

**The Environmental and Economic Implications of Switching from
Plastic to Glass at the Grawood**



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Executive Summary

This project focuses on the feasibility of the Dalhousie Campus Bar 'The Grawood' switching from using plastic disposable cups to glass, or reusable plastic cups. Currently the Grawood serves reusable glassware until it runs out or the bar gets too busy. This leads to a high volume of garbage waste which could be prevented if disposable plastic cups were no longer used. Three cup alternatives were analyzed; the Styrofoam cup, which is less harmful to the environment than disposable plastic cups, the biodegradable cup, which does not meet the current HRM composting standards and the reusable cup whose efficiency depends on the operating facility it was manufactured in. The most appropriate alternative for a bar was interpreted as the reusable cup, which was assessed for this project.

The objective of this project is the proposal of eliminating the use of disposable plastic cups all together. To reach an accurate conclusion the data for the current environmental and economic situation at the Grawood in regards to plastic and glass use was necessary. Data results the group needed for the project included a two week breakdown of the total cup use (plastic and glass), the time of switch over and the amount of water used in the current dishwasher compared to a new, more sustainable, dishwasher. After the two week period, the group collected the data from the Grawood staff and found disappointing and incomplete results. Two important findings the group were able to reach were the average plastic cups used for a day and the barrier the current dishwasher is for switching to plastic. The current dishwasher uses exorbitant amounts of water and cleans $\frac{1}{4}$ of the amount of glasses in an hour a new dishwasher can.

Considering there was insufficient data, the focus of the project was limited to the economic viability of buying a new dishwasher which is much more efficient and would facilitate switching from plastic to glass at the Grawood. The expense of a new dishwasher was \$13,805.00. The results exhibited that any extra funding the Grawood and DSUSO have would have to cover the entire cost of this expense. This project concluded that currently switching from plastic cups to reusable or glassware is not feasible at the Grawood because of the lack of accurate data and funding for a new dishwasher. A suggestion for future groups doing this project is to take a more hands on approach, to collect data themselves and not relying on the Grawood staff.

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1.0 Introduction

The purpose of this project is to assess the feasibility of switching from plastic disposable cups to reusable cups at Dalhousie University's on campus bars. The group will specifically be looking at the environmental and economic impacts of this switch. Due to time constraints the scope of this study will be limited to the Grawood. However, the results of the study may be extrapolated for the use of future studies on other campus bars, such as the T Room. For the purpose of this study the term *disposable cup* represents a thin plastic cup provided to the bar free of charge, and *reusable cup* includes both hard plastic and glass.

Currently the Grawood serves beverages to customers in glassware until the bar runs out. This usually takes place when occupant numbers increase beyond glassware availability, forcing a switchover. Bar staff at this point provide customers with drinks served in disposable plastic cups. Within the Halifax Regional Municipality only plastic bottles, cups and containers marked with specific numbers are accepted for recycling purposes. This includes hard plastics known as #1 PETE, and #2 HDPE containers (Halifax Regional Municipality, 2011). The disposable cups that are currently being used are neither of these numbers and therefore have to be disposed of, potentially sending thousands of cups to landfills annually.

1.1 Background

The current option used by the Grawood is plastic disposable cups. These cups are cheap (and in most cases free) to the Grawood, causing the economic benefits of this option to be great. However studies have shown that with this seemingly "great" economic benefit, there are environmental costs. In 2006, Canadians produced 1000 kg of waste per person per year and of this, 835 kg went straight to landfills (CBC, 2010). According to the Environmental Protection Agency (EPA), just under 54% of landfill waste is composed of non durable goods, such as plastic cups and plates (EPA, 2011). This means, if we assume Canadian waste patterns are somewhat comparable to those of the United States, using extrapolation, an average Canadian may produce around 450kg of waste in the form of non durable goods each year. Not only are plastic cups filling up our landfills, but they are making their way to our oceans as well. According to figures from the Great Canadian Shoreline Cleanup (2011), in 2009, 40,799 items

were found along our shoreline under the heading “plates, forks, spoons, knives, and cups”. It is evident that plastic disposable cups are contributing to Canada’s excessive waste. The question remains whether or not there is a more environmentally friendly alternative that is at the same time an economic one.

1.12 Alternatives

The Styrofoam cup, also known as the polystyrene cup is an alternative often overlooked. In Bower & Leon’s (1999) “Consumer's Guide to Effective Environmental Choices”, they explain that this is mostly due to the polystyrenes harmful reputation given to it in the 1980s, when the effects of CFC’s (an ingredient in the making of polystyrene cups at the time) were becoming a concern. Today however, polystyrene cups are made with Hydrochlorofluorocarbons, which are thought to be significantly less harmful to the environment than chlorofluorocarbons (Kremer, 2003). The production of polystyrene cups has actually shown to have one of the lowest production energy costs (Hocking 1994). Another difference today compared to the 1980s, is that polystyrene cups can actually be recycled where facilities are able (Halifax however, is not one of them). Despite the seeming benefits of using polystyrene cups, their negative reputation paired with the fact that Halifax Regional Municipality (HRM) currently does not recycle polystyrene, does not make a good case for it to be used in the Grawood.

The biodegradable cup approach was the option that seemed to have the most controversy between studies. Due to the fact that these cups are made from corn-based plastics (or polylactic acid (PLA) as opposed to regular petroleum based plastics, biodegradable cups are at first glance a great alternative. However, some studies have taken a closer look at bioplastic production and disposal and have raised some concerns about its true environmental benefits. Firstly, PLA is said to biodegrade most efficiently in what is called a “controlled composting environment”, where plastic is to sit in carbon dioxide and water that reaches 140 degrees for ten days straight (Royle, 2006). These are not the conditions under which the average compost or landfill operates. The second issue is the lack of regulation in bioplastic production. The measure of how bioplastic is made and degrades is not standardized for biodegradable polymers, which means many different polymers can claim to be biodegradable, even though they are vastly different with regards to degradation time and conditions (California, 2007). In fact, HRM has forbidden

all plastic (degradable or not) from being placed in the green bins. Lastly, there are concerns with the fact that these cups are made from a starch base. Similar to the argument raised about biofuels, many objections have been made about using a food source for a non-food product (Ziada 2009). Therefore, due to their incompatibility with the current HRM composting regulations, their connotations in terms of food use and their lack of production regulation, this study has deemed biodegradable cups not a viable alternative for the Grawood.

The reusable cup alternative is one that is hard to assess by study comparisons alone. The efficiency of a reusable cup depends on the existing washing and operating facilities currently in place. Producing a reusable cup made of glass or a more durable plastic, requires more than 5 MJ of energy per cup as compared to disposable paper or foam cups which both require less than 1 MJ of energy per cup (IREA, 1994). Therefore, there becomes a set amount of re-use times required in order for a glass or durable plastic cup to be worth the energy investment. Determining this break-even mark entails measuring the economic costs of purchasing the cups and the increase in electricity and soap use for washing, as well as the environmental costs in terms of increase water usage. These factors are not the same across the board for every drinking establishment. Therefore the economic and environmental costs and benefits can only really be measured and estimated on the basis of a specific operating system (Ligthart & Ansems 2007).

This lends this study reason to undertake an analysis of the current disposable cup use at the Grawood. The literature and studies previously done on disposable plastic cups agree that their contribution to society's excessive waste is significant. Through previous research, alternatives such as the less energy embodied Styrofoam cup and the seemingly more environmentally friendly biodegradable cup have been found to be a poor choice for the Grawood in terms of its current operations and the waste operations of HRM. The reusable cup option has yet to be assessed, and as literature recommended, should be considered on a case by case basis.

1.2 Literature Review

The question as to whether or not the switch from disposable to reusable cups is feasible is not one that is easily answered. Many different studies have been done to try to answer the question of which is more environmentally and economically efficient. According to the

literature, it seems that the answer to this question needs to be considered on a case for case basis. Some studies focused on cups specifically for coffee and hot beverages, where factors such as beverage temperature had to be considered, while others were looking at large scale change within chains of vendors. Both large and small scale studies were reviewed to gain a general idea as to what has been researched and understood in the realm of disposable vs. reusable cups. To keep the literature relevant, the background research was delimited to cups and beverage container studies.

Many studies looked at more than one alternative to the disposable plastic cup, including Styrofoam, biodegradable, different types of plastic and reusable glass cups. The purpose of this study is to provide the Grawood with the most efficient (both economically and environmentally) beverage container option. Therefore all of the alternatives will be considered. Studies show that there are costs and benefits to every alternative. Many of the issues that arise have to do with cost, durability, replacement rates, sanitation, and general facilitation. Taking these variables into consideration, each alternative was explored.

1.3 Goals and Objectives

As a solution to this unnecessary waste generation the group would like to propose the possibility of abandoning the use of disposable cups all together, only if it is both economically and environmentally feasible. The goal of this study is to determine if our resolution is realistically beneficial to the bar. To look at the environmental impacts we will be conducting a study on cup use. A physical cup count will determine the average number of cups being used and thrown away monthly by the bar. In addition to this we will look at the dishwasher appliances inside the bar to gather information pertaining to water waste and energy use, which is necessary to clean the proposed reusable cups. In terms of economic benefits we will be looking at whether it is cost efficient to buy reusable cups, as well as other factors such buying a new dishwasher. Reducing the amount of waste generated at the on campus bar will significantly contribute to the greening of Dalhousie campus.

2.0 Materials and Methods

The materials and methods section will outline the details of obtaining and analyzing our data. Due to the nature and scope of the project, vast data was required to properly analyze the different impacts. We were unable to obtain all of the data necessary to assess the environmental and economic impacts of switching from plastic to glass, so we decided to focus on the dishwasher as a barrier to switching. We obtained data of disposable cup use so this data was used in our analysis. It is worth noting that this project took into consideration only evening service at the Grawood, which is open Wednesday to Saturday, 5 PM until 1 AM. It is at this time that disposable cups are brought out to service the patrons.

2.1 Data Collection and Analysis

Data was collected on nights the Grawood was open between March 2 and March 18. This included weekly events held at the Grawood such as trivia and wing night and special events such as St. Patrick's Day. Collecting data over a 3-week period gives this study good estimate data that can then be extrapolated over an entire semester. Our client agreed to collect data for us so we provided data sheets (see Appendix A) that were filled out during nights of operation.

Permission was granted from our client to view the dishwasher. Since the dishwasher was old and many parts had been replaced in the past, we needed to contact the manufacturer to determine the dishwasher's specifications. Data on the function of the dishwasher was collected via email with the manufacturer.

Although the data was collected over a 3-week period (12 working days), the calculations were extrapolated for an entire semester, or 14 weeks. However, knowing that the Grawood is only open on evenings for 4 days a week means that the data would be applied to a total of 56 days. A bar graph was used to visually compare the water usage of the current dishwasher to the new dishwasher that would have to be purchased for the switch from plastic to glass to be environmentally and economically viable.

2.2 Limitations / Delimitations

This project was primarily limited by time. It is part of a 1-semester long course and therefore the group only has approximately 2 months to complete it. Since time is limiting the amount of data we will be able to acquire, we made a number of assumptions. We assumed that the dishwasher operated with a full load capacity, and was used only until glass washing could not keep up with demand. We also ignored idling time when calculating the environmental impacts of the dishwasher. This number may be irrelevant with the increased amount of cups going through the machine, but was impossible to predict. Other limitations include the turnout of patrons on the perceived busiest night. An extreme turnout, being more than usual or less than usual, affected the calculations and the final utility of this project.

We were also limited by the amount of data we received from our client. Data sheets provided to our client requested information on the total number of glass cups, amount of plastic cups and glass cups used, total cups use, time of switch over, yards and pitchers sold. These sheets were usually minimally filled out and did not indicate the number of glass cups used on any night. Therefore we were unable to assess the total environmental and economic impacts associated with switching from plastic to glass.

The delimitations for this project were primarily decisions made by the group that coincided with time restraints. We only studied the Grawood (rather than the Grawood and the T-Room) because the Grawood is on the main campus and it usually holds more events and is generally busier than the T-Room. With respect to reusable cups, we spatially limited our scope to within use at the Grawood. We did not consider the impact of the entire lifespan of reusable cups including emissions generated from product, packaging and transportation. Since the potential cost of turnaround time associated with bussing and washing reusable cups was ignored, we assumed that the total number of disposable cups used equaled to the number of reusable cups needed to be purchased. In addition, we did not address the social aspect of disposable versus reusable cups. Regardless of the delimitations and limitations, this project provided a realistic foundation should ever a large scale assessment be considered.

3.0 Results

The data sheets that were completed by the staff at the Grawood are summarized in Table 1. March 17th was St. Patrick’s Day and the bar received an extraordinary amount of patrons that is not representative of a typical day, so the plastic cup usage was left out of the average. ‘Switch Over’ refers to what time bartenders started using disposable cups. Question marks are beside the ‘Yards’ and ‘Pitchers’ headings because these numbers are not accurate; they are estimates made by the bartenders. The cash register at the Grawood does not distinguish between yards and pitchers, but rather groups them together. Yards are served with glasses, but pitchers are served with disposable plastic cups; the number of cups served depends on how many patrons are drinking from the pitcher. Figure 1 (on the following page) reveals the relation between number of disposable cups used and the number of pitchers that were estimated to be served. Although the number of pitchers sold is an estimate, the numbers can still be useful to determine if disposable cup use increases with the sale of pitchers.

Table 1. Summarized data from the data sheets (Appendix A) collected from the Grawood Staff. Data was collected for twelve days over a three-week period.

Date	Variable Counted			
	Plastic cups used	Yards (?)	Pitchers (?)	Switch Over
March 2nd	100	6	89	10:30
March 3rd	0	-	31	-
March 4th	154	32	29	-
March 5th	120	-	32	9:00
March 9th	50	19	57	-
March 10th	100	-	101	-
March 11th	126	16	49	-
March 12th	-	-	-	-
March 16 th	100	7	58	-
March 17 th	3000	139	764	2:30
March 18 th	0	-	13	-
March 19 th	-	-	-	-
*Avg	83.33333333333333	16	51	
*Avg = average of all the nights excluding St. Patrick’s Day				

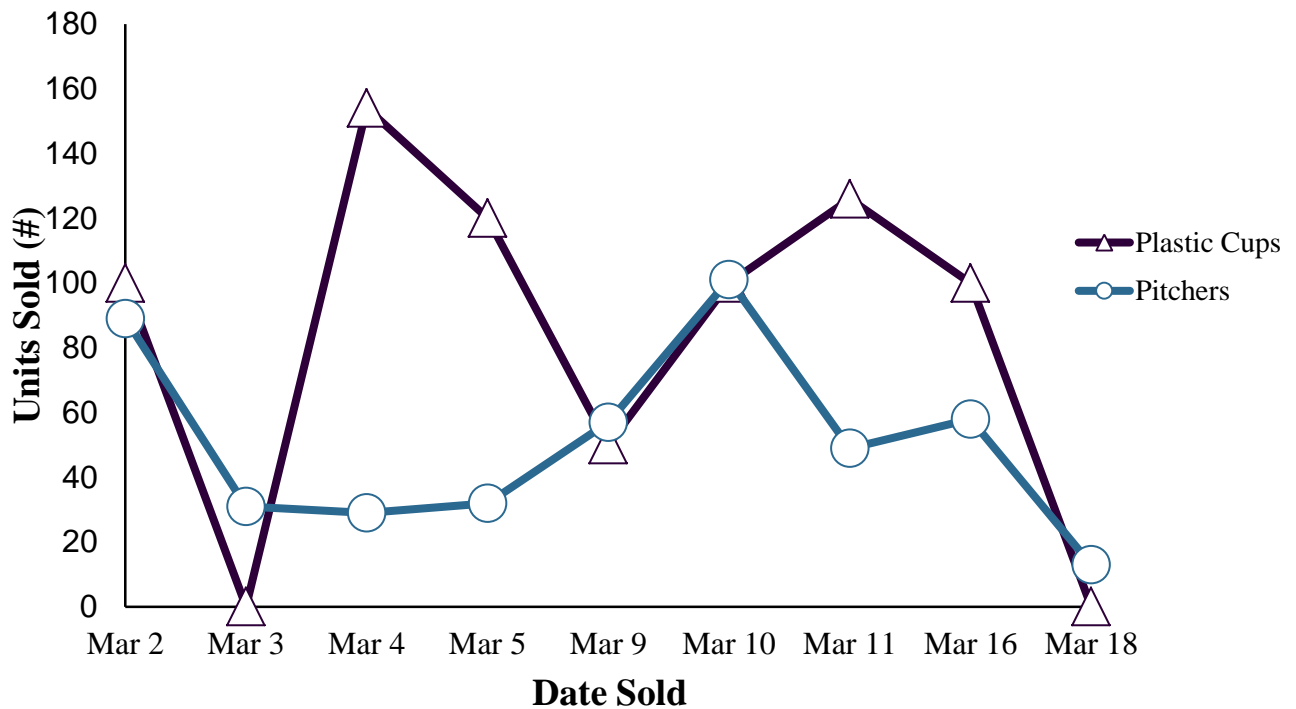


Figure 1. Number of plastic cups and pitchers sold over a three week period at the Grawood

In response to the facility costs of the Grawood, the bar manager claimed that the bar does not pay for the power or water (Greg Wright, personal communication, April 6, 2011). The disposable plastic cups are supplied free of charge, and so are glasses that have been labeled with a company's brand logo (ie. Molson Canadian). However, these are not supplied in large quantities, but rather given either as a marketing scheme, or in smaller quantities to replace glasses that have been broken, stolen, misplaced, etc. Reusable plastic cups coming in sets of 12 cost \$11 and \$14.95 for the 9 oz. and 16 oz. sizes respectively (Greg Wright, personal communication, March 4, 2011). These costs were necessary in finding potential costs for increasing the reusable cup quantities; however we were unable to attain an inventory of the current cups from the Grawood.

We contacted the glasswasher manufacturer to get the energy and water consumption of the model used in the Grawood, but because the model is no longer in production, they could not supply all the information we needed. The estimated water use for the Grawood's glasswasher was 38 gallons of water per hour, and the newer models use only 10 gallons per hour. The newer model is also capable of washing many more glasses: 1200 glasses per hour, compared to 280

glasses per hour (Kevin Maddy, personal communication, March 15, 2011). This new dishwasher costs \$13, 805.00 (Moyer Diebel, 2011).

From Table 1, we find that the average switch over time is 9:45 PM (St. Patricks Day is not included) which means that when the Grawood starts its evening shift at 5:00 PM, the glasswasher is in use for approximately 4 hours and 45 mins. Figure 2, below, compares the current consumption rates per night with those of an updated model. The new glasswasher would save 133 gallons of water on an average night.

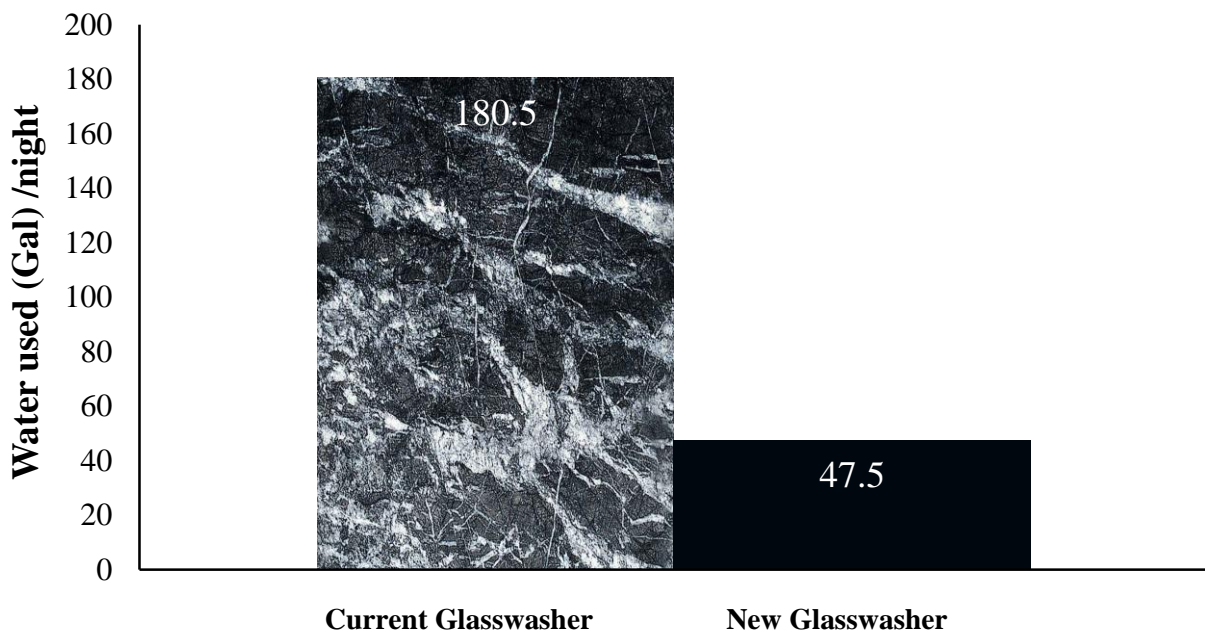


Figure 2. Water used (measured in gallons) per night for the current glasswasher and estimates of water use for a new glasswasher.

4.0 Discussion

The goal of our research of cup use at the Grawood has been to determine the feasibility of eliminating disposable plastic cup use from campus bars at Dalhousie University. Our research has sought to replace disposable plastic cups with reusable plastic cups or glassware to reduce the environmental and economic burden resulting from the use of disposable plastic cups.

Our findings revealed that disposable cup use varied according to bar patronage (which is tied events, i.e. bingo night, St. Patrick’s Day) and the discretion of the bartender (whom decides when to favour plastic cups over re-usable cups [“switch-over”]). The motive behind switching

to disposable cups over reusable is considered a practical decision to increase cup-turnover without relying on the bar dishwasher and reducing losses due to broken glasses (Greg Wright, personal communication). The bar dishwasher was identified as one of the key barriers to eliminating plastic cup use. The slow-moving conveyor belt of the dishwasher could not process high volumes of glassware fast enough to serve bar patrons on high-capacity nights. Plastic cups are brought in on these high-volume nights to compensate for the slow turn-over of the bar dishwasher (Greg Wright, personal communication). The installation of a new bar dishwasher with a lower washing time could eliminate plastic cup use on most nights (with the exception of large patron events such as St. Patrick's Day) and reduce water and energy costs through improved efficiency (Moyer Diebel, 2011). The initial investment costs associated with replacing plastic cups with glassware are negligible as beer companies may provide glassware (bearing company insignia) free of charge (Greg Wright, personal communication). The investment costs for a new dishwasher is relatively significant, but may be offset with the sale of the current dishwasher and through DSUSO funding.

The questionable quality of our received data was an important factor influencing our decision to concentrate on the dishwasher as a barrier to sustainability. Our data was collected on a second hand basis with bar-staff recording data onto supplied data sheets. Because data was not personally collected, we were unable to ensure the quality and reliability of recorded data. The format of how cup use was recorded (no difference was noted between disposable and re-usable cups were made) limited the conclusions we were able to draw from the data (see Appendix A). The number and frequency of drinks sold were not made available to us, which limited our determination of whether plastic cups were used to account for demand or custom.

We were unable to locate any other studies that dealt with replacing disposable cups in bars that would allow comparisons with the findings of our study. In light of this, our focus on the importance of bar infrastructure (i.e. dishwasher) for reusable glassware may set the precedent for future studies.

5.0 Conclusion

After an extensive literature review regarding alternatives to plastic disposable cups, it is concluded that there are several different alternatives to the disposable plastic cup, including Styrofoam, biodegradable, reusable plastic and reusable glass cups. Eliminating the use of disposable cups would divert unnecessary waste from landfills. It is evident that Dalhousie University would like to be recognized as a sustainable campus, as it would encourage potential students to attend the university, increase attractiveness to potential financial donors, and make it a leader among Canadian universities. Eliminating plastic disposable cup use at our on campus bar The Grawood is something that could be implemented at Dalhousie in the near future. However, we have found that the majority of our study's results are inconclusive.

From the information gathered concerning the dishwasher, it is believed that a newer and thus more efficient washer could not only reduce the amount of time it takes to clean the reusable glasses, but reduce the amount of water used. Funding from additional sources would be required to purchase the dishwasher, as the Grawood currently does not make enough money to support this outright expensive. This funding could come from DSUSO, or associated Dalhousie organizations and fundraisers. Additional research into the cost of new washing appliances, as well as where funding would come from is a recommendation for future groups. Reducing the turn over time of reusable cups may prove to push back the average switch over time.

In addition to this we suggest future groups use different methods in regards to the collection of data. Our group created data sheets, given to the staff members, with the intention of having them complete them at the conclusion of their shifts on a nightly basis. Some staff members were extremely attentive to details and completed them fully however the majority of supervisors and staff on duty failed to fill in crucial sections. Recording data for us was not high in staff members priority lists and therefore we believe estimations and guesses were made in regards to the data collection results. As a future suggestion we propose that group members take a more hands on approach. Alternating nights at the bars to record data would be a more effective way of ensuring the results were accurate, and complete.

At the time of conclusion our study provided us with an inadequate amount of detail to determine whether it is feasible to make the suggested switch at Dalhousie University's on

campus bar. Nonetheless we believe with Dalhousie's determination to become more sustainable and the hard work of groups much like our own plastic cups will be a thing of the past at the Grawood.

6.0 Acknowledgements

We would like to thank our clients Emily Rideout and Greg Wright for taking an interest in this issue and providing the project idea and support. Our thanks also goes to DUSUSO for their feedback with regards to possible future funding for the Grawood, along with the representatives from Moyer Diebel, who provided us with glasswasher estimates. We also thank in particular the staff at the Grawood for taking the time to fill out data sheets on top of their regular working duties. Finally, we would like to thank our project mentor John Choptiany for the valuable advice and support throughout the undertaking of this study.

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8.0 Appendices

8.1 Appendix A.

(Data sheet template given to the Greg Wright and the Grawood Staff.)

Date: _____

Supervisor/Recorder: _____

Campus As A Living Lab Project

Glass Cups*:

Plastic Cups Used:

Glass Cups Used:

Total Cups Used:

Time of Switch Over:

Yards Sold:

Pitchers Sold:

*Please count the number of glass cups before the evening starts as this number can change nightly with breakage/theft