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Subject: **Water Conservation and Efficiency Program Progress Report**

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CITY OF GUELPH

WATER CONSERVATION AND EFFICIENCY PROGRAM PROGRESS REPORT (2006 – 2014)

C3 WATER INC.

24 MARCH 2016

VERSION	DATE	DESCRIPTION OF REVISIONS	REVISED BY	REVIEWED BY
1	19 February 2016	Draft Water Conservation and Efficiency Program Progress Report (2006 – 2014)	Andrea Williams	Bill Gauley
2	24 March 2016	Final Water Conservation and Efficiency Program Progress Report (2006 – 2014)	Andrea Williams	Bill Gauley

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1.0 INTRODUCTION

The purpose of this report is to evaluate the water savings and other benefits to the City resulting from the implementation of water efficiency programming developed from recommendations contained in the 2009 Water Conservation and Efficiency Strategy. Those recommendations were based on the water conservation targets set in the 2006 Water Supply Master Plan. In the 2006 Master Plan, water conservation was determined as the best alternative for meeting the City's growing water demand. The 2006 Water Supply Master Plan identified the following time-based average annual day water reduction targets based on 2006 average daily water production (Figure 1):

- Reduction of 10 percent (5,300 cubic metres per day) in average day water use by 2010;
- Reduction of 15 percent (7,950 cubic metres per day) in average day water use by 2017; and
- Reduction of 20 percent (10,600 cubic metres per day) in average day water use by 2025.

Based on these targets, the 2009 Water Conservation and Efficiency Strategy Update recommended preferred conservation measures and programs to meet the water reduction goals of the Water Supply Master Plan.

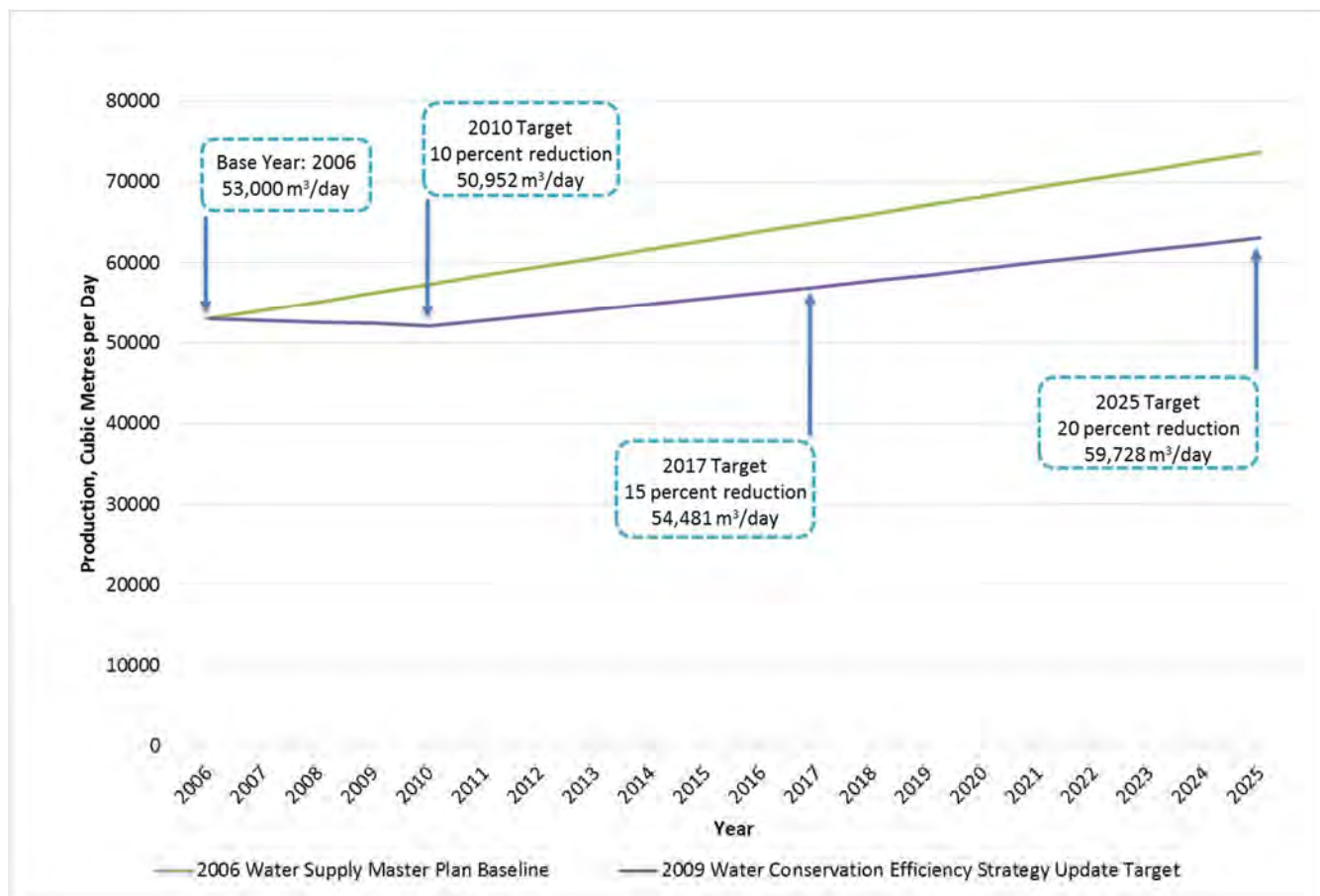


Figure 1: Establishing Targets for the 2009 Water Conservation and Efficiency Strategy Update

2.0 CURRENT PROGRAMS

The City implemented a suite of programs to facilitate achieving the 2006 Master Plan water conservation targets. This programming was included in the Council-approved 2009 Water Conservation and Efficiency Strategy Update and outlined below (Resource Management Strategies Inc., 2009).

2.1 *Outside Water Use Program*

The Outside Water Use Program was created in 2002 and approved by City Council in 2003 to address peak demand pressures within the City. This program is linked to the requirements of the Ontario Low Water Response Plan and seeks to best manage Guelph's finite groundwater supply during times of seasonal stress. The program, which was designed to help reduce peak water demands during periods of drought, "has helped reduce Guelph's average summer daily water use by over 18 million litres" (<http://guelph.ca/outside-water-use>). The program has three levels that affect residential outside water use. These levels are triggered by local weather and watershed conditions:

- Level 0 Blue - Careful use
- Level 1 Yellow - Reduce outside use
- Level 2 Red - Reduce and stop non-essential use

The Outside Water Use By-Law, which is the legal basis for the program, is enforced by City of Guelph Bylaw Enforcement Officers. This program underwent its own review and revisions in 2013 and was subsequently approved by City Council on February 24, 2014. For more information, see www.guelph.ca/outside-water-use.

2.2 *Healthy Landscapes*

The Healthy Landscapes program was launched in May 2008. The program offers a free 45-minute home visit to residents of the City of Guelph to discuss methods to reduce outside water use (visits are available May through August). In many communities water use during the hot summer months is 30 per cent higher than demands during the winter months. In Guelph, however, the average demand increase during the summer is only about 5 percent – reflecting a high level of community stewardship and outdoor water use efficiency for Guelph customers. From installing a rain barrel to choosing native or drought-tolerant plants to adjusting lawn care practices, there are many simple ways to decrease outside water use. The Healthy Landscapes Program aims to support local residents in decreasing outdoor water use and sustaining community peak season water savings already achieved through the Outside Water Use program. For more information on this program please visit: www.guelph.ca/healthy-landscapes.

2.3 *Water Conservation Rebate Programs*

The City of Guelph offers a variety of rebates for residents and local businesses that make an effort to conserve water. These programs include:

- Royal Flush Toilet Rebate Program: Customers can replace up to two inefficient toilets with a new high-efficiency WaterSense®-approved model flushing with 4.8 litres or less and receive a \$75 rebate. Commercial facilities and multi-residential buildings can also apply for \$75 rebates (www.guelph.ca/royalflush).

- Smart Wash Rebate Program: Customers can replace their inefficient top-loading washing machine with a new Energy Star® rated model and receive a \$100 rebate from the City of Guelph. Commercial laundries can receive up to a \$200 rebate (www.guelph.ca/smartwash).
- Greywater Reuse Rebate Program: This program promotes the installation of a City-approved greywater reuse system. A rebate of \$1,000 is offered (www.guelph.ca/greywater).
- Rainwater Harvesting System Rebate Program: This program promotes the installation of a City-approved seasonal outdoor rainwater harvesting tank to receive a one-time rebate of \$0.10 per litre of tank storage (to a maximum of \$400). Customers can also install a City-approved rainwater harvesting system in their home and receive a \$2,000 rebate (www.guelph.ca/rainwater-harvesting-system-rebate).

2.4 **Home Visits/Audits (previously eMERGE Home Visits)**

These one-hour consultations are coupled with a free retrofit package and on-site expert advice to provide information, resources and practical recommendations. The program focuses on viewing the home as a whole system by looking through the lenses of energy, waste, water, alternative transportation and sustainable food choices. The program goals are to remove barriers, to provide information, and to inspire action. Program partners include: Transition Streets, Project Neutral, Guelph Hydro, Union Gas, and the Township of Elora. For more information, visit www.emergeguelph.ca/.

2.5 **Blue Built Home Water Efficiency Standards and Rebate Program**

Blue Built Home is a certification program designed for new homes. The program uses an approved set of efficient home fixtures and appliances designed to save water and reduce utility bills by as much as 62 percent. Blue Built Homes are certified according to three water efficiency standards - Bronze, Silver and Gold. The City of Guelph administers the Blue Built Home program and the program is supported by Tarion-registered home builders. Participants can receive a one-time rebate of up to \$2,420. The advertised cost savings to participants in the Blue Built Home program are presented in Figure 2. These cost savings are based on 2015 water and wastewater rates. For more information, visit www.guelph.ca/blue-built-home.

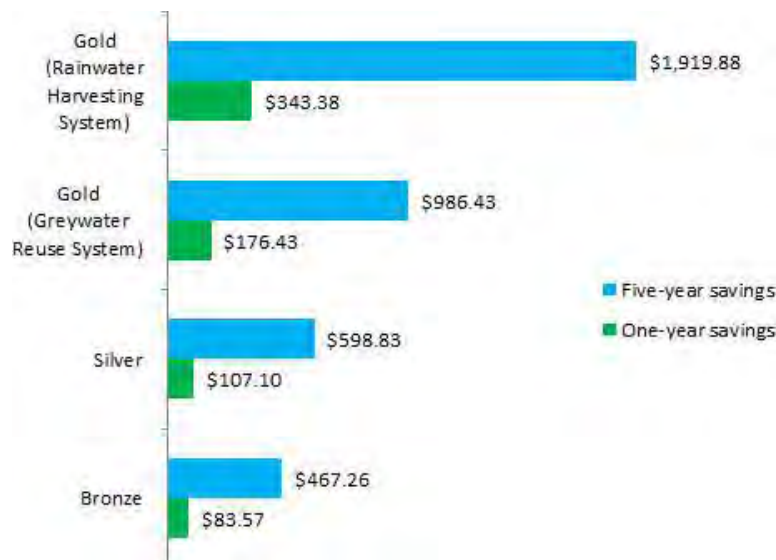


Figure 2: Advertised Savings for a Blue Built Home (Bronze, Silver and Gold)

2.6 **Industrial/Commercial/Institutional Capacity Buyback Program**

The Capacity Buyback Program offers industrial, commercial and institutional water consumers free facility water use audits and one-time financial incentives for the implementation of retrofits that permanently reduce water use. The City offers \$0.30 per litre per day of water saved. For more information on the Capacity Buyback Program visit www.guelph.ca/water-smart-business.

2.7 **Public Education**

The City offers interactive and educational activities to teach youth about Guelph's water, including the protection and conservation of our precious water resources.

These include:

- Tours of Water Services and Arkell Spring Grounds
- Water Wagon- Tap Water Promotion
- Canada Water Week
- Civic Museum events
- Waterloo Wellington Children's Groundwater Festival
- Grade 2 and 8 School In-School Educational Programs
- H2O Go Festival
- Children's Groundwater Festival
- Wacky Water Week at various library locations
- H2Awesome event
- Thrills and Spills board game
- The Yellow Fish Road Program

For more information, visit www.guelph.ca/ourstoconserve

2.8 **Water Conservation and Efficiency Public Advisory Committee**

The Water Conservation and Efficiency Public Advisory Committee was initially formed to provide public consultation during the development of the 2009 Water Conservation and Efficiency Strategy Update. One of the recommendations from the Strategy Update was that the Council-appointed committee of residential rate payers provide ongoing feedback and advice to City Staff and Council on water conservation program activities. This Committee provides recommendations on the following:

- Issues and opportunities to be addressed in the implementation of the Water Efficiency Strategy Update
- Alternative solutions
- Design considerations
- Community consultation and marketing activities

For more information, visit www.guelph.ca/water-conservation-and-efficiency-public-advisory-committee.

2.9 ***Water Loss Management***

The City actively pursues water efficiency in its own operations. Water loss in the distribution system is managed with annual leak detection activities including sonic leak detection in areas with metal pipes and the installation of district metered areas where practical.

2.10 ***Municipal Facility Upgrades***

The City continues to upgrade water-consuming equipment and implement other water-savings measures each year in its own municipal facilities. An example is the recent rainwater harvesting system installed for bus washing at the City's Transit Facility.

3.0 RETIRED PROGRAMS

The following programs, recommended through the 2009 Water Conservation and Efficiency Strategy Update, were initiated by the City as pilot programs but were subsequently ended due to low customer uptake, market saturation or transitioned into an existing program.

3.1 *Pre-rinse Spray Valve Program*

The Pre-rinse Spray Valve Program was recommended through the 2009 Water Conservation and Efficiency Strategy Update. A similar program was offered by Union Gas (through a contractor) and the City collaborated with Union Gas by providing marketing for the program. The joint program offered a rebate for restaurants to replace their inefficient spray valves in 2009 and 2010.

3.2 *Floor Drain*

The residential construction industry uses the practice of installing a bleed line from one of the faucets in the home to drip water into a basement floor drain to maintain a trap seal to prohibit sewer gas from entering the home. The City had offered a rebate for the replacement of floor drains with waterless models that allow water to drain, yet prevents hazardous gases from seeping into the home. The rebate was valued at \$60 and the program ran from 2010 to 2012.

3.3 *Home Humidifier Rebate Program*

The City launched the home humidifier rebate program in conjunction with Peel and York regions in 2010. They were the first three municipalities in Canada to offer such rebates. The pilot program offered rebates to Guelph residents who replaced a high-water-use, furnace-mounted humidifier with an approved water-efficient model. The rebate ranged from \$30 to \$70 depending on the water efficiency of the replacement. The retrofit was estimated to save a household up to 127 litres of water a day during the home heating system (Guelph Tribune, 2010).

3.4 *Multi-residential Audits*

In 2009 and 2010, through the program Green Impact Guelph, the City supported a water and energy audit and retrofit initiative. Trained volunteers from Guelph Environmental Leadership would go to participating buildings and accompany the superintendent to assess the efficiency of key features of each unit. Inefficient faucet aerators, showerheads and light bulbs were replaced with efficient models. Leaky toilets were also identified so that they could be repaired or replaced. During the two years of operation the Multi-residential Retrofit Program assessed and retrofitted 1,000 apartment units in Guelph. This program later evolved and became the eMERGE audit program.

4.0 OVERALL REDUCTION IN WATER PRODUCTION AND DEMAND

Annual water production has continued to decline in the City between 2006 and 2014 – both on a system-wide and per capita basis. This reduction has been the combined result of the following three types of savings:

- **Direct savings** – savings that would not have occurred without municipal programs and can be directly quantified. An example of direct savings would be a customer that receives a rebate to replace an inefficient fixture or appliance (that they would not have replaced without the rebate) with an efficient model¹. The savings are calculated as the average water savings per fixture multiplied by number of rebates provided.
- **Indirect savings** – savings that would not have occurred without municipal programs but cannot be directly quantified. An example of indirect savings would be a customer that hears about a City’s rebate program and replaces an inefficient fixture or appliance with an efficient model but does not take the time or effort to apply for the rebate (the Wall Street Journal estimates that approximately forty percent of mail-in rebates are never redeemed). Indirect savings are also generated by public education and outreach programs that foster a growing public awareness that natural resources should be used wisely.
- **Natural savings** - savings occurring naturally without any influence from the municipality. Per capita water demands have had a declining trend across North America for the last 10 to 15 years primarily due to the marketplace shift towards the use of high-efficiency clothes washers and toilets (two of the largest water uses in the home) and the introduction of entities like WaterSense® and ENERGY STAR®. In fact it is estimated that the current rate of natural indoor residential savings is about 2.7 litres per capita per day per year.²

The first step in analyzing the progress achieved by Guelph’s 2009 Water Conservation and Efficiency Strategy Update is to determine the reduction in total water production (including direct, indirect, and natural savings) during the study period.

In the report Analysis of Water Demand and Consumption, it was determined that between 2006 and 2014 the City’s population increased by 13,686 persons (about 12 percent) while water production actually *decreased* by 5.9 million litres per day (almost 12 percent).

¹ Customers that receive rebates to take actions they would take even without a rebate are called “free riders”.

² Based on detailed in-home monitoring completed in 737 representative homes in nine different cities in the USA and Canada as part of the 1999 Residential End Use Study (American Water Works Research Foundation) and the 2014 Residential End Use Study Update (National Research Centre Inc.) over the 15-year period between 1999 and 2014 average per capita indoor demands have declined by from 262.3 litres per capita per day to 221.8 litres per capita per day, a reduction of 40.5 litres per capita per day in 15 years for an average of 2.7 litres per capita per day per year. This reduction was found to be statistically significant at the 95 percent confidence level.

4.1 Production Rates

Figure 3 shows *actual* water production versus the 2006 Water Supply Master Plan *projected* water production if the City's total production-based per capita demand had remained at the 2006 level of 447 litres per capita per day. While it was predicted that production would increase with time, actual production declined. Based on the linear trends of the projected versus actual production, average annual day production in 2014 was 13.5 million litres per day lower (57.1 – 43.6) than it would have been had per capita demands remained constant³. The total cumulative reduction in actual water *production* between 2006 and 2014 is approximately 23,995 million litres.

- **Reduction in Projected versus Actual Daily Production (2014): 13.5 million litres per day**

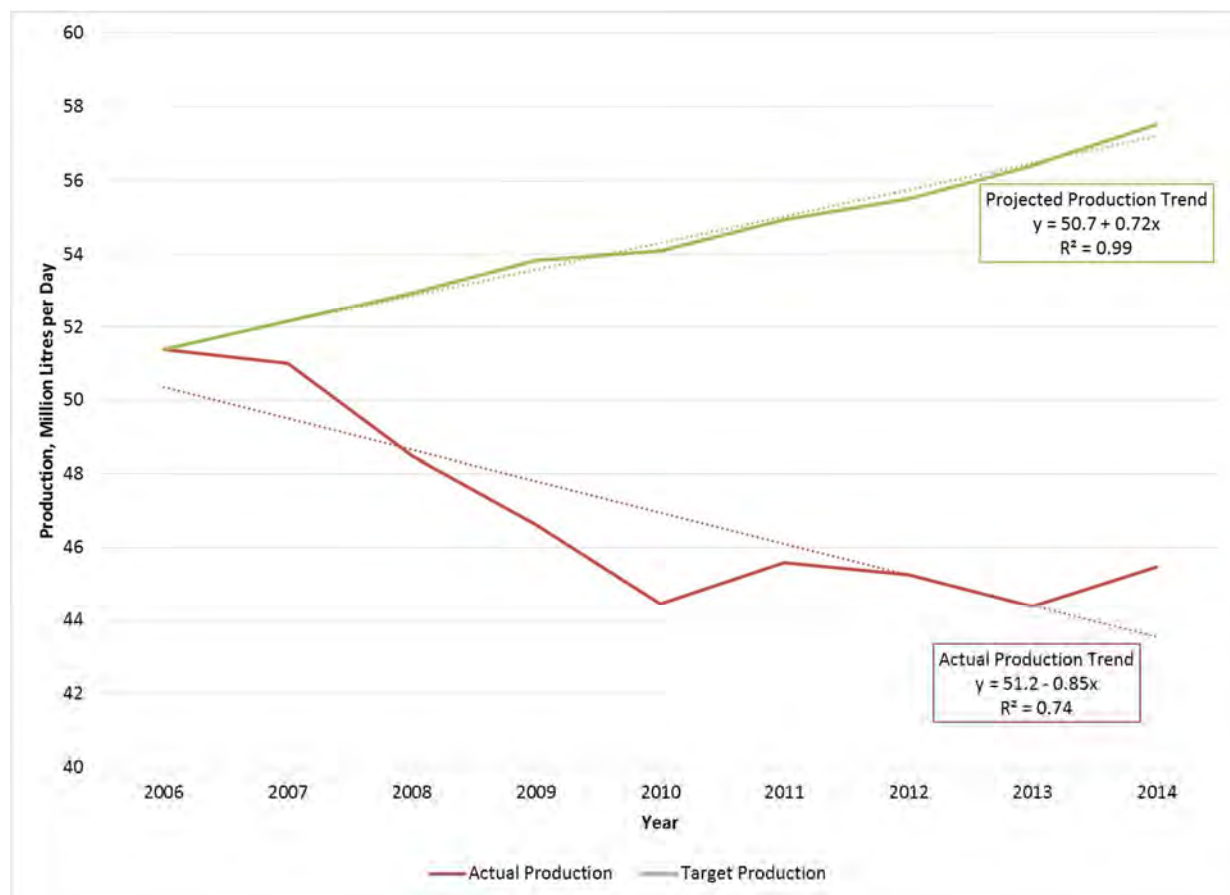


Figure 3: Actual versus Projected Average Annual Day Water Production Values

³ The R^2 value displayed on many charts contained in this report is a statistical measure of how close the data are to the fitted regression line - the higher the R^2 value the better the fit with a value of 1.0 indicating a perfect fit.

4.2 Demand Rates

Figure 4 shows *actual* water demand versus *projected* demand if the City's demand-based (i.e., not including non-revenue water⁴) per capita demand had remained at the 2006 level of 379 litres per capita per day. Based on the linear trends of the projected versus actual demand rates, average annual day demand in 2014 was 9.7 million litres per day lower (48.5 – 38.8) than it would have been had per capita demands remained constant. The total cumulative reduction in actual water demand between 2006 and 2014 is approximately 17,246 million litres.

- **Reduction in Projected versus Actual Daily Demand(2014): 9.7 million litres per day**

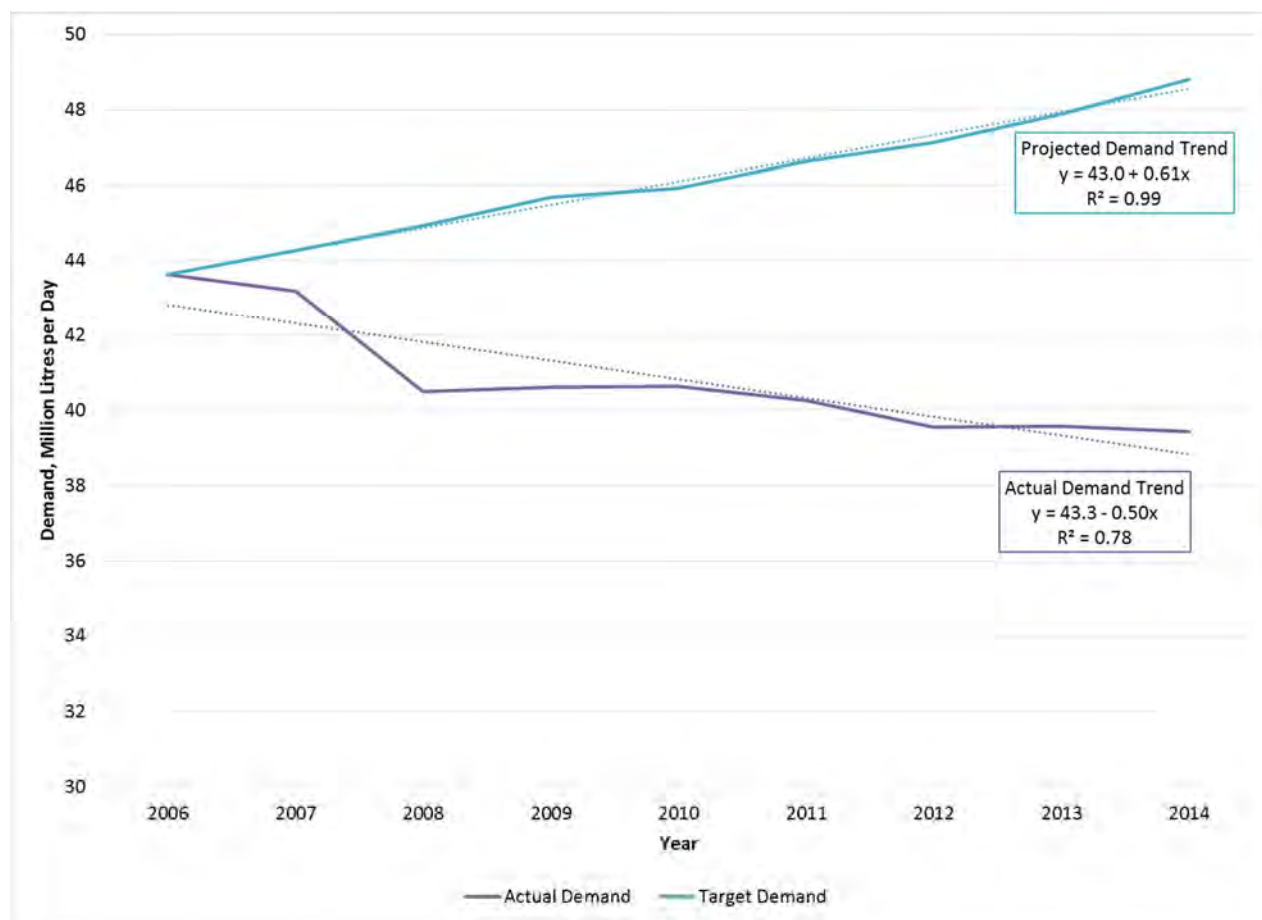


Figure 4: Actual versus Projected Average Annual Day Water Demand Values

⁴ Water that is produced but not billed to customers is referred to as non-revenue water. Non-revenue water includes physical losses such as water used for firefighting, mains flushing, system leakage, un-metered municipal uses, etc., as well as apparent losses resulting from metering or accounting inaccuracies.

4.3 Non-revenue Water Rates

The difference between the production and demand rates reflects non-revenue water rates in the City. Non-revenue water includes physical losses such as water used for firefighting, mains flushing, system leakage, unmetered municipal uses, etc., as well as apparent losses resulting from metering or accounting inaccuracies. If the City spends too little to reduce system leakage, the volume and value of water lost each year will increase; if the City spends too much, the cost of the program will outweigh the savings. Between these two extremes is an economic level of leakage where program costs and program savings are optimized. The City's goal is to reduce and maintain leakage levels at the economic level of leakage for their system⁵.

The City of Guelph has adopted the International Water Association/American Water and Wastewater Association Water Audit Method – broadly accepted as the Best Practice - to manage the level of non-revenue water. The International Water Association/American Water and Wastewater Association Water Audit Method allows water utilities to assess non-revenue water levels in their system compared to established benchmarks. Please see Appendix A for more information on the City of Guelph's Water Balance Report.

Based on the trend of historical water production and demand rates (Figure 5) non-revenue water rates have declined from an average of 7.6 million litres per day in 2006 to just 4.8 million litres per day in 2014 – a reduction of 2.8 million litres per day.

- **Reduction in Daily Non-revenue Water Rate: 2.8 million litres per day**

⁵ It is not possible to eliminate all leakage in a water supply system. The Economic Level of Leakage is the term used for the level of leakage below which it costs the municipality more to eliminate than it would recover in cost savings.

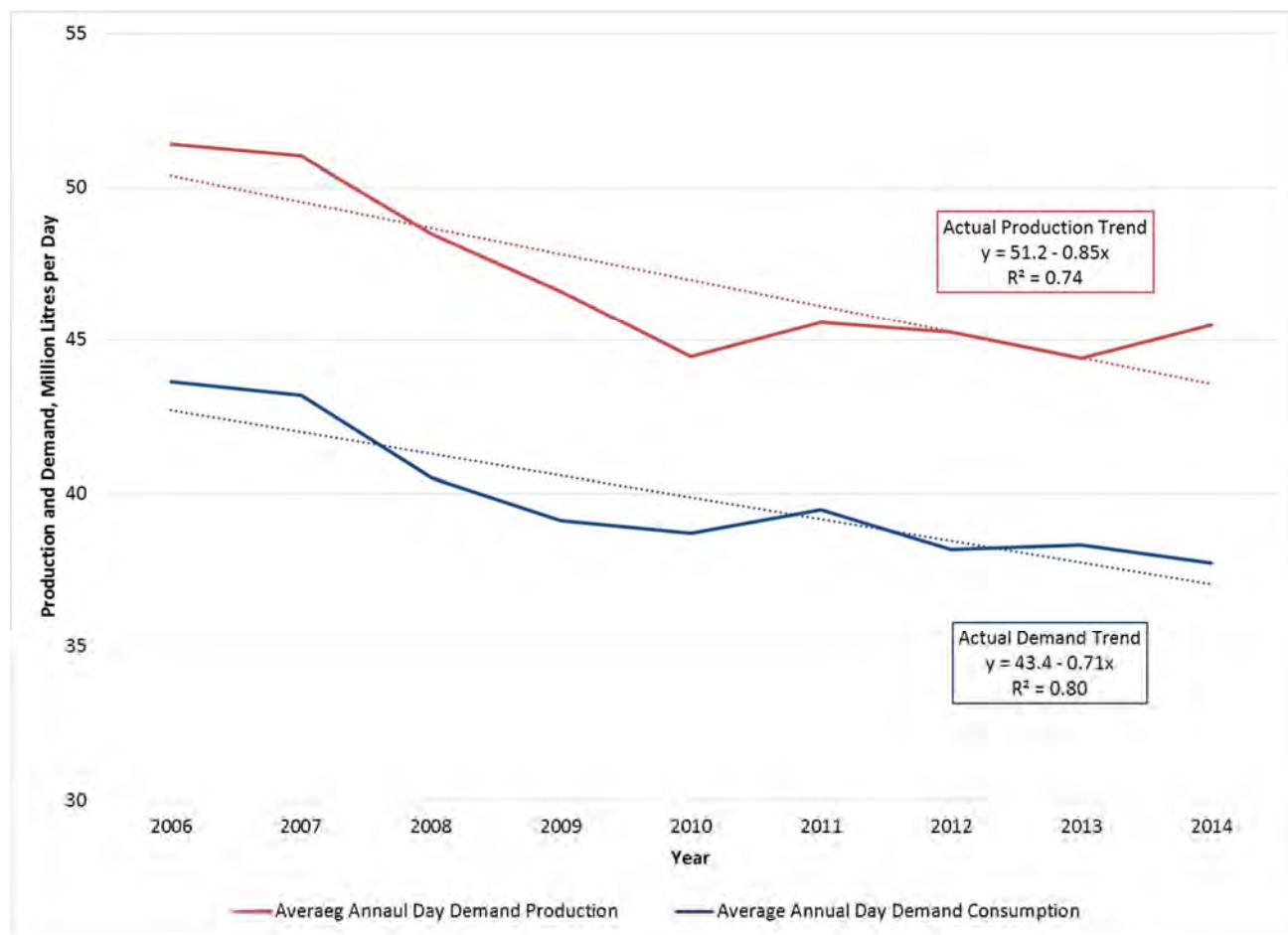


Figure 5: Trend lines for Historical Average Annual Day Production and Demand

5.0 QUANTIFICATION OF PROGRAM SAVINGS

The City actively tracks the volume of annual water savings achieved by the implementation of programs included in their water efficiency strategy. Between 2006 and 2014 the City estimates that their programs (not including reductions in system leakage) have reduced the average annual daily demand rate by 3.82 million litres per day.

Reductions in water loss must be assessed in a different way because as existing leaks are repaired, new leaks are forming. Reductions in water loss are assessed based on the difference between production and consumption (demand) values, with a declining differential between these values indicating a reduction in water loss. Based on this methodology it is estimated that the City has reduced the average level of leakage by about 2.8 million litres per day since 2006. Savings related to lower leakage levels are reflected in reduced non-revenue water rates and lower infrastructure leakage index values (see section 5.5).

- **Overall Reduction in Daily Production (2006 – 2014): 13.5 million litres per day**
- **Overall Reduction in Daily Demands (2006 – 2014): 9.70 million litres per day**
- **Reduction Achieved by Water Efficiency Programs (2006 – 2014): 3.82 million litres per day**
- **Reduction Achieved by Water Loss Reduction Program (2006 – 2014): 2.80 million litres per day**
- **Total Reduction Achieved by City (2006 to 2014): 6.62 million litres per year**

5.1 *Gross Demand Savings*

Between 2006 and 2014 gross per capita demands in the City declined by an average of 10.2 litres per capita per day per year (based on the linear trend), with a high R^2 values of 0.93. This total savings is divided between savings in the residential customer sector (including low density, medium density and high density housing) and savings in the industrial, commercial, and institutional customer sector (including miscellaneous non-residential accounts). As presented in Figure 6, residential demands have declined by about 6.5 litres per capita per day per year and industrial, commercial, and institutional demands have declined by about 3.7 litres per capita per day per year.

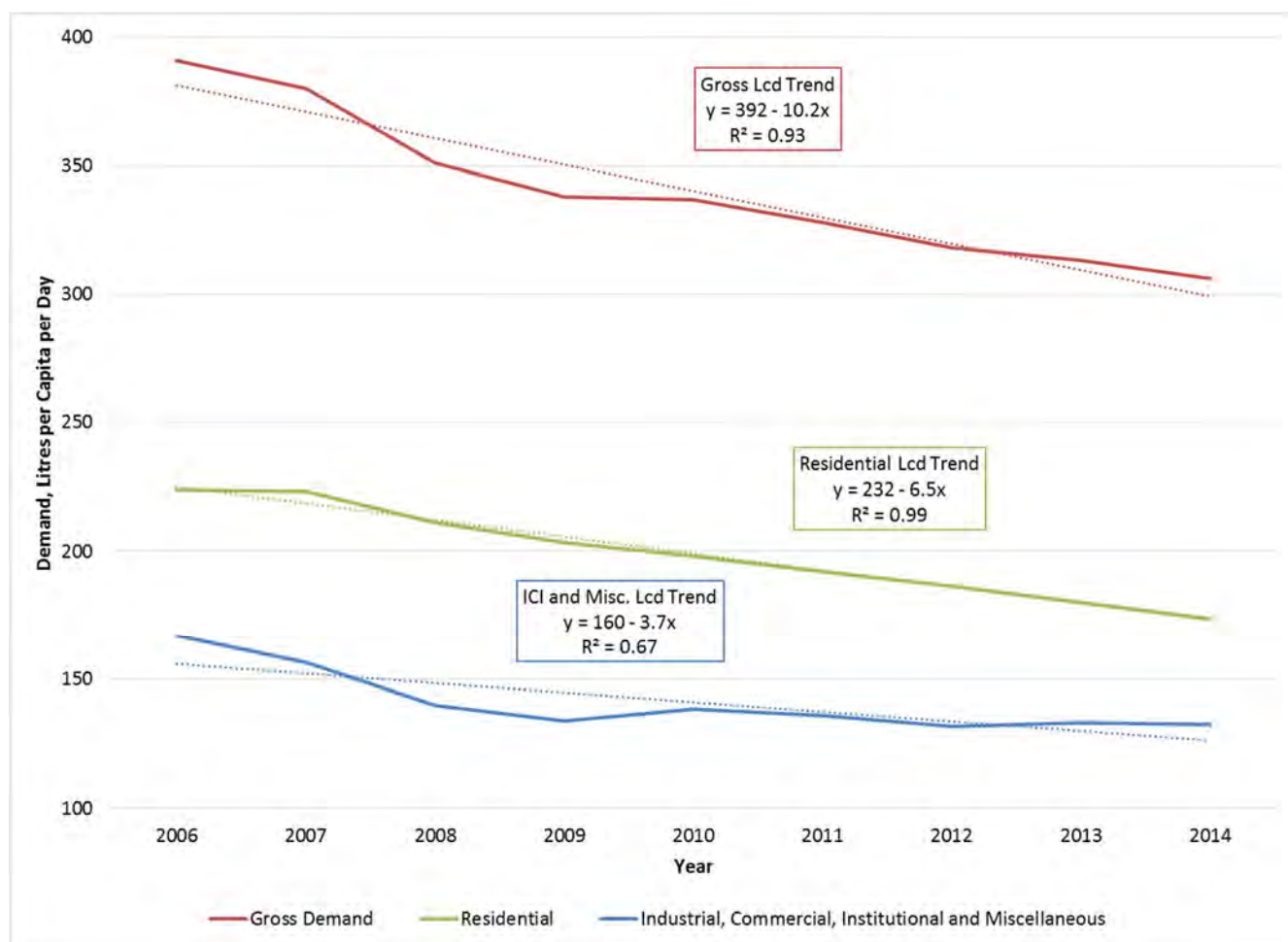


Figure 6: Per Capita Demand Trends for Gross, Residential and Industrial, Commercial, Institutional and Miscellaneous

5.2 Residential Demand Savings

The reduction in Guelph's residential water demands of about 6.5 litres per capita per day per year has been the result of the effectiveness of the City's water efficiency measures (direct savings) combined with changes to the Ontario Building Code and the impact of the recent marketplace shift towards more efficient plumbing fixtures and appliances (natural savings), and a growing public awareness of the need to use our natural resources wisely (indirect savings). Since the introduction of the United States Environmental Protection Agency's WaterSense® program in 2006, the focus of most plumbing fixture manufacturers has been on developing water-efficient products. As such, most toilets, showerheads, and faucets available in the marketplace are efficient models. The United States Environmental Protection Agency's ENERGY STAR® program has had a similar impact regarding the efficiency of clothes washers and dishwashers available in the marketplace. Largely because of the improved efficiency of plumbing fixtures and appliances available in the marketplace there has been a decline in per capita residential water demands across North America. As stated earlier, it is estimated that the current rate of natural indoor residential savings is about 2.7 litres per capita per day per year. For this reason, the City expects to modify its Royal Flush rebate program by the end of 2016

to only provide rebates for toilet models flushing with 4.0 litres⁶ or less (versus 4.8 litres currently) and to sunset its Smart Wash clothes washer rebate program completely by the end of 2016.

5.2.1 City's Residential Program Savings

Since 2006 the City's residential-based water efficiency programs have saved an estimated **2,418 cubic metres per day (2.42 million litres per day)**. As shown in Table 1 and Figure 7, about 96 percent of the total residential water savings is attributed to just two programs - the Royal Flush toilet rebate program (80 percent) and Smart Wash clothes washer rebate program (16 percent).

Table 1: Water Savings for Residential Programs (Cubic Metres per Day), 2006 – 2014

Year	Royal Flush	Smart Wash	Multi-residential	Floor Drain	Humidifier	Blue Built Home
2006	39.7					
2007	72.3					
2008	179.4	30.7				
2009	262.6	59.3	35.0			
2010	339.1	82.1	34.6	0.1	0.6	
2011	380.7	71.4		0.7	5.4	1.2
2012	306.4	48.4		0.4	2.4	1.7
2013	178.0	52.7			2.0	0.9
2014	185.7	44.1			0.3	0.1
Sub Total	1,943.8	388.8	69.6	1.2	10.7	4.0
Grand Total	2,418					

Savings from the multi-residential audits provided 3 percent of the savings, while efficient humidifiers, floor drains, and Blue Built Homes combined for less than 1 percent of the total residential savings. Residential programs have provided 64 percent of the estimated overall water savings from conservation programming (51 percent from the Royal Flush program alone). Table 2 shows the amount of participation per program per year for residential programs. As illustrated in Figure 7, the Royal Flush Program has garnered the majority of participation each year. The remaining 12 percent of total participation in residential programs was for Healthy Landscapes with 2,146 participants.

⁶ While 4.8-litre toilet models are popular in retail outlets (80 percent of the 3,348 residential toilet models listed on the [www.map-testing](http://www.map-testing.com) website are WaterSense® fixtures flushing with a maximum of 4.8 litres. There are currently 175 different models listed on the www.map-testing.com website that flush with 4.0 litres or less (MaP PREMIUM) and this number continues to grow.

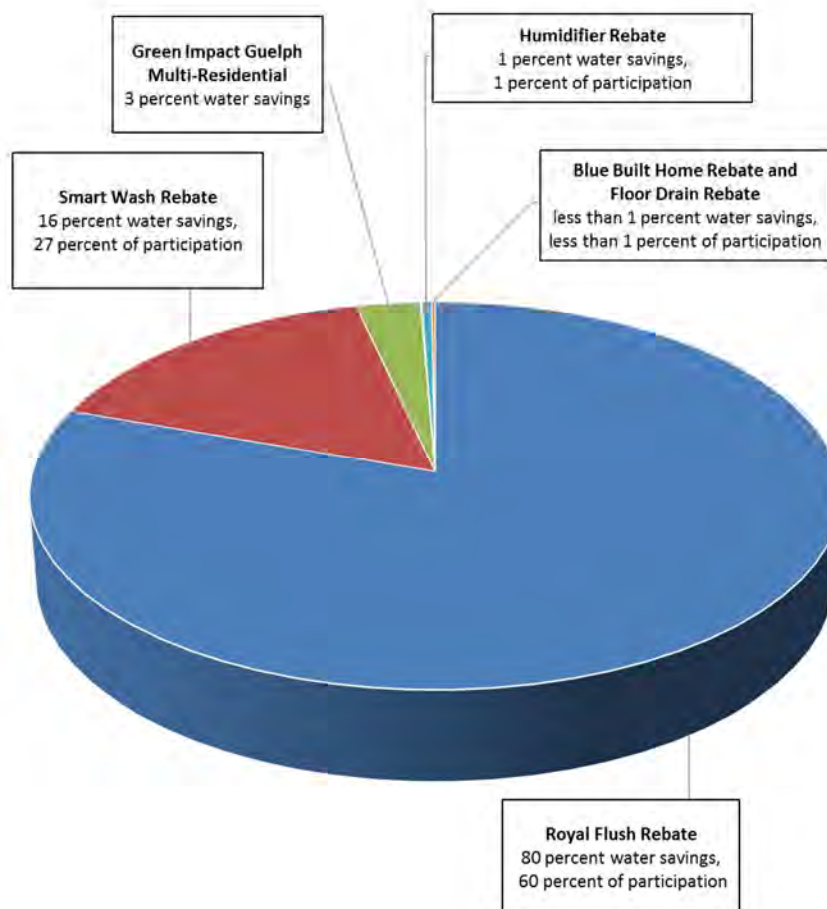


Figure 7: Residential Water Savings and Participation, 2006 – 2014

Table 2: Residential Program Participation per Year, 2006-2014

Year	Royal Flush	Smart Wash	Humidifiers	Floor Drains	Blue Built Home Bronze	Blue Built Home Silver	Blue Built Home Gold	Healthy Landscapes
2006	422							
2007	587							
2008	683	279						216
2009	1532	886						481
2010	2232	970	5	1				295
2011	839	783	45	11	8	1	0	272
2012	1956	595	21	8	12	1	0	321
2013	1297	666	17	0	7	0	0	312
2014	1177	662	3	0	1	0	0	249
Total	10725	4841	91	20	28	2	0	2146

Beginning on January 1, 1996, the Ontario Building Code began requiring new homes to be fitted with toilets that flushed with no more than 6 litres versus 13.25-litre fixtures allowed prior to this date. With a population of about 95,821 in 1996 and approximately 0.8 residential toilets per person there would have been an installed base of approximately 76,650 inefficient toilets in Guelph in 1996 (American Water Works Association, 1999). Based on an expected average life-cycle of 25 years for residential toilets, approximately 4 percent of the City's inefficient toilets – about 3,066 fixtures – would be replaced each year. By the end of 2015 it is estimated that approximately 80 percent of the 1996 base of inefficient toilets (about 61,320 fixtures) would have been replaced as part of the natural change-out process. Of course, not all of these fixtures would have been replaced with more efficient 6-litre models, especially during the first decade when there was some question about the level of performance offered by efficient toilet models. By 2006, however, the toilet fixture marketplace was clearly shifting to a preference for 6-litre and even 4.8-litres toilets, largely in response to the growing impact of the United States Environmental Protection Agency's WaterSense® program. Between 2006 and 2014 the City of Guelph provided 17,151 rebates as part of their Royal Flush program⁷. As such, almost half of the estimated total number of residential toilet change-outs in the City between 2006 and 2014 (based on a 4 percent change-out per year) received a Royal Flush rebate.

While clothes washers are not covered by the Ontario Building Code, there has been a significant growth in market share of water- and energy-efficient clothes washer models – including both front-loading and top-loading models – over the last 10 to 15 years, largely in response to the growing impact of the United States Environmental Protection Agency's ENERGY STAR® program. Based on a clothes washer life-cycle of 14 years (Yalanovsky, 2015) it is expected that about 1,600 residential clothes washers would be replaced each year in Guelph, or about 11,200 machines replaced between 2008 (first year of the City's Smart Wash program) and 2014. Between 2008 and 2014 the City actually provided 5,380 Smart Wash rebates. As such, almost half of the estimated number of residential clothes washer change-outs between 2008 and 2014 received a Smart Wash rebate.

5.3 *Industrial, Commercial and Institutional Demand Savings*

While some level of natural savings are expected in the industrial, commercial and institutional customer sector as existing customers replace old fixtures and equipment with newer, more efficient models and new facilities are constructed with efficient equipment, there is no documented estimate of at what rate this natural savings would be expected to occur. Because industrial, commercial and institutional customers often only replace existing inefficient equipment with new efficient equipment if there is a favourable payback period (typically less than two years), it is very likely that Guelph's Capacity Buyback program – which provides rebates to reduce payback periods – has had a significant impact on reducing water demands in the industrial/commercial/institutional customer sector.

5.3.1 City's Capacity Buy Back and Pre-Rinse Spray Valve Program Water Savings

Since 2008 the City's Capacity Buy Back and Pre-rinse Spray Valve programs have saved **1,288 cubic metres per day (1.29 million litres per day)** – or about 34 percent of the total conservation programming savings. Almost all of the savings (98 percent or 1,264 cubic metres per day) was achieved by the Capacity Buy Back program

⁷ Another 1,075 rebates had been provided between 2003 and 2006.

while about two percent (24 cubic metres per day) was achieved by the Pre-rinse Spray Valve program. Despite water savings, the Pre-rinse Spray Valve program was discontinued due to market saturation from previously existing Union Gas program that the City parted with during the two year run.

The following table highlights the organizations that have participated in the Capacity Buyback Program and implemented water efficient measures during the reviewed time period (Table 3). The water saving were based on the measured water consumption at each site before and after implementation of the water-efficiency measure.

Table 3: Capacity Buyback Water Savings (2006 – 2014), Cubic Metres per Day

Participant	2007	2008	2009	2010	2011	2012	2013
Cargill		209					79
Elliot Community			25.4				
University of Guelph	311.9		67.3				102
Gay Lea				19.5			
Sleeman			91.6				
AOC					10.3		
GGH					29.6	42.9	
Metalumen					13.4		
MF Property Management						12.6	
Blount						30	
Polycon						158.2	
Homewood							4.4
Hammond							54.7
ProMinent							2.2
Sub Total	311.9	209.0	184.3	19.5	53.3	243.7	242.3
Grand Total	1,264						

5.4 *Water Loss Management*

Based on historical production and demand data, between 2006 and 2014 the City reduced water loss in the system by **2,800 cubic metres per day (2.8 million litres per day)** (i.e., from an average of 7.6 million litres per day in 2006 to only 4.8 million litres per day in 2014).

One of the most important elements of the Water Audit Method is the calculation of the system's Infrastructure Leakage Index – a ratio of the Current Annual Real Losses in the system to the Unavoidable Annual Real Losses. A system with an Infrastructure Leakage Index value of 1.0 would have no unavoidable leakage; a system with an Infrastructure Leakage Index value of 2.0 would theoretically be able to reduce their leakage level by half.

Guelph's current (2014) Infrastructure Leakage Index value is 1.59, much lower than the 3.01 value in 2006. A declining Infrastructure Leakage Index value indicates that the City is reducing the level of avoidable leakage in their system (Refer to Section 2.9 for measures taken by the City of Guelph to reduce leakage). Table 4 presents historical Infrastructure Leakage Index values in Guelph between 2006 and 2014. Note that because as existing leaks are discovered and repaired, new leaks are forming, Infrastructure Leakage Index values will fluctuate from year to year.

Table 4: Infrastructure Leakage Index Values

Criteria	2006	2007	2008	2009	2010	2011	2012	2013	2014
Infrastructure Leakage Index Value	3.01	2.94	3.3	3.37	3.42	2.68	1.95	1.65	1.59

Table 5 presents the banding/rating system introduced in 2005 by the World Bank Institute into their non-revenue water training manuals to help assess system performance. While Guelph would have been classed in Band B from 2006 to 2011 with Infrastructure Leakage Index values between 2 and 4, since 2012 the City has moved up to Band A with Infrastructure Leakage Index values of less than 2.0. The City's goal is to reduce and maintain leakage levels at the economic level of leakage level for their system – estimated to correspond to an Infrastructure Leakage Index of about 1.50.

Table 5: World Bank Institute Target Matrix for Infrastructure Leakage Index

Infrastructure Leakage Index Range	Band	General Description of Real Loss Management Performance Categories for Developed and Developing Countries
1-2	A	Further loss reduction may be uneconomic unless there are shortages; careful analysis needed to identify cost effective improvement.
2-4	B	Potential for marked improvements; consider pressure management, better active leakage control practices, and better network management.
4-8	C	Poor leakage record, tolerable only if water is plentiful and cheap; even then, analyse level and nature of leakage and intensify leakage reduction efforts.
>8	D	Very inefficient use of resources; leakage reduction programs imperative and high priority.

5.5 *Municipal Facility Upgrades*

The City chose to lead by example and retrofitted the City facilities listed in Table 8 to achieve water savings. The retrofits have amounted to water savings of **110 cubic metres per day (0.11 million litres per day)**. Upgrading municipal facilities between 2006 and 2014 has contributed about 3 percent of the estimated overall water savings from conservation programming. Table 6 presents the cumulative savings related to municipal facility upgrades.

Table 6: Municipal Facility Water Savings (2006 – 2014), Cubic Metres per Day

City Facility	2010	2011	2012	2013	2014
West End Rec Centre	20				
Victoria Road Pool	9				
Exhibition Arena	14				
Police Services		1.1			
Sleeman Centre		5.8			
Library, Main Branch			0.95		
Norm Jary Splash Pad				50	
Transit Building					9
Total	43	6.9	0.95	50	9
Grand Total	110				

5.6 *Public Education and Outreach Programs*

It is difficult to quantify program savings for the City's education and outreach programs: Outside Water Use Program, Healthy Landscapes, eMERGE Home Visits, Resources for Youth, and the Water Conservation and Efficiency Public Advisory Committee, though these programs are expected to contribute to the indirect program savings.

6.0 OVERALL PROGRAM EVALUATION

6.1 Progress towards 2006 Water Supply Master Plan Target

The 2006 Water Supply Master Plan target to reduce the average annual day production to 54,187 cubic metres per day through Water Conservation Programming by yearend 2014 (Figure 8). In 2014 Guelph's actual average annual day production was only 45,463 cubic metres per day, or 9,433 cubic metres per day lower than the target. From a combination of direct, indirect and natural savings the City has achieved and surpassed the target and has well positioned itself to achieve the more aggressive water savings target set by the 2014 Water Supply Master Plan Update.

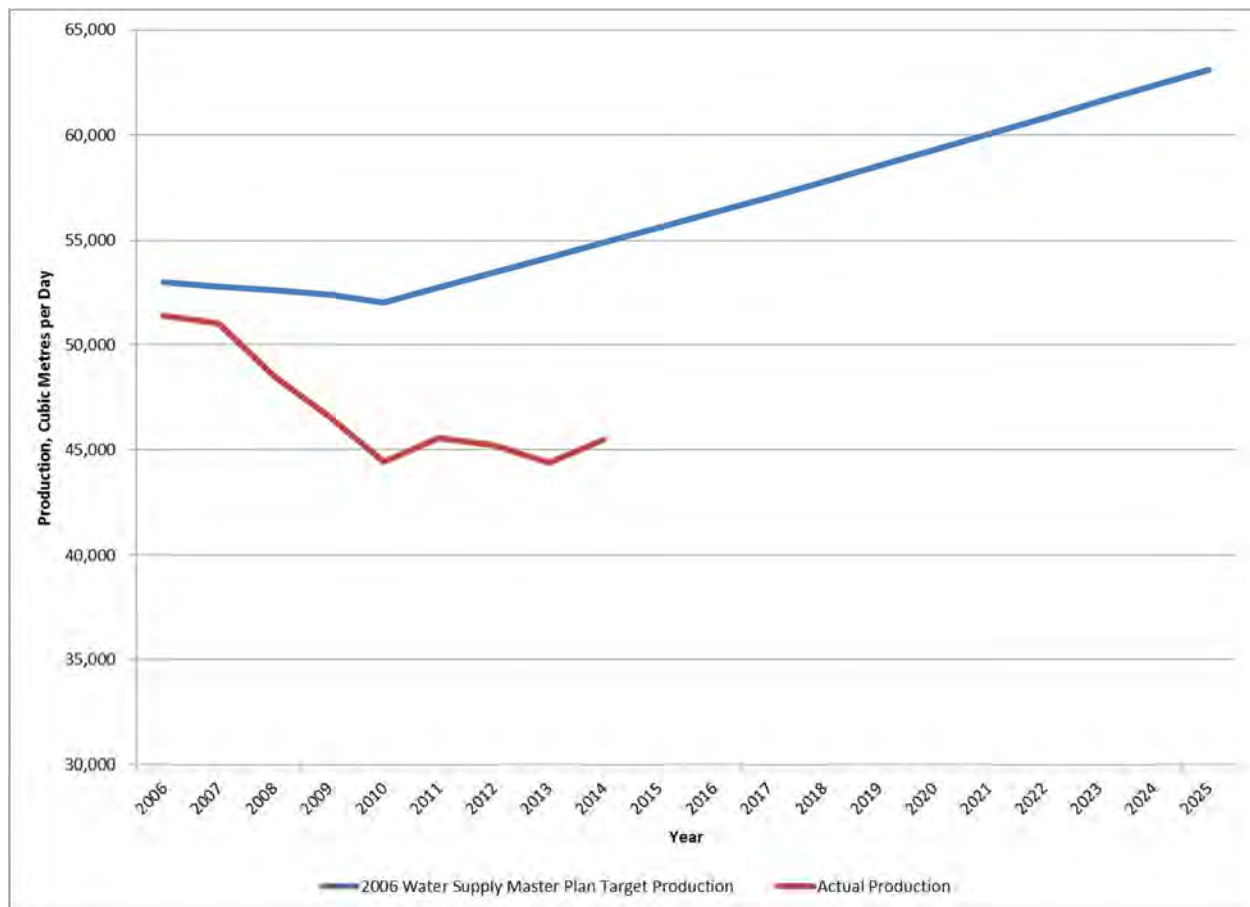


Figure 8: Projected and Actual Production

6.2 Update on the Community Energy Plan Goals

Beyond targets of the 2006 Water Supply Master Plan, the City of Guelph Community Energy Plan had recommended several long-term goals including that ***“Guelph will use less energy and water per capita than comparable Canadian cities”***. Water savings have contributed to Guelph progressing towards this goal as well. The average annual day production rate in 2014 was 353 litres per capita per day compared to 447 litres per capita per day in 2006, a savings of 21 percent.

6.3 *Progress towards 2009 Water Conservation and Efficiency Strategy*

The 2009 Water Conservation and Efficiency Strategy recommended a 10-year plan to meet the targets outlined in the 2006 Water Supply Master Plan. Table 7 below shows the target savings from the 2006 Water Supply Master Plan and the estimated actual program water savings. While not all sectors had reached their target water savings, overall program water savings surpassed the 2009 target by an additional 1.37 million litres per day (1,370 cubic metres per day). It should be noted that the total reduction in water production rates (including all direct, indirect, and natural savings) by 2014 was 13.5 million litres per day.

Table 7: Target and Estimated Actual Water Savings, Million Litres per Day by 2014

	Planned Water Savings	Estimated Water Savings
Residential	2.96	2.42 ⁸
Water Smart Business	0.57	1.29
Water Loss Management	1.73	2.80
City retrofits	0.00	0.11
Total	5.25	6.62

6.4 *Program Saturation Estimates*

As programs are offered year after year, a discussion regarding anticipated saturation points becomes necessary in order to determine whether a program should either transition to reflect marketplace change or end, and make funding available for new opportunities of promise. It is expected that no program will ever achieve 100 percent saturation, however estimating the potential for participation in programming does allow for prudent water conservation planning.

6.4.1 Blue Built Homes and Healthy Landscapes

Guelph's population is expected to grow from 128,726 in 2014 to 175,000 in 2031 – an increase of about 36 percent (The City Of Guelph, 2001). This strong growth would suggest that the Blue Built Program could have an impact on the Guelph marketplace. Healthy Landscapes will also continue as a program since the program can be applied to both existing and future housing.

6.4.2 Royal Flush

The North American toilet industry is heavily influenced by American fixture manufacturers. The United States Energy Policy Act of 1992 (United States Government, 1992) mandated that, as of January 1, 1994, all toilets sold in the United States must flush with no more than 1.6 gallons or 6.0 litres. On January 1, 1996 the Ontario Building Code began requiring all toilets installed in new construction to flush with no more than 6 litres (prior to this date 13.25-litre toilets were allowed; in 2011 the Province banned the sale of 13.25-litre toilets). In 2006 the United States Environmental Protection Agency launched their WaterSense® water-efficient product labeling program – a voluntary but highly influential program that only certified toilet fixtures that flushed with 4.8 litres or less. In anticipation of the WaterSense® program, toilet manufacturers began focusing on the development of 4.8-litre fixtures by 2004 and since the launch of the WaterSense® program in 2006

⁸ Value includes natural water savings.

manufacturers have focused almost exclusively on developing models that flush with 4.8 litres or less. Currently, 79 percent of all toilet models listed on the www.map-testing.com website are certified to WaterSense® (i.e., flush with no more than 4.8 litres) and this percentage continues to grow. The Ontario Building Code was revised in 2012 to require all toilets installed in new construction to flush with no more than 4.8 litres beginning in January 2014. While, it is becoming increasingly more difficult for consumers to purchase inefficient toilet fixtures, the City will continue to offer rebates for all WaterSense® certified toilet fixtures that flush with 4.8 litres or less as part of their Royal Flush Program.

6.4.3 Smart Wash

A 2014 ENERGY STAR® presentation states that more than 60 percent of industry shipments in recent years have been ENERGY STAR® washers (Environmental Protection Agency, 2014). A Consumer Reports article states that market share of ENERGY STAR® washers increased from about 4 percent in 1997 to 64 percent in 2010 (DiClerico, 2013). A recent internet search of Big Box stores identified that 75 percent (42 of 56 models) of clothes washer models currently carried in Lowes are ENERGY STAR® certified with a similar percentage carried by Home Depot.

Because the marketplace for clothes washers is clearly moving towards more efficient machines, it is recommended that the City of Guelph cease to offer rebates to customers installing efficient clothes washers as part of its Smart Wash program at the end of 2016.

7.0 NET PRESENT VALUE SINCE 2006

The City estimates that it would cost \$4.68 per litre per day of capacity to expand their water and wastewater infrastructure. Since 2006 the City water efficiency programs have reduced demands by 3.82 million litres per day with an associated value of \$17.9 million (\$4.68 times 3.82 million litres per day). The City's water loss reduction program has reduced demands by about 2.8 million litres per day with an associated value of \$13.1 million (\$4.68 times 2.8 million litres per day).

As shown in Table 8, each program can be evaluated separately to determine which program delivered the greatest value. Program costs were provided by the City and did not include the City staff cost (operation and salaries). Costs were inflated based on the Canadian yearly inflation rate released by Statistics Canada (Statistics Canada, 2015).

Table 8: Net Present Value for Programs, 2006 - 2014

Program	Cubic Metres per Day Saved	Present Value Cost (\$)	Present Value Benefit (\$)	Net Present Value (\$)	Benefit/Cost Ratio
Royal Flush	1,944	\$1,206,244	\$9,096,886	\$7,890,642	7.5
Smart Wash	389	\$461,268	\$1,819,397	\$1,358,129	3.9
Green Impact Guelph Multi-Res	70	\$86,446	\$325,728	\$239,282	3.8
Floor Drain	1.2	\$1,791	\$5,635	\$3,844	3.2
Humidifier	10.7	\$4,837	\$50,100	\$45,263	10.4
Blue Built Home	3.9	\$12,996	\$18,645	\$5,649	1.4
Water Smart Business	1,264	\$710,369	\$5,916,080	\$5,205,711	8.3
City Retrofits	110	\$257,415	\$514,098	\$256,683	2.0
Leakage	2,800	\$929,151	\$13,104,000	\$12,174,849	14.1
Total	6,615	\$3,670,517	\$30,850,569	\$27,180,052	8.4

All programs resulted in a benefit to cost ratio above 1 which concludes that all programs provided an increased value per dollar spent.

8.0 CO-BENEFITS

While the potential to save money by deferring or downsizing infrastructure expansion projects is often one of the primary drivers for communities to implement water efficiency programs, there are also many other co-benefits to the municipality, such as reducing operational costs and greenhouse gas emissions. And, of course, customers that reduce their water demands will save money on their water bill and sometimes (if the saved water is heated) they can also save on their energy bill. While water and wastewater treatment plants are designed based on capacity (the volume they are able to treat per day), the magnitude of operational, greenhouse gas emissions, and energy savings to the municipality and customer is related to the total volume of water saved over time.

Table 9 shows the total volume of direct savings for each of Guelph's programs on an annual basis between 2006 and 2014. Table 10 shows the total cumulative savings as well as the estimated percentage and total volume of hot water savings associated with each program. Some programs (e.g., Royal Flush program) have no associated hot water savings.

Table 9: Direct Annual Savings, Cubic Metres per Year

Year	Royal Flush	Smart Wash	Green Impact Guelph	Floor Drain	Humidifier	Blue Built Home	Municipal Retrofit	Capacity Buyback
2006	14,491							
2007	26,390							113,844
2008	65,481	11,206						76,285
2009	95,849	21,645	12,775					67,270
2010	123,772	29,967	12,629	37	219		15,695	7,118
2011	138,956	26,061		256	1,971	438	2,519	19,455
2012	111,836	17,666		146	876	621	347	88,951
2013	64,970	19,236			730	329	18,250	88,440
2014	67,781	16,097			110	37	3,285	
Total Volume								1,384,025

Table 10: Cumulative Water Savings and Hot Water Savings, Cubic Metres -

Cumulative	Royal Flush	Smart Wash	Green Impact Guelph	Floor Drain	Humidifier	Blue Built Home	Municipal Retrofit	Capacity Buyback
Water Savings	3,082,900	569,948	139,795	1,643	13,177	4,307	129,374	2,405,496
							Total Volume	6,346,638
Percent Hot Water	0	30	35	0	0	5	5	5
Hot Water Savings	-	170,984	48,928	-	-	215	6,469	120,275
							Total Volume	346,871

8.1 *Energy Savings*

The City recorded an average operational and maintenance cost of \$0.18 per cubic metre for its water supply (2013) and an average cost of \$0.14 per cubic metre for wastewater (2011). Of course not all of the operational and maintenance costs are directly related to system output. For example, energy used for lighting, computer and supervisory control and data acquisition systems, heating, and some internal pumping is not affected by the volume of water or wastewater treated. An energy study conducted by the Polis Project (Maas, 2009) outlined the various energy intensity factors for the different aspects of the municipal water cycle including source water extraction, water treatment, wastewater collection, and wastewater treatment based on the plant size and source of water supply.

The energy savings achieved by reducing water demands in Guelph can be calculated by multiplying the energy intensity factor identified in the Polis report for each component in the City's water use cycle by the total volume of water saved. For Guelph, the municipal energy (indirect) costs were calculated using the following energy intensity values from the Polis report for a large (i.e., greater than 500 cubic metres per day) well-based system:

- Source water extraction and treatment: 0.47 kilowatt-hour per cubic metre
- Water distribution: 0.17 kilowatt-hour per cubic metre
- Wastewater collection: 0.06 kilowatt-hour per cubic metre
- Wastewater treatment: 0.04 kilowatt-hour per cubic metre

As such, a total Energy Intensity Factor of 0.74 kilowatt-hour per cubic metre will be used to assess energy and Greenhouse Gas emission savings when both water and wastewater pumping are involved (e.g., for programs that affect indoor water use) and an Energy Intensity Factor of 0.64 kilowatt-hour per metre cubed will be used when only water pumping is involved (e.g., for irrigation programs and leak detection programs). Reducing water demands will also reduce the amount of chemicals required for water treatment⁹ and, therefore, the

⁹ Chemical use in wastewater treatment is largely dependent on the biological loading that is not affected by lower water demands. As such, no savings in embedded energy has been assigned to lower wastewater volumes.

energy used to produce these chemicals. This energy is referred to as embedded energy and the Polis report identifies the embedded energy factor water treatment as 0.01 kilowatt-hour per cubic metre of water production. Reducing energy demands also reduces greenhouse gas emissions. In Ontario the greenhouse gas coefficient is 0.27 kilograms of carbon dioxide equivalent¹⁰ per kilowatt-hour of energy produced. Table 11 presents the indirect and embedded energy savings (based on the current cost of \$0.12 per kilowatt-hour), as well as the greenhouse gas savings achieved by Guelph through the implementation of their water efficiency programs.

Table 11: Municipal Energy and Greenhouse Gas Savings from City Programs

Water Saved, Cubic metres	Indirect Energy Megawatt-hours	Embedded Energy, Megawatt-hours	Total, Megawatt-hours	Cost per Megawatt-hour	Municipal Savings	Carbon Dioxide Equivalent Reductions, Tonnes
6,346,638	4,671	63	4,735	\$120	\$568,151	1,278

It is also estimated that the City has reduced non-revenue demands by about 2.8 million litres per day since 2006. Over this period it is estimated that the total volume of water saved through the City's leak detection and repair program is about 3,675,116 cubic metres. Because there are no wastewater savings associated with reducing leakage, the energy co-efficient for leakage savings is 0.64 kilowatt-hour per cubic metre of water saved. Table 12 presents the energy and Greenhouse gas savings achieved by the City's water loss reduction program.

Table 12: Municipal Energy and Greenhouse Gas Savings from Water Loss Reduction

Leakage Saved, Cubic metres	Indirect Energy Megawatt-hours	Embedded Energy, Megawatt-hours	Total, Megawatt-hours	Cost per Megawatt-hour	Municipal Savings	Carbon Dioxide Equivalent Reductions, Tonnes
3,675,116	2,352	37	2,389	\$120	\$286,659	645

As stated above, water efficiency measures that involve heating water not only save water but energy as well – for example, the Smart Wash program (efficient clothes washers save both cold water and hot water). This energy savings is referred to as direct energy savings for the customer. The percentage and volume of hot water savings is presented in Table 10 above. It has also been estimated that it requires approximately 8 cubic metres of natural gas to heat 1.0 cubic meters of water by 55 degrees Celsius (using a water heater efficiency

¹⁰ Equivalent carbon dioxide is the concentration of carbon dioxide that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas (e.g. methane, perfluorocarbons and nitrous) (Maas, 2009)

of 75 percent) (Abraxas Energy Consulting, 2016), that 5.3 tonnes of carbon dioxide equivalent are produced for every thousand therms of natural gas burned (Environmental Protection Agency, 2015), and that the current marginal cost for natural gas in Guelph is about \$0.20 per cubic metre. Table 13 shows the energy and greenhouse gas savings achieved by customers during the 2006 to 2014 study period.¹¹

Table 13: Customer Energy and Greenhouse Gas Savings from City Programs

Heated Water Savings, Cubic metres	Natural gas savings, Cubic metres	Cost Savings, Customers	Natural gas savings, Therms	Carbon Dioxide Equivalent Reductions, Tonnes
346,871	2,774,971	\$554,994	998,990	5,297

¹¹ It is assumed that virtually all City customers have natural gas water heaters.

9.0 COST PER CUBIC METRE SAVED

The cost of the water saved from 2006 to 2014 averaged \$1,313 per cubic metre or \$1.31 per litre (Table 14). The City estimates that it costs about \$4.68 for every litre per day of supply capacity they add to their system. Therefore the cost of water efficient programming has been cost-effective in extending the operational horizon for the existing system.

Table 14: Cost per Cubic Metre Saved, 2006 - 2014

Year	Total Annual Program Costs	Average Daily Water Savings (cubic metres)	Cost of Savings (cost per cubic metres per day)
2006	\$434,475	40	\$10,862
2007	\$303,666	384	\$791
2008	\$319,869	419	\$763
2009	\$799,788	541	\$1,478
2010	\$1,046,585	519	\$2,017
2011	\$1,327,831	1358	\$978
2012	\$1,391,042	909	\$1,530
2013	\$1,412,708	917	\$1,541
2014	\$1,622,311	1505	\$1,078
2006 - 2014	\$8,658,276	6592	\$1,313

10.0 CONCLUSION

The total reduction in production rates (including customer savings and reduced water loss rates) between 2006 and 2014 is 13.5 million litres per day. The total demand reduction between 2006 and 2014 equalled 9.7 million litres per day. Between 2006 and 2014 overall demands declined by 10.2 litres per capita per day. This demand reduction is divided between the residential customers (6.5 litres per capita per day per year) and Industrial/Commercial/Institutional customer sectors (3.7 litres per capita per day per year, based on the residential population).

During the last decade there has been a significant shift in the marketplace towards more efficient toilet and clothes washers. As a result of this shift, residential per capita water demands are declining across North America. In fact, based on the results of detailed multi-year residential monitoring completed in various North American cities between 1999 and 2014, the expected natural rate of decline in indoor residential water demands (due to the market shift to more efficient fixtures and appliance) is 2.7 litres per capita per day per year. This annual decline in residential water demands is expected to continue, albeit possibly at a lower rate, until average demands reach approximately 150 litres per capita per day. Because of the impact of this 'natural' decline in demands, it is recommended that the City ceases its Smart Wash rebate program by the end of 2016.

The City will continue to offer its Capacity Buyback program to industrial, commercial, and institutional customers with the rebate amount recommended to increase from its current level of \$0.30 per litre per day of saving to \$0.75 per litre per day of savings. The higher rebate level will help reduce the payback period even more for facilities implementing water efficiency measures and still possesses great value to the City. It is hoped that the higher rebate rate will influence further business customers to participate in the program.

The City of Guelph has operated a successful program in regards to both water and cost reduction. Even though the City's population has increased over the analyzed timeframe, production volumes and customer demands have decreased. Over the period of 2006 to 2014, the City's programming has contributed to those reductions with an estimated direct savings of 3.82 million litres per day. The City's system water loss reduction program has also reduced leakage by an estimated 2.8 million litres per day, for a total reduction in production rates of 6.62 million litres per day.

With a total program cost (including leak reduction) of approximately \$8.7 million and an estimated benefit of approximately \$31.7 million, the City's water efficiency strategy has proven to be very cost-effective.

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Appendix A – Water Balance Report



CITY OF GUELPH

2006 to 2014 IWA Water Audit and Water Balance Results

Final Report

Julie Anne Lamberts

August 2015

Summary of Gathered Data

IWA Water Balance Totals	2006	2007	2008	2009	2010	2011	2012	2013	2014
Annual Water Pumped (m³)	18,756,338	18,616,944	17,772,368	17,739,851	17,677,837	17,378,451	16,559,330	16,220,762	16,695,678
				Propellor meter pumpages were replaced with the more accurate magnetic meters' pumpages for Woods Station.					
Source Meter Inaccuracies (m³)	174,434	173,138	+ 358,292	- 117,693	- 94,206	- 49,086	+ 35,119	- 122,526	+ 5,924
Bulk Water Supply Export and Import (m³)	0	0	0	0	0	0	0	0	0
Billed Metered Consumption (m³)	15,923,355	15,763,551	14,783,455	14,171,873	14,088,084	14,372,548	14,168,469	13,919,074	14,440,136*
				(Data grossly adjusted from billed use to actual use; seasonal meters added)					
Billed Unmetered Consumption (m³)	15,912	20,800	0	0	38,555	29,615	0	0	0
					Ice rinks billed.				
Unbilled Metered Consumption (m³)	0	44,652	94,920	111,767	59,673	1,872	0	0	17,302
Unbilled Unmetered Consumption (m³)	53,973	71,930	49,775	73,098	56,120	101,957	178,489	169,756	212,874

Unauthorised Consumption (m³)	94,653	93,950	45,327	44,055	43,959	43,323	41,486	40,246	41,754
			Formula was corrected.						
Number of Customer Meters	35,400	36,500	37,706	38,364	39,208	40,052	40,603	41,233	41,644
Customer Meter Inaccuracies (under registering)	4.63%	4.63%	4.30%	4.30%	4.30%	4.30%	4.30%	4.30%	4.30%
Length of Network – Mains (km)	506.1	517	532	531.5	531.6	547	544.6	539.2	548.3
			Aquaduct excluded and Gazor-Mooney is included.						
Avg. Length of Services (Curb Stop - Customer Meter)	9.8 m	9.8 m	9.8 m	9.8 m	9.8 m	9.8 m	9.8 m	9.8 m	9.8 m
Pressure in Distribution System	42 m	42 m	42 m	42 m	42 m	42 m	42 m	42 m	42 m
Financial Data - Customer Rate per m³ water only; per m³ water and wastewater	\$0.690	\$0.75	\$0.82 \$1.70	\$0.97 \$2.02	\$1.07 \$2.22	\$1.17 \$2.43	\$1.30 \$2.71	\$1.38 \$2.90	\$1.43 \$3.02
Water Production Cost per m³		\$0.1316	\$0.142	\$0.144	\$0.1775	\$0.1727	\$0.1803	\$0.1788	\$0.2066

<i>Variable Production Cost per m³ of water</i>	\$0.0612	\$0.0612	\$0.0608	\$0.0629	\$0.0660	\$0.0691	\$0.0689	\$0.0766	\$0.0896
<i>Fixed Production Cost per m³ of water</i>	\$0.1277	\$0.1277	\$0.0812	\$0.0821	\$0.1115	\$0.1036	\$0.1113	\$0.1022	\$0.1169
Total Annual Cost of Operating Water System	\$3,542,937	\$2,449,681	\$2,574,512	\$2,555,072	\$3,120,837	\$2,992,942	\$2,991,197	\$2,878,250	\$3,450,163

IWA Software Analysis

Parameter	Value								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Current Annual Real Losses (CARL) (ML)	2,069	2,073	2,488	2,580	2,661	2,134	1,569	1,670	1,304
Unavoidable Annual Real Losses (UARL) (ML)	688	705	755	765	778	796	805	813	822
Infrastructure Leakage Index (ILI)	3.01	2.94	3.3	3.37	3.42	2.68	1.95	1.65	1.59
System Input Volume (ML)	18,931	18,790	18,130	17,622	17,584	17,329	16, 594	16,098	16,702
Revenue Water (ML)	15,939	15,784	14,783	14,171	14,127	14,402	14,169	13,919	14,440
Non-Revenue Water (ML)	2,992	3,001	3,347	3,450	3,457	2,927	2,426	2,179	2,262
Volume of Non-Revenue Water - % of System Input Volume	15.8%	16.0%	18.5%	19.6%	19.7%	16.9%	14.6%	13.5%	13.5%

NOTES:

Data from 2008 to 2012 was reviewed and updated entirely in March 2014.

DEFINITIONS:

- Source Meter Inaccuracy – positive numbers indicate an under-registry, while negative numbers indicate over-registry.
- Billed Metered Consumption – 2006 to 2013 all values determined by converting revenue dollars to volume. Therefore, any back-billing for meters not registering is included, however, rate changes that occurred in March within years of new Council were not incorporated.
*2014 value determined using the actual consumption as indicated in the Hydro Meter Reading Database, as this value is more accurate due to the unbilled metered water use resulting from Frozen Services in 2014. This value does not include any back-billing for meters not registering as the volume of water associated with this is not available, revenue MAY BE available and if so, I'll use this to convert into volume based on rate – awaiting response from Hydro via Annette (May 8, 2015; May 22,2015).
- Current Annual Real Losses includes Water Supplied - Authorized Consumption – Unauthorized Consumption – Customer metering inaccuracies – Systematic data handling errors. The last three components of this equation make up the “Apparent Losses”.
- Unavoidable Annual Real Losses value comes from the AWWA software. It is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today’s best technology could be successfully applied. It takes into consideration length of mains, number of service connections, total length of customer service lines, and pressure in the system.
- System Input Volume = Annual Water Pumped – Source Meter Inaccuracies
- Revenue Water = Billed Metered Consumption + Billed Unmetered Consumption
- Non-Revenue Water = Unbilled Metered Consumption + Unbilled Unmetered Consumption + Unauthorized Consumption + Customer Metering Inaccuracies + Systematic Data Handling Errors + Real Losses
- Volume of Non-Revenue Water - % of System Input Volume = Non-Revenue Water / System Input Volume