Rain Barrels:
Are They Effective?

Are rain barrels making a comeback?

It seems that some municipalities are now endorsing rainbarrels as a means to:
a) decrease residential irrigation demands,
b) reduce volumes of storm water entering sanitary sewer systems and/or
c) educate/promote water efficient practices.

There are many different types and sizes of rain barrels available. The Region of Waterloo, Ontario alone lists nine different types of barrels on their webpage. Most barrels are made of plastic, weigh between 9 to 15 kg and hold between 190 to 400 litres of rainwater. They are generally fitted with a child-resistant lid, an overflow, a filter or screen, and a hose bibb installed near the bottom of the barrel. Rainbarrels can be quite decorative or very plain, and most range in price between $75 to $150, though some municipal programs subsidize this cost. The City of Ottawa even has a brochure explaining *How to Build Your Own Rain Barrel* with costs in the $30 to $50 range.

But… how much water do rain barrels actually save?
And… how much storm water do rain barrels actually divert?

Decision makers need accurate field data, not simply intuition, anecdotal information, or promotional material to correctly evaluate the potential for water savings or storm water reductions.

An example of the promotional literature from one Ontario rain barrel supplier claims:

- "The 220-litre barrel will 'fill-up' an average of 15 times per month."
- "You will reduce your water consumption by 27,000 litres per growing season."
- At a combined water/sewer cost of $\$0.74/m^3$, you will save about $20 per year and the payback for the $90 barrel is less than 5 years.

These claims would only be true if your growing season were nine months long and it rained every second day (but then, if it rained every second day you wouldn't need a rain barrel).

Municipal Objectives for Distributing Rain Barrels

Improving Water Efficiency

Consider -

1. Rain barrels tend to be full immediately after a rainfall (when the water is not required), and empty after a long dry period (when the water would be useful for watering).
2. Although a 220-litre rain barrel appears to hold a large volume of water, it actually holds the equivalent of about 9 minutes of watering with a garden hose. Most literature states that 25 mm (one inch) of water per week is required to keep a lawn healthy – a 300 m^2 property with 150 m^2 of either lawn or garden would require about *seventeen* 220-litre rain barrels to provide this depth of water.
3. Some home-owners use the collected rainwater as an *additional* rather than an *alternative* source of irrigation water. When used this way, rain barrels will not lower household water bills nor reduce demands on municipal water supply systems.

Reduced Storm Water Runoff

1. A total of 3,000 litres of water falls on a 300 m^2 property during a 10 mm rain event. Collecting 220 litres in a rainbarrel equates to capturing about 7% of this volume. Reducing storm water runoff is generally only a concern during heavier rain events (i.e., events greater than 10mm) when the percentage of captured water would be reduced even further.
2. Rain barrels collect rain that falls on a home's roof. They do not affect rain that falls on sidewalks, driveways, boulevards, and roadways – all of which may all drain to the storm sewers. During significant rainfall events, a rain barrel program may reduce overall storm water runoff by 1% or less.

Educational and Promotional Messages

1. Several behavioural studies have indicated that it is difficult to get people to change their habits. Since watering plants from a rain barrel takes more time and effort than using a garden hose, rain barrels may not always be emptied between rain events.
2. Sometimes rain barrels are distributed by municipalities simply as a water conservation educational tool. In this case they are intended to act as a prompt or a reminder to encourage people to conserve water in their homes and yards, and significant water savings or storm water diversions directly related to rain barrels are not expected.
3. Rain barrels are sometimes used as an incentive to entice participation in programs, such as a downspout disconnection programs. In this case there is little or no water savings or storm water diversion expected directly from the installation of rain barrels.

Considerations for Municipal Programs that Could Further Reduce Potential for Water Savings and Storm Water Diversion

1. The size of barrels used as part of customer 'pick up' programs must be small enough to be transported in an automobile. Although a 400-litre barrel will hold more water than a smaller unit, it is likely too large to fit in most car trunks.
2. Free or subsidized barrels may be undervalued by customers, i.e., people who think that 'the barrel is only worth what it cost' may never actually install it.
3. Barrels that are no longer used or wanted may end up in the landfill or being used for other purposes.

Potential Effectiveness

Table 1 at the end of this paper was created using Environment Canada data for the Waterloo area. The table documents all rainfall events greater than a 'trace' from May to September for the four years from 1998 to 2001. The shaded areas indicate days when rainfall could be captured, i.e., they are preceded by at least two *non-rain* days to allow some time for the barrels to be emptied. At the bottom of each column is the number of potentially captured events in each month.

Calculations based on Environment Canada precipitation data for Waterloo, Ontario (1998-2001) -

- The total average rainfall per 5-month growing season is 365 mm.
- There was an average of 62 rain days per season during this period, but there was an average of only 20.5 *potentially captured* rainfall events per season (about 33%).
- An average of 4.5 m^3 would be potentially captured each year during the growing season using a single 220-litre rain barrel (i.e. 20.5 captured events x 220 litres per capture = 4.5 m^3). Note that based on a roof area of 100 m^2 the total average volume of rain that would fall on the roof each growing season would be about 36.5 m^3 (i.e. 365 mm of rainfall x 100 m^2 = 36.5 m^3).
- At a combined water and sewer cost of $1.00 per m^3 (approximate average of Ontario rates), **the water savings equates to about $4.51 per year**.
- At a cost of $75 per barrel (the cost of an inexpensive rain barrel) ***the payback period is about 16.6 years.*** *(Note*: if the figures referred to in the previously mentioned promotional material are used, i.e., a cost of water of $0.74 per m^3 and a $90 barrel, *the payback period is about 27 years.)*

Although the number and severity of rain events changes from year to year, it appears that achieving a payback of 5 years is extremely optimistic. The payback period of 16.6 years identified in the example above assumes that the rain barrel is used *as effectively as possible* - the savings and associated payback period would be even poorer if the rain barrel is not emptied after each time there are at least two consecutive non-rain days.

Conclusion

Some people ***like*** rain barrels! Perhaps they feel that using a rain barrel is "*doing their part*" to save water. Perhaps they feel that using rainwater on plants is better than using treated tap water.

But … should municipalities distribute rain barrels?
And … will a rain barrel program achieve municipal objectives?

Let's review the municipal objectives for rain barrels.

Water Efficiency: Some rain barrel distribution programs are intended to reduce residential irrigation demands, divert storm water, and/or promote water efficiency. Using Environment Canada data for Waterloo, this paper has demonstrated that the annual water savings achieved by installing a rain barrel, *and using it effectively*, would equate to approximately 4.5 m^3, or a savings of between about $3 to $7 per rain barrel per year on a household water bill.

Storm Water Reduction: The use of rain barrels throughout a municipality may reduce the volume of storm water entering the sanitary sewer system by as little as 1% or less during significant rainfall events.

Education/Promotion: The use of rain barrels to successfully promote water efficiency is up for debate. Homeowners may believe that rain barrels, especially when they are offered as part of a municipal program, are effective tools for saving water and, ultimately, for improving the environment. In reality, even the most successful rain barrel programs may save or divert less than 5 m^3 per barrel per year.

In conclusion, it appears that the actual volume of water savings or storm water retention associated with rain barrel distribution programs may be less than that promoted by rain barrel companies or expected by the public or municipalities participating in rain barrel programs. It is hoped that the information contained in this paper will help decision makers to make more informed decisions regarding their programs.

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Table 1: Rainfall Data in mm from 1998-2001 for Waterloo, Ontario

(Shaded Areas denote a 'Captured' rainfall event)

Day	1998					1999					2000					2001				
	May	June	July	August	September	May	June	July	August	September	May	June	July	August	September	May	June	July	August	September
1	1.2						19.4	4.2			7.9			16.8			5.6	0.6		
2	0.4	2.2			7.8		9.4					2.6	3.0	1.8	18.0		1.2			
3			0.6					1.2	2.2				1.6		6.2		9.2			2.7
4			2.0						4.6							4.2		1.4		
5	0.2			1.8						0.6		7.0		1.2						
6			3.2	16.6		1.4			0.2	57.8		6.0		1.4						
7			6.0	4.8	0.8		0.2		6.0	1.2	5.8	0.2						4.6		
8	0.4		6.2		3.2	3.0			4.6					1.6	3.2	9.1				
9								6.8		2.4	30.0	18.8	22.2	4.6	5.6		1.1		0.4	
10	10.2								3.8		7.0				1.6		6.2	2.0		2.0
11	8.6	6.2									3.6	6.0				0.6	5.2			
12	0.6	9.4			0.3				0.2		42.0	1.2			4.0					
13		3.2							21.6	10.6	2.0	30.0								
14							17.6			0.2		7.4	18.4		10.1					
15				4.4	1.4							0.2	6.2	1.6	7.0		0.7			
16		10.0	0.8								2.4	8.4	0.8		0.2		2.1	1.1	10.3	
17			8.0	1.6			1.0	5.8			1.4	0.2	0.2			2.4	8.0			
18	0.2					10.2					24.2	9.0	0.4	2.0		0.9			1.2	
19			0.4			4.8	0.2	15.6	0.2		2.6						0.4		19.2	14.1
20									4.6	1.2	1.0	4.0	1.0		3.3		2.6		3.2	6.7
21		0.4	1.0									9.4			0.7	6.0	6.2	1.1		44.0
22		0.4	0.2		0.6	0.8					0.2	0.4		10.4	6.0	24.2	4.2	0.3		0.2
23		14.8		4.4		1.0					15.2			7.2	29.2			9.2	0.6	2.6
24				6.0		14.0	4.0	5.8	2.6	5.4	4.6	13.4		0.2	0.4	10.0				0.3
25	12.4	0.8		0.6		4.8	7.4		3.2			17.0				19.6				9.7
26		5.2			0.8	0.2			9.2			5.2		2.2		2.2			0.8	3.8
27			2.0		20.0		20.0							2.0		6.4				0.2
28							0.4	0.4					29.2			2.6			22.1	1.6
29							6.4			35.2		3.6	0.2							
30		22.4			7.6					1.0			9.2				1.0			
31	5.6					2.6		31.2			0.4		5.6							
Events	6	4	3	3	7	4	4	5	3	5	4	2	4	4	3	5	4	5	4	3

Average Rainfall per 5-Month Growing Season = 365 mm

Average Number of Captured Events During 5-Month Growing Season = 20.5

Number of Captured Events x 220-litre Rain Barrel = 4,510 litres per year.

Cost savings @ a cost of water of $1.00 per m^3 = $4.51 per year.

Payback Period for a $75 Rain Barrel = 16.6 years.