Costs and Benefits of Decentralized Water Conservation and Stormwater Measures

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Issue

Decentralized water conservation and stormwater measures promise millions in direct and indirect economic benefits for Montreal

Background

Montrealers rank among Canada's largest water users and wastewater producers, and the city lags behind comparable North American cities in applying best practices in stormwater management. Over 1000 combined sewer overflow events are recorded per year, forcing beach closures and harming aquatic life in the St-Laurent. Today, Montreal is facing high costs for maintaining and upgrading water and wastewater infrastructure, increasing pressure to reduce the environmental impact of wastewater and stormwater releases and an urgent need to address the impacts of climate change on urban drainage.

In recent years, forward-thinking water managers have traded in the traditional supply-side approach to embrace a number of innovative, decentralized technologies that conserve water, increase efficiency and reduce the environmental impacts of water and wastewater services. Small-scale, distributed technologies such as low-flow fixtures, green roofs, permeable paving and downspout disconnection, to name only a few, may in many cases present an effective, cost-efficient, and environmentally sensitive complement or alternative to traditional water and stormwater infrastructure.

The costs and benefits of water efficient measures can nevertheless vary greatly from one locale to another, depending on a variety of factors: natural (ex. precipitation), economic (ex. cost of provision of water and wastewater services) and the built environment (ex. land use).

Key Considerations

An estimation of the costs and benefits of four water efficient measures applicable to Montreal - water-efficient fixtures (toilets, showerheads and faucet aerators), downspout disconnection with rain barrels and raingardens, replacement of asphalt in back alleys with more permeable materials and green roofs – demonstrates that these measures provide a wide variety of environmental and social services, far beyond their primary functions of conserving water and reducing wastewater and stormwater. These auxiliary benefits comprise the majority of the benefits of some of the measures, and are a key aspect of their advantage relative to traditional infrastructure.

The benefits identified for low-flow fixtures, green roofs, permeable paving and downspout disconnection include:

- Reduced cost of potable water production
- Reduced cost of wastewater treatment
- Reduced infrastructure costs
- Energy conservation
- GHG emissions reduction
- Reduced risk of human morbidity and mortality
- Reduced potable water production costs downstream
- Expansion of the outdoors recreation industry
- Increased property values
- Flood protection
- Foundation protection
- Improved habitat and conservation of biodiversity
- Longer roof life

Table 1 shows the economic value of each benefit, calculated for Montreal. Many of the benefits of the measures studied could not be measured with currently available information. However, a review of the literature suggests that several of these benefits may be quite significant and have an important impact on the outcome of a comparison of the costs and benefits of the measures.

For all measures except replacement of paved alleys with permeable pavement, the economic benefits greatly outweigh the costs of implementation. The estimated simple payback period is 10.1 years for water efficient devices, 0.53 years for downspout disconnection, 3.5 years for alley revegetation, 120,000 years for permeable paving of alleys, and 2.1 years for green roofs. Since these calculations do not include all benefits, we can expect that the actual payback periods would be somewhat shorter.

Failing to take into account certain benefits, particularly auxiliary benefits, can significantly bias the results of a cost-benefit analysis of the measures studied. In Montreal, the majority of the economic benefits associated with the use of water-

efficient plumbing fixtures are not related to reduced water production costs but rather cost savings associated with energy conservation and reduced wastewater treatment costs. Similarly, the estimated value of the health benefits of green roofs considerably outweighs the value of stormwater retention.

Recommendations

- In light of this preliminary study, further consideration of use of downspout disconnection, alley revegetation, green roofs and use of water-efficient fixtures in Montreal is warranted. Permeable pavement appears to offer a less promising return on investment than the other measures studied.
- Given that a significant part of the total benefits accrue to the population of Montreal, communicating these potential benefits will be important for effectively generating interest and support for such measures.
- Horizontal linkages with policies and programs in the areas of health, recreation and energy conservation should be developed. Such linkages can further increase support for such measures and can help maximize potential benefits.
- Several key areas for further research stand out. Further study is needed on several potentially significant benefits that cannot be adequately measured with currently available information: health benefits of green space and water quality, protection against flooding, protection against foundation damage and the impact on property values. A more thorough study of potential costs is also necessary.
- The City of Montreal should also explore strategies to encourage uptake of the measures, such as:
    - Introducing metering and volume-based pricing in the residential sector where cost-effective, such as in new constructions, major renovations and residential buildings that already have water meters.
    - Offering rebates for water-efficient fixtures or a rebate on property taxes for stormwater management measures.
- While cost-benefit analysis provides a valuable tool for decision-making, decisions should not be based on this alone. The City of Montreal should engage the public to further define priorities in the area of urban water cycle management

Table 1: Economic Value of Benefits

ANNUAL BENEFITS	Economic value	Water-efficient devices	Downspout disconnection	Green alleys (perm. paving)	Green alleys (revegetation)	Green roofs
Potable water conservation	8.56 ¢/m^3 water conserved	$568,700	$30,000			
Wastewater reduction	16.37 ¢/m^3 wastewater reduced	$9,031,500	$2,674,600	$2,500	$86,500	$1,981,800
Reduced infrastructure costs						
Ozonization plant	1.04 ¢/m^3 wastewater reduced	$573,400	$169,800	$160	$5,500	$125,800
Energy conservation						
From reduced hot water use	$1.54/$m^3$ hot water conserved	$23,677,600				
From reduced space cooling	$40,580 per 1% increase in urban green space				$312,500	$4,408,700
Increased insulationof green roof	21.8 ¢/m^2 of green roof					$4,617,500
GHG emissions reduction						
From water and wastewater treatment	0.08 ¢/m^3 water conserved; 0.31 ¢/m^3 wastewater reduced	$225,000	$53,400	$50	$1,600	$37,500
From residential hot water conservation	15.3 ¢/m^3 hot water conserved	$2,346,700				
From reduced space cooling	$1930 per 1% increase in green space				$14,900	$210,200
Increased insulationof green roof	0.78 ¢/m^2 of green roof					$165,600
Health						
Health impacts of air quality	$61.20/hectare green space (particulates); $8.94/hectare ($NO_2$); $17.74/hectare ($SO_2$); $3.44/hectare ($O_3$)				$13,700	$193,300
Health impacts of thermal stress (mortality only)	$6,855,603 per 1% increase in green space				$52,788,100	$728,683,500
Health impacts of proximity to green space	?				?	?
Health impacts of shoreline water quality	?		?	?	?	?
Property values						
Impact of water quality on waterfront property values	?		?	?	?	?
Impact of adjacent green space on property values	?				?	?
Flood protection	?		?	?	?	?
Foundation protection	?		?	?	?	?
Reduced cost of water supply downstream	?		?	?	?	?
Outdoors recreation industry	?		?	?	?	?
Habitat and biodiversity						
Associated with improved water quality	?		?	?	?	?
Associated with additional urban green space	?				?	?
ONE-TIME BENEFITS						
Reduced infrastructure costs						
Ozonization plant	18.19 ¢/m^3 wastewater reduced	$10,034,200	$2,971,500	$2,800	$96,100	$2,201,800
Stormwater retention	$31.45/$m^3$ stormwater managed on-site		$513,677,400	$475,400	$16,616,400	$380,618,000
Longer roof life	$86/$m^2$ green roof					$1,820,686,900