RESEARCH HIGHLIGHT

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Rainwater Harvesting and Grey Water Reuse

INTRODUCTION

Many countries, including some regions in Canada, have a limited amount of water that can be economically delivered to residences as potable water. Limiting factors may be regional, seasonal, remote or urban. They may also relate to the ambient quality of available water and the technology available to treat the water.

To help meet water demand, rainwater harvesting and grey water practices are commonly used in several European countries, as well as some others, whereas they are less frequently employed in North America and effectively prohibited by regulation or custom. To better understand current practices in North America and elsewhere, the Canadian Water and Wastewater Association (CWWA), on behalf of Canada Mortgage and Housing Corporation (CMHC), undertook to review practices involving water reuse in residential and other buildings. This included looking at regulations and standards governing non-potable water.

METHODOLOGY

CWWA distributed a questionnaire to all Canadian provincial and territorial drinking water and plumbing regulators, to the same regulators in all U.S. state and federal jurisdictions and to a wide range of CWWA contacts in other countries. The Association received a total of 48 responses: 6 from Canadian jurisdictions; 8 from U.S. jurisdictions; and 34 from other contacts. Responses came from regulatory bodies, water utilities and water districts.

CWWA also researched information using the Internet; met with several European suppliers of harvesting equipment and town engineers in Belgium, where harvesting is required by state law; and spoke with officials of France's Ministry of Health.

Some Internet sites

The following sites were among those accessed for this research project:

Florida—**www.dep.state.fl.us/water/reuse/index.htm**

California—**www.waterreuse.org**

India, Germany—**www.unep.or.jp/ietc/Focus/RWH2.asp**

10th International Rainwater Catchment Systems Conference, 2001—www.worldwatercouncil.org/download/report_mannheim.pdf

FINDINGS

Research results indicated that rainwater harvesting and grey water reuse are rarely practiced and almost never encouraged or permitted in Canada or the U.S. The exceptions are areas where there is a critical water shortage, notably Florida and California.

In contrast, these practices are used relatively frequently elsewhere, with rainwater harvesting being the more widely practiced of the two and even required in some jurisdictions.

Canada

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HOME TO CANADIANS

Incentives for rainwater installations include subsidies for rainwater tanks, reductions in metered billings and rebates on water barrels for rainwater use in gardens. Only two respondents, from Korea and Tokyo, reported having incentives for grey water reuse installations.

Sanitary use (toilet flushing) and garden irrigation topped the list of uses for both practices. These and other reported uses are shown in figure 1.

Uses	Rainwater				Grey Water			
	CAN.	U.S.	Other	Total	CAN.	U.S.	Other	Total
Potable water uses		1	6	7		1	1	2
Sanitary use (toilet flushing)	1	1	17	19	—	2	10	12
Laundry	1	1	7	9	—	1	—	1
Bathing/showering	1	1	8	10	—	1	—	1
Garden irrigation	4	1	19	24	—	2	12	14
Animal husbandry	1	1	5	6	—	1	2	3
Industrial	1	1	4	5	1	2	1	4
Groundwater recharge	1	1	4	5	—	1	1	2
Golf course irrigation	—	1	—	1	1	1	—	2
Vehicle washing	—	—	—	—	—	—	1	1
Helicopter washing	—	—	—	—	—	—	1	1
Firefighting	—	—	—	—	—	—	1	1

Figure 1 Primary uses of rainwater and grey water

These results show that rainwater and grey water are rarely used for potable water. In fact, many jurisdictions ban this practice, even though individuals may have installed such systems. Regulations for rainwater and grey water reuse vary between jurisdictions. Many require specific water quality parameters or treatment levels. Most require that pipes carrying harvested or recycled water be clearly marked, and cross-connections must be avoided. Plumbing systems for non-human consumption or contact waters are to be completely separate.

In addition to the uses identified in figure 1, other water reuses reported elsewhere include; crop irrigation; ornamental lakes and streams; industrial construction; dust control; street washing/snow melting; and sale to other agencies.

Quality standards range from relatively simple to relatively complex. Generally, if the water is intended for human contact or consumption, it must be treated to fully potable standards. An exception is France, where the technology supply company uses a lesser standard for human contact than for human consumption.

It argues that the water quality required for swimming in environmental waters should be sufficient for the quality of water used for bathing, showering and laundry purposes. In more complex water reuse systems, such as found in California, gradations of quality or treatment are required for human consumption or contact down through non-contact situations to irrigation waters.

Rainwater and grey water practices in North American and other jurisdictions are employed primarily at an individual lot level by residential, commercial, industrial and institutional owners, although some are employed at the community level.

In Florida, reuse has become an integral part of wastewater management, water resource management and ecosystem management. Since the late 1980s, Florida become a national leader, along with California, in water reuse. Approximately 584 million gallons per day (mgd) of reclaimed water were used in 2001. Irrigation of areas accessible to the public represented about 44 per cent of this. The total reuse capacity of Florida's domestic wastewater treatment facilities increased from 362 mgd in 1986 to 1,151 mgd in 2001, an increase of 281 per cent. Current reuse capacity represents about 52 per cent of the total permitted domestic wastewater treatment capacity in Florida. Reclaimed water has been used to irrigate residences, golf courses, parks and schools. In California and Florida, treated wastewater effluents are condition to a reclaimed water quality level and are pumped into aquifers in order to replenish the aquifer or prevent salt water intrusions in coastal aquifers.

Some states in Australia permit grey water to be reused for irrigation if it has passed through a secondary treatment system, such as a reed bed or aerating package plant, and has been disinfected, for example by chlorine tablets, ultraviolet light or ozone treatment. Some state health departments appear to have unjustified concerns regarding grey water reuse, given research on grey water health risk in Australia and the U.S. Regulators are also sometimes unduly concerned about high nutrients in grey water, as research shows these concerns to be unfounded for households that do not use detergents containing phosphates. Local councils can choose to override state regulations, which has occurred in some unsewered areas.

Direct grey water reuse for garden irrigation is being examined by some Australian water authorities as an option for reducing fresh water demands. Significant direct grey water reuse already occurs in Australia, and regulators are working towards recommending specific reuse techniques that minimize health and environmental pollution risks.

France's national health legislation states that all water entering a building from a central water supply is presumed to be potable. Any other water is presumed to be non-potable and not fit for human contact or consumption. There is no leeway for use of non-potable water, with two exceptions: the legislation does not apply to individual homes that are not served from a central system (rural residences); and other buildings, such as schools, can be approved for exemption.

Other legislation in France permits the use of rainwater for certain uses and under certain conditions. Untreated, the water can be used only for external water uses, such as irrigation and automobile washing, or where there is suitable plumbing construction preventing cross-contamination or cross-connections, it can be used inside homes for toilet flushing.

A number of experimental buildings that incorporate rainwater harvesting systems have been constructed in France. Studies have demonstrated unequivocally that such systems can be designed, constructed and implemented with due regard to public and environmental health.

National legislation in Belgium requires all new construction to have rainwater harvesting systems for the purposes of flushing toilets and external water uses. The purpose of this legislation is twofold: 1) to reduce demand for treated water and the expansion of the water supply infrastructure; and 2) to collect and use rainwater instead of surcharging stormwater management systems.

Bangalore is the first city in India to have a rainwater harvesting policy. With an average rainfall of 900 to 970 mm over seven months, and an elevation of 900 MSL, water has to be pumped in from 400 MSL. Pumping costs are enormous and so are power charges. A local non-governmental organization has developed innovative approaches for rainwater harvesting. It has also drafted policy mapping all possible sources for harvesting rainwater. Some other cities in India have rainwater harvesting regulations incorporated into their municipal bylaws, but only for multi-storey buildings. The Bangalore approach proposes to incorporate rainwater harvesting into bylaws for all new construction. Some government buildings will be used for demonstration purposes.

In Europe, Germany leads the way in encouraging widespread utilization of rainwater catchment systems for domestic supply and other purposes. Interest in household rainwater catchment focuses mainly on non-potable uses, such as garden watering, toilet flushing and use of washing machines.

However, Germany has no comprehensive or systematic legislation. Rainwater harvesting legislation is hindered by a general obligation to connect to and use water mains supplied by the local service provider.

CONCLUSIONS

Traditional regulatory practices prohibiting rainwater harvesting or grey water reuse as substitutes for potable water supply are changing. Examples exist in Europe, the Caribbean and other parts of the world that demonstrate the viability of these two water sources as means of meeting water demand. However, there is a marked reluctance on the part of most jurisdictions in North America to consider these options.

Applications of these practices are supported by commercially available technologies. Where these practices and technologies are encouraged by regulations, they are increasingly being used. The incentive may be a lack of alternative water supply, or where available water is not an issue, the cost of publicly supplied water may be encouraging acceptance. In France, it is claimed that an average residential rainwater harvesting system can be fully amortized in less than three years.

In Canada, changes to plumbing codes could open the way for many opportunities to reduce fresh water demand. Reuse of rainwater and grey water would be particularly beneficial in areas facing water shortages.

CWWA recommends that a national working committee be established to develop a comprehensive report on how rainwater and grey water could be used in Canada to ensure adequate access to water. The committee should also consider modifications needed to plumbing and building codes as well as standards for harvesting and grey water re-use treatment systems.

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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