

# BETTER BUILDINGS

Case Study Number 62



## Community Housing Water Efficiency Project Region of Waterloo

### Summary

The Water Efficiency Section of the Water Services Division (Water Efficiency) and the Planning, Housing and Community Services Department of the Region of Waterloo tested 51 Caroma 3 L/6 L (0.6 gal./1.32 gal.) dual-flush toilets in two housing developments in Kitchener.

The toilets saved 37 to 99 L (8.14 to 21.78 gal.) of water per day per housing unit. This is a yearly water and wastewater rate savings of \$23.95 to \$63.86 per unit (2004 rates), depending on location. The estimated payback is between 2.9 and 7.7 years depending on whether a 6 L, 13 L, or 20 L toilet is replaced.

After reviewing the data, Water Efficiency recommended that the Region purchase dual-flush toilets when they replace 13 L (2.86 gal.) or larger toilets if the unit purchase cost is the same as a 6 L (1.32 gal.) toilet. Water Efficiency also recommended the Region continue auditing its housing developments to target inefficient toilets for replacement to maximize water savings.

## Background

The three objectives of the testing were to:

1. Measure the water savings, costs and benefits of installing dual-flush toilets in Region housing;
2. Inventory the number and efficiency of toilets in housing developments and help Housing staff develop a replacement schedule;
3. Report project results.

Veritec Consulting Inc. monitored water savings. A team of University of Waterloo students, led by Jim Robinson, a professor of Environmental Studies, conducted pre- and post-installation surveys and measured original toilet water usage.

## Methodology

In 2003, Water Efficiency chose two metered buildings for the project: a 45-unit, adult-only apartment building and a six-unit, family-townhouse complex.

An open house for residents explained the project and showed them the dual-flush toilets and how they work. Most of the residents felt comfortable with the project, but some were not sure that the toilets would clear the waste with one flush.

Forty-two households—30 apartments and 12 townhouses—were surveyed.

Two teams of students recorded the flush volumes of 42 toilets in both complexes. Observations were made about the general state of plumbing and whether

leaks were evident. At the same time, a survey gathered information about the number of residents in each unit, number of hours a day residents were at home, how well their toilets flushed and what they liked and disliked about their toilets.

A post-installation survey determined what residents liked and disliked about the dual-flush toilets.

Veritec monitored toilet water usage with data loggers. The data loggers were installed on the water meters in both the apartment building and the townhouses. Two weeks of pre-installation and two weeks of post-installation data on toilet water use were collected in order to compare consumption rates.

## Relevant Survey and Anecdotal Findings

The pre- and post-installation surveys showed that:

1. Dual-flush toilets are easy to install.
2. There were more 6 L (1.32 gal.) toilets already installed and functioning properly than originally anticipated.
3. The original toilets ranged from old, leaky 22 L toilets to properly functioning 6 L toilets.
4. Apartment residents felt their original toilets performed “average” to “well” while townhouse residents felt their original toilets performed “poor” to “average”.

5. Residents had varying perceptions as to how much water their original toilet used per flush.

6. Residents accepted dual-flush toilets, were comfortable with the use of the toilet (possibly due to advanced education) and were pleased with the toilet’s performance. There were no negative comments about the dual-flush toilets.

## Water Savings and Cost-Benefit Analysis

Based on results of similar CMHC-sponsored dual-flush projects, the effective flush volume of the dual-flush toilet is 5.4 L (0.99 gal.),<sup>1</sup> when the number of times they are flushed at 3 L (0.66 gal.) versus 6 L (1.32 gal.) is factored in. The duty rate (number of flushes per day) as identified in the *Residential End-use Study* by the American Water Works Association is about five flushes per capita per day.

The total cost for each dual-flush toilet was \$244—a purchase cost of \$189 and installation cost of \$55. The 2004 Kitchener water–wastewater user rate was \$1.7739 per m<sup>3</sup> (35.32 cu. ft.).

<sup>1</sup> Dual-flush studies in Canada and the U.S., for example, CMHC (2002), U.S. EPA/Seattle REUS (2002)

<sup>2</sup> The Region of Waterloo offers a rebate of \$40 for replacing a 13 L (2.86 gal.) or more toilet with a 6 L (1.32 gal.) toilet and \$60 for replacing a 13 L toilet with a 3 L/6 L (0.66 gal./1.32 gal.) dual-flush toilet.

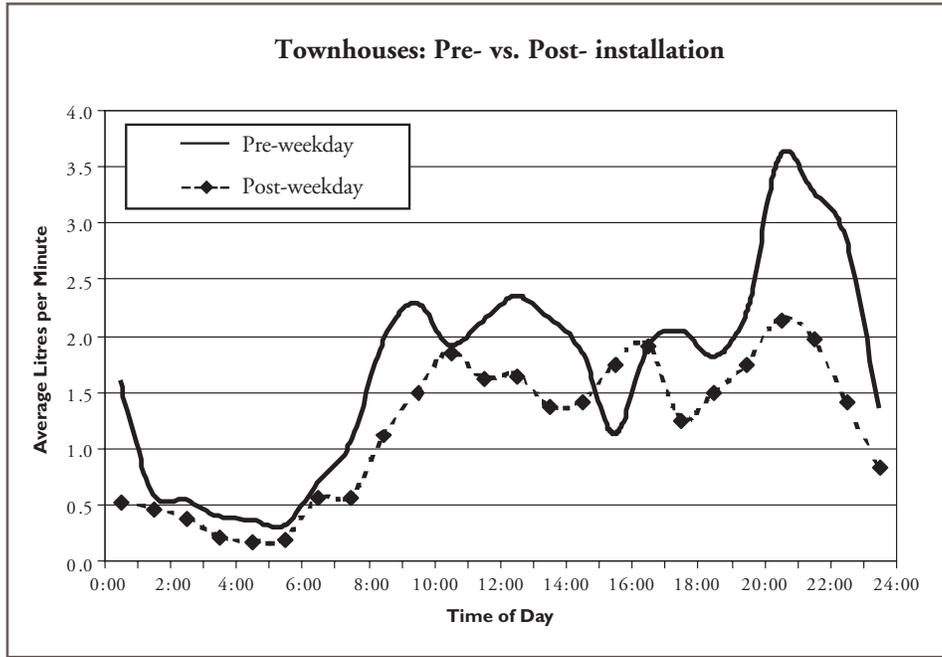


Figure 1—Townhouse weekday water consumption  
Source: Veritec Consulting Inc., June 2003

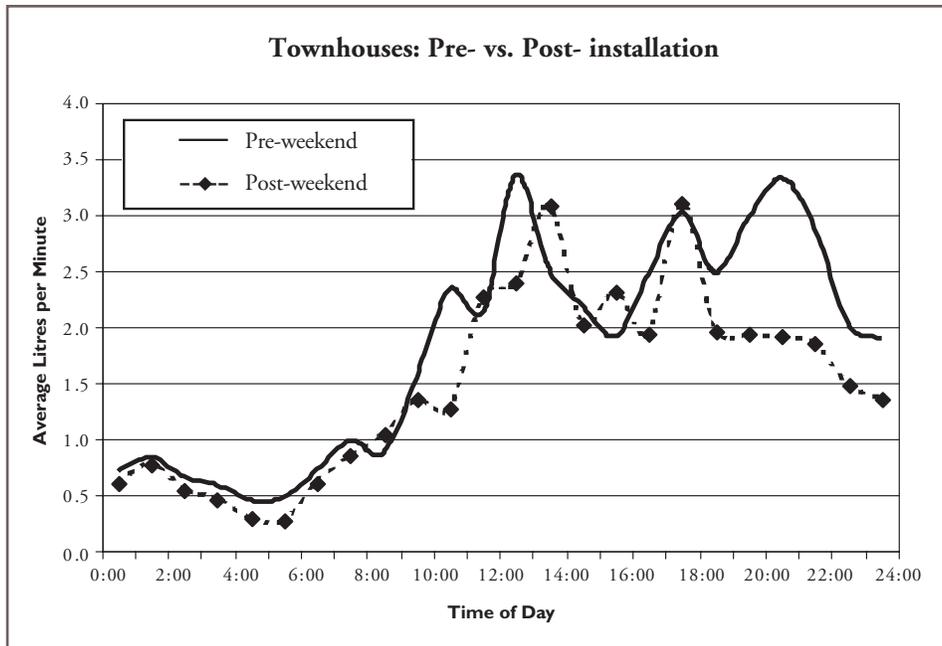


Figure 2—Townhouse weekend water consumption  
Source: Veritec Consulting Inc., June 2003

Townhouse Results

In the townhouse complex, the old toilets averaged 14.8 L (3.26 gal.) per flush. The average number of tenants per unit was 2.67. The results of the water demand monitoring in six townhouses were:

**Average pre-installation water demand**  
419 L/unit/day  
(92.17 gal./unit/day)

**Average post-installation water demand**  
320 L/unit/day  
(70.39 gal./unit/day)

**Savings**  
99 L/unit/day  
(21.78 gal./unit/day—23.6%)  
37 L/person/day  
(8.14 gal./person/day)

This equals an annual savings of 36 m<sup>3</sup> (1,271.33 cu. ft.) or about \$63.86 per unit per year. With the total installed cost of \$244 the payback period would be 3.8 years, or with the Region’s Toilet Replacement Program (TRP)<sup>2</sup> rebate of \$60, 2.88 years.

Figures 1 and 2 are the pre- and post-water demand profiles obtained by data logging the water meter. Figure 1 gives weekday consumption and figure 2 weekend consumption. Water demands peak later in the morning and remain relatively constant throughout the day, indicating many of the tenants may spend a large portion of their time at home.

### Apartment Building Results

In the apartment building, the old toilets averaged 9.92 L (2.18 gal.) per flush (some of the toilets were 6 L [1.32 gal.]) and the average number of tenants per unit was 1.18. The results of the water demand monitoring were:

#### Average pre-installation water demand

273 L/unit/day  
(60.05 gal./unit/day)

#### Average post-installation water demand

236 L/unit/day  
(51.91 gal./unit/day)

#### Savings

37 L/unit/day (8.14 gal./unit/day) 13.6%

31.4 L/person/day  
(6.91 gal./person/day)

This equals an annual savings of 13.5 m<sup>3</sup> (476.75 cu. ft.) or about \$23.95 per unit per year. With the total installed cost of \$244 the payback period would be 10.2 years, or with the Region's Toilet Replacement Program rebate of \$60, 7.68 years. Since a number of the apartment toilets were 6 L, the savings would have been more substantial if only old, high-volume toilets had been replaced.

As figures 3 and 4 show, water demands peak later in the morning and remain relatively constant throughout the day. There is very little difference in the weekday and weekend demand patterns. This indicates that a large portion of the tenants may spend most of their time at home.

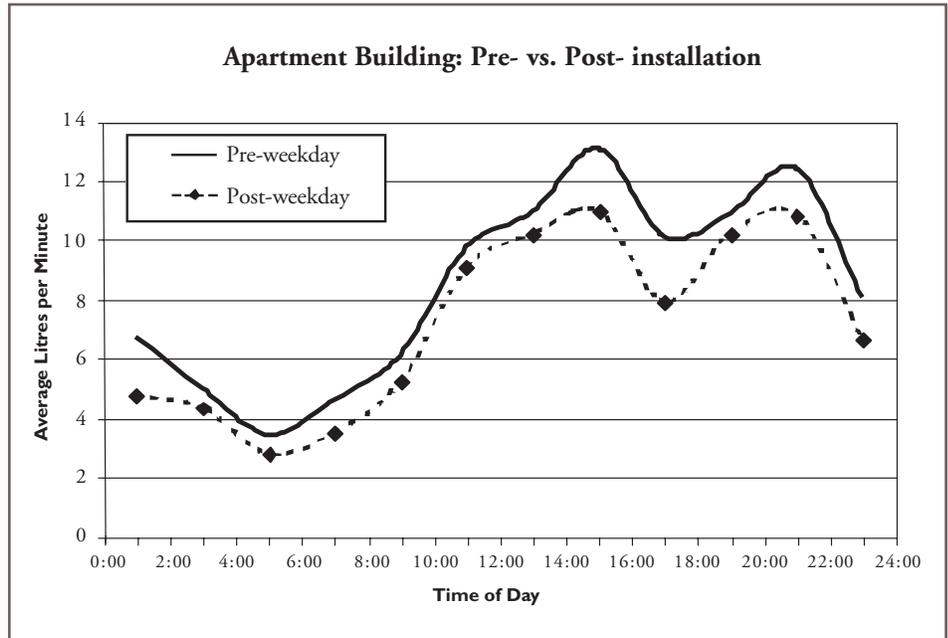


Figure 3—Apartment building weekday water consumption  
Source: Veritec Consulting Inc., June 2003

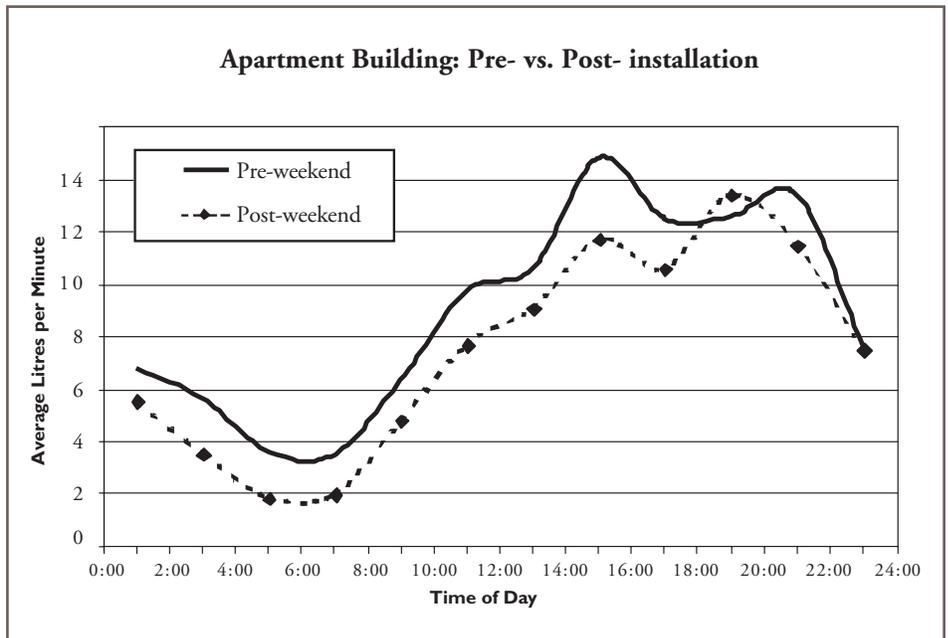


Figure 4—Apartment building weekend water consumption  
Source: Veritec Consulting Inc., June 2003

## Conclusions and Recommendations

Water savings from replacement of inefficient toilets with efficient models is a function of three factors: reduced effective flush volume, duty factor (that is, the number of flushes per day) and reduced leakage. The townhouses saved more water than the apartment building per unit because there were more tenants using each toilet and the average flush volume of the original toilets was greater.

Considering the research findings, Water Efficiency recommended that:

1. The Region use dual-flush toilets for retrofit replacement, if they can be purchased for under \$200 each and if the toilets being replaced are 13 L (2.86 gal.) or larger.
2. Preference should be given to installing dual-flush toilets in high-use developments. This, along with the first recommendation, would cost-effectively maximize water savings.
3. There should be an inventory and audit of the Region's housing to determine and target the most-needed toilet replacements.
4. The Region should refer to the CMHC-sponsored *Maximum Performance Testing of Popular Toilet Models Report* (MAP Testing) for the purchase of any 6 L or dual-flush toilet. See [www.cwwa.ca](http://www.cwwa.ca) for updated reports.
5. The Region should provide educational material to residents before replacing their toilets with dual-flush toilets.



Figure 5—The high-efficiency (HET) Caroma dual-flush toilet used for this project. It uses three litres of water to flush liquid waste and six litres to flush solid waste.

If you have any comments, or  
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