UBC Social Ecological Economic Development Studies (SEEDS) Student Report

AN INVESTIGATION INTO LOW-FLOW SHOWERHEADS IN PLACE VANIER'S TEC DE MONTERREY RESIDENCE

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APSC 261

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APSC 261 INVESTIGATION REPORT

Submitted to David Gill, SEEDS Coordinator

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ABSTRACT

This report provides insight to UBC Student Housing and Hospitality Services about possible alternative showerheads for Place Vanier's Tec de Monterrey to decrease water consumption whilst providing a satisfactory experience to students living as residents. This report builds on previously conducted reports of showerheads and provides alternatives that are more affordable and provide long term benefits. Viability of shower heads will be assessed through a Triple Bottom Line (TBL) assessment.

A TBL assessment evaluates the environmental, social, and economic impacts of each alternative. The report compares three proposed alternative shower heads: the Niagara Earth Massage, WaterPik Model ETC-411, and American Standard 1660.710.002 to the current replacement showerhead Delta RP44809BN. To assess environmental impacts, an estimate of average water consumption of each shower head is provided; the social impacts are determined through a satisfaction survey offered to TDM residents. The economic impacts are estimated using a life cycle cost analysis of each shower head.

The TBL analysis has determined that the American Standard 1660.710.002 has the most balanced performance compared to all other alternatives. Analysis of survey results and the TBL assessment agree with this result.

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GLOSSARY

Watersense:	A U.S. Environmental Protection Agency program designed to advocate water conservation by promoting and labeling water efficient products using watersense labels.
Low-flow showerhead:	A type of showerhead that uses significantly less water and energy than a conventional showerhead model.
Life-Cycle Costs:	The sum of all fixed and variable costs over the lifespan of a product.

LIST OF ABBREVIATIONS

GPM:	Gallons Per Minute
TBL:	Triple Bottom Line
UBC:	University of British Columbia
LCC:	Life Cycle Cost
SEEDS:	Social Ecological Economic Development Studies
SHHS:	Student Housing and Hospitality Services
TDM:	Tec de Monterrey
EPA:	Environmental Protection Agency
DR:	Delta RP44809BN
NE:	Niagara Earth Massage
WP:	WaterPik Model ETC-411
AS:	American Standard 1660.710.002
WAP:	Water Action Plan
LFS:	Low-Flow Showerheads

1.0 INTRODUCTION

This report provides information on the use of low-flow showerheads in Place Vanier's Tec de Monterrey of University of British Columbia's Vancouver campus. The goal of this project is to assess the feasibility of low-flow shower heads in residence by considering their social, environmental, and economic factors.

The University of British Columbia (UBC) is currently working towards a sustainable campus; water conservation is a main focus as evidenced by UBC's Water Action Plan (WAP) [UBC 2013]. Figure 1 shows the water usage distribution at UBC. Showers make up 13% percent of the total water usage [UBC Sustainability, 2011], the fifth highest amount on campus. Low-flow showerheads (LFS) have a significantly lower water consumption rate than regular shower heads while providing similar performance making them an attractive option for saving water.

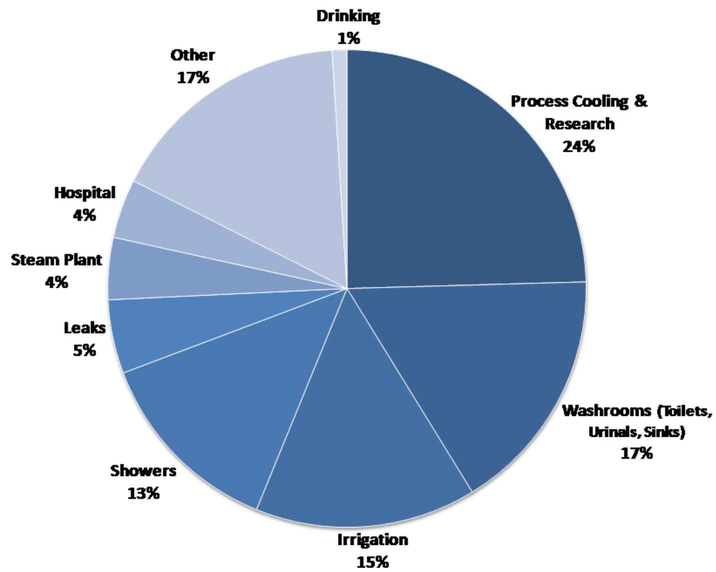

Figure 1. Water Usage at UBC
Source: <sustain.ubc.ca>

User satisfaction, water consumption, and showerhead cost were three major factors that influenced showerhead decisions. All alternatives: the Niagara Earth Massage (NE), WaterPik Model ETC-411 (WP), and American Standard 1660.710.002 (AS) have lower costs to the current Delta RP44809BN (DR) showerhead and also consume much less water. To test user satisfaction, the showerheads were set up temporarily for students in residence and surveys were given out to collect data on showerhead preference.

The next sections provide a description of the methodology used, technical specifications of each showerhead, survey results/calculations, a Triple Bottom Line (TBL) assessment, and recommendations.

2.0 METHODOLOGY

In the selection process for alternative showerhead models, priority was given to showerheads that displayed exceptional water efficiency for its fixed cost. The reasoning behind this is that the selection for showerheads were made before any detailed investigation was conducted; although social, economic, and environmental components are ideally weighed equally, it is difficult to evaluate social aspects or variable costs without delving into further research. Therefore emphasis was first placed on water conservation because this was the most significant long-term variable. Then the product prices, as well as available of large-scale ordering, were considered. Table 1 displays the current showerhead replacement, and the selected alternative models along with their corresponding flow rate in GPM* and approximate prices online.

Table 1. Showerhead Models

Showerhead Model	Flow Rate (GPM)	Price ($)
Delta RP44809BN	2.0	14.99
Niagara Earth Massage	1.25	8.30
WaterPik Model ETC-411	1.6	12.99
American Standard 1660.710.002 Spray Pattern	1.5	12.99

After the model selection process was completed, Facilities Coordinator of SHHS* Ricky Biring, organized the installation of the alternative showerheads on the 3rd floor of TDM. Due to unforeseen circumstances however, the WP model was not purchased and tested on. Each of the other showerheads were installed and tested for 3 to 4 days. The demographics of the residents subject to this test was co-ed UBC students.

Multiple showerhead project groups submitted survey questions to UBC SEEDS* Coordinator, David Gill. These questions were made to help evaluate each of the showerhead products. David selected the intersection of submitted questions and created the survey which also asked general questions. The general questions included obtaining user demographics, usual shower durations and patterns, and gauging the user's value for water conservation. The main focus of the survey was to obtain data on user satisfaction of each showerhead. The users were asked to rate the pressure, spread, and overall functionality of the specified showerhead product.

These procedures were carried out so that an accurate TBL assessment could be carried out to represent the feasibility of each selected alternative showerhead.

3.0 TECHNICAL SPECIFICATIONS

3.1 Current Shower Head: Delta RP44809BN 2.0GPM

The Delta RP44809BN (Figure 1) shower head is the current replacement that is used in all residences. The Delta shower head passes the specifications required to obtain a Water Sense label. Any shower head with this label has a GPM of no more than 2.0 and performs better than its counterparts as evaluated by the EPA (Environmental Protection Agency). Although this product is Water Sense certified, there still exists more efficient alternatives.

Figure 2. Delta RP44509BN Spray Pattern
Source: Home Depot, 2013 <www.homedepot.com>

Table 2. Delta RP44809BN Technical Specifications

Flow Rate	2.0 GPM
Weight	136 g
Head Length	73.0 mm
Head Diameter	50.8 mm

Angle	Adjustable Angle
Mounting Type	Fixed Mount
Spray Settings	10 - Jet Needle
Material	Brushed Nickel

Source: The Home Depot, 2013 <http://www.homedepot.com>

3.2 Alternative 1: Niagara Earth Massage 1.25GPM

The Niagara Earth Massage 1.25GPM (Figure 2), manufactured by Niagara's Earth® Showerheads, are the leading product for saving water as they use 50% less water than other low-flow showerheads currently available on the market. To make up for its minimal water flow rate, the showerhead uses its patented pressure compensating technology to provide a feeling of greater force. The water stream of this showerhead is non-aerated, resulting in less temperature loss and greater energy savings. Below, Figure 2 represents the spray pattern and Table 2 provides the technical specifications for the Niagara Earth Massage 1.25GPM.

Figure 3. Niagara Earth Massage Spray Pattern
Source: Amazon, 2010 <www.amazon.com>

Table 3. Niagara Earth Massage Technical Specifications

Flow Rate	1.00-1.25 GPM
Weight	90.7 g
Head Length	105 mm
Head Diameter	68 mm
Angle	Adjustable Angle
Mounting Type	Fixed Mount
Spray Settings	9-Jet Needle, Massage, Combination
Nozzle Quantity (Spray dependant)	9-45
Material	White/Chrome Finish
Maintenance	Corrosion-Resistant, Maintenance-free

Source: Ecofitt, 2014 <www.ecofitt.ca>

3.3 Alternate 2: American Standard 1660.710.002 FloWise Water Saving Showerhead 1.5 GPM

The American Standard 1660.710.002 FloWise Water Saving Showerhead, manufactured by American Standard®, features a single-function turbine spray that rotates on a swivel ball. This showerhead uses its patented turbine technology which pressurizes and spins water to provide a relaxing and vitalizing spray while producing only 1.5 GPM. Below, Figure 3 represents the spray pattern and Table 3 provides the technical specifications for the American Standard 1660.710.002.

Figure 4. American Standard 1660.710.002 Spray Pattern
Source: Amazon, 2009 <www.amazon.com>

Table 4. American Standard 1660.710.002 Technical Specifications

Flow Rate	1.5 GPM
Weight	181.4 g
Head Length	125 mm
Head Diameter	125 mm
Connection Length	12.7 mm
Angle	Adjustable Angle
Mounting Type	Fixed Mount
Spray Settings	Turbine Spray
Material	Metal with Polished Chrome/Nickel Finish

Source: The Home Depot, 2009 <www.homedepot.com>

3.4 Alternative 2: WaterPik Model ETC-411 1.6 GPM

The WaterPik Model ETC-411 (Figure 3) is an eco-friendly shower head that is WaterSense certified, using 20% less water than models with similar performance. This shower head has four settings: Pulsating Massage, Full Body Spray, Full Body and Massage, Water-Saving Trickle providing users with selection for an optimal showering experience. With its 1.6 GPM and 80 PSI, it provides superior water saving potential compared to the current Delta shower head. This model was chosen, but not used for the investigation due to insufficient time.

Figure 5. WaterPik Model ETC-411 Spray Pattern
Source: Amazon, 2010 <www.amazon.com>

Table 5. WaterPik Model ETC-411 Technical Specifications

Flow Rate	1.6 GPM
Weight	226 g
Head Length	95.25 mm
Head Diameter	82.55 mm
Angle	Adjustable Angle
Mounting Type	Fixed Mount
Spray Settings	Pulsating Massage, Full Body Spray, Full Body and Massage, Water-Saving Trickle
Material	Plastic

Source: <http://www.peaksalesandmarketing.com/docs/Waterpik_ETC-411.pdf>

4.0 SURVEY RESULTS

The survey used in the investigation (can be found in Appendix A) targeted individuals of Tec de Monterrey, third floor, which consisted of co-ed individuals ranging from age 18 - 24. The sample size was approximately 10 people. Surveying spanned across three weeks. Each of the three sets of surveys (one for each showerhead) were distributed at the beginning of the week which was also the time of showerhead replacement. Results for each set were also collected before distribution of the next set of surveys. The questions on the survey assessed the following:

- shower time
- shower frequency
- factors that influence results (eg. spread, pressure, etc.)
- user satisfaction

Figure six shows the average shower duration of residence demonym with respect to each showerhead. The DR showerhead has the lowest shower duration, out of the three showerheads, likely resulting from the higher 2.0 GPM flow rate.

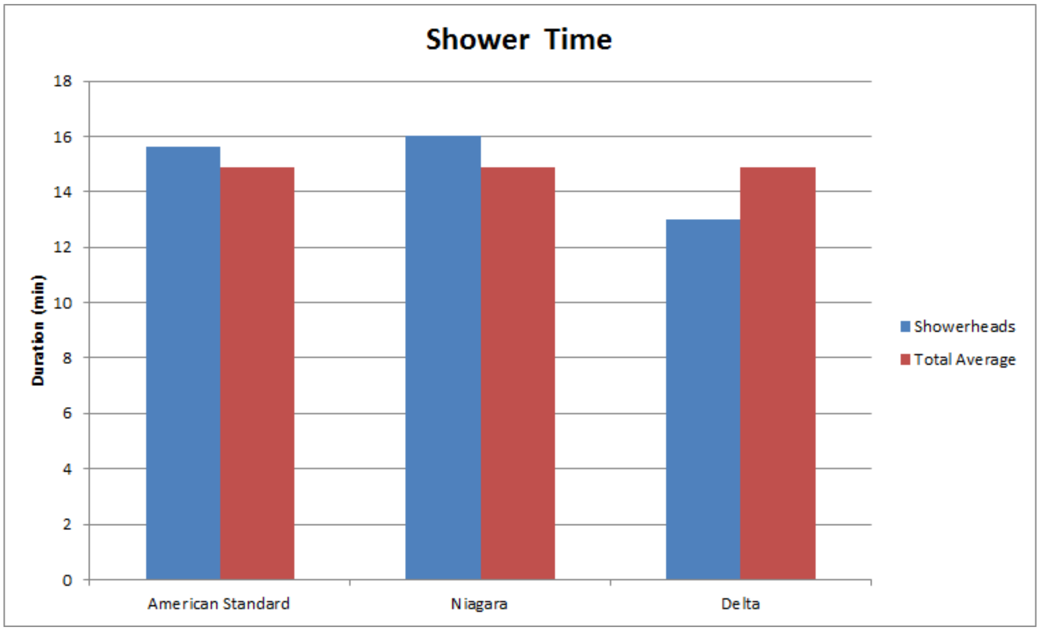

Figure 6. Shower Durations

Although the DR showerhead duration is the lowest, it does not necessarily save the most water as the NE and AS showerheads have significantly lower flow rates. However, having shorter shower durations allows students to have more time for their busy schedules and is more efficient during high occupancy times.

The pressure evaluation of each showerhead is shown in Figure 7. An average rating of 3 is the ideal pressure; a rating more than three means too much pressure is exerted while a rating less than three means there is insufficient pressure. The NE showerhead shows a significant lack of pressure. This may be due to the extremely low 1.25 GPM. The patented pressure-compensating technology seems to be lackluster providing weak results.

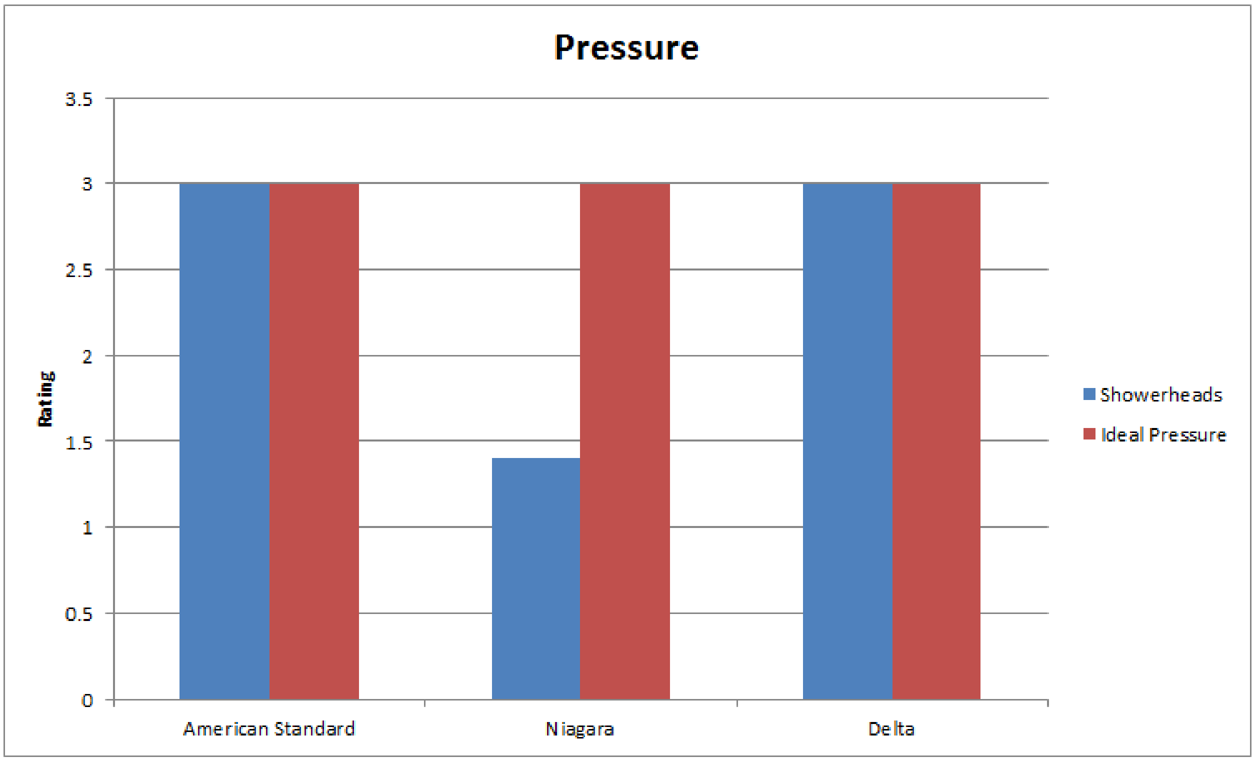

Figure 7. Flow Pressure

Survey results showed that each showerhead had an ideal amount of spread. Figure 8 illustrates that both the AS and NE showerheads had slightly greater than ideal spreads, but both these showerheads have an adjustable spread setting. A lack of knowledge by the demonym may have resulted in these slightly imbalanced results.

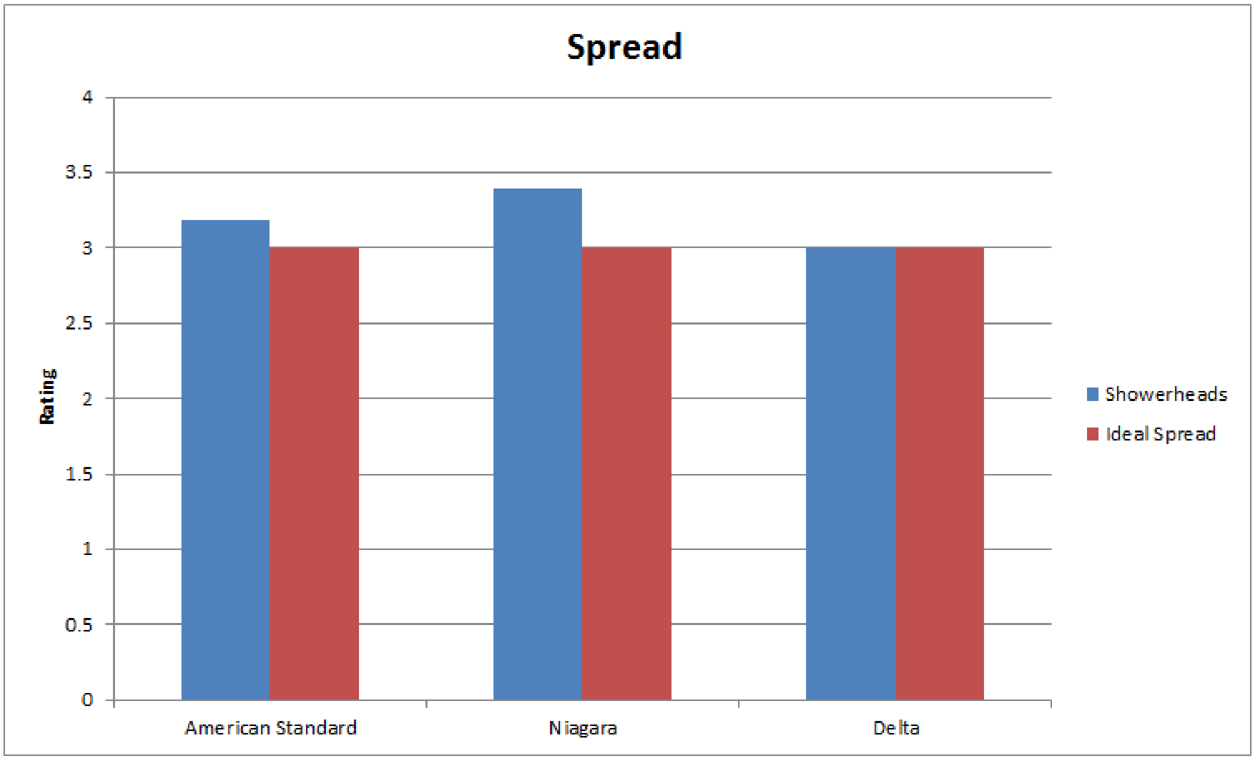

Figure 8. Spray Spread

Figure 9 illustrates the user satisfaction. The DR showerhead shows the highest levels of user satisfaction. Because the DR showerhead has the highest flow rate, users may have more enjoyment when showering. Although results show that the DR showerhead may be slightly superior to the AS, many of the users are interested in saving water as survey results show that users value the importance of saving water at 3.8/5. Such high importance ratings suggest that users are indeed willing to try new alternatives to reduce water usage.

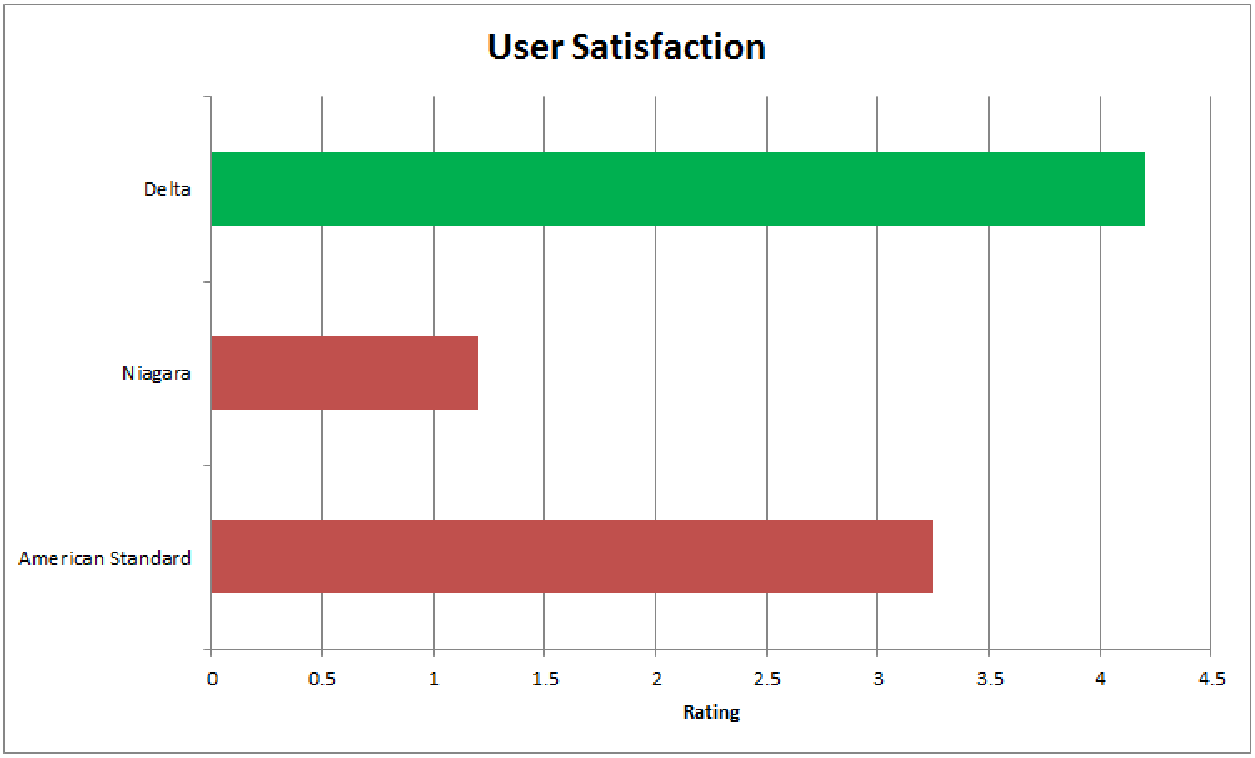

Figure 9. User Satisfaction

5.0 TRIPLE BOTTOM LINE ASSESSMENT

The TBL is an assessment guideline which consists of three main sectors: environmental, financial, and social. Government and business owners have adopted the TBL assessment to evaluate their long-term performance and practices. Survey results will be used to provide a basis for the assessment.

5.1 Environmental Assessment

According to Table 6, all shower heads provide efficient flow rates of 2.0 GPM or less. In order to consider the most sustainable option, we will estimate the water usage per week using the formula:

(Water Usage / Week) = (Flow Rate) * (Average Shower Duration) * (Average Showers/Week). The value calculated is the average water savings per person.

Table 6. Water Usage

Showerhead Model	**Flow Rate (GPM)**	**Water Usage (G / Week)**
Delta RP44809BN	2.0	156
Niagara Earth Massage	1.25	136
American Standard 1660.710.002	1.5	140.625

Delta RP44809BN:

Water Usage = (2.0 GPM) * (13 min/day) * (6 days/week) = 156 Gallons/week

Niagara Earth Massage:

Water Usage = (1.25 GPM) * (16 min/day) * (6.8 days/week) = 136 Gallons/week

American Standard 1660.710.002:

Water Usage = (1.5 GPM) * (15.625 min/day) * (6 days/week) = 140.625 Gallons/week

The NE is the most sustainable option providing 20 Gallons (~76 L) of water savings per week which is approximately 1040 Gallons (~3940 L) per year. The AS comes in a close second with about 16 Gallons (~60 L) of water savings per week, 835 Gallons (~3160 L) per year. The two alternative showerheads show significant water savings compared to the DR.

5.2 Economic Assessment

When the economic component of showerheads, we must consider the cost of water, showerhead cost, and replacement cost. We will assess this on a cost per annum basis. Cost/Annum = Cost/Lifetime + Water Cost/Year where Cost/Year = (Water Usage/year) * (Rate) . The value calculated is the estimated cost per showerhead. UBC uses 2.97862*10^9 L of water annually (UBC Sustainability, 2013) and 13% per that is used for showers resulting in a 3.872206*10^8 L used on showers. With the average rate of $2.5/2830 L (City of Vancouver, 2014), we can see that UBC spends ~$342,000 on shower usage. Calculations will consider cost per person. The following calculations assume that showerhead replacement costs are negligible compared to the cost of water as the cost of the showerhead is distributed across each individual who uses it.

Table 7. Cost and Lifetime

Showerhead	Cost ($)	Lifetime (years)
Delta RP44809BN	14.99	16
Niagara Earth Massage	8.30	10
American Standard 1660.710.002 Spray Pattern	12.99	14

Delta RP44809BN:

Water Usage/Year = (156 Gallons/week) * (52.1775 weeks/year) = 8140 Gallons/year ≈ 30813 L/year

Cost/year = (30813 L/year) * ($2.5/2830 L) = $27.20/year

Niagara Earth Massage:

Water Usage/Year = (136 Gallons/week) * (52.1775 weeks/year) = 7096 Gallons/year ≈ 26861 L/year

Cost/year = (26861 L/year) * ($2.5/2830 L) = $23.70/year

Water Usage/Year = (140.625 Gallons/week) * (52.1775 weeks/year) = 7337 Gallons/year ≈ 27775 L/year

Cost/year = (27775 L/year) * ($2.5/2830 L) = $24.50/year

Once again, we see that the Niagara has the highest savings due to its low flow rate, with saving $3.50 per year per individual. American Standard again comes in a close second with savings of $2.50 per year per individual. Multiplying this result with the number of people on residence using the showerheads will lead to significant savings.

5.3 Social Assessment

In evaluating the social impact of implementing low-flow showerheads, the compiled ratings for the installed showerheads from the survey results were inspected. Table 8 represents the average performance ratings for each of the showerhead products on a scale of 1 to 5 with 1 being poor and 5 being exceptional.

Table 8. Average Performance Rating

Showerhead Model	**Flow Rate (GPM)**	**Average Performance Rating**
Delta RP44809BN	2.0	4.20
Niagara Earth Massage	1.25	1.20
American Standard 1660.710.002 Spray Pattern	1.5	3.25

It is apparent that survey recipients were disappointed with the performance of the NE. Not only did it lack ideal pressure and spread, it led to longer shower durations because of its incredibly low-flow rate. The DR performed remarkably well while the AS obtained a satisfactory rating. Both of these received recognition for their optimal pressure and spread.

It is important to take demographic consideration in regards to the survey responses. Males appear to take showers more frequently and at a higher duration than females. This may be because males are generally more active and undergo perspiration more often, leading to the requirement of taking more showers. Females would also generally require more effort in washing their hair and the rating of a showerhead may reflect the showerhead’s performance of carrying out this task. Although these were factors that were not evaluated through measurements and calculations, they are important to consider.

6.0 CONCLUSION AND RECOMMENDATIONS

From the selection of showerhead alternatives, the survey results followed by a TBL assessment, has provided clarity to which product models are most fitting for maximizing social, economic, and environmental benefit. The most significant consideration in the recommendation of a product was that they possess the ability to contribute both effectively and equally towards the aforementioned factors.

The survey results have made it evident that the NE faced great difficulty in satisfying user expectations. Even with its patented pressure compensating technology, it did not meet ideal pressure conditions. The information gathered on the NE’s spread however, was tremendously inconsistent and did not provide constructive feedback. On the other side, the survey recipients were content with the performance of the DR while the AS slightly trailed it in rating. Both of these models maintained consistent evaluations from the students of TDM.

There was a direct relationship between the user satisfaction of the showerhead and its costs although it shouldn’t be much of a surprise that luxury comes with greater expenses. The life cycle costs of the NE are the lowest and while the DR is the most expensive, it is still considerably cheap and reasonable. Once again, the AS ranks right in the middle between the other two.

From further analysis of the survey results, an inverse relationship was found between the flow rate of the showerhead and the duration of shower. Although the showerheads with lower flow rates extended shower durations, they still ended up saving more water. Despite not meeting user expectations, the NE and AS saves an enormous amount of water when compared with the DR based on their substantially lower flow rate.

Since it was not possible to install and test the WP, this assessment could still be improved upon. However, within the restraints of this project, the AS model is the recommended product for fulfilling the social, economic, and environmental requirements. Overall, the AS is simply the most feasible and balanced product as it maximizes user satisfaction and water conservation for its cost. By implementing the AS showerhead, UBC can increase both economic and environmental savings.

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APPENDIX

Showerhead Survey Questions

1) Please circle your gender: Male Female Other

2) Which residence do you live in? ________________

3) Based on these images of showerheads, please identify the showerhead that you are using. For the following questions, please answer based on your opinion of that showerhead.

Original Showerhead First Alternative Second Alternative

4) How long do you spend in the shower with the water flowing, on average? Please note that this is for the showerhead at your residence, not at home. Please circle from the following options:

Less than 3 minutes 3-6 minutes 7-11 minutes 12-15 minutes More than 15

5) How often do you shower at your residence every week? ________________

6) On a scale from 1 to 5, is the pressure from the showerhead sufficient for your needs? (1 meaning there is not enough pressure, and 5 meaning there is too much pressure)

1	2	3	4	5
Not enough pressure		Good amount of pressure		Too much pressure

7) Is the spread on the showerhead to your preference? (1 meaning "it can be more focused", 5 meaning "it can be wider"). If not applicable, please indicate why (e.g. adjustable): ________________

1	2	3	4	5
Not focused enough		Good		Too focused

8) Please rate your overall satisfaction with the showerhead:

1	2	3	4	5
Very dissatisfied		Neither Satisfied nor Dissatisfied		Very Satisfied

9) How important would you say conserving water is to you?

1	2	3	4	5
Not at all important		Somewhat Important		Very Important