

Waste Management at Dalhousie University, Canada: Social Factors Affecting Recycling Behavior and use of the Four Bin System at the Studley Campus



ENVS 3502

April 10th 2018

Group members: **Laura Smith, Jessica Tam, Phil Martel, Jeremy Holleran**

Table of Contents

1.0 Executive Summary.....2

2.0 Introduction.....3

 2.1 Background.....3

 2.1.1 Global Waste Management.....3

 2.1.2 Waste Management at Dalhousie University.....4

 2.2 Waste Management at Universities: Past Research.....4

 2.3 Research Question.....5

 2.4 Goals and Objectives.....6

 2.5 Purpose.....6

3.0 Research Methods.....7

 3.1 Data collection.....8

 3.2 Interviews.....8

 3.3 Limitations.....8

4.0 Results.....9

5.0 Discussion.....11

 5.1

Findings..... 11

 5.2 Prior Research.....12

 5.3 Implementation.....12

6.0 Conclusion.....13

Acknowledgements.....14

References15

Appendix A oral consent script.....19

Appendix B Interview questions.....10

Appendix C Organic Audit.....19

Appendix D Garbage Audit.....20

Appendix E Compliance Data.....20

1.0 EXECUTIVE SUMMARY

In this paper, we outline and explore student behaviour and habits toward the four-bin waste management system implemented at Dalhousie University. The purpose of the four-bin waste management system is to better manage and mitigate the amount of solid waste produced by Dalhousie and to also make the choice easier for students and faculty when throwing out their waste. Making Dalhousie greener has always been an important goal while moving forward. Increasing waste diversion from landfills will reduce environmental impacts and costs (Reeder, M. 2015).

The four-bin waste management system is just one of many ways that Dalhousie has committed to improving overall university standards and becoming a greener, more sustainable work environment for everyone that calls Dalhousie their home. This new system will help Dalhousie staff and students comply with the waste management policy and support the university sustainability target of 70 per cent diversion from landfills by 2020 (Facilities Management and the Office of Sustainability, 2017).

Our team of students conducted this study with the hope of finding trends in student behaviour toward proper garbage disposal and waste diversion methods. When discussing options for a project, we went over many different possibilities on where we could take this research project, and collectively felt that this is an issue that affects everyone on campus. We collected our observation and survey data in the student union building, in order to incorporate people with different backgrounds. After performing a chi squared test we found that there is a significant difference between people that did comply with the four bin system and people that did not. Through our analysis we also found that the main reason for non compliance was people not caring. Our research confirms that there is still work to be done in waste diversion and disposal on campus.

2.0 INTRODUCTION

2.1 Background

2.1.1 Global Waste Management

Solid waste management (SWM) and post-consumer waste is a global issue as rising population urbanisation of global landscapes is linked to waste generation (IPCC, 2007). It has been predicted that the amount of waste produced on a global scale will rise to 2.2 billion tonnes by 2015 (Hoornweg & Bhada-Tata, 2012). Proper waste management practices have become integrated into sustainable development as outlined in ‘Goal 12’ the most recent publication of Sustainable Development Goals by the United Nations (Goal 12: Sustainable Development Knowledge Platform, 2017).

Not incorporating sufficient management practices into global communities can lead to a variety of environmental, social, and economic consequences. In 2010, the Intergovernmental Panel on Climate Change (IPCC) estimated that approximately <3% of greenhouse gas emissions were sourced from the solid waste management sector which was mainly attributable to methane (CH₄) production in landfill sites (Hoornweg & Bhada-Tata, 2012). Further environmental impacts of landfilling large volumes of waste include leachate production and groundwater contamination in landfill areas El-Fadel, Findikakis & Leckie, 1997). Waste accumulation in landfills can lead to health hazards. Health implications arise from burning of waste and open landfills, which are forms of poor waste management used in communities without proper management strategies in place (Hossain, Santhanam, Nik Norulaini & Omar, 2011). Not effectively managing waste results in a subsequent increases in expense rates through use of mitigation technologies as opposed to developing waste management systems beforehand (Hoornweg & Bhada-Tata, 2012).

Source separation of waste into multiple waste streams has been identified as a successful method to improve the quality of waste for more effective recycling, and reducing contamination between waste streams (UNEP, 2015). Segregating waste through bin separation systems can divert waste from landfill and contribute to lessening the severity of associated landfill effects

(Solid Waste Management, 2018). The Halifax Regional Municipality (HRM), Canada has produced By-law 600 which identifies bin standards and separation expectations. These apply to Dalhousie University's Waste Management System for waste separation (Dalhousie University Office of Sustainability, 2015).

2.1.2 Waste Management at Dalhousie University

The solid waste management system at Dalhousie University is important in complying with waste diversion expectations as outlined by the HRM and reducing the university's environmental impact. Facilities Management and the Office of Sustainability at Dalhousie University have published waste bin standards for campus areas. This is part of Dalhousie's sustainability initiatives and goal in diverting 70% of waste produced on campus from landfill by 2020 (Facilities Management and the Office of Sustainability, 2017). In December of 2016, Dalhousie fully replaced previous single stream waste disposal bins with multi-waste stream systems in coordination with the implementation of Dalhousie's Waste Bin Standards. Design and placement standards were set for four-bin waste disposal systems across the university in order to increase sustainability and meet landfill diversion targets (Facilities Management and the Office of Sustainability, 2017).

2.2 Waste Management at Universities: Past Research

Research publications based on waste separation at higher educational facilities such as university's are limited, although they have been found to be one of the best ways to achieving sustainability on campus (Smyth, Fredeen & Booth, 2010). While waste bin composition has been studied in relation to bin contamination, source separation behaviour and compliance through observation has not been to the same extent (Smyth, Fredeen & Booth, 2010).

In university environments, it has been found that attitudes surrounding waste management initiatives and sustainability efforts are related to source separation. A study of universities in Beijing found that almost half of survey participants mixed their waste at the source instead of separation into multiple waste streams. They found that qualities of those more likely to participate in source separation were participants with increased environmental knowledge on

waste classification, and those with more awareness of campus waste management systems. (Zhang, Liu, Wen & Chen, 2017). A large survey study conducted in New Zealand found that positive attitudes were correlated with self-reported recycling rates (Kelly, Mason, Leiss & Ganesh, 2006). This concurs with findings of another study done on the key determinants of waste separation of university students, where attitude was a large factor in separation (Ayob & Sheau-Ting, 2016).

Concerning management improvements, previous completed research indicates that better signage, knowledge on classification of waste streams and awareness of campus waste management initiatives can influence separation behaviour (Sheau-Ting, Sin-Yee & Weng-Wai, 2016; Zhang, Liu, Wen & Chen, 2017; Kelly, Mason, Leiss & Ganesh, 2006). Past studies on waste management in universities provide valuable recommendations, but there is limited information on actual compliance levels and reasoning through behaviour through direct observation in combination with surveying.

At Dalhousie University, multiple studies have been done surrounding the four-bin waste system for source separation. In 2011, levels of compliance to the bin system were studied in the Killam Library through waste auditing. It was found that contamination existed in all bins in the Killam Library, especially coffee cups and cans (Allan, Lamarque, Liu, Scotland & White, 2011). In 2012 a study was done on the effect of the implementation of the four bin waste systems, and it was concluded that diversion rates have increased with the new system (Arany, Boivin, Halloran, Poltarowicz & Ricketts, 2012). These studies identified contamination levels and areas for improvement in the system but not an explanation toward why contamination was occurring in relation to compliance.

2.3 Research Question

This research project aims to study compliance rates at Dalhousie University, and identify reasoning for not complying with the four-bin waste disposal system that has been implemented over the last few years. Specifically, our research question is: how the four-bin waste disposal system affects student compliance and behaviour on garbage disposal at Dalhousie University in the Student Union Building.

2.4 Goals and Objectives

The primary goal of this research project is to develop an increased understanding of the use of the four-bin waste system as a route to improving solid waste management at Dalhousie University. By studying compliance levels to the four-bin waste system and reasoning for non-compliance, we hope to identify areas for improvement of this system. This can contribute in future implementation of university initiatives regarding waste management and diversion.

Through observation of use of the four-bin system in the Student Union Building and surveying university members who did not use the bins correctly, the main objective of this research project is to establish compliance levels to the system and determine reasoning for not using the bin system correctly. Through this study, areas for improvement of the success of the bin system can be identified such as potential lack of positive attitude, education on how to properly use the bins and better signage as found in previous research.

2.5 Purpose

By conducting research on compliance to the four-bin waste system, we hope the conclusions can be contributed to current available research on source separation in university environments. This study can help address gaps in knowledge regarding reasoning for not using the system correctly, as previous studies have not been done on this topic in combination with compliance observations. This research can build on research already done at Dalhousie University, because no previous studies have been completed on this topic at the Student Union Building.

Conclusions and recommendation for improvement of proper waste disposal and recycling on campus can be taken into consideration by Dalhousie in future construction of four-bin system standards. Findings from this study can contribute to the development of university environmental initiatives to increase waste classification education and improve positive environmental behaviour in university populations. This can potentially help in reaching

Dalhousie's sustainability goals and associated 70% waste diversion target by 2020 (Facilities Management and the Office of Sustainability, 2017).

3.0 RESEARCH METHODS

For this project we sampled the Dalhousie staff and students in order to determine waste bin compliance and reasons for not complying on the Dalhousie studley campus. Our sampling frame was the Dalhousie staff and students. We decided to use the simple random sampling method, allowing the population to have equal probability of being chosen. This would represent the population of Dalhousie studley campus. For our sampling we decided that we would look at compliance rates in the Dalhousie student union building, 6136 University Ave, Halifax, NS B3H 4J2. We chose this building because there is a lot of foot traffic and people with a variety of degree backgrounds. We decided that the best way to collect our data was through observations and interviewing. We chose to observe people in order to gain more accurate data. Because proper garbage disposal is something people know they should be doing they may be more inclined to about what they are doing on a survey. We chose to interview people with a structured questionnaire because it would also allow participants to voice their opinions if they chose to to do so (Palys and and Atchison, 2014, p.144).

3.1 Data collection

To gain our results we observed waste bins in the student union building and how people sorted their waste. We chose to do our observations from 12 until 1 o'clock pm because this is a busier time of day, allowing us to collect more data. We observed waste disposal for 1 hour, this was then repeated three more times for a total of four hours of observations. We determined the four most used bin sorting stations in the student union building based on the amount of garbage in each station. We determined that the 4 most used bins were by booster juice, the loaded ladle, Tim Horton's and Petes to go. We sat near a waste disposal station and watched as people approached the bins. We watched one sorting station for 15 minutes, then switched to another station. We repeated this 3 more times for a total of 1 hour of observations.

In order to collect our data, we identified what people were holding and watched which bin they sorted it into. If people complied with the bin regulations, we recorded the data on a sheet of paper in the form of tallying. If people did not comply with the bin regulations, we approached them and read a brief oral consent form, stating that this would be anonymous see appendix A. We collected this data in pairs in order to ensure our interview results were recorded properly.

3.2 Interviews

If people agreed to our interview, we asked them three brief questions regarding the waste disposal system see appendix B. If people did not want to take our survey we still recorded our observation, that they did not comply with the bin regulations and left the survey portion blank. After all data was collected, the observations and survey answers were coded and input into excel. We then performed a chi squared test in order to test for independence. We also found the mean value for the amount of people that complied with the bin system and people who did not comply. The mean value was also calculated for the amount of people that said there was no issue with the current signs and the people that said there is an issue with the current signs. We chose to interview people because there would be a higher response rate. We also thought that due to the nature of our approach it would be helpful to see people's body language and how they react to these questions. Additionally, if we conducted a written survey it might have lead people to give dishonest answers if they had more time to think about what they were saying.

3.3 Limitations

A limitation to this research was that at times it was hard to determine what people were holding before they threw something out. We could not use some data because we were unsure of what the person was holding, we could only see which bin the item was thrown into. In order to determine all items, it might have been beneficial to stand directly next to the bins however, we thought people might be aware of what we were doing. Another limitation to this research is that we would have liked to collect more data. Our goal was to collect 300 observations and survey 50 people. We collected around 200 observations however, many people that did not

comply said no to the survey. Majority of people said that they were in a rush to leave and did not have the time to take the survey. In order to collect a larger sample size for the survey it would have been beneficial to do observations at different times of the day when people are not in a rush to get to class and for a longer period of time. We also would have liked to survey people that did comply to the system however, due to time restrictions we decided it would be best just to survey people who did not comply because this was the main focus of our research.

4.0 RESULTS

Based on our chi-squared statistical test The results that we found were statistically significant for the chi squared test (p-value 1.294×10^{27} at $\alpha = 0.05$). We reject our null hypothesis, meaning that there was a difference between the groups of people that complied and people that did not comply.

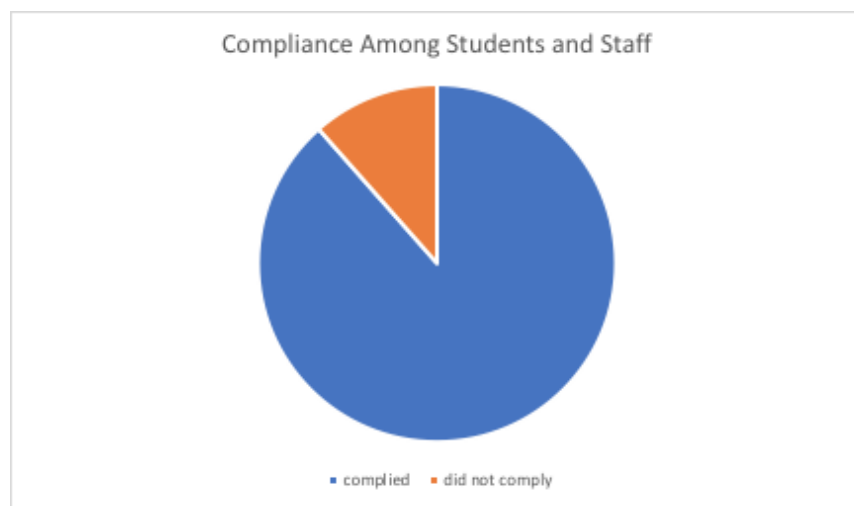


Figure 1: Dalhousie University staff and student compliance rates of the four bin system.

This pie chart depicts the compliance rate among students and staff disposing of waste in the Student Union Building, located on Dalhousie's Studley campus. We observed whether or not students complied with the new four bin garbage system which has been set up across Dalhousie campuses. The information shows that of the students observed, 88.5% of them put waste in the appropriate bins, while 11.5% did not comply with the new garbage disposal system (Figure 1).

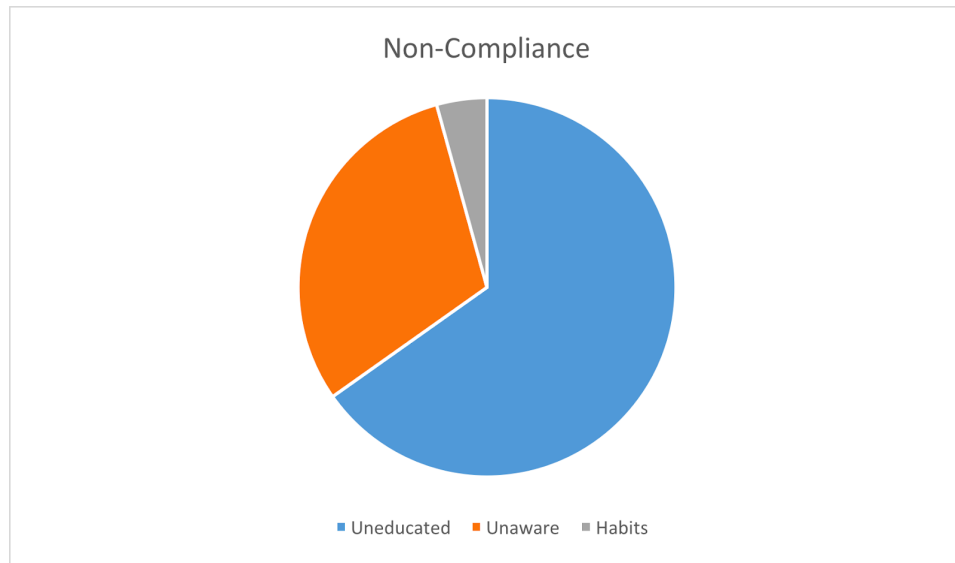


Figure 2: Reasons for non compliance to the four bin system at Dalhousie University.

This pie chart follows the previously posted chart as it takes a deeper look as to reasons for non-compliance from Dalhousie students and staff. As stated previously, there was an 88.5% compliance rate from students and staff at Dalhousie University observed throughout the Student Union Building (Figure 1). This chart breaks down the 11.5% non-compliance rate and separates it into three sections: uneducated, unaware, and habits. Of the students and staff who did not comply with the new garbage disposal system 65.22% of them were simply uneducated on the matter (Figure 2). This 65.22% of people did not properly dispose of their garbage simply because they did not know of the impacts caused by dumping garbage into landfills, they saw the signs for proper garbage disposal but disregarded them and did not sort out their trash (Figure 2). 30.48% of students and staff who did not comply with proper garbage disposal said that they had no idea they were misusing the garbage system and blamed the usage of signs surrounding the garbage bins for their misuse (Figure 2). The remaining 4.3% of non compliance was due to past habits that were formed by students or staff previous to the implementation of the four-bin garbage system (Figure 2).

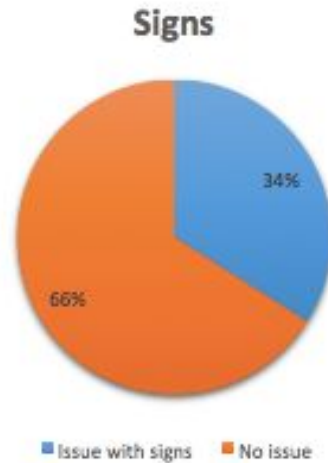


Figure 3: Non compliance rates and problems regarding waste disposal signs.

The signs above the garbage bins are often what people look at for guidance. We wanted to determine if people thought that the signs were helpful or if people thought that there needed to be improvements made. Figure 3 shows the results of our findings, of the people that did not comply with the system 66% of those people thought that the signs did not need any improvements and 34% of people thought that there needed to be improvements made.

5.0 DISCUSSION

5.1 Findings

The purpose of our research was to improve waste diversion at the Dalhousie studley campus. We also wanted to determine if modifications were needed to the current four bin system. To determine this, we looked at compliance in the student union building. Our main null hypothesis was that there is no difference between the amount of people that complied and did not comply with the bin system. Our results were statistically significant for this test and we can say there was a difference between groups. We found that 88.5% of our participants put waste in the appropriate bin and 11.5% did not comply. Of the 11.5% that did not comply we found that 66% of people did not think that there was an issue with the signs, while 34% of people that did not comply thought that there was an issue with the signs (Figure 3). The biggest reason for non compliance was that people did not care, the second reason was that people felt uneducated and the third reason was because of habits. Although the compliance rates were higher than expected

we were surprised to find that the biggest reason for non compliance was due to people not caring. In order to raise awareness and peoples concerns, we think that education is the best way to achieve this. The best way to educate people about the effects of improper garbage disposal and environmental effects would be integrating this into courses.

We can relate our findings

5.2 Prior research

Desa, A., et.al (2012) did similar research to ours, they focused more on waste education and awareness strategies. However, they found similar results to ours. Similarly to our research there was high levels of responsibility regarding the system in place. They also found that attitude and behaviour is affected by awareness and education. Our results were similar in that our compliance rates were high and of lack education was a reason for non compliance at Dalhousie.

Concerning bin contamination and waste composition, our findings are similar to previous research conducted at Dalhousie. The garbage or landfill bin was reported as being the bin that had the most contamination, related to our observations that showed recyclable and organics being put in the garbage bin or landfill bin. A previous audit at Dalhousie University found that paper napkins were one of the most misplaced items, which relate to our observations were one of the most commonly misplaced items as well (Heathcote et al., 2010). Regarding previous research at other universities, our observations are similar in that recommendations for improved compliance were better signage and knowledge on waste classification (Sheau-Ting, Sin-Yee & Weng-Wai, 2016; Zhang, Liu, Wen & Chen, 2017; Kelly, Mason, Leiss & Ganesh, 2006).

5.3 Implementation

In a study conducted on employee behaviour in Dalhousie kitchens, Maguire (2012) found that garbage bins were often contaminated with paper napkins. During our observations we observed the same trend. The signs above the compost bins have a picture of napkins and the bins also have a sign reading that paper towel and food napkins are compostable. This indicates

that there may not be an issue with what is being depicted on the signs. This is more of an issue with people not taking the time to look and see where things go. This also points to a lack of education because people may not understand the environmental impacts of improperly disposing waste. It might also be beneficial to place the bins in a different arrangement rather than a straight line. Attardo et. al (2001) found that during their evaluation of bin programs along highway rest stops, contamination rates were lower when other bins were placed in a semi-circle behind trash cans over all bins in a straight line.

Although the compliance rates were high, from our observations we know that there are specific items such as Mezza containers that are often placed in the wrong bin. In areas with trends such as this there should be specific signs that relate to what is being sold. Near mezza there should be signs that direct people to throw out the black containers in the recycling bin. Additionally, we noticed that on some bins there was a small advertisement for the Halifax Recycles app. This app would benefit many people if they were unsure of where their waste goes. Dalhousie should promote this app by enlarging the advertisement on the bins or posting signs near the bins. Many Dalhousie staff and students are from out of the province. This app would be beneficial for people that are unfamiliar with the Halifax waste sorting system. This app was extremely helpful when we were conducting our observations, if we were unsure of any items we used the app to help us. Another way to teach Dalhousie staff and students about proper waste disposal would be to have a brief course on Brightspace that must be completed, in order to remind people where things should be sorted.

6.0 CONCLUSION

The research conducted, and conclusions found in this paper are an important stepping stone to improving Dalhousie's efforts in mitigating solid waste and finding greener alternatives in waste diversion. The goal, ultimately, is to use our results to find out why students might not comply with the four-bin system and adapt current methods to meet needs of faculty and students alike. This study can be seen as an added contribution to sustainability initiatives laid out by Dalhousie University to improve existing waste management systems and hopefully implement new ones.

Since the majority of people that participated in our survey did comply, we can conclude that the four-bin system is adequately doing its job. However, it has also been noted that the people that did not comply with the four-bin system replied that they either “didn’t care enough” or that they weren’t “educated enough on the topic.” This leaves space for improvement, that Dalhousie should act on. A possible solution to this gap in compliance, could be to further educate students in all faculties regarding waste management to avoid confusion in the future.

As Dalhousie continues to grow in student population, waste management is an issue that will continue to grow with it, meaning it will be too hard to mitigate if this problem doesn’t receive adequate attention. In order to change this, it rests upon the shoulders of students and faculty to make the right choices when throwing out their waste. And the school’s administration to implement new strategies, such as educational programs and improved signs in specific areas. We also recommend more extensive research into waste management and behaviour here at Dalhousie, so that we can take an active stance in mitigating the issue and stay committed to our goals.

Acknowledgements

Special thanks to the office of sustainability and Rochelle Owens for providing waste audit data on the Dalhousie campus. We would also like to thank all of the Dalhousie staff and students that participated in our research and allowed us to interview them. Finally, we would like to thank our professor Amy Mui and our Ta, Romeet for all of their guidance along the way.

References

Adomavičiūtė, T., Kruopienė, J., Varžinskas, V., & Gorauskienė, I. (2012, December 10). Waste sorting Habits by the community of Kaunas University of Technology, Reasons and Influencing Factors. April 5, 2018, <http://dx.doi.org/10.5755/j01.arem.62.4.2954>

Allan, J., Lamarque, M., Liu, H., Scotland, E., & White, A. (2011). *Analysing the Levels of Compliance to the Killam Library Four-bin Waste Management System to Determine Areas of Concern for Future Management*. Halifax. Retrieved from <https://cdn.dal.ca/content/dam/dalhousie/pdf/science/environmental-science-program/ENVS%203502%20projects/2011/LibraryGreenTeam.pdf>

Arany, J., Boivin, A., Halloran, S., Poltarowicz, J., & Ricketts, A. (2012). *Effective Placement and Design of the Four-bin Waste Disposal System in Lobby and Classroom Areas at Dalhousie University*. Halifax. Retrieved from <https://cdn.dal.ca/content/dam/dalhousie/pdf/science/environmental-science-program/ENVS%203502%20projects/2012/EffectiveBinPlacementandDesign.pdf>

Attardo, C., Chen, S., & Napoleon, A. (2001). *State rest area recycling programs*. Massachusetts, Boston, US: Executive Office of Environmental Affairs (EOEA) Massachusetts

Ayob, S., & Sheau-Ting, L. (2016). Key Determinants of Waste Separation Intention among Students on Campus. MATEC Web Of Conferences, 66, 00066. <http://dx.doi.org/10.1051/mateconf/20166600066>

Dalhousie University Office of Sustainability. (2015). *Solid Waste Management Plan*. Halifax. Retrieved from <https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/sustainability/Solid%20Waste%20Management%20Plan-Final.pdf>

Desa, A., Yusoooff, F., & Kadir, N. (2012, October 12). Waste Education and Awareness Strategy: Towards Solid Waste Management (SWM) Program at UKM. Retrieved April 4, 2018, from

https://www.researchgate.net/publication/257716817_Waste_Education_and_Awareness_Strategy_Towards_Solid_Waste_Management_SWM_Program_at_UKM

El-Fadel, M., Findikakis, A., & Leckie, J. (1997). Environmental Impacts of Solid Waste Landfilling. *Journal Of Environmental Management*, 50(1), 1-25.
<http://dx.doi.org/10.1006/jema.1995.0131>

Facilities Management and the Office of Sustainability. (2017). *Indoor/Outdoor Waste Bin Standards for Dalhousie University*. Halifax. Retrieved from
<https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/sustainability/Waste/Waste%20Bin%20Standards%20Version%206.pdf>

Goal 12: Sustainable Development Knowledge Platform. (2017).
Sustainabledevelopment.un.org. Retrieved 7 April 2018, from
<https://sustainabledevelopment.un.org/sdg12>

Heathcote, A., et al. (2010). Conducting a Waste Audit in the Killam Library at Dalhousie University to Establish Waste Habits and Locate Problem Area. Retrieved April 7, 2018, from Campus Student Research, Office of Sustainability, Dalhousie University:
<https://cdn.dal.ca/content/dam/dalhousie/pdf/science/environmental-science-program/ENVS%203502%20projects/2010/WasteAudit.pdf>

Hoornweg, D., & Bhada-Tata, P. (2012). *What a Waste: A Global Review of Solid Waste Management*. Washington: World Bank.

Highway Department (MassHighway). doi: Retrieved from:
<http://www.mhd.state.ma.us/downloads/recycle/publications/restareas.pdf>

Hossain, M., Santhanam, A., Nik Norulaini, N., & Omar, A. (2011). Clinical solid waste management practices and its impact on human health and environment – A review. *Waste Management*, 31(4), 754-766. <http://dx.doi.org/10.1016/j.wasman.2010.11.008>

Intergovernmental Panel on Climate Change (IPCC). (2007). *IPCC Fourth Assessment Report: Climate Change 2007*. Retrieved from
http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch10s10-1.html

Kelly, T., Mason, I., Leiss, M., & Ganesh, S. (2006). University community responses to on-campus resource recycling. *Resources, Conservation And Recycling*, 47(1), 42-55. <http://dx.doi.org/10.1016/j.resconrec.2005.10.002>

Kelly, P. (2016, April 20). Cash in the trash: Interactive composting, recycling station shows savings in real time. Retrieved April 05, 2018, from <https://www.washington.edu/news/2016/04/20/cash-in-the-trash-interactive-composting-recycling-station-shows-savings-in-real-time/>

Maguire, B. (2012). Employee Behaviour and sustainability in a Dining Hall at Dalhousie University. *Dalhousie University*. Retrieved April 5, 2017, from <https://cdn.dal.ca/content/dam/dalhousie/pdf/science/environmental-science-program/HonoursTheses/2013/BrittanyMaguireFinalThesisApril14.pdf>.

Palys, T., Atchison, C. (2014). *Research Decisions: Quantitative, Qualitative and mixed methods approaches* (5th ed.). Toronto: Nelson

Reeder, M. (2015, September 1). The next generation of waste management on campus. Retrieved April 9, 2018, from <https://www.dal.ca/news/2015/09/01/the-next-generation-of-waste-management-on-campus.html>

Sheau-Ting, L., Sin-Yee, T., & Weng-Wai, C. (2016). Preferred Attributes of Waste Separation Behaviour: An Empirical Study. *Procedia Engineering*, 145, 738-745. <http://dx.doi.org/10.1016/j.proeng.2016.04.094>

Smyth, D., Fredeen, A., & Booth, A. (2010). Reducing solid waste in higher education: The first step towards 'greening' a university campus. *Resources, Conservation And Recycling*, 54(11), 1007-1016. <http://dx.doi.org/10.1016/j.resconrec.2010.02.008>

Solid Waste Management. (2018). *World Bank*. Retrieved 7 April 2018, from <http://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>

United Nations Environment Programme (UNEP). (2015). *Global Waste Management Outlook*. Retrieved from http://eprints.whiterose.ac.uk/99773/1/GWMO_report.pdf

Zhang, H., Liu, J., Wen, Z., & Chen, Y. (2017). College students' municipal solid waste source separation behavior and its influential factors: A case study in Beijing, China. *Journal Of Cleaner Production*, 164, 444-454. <http://dx.doi.org/10.1016/j.jclepro.2017.06.224>

Appendix

Appendix A - Oral consent script

Hello. I'm [*insert researcher name*]. I am conducting a brief survey about the four bin garbage system here at Dalhousie for a class research project. No personal information will be recorded for this survey. would you be interested in answering a few questions?

Appendix B - interview questions

Are you aware that you have disposed of your waste improperly?

Answer yes:

is there anything unclear about the signs?

Why have you chosen to improperly dispose of your waste

Answer no:

Is there anything unclear about the signs?

Do you understand which bin it should have gone into?

Appendix C Audit Data

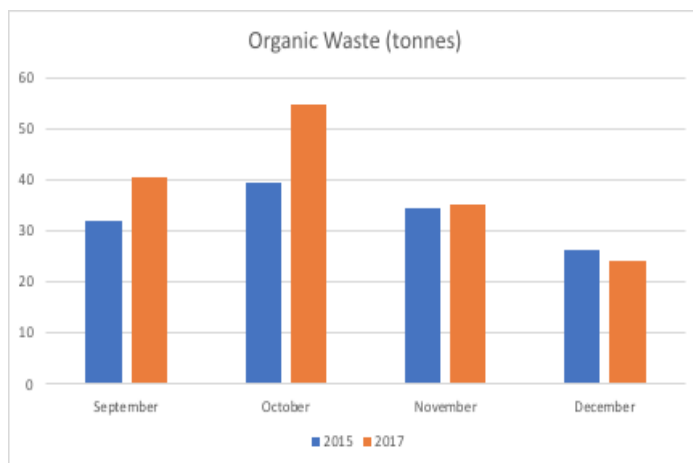


Figure 4: Organic waste audit comparing 2015 to 2017 at Dalhousie.

Appendix D

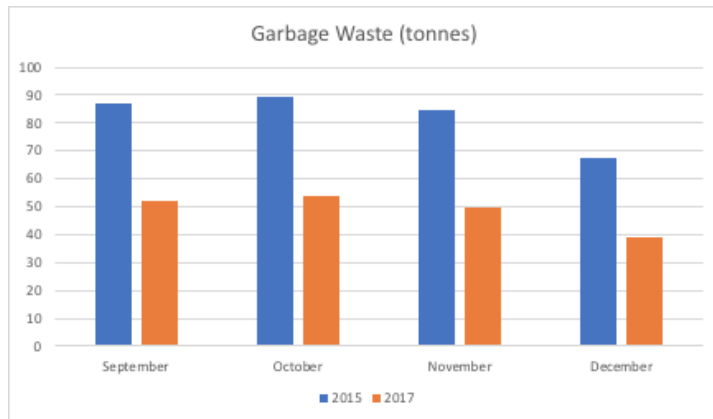


Figure 5: Audit data of waste disposed at Dalhousie University comparing 2015 to 2017.

Appendix E Compliance Data

Category Observed

Complied 177

Did Not
Comply 23

P-value 1.29427E-27

Table 1: Compliance data at the Student Union Building, Dalhousie University, Canada

Category Observed

Uneducated 4

No Concern 7

Habit 1

Table 2: Reasoning for non-compliance data at the Student Union Building, Dalhousie University, Canada