An Inquiry into Residential Water Conservation in Canada

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Abstract

Municipal water service providers nationwide are faced with the challenge of networks of deteriorating infrastructure and expansion needs but unfortunately happen to be cash-strapped and unable to fulfill growth demands. The implementation of water conservation measures has the potential of averting the collapse of the municipal water service network along with delivering economic and environmental benefits. The numerous applications of water conservation principles within the Canadian home include rain water and grey water harvesting systems, water efficient household fixtures and appliances, water user behavioral changes, seasonal water bans and public policy measures. The outcome of the confluence of water conservation measures with public policy tools include economic, environmental, societal and public health impacts, which therefore illustrate the importance and value of the measures. The recognition of these water conservation measures and associated benefits has prompted municipal water service providers, city water departments, the provincial and federal government to give consideration to the inclusion of water conservation as part of the planning of infrastructure growth and water distribution. This inquiry examines the trends and extent to which water conservation has evolved within the residential home in Canada, along with the possible implementation barriers, policy implications and considerations pertaining to this desired outcome.

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1.0 Introduction

1.1 Rationale Behind Investigation

From late April 27th till June 27th 2011, the City of Ottawa imposed a water ban on residents of the Barrhaven, Riverside South and Manotick areas. The water ban affected more than 80,000 residents and entailed the prohibition of water usage for outdoor activities such as landscape watering, washing of cars or hosing down of driveways, sidings or decks **(80,000 Blindsided by Water Ban, The Ottawa Citizen, 2011)**. Residents of the City of Ottawa and other Canadian cities double their water usage over the summer months **(Watering Ban Angers South Ottawa, The Ottawa Citizen, 2011)** so residents of the affected regions, faced the challenge of compensating for the loss of municipal water supply while still meeting or curtailing their needs in order to adjust to the conditions of the water ban. The reason behind the water ban was not centered on environmental sustainability purposes but rather based on the fact that a water main serving the area had failed earlier in January and could not sustain the summer demands beyond the basic water use needs **(Watering Ban Angers South Ottawa, The Ottawa Citizen, 2011)**. As a consequence, the water ban marked the advent of immense engagement in water conservation practices such as rainwater harvesting. It is reported that residents stormed hardware stores and purchased a multitude of rain barrels - the sheer demand resulting in organizations like the Arbour Environmental Shoppe and www.rainbarrel.ca selling out of its stock of rain barrels **(Rain Barrels Help with Ban, The Ottawa Citizen, 2011).** In addition, immediately after the ban was announced, local Home Depot stores could not meet the rain barrel demands of affected residents **(New Rainbarrels Fly, CBC News, 2011)** showcasing the potential momentum and feasibility of water conservation measures within residential areas in Canada.

The willingness to engage in rainwater harvesting in order to fulfill outdoor water use needs is striking, noteworthy and indicative of the fact that given the right

policy decision, the citizenry is prepared and capable of making environmentally prudent choices despite the inconveniences caused. The counter measures undertaken by the residents denote a form of water conservation that would benefit the cause of environmental sustainability, contribute to lessening the burden on municipal water supply systems and reducing the energy demands involved in residential water provision. The practicality of rainwater harvesting is also bolstered by the success of studies conducted by Dr. Khosrow Farahbakhsh at the University of Guelph **(University of Guelph, 2007)**, the inclusion of rainwater harvesting systems in residential homes built by Reid Heritage Builders **(Khosrow et al, 2009)** and industrial facilities within the Guelph-Waterloo area **(CMHC, 2009).**

Rainwater harvesting is clearly a feasible measure and could gain prominence if the proper incentives are provided. Arguably the lack of some impetus prevents this practice from presently being a popular reality. As such, a more direct impetus could be a comprehensive government policy with the specific objective of encouraging participation in water conservation measures within the community. Following this realization, the potential for other technologies, practices and policies that could spur civic action on the issue of water conservation at the residential level across the country underpins the rationale behind this investigation.

1.2 Inquiry

This inquiry examines the capacity of water conservation measures and technologies in relation to the prominence of such measures within the domestic dwelling in Canada and under the backdrop of water related challenges across the country. The paper also discusses the potential policy implementation barriers, implications and considerations with respect to advancing water conservation practices within homes in Canada. The inquiry further delves into how the influences and workings of political momentum, environmental economics, social perceptions and norms play a role in advancing or immobilizing water conservation initiatives across the country. The scope of the inquiry is limited to the residential or domestic dwelling of a single family detached residence.

1.3 Background

A vast majority of Canadian municipalities are currently cash-strapped and unable to financially support the operations, maintenance and expansion requirements of their water and waste-water treatment infrastructure **(Polis Project, 2009)**. The financial delinquency has resulted in a significant degree of water service infrastructure degradation and in some cases potential danger to public health and safety. The root cause of the above situation can be attributed to the historically low and subsidized water rates that Canadians have been paying for decades **(Brandes, 2010)**. Other factors that have sprung about as a result of the low water rates and further exacerbated the pressures on the municipal water service network include the indiscriminate consumption habits of end-users, the misconception that Canada possesses an infinite water resource and the relative non-existence of a water conservation culture amongst municipal residents **(Environment Canada, 2011)**.

Despite the fact that municipal water use represents a small percentage of Canada's total consumption, an investigation into the challenges faced by this sector is of significance because of the alarming percentage of water use wastage, the greater

visibility and familiarity to tax-paying and voting populace. Environment Canada reports that Canadian municipal water use is broken up into the residential component with fifty-two (52) percent, commercial with nineteen (19) percent, industrial with sixteen (16) percent and leakage and losses at thirteen (13) percent **(Sproules-Jones, 2008)**. Based on the distribution it is worthwhile to focus solution development on the residential component that constitutes a greater share of the municipal water use profile in Canada. A variety of legislation, technologies, policies and common sense practices are capable of enhancing water conservation principles within Canada in order to arrest the financial challenges faced by municipal water services while bestowing environmental benefits unto our communities.

2.0 The Challenges

2.1 Burden on Municipal Infrastructure

The deterioration of municipal infrastructure coupled with the lack of capital to implement repairs or support new developments represents one of the major challenges facing Canadian municipalities. The concerned infrastructure includes water treatment plants, waste water treatment plants, storage towers and reservoirs, water transmission and sewage pipelines **(Environment Canada, 2011)**. The burden on the municipal infrastructure in many Canadian cities is greatest during the summer months when water consumption doubles by means of water-use in outdoor recreational, maintenance and landscaping activities **(Environment Canada, 2010)**. These non-essential and seasonal outdoor water use activities consume large volumes of drinking quality water and force municipal systems to maintain artificially high capacity year round in order to sustain the summer usage **(Environmental Defence, 2010)**.

In view of the increasing water demands of a growing population, the decline of municipal water infrastructure and the limitations of capital, Canadian municipalities are gradually embracing water conservation as essential to curtailing infrastructure replacement and development needs, sustaining current operations and growth within financial constraints and optimizing plant efficiency **(Environment Canada, 2011).** The recognition of the challenges and more importantly the identification of an environmentally prudent and amicable solution underscore the importance of water conservation measures and requisite policy to support its acceptance and prominence.

In some proactive municipalities such as the cities of Vancouver, Toronto and Guelph, the practice of water conservation has long been promoted, advocated for and practiced as a means of lessening the burden on the municipal water infrastructure network with varying degrees of prominence and success **(CMHC, 2009)**. Many advocates of water conservation emphasize the reduction of property taxes to the tax

payer as a positive result of prominent water conservation action within a municipality. This is due largely in part to the notion that water conservations measures could postpone the construction of new and retrofit water and waste-water projects and consequently result in a yearly savings of $5.5 billion **(Environmental Defence, 2010)**. It is expected that this savings will be passed down to the taxpaying resident and that greater recognition amongst the general public of the financial benefits will motivate residents to engage in water conservation. The counter argument is that there is the possibility that too much water conservation measures may reduce tax revenues to an extent that may be detrimental to the municipal purse and jeopardize other infrastructure projects. In addition, many argue and some evidence shows that increases in water rate prices is also likely to negate any cost savings residents may seek to gain via water conservation measures **(Water Canada, 2010)**. For example, The City of Toronto, which has been a flag bearer in the water conservation initiative in Ontario was $164 million short of the $800 million needed to conduct repair and new water infrastructure construction in 2008 – similar statistics were reported in the Region of Peel and Durham Region **(High Cost, The Star, 2008)**.

Concurrently, City of Toronto and many other conscientious Greater Toronto Area (GTA) residents implemented numerous water conservation measures only to be faced with the reality of price rate increases that would erase their expected savings **(Water Canada, 2010)**. The irony of the trends are such that the coagulation of water conservation measures has resulted in less water consumption and thus reduced financial revenue for municipalities, who in turn revert to water rate hikes to increase or make up for lost revenue, all counter to the financial motivation that prompted action from residents in the first place **(High Cost, The Star, 2008)**. For taxpaying residents, the trends oddly and sadly suggest that perhaps gratification for engaging in water

conservation measures should solely be geared towards an appreciation for the environmental and not the financial benefits.

2.2 Political Barriers

Change within a community may sometimes be met with resentment and resistance culminating in political repercussions for authority figures in government. As such, the possibility of the latter unfortunately becomes a factor in the decision making process and prevents the sole consideration of merits of a technology, policy or a combination of both from being conducted in the best interest of the community. In the long run, policy decisions are sometimes curtailed or suspended due to the intentional reluctance from authority figures in order to safeguard political standing or aspirations **(Dye, 2005)**. Such a barrier undoubtedly, represents an unfair challenge and hindrance to the social, technological and/or economic advancement of communities and should be addressed.

A strategy to overcome political barriers entails a variety of component solutions which can be applied on a case-to-case basis and are summarized in (Figure 1) below.

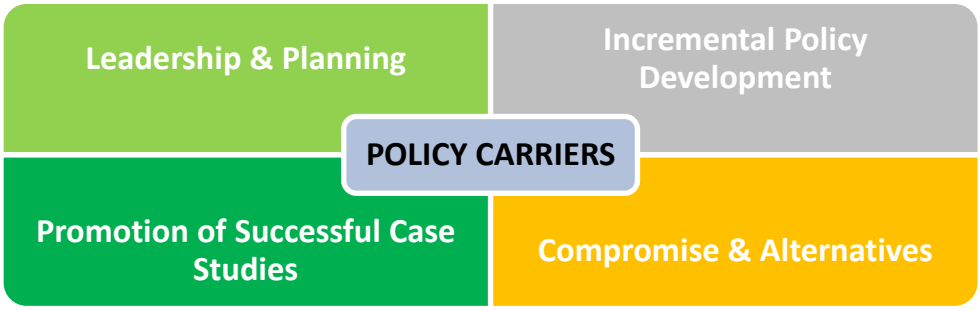

Figure 1 – Strategy to overcome Political Barriers

Leadership & Planning: This involves politicians adopting a more courageous and resolute approach to leadership, a diligent focus on research and planning and finally a robust conviction based on moral and ethical bearings. Subsequently, these attributes should be applied to galvanize community support through "town hall" meetings, consultation sessions and public education campaigns **(Water Canada, 2010)**.

Incremental Policy Development: In balance with a bold leadership approach, this component advocates the application of existing programs as a foundation upon which a new program is developed, allowing for end-users and planners to adjust to the new plan and conduct reviews and modifications respectively **(Dye, 2005)**.

Promotion of Successful Case Studies: Just as policy development in the above component is to be built on acceptable existing programs, it would be prudent for the policy maker to cite widely recognized successful programs through case studies in support of the proposed plan/policy.

Compromise & Alternatives: This component illuminates the importance of considering the interests and concerns of a reasonable amount of stakeholders in addition to giving due consideration to other solutions.

The above components termed "policy carriers" can aid in advancing the conception and implementation of a policy beyond the traditional political barriers. The embodiments and merits of a policy, if well communicated, supported by sound research and indications of success, entailing the long term interest of the wider society stands a great chance of being accepted by the public. As such, hopefully the threat to and conflict with one's political aspirations or philosophy respectively do not obstruct the pursuit of the policy in the interest of the public wellbeing.

2.3 Counterproductive Water Pricing

The prominence of water conservation is largely hindered in Canada due to low prices and unfavorable price rate structures for water services. Amongst OECD countries, Canada is reported to have the lowest prices for water treatment and provision services with the user paying on average $28 per month while consuming approximately 395 litres per day **(Sproule-Jones, 2008).** It is estimated that approximately fifty-five (55) percent of Canadian municipal residents fall under a category of rate structures that discourage the practice of water conservation **(Environment Canada, 2011).** The diagram below shows the four (4) main pricing rate structures employed by municipal water and sewage providers in Canada in accordance with a 2001 study by Environment Canada on 1999 statistics.

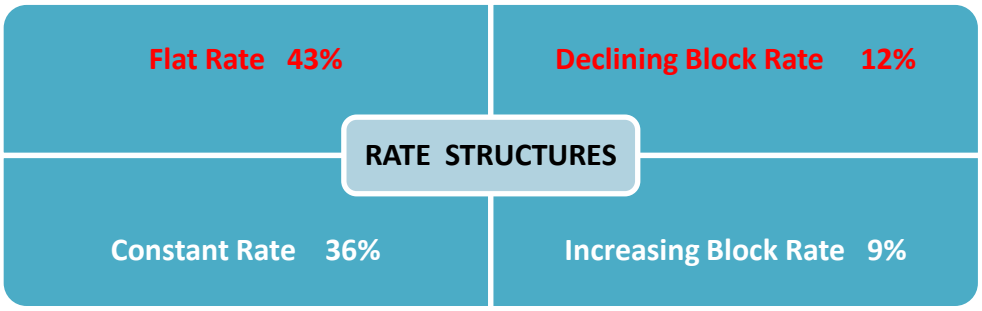

Figure 2 – Water Rates Structures in Canada (Environment Canada, 2011)

The study revealed that a majority of municipal serviced residents (55%) in Canada fall under the water conservation-deterrent categories of flat and declining block rate structures. The flat rate structure entails the charge of a fix fee irrespective of volume consumed by a resident while the declining block rate structure actually charges a lower fee as a resident consumes larger volumes of water **(Environment Canada, 2011)**. The potential impact on water resources in Canada is significant in view of the fact that more than half the population under municipal services is categorized

under rate structures that not only dissuade the practice of water conservation but also suggest the irrelevance of the practice through notions of water resource infiniteness and through cheap charge rates. It is also alarming that these rate structures impose no additional financial obligations on a resident consumer as larger volumes of the water resource are consumed. On the contrary, the resident consumer is actually rewarded financially under the declining block rate structure with lower charge rates when they consume more volume of water. Such rate structures are out of tune with the reality of the looming crisis of water infrastructure degradation beyond repair due to the lack of municipal revenues.

On the other hand, the constant rate structure entails the uniform increase in charge as the resident volume consumption increases while the increasing block rate structure involves the incrementally higher charges as greater volumes of water are consumed. Despite the fact that both of these two (2) rate structures are deemed as positive incentives to the practice of water conservation, only forty five (45) % of the Canadian residents fall under either of these structures **(Environment Canada, 2011)**. Several studies suggest that price inelasticity governs water as a commodity and as such pricing has minimal influence on consumer demand **(Great Lakes Commission, 2011).** For example, a study by M.E. Renwick and S.O. Archibald found that a ten (10) percent water price increase results in a mere 3.3 percent and 3.9 percent consumer demand decrease for the short and long term respectively **(Renwick and Archibald, 1998)**. Such trends suggest that even significant increases in water pricing still affordable to municipal residents and thus fail to serve as a deterrent to wasteful behavior or motivation to conserve water. None-the-less, the notion of water as an under-priced resource prevails and supports the action for even further increases in water pricing until consumer demand is influenced and a condition of price elasticity is attained.

There is arguably a correlation between the cheap water rate structures in Canada and the high consumptive behavior across the country. Amongst Organisation for Economic Co-operation and Development (OECD) countries, the average Canadian water service charge of $0.70 per 1000 litres stands at a quarter of the average rate paid in Europe **(Flow, 2011)**. Consequently amongst OECD countries, Canada ranks as one of the worst consumers of municipal water while paying one of the lowest rates. The average Canadian annual municipal water consumption rate of approximately 1420 cubic metres per year (327 litres per day) is more than double the French average and sixty five (65) percent above the OECD average **(Flow, 2011)**.

The prevalence of low water prices and rate structures has cultivated the habit of over-consumption and perception of water abundance amongst Canadians. As such, there is minimal impetus to engage in water conservation practices despite the looming crisis of infrastructure deterioration and lack of funds.

2.4 Perception of Abundance

The indiscriminate wastage of water by residents in Canada can be attributed to their belief and misconception that water as a resource in Canada is undoubtedly infinite. The contrary is however the case and water resources in Canada are currently under strain due to the growing population, urbanization, growth or suburbia associated greater water demands **(Sproules-Jones, 2008)**. The continued misconception of water abundance will dissuade Canadians from being conservative with their water use practices – it is therefore imperative to propagate the truth and reality of case studies illuminating the crisis of diminishing water resources in Canada.

The Great Lakes which serves as a source of water for Ontario, Quebec, Michigan, Wisconsin, Ohio, New York, Indiana, Illinois, Minnesota and Pennsylvania is regarded to be under undue stress due to the collective factors of perceived limitless nature of the

resource, indiscriminate and wasteful water use practices and cheap water rate charges **(Environmental Defence, 2010)**. The perception of the Great Lakes as an infinite resource is refuted by the fact that annually, just one (1) percent of the lake's total volume is replenished via precipitation and runoff **(Environmental Defence, 2010)**. Despite not ascertaining the current deviation to the critical one (1) percent, the arguments in the inquiry suggest that the Great Lakes could potentially attain a net zero gain in annual volume if wasteful water-use practices persists or exacerbate to the point of offsetting the one (1) percent total volume. The behavior of residents in Ottawa and concerned municipalities within the Great Lakes Basin coupled with enabling government policy are rendering the Great lakes susceptible to decline. The Great Lakes represent twenty (20) percent of available freshwater supply worldwide **(Brandes, 2010)** and is regarded as a valuable resource, an international heritage icon and the foundation of sustenance for the livelihood and cultures of encompassing surroundings and communities. The realization by user-residents of the fact that this water resource is under threat could be impactful in cultivating the requisite water conservation practices that could assist negating the demand pressures on the Great Lakes. The potential for a negative economic impact due to water decline should also be given due consideration. For example, the Great Lakes region in Ontario supports many energy generation outfits (hydropower, nuclear power, coal, natural gas and bio-fuel), mining operations, agricultural activities, industrial processes and water needs for an excess of 40 million residents **(Krantzberg, 2010)**. The economic importance of the Great Lakes to Ontario is undeniable for it serves as the backbone for eighty (80) percent of power generation, represents the drinking water source for seventy (70) percent of Ontarians and the "seed" for ninety-five (95) percent of farm cash receipts in the province **(Ontario Ministry of Environment, 2011).** The prospect of any of these sectors collapsing due to inadequate water supply would have severe economic ramifications. As such, it is a

worthy endeavor to investigate what technological and policy measures could be adopted within residences in order to lessen the impact on the Great Lakes while elevating the pursuit of water conservation as a sound driver of economic development and environmental sustainability.

Overall, the misguided belief in water resource abundance creates a false sense of security and encourages wasteful water use behavior amongst Canadians. Knowledge about the stress and critical demands being placed on our water resources should be shared in order to educate and inform the Canadian population and thereby instill greater awareness for the need for judicious water usage.

3.0 The Current Approach: Trends & Solutions

This section outlines implemented or proposed policies, measures or strategies that advocate or advance the cause of water conservation in Canada.

3.1 Emerging Legislation

The recent passing of the Water Opportunities and Water Conservation Act, also known as Bill 72 in the province of Ontario denotes a major acknowledgment for the relevance of water related issues such as water conservation and the associated economic opportunities. Within this main act is a new stand-alone act Water Opportunities Act (WOA), 2010 which entails the desired outcomes of firstly, supplanting Ontario as the North American leader in water conservation and treatment technology research, development and sales, secondly to encourage sustainable water, wastewater and stormwater infrastructure planning, development and growth in Ontario with province-produced products and thirdly to encourage wise water usage in Ontario **(MOE, 2011).** The Water Technology Acceleration Project (WaterTAP) under the WOA, is a non-crown corporation invested in facilitating collaboration with industry, government and academia **(MOE, 2011).** In addition, the act is designed to assist municipalities improve the efficiency of water infrastructure through system optimization and water conservation schemes while also imposing the requirement of water sustainability plans from water service providers **(MOE, 2011)**.

It is apparent in much of the current provincial literature that the act places a great deal of emphasis on the job creation and commercial aspects while shedding minor focus on the environmental and public health relevance **(MOE, 2011)**. None-the-less, there is sufficient provision in the act to be capitalized on to advance the philosophy of water conservation in Ontario. For example, over the course of three years, the province intends to invest $30 million on public awareness programs on

water conservation and Showcasing Water Innovation, a program designed to award grants for water, wastewater and stormwater management demonstration projects **(MOE, 2011).**

The aforementioned act solely serves the interest of Ontario, however similar legislation could be introduced in other provinces and tailored to address the specific environmental and economic challenges brought on by dilapidating municipal water infrastructure in those jurisdictions. In the province of Bristish Columbia, the Water Act of 1909 currently governs water diversion management and usage **(British Columbia Government, 2011)**. Unfortunately, the act was not written with long-term sustainability, anthropogenic contentions or climate change pressures under consideration – as such, there are currently proposals and efforts geared towards modernization of the act into the Water Sustainability Act **(British Columbia Government, 2011)**. Generally, the proposed act intends to protect BC water from present day and future burdens – with specific regard to water conservation, the act seeks to provide financial incentives for water efficiency measures alongside the broader objective of gaining civic engagement towards the protection of ecological values **(British Columbia Government, 2011)**.

A review of all the governing water related acts in all the respective provinces would be an ideal measure in commencing the verification of act's ability to address the challenges within present day context. The recognition of the need for water efficiency should be paramount and as such frameworks should be included to ensure the promotion of water conservation principles. Concerted efforts in this regard in respective provinces will ensure the reversal of Canada's dismal record as a wasteful user of water amongst OECD countries.

3.2 Increases in Water Rate Prices

The recognition of the wanton consumption of water by Canadian users due to cheap prices along with the dire need to raise revenue to meet the demands of water infrastructure expansion, several municipalities across Canada plan to and have increased water rate prices. The Canadian Environmental Law Association states that the cheap price of water in Canada plays a role in the country being second only to the United States as the least efficient consumer of water amongst OECD countries **(Polis Project, 2009)**. Municipalities that have taken heed to such messages include the Greater Toronto Area (GTA), Calgary, Guelph, Vancouver and a few others.

On March 1, 2011 the general water rate of the City of Toronto was increased by 10.8 percent **(City of Toronto, 2011)**, falling in line with the expressed commitment to increase water prices by 9.4 percent on an annual basis for a period of years **(High Cost, The Star, 2008)**. Next door to the GTA, the City of Guelph had instituted a series of price increases over the last eight (8) years and recently in 2008 approved a nineteen (19) percent increase resulting in a net cost markedly high by Canadian standards of $2.00 per cubic metre **(Brandes, 2010)**. In January 2011, the City of Guelph yet again approved a ten (10) percent increase of its water and wastewater rates **(City of Guelph, 2011).** Meanwhile, the Windsor Utilities Commission (WUC) recently cited the dire need for rate charges to support operations and maintenance and expansion of the water infrastructure network as the reason for the sixty (60) percent increase in rate prices **(WUC, 2011)**. In Alberta, the City of Calgary observed 5.8, 4.2 and 5.8 percent rate increases for 2009, 2010 and 2011 respectively **(City of Calgary, 2011)** while Vancouver rates were increased in 2011 by twelve (12) percent with further projected increases of approximately ten (10) and five (5) percent in 2012 and 1013 respectively **(City of Vancouver, 2011)**.

These trends are arguably desirable because price increases will induce more informed and judicious water use practices amongst Canadians. The claim is based on the European model whereby increases in water prices resulted in the reduction of water withdrawals and usage **(The Conference Board of Canada, 2011)**. However, the trend is simply sporadic and not widespread across the country. For example, in contrast to the price increases in Calgary, in next door Edmonton, price rates have been relatively constant since 1994 with a minute increase in 2003 to adjust for inflation **(City of Edmonton, 2011).** The water rate price increase initiatives and stated rationale undertaken by some municipalities will hopefully serve as ideal examples and convince other municipalities to consider water rate pricing as an arsenal to instill water conservation principles within its populace in order to achieve economic gains, reduce energy usage and enhance environmental sustainability across Canada.

Despite greater occurrence of these projected and ongoing price increases, other complimentary actions such as water conservation measures should be encouraged through other mechanisms rather than by relying on inducement by price increases. Residents and users must be cognizant of the fact that despite required investments in water conservation measures, they may still not receive savings but rather be faced with continuous water rate price increases – all should acknowledge the association with decades of subsidized and "frozen" water rates that has now become inadequate in maintaining or expanding the current water infrastructure.

3.3 Growth of Water Conservation Plans

Within the Greater Toronto Area (GTA) water conservation has been actively promoted and successfully embraced by residents – leading to significant changes in water consumption trends. For example, residents of Mississauga, Brampton and Caledon collectively converted 7,103 high-flush toilets to low-flush toilets through the

provincial government subsidized rebate program in 2007 while City of Toronto residents consumed 50 million cubic metres less in 2007, which represents a twelve (12) percent water consumption reduction from the previous year **(High Cost, The Star, 2008)**. The public acceptance to the aggressive promotion and public education on the part of municipal governments, cities and the provincial government are collectively primarily responsible for the success and growth of water conservation in the GTA. Another plausible explanation for the reduction in water consumption in the GTA could be the recent amendments to the Ontario Building Code, requiring more energy and water efficient devices in the home **(Ontario Building Code, 2011)**. The acknowledgement of the impending energy challenges due to the phasing out of coal plants in Ontario precipitated several initiatives within government such as the Green Energy and Green Economy Act **(York University, 2009)** The growing awareness of energy conservation, the job creation and the economic merit potentials could be defined as contributing drivers to the amendments to the Ontario Building Code.

The City of Toronto, by virtue of its adopted water conservation action plan is regarded as one of many municipalities that have acknowledged the financial and environmental merits of water conservation measures and as such serves as a positive example of a comprehensive a water conservation strategy. In order to postpone or avoid spending an estimated $220 million in water infrastructure expansion to cater to the rapidly increasing population, the City of Toronto opted to implement a water conservation strategy that designated as the Water Efficiency Plan (WEP) **(City of Toronto, 2011)**. The City of Toronto's WEP was instituted in 1993 and generally involves the provision of financial incentives to home residents who replace low efficiency household water fixtures such as toilets, shower heads and laundry washing machines with high efficiency alternatives **(City of Toronto, 2011)**. The City of Toronto plan serves as a positive example of a comprehensive water conservation strategy,

which by virtue of the 2.3 million population of the city creates a major impact in terms of encouraging awareness and change.

The City of Guelph also boasts of an exemplary water conservation scheme that includes a strategic plan to become the city with the lowest per capita usage of water in Canada. For the purpose of water use reduction in single family detached homes, their Water Conservation and Efficiency Strategy contains a matrix of programs that includes toilet, clothes washer, grey water reuse system and rainwater harvesting system rebate programs **(City of Guelph, 2011)**. In addition, the City of Guelph offers a rain barrel, landscape assessment along with a host of public education programs **(City of Guelph, 2011)**.

A noteworthy objective of the City of Guelph which may be based on the fact that it relies solely on a finite groundwater source for its water use and is currently faced with the rapid demands of growing communities, is to reduce overall water use by twenty-five (25) percent by 2025 in pursuit of the title of the least residential water consumer per capita in Canada **(Brandes, 2010).** In addition to the above retrofit efficiency programs, Guelph has also instituted a nineteen (19) percent in 2008 water rate pricing increase after a series of previous increases and justified decision to the City Council with a host on arguments focused on the economic and environmental rationales **(Brandes, 2010)**. All of the above trends are positive and suggest the feasibility of water conservation practice within other municipalities and provinces and could serve as model case studies in developing inter-provincial and national policies pertaining to water conservation practices and measures.

4.0 Policy Considerations

This section showcases the benefits and drawbacks of a host of technologies and practical measures through which water conservation measures can be incorporated into the Canadian home:

4.1 Water Conservation – Rainwater Harvesting

Rainwater harvesting (RWH) entails the collection of rooftop surface runoff and capture in a cistern, such as a rain barrel of an underground storage tank and is primarily intended for general domestic outdoor watering needs **(CMHC, 2009)**. RWH can be a viable water conservation application in areas where it is apt to separate water for consumption and water for non-consumptive purposes **(Riversides, 2009)**. Based on this criterion, the residential home is thus an ideal location for the practice of RWH.

The rationale for incorporating RWH in the domestic setting is based on the sound argument that it is wasteful, costly and unreasonably for the use of clean drinking water for outdoor domestic activities such as toilet flushing, landscape irrigation, deck, patio, siding and car washing to continue while municipal water service providers are currently faced with financial, operational and logistical challenges with respect to delivering the service. The practice of RWH can be beneficial in offsetting increased water demands, reducing ecosystem impacts due to less water withdrawals **(Environmental Defence, 2010)**, stalling the need for water infrastructure expansions and ultimately saving money.

The application of RWH basically caters to outdoor watering needs and this enables the potential for the greatest water savings impact for residences in Canada. Water consumption in Canada doubles during the summer months by virtue of outdoor watering activities **(Environmental Defence, 2010)** so RWH can cater to this seasonal demand – Statistics Canada projects a 140 billion litres per year savings in the Great

Lakes basin with introduction of water conservation strategies like RWH **(Statistics Canada, 2010)**. This specific scenario provides a general insight onto the potential savings that could be attained in other municipalities across the country. The most poignant confirmation of the feasibility of water conservation measures was recently demonstrated when residents in the Manotick, Barrhaven and Riverside South areas of Ottawa overwhelmingly engaged in rain barrel – water conservation during an imposed 2-month long water ban. The entire episode highlighted the fact that given the right impetus (water ban) or incentive, residents will embrace RWH in order to fulfill their outdoor water needs.

Grey water harvesting (GWH) denotes the advanced modification of the RWH system would allow for collection and treatment of sink, shower and laundry residual water prior to its usage for laundry requirements, flushing of toilets and outdoor water applications. Arguably, such a system gaining a foothold in Canadian homes, would enable further water savings since it enables both indoor and outdoor water use. The possible savings are illustrated in a pilot project led by Professor Khosrow Farahbakhsh of the University of Guelph who installed and tested a GWH system that revealed a seventy (70) percent reduction in water consumption **(University of Guelph, 2007)**. Professor Khosrow Farahbakhsh is also of the conviction that forty (40) percent of residential water needs can be catered for with rainwater and grey water instead of clean municipal water **(University of Guelph, 2010)**. If proven accurate, GWH can therefore play a major role in water conservation plans.

All of the above lends credence to the suitability and potential of RWH and GWH systems to at least meet the basic outdoor water needs of Canadian residences and undoubtedly illustrates the ability of water harvesting practices in confluence with a host of other conservation measures to lighten the burden on challenged municipal water services nationwide.

4.2 Water Conservation – Leakage Identification & Repairs

The assessment of existing municipal infrastructure to identify and repair leaks is a critical endeavor that must be carried out in order to promote water conservation while contributing to the long term sustainability of municipal water provision networks and services. As depicted by the diagram below, Environment Canada statistics report that in 2006, approximately 12.8 percent of water was consumed by system losses, which are attributed to not only basic leaks within the distribution system but also illegal connections to supply networks, system flushing and maintenance works, system overflows and other unidentified sources **(Environment Canada, 2010).**

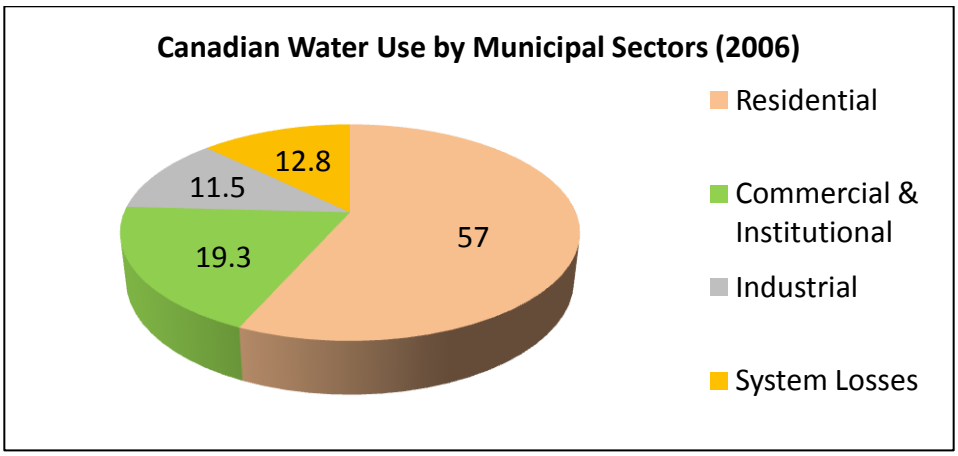

Figure 4 – Water Usage in Canada **(Environment Canada, 2010)**

Meanwhile, 57 percent of municipal water serviced the residential sector and here, yet again system losses are deduced to take place in the form of leaks in toilet water tanks, kitchen faucets and other household water fixtures and appliances. Ultimately, more damning estimates suggest that the combination of residential losses

and municipal system losses contribute to a total loss of 30 percent **(Environment Canada, 2010)**.

The potential net losses of 30 percent are clearly very high and under any business model would be regarded as unacceptable. On the other hand, investment in repairs is shown to create impressive financial savings for Environment Canada reports that studies project a savings of $3.00 for every $1.00 spent on leak detection and repair measures **(Environment Canada, 2010)**. As such, the slim and dire prospects of continued net losses should incline preference towards the afore-mentioned cost-effective and financially rewarding option and motivate municipal service providers and home owners to conduct identifications and repair procedures on their respective systems.

4.3 The Impact of Water Efficient Appliances & Fixtures

The adoption of water efficient appliances and fixtures within laundry rooms, kitchens and washrooms in the home, could have a significant positive impact on water conservation within the City of Ottawa.

Across Canada, the average daily water use per person attributed to toilet water flushing is 92 litres at 28% of the total daily usage **(Environmental Defence, 2010)**. The wasteful nature of the amount of water used in toilet flushing is not only emphasized by the above volume, which amounts to 46 bottles of the common 2-litre Coca-Cola containers but also by virtue of the fact that the water used is of safe drinking quality. In view of the fact that a great deal of financial capital is invested in the provision of safe drinking water to municipal residents, the use of such large amounts of a pristine resource for toilet flushing is confounding, arguably irresponsible and deserving of re-consideration via firstly technological modifications and secondly via public policy mechanisms. Water and energy provision in Ontario are intimately related since vast

quantities of water are required in the generation of nuclear, bio-fuel and hydro-power energy sources – as such, it is expected that as energy demands continue to rise, further investments will be poured into water provision services **(Krantzberg, 2010).** Toilet flushing accounts for the largest water use within the household **(Environmental Defence, 2010)** and as such, the greatest improvement can be attained by instituting a water conservation measure in this area of domestic water usage. The introduction, availability and abundance of low-flush toilets that use 6 litres per flush compared to the 17 litres per flush of traditional older toilets **(Environmental Defence, 2010)** represent a straight forward solution to significantly improving water conservation within the home. The replacement of older toilets with low-flush toilets in all Ontario households will reduce water usage by 2/3 and consequently amount to 213 billion litres of water conserved annually **(Water Canada, 2010)** which translates to approximately $90.00 in annual savings **(EPA, 2011)**. The cost of installing a low-flow toilet is approximately $500.00 (labor and materials), therefore the return on investment (ROI) for a typical low-flow toilet is close to 20 percent with a payback period of around five years **(Tolson, 2011)**.

The household showerhead is the next water fixture of concern because it represents the largest and second largest water consumption device in the Canadian and Ontario household respectively **(Sproule-Jones, 2008)**. Traditional showerheads which happen to be the vast majority currently installed in Canadian homes, work at a rate of 14 litres per minute culminating in the average shower usage of 73 litres of water per day **(Environmental Defence, 2010)**. A low-flow shower fixture capable of operating at a rate of 5 litres per minute represents a simple, affordable, easy-to-assembly and cost-effective alternative to traditional showerheads **(Environmental Defence, 2010)**. The potential water savings are blatantly obvious and precursory to

financial savings for the municipal water service provider and resident, and the lessening of environmental impacts for all.

In terms of feasibility and motivation, installation (labor and material) of a low-flow showerhead accounts to approximately $50.00 in annual savings and $200.00 in costs and translates a 25 percent ROI and a payback period of around four years **(Tolson, 2011).** Most home owners should be able to bear the cost of the high efficiency showerhead fixture and could find the above economic projections mildly attractive. The remaining onus should be shouldered by the government in the form of provision of incentives to all households in order to encourage the trend of switching from low to high efficiency shower fixtures. An incentive program will imply government support for the replacement technology, impress upon the residents the shared accountability and responsibility of the program and most significantly will create an impetus in the form of a financial gain rather than one solely based on environmental consciousness. A similar program was implemented by the City of Toronto whereby financial incentives were given to residents that retrofitted their homes with high efficiency water fixtures and appliances **(Polis Project, 2009)**. Overall, the high efficiency shower fixture affords household residents, municipalities and Canada at large a small but significant component in the overall matrix of technical solutions and policy tools that could propagate all stakeholders towards indulgence in a water conservation and environmental sustainability culture.

Lastly, the household clothes washer is another domestic appliance with a water consumption rate that needs to be curtailed because it consumes a significant amount of water in the Canadian home. On average, the clothes washer takes up twenty (20) percent of water use in the Canadian household **(Sproule-Jones, 2008)** and consumes a daily per capita average of seventy two (72) litres of water **(Environmental Defence, 2010).** The conservation measure being undertaken with respect to this appliance

involves replacing top (vertical-axis) with front (horizontal axis) load washers since manufacturers claim that water and energy consumption can be reduced by at least forty (40) and sixty-five (65) percent respectively **(City of Toronto, 2003)**. As part of the City of Toronto's WEP, an eight (8) week long pilot project concluded that front load washers indeed reduced water consumption by forty-five (45) percent from 127.8 to 20.75 litres **(City of Toronto, 2003)**. This reduction also represents a seventy (70) percent decrease or approximately a fifty (50) litre drop from the average daily per capita water consumption. Natural Resources Canada and Environment Canada have elaborated repeatedly on the burden and threat that continued indiscriminate domestic water consumption has on the Great Lakes basin and cited the potential impact front load washers can have through water savings as high as 163 billion litres annually **(Environmental Defence, 2010)**. All of the above along with the fact that a vast majority of these preferred front load washers are ENERGY STAR certified lends credence to claims of being more efficient than top loader machines. In order to improve water conservation in the Canadian home, the conversion to front load washers will be sensible and impactful. Unfortunately, only seventeen (17) percent of front load washers are present and operational in Canadian homes **(Environmental Defence, 2010)**, further emphasizing the gravity of the challenge and the importance of incentive based programs such as under the City of Toronto WEP, the Calgary WEP, City of Vancouver initiatives and many others that encourage residents through monetary incentives to switch to water efficient front load washers.

4.4 Water Rate Pricing Adjustments

There are several striking observations that suggest the need to increase the price of water provision to consumers in order to encourage more judicious water-use and generate greater revenues towards improved service. For example, in contrast to other

developed nations, Canada has significantly lower rates for residential and commercial water consumption **(Water Canada, 2010)** and yet ranks amongst the highest per capita consumers of water worldwide. Both observations suggest a chronic wasteful behavior void of a regard for the value and finite nature of water as a resource and a lack of recognition and political will to command due remuneration for municipal water treatment and provision services. In support of the latter, it has been identified that water bills issued by several Canadian municipal water service providers fail to cover the costs of basic operations, maintenance or repair **(Water Canada, 2010)**. The resulting detriments include the lack of needed revenue to arrest the deterioration of municipal water infrastructure aligned with the lack of a deterrent to residents against indiscriminate and wasteful water-use practices. Over a decade ago, Environment Canada advocated unsuccessfully through studies for an increase in water rate pricing in order to prevent the deterioration of municipal water supply and sewage infrastructure beyond repair **(Environment Canada, 2010)** The fact that the current maintenance and repair cost stands at an estimated $23 billion over the next ten (10) years **(Conference Board of Canada , 2008)** in the backdrop of aging infrastructure, lends credence to the Environment Canada argument, confirms the current lack of revenue to meet development needs and most importantly substantiates the dire need for revenue generation by means of a water rate pricing adjustment measure.

There are several other proponents for the full recovery of costs involved in treating and providing clean water to residents via Conservation-Oriented Pricing. Conservation-Oriented Pricing (COP) is defined as a water pricing rate structure that is instituted by the water service provider with the intent of enabling the recovery of full costs associated with the water provision, metering of consumer and billing for exact amounts consumed, and finally to encourage water conservation measures and prudent water-use practices by consumers **(Polis Project, 2010)**. The leaders of such a measure

should be cognizant of a potential electoral backlash and thus regard the prospect of a failed political career as "collateral damage" or a noble sacrifice in the pursuit of the higher priority of water conservation. In reality, many politicians are simply not that selfless so a different approach needs to be adopted. The political team should be capable of firstly, delivering a sound public education campaign highlighting the economic and ecological merits of the measures to residents and secondly, facilitating consultation sessions through town hall meetings to allow residents to contribute to the policy development process. This approach may go a long way in achieving successful implementation of COP within municipalities.

It is purported that such a rate structure will generate the following advantages:

- Residents will be encouraged to be more conservative and judicious water consumers
- Residents will pay for exact volumes consumed
- Municipal water service providers will attain increased revenue
- Water technology development and growth
- Water conservation will enhance the environmental and ecological footprint

It is conceivable and likely that the recognition of higher water rates will be countered by a resident with the proactive measure of either consuming less water both indoors or outdoors, seeking other sources of cheaper or free water such as adopting rainwater harvesting practices or incorporating high efficiency fixtures and appliances in the home. Naturally, the prospect of achieving financial savings is likely to compel a resident to adopt one or many of the water conservation measures outlined above. It is therefore imperative and note-worthy that the financial policy measure of pricing structure adjustment possesses the potential of also enacting other desirable (technological and behavioral) policy measures such as water conservation. As such, it is critical that in order to optimize results as part of a comprehensive strategy to

encourage water conservation practices within Ontario households, the adjustment of pricing structure should act as a pre-cursor to all other policy measures.

A key component of COP is to charge a consumer for the exact volume of water consumed - knowledge of the exact volume consumed by the resident is required and therefore a metering system is needed. The immediate challenge for COP implementation is the metering component because approximately forty (40) percent of Canadian homes are not metered **(Environment Canada, 2010).** The inclusion of meters in the homes of all residents is not only imperative for the success of a COP structure but also relevant for maintaining accountability and transparency in administrative affairs **(Water Canada, 2010)** and also monitoring and educational purposes to enhance domestic water conservation practices respectively.

In summary and in accordance with common practice amongst model OECD member countries, Ontario and Canada must seek adjustment of water rate pricing in order to encourage water conservation practices and increase municipal revenue to address operational, expansion and repair costs of municipal water infrastructure.

5.0 Policy Recommendations

The recommendations outlined below are listed in order of preferred implementation timeline since the execution of the former is projected to enhance the success or impact of the latter in the listed order. Deviation from the listed order however should not create a major negative drawback of the beneficial impacts of the following individual recommendations:

5.1 Nation-Wide Water Metering Policy

The adoption of conservation-oriented water pricing is imperative in order to influence consumer behavior to embrace water conservations and realize the above discussed benefits. The installation of meters in all Canadian residential homes is requisite to facilitating the measurement, management and billing of water volume usage. Indeed, studies provided by the United States Environmental Protection Agency (EPA) argue that the mere act of installing meters in homes cultivates a psychological deterrent within the resident user and ultimately results in a twenty to forty percent decrease in water consumption **(City of London, 2011)**. Measurement will assist in ensuring full cost accounting of expenditure which further justifies whatever price increases are passed on to the end-user. As such, the adoption of campaigns to facilitate the installation of water meters in all residences in Canada is highly recommended.

5.2 Nation-Wide Conservation-Oriented Pricing Policy

Water rate prices should be "conservation-oriented" and structured such that they reflect a fair value and means of cost recovery for services provided and thereby incentivize Canadians to be more conscientious and judicious about water use within the domestic setting, increase revenue for financially handicapped municipalities and prompt industry investment in sustainable water technologies. Once the recommendation outlined in (6.1) has been accomplished, municipalities can now

proceed with implementing this recommendation which in turn may likely spur interest in the fundamental objective of water conservation practices. The following recommendations may likely further encourage, incentivize and justify to many water end users their enrollment in the practice of residential water conservation schemes.

5.3 Spring-Summer Water Ban Policy

The circumstantial success of the water ban in the City of Ottawa in the Spring of 2011 highlights the fact that the vast majority of residents are willing and capable of actively engaging in rainwater harvesting practices. Local municipal governments should assume a lead role in inducing that practice to the point where it becomes habitual and customary within the fabric of the domestic Canadian setting. Subsequently, the provincial then the federal government should lend both financial and philosophical support as required to the local initiative. In order to do this, a Spring-Summer Water Ban should be instituted in all residential areas in Canada. The benefits would include environmental damage mitigation, energy savings and the arresting of the doubling of water demands in the summer months. The drawbacks of adverse financial impacts to local businesses that rely on water to operate can be reviewed for water ban exemptions on a case by case basis while the inconvenience to residents can be curtailed with the passage of time along with the delivery of prudent educational and public relations campaigns.

5.4 Federal Retrofit Incentive Policy

The switch from low to high efficiency water fixtures and appliances like toilets, shower heads and laundry machines can be galvanized by government commitment to providing financial incentives to participating residents. These three (3) water-use applications constitute a net 70 percent of water use in the average Canadian household **(Sproule-Jones, 2008)** and as such the greatest impact in water conservation can be

achieved by focusing remedial efforts in these areas. The financial incentives can be in the form of cash-back, instant discount and tax credit initiatives.

5.5 Public Education & Consultation Campaign Policy

A public awareness campaign must be launched across the country with the purpose of instilling within the Canadian ideal, a water conservation philosophy. The notion of water conservation should be held in high esteem and regarded as an obligatory endeavor, in consideration for the environmental sustainability of national water resources and economic perspectives. The awareness campaign ought to be focused not only on altering the mindset of citizens but also inducing change from the bottom up, from the grass-roots environmental movement, non-governmental organizations, stakeholders, conservations authorities, municipal authorities, city bureaucrats, provincial and federal agencies along with lawmakers within all three levels of government. Leadership initiatives, exemplary individual endeavors and successful case studies and stories should be cited as a means of demonstrating the extent to which the practice is realistic, applicable and feasible within the residential setting.

6.0 Conclusions

The inquiry has shown that several water conservation measures such as the retrofitting of homes with high water efficiency toilets, shower heads and laundry machines can dramatically reduce water consumption in the home. Consequently, the resulting benefits include relief of the burden and financial demand on municipal suppliers, generation of savings for the domestic user and reduced detrimental impacts on the environment. Municipal water infrastructure across the country is in near collapse and in order to prevent complete failure and risk to public health and economic viability, not only will prevailing ineffective policy tools need to be arrested but water conservation technology and schemes will need to be endorsed and bolstered by public policy measures. Most significantly, certain public policy measures such as the mandating of water metering and water rate pricing increases can be influential in increasing the rate of adoption and the magnitude of participation in water conservation practices in the Canadian home.

Further inquiries of interest could entail research work on the potential energy savings from the individual and collective large-scale application of a variety of water conservation technologies or practices. The potential to gain public acceptance and awareness of water conservation schemes due to association with energy saving is great by virtue of the corresponding financial savings to the end-user. To a large extent, the implementation of energy saving measures has been more successful and welcomed by the public, than water conservation measures. The intimate relation between energy and water conservation should be propagated to the general public in order to elevate awareness and spearhead policy development in favor of water conservation. The

negative implications of the contrary occurring should be emphasized since residents are more likely to take heed to initiatives that are associated with financial savings.

All the above summaries highlight the essence of the participation of both the government and the consumer. Overall, the practice of the discussed water conservation measures in residential homes in Canada takes place in a small quantity of major municipalities but not profusely amongst Canadians. It can be fairly judged that the practice is neither extensively practiced nor rapidly being adopted throughout the country. The reality is that despite the merits of water conservation, many municipalities have not embraced the measure as a tool in the efforts aid municipal water supply or environmental degradation challenges. The government(s) must exercise astute vision and courage in acknowledging the gravity of the problem, embracing the outlined solutions and communicating policy decisions in a persuasive manner to consumers, stakeholders and the general public. On the other hand, consumers need to embrace water conservation to the extent of being a Canadian cultural facet and a philosophical virtue that encompasses the Canadian appreciation for nature and environmental sustainability. The consumer must also be cognizant of the fact that embracing this policy decision or new philosophy may come along with financial disadvantages or domestic inconveniences - these detriments need to be taken into context of what is ultimately beneficial for the larger community in the long-term. These approaches will go a long way in enabling a smooth introduction and adoption of water conservation within the Canadian residential fabric.

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