

Campus Wide Soft Plastics Recycling



Prepared for:

Jason Wolting, University of Victoria Plastics Recycling
Manager

Prepared by:

Ryan Woodward, Gareth Marriot, Joel Cohen

Ryan Woodward

Joel Cohen

Gareth Marriott

3800 Finnerty Rd.

Victoria BC, V8P 5C2

June 27th, 2020

Jason Wolting

University of Victoria Plastics Recycling Manager

3800 Finnerty Rd.

Victoria BC, V8P 5C2

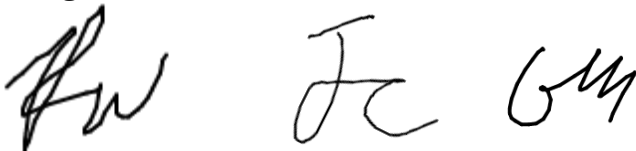
B Hut Room 110

Dear Mr. Wolting

Enclosed you will find a feasibility report in response to your RFP FM/WR 0519.

If you have any questions about this submission or if additional information is required you may reach us at rnw@uvic.ca. Thank you in advance for your attention.

Regards,



Ryan Woodward, Joel Cohen, Gareth Marriott

Enclosed: Feasibility report documentation.

Executive summary

Presently, the University of Victoria only accepts soft plastics recycling at the expanded recycling facility in the SUB (student's union building) [1]. This system is inadequate in three respects: first, it is too isolated of a location to provide the means for students to recycle soft plastics conveniently. Secondly, the current sort-it-out bins, installed in 2019, recommend throwing soft plastics in the landfill bin, with no information about the expanded recycling facility. Thirdly, in 2018 plastic bags & 'waste' took up 14.8 % of UVic Landfill Waste Composition. This was the second highest category behind food waste at 23.8 %. The proposed project would implement soft plastics recycling bins at existing sort-it-out stations. There is high potential for scalability due to existing infrastructure. This is a feasible addition to the current methods because it provides students with more bins to recycle their soft plastics. The existing sort-it-out stations would simply have the same model of bin added. Transportation of the soft plastics from the bins can easily be added to the routine of UVic Waste Management as they empty the existing bins during their routines. Initial capital costs are less than 50 % of the allocated budget. We recommend installation would begin with a trial phase at the highest traffic areas. If the trial proves successful, the soft-plastics bin solution could provide up to 3.8% of the means necessary to meet the landfill waste diversion rate of 82% [2]. This is a major goal of the UVic sustainability action plan of 2020/21.

Table of Contents

Executive summary	3
Table of Contents	4
List of Figures	5
1. Introduction	6
1.1 Client Context	6
1.2 Problem Definition	7
1.2.1 Need Statement	7
1.2.2 Goal Statement	7
1.2.3 Objectives	7
1.2.4 Constraints	8
2. Methods	8
2.1 UVic Current Recycling Plan Research	8
2.2 UVic Infrastructure Research	9
2.3 Purchasing Research	9
2.4 Installations, Maintenance, Collection Research	10
2.5 Transportation Off Campus	10
2.6 Required Cleanliness	11
3. Results	11
3.1 Recycling Plans and Waste Composition	12
3.2 On Campus Bin Infrastructure	14
3.3 Bin cost, Waste Storage Capacity and Transportation costs	16
3.3 Emterra's soft plastics cleanliness standards	17
3.4 Industrial soft plastic cleaning solutions	17
4. Discussion	18
4.1 Bin installation	18
4.2 Waste transportation cost increase	18
4.3 Cost of plastics cleaning	20
5. Recommendation	20
5.1 Soft Plastic cleaning	21

5.2 Bin Installation	21
5.3 Emterra transport cost	22
5.4 Budget Updates	22
6. Conclusion	23
References	25
Glossary	26
Appendices	28
A. Recorders Document	28
B. Work Log	29
B.1 Gareth	29
B.2 Joel	29
B.3 Ryan	30

List of Figures

Figure 3.1.1: Breakdown of UVIC's landfill waste composition 2018	12
Figure 3.1.2: Bar Graph breakdown of UVic Landfill Waste	13
Figure 3.1.3: UVic Estimated Annual Landfill Disposal Weight of Plastics in 2018	14
Figure 3.2.1: UVic Recycling and Composting Station Map	15
Figure 3.2.2: Current UVIC sort-it-out stations recommended landfill waste	16
Figure 3.3.1 Costs for Bin installation and Waste transportation	17

1. Introduction

This proposal provides a plan to implement campus-wide soft plastics recycling across the University of Victoria in an attempt to lower UVic's plastic landfill waste.

1.1 Client Context

UVic is internationally recognized as a leader in sustainability. A pillar of UVic's sustainability framework is to promote sustainable recycling programs. The university's goal is to build on the current successful framework with a new five-year sustainability action plan [2]. A mission within this plan is to provide services and infrastructure that advance the university as a Zero Waste Campus. Goals of this mission include: increasing the waste diversion rate from 75% to 82% by Dec 31, 2021, and reducing the total amount of waste produced, as measured in kilograms per campus user, by 2019.

1.2 Problem Definition

1.2.1 Need Statement

University of Victoria's 2020/21 sustainability action plan intends to increase the landfill waste diversion rate to 82% [2]. The sort-it-out stations, installed in 2019, do not have a compartment to recycle clean soft plastics nor clean styrofoam; These stations do not have information about University of Victoria's soft plastics recycling program listed. The stations recommend placing these items in the landfill waste bin (see fig 3.2.2). This means that 100% of the sort-it-out stations will fail to divert soft plastics and styrofoam from the landfill.

1.2.2 Goal Statement

The goal is to determine the feasibility of introducing a soft plastics recycling option at each of the sort-it-out stations.

1.2.3 Objectives

The proposed actions should help meet UVic's waste diversion rate of 82% [2] by diverting soft plastics away from waste bins and into recycling bins. We also hope to educate our community about soft plastic recycling by making people who might otherwise be unaware of this waste disposal

option, recycle their soft plastics. These are both working towards UVic's ultimate zero waste goal.

1.2.4 Constraints




This project is supposed to have a 5 year payback period with a maximum spending limit of \$100,000.

2. Methods

This section outlines the strategies our team used to determine the feasibility of our proposal

2.1 UVic Current Recycling Plan Research




We performed the following research on University of Victoria's recycling programs and goals:

-  Identified UVic's long term recycling objectives
-  Identified current recycling projects UVic are undertaking
-  Identified UVic's current waste diversions needs and shortcomings

We gathered this data by analyzing existing UVic documentation regarding the recycling vision moving forward.

2.2 UVic Infrastructure Research



The following methods attempted to analyze the current state of UVic's soft plastics recycling infrastructure.

-  Mapped locations of UVic sort-it-out stations
-  Investigated soft plastic waste capacity of UVic's expanded recycling station
-  Determined high traffic areas of people on campus

We analyzed existing UVic facility documentation to determine the map of current sort-it-out stations and high traffic areas. We contacted Jason Wolting about the soft plastic waste capacity.

2.3 Purchasing Research




The following methods analyzed purchasing options for soft plastic bin additions to existing sort-it-out stations:

-  Determined the type of bins needed to house soft plastics
-  Determined the cost of each bin

We corresponded with UVic facilities to determine the type of bin they use and the cost of each bin.

2.4 Installations, Maintenance, Collection Research



The following methods analyzed installation, maintenance, and on-campus collection options for soft plastic bin additions to existing sort-it-out stations:

-  Determined bin installation cost
-  Determined bin maintenance cost
-  Determined soft plastics collection cost

We emailed Leigh Anderson, UVic's Director of Customer Service and Program information about bin installation cost, soft plastics waste capacity, and soft plastics transportation capacity and costs.

2.5 Transportation Off Campus

The following methods analyzed how UVic will transport soft plastics recycling off-site:

-  Determined the on-site capacity for soft plastics to be transported
-  Determined the cost of off-site soft plastics transportation

We emailed Leigh Anderson, UVic's Director of Customer Service and Program Information, about how the soft plastics will be moved off-site, and the current transportation costs.

2.6 Required Cleanliness

The following methods investigate questions about soft plastics contamination, minimum cleanliness to be accepted at recycling facilities, and potential cleaning methods:

- ♻ Investigated microplastics contamination
- ♻ Researched soft plastics cleaning solutions
- ♻ Researched the acceptable level of soft plastic contamination
- ♻ Researched industry standard soft plastic cleaning practices

We contacted BC Hydro for information regarding the risks and acceptable levels of microplastic contamination. We also searched the internet for soft plastics cleaning solutions. We emailed UVic's recycling transportation company, Emterra, about their standards of cleanliness regarding soft plastics. We emailed the recycling council of B.C. to determine industry standards for soft plastics cleaning.

3. Results

The following outlines the data collected from the methods we used to determine feasibility in the previous section.

3.1 Recycling Plans and Waste Composition

UVic has two main goals in its sustainability action plan [2]: increase waste diversion rate to 82% by Dec 31, 2021; reduce the total amount of waste produced as measured in kilograms per campus user. UVic's recent recycling projects included the installation of the sort-it-out stations and the introduction of paper towel composting. We found UVic's plastic bags comprised 14.8% of landfill waste composition in 2018, (see fig 3.1.1) a number that has almost doubled from 2014 (see fig 3.1.2). Soft plastics #4 LDPE, which are plastic bags, and #6 PS food packaging comprise estimated landfill disposal weights of 24 294 kg and 15 270 kg respectively in 2019 (see fig 3.1.3)

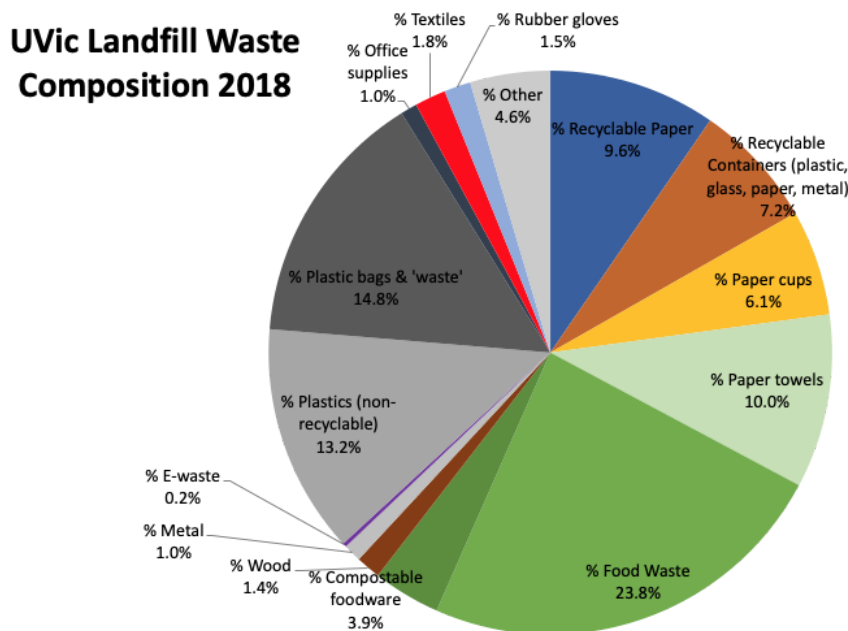


Figure 3.1.1: Breakdown of UVic's landfill waste composition 2018 [3]

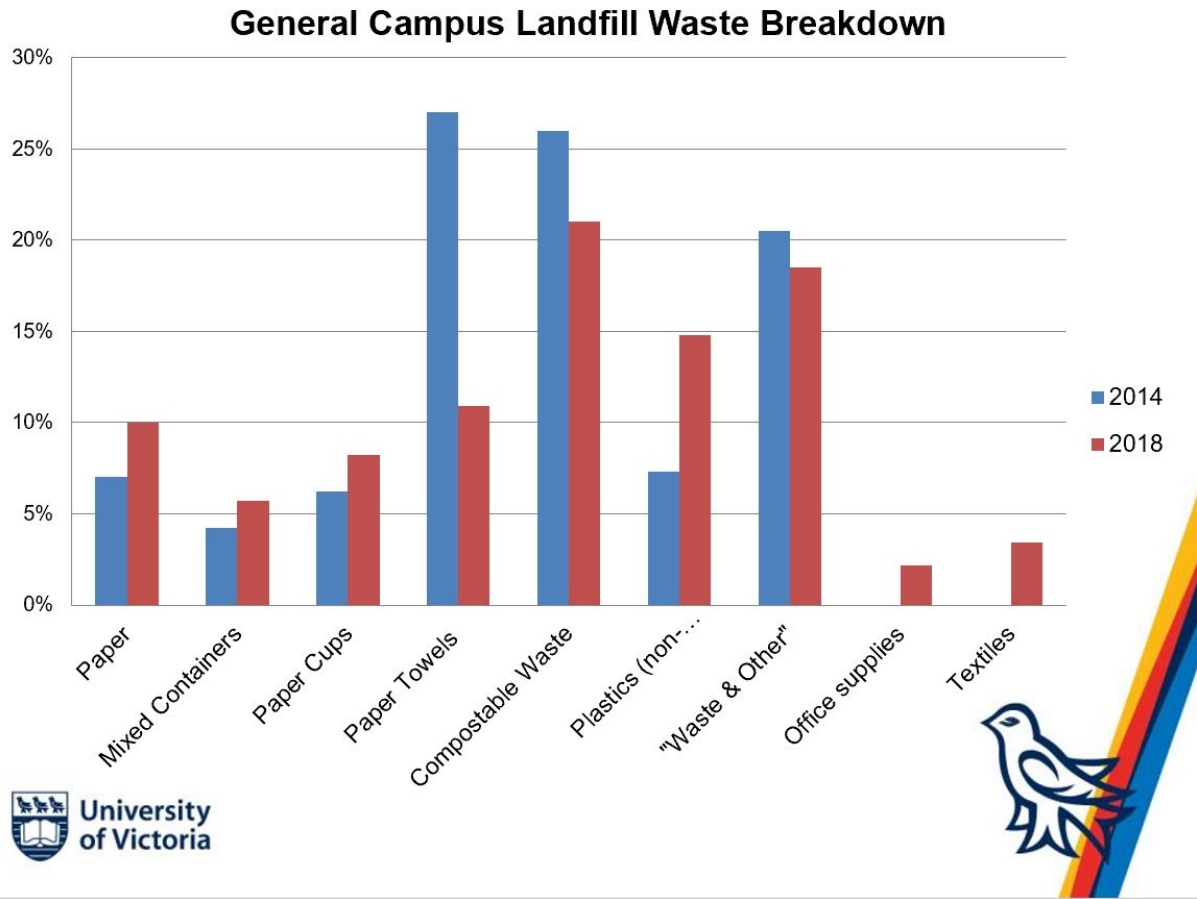


Figure 3.1.2: Bar Graph breakdown of UVic Landfill Waste [3]

UVic Estimated Annual Landfill Disposal (2018) – Plastics

*all weights in kg

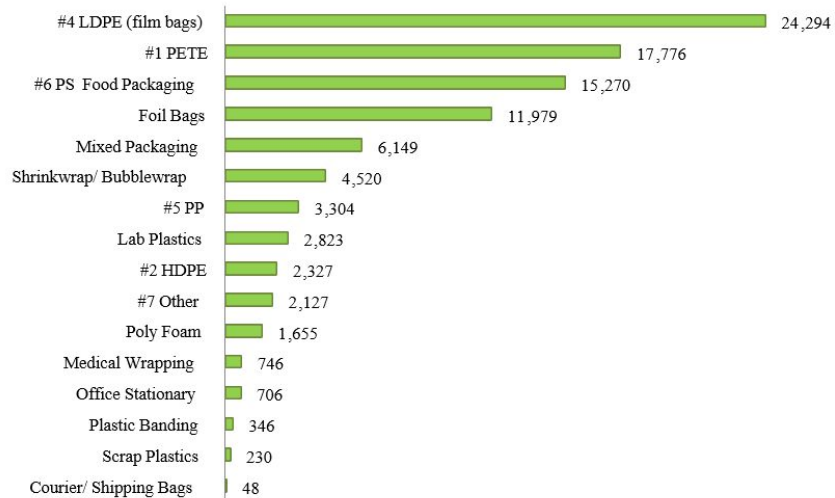


Figure 3.1.3: UVic Estimated Annual Landfill Disposal Weight of Plastics in 2018 [3]

3.2 On Campus Bin Infrastructure

UVic has only one station on campus that accepts soft plastics. It is indicated by the pink dot (see fig 3.2.1). The yellow dots indicate existing sort-it-out recycling kiosks on campus. These dots can also represent high traffic pedestrian areas. The

existing infrastructure was installed according to the potential for the area to create waste. These kiosks do not accept soft plastic as of this time (see fig 3.2.2).

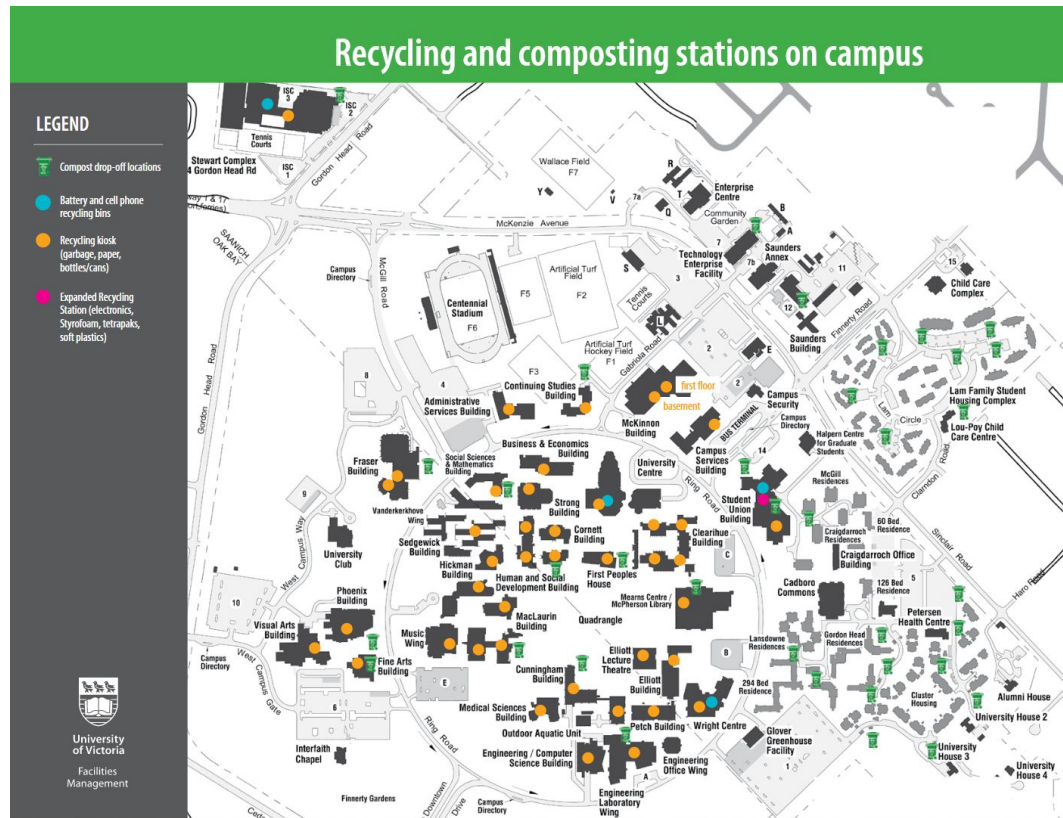


Figure 3.2.1: Uvic Recycling and Composting Station Map [4]



Figure 3.2.2: Current UVic sort-it-out stations recommended landfill waste [5]

3.3 Bin cost, Waste Storage Capacity and Transportation costs

From our correspondence with Leigh Anderson, Director of Customer Service and Program Integration, we got the following figures (see fig 3.3.1) [6]:

- ♻ The cost of each bin is \$150
- ♻ The cost of installation of 300 bins is \$45,000
- ♻ The current storage capacity on campus for soft plastic waste is 240 L
- ♻ Uvic currently pays recycling transportation company Emterra \$200,000 per year for their services

Item	Amount	Cost (CAD \$)
Bin	1	\$150
Bin installation	300	\$45,000
Emterra transportation cost	(current)	\$200,000 / year

Figure 3.3.1 Costs for Bin installation and Waste transportation

3.3 Emterra’s soft plastics cleanliness standards

Emterra accepts soft plastics that are contaminated with dyes. However, “any other type of contamination of soft plastic like significant amounts of soil, oil, etc. renders it unacceptable for recycling.” [7]

3.4 Industrial soft plastic cleaning solutions

Upon researching solutions to cleaning soft plastic our group ran into difficulties faced by many soft plastic recyclers. The process of soft plastic recycling requires plastic to be shredded into pellets and cleaned. Upon corresponding with the Recycling council of BC they informed us soft plastic recyclers in Victoria require a certain level of cleanliness prior to their shredding process. To properly clean soft plastic enough to reach emterra’s standards requires heating and manual agitation, but soft plastic has a low melting point compared to other plastics which makes the problem difficult to automate. Upon researching pre-cleaning solutions we found no simple industrial solution to deal with the shapes and sizes that soft plastic will come in at UVic.

4. Discussion

The following section discusses the results of the data collection of soft plastic bins installation at sort-it-out stations.

4.1 Bin installation

Implementation of soft plastics bins are contingent on budget restrictions. Each bin costs \$150 to install. Widespread installation at 300 sort-it-out stations would cost \$45 000. The total volume of soft plastics that each bin will collect is unknown, but can be approximated to the volume of a large garbage bag. The installation will be handled by UVic facilities. The time required to install is unknown.

4.2 Waste transportation cost increase

The cost of waste diversion vs cost can be approximated. Using an existing waste diversion percentage of 74 % and \$200 000 / year cost data, we determined that the cost for 1 % waste diversion is \$2703. The additional cost to pay Emterra to collect 84% of waste is estimated to be \$27 030 (see fig 4.2.1)

% Waste diverted vs. \$ Amount / year

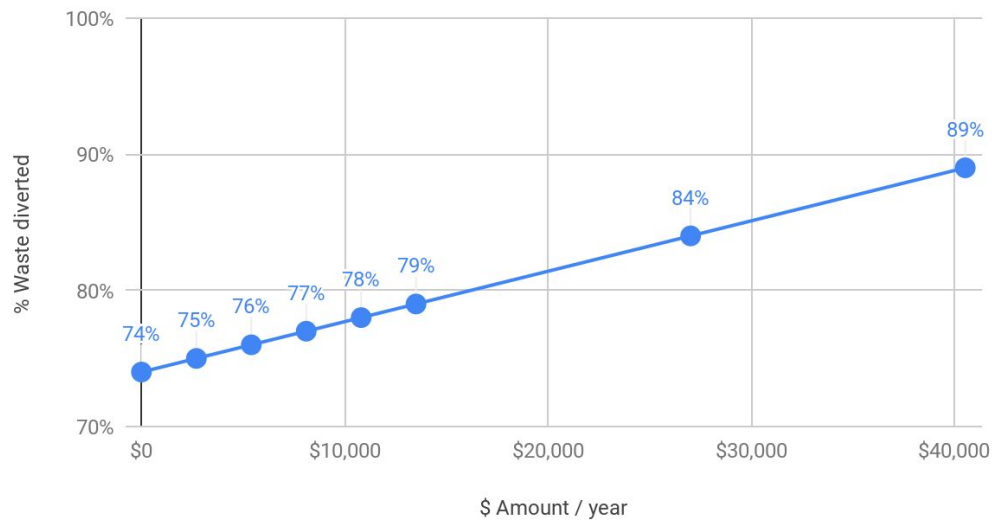


Figure 4.2.1 Waste Diversion vs. Cost of increase

Collection and transportation of soft plastics is more expensive than the current forms of recycling Emterra takes from UVic. A specific quote was not obtained, so \$27 030 is a conservative estimate.

In 2018, 14.8 % of UVic's landfill waste was made up of plastic bags and 'waste.' [3]
Assuming this figure is still roughly accurate in 2019, recycling all of this waste

could increase the landfill waste diversion rate as much as 3.8 % (14.8 % of 26 % of waste still going to landfill).

4.3 Cost of plastics cleaning

Soft plastic cleaning solutions require plastic to be pelletized prior to the start of the cleaning process. The machines need to do so is beyond the budget and requires skilled operators.

In German inventor Louis Bindernagel's investigation of the topic he found two workable solutions: manually agitating plastic in a warm water solution with an improvised drill system or using a washing machine [8]. Both require manual oversight and will require extra staffing costs. Microplastic contamination is a serious concern when using this method and BC Hydro have been contacted. BC Hydro has yet to respond on the matter. The cost of setting up the facilities to clean soft plastic is difficult to determine. A low cost solution can be as low as \$100, but it is difficult to predict the problems. We have budgeted \$500 to compensate for the uncertainty of the situation.

5. Recommendation

This section outlines our recommendations for implementation based on our research.

5.1 Soft Plastic cleaning

The soft plastic cleaning problem is nuanced and difficult to solve. True efficient handling of soft plastic requires changes to the recycling industry in victoria to offer a scalable solution to cleaning soft plastic. Louis Bindernagel's solutions [8] are the most feasible for UVic but will require an extra staff member to oversee the increased capacity of soft plastic recycling. The cost of setting up a warm water drill cleaning system is negligible but the real cost of the program is going to be the staffing cost of the new soft plastic coordinator. This new staff member will be responsible for examining and cleaning soiled soft plastic to a level determined adequate by Emterra.

This extra employee would work four times a week and incur a cost of \$12,480 per year. This figure is acquired by multiplying 16 hrs a week \times 15 dollars an hour \times 52 weeks. This employee requires no special skills and can easily be sourced from the UVic population. The employee working in conjunction with Jason would use a budget of \$500 to acquire adequate tools to assist in the cleaning of soft plastic.

5.2 Bin Installation

The installation of soft plastics bins in high traffic areas is recommended. At current sort-it-out stations soft plastics are disposed of in the landfill bin.

Installation of soft plastics bins will immediately divert all soft plastics that would otherwise go into landfill, into the soft plastics recycling stream. Assuming 60 bins will allow for collection of one fifth (60 / 300) of the soft plastics currently going

into landfill waste this will yield a soft plastics diversion increase of approximately 0.7 %. The amount diverted could even be greater than that depending on strategic placement of bins. Our estimate of the relationship between increased diversion rate and increased transportation costs is conservative, it would be a good idea to consider this a 2 % waste diversion increase in terms of transportation cost.

5.3 Emterra transport cost

Based on the estimated relationship between waste diversion and increased transportation costs (see figure 4.2.1), if we assume a 2 % increase in waste diversion, the cost of transportation of soft plastics will be \$5,620 / year.

5.4 Budget Updates

The figures we have in our budget (see figure 5.4.1) are estimates based on the data we have available. However we do not have concrete figures showing how much soft plastics each bin will collect, the actual amount of time it will take to clean the soft plastics, or an exact figure for how much transportation will cost based on the amount of soft plastics collected. Therefore, we recommend trying the solution we've laid out until the first soft-plastics collection, then update the budget based on the results.

Yearly Cost (5 Year Roll-out) - \$20,000 per year

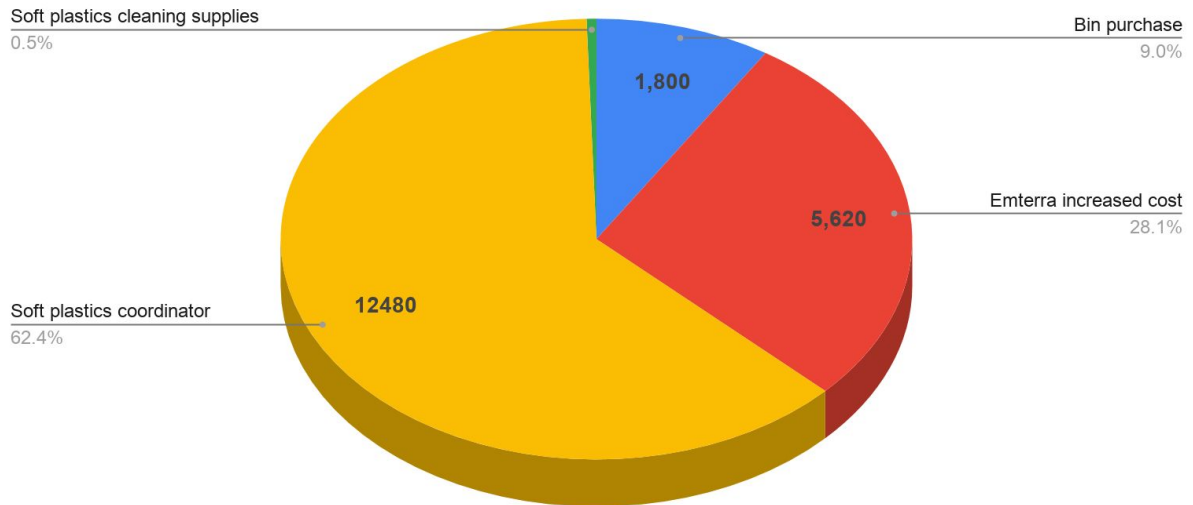


Figure 5.4.1 Yearly budget

6. Conclusion

UVic's sustainability action plan aims to increase landfill waste diversion rate to 82 % by Dec 31, 2021. Our research indicated that soft plastics are responsible for 14.8 % of the landfill waste. Currently there is only one place on campus to recycle soft plastics. Existing sort-it-out stations have direct students to throw soft plastics in the landfill bin. We propose that UVic should install soft plastic recycling bins on campus to divert this waste. To assess the feasibility of this installation: we contacted UVic facilities to learn

about bin cost, waste transportation cost, and waste storage capacity; we contacted UVic's waste transportation company Emterra for details about soft plastics cleanliness standards; and we researched soft plastics cleaning solutions. Our research indicated as follows: each bin will cost \$150, UVic currently pays Emterra \$200,000 to take their recyclables, and we could clean soft plastics for the cost of \$12,480 / year. Based on the current transportation costs, we estimate we could increase the waste diversion by 2 % for \$5,620 / year. Based on these figures, we recommend starting with 60 bins for \$9000 and \$500 for soft-plastics cleaning materials.

References

- [1] “Plastics recycling - University of Victoria,” *UVic.ca*. [Online]. Available: <https://www.uvic.ca/sustainability/topics/waste/recycle/plastics/index.php>. [Accessed: 25-Jun-2020].
- [2] “SUSTAINABILITY ACTION PLAN:CAMPUS OPERATIONS 2020-2021”, Uvic.ca. 2020. [online] Available: <https://www.uvic.ca/sustainability/assets/docs/uvic-sustainability-action-plan-2020-2021.pdf> [Accessed 28 June 2020].
- [3] Jason Wolting, “[ENGR 240 Hard Plastics Final.pptx](#)”, unpublished
- [4] Uvic.ca. 2020. [online] Available: https://www.uvic.ca/sustainability/assets/docs/FMGT_02673_RecyclingTentCardUpdate_map_webOUTrev.pdf [Accessed 29 June 2020].
- [5] UVic.ca. 2020. *Zero Waste Stations - University Of Victoria*. [online] Available at: <https://www.uvic.ca/sustainability/topics/waste/sort-it-out-stations/index.php> [Accessed 28 June 2020].
- [6] L. Anderson, *Re: Request to email*. [Personal email], 12-Jun-2020.
- [7] J. Vogelgesang, *RE: UVic Student Enquiry*. [Personal email], 18-Jun-2020.

[8] Bindernagel, Louis. “Washing-Plastic-v4.” *Https://Davehakkens.nl/*, 2 Dec. 2018, davehakkens.nl/community/forums/topic/washing-plastic-v4/.

Glossary

Emterra. (1) The waste management company responsible for UVic plastic recycling.

See also: **UVic.**

hard plastic. (1) Plastic containers marked #1 (e.g. drink bottles); #2 (e.g. milk jugs and yogurt tubs); #3 (e.g. shampoo bottles, cooking oil bottles); #4 (squeeze bottles); #5 (e.g. ketchup bottles, caps) and #7 (e.g. dvd cases) can be recycled in the mixed containers recycling bin.

Contrast with: **soft plastic.**

microplastic. (1) Microplastics are very small pieces of plastic that pollute the environment. (2) Any type of plastic fragment that is less than 5 mm in length according to the U.S. National Oceanic and Atmospheric Administration (NOAA).

pelletized. (1) The process of shredding/melting plastic to standardize the size prior to cleaning.

Recycling Council of British Columbia (RCBC). The Recycling Council of British Columbia is a registered charitable organization and is Canada's longest-serving recycling council.

sort-it-out stations. (1) UVic's all in one recycling/compost/trash station.

soft plastic. (1) Soft plastics include retail bags, other soft plastic bags (i.e. bags for bread, newspapers, produce or bulk foods), and overwrap (i.e. outer wraps for diapers and feminine hygiene products).

Contrast with: **hard plastic.**

SUB. (1) Student's Union Building

UVic (UVIC) (uvic). (1) University of Victoria

waste. (1) Non recyclable material not classified by any other category as seen in Fig. 3.1.1

waste diversion. (1) The percentage of total waste sent to recycling centers as opposed to the landfill.

Appendices

A. Recorders Document

5/22 - 21min	<ul style="list-style-type: none">♻ Group introductions♻ Designating roles♻ Timetable for meeting♻ Team Charter
5/28 - 23min	<ul style="list-style-type: none">♻ Pair proposal problem statement finalized♻ Plan of Action work divided up
5/29 - 8min	<ul style="list-style-type: none">♻ Milestone One Plan of Action remaining work divided up
5/30 - 1hr	<ul style="list-style-type: none">♻ Pair Proposal collaborative work session.
5/31 - 34min	<ul style="list-style-type: none">♻ Milestone 1 collaborative work session and submission.
6/1 - 6min	<ul style="list-style-type: none">♻ Pair proposal check-in.
6/2 - 28min	<ul style="list-style-type: none">♻ Pair proposal final revisions and submission.
6/5 - 1hr	<ul style="list-style-type: none">♻ Milestone 2 work session.
6/7 - 20min	<ul style="list-style-type: none">♻ Milestone 3 coordination meeting
6/8 - 20min	<ul style="list-style-type: none">♻ Final Report work divided up
6/16 -1hr	<ul style="list-style-type: none">♻ Final Report check-in♻ beginning work on the progress report

6/17 - 1hr	♻️ Progress report check-in and final preparations
6/23 - 16min	♻️ Final report check-in and division of labour

B. Work Log

B.1 Gareth

- ♻️ Created many of the questions for our Plan of Action
- ♻️ Participated in the pair proposal collaborative work session and lead the design of the document
- ♻️ Worked with the team to finalize the milestone one
- ♻️ Participated in Milestone 3 work session
- ♻️ Wrote script and presented half of the progress report slides
- ♻️ Led the choice of colours and style for the report 2 template
- ♻️ Began research on the soft plastic recycling process
<https://davehakkens.nl/community/forums/topic/washing-plastic-v4/>
- ♻️ Examined affordable industrial pre-cleaning solutions on websites like directindustry.com
- ♻️ Emailed the Recycling Council of BC

B.2 Joel

- ♻️ Collaborated on plan of action

- ♻️ Participated in pair proposal collaborative work session and gave input on document design
- ♻️ Collaborated on milestone 1
- ♻️ Collaborated on milestone 3 (progress report) slides
- ♻️ Wrote and presented half of the progress report
- ♻️ Created cover page for report 2 design document
- ♻️ Corresponded with University of Victoria facilities
- ♻️ Corresponded with waste diversion company Emterra
- ♻️ Wrote client background section
- ♻️ Collaborated on methods section
- ♻️ Collaborated on results section
- ♻️ Collaborated on recommendation section
- ♻️ Wrote conclusion

B.3 Ryan

- ♻️ Came up with initial proposal of soft plastics as a waste reduction tactic
- ♻️ Collaborated on plan of action
- ♻️ Participated in pair proposal collaborative work session and gave input on document design
- ♻️ Edited pair proposal document
- ♻️ Participated in Milestone 1. The creation of the team charter
- ♻️ Delegated tasks for research and data collection
- ♻️ Emailed BCHydro about micro plastic contamination

-  **Emailed RecycleBC about commercial soft plastic collection rates**
-  **Collaborated on Milestone 3 slides.**
-  **Answered questions during the team presentation**
-  **Edited presentation including content, and several slide designs**
-  **Wrote Executive Summary section**
-  **Collaborated on introduction**
-  **Collaborated on methods section**
-  **Collaborated on results section**
-  **Collaborated on discussion section**
-  **Collaborated on recommendation section**
-  **Edited the feasibility report**