

AN INVESTIGATION INTO CAMPUS WATER CONSERVATION – LOW FLOW SHOWERHEADS

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University of British Columbia

APSC 262

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AN INVESTIGATION INTO CAMPUS WATER CONSERVATION – LOW FLOW SHOWERHEADS

APSC 262 SUSTAINABILITY PROJECT REPORT



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ABSTRACT

Water is a very valuable resource that is depleting in a rapid pace. Shortage of water all over the earth is shown from time to time to create awareness of this issue. Therefore, to ensure future sustainability, the entire world is in the process of conserving water usage and rationing it. This report highlights the use of low flow shower heads for the same purpose.

It presents a comparison of the performance of current shower heads in the UBC housing and their water consumption to the new low-flow shower heads available in the market. It contains research conducted on how much water is being used currently in the different housing units and proposes solutions to reduce this usage over time while keeping in mind the triple bottom line. It contains research on different low-flow shower heads that are available in the market, their properties and some of their technical data.

Based on the most acceptable features and also keeping in mind the economic, environmental and social sustainability aspects of the triple bottom line, there are a few recommendations for selecting a new low-flow showerhead. There is also a survey that shows the social acceptance of the low-flow showerhead. The survey shows the different requirements of the society based on gender and demographic.

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Low Flow shower head:

A low flow shower head is a replacement fixture for showers. It is used to reduce the amount of water flowing through the shower's tap.

Triple Bottom Line Assessment:

This type of assessment is used to test the feasibility or performance of a system. This assessment takes into account all of the economic, environmental, and social impacts, as opposed to traditional assessments, where the single bottom line is economic cost.

Walmart:

Walmart is an American multinational retail corporation that runs chains of large discount department stores and warehouse stores.

Aeration:

The process, by which air is circulated through, mixed with or dissolved in a liquid.

LIST OF ABBREVIATIONS

UBC	University Of British Columbia
GPM	Gallons per Minute
TBL	Triple Bottom Line
UN	United Nations

1 INTRODUCTION

Water is a valuable resource and is often taken for granted. Shower heads in student housing account for a significant portion of water usage on the UBC campus. This report is an investigation into methods that would allow UBC Campus to:

- Identify existing residences that require shower head replacement to low flow shower heads.
- Identify available low-flow shower head products from certified resources.
- Carry out preliminary assessment of shower heads based on available information such as previous studies, case studies and technical specifications.
- Consider assessing user experience in existing residences, where low flow shower heads have already been installed.

1.1 OUTLINE

The report will follow the outline stated below:

- **Low-Flow Shower Head Solutions:** This section will cover some of the brainstormed results and explain why we chose these results for further assessment.
- **Triple Bottom Line Assessment:** This section covers an in-depth sustainability assessment on the selected methods.
- **Conclusion and Recommendations:** The report will be concluded by a recommendation to allow Campus Sustainability to reach its water conservation goals.

2 LOW-FLOW SHOWERHEAD SOLUTIONS

2.1 PRODUCT SELECTION

In recent years, many shower heads have been updated to more efficient models and these efficient shower heads, having reduced flow rates, may result in lower user satisfaction. However, it is more than just the flow rate which influences user experience: satisfaction is also affected by spray patterns, level of aeration, flow controls and other design features. Shower heads can also be matched to available water pressure. The range of features also suggests that high user satisfaction is possible with low flows. The following subsections outline the preliminary assessment performed on the products that we have considered to help reduce water usage in student housing at the UBC campus.

2.1.1 ECOFLOW EFN-651

DESCRIPTION:

The EcoFlow EFN-651 is a '**White**' finished Hand Held Shower Head readily available at **Walmart** and its retail price is **\$29.99**. This shower head conserves water while offering six powerful spray settings that deliver an incredibly refreshing shower experience. It reduces water consumption by up to 28%, and pays for itself in less than six months by saving up to \$60 annually on energy and water costs.

FEATURES:

1. 3.5" Diameter Head
2. Hand Shower with 5 feet Hose
3. Advanced Optiflow technology that can improve water force up to 30% by more efficiently channeling water.
4. Anti-Clog Nozzles
5. Limited Lifetime Warranty
6. Installs in minutes

7. 2.0 GPM

SPRAY SETTINGS:

1. Full Body
2. Pulsating Massage
3. PowerSpray
4. Full Body + Power Spray
5. Full Body + Massage
6. Water Saving Trickle

EcoFlow EFN-651 is also available in a '**Chrome**' finish for a retail price listed at **\$42.99**.



Figure 1: EcoFlow EFN-651

DESCRIPTION:

The EcoFlow EFS-553 is 'Chrome' finished Hand Held Shower Head readily available at **Walmart** and its retail price is **\$24.99**. This shower head conserves water while offering six powerful spray settings that deliver an incredibly refreshing shower experience. It reduces water consumption by up to 28%, and pays for itself in less than six months by saving up to \$60 annually on energy and water costs.

FEATURES:

1. 3.25" Diameter Head
2. Hand Shower with 5 feet Hose
3. Advanced Optiflow technology that can improve water force up to 30% by more efficiently channeling water.
4. Anti-Clog Nozzles
5. Limited Lifetime Warranty
6. Installs in minutes
7. 2.0 GPM

SPRAY SETTINGS:

1. Full Body
2. Pulsating Massage
3. PowerSpray
4. Full Body + Massage
5. Water Saving Trickle



Figure 2: EcoFlow EFS-553

2.1.3 ECOFLOW EPC-523:

DESCRIPTION:

The EcoFlow EPC-523 is a 'Chrome' finished Fixed Wall mount Shower Head available at a retail price of **\$19.99**. This EcoFlow shower head is designed to optimize spray force while saving half a gallon of water per minute and offering six powerful spray settings that deliver an incredibly refreshing shower experience. It reduces water consumption and pays for itself in less than a year by saving up to \$60 annually on energy and water costs.

FEATURES:

1. Water-saving Trickle Button
2. 3.25" Diameter Head
3. Advanced Optiflow technology that can improve water force up to 30% by more efficiently channeling water.

4. Anti-Clog Nozzles
5. Limited Lifetime Warranty
6. Installs in minutes
7. 2.0 GPM

SPRAY SETTINGS:

1. Full Body
2. Pulsating Massage
3. PowerSpray
4. Full Body + Massage
5. Full Body + Power Spray
6. Water Saving Trickle



Figure 3: EcoFlow EPC-523

NOTE: All the information provided on the EcoFlow Shower head products listed above are based on two 10-minute showers per day.

2.2 TRIPLE BOTTOM LINE ASSESSMENT

2.2.1 ECONOMIC

2.2.1.1 INTRODUCTION

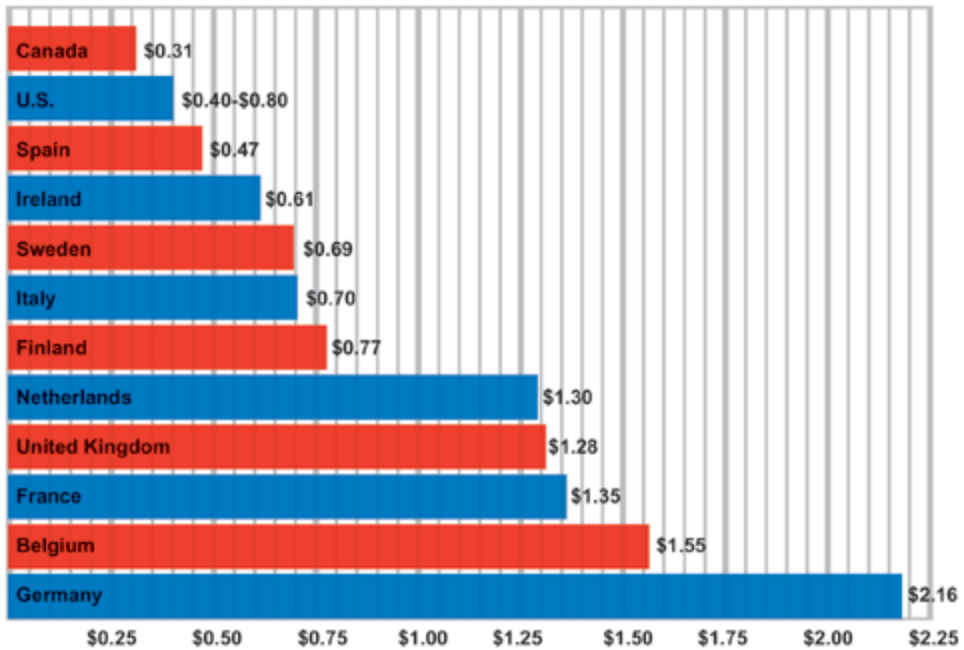
In traditional business, the fundamental bottom line refers to either making profits or deficit. Therefore, the very first aspect accessed in Triple Bottom Line (TBL) is economic. The showerheads project focuses on two aspects of the economic: cost of water and showerheads related expenses. The following paragraphs first discusses the catalysts and importance of being cost-aware in terms of water consumptions in shower, and then the following paragraphs compares the cost of our selected showerheads.

2.2.1.2 CATALYSTS OF REDUCING WATER COST AND CONSUMPTION

In the past, water has been free to use as it is considered a basic necessity and a relatively cheap and an abundant resource. However, due to the growing population in recent decades, the best way to utilize water to the most-valued uses is to put a price on water, and construct appropriate tariff structures to meet different social, political and economic goals in different situations (Rogers, 2002).

The fundamental problem of low-flow showerheads try to solve is to reduce the water usage. However, compare to other countries, water is relatively inexpensive in Canada, and hence residents are less motivated to reduce the daily water usage. The diagram below presents the water price per cubic metre among major developed countries (Environment Canada, 2013).

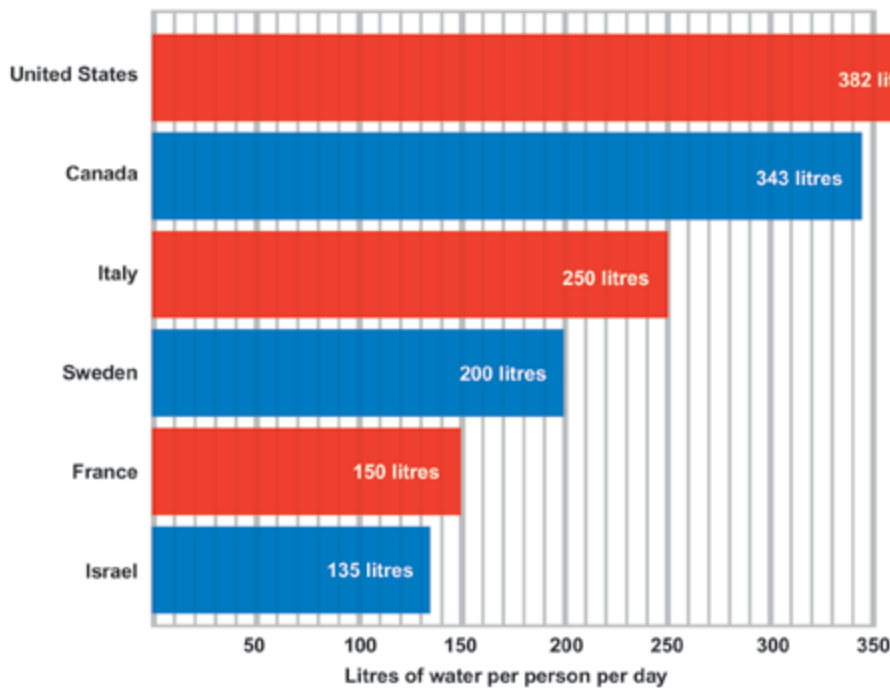
Typical municipal water prices in Canada and other countries (per cubic metre)



Graph 1: Typical Municipal water prices in Canada and other countries

The data from Graph 1 is based on a 1998 survey of developed countries and are calculated using a purchasing power parity method (The World Water Commission, 1999). We see Canada's water price is at \$0.31 per cubic metre, which is significantly lower than any other countries on the list. Graph 2 below shows top six countries with average daily water use per capita, which present a completely opposite graph (The World Water Commission, 1999).

Average daily domestic water use (per capita)



Graph 2: Average daily domestic water use

As shown in the graph, Canada and the United States, two countries with lowest water prices, have the highest water consumptions. Though the statistics cannot conclude that high water usage directly is caused by the low water prices, it is a fact that North America area has much higher water consumption than the rest of the world. Given that residents cannot actively or progressively save water upon their awareness, residency committee, however can make a significant contribution to reduce the severity of the problem by deploying low-flow showerheads.

2.2.1.3 IMPORTANCE OF CONSIDERING THE COST OF SHOWERHEADS

Prior to the beginning of this project, our team contacted our stakeholder, Mr. Bud Fraser, who is a Water and Zero Waste Engineer for UBC Campus Sustainability, regarding the budget limitation and showerheads form factor preferences. He addressed that even though there are no strict budget requirements, maintenance and cost of the showerheads must be taken into account as the residency committee has a systematic way of maintaining the functionality of

current showerheads. If the new ones require revamping the circuit and pipe layout of the building, it would be less time and cost effective. Such requirements have ruled out the automated showerheads and electronic showerheads.

Similarly, though we can improve other fixtures such as laundry and toilet use to reduce the water consumption; the expected expenses and scope are limited only to low-flow showerheads.

2.2.1.4 COMPARISONS OF THE SHOWERHEADS MODELS

Our team has chosen three different showerheads solutions: EcoFlow EFN-651, EcoFlow EFS-553, and EcoFlow EPC-523. EFN-651 and EFS-553 are of handheld form factor, whereas EPC-523 is a simple wall mount showerhead. Ricky Biring, the facilities coordinator at UBC Student Housing and hospitality Services, has also informed us that the current showerhead models in use are Delta RP44809BN (wall mount form factor) and Alson 54435-PK (handheld form factor).

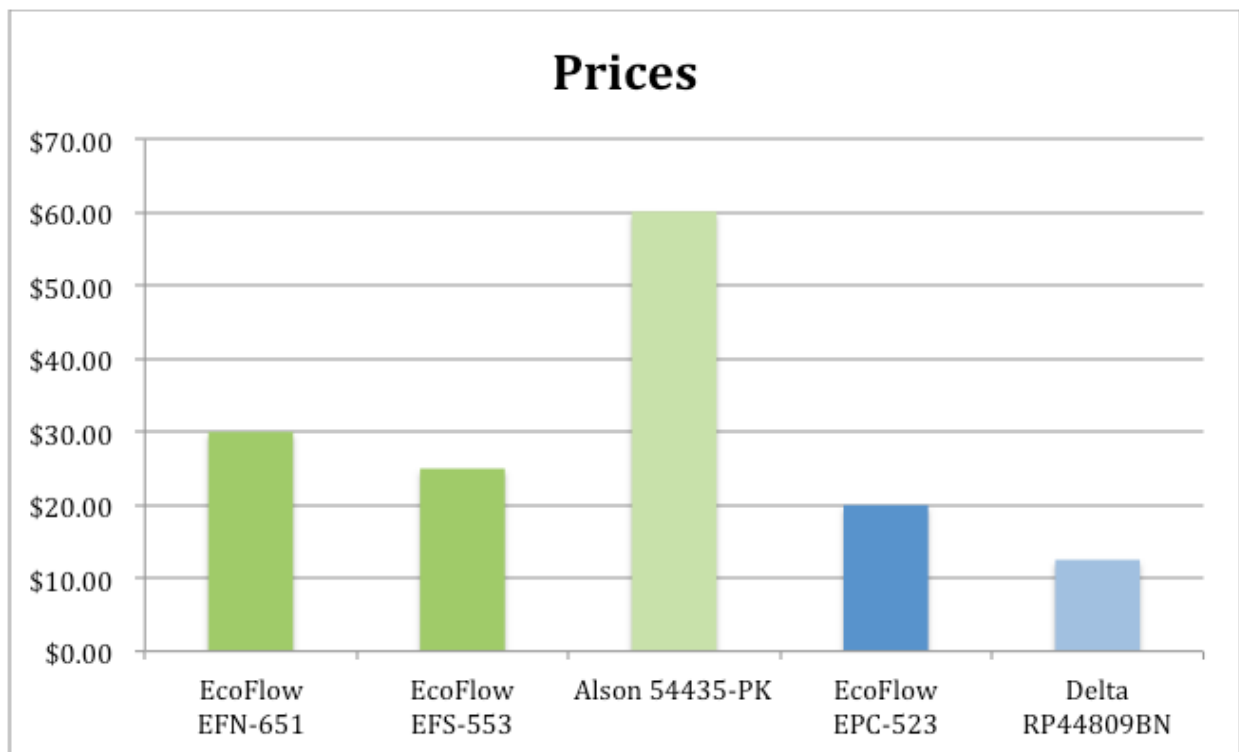
The following sections tabulate and compare the prices, installation procedures, and maintenance (warranty) of the chosen showerheads along with the existing ones. Since wall-mount showerheads are generally significantly cheaper than handheld showerheads, it is rational to view the comparisons based on the form factors, meaning that EcoFlow EFN-651, EcoFlow EFS-553 are compared with the existing Alson 54435-PK, and EcoFlow EPC-523 is compared with the existing RP44809BN.

2.2.1.5 COMPARISONS ON SHOWERHEADS PRICES

This section compares the prices of selected low-flow showerheads with the ones currently in use (Alson 54435-PK and Delta PR44809BN) in some of the residency areas. The green cells are the data for handheld form factor, and the blue cells are the data for wall-mount form factor. In addition, the bolded cells are the selected shower heads solutions.

	EcoFlow EFN-651	EcoFlow EFS-553	Alson 54435-PK	EcoFlow EPC-523	Delta RP44809BN
Prices	\$29.99	\$24.99	\$60.16	\$19.99	\$12.51

Table 1: Showerheads Price Comparison



Graph 3: Showerheads Price Comparison

In terms of handheld models, both of our solutions have significant price advantages over the existing one. EFN-651 is priced at \$29.99, half the price of Alson 54435-PK, and EFS-553 is \$24.99, even less than half the price of Alson 54435-PK.

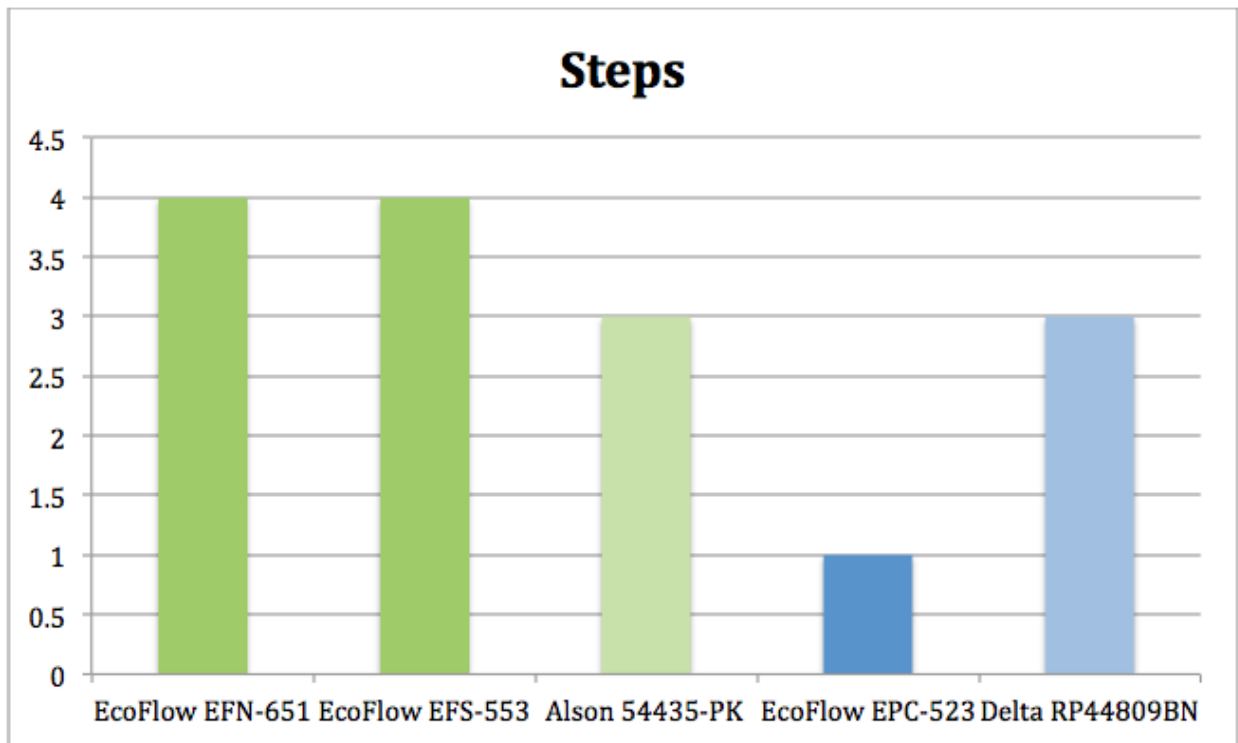
The existing wall-mount showerhead used for handicapped suites has slightly lower price point (\$12.51) than the EcoFlow EPC-523 priced at \$19.99.

2.2.1.6 COMPARISONS ON EASE OF INSTALLATION AND INSTALLATION EXPENSES

This section compares the ease of installation in terms of total number of steps needed among selected showerheads. The green cells are the data for handheld form factor, and the blue cells are the data for wall-mount form factor. Also the bolded cells are the selected shower heads solutions.

	EcoFlow EFN-651	EcoFlow EFS-553	Alson 54435-PK	EcoFlow EPC-523	Delta RP44809BN
Steps	4	4	3	1	3

Table 2: Showerheads Ease of Installation



Graph 4: Showerheads Ease of Installation

All solutions provided have an easy-to-install character. The installations do not require technicians, so no labour force and human capital is needed for installation. All EcoFlow shower heads come with user guides in the package as well as online references. Though we see that

EcoFlow EFN-651 and EFS-553 require most amount of overheads to install, the one extra step does not necessarily raise drawbacks to the EcoFlow products due to its unlimited warranty policy. More details on warranty and maintenance are discussed in the next section.

2.2.1.7 COMPARISONS ON MAINTENANCE AND WARRANTY OF THE SHOWERHEADS

This section presents the maintenance cost in terms of warranty policy. Shower heads in general do not require periodic maintenance; therefore, using warranty policy as an index of the maintenance cost is one of the rational approaches. The table below tabulates the warranty policy for all 5 policies. The information is taken directly from the user manuals from each of the products. The green cells are the data for handheld form factor, and the blue cells are the data for wall-mount form factor.

	EcoFlow EFN-651	EcoFlow EFS-553	Alson 54435-PK	EcoFlow EPC-523	Delta RP44809BN
Warranty Years	Lifetime	Lifetime	5	Lifetime	5

Table 3: Showerheads Warranty

All EcoFlow shower heads has virtually no maintenance cost. All products from EcoFlow can provide limited lifetime warranty, meaning that as long as the purchaser remains to be the owner of the showerheads, the company has the obligation to provide exchange and technical support for the products. In contrast, the shower heads currently in use, Alson 54435-PK and Delta RP44809BN, has a 5-year limited warranty. After 5 years of use, the companies no longer have the obligations to provide service for the shower heads. In conclusion, EcoFlow shower heads have apparent advantage over Alson and Delta shower heads in the warranty category.

2.2.1.8 CONCLUSION OF ECONOMIC ASPECT OF THE TBL

To conclude the economic aspect of the TBL, our team integrate all three perspectives of the economics factors (Prices, Ease of installation, and Warranty) into one table and highlight the apparently advantage each model has over others. The summarized table is shown below. Also

the bolded cells are the selected shower heads solutions. The highlighted cells are the apparent advantageous properties in the categories.

	EcoFlow EFN-651	EcoFlow EFS-553	Alson 54435-PK	EcoFlow EPC-523	Delta RP44809BN
Prices	\$29.99	\$24.99	\$60.16	\$19.99	\$12.51
Steps	4	4	3	1	3
Warranty Years	Lifetime	Lifetime	5	Lifetime	5

Table 4: Showerheads Economics

Our team claims that the hand-held shower head, EcoFlow EFS-553 has the absolute advantage over the existing Alson 54435-PK in terms of price and warranty. EcoFlow EPC-523 is more expensive than Delta RP44809BN as a wall-mount shower head, yet it has lifetime warranty and one-step installation character.

2.2.2 ENVIRONMENTAL

2.2.2.1 INTRODUCTION

Similar to economic aspect of the TBL, Environmental assessment can as well be measured quantitatively. Environmental measurement generally refers to the amount of resources (including energy, land, water) an organization uses in its operations and the by-products of the operations such as waste, air emissions, and chemical residues (Hubbard, 2009).

In terms of shower heads, the most direct index of measuring environmental impact is to use the gallon per minute (GPM). This section first introduces the motivation for B.C. residents to reduce water consumptions for environmental reasons and then discusses the GPM of each of the chosen shower heads.

2.2.2.2 WHY IS WATER USAGE AN ENVIRONMENTAL CONCERN, GIVEN B.C. BEING A WELL-HYDRATED REGION?

Though water is not yet a precious resource in most developed countries, this is not true all over the world. In Zimbabwe, for example, the degradation of the already scarce water supply has caused a cholera outbreak of epidemic proportion. Considering the fact that the world population is growing and that businesses are expanding constantly, the need of fresh water is increasing rapidly. According to the UN, water usage has grown twice the rate of population during the past century. Today, already 1.1 billion people lack access to safe water. At the same time, one flush of a western toilet uses as much water as the average person in the developing world uses for a whole day (Kappel, 2009).

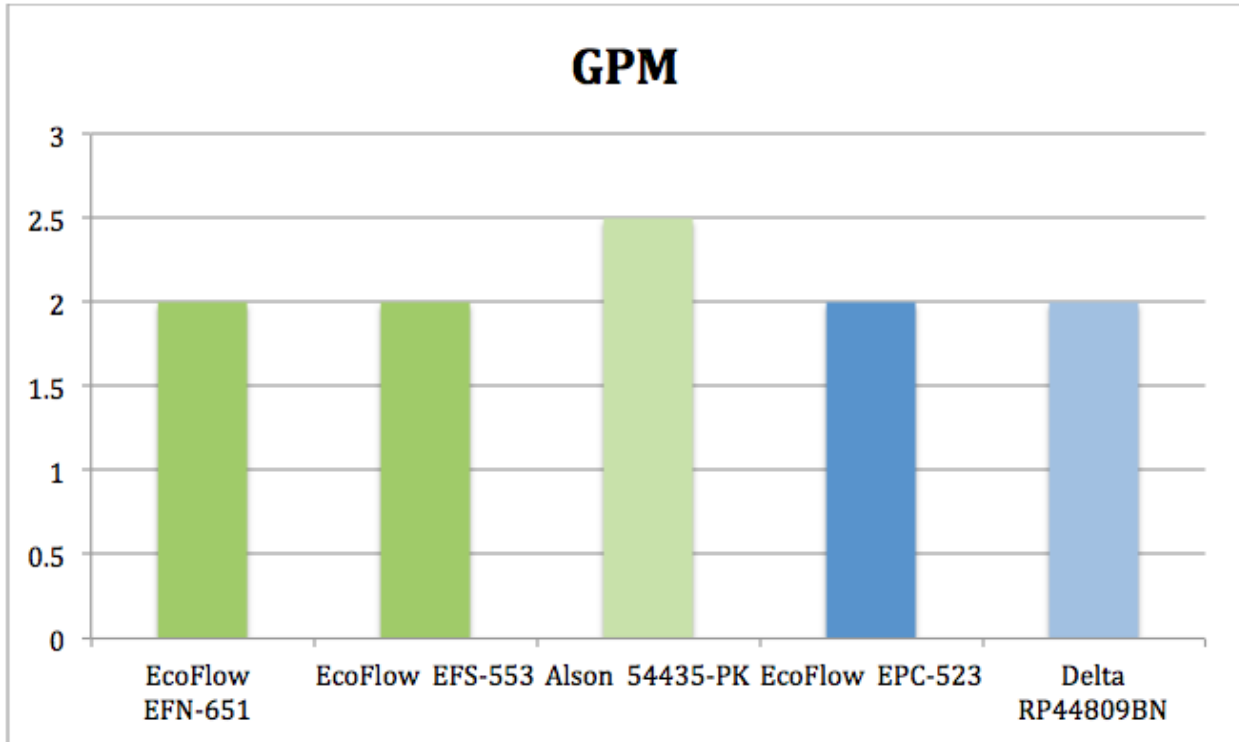
2.2.2.3 ENVIRONMENTAL COMPARISON OF SHOWER HEADS

2.2.2.3.1 WATER CONSUMPTION COMPARISONS AT SAME TIME INTERVAL

As the report mentioned before, the most direct method of comparing water consumption of shower heads is to use gallons per minute (GPM). The index is usually labelled on the package of the shower heads as well as the user manuals. The data provided below are referenced from the user manuals and guides of each shower head.

	EcoFlow EFN-651	EcoFlow EFS-553	Alson 54435-PK	EcoFlow EPC-523	Delta RP44809BN
GPM	2.0	2.0	2.5	2.0	2.0

Table 5: Showerheads Water Consumption



Graph 5: Showerheads Water Consumption

Alson 54435-PK and Delta RP44809BN has no advantage over any of the selected products in terms of water consumption. Alson 54435-PK has highest GPM value among all three handheld shower heads.

2.2.2.4 CONCLUSION OF ENVIRONMENTAL ASPECT OF TBL

In conclusion, All EcoFlow showerheads meet the Water Sense requirement, meaning that their GPM is equal to or less than 2.0. In contrast, Alson 54435-PK is unable to meet the Water Sense requirement. Though Delta RP44809BN has the same GPM rate, the lack of lifetime warranty can be a significant drawback.

2.2.3 SOCIAL

2.2.3.1 INTRODUCTION:

Social aspect of the TBL is another important factor to keep in mind while considering water conservation using Eco Low-flow shower heads. We cannot compromise the wants and needs of the society while ensuring a good economic and environmental standpoint. In simple words,

no matter how many positive economic and environmental aspects the new showerheads have, if the society does not approve of it, then no one will purchase the new shower heads. The Society should also benefit from the new Low-flow showerheads.

Unfortunately the social aspect cannot be measured quantitatively. Social needs and wants depend on a numerous factors like Comfort, Satisfaction, demographics, age and many other factors that cannot collectively be measured quantitatively.

In this section, we will see how the social aspect affects the decision of using the new showerheads and what do these decisions depend on.

2.2.3.2 HOW DOES SOCIAL ASPECT AFFECT THE DECISION OF THE SHOWER HEADS?

To figure this out, we need to know what the society needs and wants from their shower head. To understand the needs and wants of the society, our team conducted a survey of the students shower experience of those living in UBC housing. We took surveys of students from almost every student housing option available, and asked them the following questions:

1. *How important is the quality of your shower?*
2. *If your answer to the previous question was 'Important' of 'Very Important', what are the aspects of a good quality shower?*
3. *How much time do you spend in the shower per day?*
4. *How often do you shower a day?*
5. *How satisfied are you with your current showerhead?*
6. *Are you considering using a low-flow showerhead?*
7. *Would you consider using a low-flow showerhead if your current one isn't?*
8. *For what reasons would you consider using low-flow showerhead?*
9. *Does water conservation mean something to you?*
10. *What is your gender?*
11. *Which school year are you in?*
12. *What is your age?*
13. *Do you use more than one feature of a showerhead?*

14. *Would you rather use a non-low-flow showerhead that has better user experience?*

15. *Which residence are you living in?*

2.2.3.3 RESULTS:

The results from the Survey are in Appendix B.

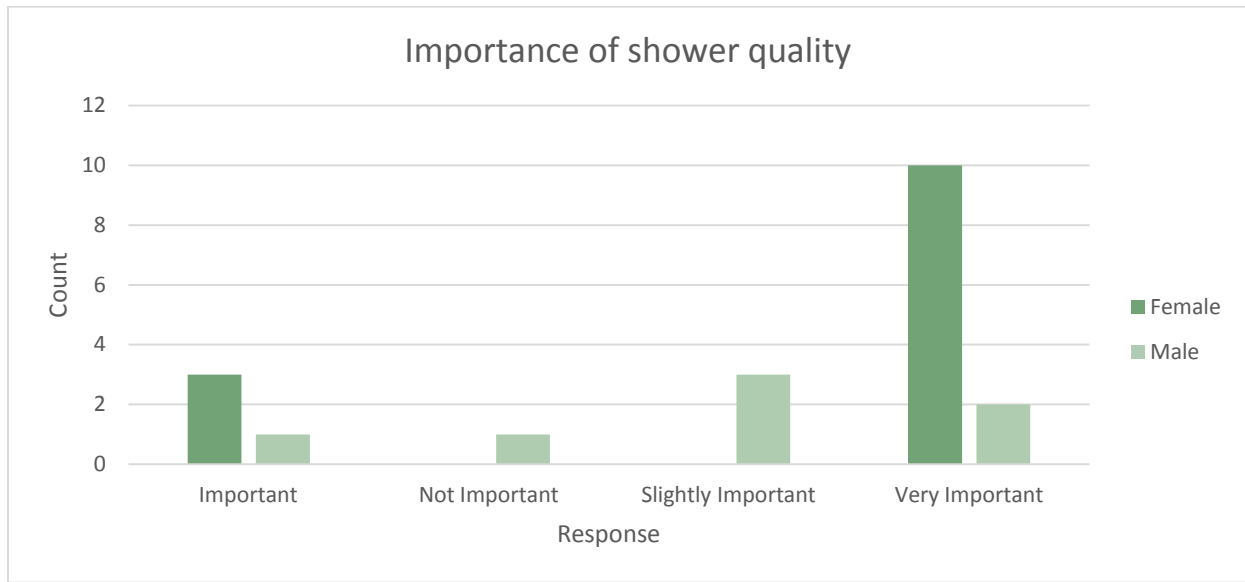
2.2.3.4 ANALYSIS

Here is an analysis of the results of the survey. The detailed graphs and tables of the result analysis can be found in the appendix. The analysis was conducted with respect to gender response for simplicity and easy comparison.

2.2.3.4.1 IMPORTANCE OF SHOWER QUALITY:

Importance of shower quality	Gender	
	Female	Male
Important	3	1
Not Important		1
Slightly Important		3
Very Important	10	2
Grand Total	13	7

Table 6: Importance of Shower Quality



Graph 6: Importance of Shower Quality

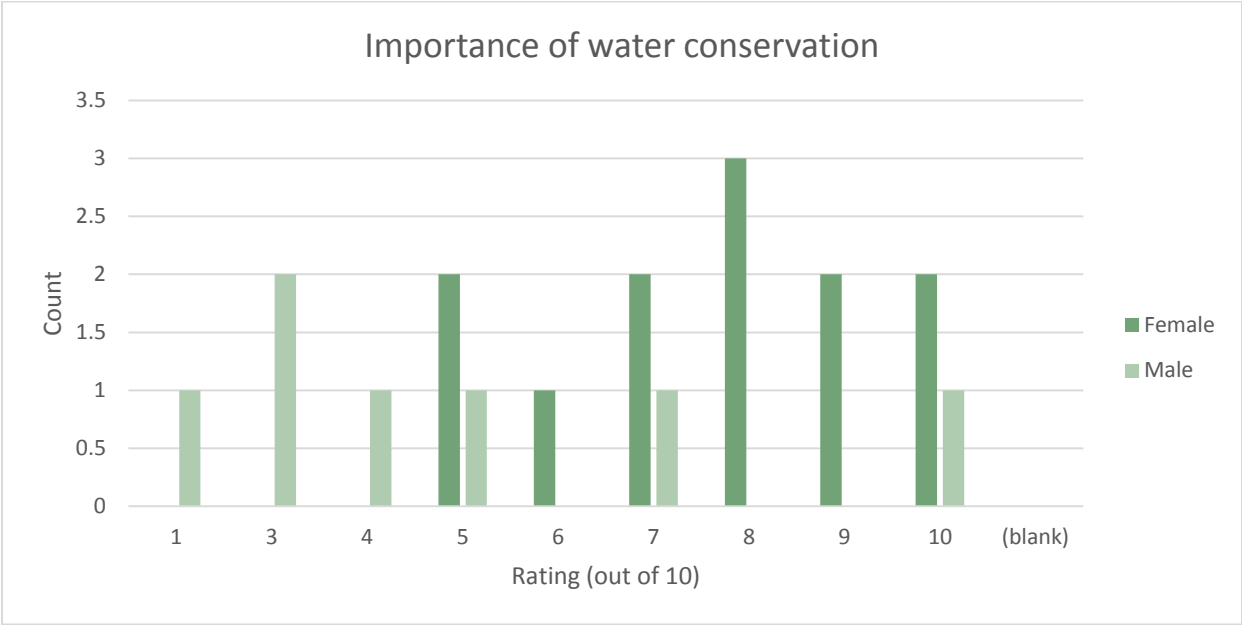
The above data shows that the quality of shower is important to most students.

2.2.3.4.2 IMPORTANCE OF WATER CONSERVATION:

Importance of water conservation	Gender	
	Female	Male
1		1
3		2
4		1
5	2	1
6	1	
7	2	1

8	3	
9	2	
10	2	1
Grand Total	12	7

Table 7: Importance of Water Conservation



Graph 7: Importance of Water Conservation

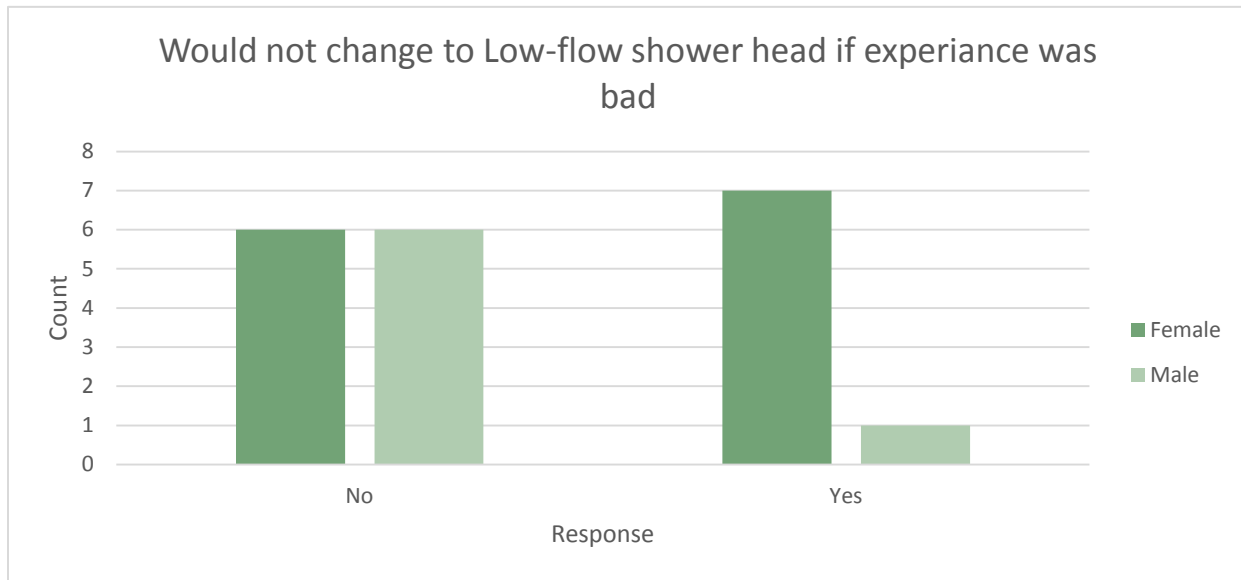
The above data shows that students would rate the importance of water conservation at an average of 7.5.

2.2.3.4.3 CHANGE TO LOW-FLOW SHOWERHEAD DESPITE QUALITY:

Would not change if experience was bad	Gender	
	Female	Male
No	6	6

Yes	7	1
Grand Total	13	7

Table 8: Change Low-flow Showerhead



Graph 8: Change Low-flow Showerhead

From the above data it can be seen that on average even if the user experience was bad from the low-flow showerhead then most students would still want to change to low-flow shower heads.

2.2.3.4.4 TIME SPENT IN THE SHOWER:

From the results it can be seen that the average time spent in the shower is between 15 to 20 minutes.

2.2.3.4.5 NUMBER OF SHOWERS A DAY:

It can be seen from the results that most students take shower only once a day.

2.2.3.4.6 CURRENT SHOWER HEAD SATISFACTION:

The average results show that the students would rate their current shower experience to be 7 out of 10.

2.2.3.4.7 CHANGE TO LOW FLOW SHOWER HEAD:

Most students would want to change to low flow shower heads.

2.2.3.4.8 THE REASON FOR CHANGING TO LOW FLOW SHOWER HEADS:

Most students would change to low flow shower heads because of environmental reasons and to save on their water bills.

2.2.3.4.9 YEAR OF STUDY:

Most students who took the survey were from second year.

2.2.3.4.10 AGE OF THE STUDENTS:

The average age of the students who took the survey was 19-20 years.

2.2.3.5 CONCLUSION:

Based on the results of the survey, it can be seen that most of the students do not know whether they are using low flow shower heads. If they were given a choice, majority of them would opt to use low flow shower heads even if they did not receive as good a user experience. Their main reason to change to low flow shower head is due to environmental concerns and lowering their water bills.

3 CONCLUSION AND RECOMMENDATION

As an Applied Science project group of UBC, our goal was to investigate the usage of Low-flow Showerheads at the UBC housing. After thoroughly investigating different sustainable and cost efficient models of showerheads in the market, the group would like to recommend two products to improve the shower head system currently being used at the UBC housing.

Firstly, in the handheld form, the group would like to recommend the EcoFlow EFS-553 over the already existing Alson 54435-PK due to its advantage in price, warranty, ease of use and reduced water consumption. Secondly, as a wall-mount shower head, it is highly recommended to use the EcoFlow-523 over the already existing Delta RP44809BN shower head due its lifetime warranty and one-step installation character.

In addition to the Economic and Environmental factors, based on the research on the new Low-flow Showerheads and the social response, it can be concluded that switching to low-flow showerheads will meet the water conservation objective provided the user experience is not degraded.

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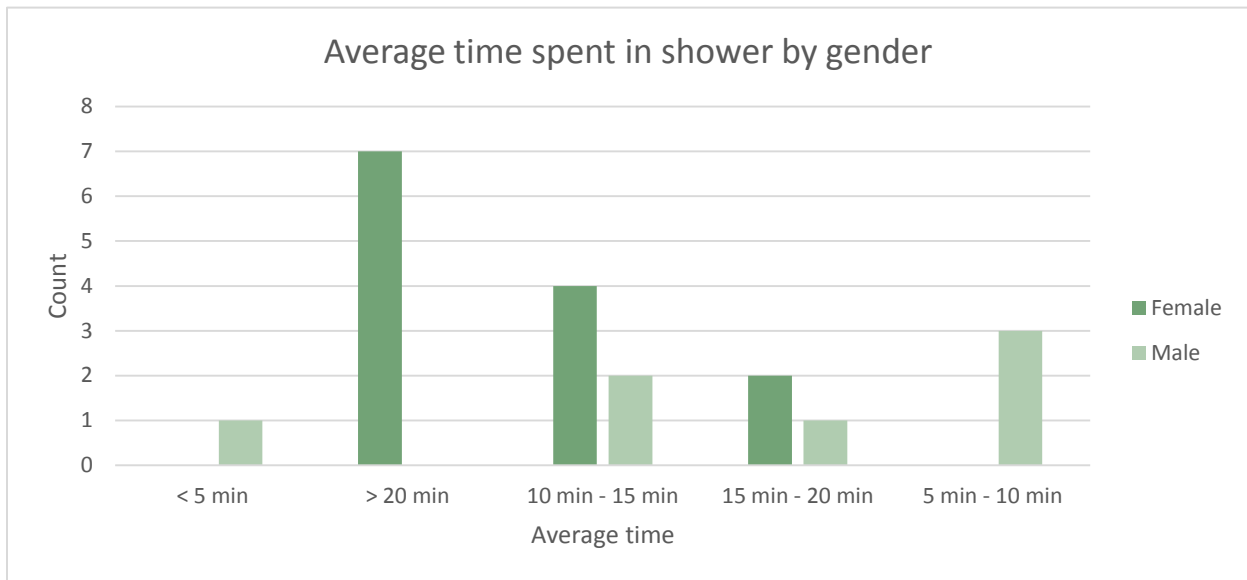
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APPENDIX A – UBC HOUSING SURVEYS

Average time spent in the showers:

Average time spent in showers	Gender	
	Female	Male
< 5 min		1
> 20 min	7	
10 min - 15 min	4	2
15 min - 20 min	2	1
5 min - 10 min		3
Grand Total	13	7

Table 9: Average Time Spent in Showers

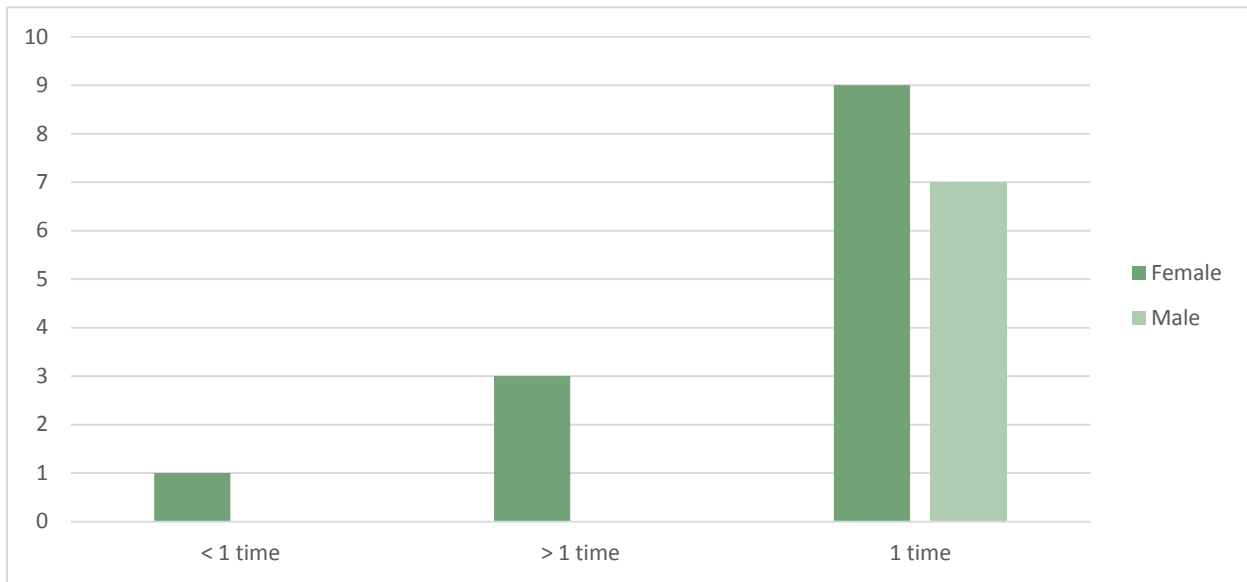


Graph 9: Average time spent in shower by Gender

Number of showers a day:

Number of times showered in a day	Gender	
	Female	Male
< 1 time	1	
> 1 time	3	
1 time	9	7
Grand Total	13	7

Table 10: Number of times showered a day



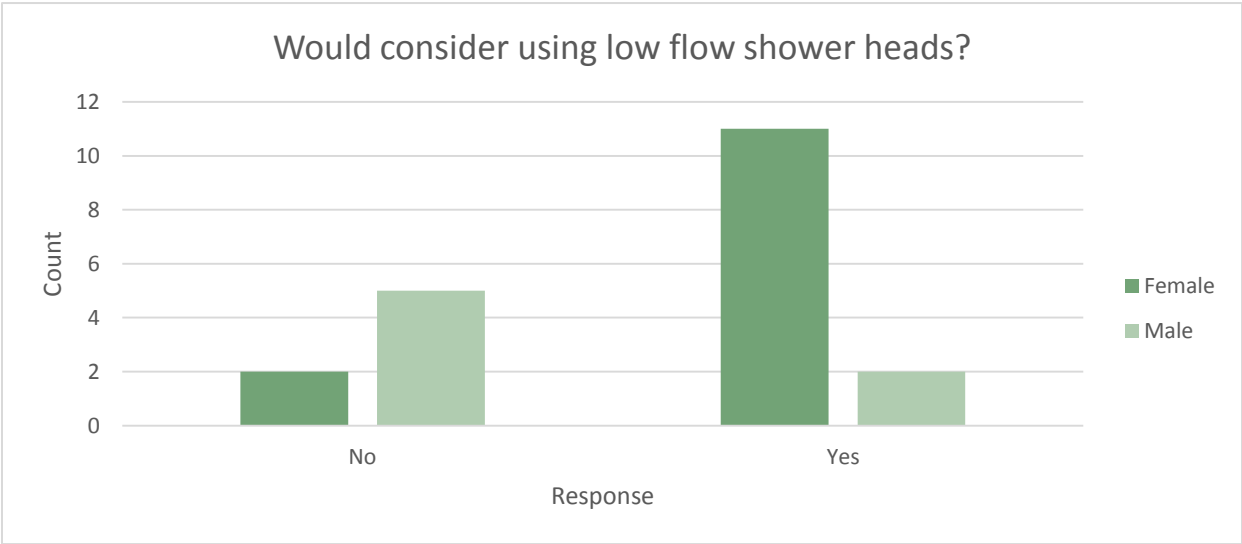
Graph 10: Number of times showered a day

Would change to low-flow shower heads:

Count Using low Flow Shower heads	Gender	
	Female	Male

No	2	5
Yes	11	2
Grand Total	13	7

Table 11: Count using Low-flow Showerheads



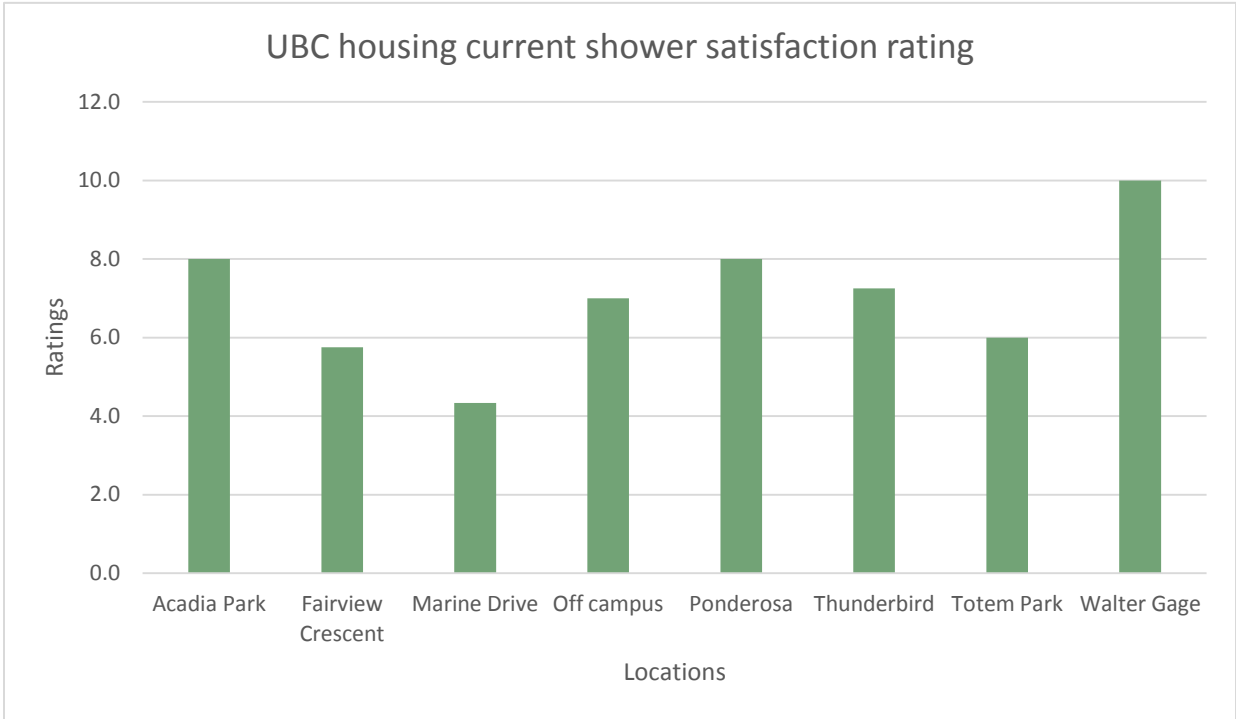
Graph 11: Count using Low-flow Showerheads

Place of residence:

Residence	Avg. Rating
Acadia Park	8.0
Fairview Crescent	5.8
Marine Drive	4.3
Off campus	7.0
Ponderosa	8.0
Thunderbird	7.3

Totem Park	6.0
Walter Gage	10.0

Table 12: UBC housing current shower satisfaction rating



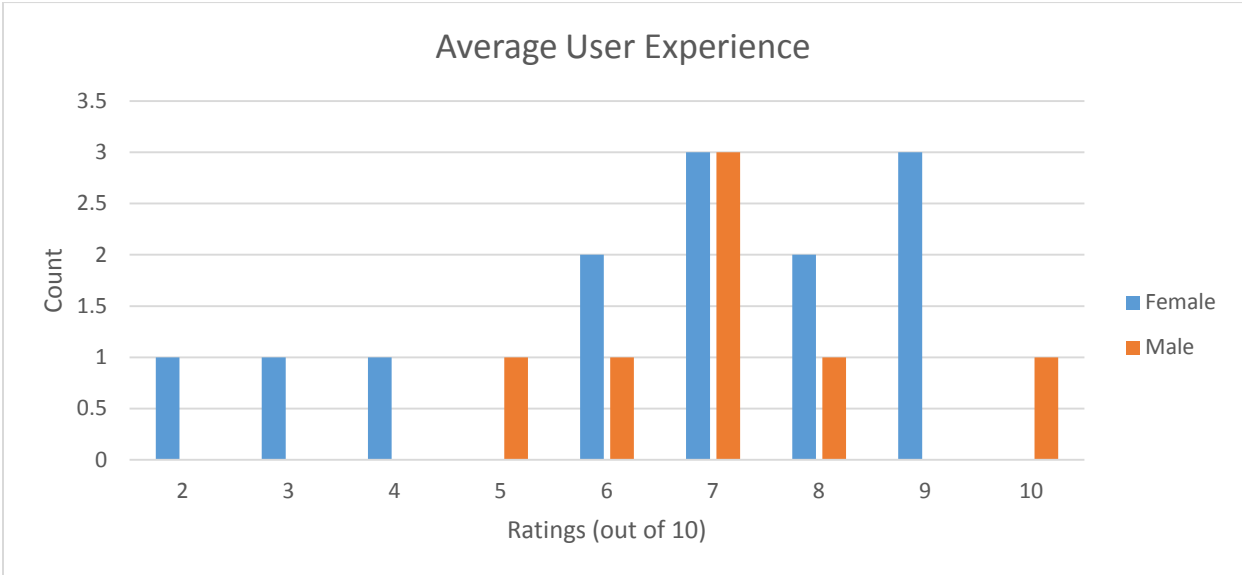
Graph 12: UBC housing current shower satisfaction rating

User Experience:

User experience index (out of 10)	Gender	
	Female	Male
2	1	
3	1	
4	1	
5		1

6	2	1
7	3	3
8	2	1
9	3	
10		1
Grand Total	13	7

Table 13: User Experience



Graph 13: Average User Experience

Link to the Survey:

https://docs.google.com/forms/d/1773pKQQMbAvyAg2h31o9i8pzGYJaq9_Z7x_KGK728Bs/view_form

APPENDIX B –SURVEY RESPONSES