Cooler Than Tap Water: A Study of Water Coolers and Tap Water on Dalhousie University Campus

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Executive Summary

Despite having consistent access to clean drinking water, nearly 100 water coolers exist on Dalhousie campus, as indicated by an audit performed by the Office of Sustainability (personal communications, February 2011). It is assumed that an underlying distrust for tap water is fuelling (or at least contributing to) these purchases. However, there has been very little research that has focused on the quality of water from water coolers, and it is often simply assumed to be a healthier and safer choice.

Our project aims to investigate whether or not water cooler water is actually cleaner, healthier, or safer than tap water, by comparing its quality to that of tap water on Dalhousie campus. Our study took water samples from ten coolers across campus and tested them for alkalinity, as well as bacterial and metal content. The samples were compared to the standards set by the *Guidelines for Canadian Drinking Water Quality.* Our research revealed that both sources adhered to these guidelines, and were of comparable quality.

Aside from the money being spent on water coolers for water of comparable quality to that of tap, there are also many environmental issues associated with water coolers, such as emissions and energy consumption associated with extraction, transportation, distribution, and storage. We hope that our findings will encourage a trust in tap water and a move away from the use of water coolers and bottled water of all kinds.

Introduction

Background Information

In a world of ever-increasing expansion, demand, and consumption of resources, sustainable practices are highly valued. To build a sustainable society, we must find a balance between current and future needs. The search for sustainability will end when our society can progress without catastrophic setbacks in the foreseeable future. Mahatma Ghandi once said, "Earth provides enough to satisfy every man's need, but not every man's greed". (Chen, 2007, n.p.)

While achieving long-term environmental sustainability is an important issue for today's society, the bottled water industry does not support a truly sustainable future. The collection, transportation, distribution and disposal of bottled water all have a negative impact on the environment. This industry contributes waste to landfills, relies on the use of petroleum-based plastic packaging, and emits greenhouse gases during production and transportation of the products (Parag & Roberts, 2009).

Polyethylene terephthalate (PET) (indicated by a "1" recycling symbol) tends to be the plastic of choice for bottled water, because of its lightweight and transparent properties (Ferrier, 2001). While recycling systems are in place as solutions to the excessive use of single-use water bottles, recycling plastic has many limitations. Unlike glass, it is extremely difficult to achieve a high-quality recycled product. To achieve quality comparable to virgin plastics, the recycled materials must be clean and can only have included one type of plastic. In these situations, recycled plastics are often used to create products where a variety of other, more sustainable, materials could be used (Astrup *et al*., 2009). Canadian bottled water consumption increases yearly, yet only 10% of these bottles are recycled each year (Pritchard, 2009). In fact, it has been estimated that nearly 65 million water bottles end up in the landfill yearly in Toronto alone (Carter *et al.*, 2009).

The 5-gallon water cooler bottles use a different type of plastic, known as Polycarbonate (usually indicated by a "7" recycling symbol). Despite being much sturdier and reusable, these bottles have a negative environmental impact in many of the same ways as PET bottles, including collection and distribution. They claim to reduce plastic waste with a 99% reclamation rate (Potera, 2002), however the reuse of these plastic bottles may be having a negative impact on human health. Howdeshell *et al.* explain that "Bisphenol A (BPA) is a monomer with estrogenic activity that is used in the production of food packaging, dental sealants, polycarbonate plastic, and many other products" (2003, p. 1). Their research found that under moderate conditions, BPA leached into water from polycarbonate pet cages, and higher levels were found in used cages (as opposed to new). Leaching of estrogenic monomers can lead to increased estrogenic effects, and can cause changes in cell functions, such as the mammary glands (Howdeshell *et al.*, 2003).

Canada's water quality has been rated as second best in the world by a recent United Nations report, only second to Finland (United Nations Report; Pritchard, 2009). Unfortunately, this perfectly healthy water has been taken for granted as a perpetually renewable resource, and has been replaced by bottled water in countless instances. This increasing use of bottled water has been contributing to many unsustainable and unnecessary practices, on both environmental and economic levels. Despite images of mountains and glaciers on labels, bottled water is often poorly regulated (Parag & Roberts, 2009). In many instances, the water contained in these bottles has been collected from the same sources as the municipal tap water, or even from the tap itself. Ineffective purification processes may be applied before the bottled water is resold at a cost between 500 to 10,000 times the cost of municipal water (Ferrier, 2001; Pritchard, 2009).

Increased use of and reliance on bottled water indicates and promotes the belief that tap water is of a lesser quality than bottled water, and reduces pressure on the government to protect municipal sources used for drinking (Pritchard, 2009). These environmental and economic considerations are only some of those that make the bottled water industry an unsustainable one.

Dalhousie and Sustainability

Dalhousie University has taken many steps toward sustainability in recent years. From the creation of the College of Sustainability and Office of Sustainability, to the opening of the Mona Campbell building, much effort has been put into 'greening' the campus and spreading information about environmental issues. Despite these tremendous accomplishments, many issues remain unaddressed, such as the presence of water coolers on campus. The Dalhousie Sustainability Policy commits the university to developing sustainable practices. This commitment can be demonstrated through a further step toward tap water by increasing educated communication surrounding the quality of water in those communal coolers as well as individual bottles.

Access to clean drinking water is a human necessity as well as an important health and environmental issue. The Canadian government has taken many actions in recent years to ensure that clean water is available for all Canadians, including monitoring water quality, the development of water quality regulations, and the enforcement to drinking water guidelines (Environment Canada, 2010). While Dalhousie is committed to providing clean and healthy drinking water to its community, this obligation is satisfied through the provision of a large number of public water fountains across campus. The quality of the municipal water provided through Dalhousie's taps and fountains is tested regularly according to the *Canadian Drinking Water Quality Guidelines*, as provided and outlined by Health Canada (Health Canada, 2011). Though the *Canadian Drinking Water Quality Guidelines* are not legally binding standards, Nova Scotia adopted them as such in 2000. These guidelines address health-related standards (e.g. Maximum acceptable standards), as well as non-health-related guidelines (e.g. taste, odour and colour) (Nova Scotia Environment and Labour, 2007). In contrast to these high standards for municipal water, bottled water plants are generally only inspected once every 3 – 5 years, while HRM's water is tested twice weekly (Pritchard, 2009).

Despite the many reasons for choosing tap over bottled water, nearly 100 water coolers exist on Dalhousie campus alone, as indicated in an audit performed by the Office of Sustainability (personal communications, February 2011). Dalhousie is, in theory, not paying for these purchases as their *Guidelines for Entertainment, Food, Beverage & Miscellaneous Expenses* states that, "Beverages (coffee, tea, fruit juices, soft drinks, bottled water) and refreshments for the general use of faculty, staff and students shall not be paid for out of University funds" (Dalhousie University, 2000). While there have been some suspicions as to whether the funds for all of these water coolers is actually coming from the individuals, or from Dalhousie's budget (personal communications, February 2011), it is at least certainly coming out of Dalhousie's budget in terms of the electricity used in running the them continually (personal communications, March 2011). The large presence of water coolers being maintained on campus, at personal cost, indicates a possible distrust of water quality provided by public fountains and a trust in, and preference for, communal water coolers. Despite Halifax's water being legally protected, a move away from drinking tap water could potentially decrease pressure to maintain high quality tap water, as discussed above (Pritchard, 2009).

Bottled water first came onto the market in 1968 in France and had grown fairly popular by the 1980's (Horrocks, 2009). Yet, today we are seeing much opposition to the bottled water industry. In recent years, the sale of bottled water has surfaced as a source of debate among Canadian universities, and bottled water bans have emerged as a response to this issue. Many universities have already implemented a bottled water ban (such as Memorial, Acadia, Ottawa, Queens, Guelph, Ryerson), but few have focussed on water coolers, although the impact is just as negative as individual water bottles (Horrocks, 2009). Dalhousie has been discussing and evaluating the feasibility of a ban in recent years, but has not yet joined the growing list of sustainably-focused schools that have. As water coolers do not fall under purchasing contracts and are not regulated through the purchasing department, a ban and removal of bottled water would not normally include these types. As Dalhousie strives to be a leader in the field of sustainability, incorporating the removal of water coolers into a prospective bottled water ban would encourage sustainable action surrounding all bottled water among other institutions. As a leader in sustainability, Dalhousie must go above and beyond current trends and standards. The application of this report toward a move away from bottled water of all kinds would further increase Dalhousie's standing as a leading institution in sustainable practice.

Literature Review

A plethora of studies have explored the barriers to using water fountains at several universities. One example is the Polaris Institute study (2009), which addressed obstacles to a bottle-free movement. It was suggested that, were this initiative to work, the quality of fountains on campus would need to be upgraded (Horrocks, 2009; Polaris, 2009; Pritchard, 2009; Food & Water Watch, 2007). UBC's Okanagan campus has installed fountain filters and water dispensing units that improve water quality (UBC, 2011).

While municipal tap water is scrutinized regularly to follow a strict set of guidelines for drinking water quality, the quality of water from individual water coolers is not regulated or controlled once installed on a dispenser (NS Environment, 2010; Halifax Water, 2007). The lack of adequate cleaning of water coolers can lead to decreased water quality or contamination. A study done in 1993 on a comparison of the microbiological quality of water coolers and municipal water systems in Quebec reported that 50% of the drinking water quality complaints received by the Ministry of the Environment were related to water coolers (Levesque *et al*., 1994). This study sought to address the same dilemma that Dalhousie is facing with water coolers and found that 28% of water coolers tested were contaminated in comparison to 22% of tap water samples. The study found that tap water was, in general, of a better quality than that of water coolers and contributed this primarily to the unsanitary condition of the water cooler dispensers. Those water cooler dispensers that were cleaned on a regular basis, similar to the suggestions of Health Canada, produced better water quality results. Only 36% - 44% of water cooler owners surveyed in this study were aware of the recommendations for regular cleaning of the water coolers, contributing to final suggestions that better education on proper cleaning be made available by water cooler providers, and that regular health inspections be performed on coolers (Levesque, 1994).

Although little research and testing has been done overall on this topic, the trend seems to lean toward a lower quality of water being provided by water cooler dispensers when compared to municipal tap water, especially when not cleaned on a regular basis.

Goals and Objectives

We hope that the results of our water testing will contribute to the available literature on the subject of water quality of communal water coolers. Our results will also allow for comparison with both the *Canadian Drinking Water Quality Guidelines* and the results from Dalhousie's tap water testing, performed by the Halifax Water Commission, in order to gain a more thorough understanding of the differences between water quality sources on campus. This will allow for educational material to be created surrounding the quality of water coolers in comparison to that of tap waters, in order to increase knowledge surrounding drinking water quality. Research of movements away from bottled water and toward tap water use will also be useful in determining the reasons for people's preference for water coolers and will assist in the preparation of education material to encourage the shift to tap water upon this project's completion. The ultimate goal of this research is that the results be used to assist in the implementation of a bottled water free campus, with the inclusion of water coolers in this ban, and to help people regain trust in municipal tap water via awareness campaigns. Application of our results and recommendations will also be beneficial in increasing Dalhousie's stance as a leader in sustainability.

Research Methods

For this project, quantitative research methods were used to gather, analyze and compare the campus water cooler samples against the known results of tap water testing performed by Halifax Water on the Dalhousie campus based on the *Guidelines for Canadian Drinking Water Quality*. This method was chosen for the project as opposed to qualitative research methods such as performing surveys or interviews because the water testing could potentially provide proof that the quality of cooler water is similar or possibly even worse than tap and fountain water on campus. If our research shows that the quality of cooler water does not exceed tap or fountain water quality, then the following step could be to use these results to educate those using communal water coolers and break down the barriers associated with consuming water from public sources on the Dalhousie campus.

As the goal of our research was to determine whether the water within these communal coolers on the Dalhousie campus meets the same quality guidelines as the public taps and water fountains on the campus, water samples from 10 coolers were collected on the week of March 14th, 2011. We attempted to get a representative sample from each of the Carleton, Sexton and Studley Campuses although we ran into the limiting factor of not being able to get permission to sample from many water coolers on the Carleton Campus so therefore more samples were taken on the Studley Campus. We collected samples from coolers in the following locations: the Philosophy Department and French Department in the McCain Arts and Social Sciences Building; the School of Public Administration, and Management Career Services in the Rowe Management Building; the Psychology Department in the Life Sciences Centre; the DSU Office, Counselling Services, and Career Services in the Student Union Building; D401 and G212 on Sexton Campus. Water samples were collected using autoclaved containers and rubber gloves were worn to ensure that the samples did not get contaminated.

During the weeks of March 21st and 28th our group, with the help of lab technician Heather Daurie at the Water Quality Lab on the Sexton Campus, began analyzing the cooler samples for bacterial and metal content, and alkalinity. A reagent called coliltert was used to test for the presence of E. Coli and coliform within the water samples. One packet of coliltert was added to each vial of water and the vials were then incubated for 24 hours. If a sample fluoresces under UV light that indicates the presence of E. Coli and if a sample turns bright yellow then coliform is present. Titrations were performed using a 0.02 mol H_2SO_4 solution to determine alkalinity. An inductively charged plasma mass spectrometer (ICPMS) was used to determine the concentrations of sodium, manganese, magnesium, calcium and copper within each sample. For this test, a calibration curve is generated with standards and the sample results are compared with this calibration curve to determine concentrations.

The results of the analyzed water cooler samples were the compared with the tap water results from Halifax Water.

Results

The results from our water cooler tests are included in this section. We conducted tests on ten water coolers on Dalhousie campus. Tests were performed to determine the presence/absence of *Escherichia coli* and coliform bacteria, alkalinity level, hardness level, and metal content (sodium, lead, copper, manganese, calcium, and magnesium). We also obtained the results of the Halifax Water tests conducted on Dalhousie University campus tap water. This data was only available for the houses on campus, as the university building results have not yet been released. In addition, in the Halifax Water test data provided (Table 5) the presence/absence results regarding bacteria were not included, thus this parameter could not be compared between the two water sources. All water cooler samples, as seen in Table 1, procured negative results for both coliform and *Escherichia coli.*

Table 1: Results of the colilert presence/absence test[1] conducted on each of the water cooler samples taken on Dalhousie University campus in March 2011. Locations 'G212' and 'D401' are found on Sexton campus. All other samples were taken from Studley campus.

	Presence/Absence	
Sample Location:	Coliform	E.Coli
McCain French Department	Absent	Absent
G212	Absent	Absent
Counselling Services	Absent	Absent
McCain Philosophy Department	Absent	Absent
Career Services	Absent	Absent
Dalhousie Student Union Office	Absent	Absent
Rowe School of Public Administration	Absent	Absent
D401	Absent	Absent
Life Sciences Centre Psychology Main Office	Absent	Absent
Rowe Management Career Services	Absent	Absent

The colilert reagent was added to each sample bottle above, and then the bottles incubated for 24 hours. At the end of this time period, a reading was taken for each sample. Bright yellow

1. See Research Methods section of this report for a further description of the colilert test

indicated the presence of coliform, whereas fluorescence under ultraviolet light indicated the presence of *E. coli* in the sample. Neither of these was observed in any of the cooler samples.

Figure 1: Cara Pembroke and Victoria Reed performing the colilert bacterial presence/absence tests.

After the colilert test, titrations were performed to determine the alkalinity and pH of each cooler sample. The results of this test are illustrated in Table 2. Both the colilert tests and titration tests were conducted by our group members, not an outside party.

Table 2: Alkalinity and pH results for each water cooler sample (and one tap water sample from the Sexton Campus Water Quality laboratory) taken on Dalhousie University campus in March 2011. Locations 'G212' and 'D401' are found on Sexton campus. All other samples were taken from Studley campus. The bracketed numbers rate each sample in order of highest to lowest alkalinity and pH level (1 is the highest, 8 is the lowest for alkalinity, and 9 the lowest for pH).

Sample Location:	Alkalinity (mg $CaCO_3$/L)	Initial pH:
McCain French Department	60.98 (6)	7.5 (4)
G212	60.6 (7)	7.78 (1)
Counselling Services	62.46 (3)	7.23 (7)
McCain Philosophy Department	No results	
Career Services	61.5 (5)	7.57 (3)
Dalhousie Student Union Office	62.4 (4)	7.41 (6)
Rowe School of Public Administration	64.8 (1)	7.15 (8)
D401	60.3 (8)	7.58 (2)
Life Sciences Centre Psychology Main Office	Dramatic fall	6.43 (9)
Rowe Management Career Services	62.5 (2)	7.45 (5)
Average	**61.9**	**7.3**
Tap Water sample	*17.5*	*7.19*

A tap water sample was titrated along with the water cooler samples so the experimenters could both practice the experimental method and have a control datum to compare results to. It was difficult to conduct the titration test (due to the precision needed for the experiment) upon the McCain Philosophy Department sample, and no accurate results were obtained as such (hence the blank data row for this sample). The Psychology Main Office sample was very finicky, possibly due to its low metal content (see Table 4), and thus the titration test was not successful on this sample either. The pH range was between 6.43 (Psychology sample) and 7.78 (G212 sample). The alkalinity ranged from 60.3 (D401) to 64.8 mg $CaCO_3$/L (Rowe School of Public Administration). $CaCO_3$ is the molecular formula of the compound calcium carbonate. This compound is used as a reference point to determine the alkalinity and hardness of water. It is measurement of both the neutralizing capacity of the substance (amount of base present), and the amount of calcium and magnesium present in the liquid of interest (New South Wales Department of Primary Industries, n.d.).

Alkalinity was calculated using the following equation;

Total alkalinity (mg $CaCO_3$/L)= [(2B-C)*N*50000]/mL sample

Where;

B= mL titrant to the first recorded pH (between 4.3 and 4.7)

C= total mL titrant to reach the pH 0.3 units lower than 'B' pH

N= normality (molarity) of the sulphuric acid used (0.02 mol)

(Eaton, Clesceri & Greenberg, 1995)

The hardness results were calculated using the metal results in Table 4 and the following equation; **Hardness (mg equivalent $CaCO_3$/L) = 2.497[Ca, mg/L] + 4.118[Mg, mg/L].**

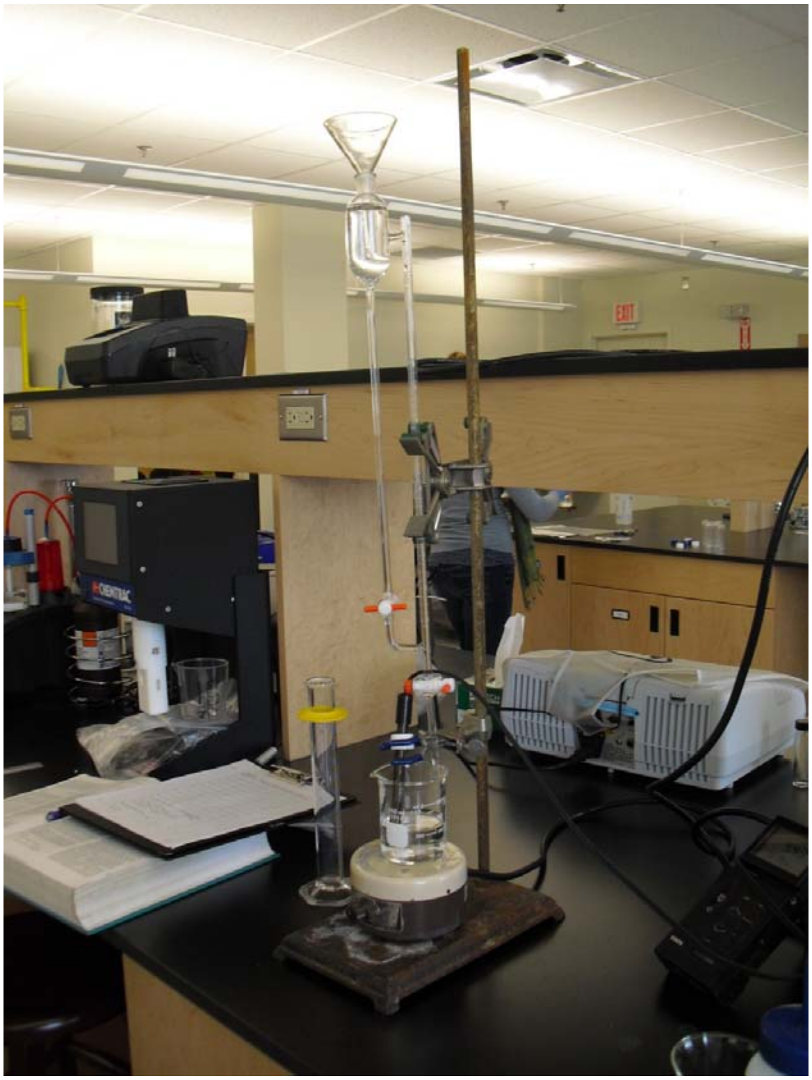


Figure 2: The apparatus used to perform the alkalinity tests upon the water cooler samples.

Table 3: Hardness results of the water cooler samples taken on Dalhousie University campus in March 2011. Locations 'G212' and 'D401' are found on Sexton campus. All other samples were taken from Studley campus. The bracketed numbers rate each sample in order of highest to lowest hardness level (1 is the highest, 10 is the lowest).

Sample Location:	Hardness (mg equivalent $CaCO_3$/L)
McCain French Department	107.90 (7)
G212	107.40 (8)
Counselling Services	108.98 (4)
McCain Philosophy Department	106.49 (9)
Career Services	108.08 (6)
Dalhousie Student Union Office	108.99 (3)
Rowe School of Public Administration	113.72 (2)
D401	118.56 (1)
Life Sciences Centre Psychology Main Office	0.06 (10)
Rowe Management Career Services	108.77 (5)
Average	**109.9**

All of the hardness values obtained were within the 107-118 mg equivalent $CaCO_3$/L range, apart from the Psychology sample, which had a very low hardness level of 0.06 mg equivalent $CaCO_3$/L. All coolers (except the Pschology sample) fall within a 'moderately hard' range (NSW Primary Industries, n.d.; United States Geological Survey, 2009). The psychology sample is considered soft by these institutions as well.

Lastly, the metal content of each water sample was collected using an ICPMS and a standard calibration curve[2].

2. Data compliments of Heather Daurie of the Sexton Water Quality laboratory

Table 4: Metal results for the water cooler samples taken on Dalhousie University campus in March 2011. Locations 'G212' and 'D401' are found on Sexton campus. All other samples were taken from Studley campus. A negative number indicates that the metal was not present in the sample. The bracketed numbers rate each sample, for each metal, in order of highest to lowest metal concentration (1 is the highest, 10 is the lowest).

		Metals (mg/L)				
Sample Location:	Sodium	Lead	Copper	Manganese	Calcium	Magnesium
McCain French Department	14.05 (7)	0 (4)	0.0006 (2)	-0.000088 (10)	21.18 (7)	13.36 (6)
G212	14.62 (5)	-3E-05 (7/8./9)	0.0001 (6)	-0.000025 (4)	21.11 (8)	13.28 (8)
Counselling Services	14.07 (6)	-2E-05 (5/6)	3E-05 (9/10)	-0.000014 (2)	21.58 (3)	13.38 (5)
McCain Philosophy Department	13.25 (9)	7E-05 (2)	0.0002 (4/5)	-0.000071 (8)	21.06 (9)	13.09 (9)
Career Services	15.4 (3)	-3E-05 (7/8/9)	3E-05 (9/10)	-0.000055 (5)	21.3 (6)	13.33 (7)
Dalhousie Student Union Office	13.87 (8)	-5E-06 (10)	8E-05 (7/8)	-0.000082 (9)	21.45 (4)	13.46 (3)
Rowe School of Public Administration	15.35 (4)	3E-05 (3)	0.0002 (4/5)	-0.000057 (6)	22.47 (2)	13.99 (2)
D401	17.3 (2)	-3E-05 (7/8/9)	0.0004 (3)	-0.00002 (3)	22.86 (1)	14.93 (1)
Life Sciences Centre Psychology Main Office	0 (10)	0.0002 (1)	0.0025 (1)	0.000005 (1)	0.02401 (10)	0.00063 (10)
Rowe Management Career Services	18.6 (1)	-2E-05 (5/6)	8E-05 (7/8)	-0.000063 (7)	21.43 (5)	13.42 (4)
Average	**13.7**	**0.00002**	**0.0004**	**~0**	**19.4**	**12.2**

In general, the water cooler samples had relatively similar metallic content, however the sample from the Psychology department demonstrated low metal concentrations for all metals, excluding copper, lead and manganese.

Table 5 depicts Halifax Water's Dalhousie campus water results for the university houses. More houses were tested than those shown, but this table represents a random, size ten, sample of said data.

Table 5: Halifax Water's Dalhousie University campus house cumulative water testing data collected in October 2010. The following is a definition of the acronyms and short forms used in the table: SRES (School for Resource and Environmental Studies); GradRes (Graduate Student Residence); Bldg (building); School of Health & Hum Perf (School of Health and Human Performance); DFA/ NSGEU (Dalhousie Faculty Association/Nova Scotia Government Employees Union); L (litre) $CaCO_3$ (Calcium carbonate); Pb (lead); Mn (manganese); Ca (calcium) and Mg (magnesium). The first litre of water drawn from the tap after the water has been stagnant in the pipes for a minimum of 8 hours is represented by the '1st L' row in each sample section. The term 'flush' indicates a sample that had been taken after the water had been running for 5 minutes[3].

			Alkalinity as $CaCO_3$	Total Pb	Total Cu	Total Mn	Total Ca	Total Mg	Hardness as $CaCO_3$
Building	**pH**		**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**
Multi Faith Center	7.76	1st L	21	0.0021	0.065	0.002	4.5	0.4	12.9
		Flush	21	<0.0005	0.017	0.002	4.7	0.4	13.4
Former SRES house	7.68	1st L	21	0.0054	0.239	0.003	4.7	0.6	14.2
		Flush	23	0.0041	0.031	0.002	4.6	0.4	13.1
GradRes	7.44	1st L	21	<0.0005	0.019	0.004	4.8	0.4	13.6
		Flush	30	<0.0005	0.09	<0.002	4.5	2.0	19.5
R1 Bldg	7.81	1st L	20	0.0036	0.06	0.004	4.9	0.4	13.9
		Flush	22	0.0019	0.012	0.003	4.9	0.4	13.9
5247 Morris	8.9	1st L	23	<0.0005	0.005	0.004	4.8	0.4	13.6
		Flush	21	<0.0005	0.028	0.003	4.7	0.4	13.4
School of Health & Hum Perf	7.59	1st L	23	0.0028	0.029	0.003	4.6	0.4	13.1
		Flush	22	0.0005	0.022	0.002	4.6	0.4	13.1
DFA, NSGEU	7.44	1st L	26	0.0055	0.094	<0.002	4.8	0.4	13.6
		Flush	26	0.0005	0.015	0.003	4.7	0.4	13.4
Social Work, Women's Centre	7.54	1st L	19	0.0029	0.315	<0.002	4.4	0.4	12.6
		Flush	21	<0.0005	0.097	0.002	4.4	0.4	12.6
Moren House	7.57	1st L	27	0.0012	0.095	0.004	4.7	0.4	13.4
		Flush	24	<0.0005	0.013	0.004	4.5	0.4	12.9
Hart House	7.93	1st L	21	0.0013	0.049	0.003	4.6	0.4	13.1
		Flush	21	0.0006	0.017	0.003	4.6	0.4	13.1
Average	**7.8**		**22.7**	**0.002**	**0.066**	**0.003**	**4.7**	**0.5**	**13.6**

3. R. Owen, personal communication, April 1st and 12th, 2011

The pH ranged between 7.44 and 8.90. The alkalinity ranged between 19 and 30 mg $CaCO_3$/L. The metal contents of each sample were within a relatively close range between the locations and for each metal. Hardness ranged between 12.6 and 19.5 mg equivalent $CaCO_3$/L.

The following table provides a summary of the maximum acceptable concentrations and/or recommended concentrations (of the chosen parameters) in the *Guidelines for Canadian Drinking Water Quality*.

Table 6: Summary of relevant recommendations contained within the Guidelines for Canadian Drinking Water Quality that pertain to the parameters focused upon in this study and by Halifax Water. The following is a definition of the acronyms used in the table: Na (sodium); Mg (magnesium); Ca (calcium); Mn (manganese); Cu (copper) and Pb (lead) (Health Canada, 2010).

Parameter	**Max. Acceptable Conc./Recommended Level (e.g. for aesthetics)**
Coliform and *E.coli*	None detectable per 100mL sample
Alkalinity	No numerical or subjective guideline provided
pH	6.5-8.5
Hardness	Acceptable: 80-100mg/L as $CaCO_3$; Poor: >200 mg/L as $CaCO_3$
Na	≤200 mg/L
Mg	No numerical or subjective guideline provided
Ca	No numerical or subjective guideline provided
Mn	≤0.05 mg/L
Cu	≤1.0 mg/L
Pb	0.01 mg/L

The results gathered by Halifax Water and by this study are compared to one another and the *Guidelines for Canadian Drinking Water Quality* in the following Discussion section.

Discussion

Brief Summary

The purpose of this research project was to compare water cooler quality with that of municipal tap water on Dalhousie University campus, based upon the alkalinity, hardness, metal content and pH of these water sources. Both were then evaluated using the Guidelines for Canadian Drinking Water Quality (a constant between the sources that allowed for an unbiased comparison). Ten samples were taken from water coolers across the university's two of three campuses (unfortunately, due to scheduling and communication errors, samples could not be taken from Carleton campus). The staffs at Carleton campus were not receptive to signing a permission form that allowed our group to take samples from their water coolers on the day we visited. Time constraints forced us to abandon the original plan to sample all three campuses, and instead we took additional samples on Studley campus.

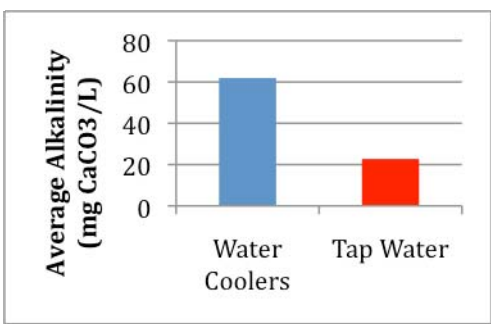
These samples were run through various tests to determine the concentrations of the same parameters assessed by Halifax Water at Dalhousie. These parameters are; alkalinity, hardness, and metal content (magnesium, calcium, manganese, copper and lead). Other parameters of interest were also investigated; these were sodium levels and the presence/absence of *E.coli* and coliform bacteria.

Once this data was collected, data from the Halifax Water campus tests was provided by Halifax Water; via Rochelle Owen- the director of the Office of Sustainability (only the university house data was available, as the building results had not yet been released). The group's and Halifax Water's result were compared with one another and to the *Guidelines for Canadian Drinking Water Quality* (hereafter referred to as 'the Guidelines'). The following is a summary of our findings.

Significant Findings

The Guidelines mandate that no *E.coli* or coliform bacteria be present in detectable quantities in 100ml samples of water (Health Canada, 2010). This 24 hour system can detect a single viable coliform or *E.coli* bacterium per 100ml sample (IDEXX Laboratories, 2011). Neither bacterium was detected in the water cooler samples taken (Table 1), but the bacteria data from the Halifax Water tests was not yet available at the time of this project. However, Halifax water conducts bacteriological tests twice per week at 48 system locations within the Halifax urban core, and weekly at each smaller system (Halifax Regional Municipality, 2011). The extensive monitoring of this parameter leaves little question as to the quality of Halifax water, at least in terms of bacterial content.

In terms of alkalinity and pH, no numerical suggestions exist for alkalinity, but an aesthetic objective of 6.5-8.5 for pH is presented in the Guidelines (Health Canada, 2010). This range, therefore, is not an exclusive and restrictive data range, and is merely suggested for aesthetic purposes. In general, both the water cooler samples (Table 2) and the campus water data (Table 5), conformed to this element of the Guidelines. Though both vary in alkalinity, this parameter is not considered to pose any health or aesthetic risk at the levels currently found in Canada (Health Canada, 2010).

a) 

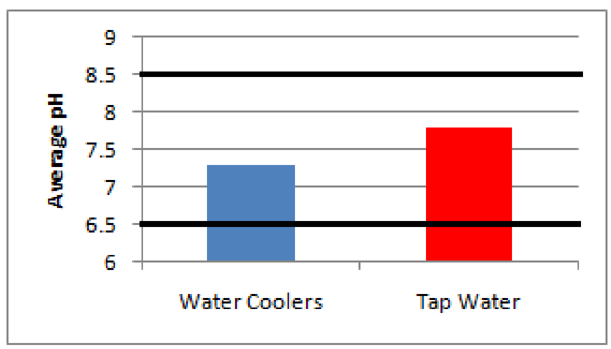
b) 

Chart 1: a) Comparison of the alkalinity values obtained for campus water coolers and tap water. b) Comparison of the pH values obtained for campus water coolers and tap water. The black lines indicate the Guidelines' recommended pH range between 6.5 and 8.5 (Health Canada, 2010).

Though the Guidelines do not mandate a particular hardness level or range, they do state that public acceptance of hardness levels generally falls between 80-100 mg/L. Water having hardness levels greater than 200 mg/L is considered poor quality, though drinkable (Health Canada, 2010). Thus, the water cooler hardness average of 109.9 mg equivalent

$CaCO_3$/L (Table 4) and the campus water hardness average of 13.6 mg equivalent $CaCO_3$/L (Table 5) are not of concern, given that it is simply a matter of personal preference.

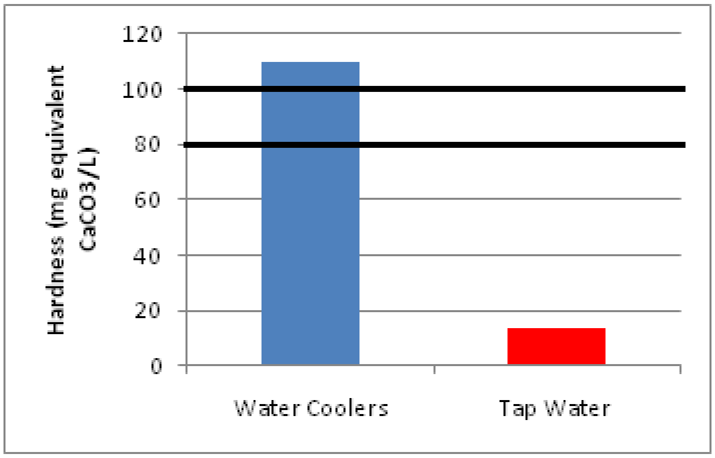
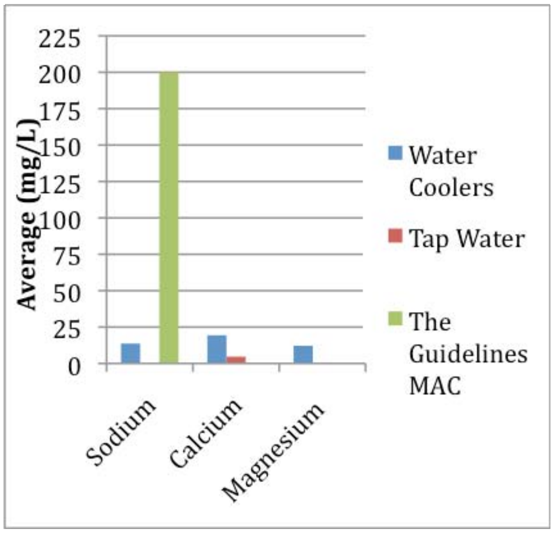


Chart 2: Comparison of the hardness values obtained for campus water coolers and tap water. The black lines indicate the preferred public hardness level range (Health Canada, 2010).

Both water coolers and campus water samples adhered to the maximum acceptable metal concentrations summarized in Table 6. It was observed that tap water tended to have a greater concentration of all the metals, except calcium and magnesium, while still remaining within the range specified by the Guidelines. Though Halifax Water did not test for sodium in the data provided (Table 5), the sodium concentration found in all water coolers adhered to the ≤200 mg/L mandate in the Guidelines (Table 4). No quantitative or subjective values for calcium or magnesium concentrations are given in the Guidelines because, as previously stated for alkalinity, these parameters are not considered to pose any health or aesthetic risk at the levels present in Canada (Health Canada, 2010).

a) 

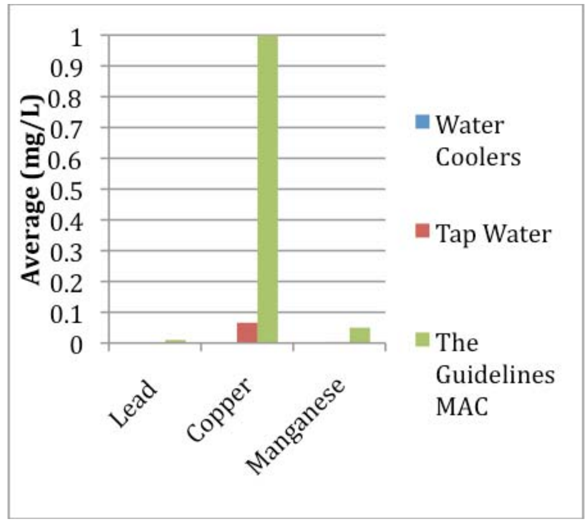
b) 

Chart 3: Comparison of the metal concentrations obtained for campus water coolers and tap water, and compared to the maximum acceptable concentration (MAC) provided in the Guidelines (Health Canada, 2010). The results were split into two tables for ease of observation.

The Life Sciences Centre Psychology main office water cooler was quite different from the other water coolers sampled. It had the most acidic pH of the water coolers and campus tap water, was very difficult to perform a titration experiment upon (in comparison to the other coolers), had extremely low hardness, sodium, calcium and magnesium levels, but the highest lead, copper and manganese levels out of the ten coolers. The reason behind these differences is unknown but of interest for further investigation. Overall, the water coolers and Dalhousie campus water data conform to the Guidelines, and are of comparable quality. Neither water cooler, nor municipal, water appeared to be of greater quality than the other, though municipal water is tested much more frequently than cooler water (Halifax Regional Municipality, 2010). These findings support the conclusion that cooler water is not of superior quality than tap water, and the purchasing of such apparatuses is therefore a wasteful use of monetary and natural resources.

Implications

The most recent study found, similar to this research project, (in that it also compared the quality of cooler water to municipal water) occurred in Quebec 17 years ago

(Levesque *et al.*, 1994). Our findings do correlate with the results of this study, but consist of a much more recent data set. They are, therefore, arguably more applicable to today's water cooler owners and those who continue to drink publicly available municipal water. Given the relatively recent movement to rid campuses of bottled water (Food & Water Watch, n.d.), this study could very well be one of many to appear in the near future comparing the quality of cooler and municipal water. Because this project is the most recent of its kind in more than a decade, it may instigate further research and interest in this area of study. The more publicity this issue garners, the more likely the 'Take Back the Tap' movement on university campuses is to succeed. The results of this study, and others, will hopefully motivate cooler purchasers to rethink this use of their money and revert back to the once well-trusted public tap water.

Conclusion

Our project aimed to explore whether or not water cooler water is in fact cleaner, safer, or healthier than tap water on Dalhousie campus. We found that both the water cooler and tap water adhered to the *Canadian Guidelines for Drinking Water Quality (date for reference).* We hope to use our results to promote a bottled water free campus and to help people regain trust in municipal tap water. This could be achieved by distributing information and our results to Dalhousie students, staff, and faculty through awareness campaigns at Dalhousie and in the community.

To begin with, we plan to send our results to locations on campus that currently use water coolers. In addition, we would like to make our results public and accessible by sending our report and/or articles to DalNews, the Gazette, and Sustainability News @ Dal blog. We will also be sending our report to the Office of Sustainability for further use.

Since so much effort has been put into ensuring quality and accessibility of drinking fountains on campus, we recommend Dalhousie take further action to ensure those wanting to drink tap water can easily make that choice. We suggest raising awareness about water fountain locations. This could be done by posting tap water quality results, by increasing and improving water fountain signage, and perhaps by including a campus water fountain map in Dalhousie's annual 'Green Guide'. We hope that spreading knowledge of tap and cooler water's comparable quality, and ensuring adequate knowledge of drinking fountain locations will encourage a trust in tap water and a move away from bottled water of all kinds on Dalhousie campus, as it is not part of a truly sustainable future.

For further research in this area, we suggest that studies test for a greater range of bacteria types in coolers. As a result of inadequate cleaning of water dispensers, other types of bacteria might be more likely found in water cooler water than those we tested for. Also, we would like to see further investigation of the presence of Bisphenol A (BPA) in water from water coolers. This endocrine disruptor is found in polycarbonate plastic, which water cooler bottles are made of. It other research, BPA has been found to leach into water from pet cages. It might also be interesting to compare water quality from different brands of water coolers. This information could provide further incentive to step away from the cooler and ultimately, a 'greener' and more sustainable campus.

Acknowledgements

Our group would like to thank Gill Pritchard for answering our many questions, and for providing direction, suggestions, and a great deal of contact information that made this project possible; Dr. Graham Gagnon for generously providing us with equipment and lab time to do water testing; Heather Daurie for voluntarily doing our metal test and hardness calculations, for her help with bacteria and alkalinity testing, and for her guidance during our lab time; John Choptiany for his guidance and feedback through every stage of this project.; Rochelle Owen and Tarah Wright for their instruction and for providing us with Halifax Water data; The many owners of water coolers who gave us permission to take samples. Your accommodation and assistance was very much appreciated!

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Annex 1: Preliminary Proposal

SustainDal Water Cooler

Preliminary Proposal
SUST/ENVS 3502
February 28, 2011

Jill MacDonald
Courtney Morrison
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Victoria Reed
Sonya Tancock

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Project Definition

Dalhousie University has taken many steps towards sustainability in recent years. From the creation of the College of Sustainability and Office of Sustainability, to the opening of the Mona Campbell building, much effort has been put into 'greening' the campus and spreading information about environmental issues. Despite these tremendous accomplishments, many issues remain unaddressed. A major one is the presence of nearly 100 water coolers on campus, as indicated an audit performed by the Office of Sustainability (personal communications, February 2011).

Bottled water, including the 5-gallon water cooler option, is not part of a truly sustainable future. The collection, transportation, and disposal of bottled water all have a negative impact on the environment. Also, unnecessary use of plastics and other packaging materials (which in turn, increases our dependency on oil) is a major concern. (Parag, Roberts, 2009). Polyethylene terephthalate (PET) tends to be the plastic of choice for bottled water, because of its lightweight and transparent properties (Ferrier, 2001). Though recycling seems like a solution to this issue, recycling plastic has many limitations. Unlike glass, it is extremely difficult to achieve a high-quality recycled product. To achieve quality comparable to virgin plastics, the recycled materials must be clean, and can only include one type of plastic. Without this, recycled plastics are often used to create products where a variety of other materials could be used (Astrup, Fruergaard, Christensen, 2009). It also requires a great deal of financial investment in infrastructure and the like.

Aside from the choice of plastic, the same is true for water coolers, and they also depend on water dispensing appliances that must be repaired and replaced. While water cooler bottles reduce plastic waste with their 99% reclamation rate (Potera, 2002) this may not be a good thing in terms of human health. Howdeshell, et al. explain that "Bisphenol A (BPA) is a monomer with estrogenic activity that is used in the production of food packaging, dental sealants, polycarbonate plastic, and many other products," (2003, p. 1). Their research found that under moderate conditions, BPA leached into water from polycarbonate pet cages, and higher levels were found in used cages (as opposed to new) (Howdeshell, et al., 2003).

There is also a significant amount of money being unnecessarily spent on water that is freely available from taps; the average cost of bottled water remains between 500 and 1000 times more than tap water (Ferrier, 2001). Despite images of mountains and glaciers on bottled water labels, bottled water is poorly regulated (Parag & Roberts, 2009) and there are many instances of bottled water being simply bottled tap water (Ferrier, 2001). Despite the many reasons for choosing tap over bottled water, nearly 100 water coolers exist on Dalhousie campus alone, that Dalhousie is (in theory) not paying for, as their *Guidelines for Entertainment, Food, Beverage & Miscellaneous Expenses* explains: "Beverages (coffee, tea, fruit juices, soft drinks, bottled water) and refreshments for the general use of faculty, staff and students shall not be paid for out of University funds," (Dalhousie University, 2000).

Though the *Guidelines for Canadian Drinking Water Quality* are not legally binding standards, Nova Scotia adopted them as such in 2000. These guidelines address health-related standards (e.g. Maximum acceptable standards), as well as non-health-related guidelines (e.g. taste, odour and colour) (Nova Scotia Environment and Labour, 2007). Though Halifax's water is legally protected, a move away from drinking tap water could potentially decrease pressure to maintain high quality tap water.

It is assumed that an underlying distrust for tap water is fuelling (or at least contributing to) these purchases of water coolers on campus. Our project aims to investigate whether or not water cooler water is actually cleaner, healthier, or safer than tap water. Water from water coolers around campus will be tested based on the *Guidelines for Canadian Drinking Water Quality.* Conducting these tests will provide insight on the reasons behind purchasing water and could encourage less water to be purchased. We hope that if water cooler water is no safer than tap water, disclosing this information to buyers could make it seem less appealing. It could also lead into discovering other reasons for purchasing water, for example, physical boundaries to water fountains in buildings. Optimistically, we hope this project will encourage a trust in tap water and a shift away from bottled water, as this is clearly an important step in the movement towards a sustainable future.

Literature Review

Dalhousie University is home to a total of 99 water coolers, purchased and maintained by various individuals and departments across campus. While Dalhousie is committed to providing clean and healthy drinking water to its community, this obligation is satisfied through the provision of a large number of public water fountains across campus. Water quality is also regularly tested and maintained according to the *Canadian Drinking Water Quality Guidelines* as provided and outlined by Health Canada (Health Canada, 2011). The large presence of water coolers on campus suggests a distrust of water quality provided by public fountains and a trust in, and preference for, communal water coolers.

A handful of studies have explored the barriers to using water fountains at several universities. The Polaris Institute study addressed obstacles to a bottle-free movement and suggested that, were this initiative to work, the quality of fountains on Dalhousie's campus would need to be upgraded. (Polaris, 2009; Pritchard, 2009; Food & Water Watch, 2007). UBC's Okanagan campus has installed fountain filters and water dispensing units that improve water quality. This could be a possibility for improvement at Dalhousie, depending on the outcome of this project (UBC, 2011). This study aims to determine whether the water quality in these communal coolers meets or exceeds the water quality guidelines that public tap and fountain water meet. Previous studies regarding water cooler use and quality will be examined. Research of movements away from bottled water and toward tap water use will also be useful in determining the reasons for people's preference for water coolers and will assist in the preparation of educational material to urge the shift to tap water upon this projects completion.

Dalhousie's Office of Sustainability is currently exploring the possibility of having Dalhousie become a bottled-water free campus. While this does not specifically address the plastic water coolers currently being used, it does address the goal of sustainability in the move toward the use of tap water. Dalhousie's Bottled Water initiative has also provided information about the benefits of using tap water that will be part of final educational materials that may be provided to water cooler users on campus; financial, local, and environmental benefits will be discussed (Carter, 2009; Horrocks, 2009).

A current study is being undertaken by a Dalhousie class (ENVS 3502 Water Bottle) to address the current use of bottled water and will be helpful in determining the mindset that favours bottled water over tap water. To avoid repetition of similar findings and because of time restraint for this project, we have limited our study to focusing on the microbiological quality of the water and not the psychological, physical or other barriers to accessing it. Past surveys of this preference at Dalhousie suggest that a large part of the reason the Dalhousie community opts for bottled water is based on taste preference and in response to a general distrust of the quality of tap water (Pritchard, 2009; Carter, 2009). Health Canada, who provides the guidelines for safe drinking water quality, suggests that water coolers be cleaned after every bottle change with bleach or vinegar (Health Canada, 2011). It is suspected that this cleaning is not done regularly, which could promote bacteria build-up and a decrease in water quality. If testing proves this to be the case, a comparison between water cooler and tap water test results would be useful in preparing educational material and encouraging Dalhousie water cooler purchasers to switch over to tap water.

While municipal tap water is scrutinized regularly to follow a strict set of guidelines for drinking water quality, the quality of water from individual water coolers is not regulated or controlled once installed on a dispenser (NS Environment, 2010; Halifax Water, 2007). The lack of adequate cleansing of water coolers at every change is a possible contribution to decreased water quality and contamination through the use of such coolers. A study done in 1993 on a comparison of the microbiological quality of water coolers and municipal water systems in Quebec reported that 50% of the complaints received by the Ministry of the Environment were related to water coolers. This study sought to address the same dilemma that Dalhousie is facing with water coolers and found that 28% of water coolers tested were contaminated in comparison to 22% of tap water samples. The study found that tap water was, in general, of a better quality than that of water coolers and contributed this primarily to the unsanitary condition of the water cooler dispensers. Those water cooler dispensers that were cleaned on a regular basis, similar to the suggestions of Health Canada, produced better water quality results. Only 36% - 44% of water cooler owners surveyed in this study were aware of the recommendations for regular cleaning of the water coolers, contributing to final suggestions that better education on proper cleaning be made available by water cooler providers and that regular health inspections be performed on coolers (Levesque, 1994).

Eckner performed a comparison of the water quality from average water coolers with modified dispensers that minimized contact with water bottles or cups. Similar results were found concerning the contamination of water coolers when not cleaned regularly (Eckner, 1992). Although little research and testing has been done overall on this topic, the trend seems to lean toward a lower quality of water being provided by water cooler dispensers when compared to municipal tap water, especially when not cleaned on a regular basis. This study is necessary to add to the minimal body of information surrounding the quality of water cooler dispenser water. A local study of the health and contamination of dispensed water on Dalhousie's campus will provide the opportunity for direct comparison to Dalhousie's tap water (based on recent test results performed by Halifax Water). Real, local results will be useful in encouraging water cooler holders to switch to tap water, provided that the quality is superior to that of their coolers. A study at Dalhousie would be in direct alignment with Dalhousie's goals of sustainable practice and will benefit other universities, businesses and homeowners in the move away from bottled water and toward municipal tap water.

A large amount of attention has been paid to the comparison of the quality of individual, single-use water bottles to that of tap water, but there has been little focus on communal water coolers. The various sustainability groups and movements at Canadian universities (Memorial, Ottawa, Winnipeg, Queens, Guelph, Ryerson and Dalhousie) are focusing on a movement towards the use of tap water, very few have included a concentration on communal water dispensers. Such a study, as is being proposed here, would both contribute to national sustainability and promote Dalhousie even further as a leader in sustainable practice and initiative. The Dalhousie Sustainability Policy commits the university to developing sustainable practices and this commitment can be demonstrated through a further step toward tap water by increasing educated communication surrounding the quality of water in communal coolers as well as individual bottles and possibly including these coolers in a proposed ban of bottled water (DOS, 2009).

Research Methods

For this project, quantitative research methods will be used to gather, analyze and compare the campus water cooler samples against the known results of tap water testing performed by Halifax Water on the Dalhousie campus based on the *Guidelines for Canadian Drinking Water Quality*. This method was chosen for the project as opposed to qualitative research methods such as performing surveys or interviews because the water testing could potentially provide proof that the quality of cooler water is similar or possibly even worse than tap and fountain water on campus. If the research shows that the quality of cooler water does not exceed tap or fountain water quality, then the following step would be to use these results to educate those using communal water coolers and break down the barriers associated with consuming water from public sources on the Dalhousie campus. Qualitative research methods may be added in the form of interviews with members of the community or university who have knowledge and experience in water testing, for example Dr. Graham Gagnon, to enhance our results.

As the goal of our research is to determine whether the water within these communal coolers on the Dalhousie campus meets the same quality guidelines as the public taps and water fountains on the campus, water samples will be analyzed from a currently undetermined number of water coolers. A meeting with Dr. Graham Gagnon, a professor of engineering at Dalhousie, has been planned for the week of March 1st to finalize the details regarding the number of tests that are feasible within the research time as well as within our budget. Sampling will likely be random, although using stratified random sampling could ensure that majority of coolers are not located in the same building or location on campus, therefore making sure that the results represent the campus as a whole (Palys and Atchinson, 2008). In addition to the number of coolers to be tested, we will also be discussing sampling procedures and the parameters that we will be testing for. Some of the potential testing parameters are bacterial content, alkalinity, hardness, sample disposal, and metals such as copper, lead, manganese and calcium. Alkalinity, hardness, and the four metals previously mentioned were the parameters tested by Halifax Water in their tap water analysis on campus. We are unsure if the testing parameters will be standard across all of our water cooler samples and are also currently unsure who will be participating in the collection and analysis of the water samples. These details will be determined when we can meet with Dr. Gagnon.Water sample collection and testing is scheduled to begin the week of March 1st and continue on through the week of March 8th. During the weeks of March 22nd and 29th our group, with the help of Dr. Gagnon, will compare the results of the analyzed water cooler samples with the tap water results from Halifax Water.

Some limitations in the research could include time, a lack of available resources or help to complete the water sample testing, the cost of each water sample being too high to collect and analyze many water cooler samples, and the unwillingness of a department to let us sample from their water cooler. Delimitations would include that we are only testing a certain currently undefined number of water coolers on the Dalhousie campus for a certain set of parameters as it not feasible to test all 99 coolers for every possible parameter.

Project Deliverables & Communication Plan

The products we expect to deliver upon completion of this project are manuals, advertisements, and articles. The manuals will include how our research was conducted, a timeline as well as our results. We will advertise with a poster that could be used across campus promoting responsible water use. This could aid in SustainDal's efforts in reducing water coolers and encouraging drinking tap water. Finally, a more comprehensive article will be produced for faculty, staff and students to take part in this action plan.

Once this project is complete there will need to be an arena for which the findings are to be presented. Graphs showing the differences and similarities in the quality of local tap water and Dalhousie campus' water coolers will be used.

Since SustainDal has an extensive knowledge on the issue of water accessibility on campus we met with them for an open dialogue. Our findings will be presented in documents and through presentation.

Other stakeholders that will need to be addressed is the College of Sustainability on Dalhousie Campus. They have worked to try and make Dalhousie a bottle-free campus, however our findings will take it one step further. This information will be brought to the attention of the college by meeting with a faculty member. Another important part of promoting our findings is to create accessibility and awareness to students on campus.

The target demographic is faculty and staff who are using water coolers. Depending Another forum that could attract a lot of attention is the 'Dal News 'weekly e-mails and 'Sustainability News @ Dal' blog. A summary article will be written presenting our conclusions. on the amount of information that is discovered this could potentially be multiple articles sent out over time.

Schedule

The following is a breakdown of the project completion schedule, deadlines, and the group member(s) assigned to each task for efficient research delivery, analysis and completion. Dates were chosen specifically to ensure timely achievement of all report aspects. Because the amount of time required to take, test, and analyze water samples is currently an unknown variable, a significant allotment of time has been devoted to these tasks. Given the labour intensity required to complete this research project, a very specific and organized timetable will facilitate a relatively smooth transition between its stages of completion, as follows:

What	Who	When
Draft of preliminary proposal e-mailed to John Choptiany for editing	Everyone capable of doing so	By February 25th
Each group members' proposal contributions e-mailed to Courtney	Everyone	By February 27th
Submit preliminary proposal to professors and to client	Courtney	By February 28th
Submit funding proposal	Victoria	By March 1st
Meeting with Gillian Pritchard	Everyone who can make it	Week of March 1st
Meet with Graham Gagnon to prepare water sampling and testing schedule	Everyone who can make it	February 28th
Initiate water sampling and testing	Everyone	Weeks of March 1st and 8th
Meeting with Gillian Pritchard to update her on the progress made, further work to be done and gain her feedback	Everyone who can make it	Week of March 15th
Results from water tests returned, analyzed and compared with campus water test results	With help from Graham Gagnon, all group members will take part in the analysis. Once data is gathered, the workload may be allocated accordingly	Weeks of March 22nd and 29th
Schedule group meeting (for week of March 29th) to organize the Pecha Kucha presentation and final report outline	Everyone (contribute to Doodle Poll)	Week of March 22nd
-Divvy up the Pecha Kucha presentation pictures and topics of discussion -Divvy up final report sections and draft report outline -Schedule group meeting to finalize Pecha Kucha presentation before April 5th	Everyone (at group meeting)	Week of March 29th
Group meeting to finalize Pecha Kucha presentation -Submit slides for evaluation	Everyone	Week of March 29th
Meeting with Gillian Pritchard	Everyone	Week of April 5th
Pecha Kucha slides due	Everyone	April 3rd
Pecha Kucha	Everyone	April 5th
Final Report Due	Everyone	April 13th
Peer Assessment Due	Everyone	April 13th

Detailed Budget

The majority, if not all, of the expenses incurred for this project will arise from water testing fees for the water cooler samples. A meeting with Dr. Graham Gagnon regarding water testing and sampling procedures and a feasible sampling scale (financially, structurally and temporally) is planned for the week of March 1st. Thus, the exact cost breakdown will not be finalized until after this meeting. Furthermore, the number of samples taken is restricted, in large part, by the amount of funding received from the Dalhousie Student Union Sustainability Office and the Office of Sustainability. If Dr. Gagnon or Halifax Water Commission can offer their services for a reduced fee, this will also impact the project budget, and the magnitude of water cooler samples taken.

AGAT Laboratories is a commercial laboratory in Dartmouth, Nova Scotia that offers water-testing services. The Halifax Water Commission Water Quality Inspector, Kimberly Williams, sent us the following pricing information in an analytical quotation form (personal communication, February 18, 2011) provided to them by AGAT Labs. Upon review of a 2007-2008 water quality report released by Halifax Water, detailing the parameters tested, all of the following analytical packages (provided by AGAT Laboratories) are applicable; alkalinity as calcium carbonate, hardness, metals and sample disposal (Halifax Water, 2008). Further testing parameters may be required, but this will be discussed in further detail with Dr. Gagnon this coming week.

Though the specifics have not yet been decided, with the information currently available, a general budget and expenses plan can be outlined as follows:

Number of Water Samples	Length of Time Until Results Released (# of business days)	Cost ($)
1	5-7	52.90
2	5-7	105.80
3	5-7	158.70
4	5-7	211.60
5	5-7	264.50

Even though the cost of water testing is quite expensive on a relatively small budget, it is hoped that Dr. Gagnon will be able to provide direction and assistance with minimizing these costs. If this is the case, more samples may be taken, providing a greater degree of data for analysis, and reducing sampling and experimental error.

Overall, the total project cost is dependent upon a number of factors including, but not limited to; the amount of support Dr. Gagnon, Halifax Water Commission, Dalhousie Student Union Sustainability Office and Office of Sustainability are able to provide and the extent of this assistance. Further costs are not expected to arise, other than those already listed regarding water tests.

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