



INFORMATION REPORT

TO: Chair and Members Public Works Committee	WARD(S) AFFECTED: CITY WIDE
COMMITTEE DATE: April 18, 2011	
SUBJECT/REPORT NO: High-Efficiency Toilet Replacement Program (PW11032) - (City Wide) (Outstanding Business List Item)	
SUBMITTED BY: Gerry Davis, CMA General Manager Public Works Department	PREPARED BY: Dan McKinnon (905) 546-2424, Extension 5941 Shane McCauley (905) 546-2424, Extension 1020
SIGNATURE:	

Council Direction:

On January 18, 2010 Public Works Committee directed staff:

“To investigate the implementation of the high-efficiency toilet replacement program, separate from the Water Efficiency Master Plan and to bring a report back to the Committee”.

In response to this direction staff conducted an analysis to identify the costs and benefits of implementing such a program in Hamilton.

High Efficiency Toilet (HET) Replacement Programs are undertaken throughout a number of municipalities to encourage residents to install water efficient toilets in their homes. These programs encourage water conservation and in some cases have the effect of deferring capital works where system capacity is limited or additional source water is unavailable. Water efficient toilets are units that use 6.0 litres of water per flush or less whereas HET use 4.8 litres of water per flush or less. It is not unusual to see existing toilet stock in a community such as Hamilton that uses approximately 15.0 litres of water per flush and as a result the replacement of these units can have a significant effect on water consumption.

Generally these programs involve the provision of a rebate to the resident when they install a high efficiency toilet. Rebates differ in value sometimes related to the value of capital works being deferred, but generally in the range of \$50 to \$100 per toilet.

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Background

As directed by Public Works Committee on January 18, 2010 staff investigated the implementation of a High-Efficiency Toilet (HET) Replacement Program, separate from the Water Efficiency Master Plan to determine the benefits and cost of such a program in Hamilton.

Water conservation programs have become more prevalent throughout municipalities as a result of heightened concern for the protection and preservation of water resources. Owners of municipal water systems such as the City of Hamilton have obligations to undertake water conservation programs through Provincial legislation including the Ontario Water Resources Act and the Water Opportunities Act. Additionally the potential benefits of water conservation from a capital expenditure and operating cost perspective have become more relevant due the rising cost of construction, energy and chemicals.

Prior to receiving direction from Public Works Committee and in support of the City's obligations to establish water conservation and outreach programs, Water and Wastewater Operations hosted a one-day pilot project to gain an understanding of what a program might look like in Hamilton and to support a financial analysis with real Hamilton data.

The one day toilet sale took place in November of 2008 at three Home Depot locations throughout Hamilton. The partnership with Home Depot was established through a request for proposal process and the sale occurred in conjunction with the grand opening of the new Home Depot location on the east mountain.

The essence of the event was for residents of Hamilton who purchased a toilet during the pilot from an approved list to receive a rebate from the City. A total of 711 toilets were sold to 528 individual property owners during this single day event. Rebates ranged from \$60 for HET (4.8 L) and \$50 for a Low Flow (6.0 L) toilet. Total value of rebates provided through this single event was approximately \$38,000.

Subsequent to the event a water consumption profile was established for a sample of participants and their water consumption was tracked over a period of time to determine the actual effect on water consumption as a result of the toilet replacement. A discussion of this analysis is presented later in this report. Additionally a survey of participants was undertaken to understand attitudes about these types of programs and specifically this event. The data used for this analysis is compiled from the 2008 pilot project.

Water and Wastewater Operations undertakes education and outreach initiatives to achieve a number of goals including raising awareness with respect to the protection and preservation of our water resources, the safety and reliability of our municipal water system and the value of clean, safe drinking water. As part of this outreach program and prior to Committee direction respecting High Efficiency Toilet programs staff in Water and Wastewater undertook a one day water efficient toilet rebate pilot project.

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The following analysis includes a discussion of a variety of aspects of the high efficiency toilet program and includes the following:

- Inventory of existing toilet stock
- Pilot Project experience
- Potential to defer capital works
- Potential impact on operating costs
- Direction of the Marketplace
- Survey Results
- Summary

Inventory of Existing Toilet Stock

The current inventory of residential toilets within the City of Hamilton is assumed to be approximately 252,000 units. This is based on an industry standard of approximately 2 persons per toilet in communities similar to Hamilton. This number represents the entire community and includes those toilets connected to the City's wastewater collection system and those which are not. For the purposes of this report three different categories of toilets are identified and include:

Table 1

Category	Municipal Water	Municipal Water and Wastewater	Number of Homes
1	No	No	10,000
2	Yes	No	7,000
3	Yes	Yes	235,000

Category 1 - are toilets within homes that are neither serviced by the City's water nor wastewater system (approximately 10,000 toilets).

Category 2 - are toilets within homes that are connected to the City's water system only. This is typically where the home is serviced with municipal water, but uses a septic system (approximately 7,000 toilets).

Category 3 - are toilets that are connected to the City's water and wastewater systems (approximately 235,000 toilets).

On January 1, 1996 the Ontario Building Code began requiring all new homes to be fitted with water-efficient toilets that flush using no more than 6 litres of water per flush (older toilets flush using an average of approximately 15 litres of water per flush). As such, all homes in the City built since 1996 (approximately 33,600 or 14% of existing stock in Hamilton currently have efficient toilets installed.

The average life-cycle of a toilet is about 25 years. Therefore, it can be assumed that a number of toilets currently installed in Hamilton homes built prior to 1985 have been

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replaced with newer models and that a portion of these older fixtures have been replaced with 6-L models. For the purpose of analysis it is assumed that 13% of the original older, inefficient toilets in the City have been replaced with efficient 6-L models and, therefore, about 25% of Hamilton's existing toilet stock is currently efficient. Therefore, it is estimated that approximately 75% of existing toilets or **189,000 units** in the City are inefficient and would be eligible for a rebate program and are assumed to be Category 3 toilets.

Pilot Project Experience

In 2008 Water and Wastewater undertook a rebate pilot project in the form of a one day toilet sale at three Home Depot locations where a total of 711 toilets were sold to 528 individual property owners during this single day event. Rebates ranged from \$60 for HET (4.8 L) and \$50 for a Low Flow (6.0 L) toilets. Total value of rebates provided through this single event was approximately \$38,000. The 2008 pilot project provided that all residents of the City were eligible for the toilet rebate regardless of whether or not they were connected to the City's water and/or wastewater system.

Subsequent to the rebate event staff identified a sample of pilot project participants and analyzed the water consumption patterns of 46 homes both before and after the sale in order to determine the amount of water conserved. The analysis revealed that participants reduced their water consumption by an average of 5 cubic meters per two month period (billing cycle). Extrapolating this over a twelve month period the amount of water conserved would equate to 30 cubic meters per home per year. The average uptake from the pilot project was 1.3 toilets per home.

To extrapolate further it is reasonable to assume that the replacement of each inefficient toilet represents a reduction in water use of approximately 23 cubic meters of water per year. By extension this equates to a reduction in flows to the City's wastewater treatment plant of the same **23 cubic meters of wastewater per toilet per year**.

Potential to Defer Capital Works

In many communities the implementation of a HET rebate program is supported with the business case analysis that demonstrates the long term financial benefit of implementing such a program. Generally the financial benefit is derived through the elimination or deferral of capital expenditures associated with growth. In order to determine whether or not implementing a HET program in Hamilton carried with it the potential for eliminating or deferring capital expenditures an analysis was conducted and is included below.

The potential for capital expenditure elimination or deferral in Hamilton can be associated with the City's water treatment or wastewater treatment facilities as a HET program can affect both processes. Hamilton's water treatment facilities have the capacity to service a population well in excess of the current population and additionally Hamilton is fortunate to have an ample raw water supply (Lake Ontario). As a result, there is little opportunity to defer or eliminate capital expenditures on the water treatment process.

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It is important to note that Hamilton is currently approaching the threshold at which expansion to the Woodward wastewater treatment plant is required to accommodate expected growth. Additionally Hamilton is obliged to respond to regulatory change that requires improved treatment of wet weather flows to the plant as well as commitments to the remediation of Hamilton Harbour.

Staff analyzed the potential impact that a HET program would have with respect to flows received by the Woodward Avenue wastewater treatment facility in Hamilton. Once again previously described assumptions respecting the existing stock of toilets and data compiled from the pilot project were used in this analysis.

In order to calculate the potential impact on flows to the City's wastewater plant the following analysis is based on the replacement of all inefficient toilets within the City in one year. A review of data from the Woodward Avenue wastewater treatment plant revealed that the five year average flow to the plant is approximately 336 million litres or 336 megalitres (ML) per day. Considering that the replacement of an inefficient toilet represents a reduction of flows to the plant of approximately 23 cubic meters of wastewater per toilet per year and the fact that there is believed to be approximately 189,000 of these toilets in the existing stock the analysis is as follows:

- 189,000 inefficient toilets in the existing stock in Hamilton
- Average decline in wastewater flows resulting from toilet replacement - 23 cubic meters per year or 0.023 ML/year
- Average daily flow to the wastewater treatment plant 336 ML/day or 122,640 ML/year

Calculation - $189,000 \times 23 = 4,347,000$ cubic meters per year (4,347 ML/year)

Calculation - $4,347\text{ML}/122,649 = 3.5 \%$

Based on this analysis the opportunity to reduce flows to the Woodward Avenue Wastewater Plant equates to a reduction of approximately 3.5% of the average annual flow to the plant. It is imperative to remember that this analysis is based on replacement of the entire stock of inefficient toilets within the City of Hamilton and is predicated on this occurring in one year.

An additional, critical concept to contemplate in this regard is the issue of hydraulic loadings versus chemical and organic loadings flowing to the wastewater treatment plant. HETs can have a significant affect on reducing hydraulic (liquid) loading to the plant. HETs however have little effect on reducing chemical and organic loadings (solids contained in the liquid) flowing to the plant.

Potential Impact on Operating Costs

Staff undertook an analysis of the potential impact of a HET program on operating costs. In reviewing the cost centres that would be most affected by a potential reduction in water consumption and reduced flows to the wastewater treatment plant it became evident that electricity consumption and the use of chemicals were the two main areas that would be affected by such as program.

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In 2010 the electricity costs associated with operating both the water and wastewater systems in the City was approximately \$9,525,462. Additionally the total cost of chemicals used in both the treatment of water and wastewater in Hamilton was approximately \$2,646,291.

With respect to electricity demand of the water and wastewater systems much of this load is associated with buildings and process equipment that is required regardless of the amount of water production or wastewater treatment and as a result there is not a direct 1-1 relationship between these costs and a potential reduction in consumption or flows. For the purpose of this analysis we assume that the relationship is 2-1 meaning that for every 2% reduction in water consumption and wastewater flows there is a corresponding reduction of 1% in overall electricity required.

Analysis conducted to understand the impact on chemical use in the plant was undertaken as well and revealed a similar relationship as that of electricity. Although it is not absolute the assumption made for this review is that a 2% reduction in water consumption and wastewater flow correlates to a 1% reduction in overall chemical usage on both water and wastewater treatment. This occurs as a result of the fact that chemical usage volumes relate the removal of solids. While HETs reduce hydraulic load to the plant they have little affect on chemical and organic loading to the plant and it is these organic and chemical loadings that drive chemical usage. It is important to remember that these are not exact relationships, but are used for the purpose of demonstrating an order of magnitude for this analysis.

- Annual cost for electricity in 2010 = \$9,525,462
- Annual costs for chemicals in 2010 = \$2,646,291
- Potential reduction in electricity = $3.5\% / 2 = 1.75\%$
- Potential reduction in chemicals = $3.5\% / 2 = 1.75\%$

Calculation - Electricity $\$9,525,461.74 \times 1.75\% = \$166,696$

Calculation - Chemicals $\$2,646,290.86 \times 1.75\% = \$46,310$

Calculation $\$166,695.58 + \$46,310.09 = \$213,006$

Therefore the potential savings from an operational perspective based on the forgoing assumptions equates to approximately \$213,006 per year.

Direction of the Marketplace

The Ontario Building Code began requiring all new homes to be fitted with water-efficient toilets that use no more than 6 litres of water per flush. Although this became a requirement of new construction there remained the opportunity to buy traditional, less efficient toilets from producers and retailers. Since that time there has been a slow, but steady move toward eliminating the production of units that use more than 6.0 litres per flush.

The current direction of the marketplace is toward production and marketing of only water efficient toilets. A number of jurisdictions in the United States including California,

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Texas and Georgia are moving toward banning the sale of toilets that are not HETs. It is becoming increasingly difficult to purchase a toilet that is neither a low flow (6L) nor HET (4.8L) in Canada and the United States. The US Environmental Protection Agency (EPA) WaterSense standard is quickly becoming adopted across North America for toilet performance and as a result the existing stock of inefficient toilets will, through attrition, be replaced with higher efficiency toilets. As a result of the influence of the American market and the work of the EPA it is expected that Canada will soon follow with the same requirements.

Survey Results

After the 2008 sale, staff conducted a follow-up survey with residents who participated in the pilot project. The results of the survey revealed that while residents were enthusiastic about the sale and believe that Hamilton should continue to offer a rebate program only 46% noticed or thought to check for a reduction in their consumption and that 86% of people were motivated to replace their toilet by the rebate not necessarily in an effort to conserve water. With respect to performance of toilets purchased 74% of respondents rated it as excellent while 2% were unhappy with their new toilet. 98% of respondents indicated they would purchase another toilet in future. While the pilot project was very well received there were opinions expressed that an ongoing program would be more user friendly and would eliminate the long lines associated with a single day event.

Summary

The analysis conducted in this report endeavoured to use information that represented real world behaviour as much as possible. To this extent the analysis included usage patterns observed from participants in the pilot project sample. Actual participation in a potential future rebate program is unpredictable and as a result the corresponding impacts to water and wastewater flows are variable. The analysis contained herein provides an order of magnitude and depending on sensitivity the actual costs and impacts may vary.

Considering the information collected from the 2008 pilot project and subsequent analysis, staff has been able to identify relevant information from which to guide committee going forward and has summarized it in the following statements:

- An aggressive and well promoted HET rebate program would likely take 10-15 years to achieve full replacement of all inefficient toilets in Hamilton and would likely require the provision of approximately \$9.5 million in rebates;
- On average a Hamilton homeowner can expect to see a 12.2% reduction in their water consumption by replacing inefficient toilets in their home;
- Replacement of the entire stock of inefficient toilets within Hamilton would require the replacement of approximately 189,000 toilets;
- HET rebate program is unlikely to create a substantial benefit related to capital expenditure or deferral related to the City's water and wastewater systems;

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- Replacement of the entire stock of inefficient toilets in Hamilton will reduce annual electricity and chemical costs by approximately 1.75%.

The analysis above suggests that the implementation of a HET rebate program in Hamilton will have a marginal affect on reducing capital expenditures or operating costs.

Municipalities have an obligation to promote water conservation and environmental protection and the provision of a HET rebate program has become a popular avenue through which to do this. Additionally Hamilton residents regularly advocate for such as program. There is however a trend developing throughout municipalities to reduce or eliminate these programs. This trend results from the fact that low flow and HETs have become the predominant product on the market, fixtures that are not low flow or HET are extremely difficult to find now and as a result incentives to purchase them over less efficient models is no longer required.

The Water and Wastewater Operations Section has a well established education and outreach program that raises awareness of the importance of water conservation and the value of safe, reliable drinking water. This program will continue to support the ongoing trend in the marketplace for high efficiency toilets and the regulations that will demand these fixtures for new homes and rehabilitation projects.