WORCESTER POLYTECHNIC INSTITUTE

Think Outside the Bottle at WPI

A Transition to Tap Water

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Abstract

Our goal was to promote tap water by furthering the campaign to phase out the distribution of bottled water on the Worcester Polytechnic Institute (WPI) campus. Educating the WPI community about the undesirable characteristics of bottled water and the benefits of tap water allowed us to gain support for the transition to tap water and encourage tap-friendly upgrades as a part of the WPI Sustainability Plan. These upgrades will make drinking tap water more convenient, which we believe will decrease the demand for bottled water.

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Executive Summary

Worcester Polytechnic Institute (WPI) is a leader among schools in academics, research, and sustainability. Constantly striving to remain ahead of the curve will ensure WPI's continued leadership. Our Interactive Qualifying Project (IQP) team aimed to further WPI's sustainability efforts, by gathering data on the WPI community's perceptions of tap and bottled water and reactions towards the phase out of the sale and distribution of disposable bottled water on the WPI campus.

Impacts of Disposable Bottled Water

Disposable bottled water has negative environmental, financial, and social impacts. In 2006, Dr. Peter Gleick, a world renowned expert in water issues, environmental justice, and sustainability, conducted a study of bottled water in the U.S. and found that 44% of all bottled water originated as tap water (Gleick & Cooley, 2009; Arnold & Larsen, 2006). The bottled water system creates additional and unnecessary water demands through raw materials acquisition, manufacturing, distribution, and disposal.

The harmful environmental effects of bottled water are obscured by misleading labeling and advertising that encourage consumers to pay a premium for what is essentially expensive tap water. The prices for bottled water are substantially higher than for tap water, ranging from 240 to 10,000 times more per unit volume (Jaffee & Newman, 2012). In the U.S., the average cost of a gallon of bottled water is $3.00 compared with $.002 per gallon of tap water (EPA, 2009). Bottled water has become commonplace at meetings and events in the government, education, and business sectors, and costs a substantial amount of money. Money spent on purchasing bottled water is money spent irresponsibly since most Americans have easy access to high quality tap water.

Tap Water is More Strictly Regulated than Bottled Water

The Federal Safe Drinking Water Act (SDWA) regulates public drinking water, while the Federal Food, Drug and Cosmetic Act (FDCA) regulates the quality of bottled water. To ensure the safety of the public drinking water supply, the EPA has established stringent limits on almost 100 potential contaminants pursuant to the SDWA (SDWA, 2012). States however, may choose to impose even stricter limits. The FDCA is implemented by the Food and Drug Administration (Summary of Federal Food, Drug, and Cosmetic Act, 2013). The SDWA holds tap water to higher standards than the FDCA requires of bottled water. A 2009 study conducted by the Government Accountability Office also shows that states conduct more inspections of their bottled water industries than does the FDA (US GAO, 2009).

If more consumers were aware of the inadequate regulations and lack of testing of bottled water, more consumers might choose to switch from drinking bottled water to drinking tap water. For example, many universities and even the town of Concord, Massachusetts have been able to phase out or even ban the sale of bottled water by educating their respective communities about the quality of tap water. These communities are proof of the success of the national campaign to transition to tap water known as the Think Outside the Bottle campaign. It is time for WPI to join the Campaign to transition to tap.

Think Outside the Bottle at WPI

Our IQP team promoted the Think Outside the Bottle (TOTB) Campaign on the WPI campus. Our goal was to reduce disposable bottled water sales, to spread awareness of the superior quality of tap water, to facilitate the installation of new water bottle filling stations, and to replace nonfunctioning water fountains across the WPI campus. To decrease the demand for bottled water, we educated the WPI community by holding Tap Water Challenges, posting facts

about bottled water at every water fountain on campus, maintaining a TOTB Facebook page, and hosting a TOTB concert. Tap Water Challenges are blind taste tests between three tap water sources and three bottled water sources, during which the participant (students, faculty, and staff) tasted each source and tried to match each water sample to its source. This activity put the bottling companies' claims of superior taste to the test. Our results showed that consumers cannot reliably distinguish the taste of bottled water from the taste of tap water. Also, our Tap Water Challenge results revealed that the WPI community believes some tap water has superior taste compared to bottled water.

After taking the Tap Water Challenge, each participant was asked to sign a pledge committing them to choosing tap water instead of bottled water for the remainder of the 2012-2013 academic year. Over 100 people signed this pledge, which was more than half of the Tap Water Challenge participants.

Water Fountain Assessment and Plan

In addition to educating the WPI community about the undesirable characteristics of bottled water and the benefits of tap water, our IQP team worked to facilitate the installation of new water bottle filling stations, like those in the Sports & Recreation Center, in other areas around campus. We analyzed every water fountain on campus, to which a typical student has access, to determine the current status of the water fountains on campus and develop a reasonable approach to repairing, replacing and upgrading current fountains.

We developed a priority system to determine which fountains should be replaced first and why. Tier 1 includes fountains that should be replaced first because they are in high-traffic areas and are broken or of low quality. Tier 2 includes fountains that are in working order, but are either non-refrigerated or have low pressure. Also included in tier 2 are fountains that are broken,

but are in low-traffic areas. Tier 3 includes fountains that are in working order and are not in need of immediate replacement.

Conclusions and Recommendations

For WPI to remain a leader in sustainability, water bottle filling stations must be installed to accommodate the WPI community's increasing demand for tap water. Through our awareness-raising events we found that the WPI community strongly supports the transition to tap water. This support encouraged us to assess every publicly accessible water fountain on campus. We found that the top priority fountains to update are on the 2nd floor of the Library and the 2nd floor of the Campus Center because they are the most trafficked fountains on WPI's campus and members of the WPI community complain about the sub-par quality of the water provided by these fountains. Also, there is a demand for outdoor water fountains near the entrance to the athletic field and near the fountain in the center of campus.

As renovations are made on campus, we propose several models that are suitable as replacements for the old, non-refrigerated or broken fountains. The suggested models are manufactured by the Elkay Company. We recommend this company in particular for a number of reasons: 1) Elkay is a reputable company that WPI facilities management has experience working with; 2) the WPI community has expressed great satisfaction with the current Elkay water bottle filling stations in the Sports & Recreation Center; and 3) maintaining consistency with the existing on-campus models will reduce the maintenance learning curve. Because the water bottle filling stations we recommend provide filtered water, the stations will require additional maintenance and money to replace filters.

The future of the Think Outside the Bottle campaign at WPI could benefit from a student organization, such as the Green Team, continuing to promote tap water, educating freshmen

about WPI's sustainable philosophy at an event during New Student Orientation, and maintaining high quality water fountains. Upgrading water fountains to water bottle filling stations is an investment that provides a long-term solution to the increasing demand for tap water and visible sustainability efforts at WPI.

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1.0 Introduction

Bottled water is sold for a little more than a dollar in practically every store across the country, but is bottled water really worth the price when the environment and long-term costs are considered? The entire life cycle of a disposable water bottle including sourcing, manufacturing, distributing, and disposal, is damaging to the environment and requires the energy equivalent of up to 54 million barrels of oil per year (Gleick and Cooley, 2009; Tapping Congress, 2011). Not only does the life cycle of disposable water bottles harm the environment and consume natural resources, but the processes involved are extremely expensive. The seemingly insignificant dollar spent to purchase a bottle of water may be convenient, however, the price consumers pay for this convenience adds up to a substantial price over time. Rather than purchasing environmentally harmful and expensive bottled water, consumers should opt for the high quality, environmentally benign and inexpensive alternative: tap water.

Our goal was to promote tap water by campaigning to phase out the sale and distribution of disposable water bottles on the Worcester Polytechnic Institute (WPI) campus. Our team had two primary objectives: 1) to reduce the presence of disposable water bottles on the WPI campus by raising awareness of the benefits of tap water and 2) to make the WPI campus more tap water friendly. To raise awareness of the benefits of tap water we held events, publicized our efforts to gain support, and worked with other student organizations and faculty. Our team educated the WPI community by holding events such as Tap Water Challenges and a concert. Tap Water Challenges are blind taste tests comparing tap water and bottled water that put the bottling companies' claims of superior taste to the test. These Tap Water Challenges allowed us to reveal both the quality of tap water and the misleading marketing strategies of bottling companies. We publicized the misleading marketing strategies of bottling companies and the differences in the

standards of regulations governing tap and bottled water on Facebook, through surveys, and by communicating with other college campuses. Lastly, our team raised awareness by working with student organizations and faculty on WPI's campus.

To make the WPI campus more tap water friendly, our team worked with the WPI facilities department in an effort to incorporate plans to install and/or update water filling stations throughout campus during renovation projects. We focused our efforts on installation/improvement of water bottle filling stations in the most highly trafficked on-campus locations. In this proposal, a "disposable water bottle" is defined as a plastic bottled sold containing water (Figure 1), whereas a "reusable water bottle" is defined as a bottle which may be composed of plastic, stainless steel, aluminum, etc., and is bought empty and typically filled with tap water (Figure 2).

Figure 1- Disposable water bottle

Figure 2- Reusable water bottles

The data obtained from collaborating with other organizations, holding events, and surveying the WPI community helped us determine the community's attitude toward bottled water and tap water, which gave us leverage in our efforts to phase out the sale of disposable water bottles and increase campus community access to water bottle filling stations. Our progress and methods may be used as a guide for other colleges to phase out disposable bottled water on their campuses.

The following proposal contains four chapters, the literature review, the methodology chapter, the findings chapter, and the conclusions and recommendations chapter. In chapter I we describe the background literature on the public drinking water and private bottled water regulatory frameworks. We examine the differences in the regulations in place for bottled water and tap water and the effectiveness of the agencies that enforce the regulations. Also in this chapter we explain the environmental and monetary cost of the life cycle of disposable water bottles. In chapter II, we describe our methodological approach to accomplishing our overall goal of campaigning to phase out the sale and distribution of disposable water bottles on WPI's campus and to educate the community about the quality of tap water. In chapter III we describe

our project findings, specifically, the results from our awareness-raising events and efforts to make WPI a more tap-friendly campus. In chapter IV we offer our project conclusions and recommendations for future Think Outside the Bottle campaigns. Through our efforts, we were able to educate the WPI community in support of tap water and promote tap water by providing a logical tiered plan for the installation of water bottle filling stations across the WPI campus as part of WPI's Sustainability Plan.

2.0 Literature Review

2.1 Introduction

The United States (U.S.) is the largest consumer market for bottled water in the world (Hu, Morton, & Mahler, 2011; Arnold & Larsen, 2006). A study performed in 2008 estimated the U.S. consumption of bottled water was equivalent to 27.6 gallons per person, which is over 30 billion bottles a year (Hu et al., 2011). Currently, bottled water sales in the U.S. appear to be decreasing (Hu et al., 2012). The decline in water bottle sales could be attributed to the growing impact of environmental awareness campaigns, such as the "Back to the Tap" campaign on Canadian university campuses, and the bottle ban in bars, cafes, and shops on the Leeds university campus in England (Gleick and Cooley, 2009).

Our project stems from the Think Outside the Bottle campaign (TOTB), supported by Corporate Accountability International (CAI), a grassroots government watchdog organization. The TOTB campaign aims to reduce the sale of disposable water bottles by spreading knowledge about and building support for public drinking water systems. The main strategy of the TOTB campaign is education. The campaign focuses on three themes in particular: 1) educating consumers on the environmental, financial, and social implications of bottled water, 2) educating consumers about the misleading marketing strategies used by bottled water companies, and 3) educating consumers about the benefits of public drinking water supplies. The TOTB campaign has met great success. The campaign has reduced spending on bottled water at almost 30 college campuses throughout the country, and six states have eliminated the use of taxpayer dollars to purchase bottled water.

Through this project, we worked to phase out the use of disposable water bottles and to increase the number of water bottle refilling stations on WPI's campus. In section 2.2 we examine the environmental impact of disposable bottled water, specifically how each stage in the life cycle of the bottle causes environmental harm. In section 2.3 we discuss the social impact of disposable bottled water which will touch on the public opinion, marketing strategies and the misconceptions about tap water. In section 2.4 we explain the different regulations of tap and disposable bottled water, including discussion of the different regulatory agencies, the Environmental Protection Agency and the Food and Drug Administration. In section 2.5, we reference other places that have phased out bottled water, discuss the origin of the TOTB campaign at WPI and identify the main objectives of this project.

2.2 Impacts of Bottled Water

While consumers may believe that bottled water offers a cheap and convenient "on-the-go" solution to thirst, research shows that bottled water is very much the opposite of cheap and convenient (Jaffee & Newman, 2012; Tapping Congress, 2012). The costs associated with bottled water are both financial and environmental.

2.2.1 Environmental Impact

The life cycle of a disposable water bottle includes sourcing water, manufacturing, distribution, and waste management, and each stage of the cycle damages the environment. Figure 3 illustrates these stages and the associated consumption of natural resources and resultant emissions, including the greenhouse gases methane and carbon dioxide.

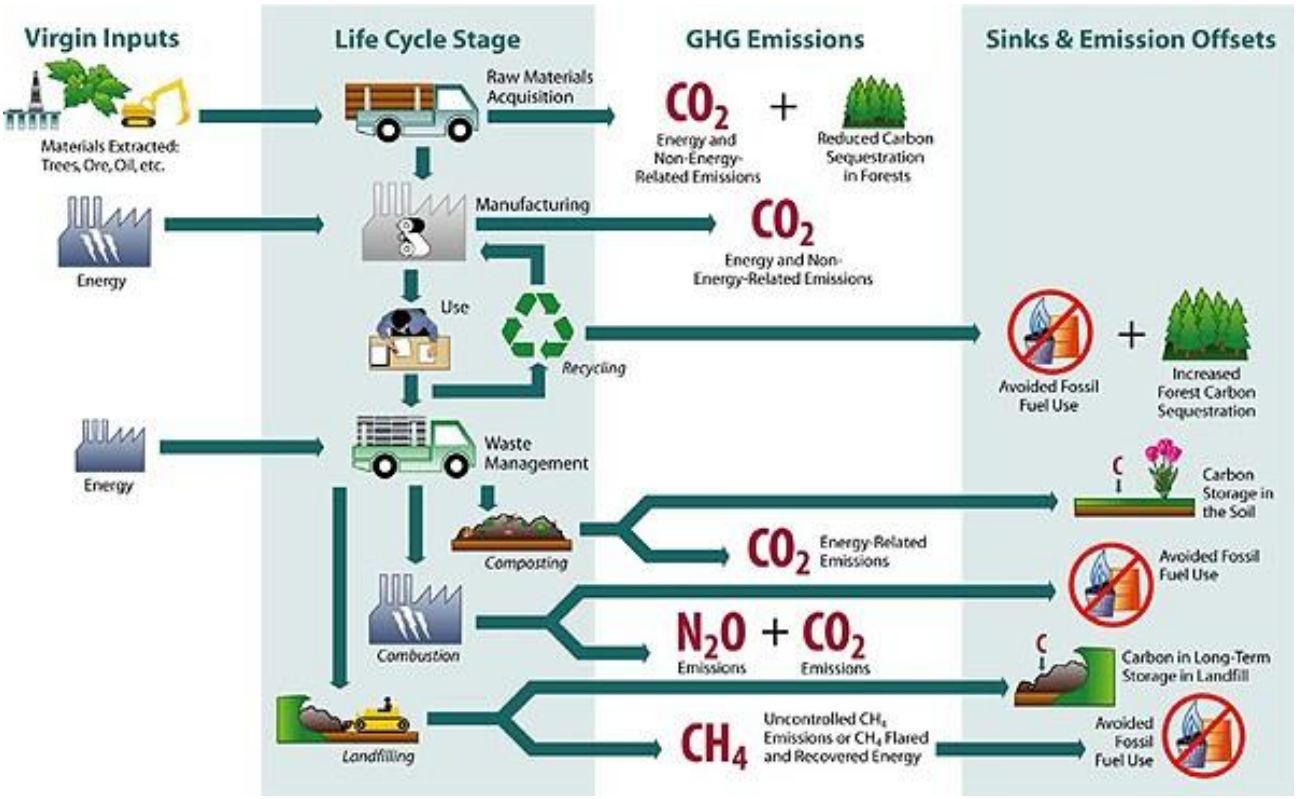

Figure 3- Life cycle of a disposable water bottle (Climate, 2010)

Sourcing water is the process of removing the water from its origin. Manufacturing is the process of making the bottles themselves from raw materials and producing the final product. Distribution involves relocating bottled water to consumers or businesses. Finally, disposal refers to the transition from a useful product into waste, which may be through recycling, incineration, or placement in a landfill. Each of these processes has negative impacts on the environment.

Sourcing Water

Bottled water is either sourced from municipal (public) tap water or from natural springs or groundwater (Jaffee & Newman, 2012). Both bottled water and tap water obtained from natural springs and groundwater stresses ecosystems by altering springs and rivers, local ecosystems, agriculture, and aquifers (Jaffee & Newman, 2012; U.S. GAO, 2009; National Academy of Sciences, 2009; Arnold & Larsen, 2006). In 2006, Dr. Peter Gleick, a world

renowned expert in water issues, environmental justice and sustainability, conducted a study of bottled water in the U.S. and found that 44% of all bottled water originated as tap water (Gleick & Cooley, 2009; Arnold & Larsen, 2006). Municipal water sold as 'purified' water is typically treated twice. Even though the water meets national standards under the Safe Drinking Water Act as it was once tap water, the bottling companies deplete additional resources to further treat the already-safe water (Gleick & Cooley, 2009). Thus, the inaccurate bottled water labeling misleads consumers into paying a premium for tap water. We discuss bottling companies misleading marketing strategies later in this proposal. In addition to misleading marketing strategies, the bottled water system creates additional and unnecessary water demands through raw materials acquisition, manufacturing, distribution, and waste management of bottled water.

Manufacturing

Regardless of the source of water being bottled, once the company identifies a water source, they need a container. Thus, the next stage of the cycle is manufacturing the disposable bottles to contain the water. The manufacturing process consumes a large amount of energy. Each disposable water bottle is made out of polyethylene terephthalate (PET), a material that requires energy to synthesize (Gleick & Cooley, 2009; National Academy of Sciences, 2009; Arnold & Larsen, 2006). Once the PET material is made, it must be shaped into a bottle through a process that also consumes natural gas and petroleum, in addition to electricity (Gleick & Cooley, 2009; National Academy of Sciences, 2009). Dr. Gleick conducted a study analyzing water bottle production in 2007, and estimated that approximately 50 million barrels of oil were consumed in the production of the PET used to make disposable bottles that year (Gleick & Cooley, 2009; U.S. GAO, 2009). In addition to the energy required to create the bottles, energy is also needed to fill, seal, label, and package bottled water. The energy needed for these

processes is only about 0.34% of the energy within the bottle itself (Gleick & Cooley, 2009). Therefore, the energy costs associated with manufacture of disposable bottles is far more than the energy costs of any other aspect of the production process, such as labeling or packaging (Gleick & Cooley, 2009; U.S. GAO, 2009). The total amount of energy needed to produce bottled water is as much as 2,000 times the energy cost of utilizing tap water (Gleick & Cooley, 2009; National Academy of Sciences, 2009; Jaffee & Newman, 2012; Arnold & Larsen, 2006). Once the bottles are manufactured, additional energy is required to transport them to various bottling locations across the country and then from bottling and distribution facilities to the retailers and ultimately the end user.

Distribution

The energy needed to transport bottled water to stores across the country is substantial. The methods of transporting bottled water, ranked most energy intensive to least, are the following: (1) air cargo, (2) truck, and (3) rail or bulk ocean shipping (Gleick & Cooley, 2009). Because water is heavy, the energy needed to transport shipments of bottled water can be substantial. The energy costs of the production of the PET bottle and for transportation are far higher than those for any other processes involved in the manufacture of bottled water, such as labeling and refrigeration (Gleick & Cooley, 2009; Tapping Congress, 2012). While refrigeration may not be the most energy consuming, its energy costs are still significant as the bottled water must be cooled to the temperature of the refrigerator or cooler and then maintained at that temperature until it is sold. Although not all bottled water is refrigerated, serious health risks have been associated with the chemical leakage from disposable water bottles into the water due to warm temperatures (Tukur et al., 2012). The various methods for disposing of used bottles,

such as incineration and landfilling, adversely affect the environment through energy consumption and the release of toxic materials.

Disposal

Consumers control the fate of disposable water bottles and their choice of disposal can have considerable impact on the environment. Water bottles are typically placed in landfills, incinerated, or recycled. Incineration results in toxic byproducts that are harmful to the environment, such as chlorine gas and ash containing heavy metals (Arnold & Larsen, 2006; Climate, 2010). Dumping water bottles into landfills is also less than ideal because landfill capacity is increasingly limited and PET decomposes very slowly (Hu et al., 2012; U.S. GAO, 2009). Because PET is a petroleum-based plastic, only certain bacteria can break it down, which can take up to 450 to 1000 years, even if the bottle was manufactured with reduced amounts of PET (Viscusi, Huber, & Bell, 2012; Arnold & Larsen, 2006). As a strategy to manage landfills, solid waste experts assume that PET plastic will never decompose (U.S. GAO, 2009). Some water bottles never actually make it to landfills and are left littering the sides of roads or in aquatic environments such as rivers, ponds, and oceans (Webb, Crawford, Sawabe, & Ivanona, 2008). Litter can have negative impacts on aquatic and other wildlife as well as community aesthetics (Webb et al., 2008).

Recycling is an alternative to incineration or disposal in landfills. While most PET water bottles are 100% recyclable, the U.S. Government Accountability Office estimated that only 24% of water bottles were recycled in 2006 (Viscusi et al., 2012) Although the bottling companies are advertising their seemingly eco-friendly efforts to reduce the negative environmental impact of their industry, such as using thinner bottles with less PET, these changes might have been made simply to reduce the cost of manufacturing the bottle. Overall,

there is not enough being done to facilitate behavioral changes necessary to encourage consumers to recycle more.

Alternatively, tap water does not directly result in the formation of any waste. Not only is tap water more eco-friendly than bottled water, but its disposal is much less expensive. *Tapping Congress to Get Off the Bottle* found that in 2012 the government paid at least $42 million in fees for the disposal of disposable water bottles (Tapping Congress, 2012).

2.2.2 Financial Impact

Bottled water has become more popular in recent years, even though prices for bottled water are dramatically higher than for tap water, ranging from 240 to 10,000 times more per unit volume (Jaffee & Newman, 2012). In the U.S., the average cost of a gallon of bottled water is $3.00 compared with $.002 per gallon of tap water (EPA, 2009). Bottled water has become very common in meetings and various events, costing the government, education, and business sectors a substantial amount of money. The increased use of bottled water also affects public drinking water infrastructure because the decrease in public drinking water revenue decreases the available funds for infrastructure improvements.

Government

As stated in *Tapping Congress to Get Off the Bottle,* the U.S. House of Representatives spent at least $860,000 between April 2009 and March 2010, or an average of about $2,000 per member on bottled water (Tapping Congress, 2012). An alternative to spending that much money on bottled water is to invest in water fountains, water coolers, and filters as shown in Table 1.

Table 1- Water fountains are a better investment than bottled water (Tapping Congress, 2012)

Type of Fountain	Description	Price per unit	Quantity that could be bought with bottled water money
Basic	Drinking Fountain	$570.00	Over 1500
Mid-Range	Office water cooler and filter attached to tap	$740.00	Over 1100
Mid-Range	Fountain with refrigerated, filtered water	$905.00	Over 900
Premium	Fountain with refrigerated, filtered water and sports bottle filling attachment	$1,422.00	Over 600

The CAI report is having an impact, as illustrated by a report on Congressman David Cicilline's website which states that members of the U.S. House of Representatives supported a cut in bottled water spending after the review of the *Tapping Congress to Get Off the Bottle* study, (Call for Cuts, 2011). Although phasing out bottled water would hurt the bottled water companies profit margin, other businesses would save money by switching from bottled water to tap water. Schools are also affected financially by bottled water.

Schools

Public schools (grades K-12) need water to operate, whether for cooking, cleaning or drinking. With public water infrastructure and school water fountains declining, some schools are struggling to provide a healthy source of tap water to faculty and students. According to the Massachusetts Water Infrastructure Financing Committee, more than 21,000 miles of public water piping in the state was installed over 50 years ago (About the WIFC, 2009) and many water fountains in schools are old as well. The declining condition of the fountains may lead to health concerns including increased bacterial contamination and trace metal concentrations (Hill, 2011). Nationally, to attempt to save money on repairs to degrading water fountains, many schools have resorted to selling bottled water instead (Food & Water Watch, 2010). In an effort to provide healthier options for kids, some schools are also replacing soft drinks in vending

machines with bottled water (Fuller, 2003). "Investing in water infrastructure at the municipal level can prevent many water problems that affect school drinking water" (Food & Water Watch, 2010). By investing in safer water fountains schools can provide clean drinking water, and relying on sources other than bottled water can save schools a lot of money as shown in Table 2. Schools may make money by selling small bottles of water, but it is more environmentally beneficial to use fountains, and it will save students money.

Table 2- Cost analysis for providing water access in a Massachusetts school with no existing plumbed drinking fountain (Cradock et al., 2012)

	Commercial bottled water dispenser	Tap-water dispensers		Plumbed drinking water	
	Bottled water cooler (5-gallon reservoir)	Refrigerated beverage dispenser (three 5-gallon reservoirs)	Nonrefrigerated beverage dispenser (5-gallon reservoir)	Wall-mounted water bottle filler	Refrigerated water fountain
Servings per dispenser	640	1,920	640	N/A	N/A
Average MA public school enrollment during lunch and afterschool snack	624	624	624	624	624
Dispensers needed	3	1	3	3	3
Water per student per meal (oz)	4	4	4	4	4
Water ($/gal)	0.41	0.013	0.013	0.013	0.013
Water, per year	1,439	46	46	46	46
Dispenser unit, each	N/A	1,955	117	963	963
Dispenser installation, each	N/A	1,500	N/A	2,000	2,000
Infrastructure total, 10 years	N/A	3,455	699	8,889	8,889
Cups, per year	1,123	1,123	1,123	1,123	N/A
Labor, per year	481	525	525	124	124
Electricity, per year	30	140	N/A	N/A	150
Water testing, per 5 years	N/A	258	258	398	398
Year 1	3,073	5,546	2,301	10,579	9,606
Average cost, Years 2–10	2,761	1,673	1,582	1,201	326
Total cost over 10 years	27,922	20,601	16,538	21,386	12,544

Although the initial cost for water fountains and filling stations is larger, these data show that long term savings are significant as opposed to commercial water dispensers.

Infrastructure

Tap water is heavily regulated by the Environmental Protection Agency (EPA) (as discussed in section 2.4.2), but the costs to maintain deteriorating pipes to keep public drinking water safe are substantial. Gallon for gallon, however it is less expensive to maintain public water infrastructure than to buy bottled water. With around 18.4 billion gallons of tap water distributed annually in Massachusetts, the price per gallon of tap water is still lower than bottled water when factoring in maintenance costs (MassDEP, 2013). The worsening condition of the pipes can release harmful chemicals and particles into the water that could pose a health risk. Each year the pipes are not replaced, the cost to repair them goes up. In 2007, Massachusetts' public water departments requested $1.543 billion from the state for maintenance of water piping, but the state could only distribute $364 million (About the WIFC, 2009). The EPA estimates that from 2007 to 2027, $6.79 billion will have to be spent to continue the financial support of the Massachusetts Water Infrastructure Financing Committee (About the WIFC, 2009). Federal support for water infrastructure has decreased in the last 30 years. This may be attributed to changes in EPA and White House administration, or the amount of infrastructure improvements needed across the country. In the 1970s, 70% of overall funds used for water infrastructure improvements were federally funded. By 2007, that number dropped to less than 5% (Tapping Congress, 2012). This could also be due to states taking up the financing for infrastructure improvements. More focus on tap water and reduction of spending on bottled water can help increase the amount of funds available for infrastructure maintenance. Increasing the use of the tap water system will result in higher revenue, increasing the available funds for infrastructure maintenance.

Private Companies

Private companies distributing public water are part of the problem, not the solution. The town of Oxford, Massachusetts has decided to try to purchase the town's public drinking water utility owned and operated by the Aquarion Water Company to alleviate the financial burden on its' residents. "The intent of the purchase is to reduce water rates for Oxford residents and businesses" (The Patriot Online, 2012). Nestle, a bottled water company, compounds the drinking water infrastructure issue by bottling tap water, profiting from it and removing that revenue source from the local water department who would reinvest the revenue in water infrastructure improvements. Nestle's actions have not gone unnoticed, however, and they have been sued on more than one occasion for false representation of their water (McCoy, 2012). By spreading the word through campaigns such as TOTB, more individuals and companies can make the switch to tap water or commit to improving public drinking water infrastructure. In addition to financial impact, marketing strategies for disposable bottled water have a social impact.

2.3 Social Impacts of Marketing

Advertising influences consumers' purchasing decisions and the resultant bottled water sales. Many people are unaware of the rigorousness of the Federal Safe Drinking Water Act, and accompanying state regulations of public drinking water. Bottled water companies take advantage of this lack of knowledge in their advertising slogans. For example, Robert S. Morrison, former Vice Chairman of PepsiCo's North American Beverage and Food Division once said, "The biggest enemy is tap water...we're not against water – it just has its place. We think it's good for irrigation and cooking" (Tapping Congress, 2012). The photo shown in Figure

4 is an example of a misleading marketing strategy that tries to convince consumers that bottled water is higher quality than its competitor brands and/or tap water.

Figure 4- An example of a misleading marketing strategy (Tapping Congress, 2012)

While this advertisement may convince some consumers of the alleged superior quality of Deer Park water over other bottled water brands, others may interpret the advertisement as a subtle attack on tap water. Daniel Jaffee (2012), an expert in the privatization of public goods, describes how some bottling company marketing delegitimizes tap water, even though over 40% of bottled water originates as tap water:

> "[B]y piggybacking on public water systems through bottling already-treated municipal tap water, bottled water parasitizes the public investment in clean tap water by serving up the very same substance for hundreds of times the cost, while the industry simultaneously 'actively delegitimizes public water.' "

These marketing tactics subliminally undermine the quality of tap water and neglect the environmental, financial, and social impact of the bottled water industry. Rather than comparing bottled water to tap water, other advertisements focus on convenience, and emphasize the ease of being able to just grab a bottle and go. According to Amy Buttell (2009), author of *4 Steps to an Effective Marketing Plan*, an effective advertisement requires clearly identifying: 1) the positioning statement, 2) the target consumers, 3) appropriate communication media, and 4) an

implementation strategy. The positioning statement defines the product and describes how it is different from competing products. The target consumer can be a wide variety of people, including those who will buy the product, those who decide which product to buy, and those who will influence others to buy the product. The communication media is the method of reaching the consumer and can include posters, radio, television, mail, and internet advertisements. Finally, the implementation strategy is the advertising campaign that includes a slogan or other way to remember the product. Implementation is the way to convince consumers that the product is superior to competitors (Buttell, 2009). Typically, advertisements present positive attributes or perspectives of the product and only negative comments about the competing products. The result is consumers make purchasing decisions based on limited and biased information. Dr. Gleick (2009) included some examples of how Brita uses some phrases to get people thinking poorly of tap water:

- "'[Brita]' turns tap water into drinking water.'"
- "'We'd like to clear up a few things about tap water.'"
- "'Tap water becomes wonderful water.'"
- "'Too often, impurities are finding their way into the water. While you may not be able to see them, you don't want them.'"
- One of Brita's television ads aired in the United States and Canada took a particularly graphic approach, with the camera focused on a glass of water in a kitchen. Viewers watch the glass drain and then refill to the background sound of a flushing toilet. Superimposed on the image were the words 'Tap and toilet water come from the same source,' and the voice-over at the end of the commercial asked viewers: 'Don't you deserve better?'"

People also may get confused by the type of bottled water. When someone looks at a bottle that has a nice scenic picture, they think it comes from a similarly scenic source. In reality, spring water simply means it was collected from an underground formation from which the water flows up naturally (Consumer Reports, 2012). Also, when people see the word 'purified,' they may think it is water in its most pure state, when really purified water just means it goes through

a filtration process to remove harmful chemicals, bacteria, or dissolved solids that the FDA requires the company to remove (Consumer Reports, 2012). However, the FDA enforcement of regulations on bottled water may not be as thorough or trustworthy as consumers believe it to be.

2.4 Tap Water is More Strictly Regulated than Bottled Water

The Federal Safe Drinking Water Act regulates public drinking water, while the Federal Food, Drug and Cosmetic Act regulates the quality of bottled water. The Federal Safe Drinking Water Act (SDWA) sets the bar for the highest permissible level of contaminants allowed in public drinking water throughout the country and is regulated by the EPA (SDWA, 2012). States however, may choose to impose even stricter limits on drinking water contaminants. The Food, Drug, and Cosmetic Act (FDCA) is implemented by the Food and Drug Administration (Summary of Federal Food, Drug, and Cosmetic Act, 2013). The SDWA holds tap water to higher standards than the FDCA requires of bottled water. The differences in regulations and regulatory agencies are described in the following sections.

2.4.1 Food and Drug Administration

The FDA has been a federal agency for over 100 years and has regulated millions of products sold in the United States. From products as simple as rice to complex drugs, the FDA has been empowered by Congress with the authority to pass consumer protection regulations. However, the FDA has come increasingly under fire in the last decade for regulatory failures in its approval of a host of consumer products. For example, in November of 2012, a response to a Freedom of Information Act request released documents that add vivid detail to the overall picture of the FDA's ineffective and halting efforts to regulate a Massachusetts Bottled Water company. The information contained in the documents showed how this inadequately regulated company caused a national meningitis outbreak which has sickened nearly 500 people and killed

more than thirty (Pollack and Tavernise, 2012). This tragedy demonstrates the need for modifications to the FDA's regulatory system.

Although the FDA has been charged with implementing the FDCA, it does not have the scope of authority that the SDWA has given to the EPA. In an article from *the New York Times*, the GAO expressed that the FDA cannot require certified lab testing or violation reporting (Goodman, 2009). This article contributes to the growing body of evidence differentiating the capacity and regulatory authority of FDA and EPA. To prevent future questioning of the safety of FDA approved bottled water, the FDA will have to increase regulatory requirements on the frequency of monitoring and number of allowable contaminants in bottled water. The New York Times article also explains how the FDA does not require companies to disclose information about the source of the bottled water (Goodman, 2009). For example, in the late 1990s, a company called Artesia Waters, failed to mention that its water "is heavily processed and comes from the same underground source that San Antonio taps for its municipal water supply" (Ingersoll, 2001). This water was being used for profit by Artesia Waters and this caused uproar by both the consumers of the product and the San Antonio community. An FDA investigation found a staggering 31% of the bottled water brands tested were found to be tainted with some sort of bacteria (Ingersoll, 2001). In the year preceding the FDA investigation, an international industry, Source Perrier S.A., Paris, was "forced to recall its trademark mineral water after U.S. health authorities found it contained traces of benzene, a suspected carcinogen" (Ingersoll, 2011). Furthermore, Dr. Peter Gleick, the author of Bottled and Sold: The Story Behind Our Obsession with Bottled Water, found disturbing discrepancies in the FDA regulations of bottled water:

> "Title 21, part 129, section 35 of the FDA regulations, which specifies details for testing bottled water, states: "Analysis of the sample may be performed for the

> plant by competent commercial laboratories (e.g., Environmental Protection Agency (EPA) and State certified laboratories).” [Emphasis added.] “May” be performed. Not “must” be performed. Not even “should” be performed.”

This excerpt (Gleick, 2010) shows just how little the FDA contributes to supplying healthy, highly regulated bottled water, as they are not required to inspect bottling plants. In addition to the limited regulatory oversight of bottled water, there is no transparency in operations. The FDA does not require these companies to be transparent in their testing results or water source whereas the SDWA mandates transparency and reporting from municipal water suppliers. Consequently, the small amount of tests that are run by water bottling companies go without notice by the public.

In contrast, all public drinking water departments are required to distribute an annual water quality report to all users of the tap water. This report, details all contaminants being tested for, what levels of each contaminant were found and the source of the water. If any of the private water bottling companies’ facilities or products are tested by the EPA or an outside agency and the company is found in violation of any regulation then the FDA may impose a penalty on the bottled water company (DWRF, 2011).

The penalties include a seizure of bottled water products that may be adulterated or misbranded, and a court-ordered injunction served against a bottled water facility found to be manufacturing or distributing adulterated or misbranded products. Lastly, the FDA may detain foods or bottled water administratively for a limited period of time, pending initiation of court proceedings to seize the product indefinitely (DWRF, 2011). Though these penalties seem lenient, the long-term effects and negative publicity could harm the company’s reputation. Losing a product for an extended period of time can also be a substantial loss to the company’s revenue and may lead to more rigorous testing and oversight within the company.

A common violation that occurs in the bottled water industry involves having excessive amounts of Bisphenol A (BPA) in bottled water. Recently, the FDA has attempted to regulate the quantity of BPA allowable in bottles.

Bisphenol A (BPA)

BPA is an organic compound that has been present in many hard plastic bottles and metal-based food and beverage cans since the 1960s (FDA, 2012). Recent studies done by both the National Toxicology Program and the FDA have raised some concern about the potential effect of BPA on the brain, including a person's behavior, as well as the prostate gland in fetuses, infants and young children (FDA, 2012). The FDA is attempting to limit the presence of BPA in disposable bottles (specifically baby bottles and various commercially sold disposable water bottles). Some states, such as Connecticut and Minnesota, have already enacted anti-BPA legislation (Michon, 2011). In January of 2010, after facing serious public scrutiny, the FDA created a plan to:

1. Review the scientific research and conduct new research on the safety of BPA;
2. Support manufacturers' efforts to eliminate BPA in products;
3. Support stronger regulation of BPA;
4. Encourage consumers to follow Department of Health and Human Services guidelines for minimizing the risk of BPA in infants and small children; and,
5. Collaborate with international partners such as Health Canada.

The FDA deals with the major issues with disposable water bottles; however the true impacts of these efforts remain to be seen. The change in the major issues of disposable water bottles will

come after years of FDA involvement in these bottling companies and enough pressure from the agency to alter the company's own regulations on their products.

2.4.2 Environmental Protection Agency

The FDA does not require as much information about the sources and quality of water as is required by the EPA. Consumers may be unaware that the FDA's testing of bottled water is not as extensive as the EPA's testing for tap water, as seen in Table 3.

Table 3- Differences between tap water and bottled water regulations (Key Differences, 2001)

Water Type (Regulatory Agency)	Bottled Water (FDA)	Big City Tap Water (using surface water) (EPA)	Small Town Tap Water (using a well) (EPA)
Disinfection Required?	No	Yes	No
Confirmed E. Coli & Fecal Coliform Banned?	No	Yes	Yes
Testing Frequency for Bacteria?	1/week	Hundreds/ month	20/month
Must Filter to Remove Pathogens, or Have Strictly Protected Source?	No	Yes	No (unless subject to surface contamination)
Testing Frequency for Most Synthetic Organic Chemicals?	1/year	1/quarter (limited waivers available if clean source)	1/quarter (waivers available if clean source)
Operator Must be Trained & Certified?	No	Yes	Yes
Must Test for and Meet Standards for Asbestos & Phthalate?	No	Yes (though limited waivers available if clean source)	Yes (though waivers available if clean source)
Must Use Certified Labs to Do Testing?	No	Yes	Yes
Must Report Violations to State, Feds?	No	Yes	Yes
Consumer Right to Know About Contamination?	No	Yes	Yes

Every public drinking water department that delivers tap water to communities is expected to follow the Federal Safe Drinking Water Act and EPA implementing regulations. These are the minimum requirements for all public tap water, but states can, and often do, impose higher standards on public drinking water. For example, the Milwaukee Water Works tests for over 500 known contaminants to ensure the highest quality drinking water possible (Milwaukee Water Works, 2012). The EPA only requires water utilities to test for maximum contaminant level violations of 90 regulated contaminants, which can initiate an enforcement order. The EPA also tests for other contaminants for maximum contaminant goal levels, which are not actual standards that must be met. An annual water quality report can be found online for almost every water utility in the country, including Worcester, Massachusetts. The 2012 Worcester Consumer Confidence Report shows a list of contaminants found, the amount detected, and if these amounts are within EPA standards. From this report, it is easy to see that all the contaminants detected were within the EPA allowable limits (Worcester County Department of Public Works, 2012).

A study conducted by the Government Accountability Office also shows that states conduct more inspections of their bottled water industries than does the FDA. An average of 300 inspections on bottled water facilities were conducted by states while an average of 100 inspections were conducted by the FDA, as shown in the Figure 5.

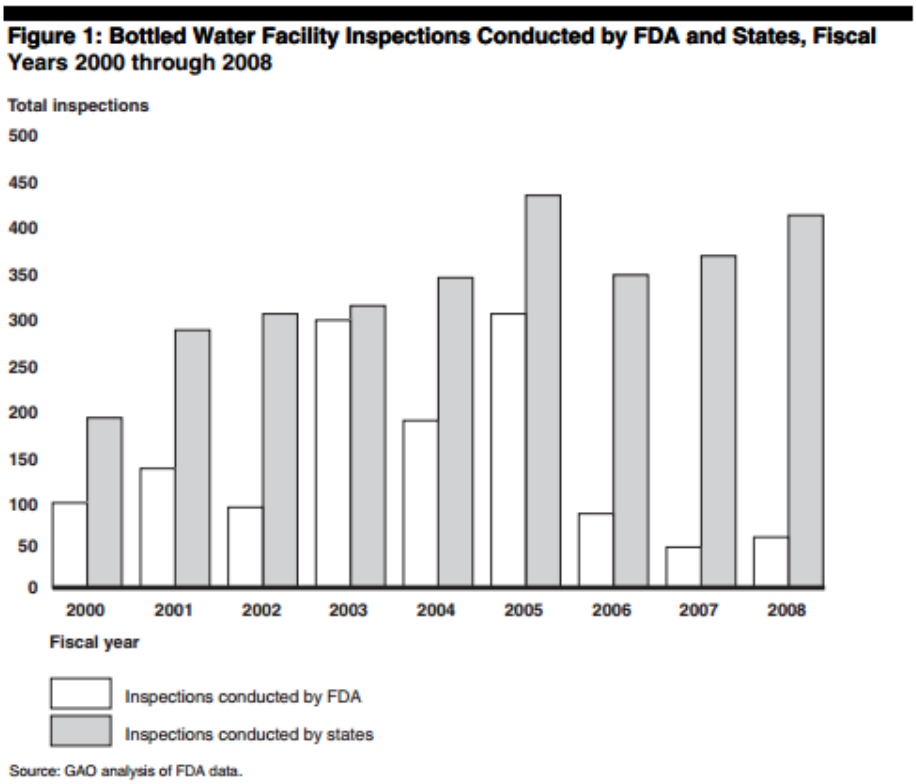

Figure 5- Bottled water facility inspections (2001-2008) (US GAO, 2009)

This information shows how infrequently the FDA monitors bottled water compared to the state run tests on public water systems as part of EPA regulations. Public drinking water departments test their water more often than bottled water is tested by the FDA. Tap water must be tested for coliform bacteria 100 or more times a month. New York City takes 500,000 samples of its water per year. That's nearly once a minute all year long. Bottled water plants only have to test once a week (4 Scary Things about Bottled Water, 2011). If more consumers were aware of the inadequate regulations and lack of testing of bottled water, more consumers might switch from drinking bottled water to drinking tap water.

2.5 Campaigns to Phase Out Bottled Water

People may drink disposable bottled water for a number of reasons ranging from safety concerns to taste differences, convenience and more. In August 2008 and again in January 2011, the city of Vancouver, British Columbia conducted studies on the reasons why residents were purchasing bottled water. The city's findings are depicted in Figure 6, below.

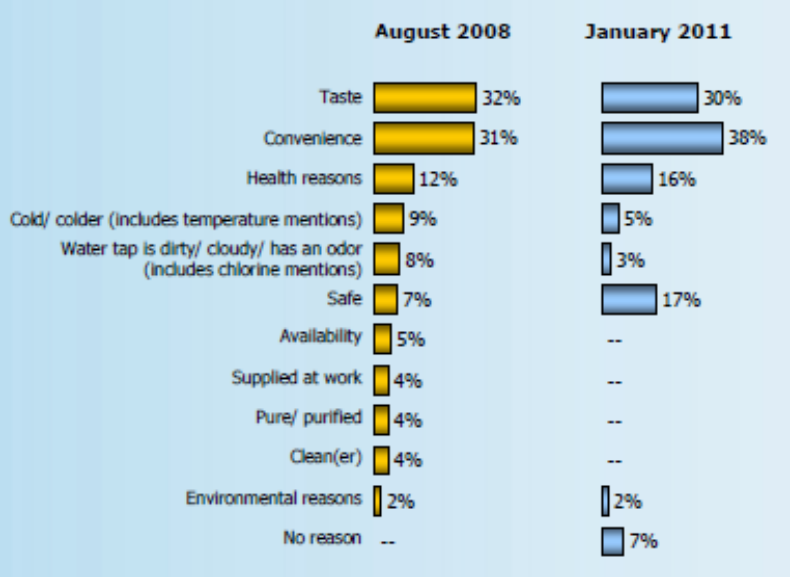

Figure 6- Reasons for Drinking Bottled Water (Mustel Group, 2011)

As shown by Figure 6, taste and convenience are the two largest reasons that participants had for buying bottled water.

Another common reason people may drink bottled water, as shown by the graph above, is health. Some disposable bottled water companies base their advertisements on the possible safety concerns of drinking tap water. For example, the McKesson Water Products Company used advertisements listing the possible contaminants that could exist in tap water (Olson, 2000). These advertisements play on an unsubstantiated fear of the public.

By understanding the reasons why consumers purchase disposable bottled water, we were able to formulate a stronger campaign to shift consumer opinion in favor of tap water. Other

colleges and towns have successfully shifted consumer opinion and banned the sale of bottled water.

2.5.1 Bottle Ban at University of Vermont

Through the TOTB campaign, the University of Vermont banned the sale of bottled water on its campus on January 1st, 2013. The Vermont Student Environmental Program worked with their campus to ban the sale of water bottles by not renewing the college's contract with Coca-Cola. By not renewing the contract with Coca-Cola the school calculated that they would lose approximately $480,000 in revenue, however, they believe entering new contracts with new companies will compensate for the lost revenue by banning bottled water (Bosque, 2012). In reaction to the bottle ban, the school received several complaints that students would opt to drink less healthy options. As a result, the University of Vermont mandated that at least 1/3 of the drinks in their vending machines be healthy options other than water (Bosque, 2012). As the bottled water ban went into effect only recently, only time can tell how the ban on disposable bottled water will affect the campus. Overall, the University of Vermont's work with the TOTB campaign is inspiring and demonstrates what can be achieved through this campaign.

2.5.2 Concord, Massachusetts Bans Sale of Disposable Water Bottles

Similar to the success of the University of Vermont, the entire town of Concord, Massachusetts banned the sale of disposable water bottles. Concord decided to ban the sale of all non-sparkling bottled water in bottles of one liter or less (Plastic Bottle Ban, 2013). Any water sold in a bottle larger than one liter is acceptable for sale in case of emergency situations (Plastic Bottle Ban, 2013). Many of the Concord citizens are pleased with the new ban. A few Concord residents were quoted by WGBH News as saying, "I love the forward thinking, and I'm OK with it," and "I think there's a lot of waste out there, and town water's pretty good" (Reilly, 2013).

Not everyone seems happy about the ban on the water bottles though; some storeowners are nervous that they may lose business. Storeowner John Cummings from Concord, MA was quoted as saying, "We will cooperate with the law, but it is not a law we support" (Ball, 2013). The ban on the distribution of bottled water started with a three-year long attempt by activists from the Ban the Bottle campaign to stop the sales of bottled water (Plastic Bottle Ban, 2013). The progress from the town of Concord demonstrates the feasibility of a project of this scale.

2.5.3 Previous Think Outside the Bottle Efforts at WPI

Similar to the Ban the Bottle campaign in Concord, MA, a group of WPI students began working with the TOTB campaign in the fall of 2012 to reduce the sale of bottled water on campus. The students organized multiple events to change campus opinion on bottled water and tap water. The team distributed surveys, held taste tests, and even went through campus trash to count discarded disposable bottles that could have been recycled (Audet, Auger, Cross, & Pepo, 2012). Utilizing surveys allowed the group to ascertain the campus attitudes toward bottled water and tap water. The team sent out surveys to all students, faculty, and campus staff at WPI and they were able to gather 364 total responses. One survey question addressed how many bottles the subjects drank per week and over 50% of the subjects responded that they drank one bottle or less per week (Audet et al., 2012). Another question revealed that a majority of the participants that live on campus are satisfied with the quality of their tap water (Audet et al., 2012). Two questions focused on the levels of satisfaction with the new water bottle filling stations and the regular water fountains around campus showed that the subjects were much more satisfied with the new water bottle filling stations (Audet et al., 2012). Overall, these surveys showed the group that the majority of the WPI campus was supportive of their campaign. Consequently their

objective was to try and educate the other 41% of WPI's campus about the importance of the TOTB campaign.

During the taste tests set up by the team, participants had to taste five different samples of water and guess whether each sample was from one of three different bottled water brands or tap water from the recreation center or campus center. The taste tests showed that only 29.3% of the 97 participants were correct. The team was then able to educate participants on the differences between tap water and bottled water (Audet et al., 2012). The results of their taste tests were very surprising, for, as shown in Figure 6, one of the largest reasons consumers purchase bottled water is for its taste, but the taste tests show that taste should not be a factor in the choice between tap water and bottled water. Figure 7 illustrates all of the results from the previous team's Tap Water Challenges.

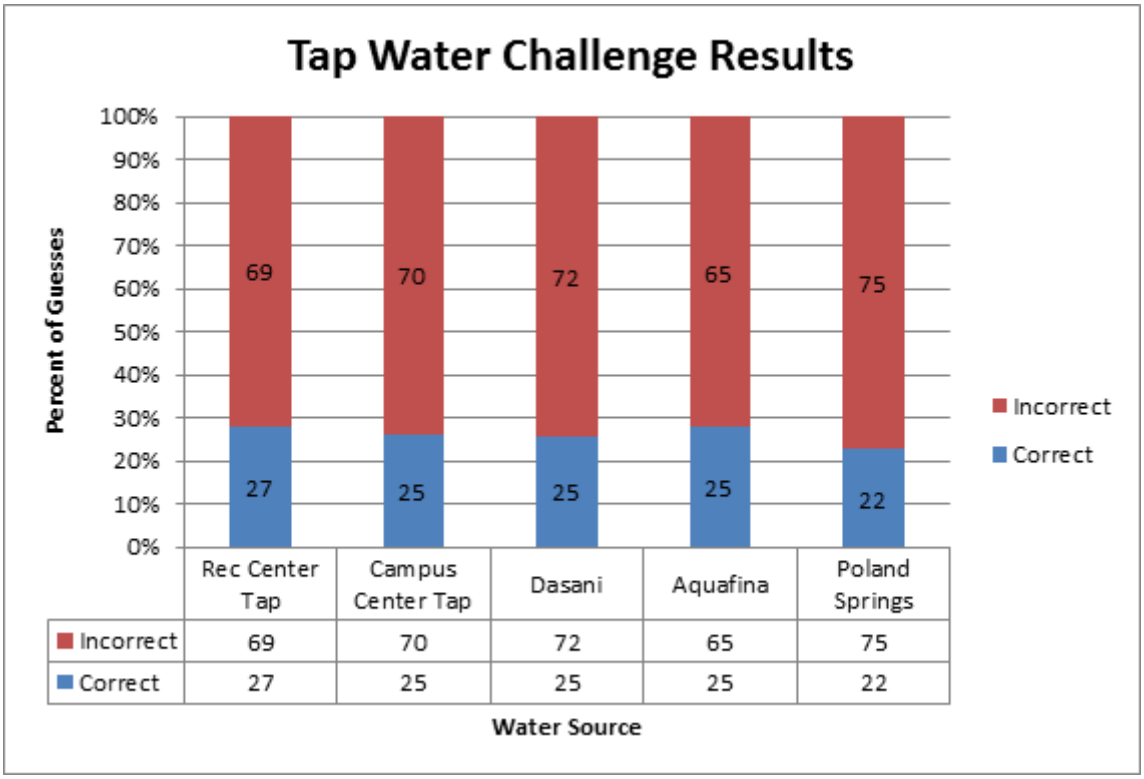

Figure 7- Tap Water Challenge results (Audet et al., 2012)

Their group was successful in informing the WPI campus about their campaign and was able to receive over 60 signatures of students pledging to use tap water 100% of the time (Audet et al., 2012).

2.6 Conclusion

Bottled water has become very popular and is responsible for approximately $22 billion in sales every year (Wilk, 2006). Bottled water is an unnecessary and environmentally damaging luxury when used outside of the context of natural disasters or situations where public water systems become contaminated. Not only is bottled water more expensive and harmful to ecosystems than tap water, but bottled water is also less strictly regulated than tap water. By following CAI's lead to educate communities across the country about the hidden truth behind bottled water in contrast to the integrity of tap water, we worked to educate the WPI campus community and facilitate an increase in tap water filling stations on campus.

3.0 Methodology

3.1 Introduction

As the environmental and financial impacts of the bottled water industry increase, it is important to raise awareness about the alternatives to bottled water. Since tap water offers a much more eco-friendly and inexpensive alternative, we worked to educate the community and reduce the effects of bottled water by facilitating a decrease in sales of bottled water on campus and an increase in water bottle filling stations.

To achieve our overall goal of developing a strategy to phase out the sale and distribution of bottled water on WPI's campus and educating the community about the quality of tap water we identified two main objectives: 1) to reduce the presence of disposable water bottles on WPI's campus by educating the community, and 2) to facilitate the installation of more water bottle filling stations around the campus. The following section describes these objectives and the methods used to accomplish them. In section 3.2, we discuss how we educated the WPI community about the quality of tap water in an attempt to reduce the demand for bottled water and therefore result in fewer disposable water bottles sold on campus. In section 3.3, we explain our efforts to increase the number of water bottle filling stations on campus.

3.2 Reduce the Number of Disposable Bottles by Educating the Community

Our team worked to phase out bottled water by educating the WPI community about the quality of tap water. In this report, "phase out" is defined as a reduction in the sale and dependence on bottled water. In this report, "educate" is defined as informing the community about the regulatory, transparency and quality differences between bottled water and tap water.

This report uses water's adherence to the federal Safe Drinking Water Act and accompanying regulations as a proxy for "water quality."

Specifically, we worked to educate the WPI campus community by: 1) collaborating with student and faculty organizations on campus; 2) creating a campus-wide campaign advertising the benefits of tap water; 3) hosting events such as Tap Water Challenges and a pledge designed to encourage individual commitments to tap water; and 4) holding an awareness-raising music concert.

3.2.1 Collaboration with Other Organizations on WPI's Campus

Collaborating with other organizations enabled us to build a stronger network throughout campus that allowed our message to reach more people. Organizations such as the President's Task Force on Sustainability, Students for a Just and Stable Future, and the student Green Team, already have a presence and a following at WPI that gave us easy access to a broad campus audience that includes students, faculty, and staff. The previous IQP team that worked on the TOTB campaign also interviewed and worked with the aforementioned organizations to spread the word about the campaign and to gain knowledge about the level of community support for their efforts (Audet et al., 2012). We incorporated information acquired from both the previous IQP team's report and organizations on campus into the events we planned. Working with other organizations allowed us to brainstorm ideas such as when and where to hold events or how to most effectively promote the event, and to have extra support for our events, which made the events more successful.

3.2.2 Think Outside the Bottle Outside at WPI

In addition to initiating changes on WPI's campus, we reached out to other colleges in Worcester. This outreach expanded the TOTB campaign to encourage others to switch to tap

water, so together we could make a more powerful impact on the environment and our city's prosperity. Our most successful way of reaching out to other campaigns was through the "Think Outside the Bottle at WPI" Facebook page that had been created by the previous IQP team. On this page we were able to share facts about tap and disposable bottled water. We did this by posting a new water fact of the day every day during our time with the project. In addition to sharing facts we also posted results of our different Tap Water Challenges and kept followers up to date on different activities pertaining to the campaign. This allowed us to follow other campus's campaigns, and let them follow ours. Through this communication, we shared ideas and insight on what had been successful and what had not. In addition to our Facebook page, we emailed groups from other colleges to share information. We connected with Clark University and the College of the Holy Cross, shared ideas, and got valuable insight on how to make our project better.

In addition to Worcester colleges, we reached out to Auburn High School. Although we were unable to host the event ourselves, the a group of WPI students working in the town of Auburn was able to host a Tap Water Challenge at the Auburn High School Earth Day celebration to help us raise awareness on the differences between bottled water and tap water. We asked them to do this because the high school was interested in the campaign and we wanted to outreach to the next generation so they could spread awareness and make an impact before they get to college.

On Earth Day, we went to the Worcester EcoTarium to hold a Tap Water Challenge. This event allowed us to reach out to families living in and around Worcester to educate families about the undesirable impacts of bottled water and the benefits of tap water to encourage a more sustainable Worcester community.

3.2.3 Educational Events

Tap Water Challenges

Tap Water Challenges put bottling companies' claims of superior taste to the test. Furthermore, these events provided an opportunity to educate the community about the quality and regulations of tap water versus those of bottled water. Tap Water Challenges are blind taste tests that determine whether people can truly taste a difference in water from various tap and bottle sources. The previous TOTB team of students hosted Tap Water Challenges regularly throughout WPI's B term (October to December 2012). We continued their efforts and held Tap Water Challenges in the Campus Center from 10am to 4pm once a week (on Tuesdays or Thursdays) for five consecutive weeks. Three different tap sources on campus and three brands of bottled water were used for the taste tests. The previous TOTB team used tap water from the Sports & Recreation Center and the Campus Center, so our team also used these sources of tap water with the addition of Library tap water because we aimed to install a water bottle filling station in both the Campus Center and the Library. Our team used the same three brands of bottled water that the previous TOTB team used: Dasani, Poland Springs, and Aquafina. These brands of bottled water were used because they are the three brands sold at WPI.

Each water sample was placed in the same type of plastic Dixie cup and labeled A through F. The tester (anyone from the WPI community) was encouraged to sample each source of water and attempt to correctly guess its source using a handout we provided (see Appendix A). The handout also asked the tester to identify which water sample he/she thought had the best taste. Once the tester had completed the handout, we revealed the correct answers and provided information on the major differences between tap water and bottled water, including level of regulatory control and the environmental impact of bottled water. We also displayed our poster

describing why members of the WPI community should opt for tap water rather than bottled water (See Appendix B).

A Pledge to Drink Tap Water

After every Tap Water Challenge, our group asked the participants if they would like to sign a pledge to drink tap water 100% of the time as an alternative to purchasing bottled water. This pledge was a way for us to gain support from members of the WPI community for our project. This pledge had a statement committing signatories to drinking tap water and refraining from purchasing bottled water for the remainder of the 2012-2013 WPI academic year ending on April 30, 2013. We asked pledge signatories for their email address so we could follow up on their success in abiding by the pledge at the end of the 7 week term. The pledge proved to be very successful and the survey responses showed that people stuck with their pledge (these can be seen in the following chapter).

In addition to running weekly Tap Water Challenges, our group decided to host a larger scale event on campus as another way to deliver our message and gain support for the campaign. We decided to host a Bottle of the Bands, a free concert for anyone to attend.

Bottle of the Bands

The Bottle of the Bands started as an idea within the first few weeks of the term and we decided it was a great idea to talk about our campaign, our accomplishments, and what we hope to accomplish in the future. We presented our idea to the Student Government Association at WPI, who granted us a Student Government Association Sponsorship Fund of $1300 to sponsor a concert highlighting the negative effects of bottled water and the benefits of tap water. The money was used to pay for the rental of sound equipment and lights, police detail, janitorial duties, bands, and all supplies needed to run the event.

We invited four local bands to perform a concert at WPI to raise awareness of the quality of tap water and the misleading marketing of bottled water, however only three showed up. The bands that were involved in the concert were A Will Away (Connecticut), Oh the Humanity (Lowell, MA), and Uncle Joel's Comb (New York). We also had two guest speakers from both the Student Green Team and the Students for a Just and Stable Future who spoke about the negative effects of bottled water and about sustainability during the transition between bands. We chose to host a concert rather than a different media event (such as a movie) because it was an opportunity to bring a different type of entertainment to campus than is typically available to students, while educating about the quality of tap water. We also felt that a concert would attract a larger audience than a movie showing focused on the quality of tap water. The rock concert was held in the Campus Center Odeum on April 14th from 5 PM to 8 PM. We encouraged all attendees to participate in our Tap Water Challenge held outside the doors to the Odeum. All participants received a raffle ticket. Before and after the last band played, we raffled off four different $10 gift cards (two to Dunkin Donuts, one to WooBerry and one to Boston Donuts) to the participants of the Tap Water Challenge. The gift cards were the incentive for participants to take our Tap Water Challenge and based on the amount of challenges taken during the concert, the incentive proved to be successful. Similarly, in addition to our desire to spread the word about the quality of tap water, cash prizes further incentivized us to enter our tap water poster into several sustainability events.

Sustainability Events

Throughout the term, we went to two sustainability poster competitions. The Water: Systems, Science, and Society Interdisciplinary Water Symposium was held at Tufts University, and the Envisioning Sustainable Futures competition was held at WPI. At the events, we set up

our poster and gave a short presentation to interested attendees. We attended the Tufts Water: Systems, Science and Society Symposium to start educating people outside of WPI. At a big event such as this, our goal was not to win the poster competition, but to gauge people's interest in our project. It also served as a networking tool to share information and get suggestions from other TOTB campaigns or groups with similar interests. The Envisioning Sustainable Futures poster competition at WPI was used to continue spreading the word around WPI, and to get valuable feedback from the judges and other attendees who listened to our short presentation.

In addition to the poster competitions, we attended the World Café program held in the Goat's Head Restaurant at WPI on March 20th, 2013. This program was open to students, faculty, and staff who wished to discuss various aspects of the developing WPI Sustainability Plan. The WPI events were a great way to educate the campus community about the benefits of tap water and gave us support to create a more tap-friendly campus.

3.3 Create a More Tap-Friendly Campus

Our second objective was to make WPI's campus more tap water friendly and encourage the use of tap water over disposable bottled water. To accomplish this objective, we met with members of the WPI Facilities Management Division, rated the quality of all the publicly accessible water fountains on campus and gave a presentation to the President's Task Force on Sustainability.

3.3.1 Increasing Accessible, Quality Water Refill Stations on Campus

The most frequent complaints from students regarding fountains on campus are the poor water pressure, warm temperature of the water, and/or bad taste (Audet et al., 2012). Consequently, in an effort to increase the usability of WPI water fountains and/or water filling

stations, we worked with WPI Facilities Systems Manager, Liz Tomaszewski and the Director of Project Management and Engineering, Chris Salter.

Some of the water fountains on WPI's campus are unpopular due to poor tasting and/or warm water. Updating some of these fountains would make them more appealing to users. To successfully update water fountains on campus, we contacted Chris Salter. Through Mr. Salter, we collected information about summer renovations on campus and how WPI can incorporate new filling stations in summer renovation plans. The creation of the tier-system of water fountains stemmed from this conversation with Chris Salter and we hope to see use of this document.

Students have also said that the best fountains on WPI's campus are the new bottle filling stations in the Recreation Center (Audet et al., 2012). We believe that students and faculty are much more likely to use reusable bottles if they have more convenient access to high quality fountains and filling stations. For any future installments of water filling stations on campus, our team prepared a document identifying which fountains (including their model number, price and estimated labor costs) would work best in which areas around campus.

3.4 Conclusion

Through our efforts, we were able to educate the WPI community on the negative aspects of bottled water and benefits of tap water. Our efforts also made it more convenient for people to fill up reusable water bottles instead of buying bottled water. Reaching out to other organizations on campus and contacting other Worcester colleges helped spread the word around WPI and the Worcester community. Our methods allowed us to begin the process of decreasing the sale of bottled water and installing more water bottle filling stations on campus. Through this, we were able to reach our goal of beginning the process of phasing out bottled water on the WPI campus.

4.0 Findings

4.1 Introduction

We have done significant work to achieve our two objectives in an attempt to make WPI a more sustainable campus. The following section describes the results of our attempts to phase out the distribution of bottled water on WPI's campus and to educate the WPI community about the quality of tap water. In section 4.2 we analyze the results of our efforts to raise awareness of the impact of bottled water and the high quality of tap water on WPI's campus. In section 4.3 we discuss our success in encouraging WPI to become a more tap water friendly campus.

4.2 Outcomes of Awareness-Raising Events and Strategies

By holding Tap Water Challenges, asking the WPI community to sign a pledge to commit to drinking tap water instead of bottled water, and hosting a concert, we have acquired data that supports three findings. These findings show that most of the WPI community: 1) cannot taste the difference between bottled water and tap water, 2) are unaware of the rigorous quality control and transparency of tap water, and 3) support the transition to tap water.

4.2.1 Cannot Taste the Difference

Many participants were surprised by their performance in the Tap Water Challenge and how difficult it was to taste the difference between the bottled water and tap water. At the beginning of the Tap Water Challenge, some participants, including students, faculty, and staff, stated that they hated tap water and believed they would successfully complete the Challenge without any difficulties. Afterwards, these participants were somewhat chastened and very receptive to the educational facts because they had performed far worse on the Challenge than

they believed they would. Furthermore, many participants expressed that the Tap Water Challenge had changed their perceptions about bottled water and tap water.

In addition to educating participants, Tap Water Challenges put the bottling companies' claims of superior taste to the test. Our results indicate that consumers cannot reliably distinguish the taste of particular water, nor bottled water from the taste of tap water, as demonstrated in Figures 8 and 9 respectively.

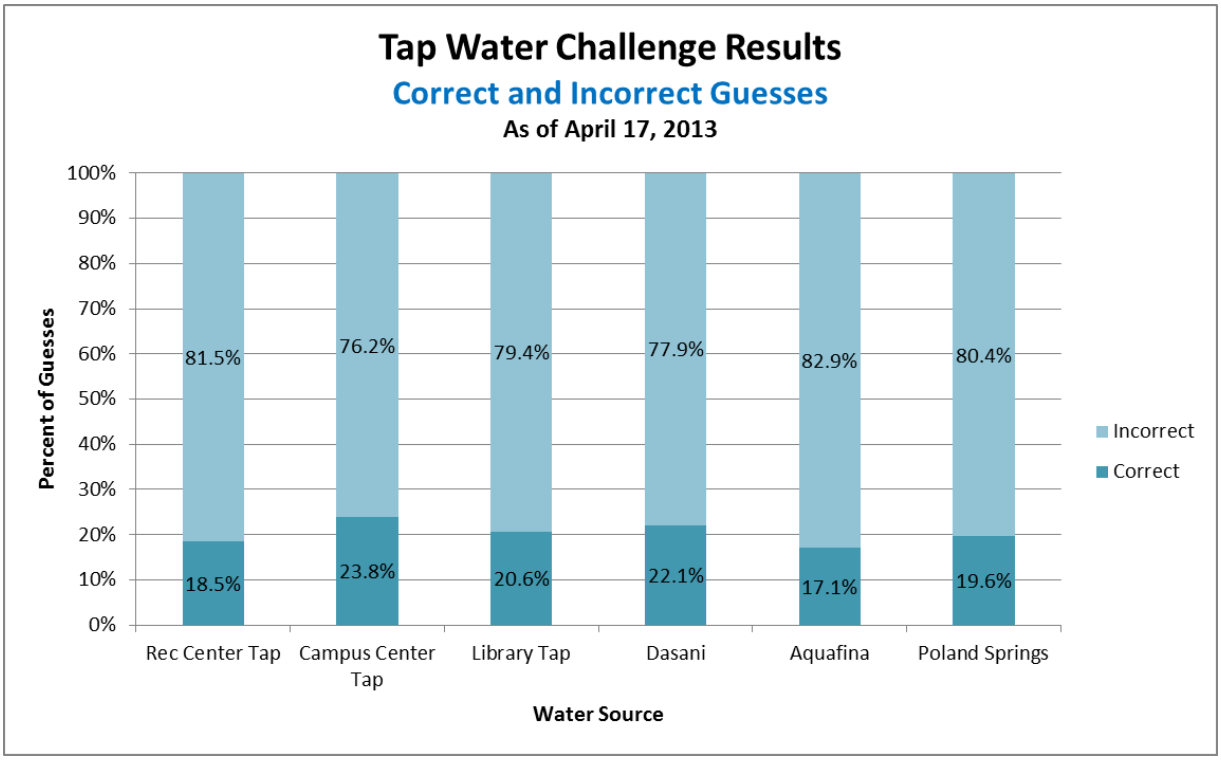

Figure 8- Tap Water Challenge results by water source (n=281)

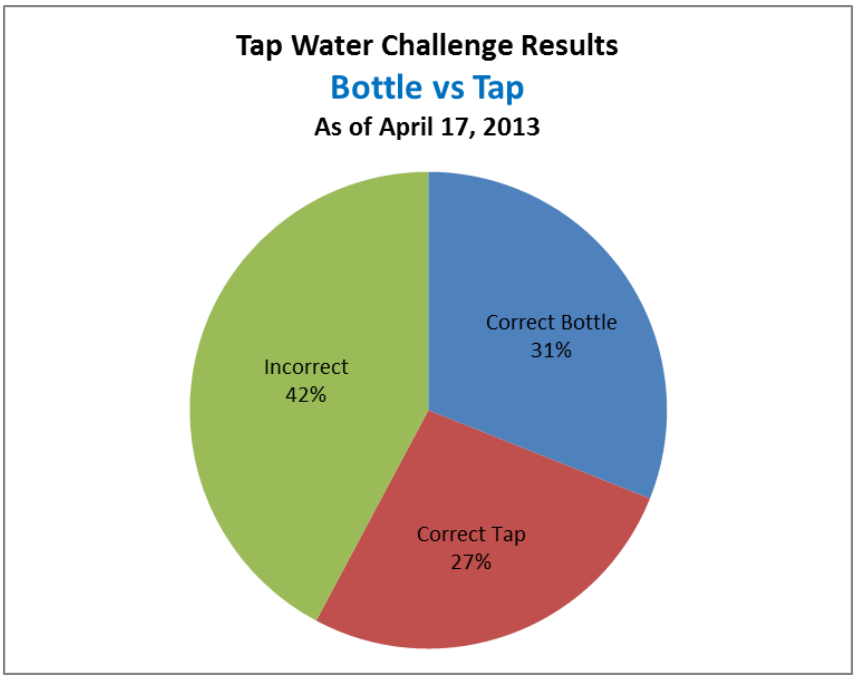

Figure 9- Tap Water Challenge results for identifying bottled water vs. tap water (n=281)

Figure 8 demonstrates how difficult it was for participants to identify each water source. The Campus Center tap water had the highest percentage of correct guesses, which means it was the easiest to identify by taste alone. Many participants expressed a dislike of the Campus Center tap water because the water is very warm and unpleasant to drink. Similarly, Figure 9 illustrates how difficult it was for participants to differentiate between bottled water and tap water on taste alone. Only 31% (87 participants) could correctly identify bottled water and only 27%, (76 participants) could correctly identify tap water, while 42% (118 participants) could not identify either.

Also, our Tap Water Challenge results reveal that even though some participants stated that they preferred bottled water, overall, we found that the Library tap, receiving 21% of the votes for best taste, was chosen more frequently than any other water source, as illustrated by Figure 10.

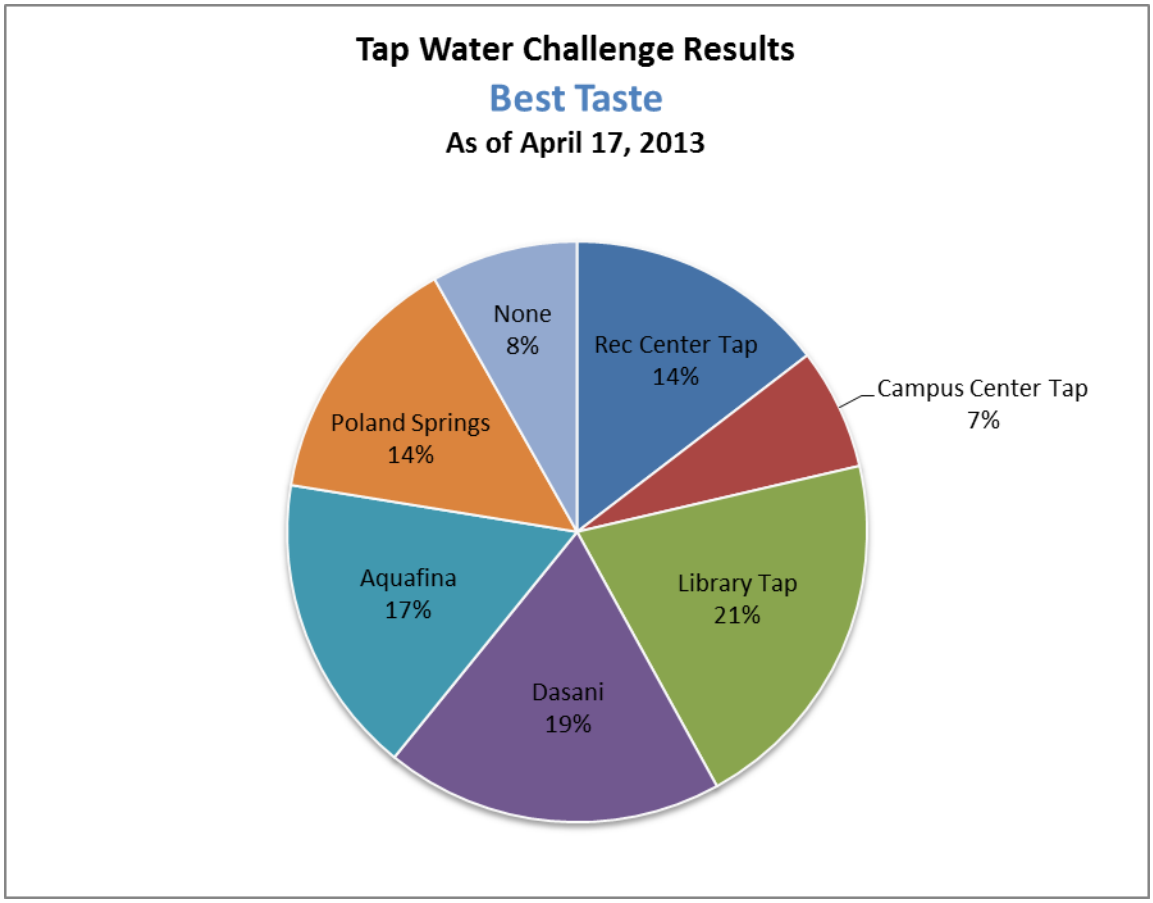

Figure 10- Tap Water Challenge results for best taste (n=281)

4.2.2 Unaware of the Quality of Tap Water

Our second finding is that most members of the WPI community were unaware of the rigorous quality control and transparency of tap water. This became apparent in our discussion with Tap Water Challenge participants and also with judges and passersby at sustainability events. Once we told them the reasons to drink tap water– how tap water is more environmentally benign, more fiscally responsible, and has equal, if not superior taste in comparison to bottled water– many people were surprised by these facts and noted that they had never heard this information and/or never stopped to think about it.

Our Experience at the Water Treatment Plant

When we began our project, we too were unaware of the quality of tap water. To educate ourselves, we contacted Darin LaFalam, Systems Administrator for the Water Treatment Plant in Holden, Massachusetts, who gave us a tour of their facilities on March 21st, 2013 and explained the treatment process for Worcester drinking water. We learned that the process of treating our drinking water is very thorough, going through several different steps to decontaminate, filter, and test the water. We were surprised to see how much work actually goes into making sure our tap water is safe. We found that significant progress has been made since the construction of the Water Treatment Plant in 1997 to increase the safety of the public drinking water. Prior to the use of the Water Treatment Plant, Worcester's water was only treated with chlorine, which did not remove all of the organic substances in the water and gave the water an unpleasant taste. Now, the water is tested, treated, filtered, and tested again to ensure the water is as clean and safe as possible.

Part of our visit to the treatment plant was to confirm one of the findings of the students who researched WPI tap water quality in the fall of 2012. The sources they tested (Campus Center tap, Sports & Recreation Center tap, Dasani, Aquafina, and Poland Springs) all came back negative for total coliform. We tested all six of our water sources that we used in our Tap Water Challenges (Campus Center tap, Library tap, Sports & Recreation Center tap, Dasani, Aquafina, and Poland Springs) while we were at the Water Treatment Plant. All of the water samples were found to not contain any signs of total coliform. The information we learned while at the Water Treatment Plant bolstered our understanding of the filtration process that tap water goes through and consequently made us better able to explain the rigors of it to the WPI

community in the hopes of changing students, faculty and staff perceptions of and commitment to tap water.

Discussions about Tap Water

Learning first-hand about the effort put into delivering high quality tap water to Worcester allowed us to enlighten members of the WPI and Worcester communities about the integrity of tap water at our many awareness-raising events. During Tap Water Challenges and at sustainability events, our concert, and the EcoTarium, we shared the information we learned both at the Water Treatment Plant and through our research on the regulatory frameworks for public drinking water and bottled water. In addition to many Tap Water Challenge participants being surprised by their inability to differentiate between the tastes of bottled water and tap water, participants were further astonished when we informed them about the environmental and financial benefits and equal, if not superior taste of tap water when compared to bottled water. After hearing these facts, almost every participant expressed support for the transition to tap water.

4.2.3 Support for the Transition to Tap Water

We found that people who saw our poster and listened to our presentation were very interested in the TOTB Campaign and, consequently, may be more willing to support a phase out of bottled water both on campus and elsewhere. Through our efforts at WPI, we achieved a total of 281 Tap Water Challenge attempts. Some participants took the Challenge multiple times to try to redeem themselves because they were unable to distinguish between the taste of bottled water and tap water the first time they participated. Over half of the Tap Water Challenge participants signed the pledge to not drink disposable bottled water for the remainder of the 2012-2013 academic year. We sent a survey to the 132 people who signed our pledge and received a

response rate of 51.5% (67 participants). The survey showed that 42% of pledge signatories who took the survey kept their pledge to drink tap water instead of bottled water (Figure 11).

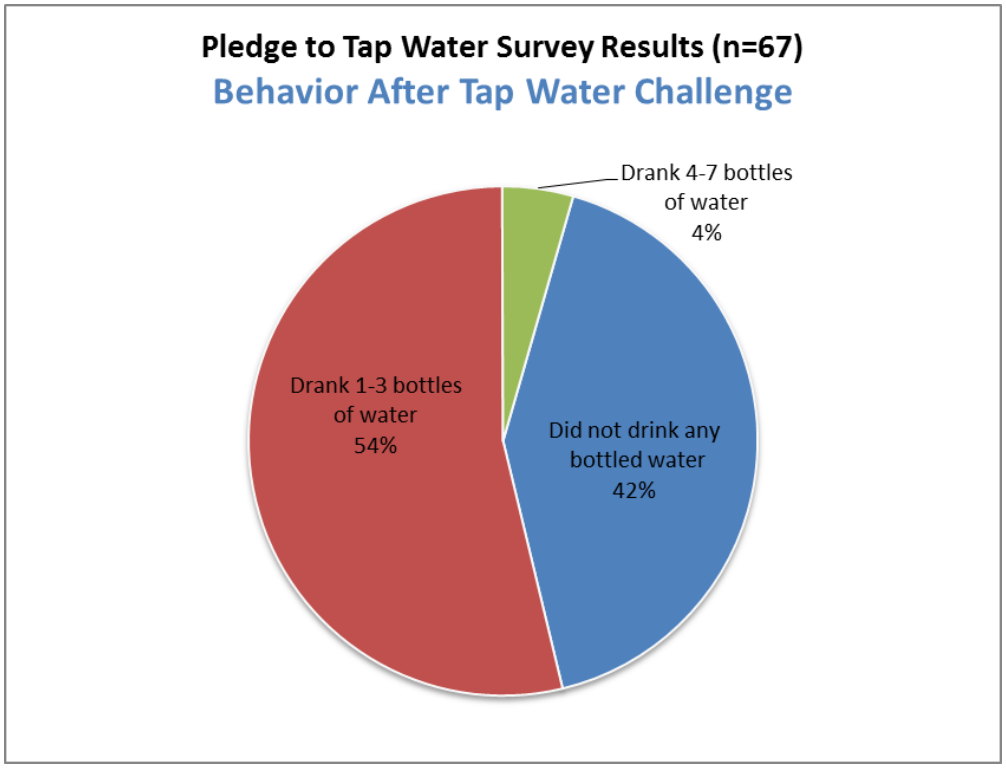

Figure 11- Behavior after Tap Water Challenges

Also, the survey revealed that 89.6% of the pledge signatories who took the survey had changed their opinions about bottled water and tap water after participating in the Tap Water Challenge (Figure 12).

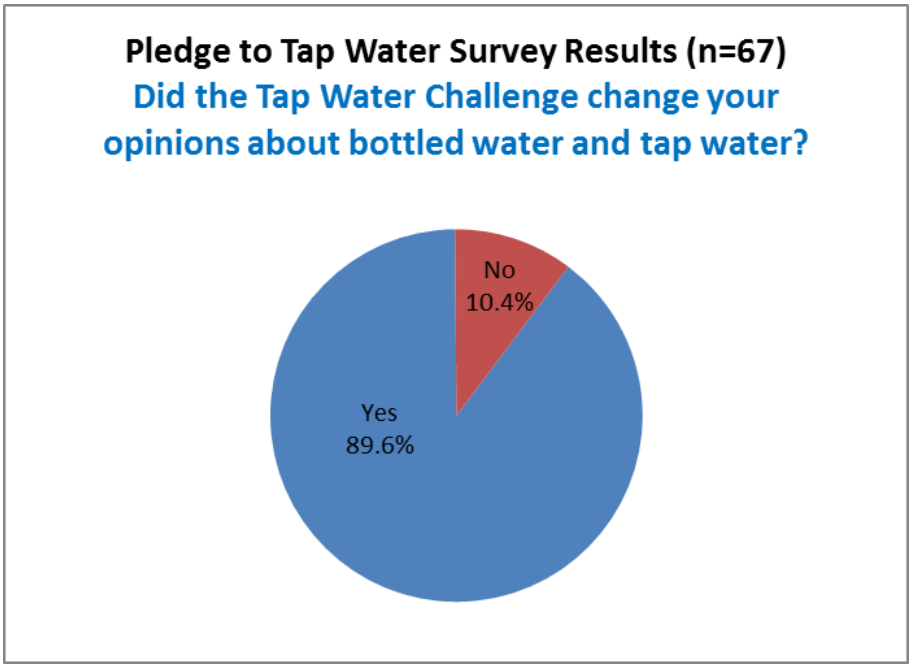

Figure 12- Opinions changed by Tap Water Challenges

Thus, our Tap Water Challenges had a significant impact on the WPI community.

We found additional support for our efforts at area colleges and institutions. We communicated with these colleges through email and our "Think Outside the Bottle at WPI" Facebook page. The most important benefits to maintaining our Facebook page were the efficient communication with other colleges, the exposure of our efforts and increased support for the TOTB campaign. Our Facebook page currently has 229 followers, an increase of 135% from the start of our efforts. Facebook viewers receive updates about our Tap Water Challenge results and water facts of the day. Our advocacy for the transition to tap water received a lot of support from Facebook users, judges and passersby at sustainability events, and EcoTarium visitors. Overall, we found overwhelming support for the transition to tap water and the installation of water bottle filling stations.

4.3 Progress in Creating a More Tap-Friendly Campus

In addition to educating the WPI community about the undesirable characteristics of bottled water and the benefits of tap water, we have worked to create a more tap-friendly campus. We worked to make drinking tap water more convenient by facilitating the installation of new water bottle filling stations, like those in the Sports & Recreation Center, in other areas around campus by proposing a water fountain replacement plan to be included in WPI's Sustainability Plan.

4.3.1 Identifying Steps to Install Water Bottle Filling Stations

To begin this process, we met with Chris Salter, the Director of Project Management and Engineering at WPI. In this meeting, we discussed the process of installing new water bottle filling stations. We found that it would not be difficult to get units and parts for new filling stations, but the main obstacle would be acquiring funding to purchase the water bottle filling stations. Mr. Salter noted that the quickest and most efficient way for increasing the number of water bottle filling stations on campus was through a capital project request. A capital project request requires a person in charge of a particular building or department to submit a funding request for the purchase and installation of a water bottle filling station. The other option was to find a project already in progress and request a modification to add installation of a filling station to that project. When speaking with Mr. Salter, this second option became a reality. He discussed the current renovation projects planned for the summer of 2013 and described a renovation to the basement of a WPI academic building, Higgins Laboratory. We inquired whether it would be possible to include installation of a water refill station into that project and he was amenable to the idea. We provided him with a specific model number of a station we would like to see

installed (Elkay model LZS8WSLK). Mr. Salter was confident that he would be able to add this model to the existing Higgins Laboratory project.

An additional option for convenient bottle filling is to retrofit existing water fountains with a spigot instead of installing a new unit, as shown in Figure 13.

Figure 13- Retrofitted water fountain

This option is beneficial if the existing fountain is refrigerated and in good working condition, but it may not be worth it if the fountain is old, or provides unrefrigerated water and would likely need to be replaced in the near future.

4.3.2 Water Fountain Assessment

To determine which fountains were eligible for retrofitting or would be most beneficial to upgrade to water bottle filling stations if funding became available, we performed a water fountain assessment. We analyzed every water fountain on campus that does not require card access, such that a typical student or visitor has access, to determine the current status of the water fountains on campus and develop a reasonable approach to repairing, replacing and upgrading current fountains. At each fountain, we took note of the water temperature, pressure, and overall quality of the fountain. A complete list of all the assessed water fountains can be found in Appendix C. Using the smartphone application "Tap Buddy" we recorded the location

of each fountain, as illustrated in Figure 14, and provided a picture and some details about the current state of the fountain, as illustrated in Figure 15.

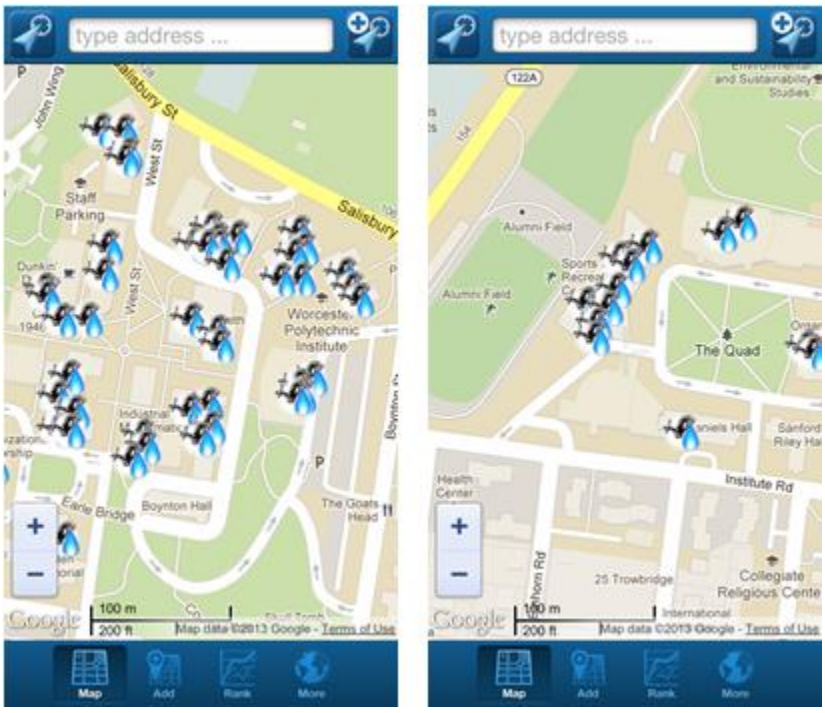

Figure 14- Tap Buddy app map

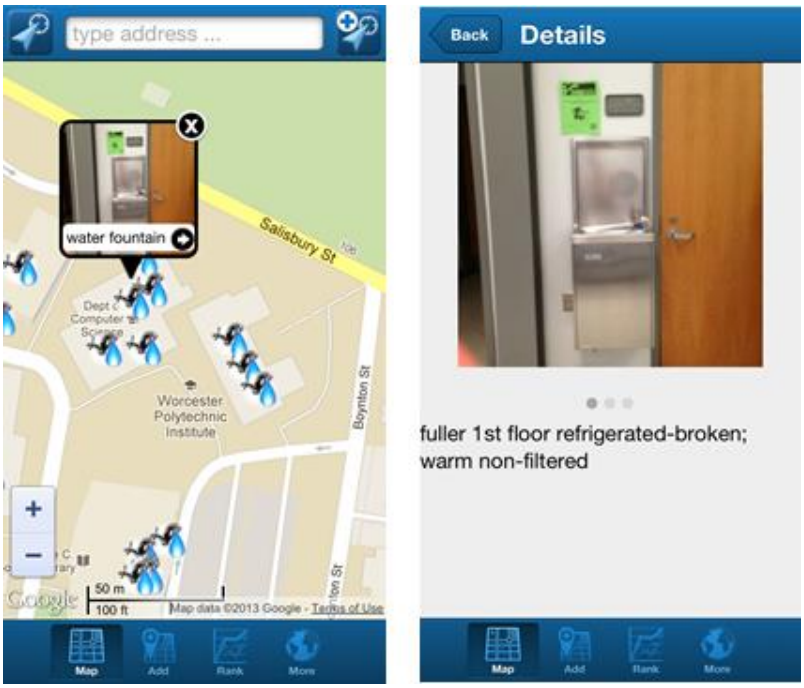

Figure 15- Tap Buddy app details

4.3.3 Water Fountain Replacement Plan

Based on the information we acquired in our water fountain assessment, we developed a priority system to determine which fountains should be replaced first and why (Table 4).

Table 4- Characteristics for tiered replacement plan

Tier	Characteristics	Fountains
1	Low quality and/or broken in highly trafficked areas	10
2	Non-refrigerated and/or low pressure; broken in low trafficked areas	13
3	Not in need of immediate repair or replacement	33

Tier 1 includes fountains that we believe should be prioritized for replacement. Tier 1 fountains are fountains in high trafficked areas that are either broken or of low quality (not cold and low pressure). Tier 2 includes fountains that are in working order, but are either non-refrigerated or have low pressure. Also included in tier 2 are fountains that are broken, but are in low trafficked areas. Tier 3 includes fountains that are in working order and are not in need of immediate replacement. Fountains in tier 3 could be retrofitted with a spigot to accommodate the demand for water bottle filling stations without replacing the entire unit. Our water fountain replacement plan includes all water fountains that are publicly accessible, thus can be accessed by a typical student or visitor (Table 5).

Table 5- Water fountain replacement plan

Tier 1	Tier 2	Tier 3
Library 2nd floor	Library Basement- Boynton St side	Founders 1st floor
Campus Center 2nd floor	Library 1st floor- Anderson Labs	Library Basement- Archives
Campus Center 3rd floor	Fuller 1st floor	Library 1st floor- Bathrooms
Harrington 2nd floor – Women's Bathroom	Fuller 2nd floor	Library 3rd floor
Higgins Labs Basement	Atwater Kent 3rd floor- WPI side	Kaven Basement
Alden Hall Basement 1	Goddard Hall 1st floor	Kaven 1st floor
Alden Hall Basement 2	Campus Center 1st floor	Kaven 2nd floor
Alden Hall Basement 3	Washburn Basement	Fuller Sub-Basement
Outdoor fountain near entrance to athletic field	Washburn 1st floor	Fuller Basement
Outdoor fountain near the fountain	Washburn 3rd floor	Fuller 3rd floor
	Higgins Labs 1st floor	Atwater Kent Basement
	Bartlett Center 1st floor	Atwater Kent 1st floor- Lobby
	Bartlett Center 2nd floor	Atwater Kent 1st floor- Bathrooms
		Atwater Kent 2nd floor- WPI side
		Atwater Kent2nd floor- Salisbury Rd side
		Atwater Kent 3rd floor- Salisbury Rd side
		Goddard Hall Basement
		Goddard Hall 2nd floor
		Goddard Hall 3rd floor
		Olin Hall Basement
		Olin Hall 1st floor
		Olin Hall 2nd floor
		Washburn 2nd floor
		Salisbury Labs 1st floor
		Salisbury Labs 2nd floor
		Salisbury Labs 3rd floor
		Stratton Hall 1st floor
		Stratton Hall 2nd floor

		Stratton Hall 3rd floor
		Higgins Labs 2nd floor
		Higgins Labs 3rd floor
		Daniels Hall 1st floor
		Harrington 2nd floor – Men's Bathroom

No fountains	Existing Filling Stations
Project Center	Harrington Basement (locker rooms)
Salisbury Labs 4th floor	Sports & Recreation Center 1st floor – Pool
Stratton Hall Basement	Sports & Recreation Center 1st floor – Trainers
Alden Hall 1st floor	Sports & Recreation Center 1st floor – Racquetball Courts
Harrington 1st floor (court level)	Sports & Recreation Center 2nd floor – Lobby
	Sports & Recreation Center 3rd floor – Entrance
	Sports & Recreation Center 3rd floor – Locker Rooms
	Sports & Recreation Center 4th floor – Lobby
	Sports & Recreation Center 4th floor – Dance Studios

As renovations are made on campus, we propose several models for replacement of the old, non-refrigerated or broken fountains. The suggested models are manufactured by the Elkay Company. We recommend this company in particular for a number of reasons: 1) Elkay is a reputable company that WPI facilities management has experience working with; 2) the WPI community has expressed great satisfaction with the current Elkay water bottle filling stations located in the Sports & Recreation Center during our Tap Water Challenges; and 3) maintaining consistency with the already existing on-campus models will reduce the maintenance learning curve. We provide information on the recommended fountains in Appendix D. Because the water bottle filling stations we recommend provide filtered water, the stations will require additional maintenance and money to replace filters. The estimated cost for filters for the water bottle filling stations in the Sports and Recreation Center is provided in Appendix E as a guide to estimate filter costs of new water bottle filling stations.

4.3.4 WPI Sustainability Plan

We presented our water fountain replacement plan to WPI's President's Task Force on Sustainability on April 23rd, 2013 in hopes of including a schedule to update water fountains in WPI's Sustainability Plan, which is to be completed during the summer of 2013. The proposal was well-received and we are optimistic that our plan will be utilized in creating a more sustainable campus.

4.4 Conclusions

The WPI community has expressed support for the transition to drinking tap water instead of drinking bottled water as demonstrated by the success of our awareness-raising events and progress made to install more water bottle filling stations around campus. Our awareness-raising events have revealed that the WPI community is interested in learning about the quality of tap water, as demonstrated by the high number of participants in our Tap Water Challenges and the number of pledge signatories. Furthermore, the high level of engagement during the discussions about the differences between bottled water and tap water that occurred after Tap Water Challenges, and at our rock concert, sustainability events, and the EcoTarium indicate the increasing desire for sustainable growth. Our proposed water fountain replacement plan offers a solution to the increased demand for tap water and promotes sustainable growth, as described in the following chapter.

5.0 Conclusions and Recommendations

In the following sections we offer detailed suggestions on what we believe would be most productive to move the WPI Think Outside the Bottle Campaign and other TOTB campaigns across the nation forward. First, in section 5.1 we discuss the Tap Water Challenges and improvements to make them even more effective. In section, 5.2 we explain the benefits and potential of our water fountain assessment. In section 5.3, we discuss the various events we held on campus and which ones we recommend repeating to raise awareness. In section 5.4, we explain the pros and cons to our marketing and outreach. Lastly, in section 5.5 we offer suggestions for continuing to promote the TOTB campaign and sustainable efforts to transition to tap water.

5.1 Tap Water Challenges

Our group successfully hosted five Tap Water Challenges on campus. We hosted them both inside in the Campus Center and outside at the fountain on campus. We found that holding a Tap Water Challenge inside warranted better involvement from students on campus. It was easier to attract people to take the Challenge and these people often brought friends with them. Outside, even when the weather was sunny and warm, the wind easily took the posters, flyers and the handouts that we prepared as giveaways to Tap Water Challenge participants. Though it was practical to host a Tap Water Challenge in various locations, we recommend that Tap Water Challenges be held in an area where community members gather and have time to participate in the Challenge rather than a location where community members are en route to class or a meeting and will not have time to participate.

5.1.1 Recommendations for Tap Water Challenges

The only recommendation we have is to only hold the Tap Water Challenge outside if there is little or no wind. If outside, cups should be filled as participants are taking the Challenge to prevent the cups from blowing away, and each pitcher should be covered to prevent debris from entering the water.

5.2 Water Fountain Assessment

The water fountain assessment was a very useful endeavor. There were fountains that many people did not know existed and many improvements could be made by the facilities staff. For example, there is only one set of water fountains in Alden Hall, and out of the three fountains, only one worked. While assessing the fountains, our group also hung a piece of paper above each fountain that had the Think Outside the Bottle name, our transition to tap logo, and a simple yet effective water fact to attempt to change people's minds about bottled water (see Appendix F). That same day we heard several people talking about these fact sheets around campus, illustrating the effectiveness of marketing.

The Tap Buddy smartphone application that we used to map each fountain during the water fountain assessment was useful, but could be more helpful if only water bottle filling stations were marked on the map for two reasons: 1) the application looks very confusing when first opened due to the copious water fountains on the WPI campus; and 2) most people on WPI's campus know where to find a standard water fountain because they are so plentiful.

5.2.1 Recommendations for Water Fountain Assessment

We believe that WPI's water fountains should be reassessed each academic year so the status of each fountain is up-to-date and usable by the facilities staff. We recommend that future efforts in the WPI campaign or campaigns at other institutions perform annual assessments to

promote tap water. Additionally, future water fountain assessments could benefit from identifying which fountains were candidates for retrofitting, as our assessment did not include this information.

Also, to reduce the clutter of the Tap Buddy app, only bottle filling stations that are of the highest quality (filtered, refrigerated, high pressure) should be added to the application. This would help create a more aesthetically pleasing application as well as making the application more usable.

5.3 Events On and Off Campus

We went to various on and off campus events regarding sustainability where we educated consumers about the quality of tap water and the environmental and financial implications of bottled water. These events helped our group learn more about the importance of sustainability on both a domestic and worldwide scale. They helped us gain confidence as we discussed all of our research with the faculty and staff at WPI and Tufts University. With this confidence, our presentations became much stronger during the final weeks of our project.

Our group also held a benefit concert to spread our message to a different crowd of people. The show was marketed around campus and the consortium but the turnout was less than expected. The concert did, however, help spread the message to the bands who attended and to the audience.

5.3.1 Recommendations for Events

We recommend going outside of your comfort zone and attending other sustainability events to have a better appreciation for your overall project and overall goal. In the future, we do not recommend hosting a concert because there is a lot of work involved with little return on

investment. The future groups' effort can be best applied into another aspect of the TOTB campaign.

5.4 Marketing and Outreach

At the beginning of our IQP, we were given authority over the previous IQP team's Facebook page for the Think Outside the Bottle campaign at WPI. The page was underutilized prior to our IQP and we decided to utilize Facebook as our main way of spreading the word about our campaign to the public. In the first week of our IQP we doubled the number of people the Facebook profile reached and decided to start doing a "Water Fact of the Day" to inform the TOTB campaign followers of the campaign's progress. These water facts proved to be successful as people would share the facts on their own wall, which allowed our message to reach people outside of our community.

During the week before the rock concert, our group created and handed out flyers to advertise the event. These were often thrown away by students or staff, which may have contributed to the limited turnout by the student body at the event.

5.4.1 Recommendations for Marketing

Facebook proved to be a very useful tool to spread information about the TOTB campaign and we recommend continuing to utilize social media as a primary method of reaching the public. If marketing for an event is needed, we recommend starting the process a few weeks prior to the event to ensure that people will not forget about the event; however our group still does not recommend hosting a concert.

5.5 The Next Step for WPI

As our IQP concludes, we have several suggestions for WPI to ensure progress for the TOTB campaign. First, we recommend selling less bottled water on campus by altering

Chartwell's contract with Coca-Cola once the contract comes up for renewal in 2018. Second, we encourage tap water education in events for freshmen to expose them to the sustainable and progressive atmosphere of WPI. Third, we believe the TOTB campaign will be more successful as a joint effort throughout Worcester, thus we recommend developing a community that embraces the transition to tap water.

5.5.1 Alteration of Chartwell's Contract with Coca-Cola

When the contract between Chartwells and Coca-Cola expires in 2018, we suggest that WPI aim to decrease, if not completely stop selling bottled water in the Campus Center and in vending machines around campus, in addition to stopping distribution of bottled water at catered events. This contract change is feasible if WPI has made the necessary upgrades to encourage and facilitate the consumption of tap water, such as installing water bottle filling stations and selling more, high quality reusable water bottles on campus. These changes will create a more sustainable campus and community as a whole.

5.5.2 Incorporate Education about Tap Water at NSO

Implementing educational programs about the quality of tap water and the harmful effects of bottled water in WPI's New Student Orientation for freshmen and transfer students will immediately immerse new students in the sustainable culture of WPI. This education could help decrease the amount of disposable water bottles thrown out in the trash in the freshmen dorms (Audet et al, 2012). Furthermore, this education will promote the consumption of tap water and use of readily available resources.

5.5.3 Expanding the TOTB Campaign to the Worcester Community

The goal of the TOTB campaign will be much more successful if the entire Worcester community, including elementary, middle, and high schools and colleges, worked together to

develop a sustainable city. By educating various age groups about the undesirable characteristics of bottled water and the benefits of tap water, the transition to tap water could be faster and more significant. This city-wide effort could be done by advertising and marketing research around local schools in Worcester. The students of Worcester schools could fill out surveys and also have parents or siblings fill them out to get a better grasp on the community feelings about bottled water. With this information, a dedicated group consisting of college students, community members, and school officials could assess the data and continue the TOTB campaign to create a community that embraces sustainability.

5.5.4 Proposing a Capital Project Request

A capital project request may be necessary to acquire the funds to make immediate water fountain upgrades. A student at Holy Cross, Emily Sullivan, recently received funding to have 15 filling stations installed. According to Ms. Sullivan, the best way to propose a capital project request is through the Student Government Association (SGA). After speaking with SGA, and getting support for the request, she recommends writing a very detailed proposal with the locations for the filling stations, the type of units that will be installed, and why installing new filling stations would benefit the campus, similar to our water fountain replacement plan. Finally, she recommends bringing the proposal to the President's Task Force on Sustainability and the facilities director to execute the request. Emily informed us that this process can take almost a year, so we recommend that the Student Green Team or a similar organization take ownership of this project to ensure its development and implementation as an IQP team does not have enough time with seven weeks to dedicate their time to submit such a request.

5.6 Final Conclusions

Overall, our project was a success. Not only were we able to influence opinions on tap and disposable bottled water, but we were able to install a new water bottle filling station, assess all campus water fountains at WPI, and proposed a tiered plan for the installation and repair of water fountains around campus. By educating the members of the WPI community about the quality of tap water and the harmful effects of bottled water, we have changed opinions in favor of tap water. Furthermore, we have revealed through our awareness-raising events and discussions about tap water that the WPI community greatly supports the transition to tap water. As a result, we assessed all of the publicly accessible water fountains on campus to propose a water fountain replacement plan to be incorporated into WPI's Sustainability Plan to meet the increasing demand for tap water. This accomplishment ensures continuity of the TOTB campaign even after our IQP has ended. The pending installation of a water bottle filling station in the basement of Higgins Laboratories during the summer of 2013 is a great accomplishment for our team and a step in the right direction for WPI's transition to tap water.

References

About the WIFC. (2009). About the WIFC: Commission Background. Retrieved from http://www.senatoreldridge.com/legislation/wifc/about-the-wifc

Andreini, M. (2011, March). *BPA, Phthalates, and the Law.* Retrieved from http://www.jonesday.com/bpa_phthalates/

Arnold, E., & Larsen, J. (2006). Bottled Water: Pouring Resources Down the Drain. Retrieved from Earth Policy Institute. http://www.earthpolicy.org/index.php?/plan_b_updates/2006/update51

Audet, E., Auger, X., Cross, M., & Pepo, M. (2012). Think Outside the Bottled Campaign at WPI (Undergraduate Interactive Qualifying Project No. E-project-121312-160551). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection: http://www.wpi.edu/Pubs/E-project/Available/E-project-121312-160551/unrestricted/CAI_Final_Report_2012.pdf

Bosque, T. (2012) University of Vermont Agrees to Ban Bottled Water, Gets Backlash from IBWA. *CTI News*. Retrieved from http://www.banthebottle.net/news/university-of-vermont-agrees-to-ban-bottled-water-get-backlash-from-ibwa/

Buttell, A. E. (2009). 4 steps to an effective marketing plan. *Journal of Financial Planning*, 6-8. Retrieved from http://ezproxy.wpi.edu/login?url=http://search.proquest.com/docview/217552626?accountid=29120

Call for Cuts. (2011). House Representatives Call for Cuts in Bottled Water Spending. Retrieved from http://cicilline.house.gov/press-release/house-representatives-call-cuts-bottled-water-spending

Climate Protection Manual for Cities (2010). Retrieved from http://www.climatemanual.org/Cities/Chapter5/LongTermInitiatives/CPM_Chapter5_LocalActionPlan_LongTermInitiatives_WasteManagement.htm#_ftn5

Consumer Reports. (2012). Bottled water. *Consumer Reports, 77*(7), 9. Retrieved from: http://au4sb9ax7m.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info%3Aofi%2Fenc%3AUTF-8&rfr_id=info:sid/summon.serialssolutions.com&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.atitle=Bottled+water&rft.jtitle=Consumer+Reports&rft.date=2012-07-01&rft.pub=Consumers+Union+of+the+United+States%2C+Inc&rft.issn=0010-7174&rft.volume=77&rft.issue=7&rft.spage=9&rft.externalDBID=n%2Fa&rft.externalDocID=293131472

Corporate Accountability International. (2012). Think Outside the Bottle. Retrieved from: http://www.stopcorporateabuse.org/think-outside-bottle

Cradock, Angie L., Wilking, Cara L., Olliges, Sarah A., Gortmaker PhD., Steven L. (2012). Getting Back on Tap: The Policy Context and Cost of Ensuring Access to Low-Cost Drinking Water in Massachusetts Schools. *American Journal of Preventive Medicine, Volume 43, Issue 3, Supplement 2,* S95–S101. doi: 10.1016/j.amepre.2012.05.016

Drinking Water Research Foundation (DWRF) (2011). *Bottled Water and Tap Water: Just the Facts.* Retrieved from http://www.thefactsaboutwater.org/uploads/BW%20PWS%20Just%20the%20Facts%202011%20Final.pdf

Environmental Protection Agency (2009). Water on Tap: What You Need to Know. Retrieved from http://www.epa.gov/ogwdw/wot/pdfs/book_waterontap_full.pdf

FDA. (2012). Retrieved from U.S Department of Health and Human Services website: http://www.fda.gov/NewsEvents/PublicHealthFocus/ucm064437.htm

Food & Water Watch. (2010). Teaching the Tap: Why America's Schools Need Funding for Water. Retrieved from http://waterinschools.org/pdfs/TeachingTapFWW.pdf

Fuller, F. (2003). Bottled water goes to school. *Restaurants & Institutions, 113*(8), 107-108. Retrieved from http://ezproxy.wpi.edu/login?url=http://search.proquest.com/docview/208288578?accountid=29120

Gleick, P. & Cooley, H. (2009). Energy implications of bottled water. *Environmental Research Letters, 4*(1), doi: 10.1088/1748-9326/4/1/014009

Gleick, P. (2010). Bottled and Sold: The Story Behind Our Obsession with Bottled Water. Covelo, CA, USA: Island Press. Retrieved from http://site.ebrary.com/lib/wpi/Doc?id=10437873&ppg=56

Goodman, S. (2009, July 9). Fewer regulations for bottled water than tap, GAO says. *The New York Times*. Retrieved from http://www.nytimes.com/gwire/2009/07/09/09greenwire-fewer-regulations-for-bottled-water-than-tap-g-33331.html

Hill, C.P. (2011). *Internal corrosion control in water distribution systems*. Denver, CO: American Water Works Association

Hu, Z., Morton, L.W., & Mahler, R.L. (2011). Bottled water: United States consumers and their perceptions of water quality. *International Journal of Environmental Research and Public Health.* 8, 565-578. doi: 10.3390/ijerph8020565

Jaffee, D., & Newman, S. (2013). A more perfect commodity: Bottled water, global accumulation, and local contestation. *Rural Sociology*. doi: 10.1111/j.1549-0831.2012.00095.x

Key Differences Between EPA Tap Water and FDA Bottled Water Rules. *Nrdc.org*. Retrieved from http://www.nrdc.org/water/drinking/bw/table1.html

MassDEP (2013). Massachusetts Energy Management Pilot. Retrieved from http://www.mass.gov/dep/water/priorities/empilot.htm

McCoy, Kevin. (2012). Disputes spring up over bottled water sources. *USA Today*. Retrieved from http://www.usatoday.com/story/money/business/2012/12/13/bottled-water-sources-disputed/1768417/

Michon, K. (2011). *Nolo.com*. Retrieved from http://www.nolo.com/legal-encyclopedia/bisphenol-bpa-litigation-fda-developments-32534.html

Milwaukee Water Works. (2012) Water Quality and Public Health. *http://city.milwaukee.gov/water/customer/FAQs/qualityandhealth*

Mustel Group Market Research. (2011) *Metro Vancouver Drinking Water Research.* Retrieved from http://www.metrovancouver.org/region/tapwater/Documents/2011DrinkingWaterSurvey.pdf

National Academy of Sciences (2009) The National Academies' Water Information Center: Drinking Water Basics. Retrieved from http://water.nationalacademies.org/basics_part_4.shtml

Plastic Bottle Ban In Concord, Massachusetts Goes Into Effect. (2013). *Huff Post Green*. Retrieved from http://www.huffingtonpost.com/2013/01/02/plastic-bottles-banned-concord-massachusetts_n_2395824.html?green-living

Pollack, A., & Tavernise, S. (2012, November 22). Oversight failures documented in meningitis outbreak. *The New York Times*. Retrieved from http://www.nytimes.com/2012/11/22/health/documents-show-fdas-failures-in-meningitis-outbreak.html?_r=2&

Tapping Congress to Get Off the Bottle. (2011). *Corporate Accountability International*. Retrieved from http://www.stopcorporateabuse.org/sites/default/files/resources/tappingcongresstogetoffthebottle_0.pdf

The Jamie Eldridge Committee. (2009). About the WIFC: Commission Background. Retrieved from http://www.senatoreldridge.com/legislation/wifc/about-the-wifc

The Patriot Online. (2012). Oxford makes progress in its water company takeover quest. Retrieved from http://www.patriotnewspaper.com/index.php?option=com_content&view=article&id=133&catid=19&Itemid=114

Tukur, A., Sharp, L., Stern, B., Tizaoui C., and Benkreira, H. (2012) PET bottle use patterns and antimony migration into bottled water and soft drinks: the case of British and Nigerian bottles. *Journal of Environmental Monitoring*. doi: 10.1039/c2em10917d

United States Environmental Protection Agency. (2011, October 13). Retrieved from http://www.epa.gov/history/

United States Government Accountability Office. (2009, June). *BOTTLED WATER: FDA safety and consumer protections are often less stringent than comparable EPA protections for tap water.* (Publication No. GAO-09-610). Retrieved from http://www.gao.gov/assets/300/291465.pdf

Viscusi, W., Huber, J., & Bell, J. (2012). Alternative Policies to Increase Recycling of Plastic Water Bottles in the United States. *Review of Environmental Economics and Policy, 6*(2), 190-211. doi: 10.1093/reep/res006 Retrieved from http://reep.oxfordjournals.org/content/6/2/190.full.pdf+html

Water Boy, Inc. (2010). What Do the Different Labels on Bottled Water Mean? Retrieved from http://www.waterboyinc.com/blog/types-of-bottled-water/

Webb, K., Crawford, R., Sawabe, T., & Ivanova, E. (2009). Poly(ethylene terephthalate) Polymer Surfaces as a Substrate for Bacterial Attachment and Biofilm Formation. *Microbes and Environments.*24(1) 39-42. doi:10.1264/jsme2.ME08538

Wilk, R. (2006) Bottled Water: The pure commodity in the age of branding. *Journal of Consumer Culture, 6(3),* 303-325. doi: 10.1177/1469540506068681

Worcester County Department of Public Works. (2012) Mystic Harbour Service Area 2012 Annual Drinking Water Quality. *Consumer Confidence Report*. Retrieved from http://co.worcester.md.us/pw/2012-Annual-Drinking-Water-Quality/MysticHarbourCCR2012.pdf

Appendix

Appendix A- Tap Water Challenge Handout

Write the letter of the water sample next to its corresponding source:

_____ Dasani	A. Cup A
_____ Poland Spring	B. Cup B
_____ Aquafina	C. Cup C
_____ Rec Center Tap	D. Cup D
_____ Campus Center Tap	E. Cup E
_____ Library Tap	F. Cup F

Please circle the water sample that had the best taste:

Cup A Cup B Cup C Cup D Cup E Cup F None

Appendix B- Tap Water Poster

Appendix C- Water Fountain Assessment

Location	Refrigerated	Pressure	Quality	Comments
Alden Hall				
Basement 1	-	-	-	Broken
Basement 2	✓-	✓	✓-	Cool
Basement 3	-	-	-	Broken
1st floor	-	-	-	*No fountains*
Atwater Kent				
Basement	✓	✓	✓	
1st floor- Lobby	✓	✓	✓	
1st floor- Bathrooms	✓	✓	✓	
2nd floor- WPI side	✓	✓	✓	
2nd floor- Salisbury Rd side	✓	✓	✓	
3rd floor- WPI side	✗	✓	✗	Warm
3rd floor- Salisbury Rd side	✓-	✓	✓-	Cool
Bartlett Center				
1st floor	✓-	✓	✓	Cool
2nd floor	✓-	✓	✓	Cool
Campus Center				
1st floor	✓-	✓-	✓-	Cool; Low pressure
2nd floor	✗	✗	✗	Warm; Poor pressure
3rd floor	✗	✓-	✗	Warm; Low pressure
Daniels Hall				
1st floor	✓	✓	✓	
Founders Hall				
1st floor	✓	✓	✓	
Fuller Labs				
Sub-Basement	✓	✓	✓	
Basement	✓	✓	✓	
1st floor	✗	✓	✗	Warm
2nd floor	✓	✓	✓	Handle missing
3rd floor	✓	✓	✓	
Goddard Hall				
Basement	✓-	✓	✓-	Cool
1st floor	✗	✓	✗	Warm
2nd floor	✓	✓	✓	
3rd floor	✓	✓	✓	
Harrington				
Basement (locker rooms)	✓+	✓+	✓+	Water bottle filling station
1st floor (court level)	-	-	-	*No fountains*
2nd floor- Women's Bathroom	-	-	-	Broken
2nd floor- Men's Bathroom	✓	✓	✓	

Higgins Labs				
Basement	✗	✓	✗	Warm
1st floor	✓-	✓	✓	Cool
2nd floor	✓	✓	✓	
3rd floor	✓	✓	✓	
Kaven Hall				
Basement	✗	✓	✗	Warm
1st floor	✓	✓	✓	
2nd floor	✓	✓	✓	
Library				
Basement- Archives	✓	✓	✓	
Basement- Boynton St side	-	-	-	Broken
1st floor- Bathrooms	✓	✓	✓	
1st floor- Anderson Labs	-	-	-	Broken
2nd floor	✓	✓	✓	
3rd floor	✓	✓	✓	
Olin Hall				
Basement	✓+	✓	✓	
1st floor	✓+	✓	✓	
2nd floor	✓	✓	✓	
Project Center				
1st floor	-	-	-	*No fountains*
2nd floor	-	-	-	*No fountains*
Salisbury				
1st floor	✓	✓	✓	
2nd floor	✓	✓	✓	
3rd floor	✓	✓	✓	
4th floor	-	-	-	*No fountains*
Sports & Recreation Center				
1st floor- Pool	✓+	✓+	✓+	Water bottle filling station
1st floor- Trainers	✓+	✓+	✓+	Water bottle filling station
1st floor- Racquetball Courts	✓+	✓+	✓+	Water bottle filling station
2nd floor- Lobby	✓+	✓+	✓+	Water bottle filling station
3rd floor- Entrance	✓+	✓+	✓+	Water bottle filling station
3rd floor- Locker rooms	✓+	✓+	✓+	Water bottle filling station
4th floor- Lobby	✓+	✓+	✓+	Water bottle filling station
4th floor- Dance Studios	✓+	✓+	✓+	Water bottle filling station
Stratton Hall				
Basement	-	-	-	*No fountains*
1st floor	✓	✓	✓	
2nd floor	✓	✓	✓	
3rd floor	✓	✓	✓	
Washburn				

Basement	✓	✓-	✓	Low pressure
1st floor	✓	✓-	✓	Low pressure
2nd floor	✓	✓	✓	
3rd floor	✓	✓-	✓	Low pressure

Legend	
Refrigeration	
✓+	Cold
✓	Cool
✓-	Warm
Pressure	
✓+	High
✓	Moderate
✓-	Low
Quality	
✓+	High
✓	Moderate
✓-	Low

Appendix D- Suggested Water Bottle Filling Stations

Model Number	Price	Picture	Example Location
Elkay LZS8WSLK	$996.50		Campus Center Library Alden Hall Founders
Elkay LZWSM8PK	$1680.00		Harrington
Halsey Taylor 4405BF	$1843.50		Outdoor near fountain attached to Project Center building

Halsey Taylor 4420BF1UDB	$4010.50		Entrance to athletic field

Appendix E- Cost of Water Bottle Filling Station Filter Replacement

This data was collected by the student Green Team over four weeks in B term 2012. The water bottle filling stations record the number of 12 oz water bottles saved by drinking tap water (1 gallon = 128 oz).

Rec Center Water Bottle Filling Station Assessment							
	4th Floor Lobby	4th Floor Dance Studios	3rd Floor Locker room	3rd Floor Lobby	2nd Floor Lobby	1st Floor Trainers	Average Number Bottles Saved
Sunday	102.5	69.5	152.5	115	4	6.5	450
Monday	369.5	222	584	411	10.5	98	1695
Tuesday	325.5	173.5	496.5	355	16.5	60	1427
Wednesday	175.5	98.5	236	191.5	9.5	60.5	771.5
Thursday	234	167.5	407.5	276.5	17	73.5	1176
Friday	255	166	452.5	349	18	63	1303.5
Saturday	128.67	109.67	262	232	20.33	46	798.67
Totals	1590.67	1006.67	2591	1930	95.83	407.5	7621.67

4th floor Lobby			
1590.67	19088.00	149.13	<- gallons saved per week
total bottles saved per week	* 12 oz per bottle	divide 128 oz per gallon	
3000.00	20.12	<- weeks per filter	
filter capacity (gallons)	divide by gallons saved per week		
52.00	2.58	<- filter changes a year	
weeks in year	divide by weeks per filter		

4th floor Dance Studios			
1006.67	12080.00	94.38	<- gallons saved per week
total bottles saved per week	* 12 oz per bottle	divide 128 oz per gallon	
3000.00	31.79	<- weeks per filter	
filter capacity (gallons)	divide by gallons saved per week		
52.00	1.64	<- filter changes a year	
weeks in year	divide by weeks per filter		

3rd floor Locker rooms			
2591.00	31092.00	242.91	<- gallons saved per week
total bottles saved	* 12 oz per bottle	divide 128 oz per gallon	
per week			
3000.00	12.35	<- weeks per filter	
filter capacity (gallons)	divide by gallons saved per week		
52.00	4.21	<- filter changes a year	
weeks in year	divide by weeks per filter		

3rd floor Lobby			
1930.00	23160.00	180.94	<- gallons saved per week
total bottles saved	* 12 oz per bottle	divide 128 oz per gallon	
per week			
3000.00	16.58	<- weeks per filter	
filter capacity (gallons)	divide by gallons saved per week		
52.00	3.14	<- filter changes a year	
weeks in year	divide by weeks per filter		

2nd floor Lobby			
95.83	1150.00	8.98	<- gallons saved per week
total bottles saved	* 12 oz per bottle	divide 128 oz per gallon	
per week			
3000.00	333.91	<- weeks per filter	
filter capacity (gallons)	divide by gallons saved per week		
52.00	0.16	<- filter changes a year	
weeks in year	divide by weeks per filter		

1st floor Trainers			
407.50	4890.00	38.20	<- gallons saved per week
total bottles saved	* 12 oz per bottle	divide 128 oz per gallon	
per week			
3000.00	78.53	<- weeks per filter	
filter capacity (gallons)	divide by gallons saved per week		
52.00	0.66	<- filter changes a year	
weeks in year	divide by weeks per filter		

12.39	4.13	<- number of 3 packs of filters needed a year for 6 stations
total number filter	divide by 3 to account for	
changes a year	buying 3 packs of filters	
for 6 stations		
$303.75	$1,254.49	<-- total cost of filters per year with data for 6 fountains
cost of filter 3 pack	*number of 3 packs	
	needed per year	
13.71	4.57	<- number of 3 packs of filters needed a year for 8 stations
total number filter	divide by 3 to account for	
changes a year	buying 3 packs of filters	
for 8 stations		
used same # for all 3		
fountains on 1st floor		
$303.75	$1,388.14	<-- total cost of filters per year with data for 8 fountains
cost of filter 3 pack	*number of 3 packs	
	needed per year	

Appendix F- Marketing Material

Phase out the sale and distribution of bottled water at WPI

Water Fact:

It takes three times the amount of water to produce the plastic bottle as it does to fill it!

Like us on Facebook! -https://www.facebook.com/ThinkOutsideTheBottleAtWpi
Email us! – wpc13bottles@wpi.edu

Worcester Community Project Center