.*** *Provide a copy of any materials to be used for recruitment (e.g. posters(s), flyers, advertisement(s), letter(s), telephone and other verbal scripts in the appendices section.*

Participants for the survey will be selected randomly based on a volunteer basis. Custodial staff will be approached and asked to complete a survey. Surveyed individuals will be approached by our team members. They will be told what the survey is for, approximately how long it will take and asked for permission to conduct the survey.

5. Compensation of Participants*:* Will participants receive compensation (financial or otherwise) for participation?
Yes [ ] No [X]
If **Yes**, provide details:

6. Feedback to Participants
Briefly describe the plans for provision of feedback and attach a copy of the feedback letter to be used. **Wherever possible, written feedback should be provided to study participants including a statement of appreciation, details about the purpose and predictions of the study, contact information for the researchers, and the ethics review and clearance statement.**
Note: When available, a copy of an executive summary of the study outcomes also should be provided to participants.

There will no forms of feedback administered to the participants; however, they will have access to view our final report on the Environmental Science website under "Research – Past ENVS 3502 Projects".

POTENTIAL BENEFITS FROM THE STUDY

1. Identify and describe any known or anticipated direct benefits to the participants from their involvement in the project.

The participants will benefit by knowing that they helped out on a project that could contribute to the environmental sustainability at Dalhousie University, and knowing they helped to possibly improve waste diversion at Dalhousie.

2. Identify and describe any known or anticipated benefits to society from this study.

If this study shows an improvement in waste diversion, it could benefit Dalhousie since the University would be closer to achieving their goal of having a more sustainable campus. It could also reduce costs from waste disposal. This study could also be helpful to other schools or communities.

POTENTIAL RISKS TO PARTICIPANTS FROM THE STUDY

1. For each procedure used in this study, provide a description of any known or anticipated risks/stressors to the participants. Consider physiological, psychological, emotional, social, economic, legal, etc. risks/stressors and burdens.

[ ] No known or anticipated risks
[X] Minimal risk * **Description of risks**: Explain why no risks are anticipated: No more risk than they would expect to experience in their everyday life.
[ ] Greater than minimal risk** **Description of risks:**

***** *This is the level of risk associated with everyday life. ** This level of risk will require ethics review by appropriate Dalhousie Research Ethics Board*

2. Describe the procedures or safeguards in place to protect the physical and psychological health of the participants in light of the risks/stresses identified in Question 1.

There is no foreseen risk and survey questions are designed to inflict no more emotional stress than the participant would obtain from their normal everyday life.

INFORMED CONSENT PROCESS
Refer to: http://pre.ethics.gc.ca/english/policystatement/section2.cfm**;**

1. What process will be used to inform the potential participants about the study details and to obtain their consent for participation?
[ ] Information letter with written consent form; provide a copy
[ ] Information letter with verbal consent; provide a copy
[ ] Information/cover letter; provide a copy
[X] Other (specify): **verbal**

2. If written consent cannot be obtained from the potential participants, provide a justification.

The survey in this study is a quick survey expecting to take no more than five minutes of the participants' time to complete. We believe it is more reasonable to explain the survey verbally and ask for their consent rather than have them read over a form and sign it, creating unnecessary waste.

ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF DATA
1. Explain the procedures to be used to ensure anonymity of participants and confidentiality of data both during the research and in the release of the findings.

The results of the surveys of students and the custodial staff will be kept confidential; only the student investigators will have access to use it for results of paper. There is no personal information asked on the surveys. In the research paper the results are the overall results that we found, no individual surveys are mentioned.

2. Describe the procedures for securing written records, questionnaires, video/audio tapes and electronic data, etc.

Data will be taken from surveys and entered into excel. The paper surveys will be kept by a student investigator until the end of the course and then shredded. The electronic data will remain on a student investigator's laptop until the end of the course when it will be deleted.

3. Indicate how long the data will be securely stored as well as the storage location over the duration of the study. Also indicate the method to be used for final disposition of the data.

[X] Paper Records
[ ] Confidential shredding after _____
[X] Data will be retained until completion of specific course.
[ ] Audio/Video Recordings
[ ] Erasing of audio/video tapes after _____
[ ] Data will be retained until completion of specific course.
[X] Electronic
[ ] Erasing of electronic data after _____
[X] Data will be retained until completion of specific course.
[ ] Other _____

(Provide details on type, retention period and final disposition, if applicable)

Specify storage location: individual laptops of student investigators

Appendices: ATTACHMENTS Please **check** below all appendices that are attached as part of your application package:

[ ] **Recruitment Materials**: A copy of any poster(s), flyer(s), advertisement(s), letter(s), telephone or other verbal script(s) used to recruit/gain access to participants.
[ ] **Information Letter and Consent Form(s)**. Used in studies involving interaction with participants (e.g. interviews, testing, etc.)
[ ] **Information/Cover Letter(s)**. Used in studies involving surveys or questionnaires.
[X] **Materials**: A copy of all survey(s), questionnaire(s), interview questions, interview themes/sample questions for open-ended interviews, focus group questions, or any standardized tests used to collect data.

SIGNATURES OF RESEARCHERS

Signature of Student Investigator(s) Date Feb. 28, 2012
Signature of Student Investigator(s) Date Feb. 28, 2012
Signature of Student Investigator(s) Date Feb. 28 2012
Signature of Student Investigator(s) Date Feb. 28th 2012
Signature of Student Investigator(s) Date Feb 28th 2012