

*Boston College Recycling: A System Review*

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Environmental Seminar (ENVS 4943.02)  
May 1st, 2019

ABSTRACT:

Plastic pollution is a byproduct of economic growth, which stemmed from the Industrial Revolution. After going largely unchecked for decades, we now have to deeply reflect upon how we are managing our waste. The linear life of plastic (single use plastics that end up in landfills) is unsustainable, and we need to create a closed feedback loop for the life of a plastic.<sup>1</sup> For decades, business has regarded plastic as a one time use substance that is created for one purpose, used, and then discarded.<sup>2</sup> Once discarded, plastic can last a very long time in the environment. It is slowly broken down and enters food chains as toxins and feed. Recycling these plastics are essential to closing this loop and decreasing degradation on the environment.

Another issue with these single-use plastics is that there needs to be some place to dispose of it. It is not an easy task because of the sheer volume. The current waste management systems in place is not able to process everything.<sup>3</sup> Since China's Sword Law policy, 65% of numbers three through seven plastics that were previously exported to China are no longer getting recycled.<sup>4</sup> With even less places to put this plastic, it often ends up in the ocean.

We have not seen the full effects of plastic consumption on animals or humans, but the short term effects are highly concerning. This is why our recycling system is essential, as the recycling system creates a somewhat closed feedback loop of plastics that allows the production of new plastics to be lessened. In terms of a waste management solution, recycling is absolutely essential for sustainable living on Earth in the future, which is why this study will focus on the efficiency and health of the recycling system at Boston College.

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<sup>1</sup> DePaolo, 875

<sup>2</sup> Ibid, 875

<sup>3</sup> Young, 2019

<sup>4</sup> Ibid, 2019

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I. INTRODUCTION:

The problem that we are tackling is the inefficiency of plastic recycling on campus, both from perspective of the individual doing the recycling and the ability of the recycler to properly process the plastic. While we are trying to find ways to clean up the plastic already in the environment, we continue to add more through inefficient recycling practices.

This study is designed to examine the effectiveness of recycling on the campus of Boston College. There are two hypotheses that were used for this study:

1. The population of Boston College is not keenly aware of recycling procedures and does not care to fix their mistakes.
2. The university makes an effort to properly recycle, but most of the recycled products are not actually recycled.

The researchers think that the BC population has become good habitual recyclers, but there is a lot of inefficiency within the system itself, which leads to plastics ending up in landfills or water sources, rather than getting recycled and reused as intended. We know that waste management is a crucial issue, and one that we could improve--both as individuals, and potentially on larger-scale waste-management operatives as well.<sup>5</sup> For example, we know that some facilities have to categorize an entire bag of recycling as waste when it includes just one piece of contaminated plastic. The margin for error when disposing of plastics is narrow and unknown to most of the population.<sup>6</sup> Additionally, we are at a time where we need the most effective method of waste management to combat a growing population and growing use of plastics.

II. METHODS:

<sup>5</sup> Fritz, Jennifer N., et al, 825

<sup>6</sup> Ibid, 826

The methods used for this project focused on collecting both primary and secondary data. Primary data is essential to any findings extrapolated by this study, so data was collected information right here at Boston College. This was done through a Google Form survey. Fifteen relevant questions to our subjects (Boston College students) were asked that targeted their behaviors, attitudes, and beliefs when it comes to on campus recycling and waste management. The sample size of this survey was seventy three people which was collected over a week's time period. The population surveyed was skewed towards the senior class, but adequate participation from the freshman, sophomores, and juniors was observed. With adequate participation from all four classes, the researchers felt as though this survey gave good data to use in this study. The survey proved to be a useful tool to observe general trends of behavior towards recycling and consumption habits on campus.

Secondary data in order to understand recycling and waste management at the administrative level. The researchers had a lengthy conversation with the director of Save that Stuff, Erik Levy. Levy's company processes the waste produced on campus and tries to sustainably discard of it. Erik shed some light upon how recycling and waste management works from the facilities perspective. He also discussed how the changes in international politics has impacted the recycling markets in the US.<sup>7</sup> Secondly, the researchers were constantly reaching out to the Sustainability Director of Boston College, Bruce Dixon. Bruce was instrumentally valuable to the findings of our project; he provided us with critical data and information. His department provided us with the campus' Waste Recycling Reports from 2016-2018.

The researchers also interviewed Juli Stelmaszyk, the manager of BC Dining Sustainability Team. Since dining halls contribute the bulk of waste on campus, hearing from the dining services was imperative. Some of the things Juli discussed procedural norms, ways BD Dining is looking to reduce waste on campus, and why plastic is a growing concern for them. The researchers also used EPA data to gather information on national trends pertaining to waste management. Doing so provided context for the study, which was specific to the Boston College campus.

The last method of research came in the form of a literature review. There have been some studies done in the past that have evaluated recycling practices on college campuses. Some of these studies have been incorporated into this study to help understand the trends that were

<sup>7</sup> Levy, et al., 2019

observed. Additionally, some of the literature review provided some insight as to changes in international law and alternative systems of recycling to single-stream.

### III. RESULTS:

The survey results were regarding the recycling behavior of the individual, facility, and administration here on campus. The survey was directed at towards the student body. The survey saw 73 students complete it. This sample-size, the researchers felt, was substantial enough to extrapolate trends from. Here is some of the trends that were noticed are as follows:

1. Most students consider themselves recyclers, and they try to do so, but there's a pervasive distrust in how successful the cradle-to-grave inner workings of waste management operate (Figure 1 and Figure 2).

Do you consider yourself a "recycler"?

73 responses

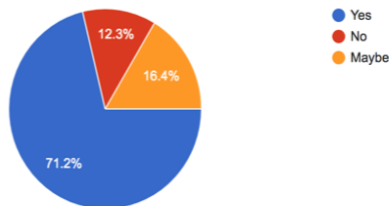


Figure 1: Survey results to the question "Do you consider yourself a 'recycler'?"

Do you feel like you are making a difference when you recycle?

73 responses

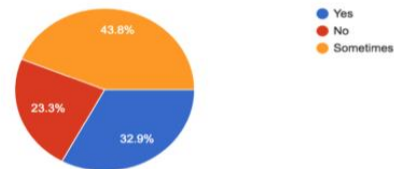


Figure 2: Survey results to the question "Do you feel like you are making a difference when you recycle?"

2. Only 15% of students said they think BC effectively manages waste, while most were either uncertain or nihilistic in the effectiveness, and only 32% of students feel they are making a difference when recycling (Figure 2 and Figure 3).

Do you feel like you are making a difference when you recycle? Do you think BC does an effective job of waste management?  
73 responses

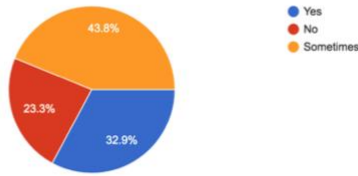


Figure 2: Survey results to the question “Do you feel like you are making a different when you recycle?”.

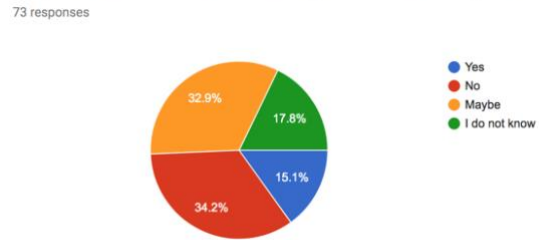


Figure 3: Survey results to the question “Do you think BC does an effective job of waste management?”.

- Individuals generally seem to feel limited in their agency to ensure we’re responsibly managing waste (Figure 2).

Do you feel like you are making a difference when you recycle?  
73 responses

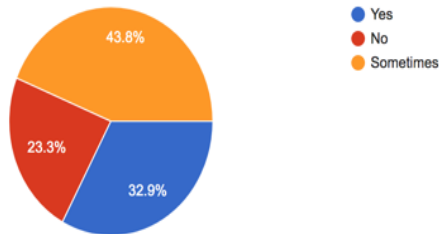


Figure 2: Survey results to the question “Do you feel like you are making a difference when you recycle?”.

- There is also a trend of detachment from consumers. Only 37% of students said they try to buy recycled products, and over 50% of students say they don’t factor sustainability into their purchases, both of which likely mean that the bulk of students feel the production and management facilities ought to heed the burden (Figure 4 and Figure 5).

As a consumer, do you actively try to buy goods made with recycled products?

73 responses

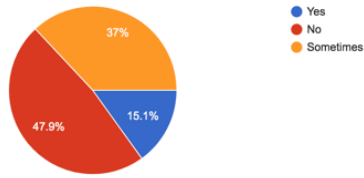


Figure 4: Survey results to the question “As a consumer, do you actively try to buy goods made with recycled products?”.

Is "sustainability" a reason why you will or will not buy something?

73 responses

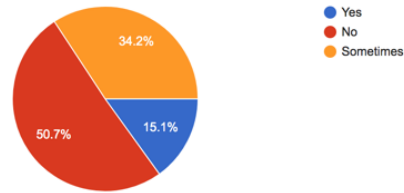


Figure 5: Survey results to the question “Is ‘sustainability’ a reason why you will or will not buy something?”.

- 82% of students said that a combination of parties are responsible for ensuring proper waste management--meaning that they're aware of the impact that manufactures, waste facilities, BC's campus itself, and (to perhaps a lesser degree) the individual student can all have (Figure 6).

Who do you think needs to take on the burden of ensuring proper waste management?

73 responses

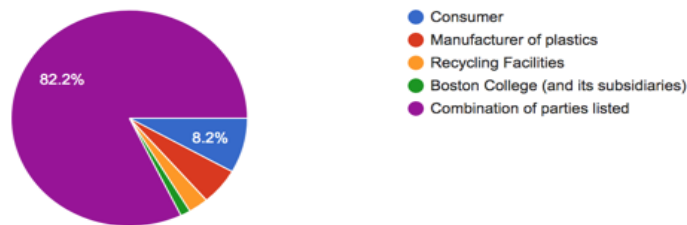


Figure 6: Survey results to the question “Who do you think needs to take on the burden of ensuring proper waste management?”.

- Most people, despite feeling detached from how they can have an impact, understand the importance of waste management issues--in the survey, an overwhelming majority said it's important to manage waste responsibly, and that it's linked to climate change (Figure 7 and Figure 8).

Do you think waste management is linked to climate change?  
73 responses

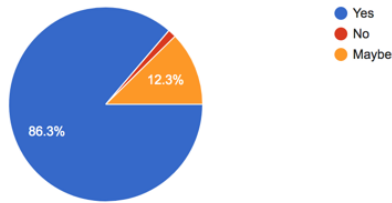


Figure 7: Survey results to the question “Do you think waste management is linked to climate change?”.

Do you think we are facing the impacts of climate change today?  
73 responses

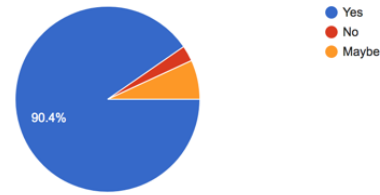


Figure 8: Survey results to the question “Do you think we are facing the impacts of climate change today?”.

7. Time is not an obstacle to recycle for the population on campus (Figure 9). 63% of respondents said they do not see time as an obstacle, while 19.2% said it might be. Only 17.8% of respondents think that time is definitely an issue with the current recycling system.

Is time an obstacle for you to recycle?  
73 responses

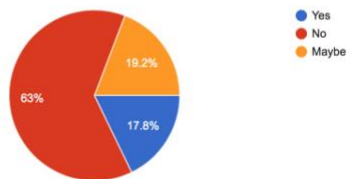


Figure 9: Survey results to the question “Is time an obstacle for you to recycle?”.

Additionally, systemic pros and cons of single-stream recycling, what potential alternatives there are, and where we can improve recycling practices (as a campus and a world at large) were researched. One intriguing alternative is multi-stream recycling, which is a collection method in which waste generators must sort different recyclables into separate bins--from there the waste gets transported to a multi-stream recycling facility; these facilities are configured to sort and process pre-separated recyclables.<sup>8</sup> The same study identified that single stream recycling has been implemented in many urban areas based on the assumption that it's cheaper and more efficient than multi-stream--and, importantly, that this assumption is largely unfounded and false.<sup>9</sup> The study concludes “Single stream recycling, on average, is 28.5% more more

<sup>8</sup> Lahkan, 386

<sup>9</sup> Ibid, 386



expensive than multi-stream recycling. As such, the assertion that single stream recycling is a preferred waste management system needs to be revisited".<sup>10</sup> It's fair to say that we ought to reevaluate the pervasive role single-stream recycling plays in cities and towns across the country.

Through research and interviews with the aforementioned parties, we've learned that single-stream recycling is far more costly than we may ordinarily think. Single stream is directly correlated with more contaminated recyclables, and more contamination means less recycling. Sorting and collecting at single stream facilities, we've found, is more costly and difficult than at multi-stream facilities--because there's a high variety of products to manage, and a higher portion of contaminated products than multi-stream bins tends to have. The way the cost has been customarily offset is through the sale of recyclables. With the change in recycling market, even municipalities are having trouble funding the effort to recycle. Single-stream recycling, especially since China's National Sword policy has been enacted, has resulted in large quantities of plastics being rendered ineligible for recycling, thus leaving most of U.S. recycling for landfills.

Plastic being made as is today is purely out of short term convenience, and not meant to be reused. Our facilities, infrastructure, and resources don't allow us to manage plastic in the way it ought to be. China and India used to be big buyers of waste resources with loose contamination standards, but the markets for waste products are shriveling up.<sup>11</sup>

The diversion rate is the best way to compare the health of the recycling systems.<sup>12</sup> The diversion rate is the tons of waste recycled over the total tons of waste produced.<sup>13</sup> The higher diversion rate, the better the recycling system is.<sup>14</sup> For an institutional comparison, the United States government, through the EPA, as of 2017 has a diversion rate is 67.8% (Figure 10). The diversion rate of Boston College in 2018 is 38.3%, which is well below the rate at which the United States government operates at (Figure 11).<sup>15</sup>

<sup>10</sup> Lakhan, 395

<sup>11</sup> Margolis, 2018

<sup>12</sup> EPA, 2018

<sup>13</sup> Ibid, 2018

<sup>14</sup> Ibid, 2018

<sup>15</sup> Dixon, 2018

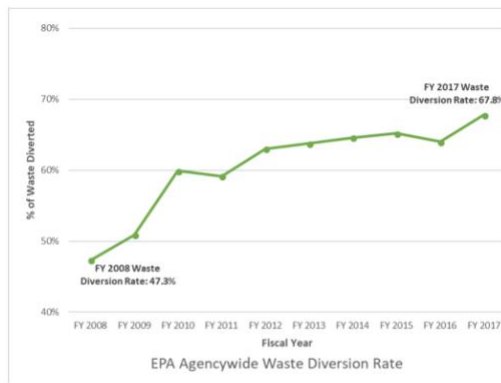


Figure 10: EPA Agencywide Waste Diversion Rate from 2009 to 2017, according to the EPA.

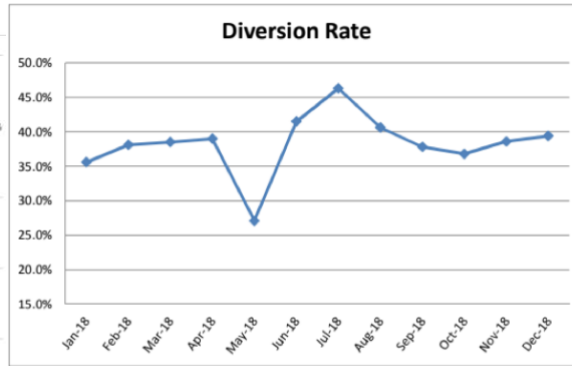


Figure 11: Boston College diversion rate for 2018, according to a report created by Bruce Dixon in the Facilities Department of Boston College.

#### IV. DISCUSSION:

While doing research for this report, we have noticed that there is a lot of data and studies that are done on a national scope, but few that have the scope of college campuses. In our research, we have learned that there are multiple issues within our recycling system due to the single-stream method we use. But how we stream recycling, regardless of its effectiveness, won't entirely solve the problem with plastics. Recycling, in general, has two major issues. The first issue comes on the side of the recycler. Because of recent political and economic changes, the recyclable goods markets have crashed.<sup>16</sup> As of right now, previously major buyers of recycling are not buying as much, which is straining the recycling process in the US. The second issue is that, even though the US population has gotten better at recycling, the US population still has to get better at sorting waste from recyclable goods on their end to ease strain on the system. The rest of this section will be used to review the literature that proves these claims.

In Fritz et al., a study was conducted to see how to increase the number of recycled goods and how to increase the rate of properly recycled goods. In this study, they were specifically testing how the location of a recycling bin in proximity to the garbage bin would increase the recycling of bottles and cans properly.<sup>17</sup> In the baseline conditions for the two different

<sup>16</sup> Margolis, 2018

<sup>17</sup> Fritz et al., 825

classrooms they tested, the average percentage of items correctly recycled was 17% and 23% respectively.<sup>18</sup> When the trash bins were removed from the classroom during intervention conditions, correct recycling saw a sharp spike. Correct recycling rose to 68% and 69% respectively.<sup>19</sup> Some issues with this study was poor procedural integrity, as some of the conditions were changed at the intervention period, and the events occurring in classrooms were not consistent. This study does prove a very cost-efficient and easy way to increase proper recycling.<sup>20</sup> There are a few other studies that we have looked at that further verify the results of this study in the literature.

The historical perspective is important when looking at the issue of plastic pollution and recycling. Plastic pollution is a byproduct of economic growth, which stemmed from the Industrial Revolution. After going largely unchecked for decades, we now have to deeply reflect upon how we are managing our waste. The linear life of plastic (single use plastics that end up in landfills) is unsustainable, and we need to create a closed feedback loop for the life of a plastic.<sup>21</sup> For decades, business has regarded plastic as a one time use substance that is created for one purpose, used, and then discarded.<sup>22</sup> Once discarded, plastic can last a very long time in the environment. It is slowly broken down and enters food chains as toxins and feed. Recycling these plastics are essential to closing this loop and decreasing degradation on the environment.

China has created a recycling crisis in Massachusetts because of tightening restrictions the types of plastic that is accepted. 80 to 90 percent of recyclable material from Massachusetts goes to China.<sup>23</sup> The price per ton of recycling has gone from \$75 per ton to \$5 per ton.<sup>24</sup> With less plastics accepted and less money in the market, municipalities are struggling to move plastics not accepted by China to landfills.<sup>25</sup> The system of recycling, in addition, is now a service that municipalities must pay for instead of the system paying for itself.<sup>26</sup> This presents a new challenge as it may be cheaper to send everything to a landfill.<sup>27</sup> A lot of this information

<sup>18</sup> Ibid, 825

<sup>19</sup> Ibid, 827

<sup>20</sup> Ibid, 828

<sup>21</sup> DePaolo, 875

<sup>22</sup> Ibid, 875

<sup>23</sup> Gellerman, 2019

<sup>24</sup> Margolis, 2018

<sup>25</sup> Gellerman, 2019

<sup>26</sup> Gellerman, 2019

<sup>27</sup> Margolis, 2018

was also verified during our interview with Erik Levy, one of the co-founders of Save That Stuff Inc. Save That Stuff is the Boston College campus recycler.

One thing we have been searching for in the literature is alternative markets for recycling and alternative systems to single-stream. Save That Stuff has acknowledged the changing markets and has attempted to create a solution of their own.<sup>28</sup> Save That Stuff has found a way to convert compostable recyclables into a bioslurry that is used similar to a biofuel.<sup>29</sup> The remains of the burning of the slurry is made into fertilizer pellets for farmers.<sup>30</sup> So far, this is what we have in the literature with more to come from the Sustainability Office of Boston College and the BC Dining Sustainability Team.

Additionally, multi-stream recycling is the most feasible type of recycling for large-scale use. As per our conversation with Erik Levy, single-stream recycling was meant to be used in small communities that would stimulate recycling in areas that were not recycling initially.<sup>31</sup> Multi-stream recycling would mean more work for the person sorting waste, but save tons of money in sorting costs. This saved money would make recycled goods even cheaper and make it more economically feasible for recycled goods to be more prominent on the market.<sup>32</sup>

In addition to the saving seen in sorting costs alone, multi-stream recycling has been generally found to be cheaper than single-stream. The general perception about single-stream is that it is cheaper, but the opposite is true.<sup>33</sup> According to Lakhan's study of multi-source recycling in Ontario, Canada, ends up being a more cost effective system to run.<sup>34</sup> Contamination and residue on recycling is a huge issue in single-stream recycling that hurts the ability of the plastics to be recycled.<sup>35</sup> Because of this, the system loses recycled goods to resell.

## V. RECOMMENDATIONS:

<sup>28</sup> Green, 2019

<sup>29</sup> Ibid, 2019

<sup>30</sup> Ibid, 2019

<sup>31</sup> Levy, et al., 2019

<sup>32</sup> Ibid, 2019

<sup>33</sup> Lakhan, 394

<sup>34</sup> Ibid, 395

<sup>35</sup> Ibid, 395

After this study, there is a series of recommendations to be made to respond to the findings.

They are the following:

- Switch to multi-stream recycling from single-stream recycling
- Incorporate education on recycling within natural science classes to help people understand the system as a whole
- Have Boston College purchase recycled goods to stimulate recycling market and habituate campus behavior of using recycled goods
- Replace any disposable plastics, especially in the dining hall, with compostable products
  - Example: compostable bowls instead of the current plastic salad bowls used in Eagles Nest
- Place single-use plastics near a recycling bin to stimulate recycling

The first issue that is addressed in the recommendations is the issue of single-stream recycling. Single-stream recycling is good in theory, but was not meant to be used on such a large scale.<sup>36</sup> The process of sorting plastics out is expensive and impractical for a large scale. The general assumption is that single-stream is what every system should strive to be.<sup>37</sup> This is simply not the case.<sup>38</sup> That is why the first recommendation is to switch to multi-stream recycling. This means that all recycling must be sorted out by the person disposing of their waste. At BC's campus, most of the survey respondents indicated that time was not a barrier for recycling (Figure 9). The sorting of recycling may be feasible on campus because of the diligent population.

To help with the transition, there must be an educational aspect. This educational aspect will be important for the implementation of multi-stream recycling and establishing its importance to the environment.<sup>39</sup> A second part of this education process will include what is actually recyclable and what is not. While the population at Boston College is pretty good about this, there is still work to be done.

The educational aspect can also help the students and campus, as consumers, to better understand the entire system of recycling. While many people understand the aspect of adding

<sup>36</sup> Levy et al., 2019

<sup>37</sup> Lakhan, 396

<sup>38</sup> Ibid, 396

<sup>39</sup> Levy et al., 2019

plastic to the recycling loop, they do not understand the importance of buying plastics back from that loop. Without purchasing recycled goods, recycling will not be effective.

The next recommendation is to have Boston College actively buy recycled goods. This will create more demand for recycled material, which will drive the market of recycling.<sup>40</sup> One of the issues in today's recycling market is the lack of demand for most of the plastics that go through the system.<sup>41</sup> If institutions like Boston College and its students were to help drive the demand up, the market can begin to thrive. This thriving market is essential to the recycling market being able to take in more plastics moving forward.<sup>42</sup>

To reduce further plastic consumption, replacing the plastic cutlery with compostable products will put less strain on the recycling system to find a buyer for the usually low quality, highly contaminated plastics used in cutlery.<sup>43</sup> The move to compostables is already an effort that BC Dining is looking to go towards, which demonstrates the diligence and commitment of the organization towards sustainability.<sup>44</sup>

Lastly, the placement of single-use plastics near a recycling bin is absolutely essential to making sure that the plastics are disposed of properly.<sup>45</sup> While BC should be moving away from single-use plastics, there are times that they will be needed or used. With this reality in mind, it is important that these plastics are disposed of properly.<sup>46</sup> The placement of recycling bins near these plastics will ensure that they are properly disposed of.

One recommendation for continued research on this topic can be focusing on how to better stimulate the recycling markets on the Boston College campus. There is a level of institutional responsibility that must be taken over the recycling that is sent away. On campus, there needs to be more of an incorporation of recycled plastics for the system of recycling to work, otherwise we are just sending assorted waste to landfills. A further study on campus of where recycled plastics can be better incorporated would be an interesting direction to take based on the conclusions reached from this study.

<sup>40</sup> Ibid, 2019

<sup>41</sup> Ibid, 2019

<sup>42</sup> Ibid, 2019

<sup>43</sup> Stelmaszyk et al., 2019

<sup>44</sup> Ibid, 2019

<sup>45</sup> Largo-Wight, Erin, et al., 30

<sup>46</sup> Ibid, 30

## VI. ACKNOWLEDGEMENTS:

The researchers have been fortunate to have worked with some of the people that have made this study possible. First, we would like to thank Tara Pisani-Gareau for her support and guidance through this project. We would also like to thank Erik Levy (President of Save that Stuff), Julianne Stelmaszyk (manager of BC Dining Sustainability Team), Katie Zona (BC Dining sustainability team intern), and Bruce Dixon (Sustainability and Energy Specialist at Boston College). Erik was able to provide lots of insight as to the issues of the current recycling markets. Juli was able to give us great insight as to the BC Dining efforts to recycle. Katie was able to send over very valuable resources to this project from the BC Dining sustainability office. Bruce was able to send over some valuable reports on recycling on campus. We are thankful to have had the opportunity to work with all of these wonderful people that has made this project such a success.

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