RESEARCH HIGHLIGHT

Technical Series 01-115

Commissioning Guide for the Toronto Healthy Houses Water Systems

INTRODUCTION

The Commissioning Guide for the Toronto Healthy Houses Water Systems is the culmination of a series of reports prepared for Canada Mortgage and Housing Corporation by Blue Heron Environmental Technology. The series deals with the selection, design, regulatory approval and monitoring of the potable water supply and wastewater renovation systems for the Toronto Healthy Houses.

CMHC's Healthy House in the heart of the city of Toronto is one of the winners of CMHC's national Healthy Housing Design Competition to promote environmentally responsible housing. This project resulted in the building of two adjoining houses—one completely independent of municipal servicing and the other connected only to the electrical power grid. Both houses have completely independent, on-site potable water supply, wastewater reclamation and ground disposal systems.

Both houses use treated rainwater and melted snow that fall on their roofs and ground patios for drinking, food preparation and dishwashing. Through a separate plumbing system, reclaimed renovated wastewater supplies water for toilet flushing, bathing, showering, clothes washing and hot water heating.

To achieve water and energy conservation, the houses use low-flow toilets, water-conserving showerheads, taps and faucets, efficient dishwashers and clothes washers, and greywater heat utilization. Depending on the house, solar panels with a back-up co-generator or electricity from the municipal service heat the hot water.

DESCRIPTION OF THE PUBLICATION

The Commissioning Guide for the Toronto Healthy Houses Water Systems consists of three parts:

Part 1: Description of the Toronto Healthy Houses Water Systems;

Part 2: Operational Maintenance Considerations for the Toronto Healthy Houses Water Systems; and

Part 3: Toronto Healthy Houses Occupant Guidelines.

Part 1: Description of the Toronto Healthy Houses Water Systems

Part 1 provides a detailed overview, with accompanying photographs and schematics, of each component of the potable water, wastewater and renovated water-treatment systems. It includes the associated water and energy conservation features.

- Potable water treatment

  Potable water for each house is obtained from a groundwater collection system consisting of three roof surfaces, two ground patios, collection piping and a 20 m^3 (4,400 gal.) concrete cistern. In the cistern, limestone imparts alkalinity to the collected water.

  The total catchment area is about 80 m^2 (860 sq. ft.). The total roof area of approximately 55 m^2 (590 sq. ft.) is divided into a top flat area of 24 m^2 (258 sq. ft.) a back sloping area of 22 m^2 (237 sq. ft.) and a front sloping area of 9 m^2 (97 sq. ft.). (Conversions to imperial measurements are rounded up.)

  Two landscaped patio areas covered with a textured concrete collect ground-level rainwater. The north side of the upper patio wall has a wall drainage system that directs groundwater to a collection drain terminating in a sump in the front yard.

  Rainwater collected from eavestroughs and upper and lower patios is carried by pipes to the respective cistern inlet catch basin. A small

pump then directs the stored water to a combined slow sand activated carbon adsorber for filtration and ultraviolet disinfection.

The treated water is stored in a concrete tank beneath the basement floor. From there, it is pumped out on demand by a Grundfos "three-in-one" wall-mounted JetpaQ pumping system and re-disinfected for use at the potable water taps and in the dishwasher.

On sunny days, the water is heated by two lower glycol circulating solar panels located on the south side of the roof. On dull days, a separate heat exchanger connected to the stand-by cogenerator heats the hot water tank in the off-grid house. In the other house, electricity from the power grid heats the water when required. The hot water tank is located under the counter in the second floor bathroom.

- Greywater heat recovery

In each house, the plumbing system includes two greywater heat recovery units. One unit recovers heat from the wastewater leaving the bathrooms (bath, shower and clothes washer). The second unit captures heat from the wastewater leaving the kitchen (sink and dishwasher). Up to 70 per cent of the energy in the greywater can be transferred to the supply water.

- Wastewater treatment

The wastewater treatment component of the system consists of a septic tank, recirculation tank with biofilter feed pump, Waterloo Biofilter™ and treated wastewater ground disposal gravel pack.

The 3,600 l (800 gal.) precast concrete septic tank serves as a trash tank to retain grease, grit, oil and other objects that could clog the piping and equipment. It also provides primary treatment by settling organic and inorganic solids.

The effluent from the septic tank flows to a 2,000 l (440 gal.) recirculation tank located under the ground floor in the solarium/office area. The recirculation tank also receives effluent from the Waterloo Biofilter™ through a downward flowing valved inlet pipe. The mixture of effluents from the septic tank and the Waterloo Biofilter™ is pumped as feed to the Waterloo Biofilter™.

The recirculating Waterloo Biofilter™ with forced air ventilation provides secondary treatment. This aerobic biological process removes organic matter and effects nitrification. Some of the treated effluent (approximately 120 l/day) is then wasted to the ground disposal gravel pack located outside of the front wall of each house, depending on the liquid level of the recirculation tank.

- Renovated water treatment

The renovated water-treatment system consists of twin combined slow sand filters and activated carbon adsorbers, ultraviolet irradiation disinfection, treated renovated-water storage and a renovated-water pressure distribution pump.

The treated Waterloo Biofilter™ effluent flows by gravity through the slow sand filter and activated carbon adsorbers. A second Trojan Aqua Advantage 5 Sterilizer then disinfects this renovated water in the same manner as the potable water.

The renovated water storage tank is underneath the ground floor beside the potable water storage tank. From here, a second Grundfos JQ2 "three-in-one" wallmounted JetpaQ pumping system supplies the renovated water to the house through a separate piping system for toilet flushing, bathing and clothes washing. It also supplies the hot water radiant-heating system as required.

Part 2: Operational Maintenance Considerations for the Toronto Healthy Houses Water Systems

Part 2 deals with operational and maintenance requirements as the systems are put into service. It provides initial operating instructions as given by the equipment manufacturers, as well as maintenance instructions taken from equipment owner guides. It recommends that the homeowners use qualified professionals to service some of the equipment.

This section of the guide also describes the operating procedures for the potable water, wastewater treatment, and renovated water systems. These include maintaining the water-collection facilities, filtering and backwash operations, checking the ultraviolet sensors, inspecting the potable water storage tank, cleaning the Waterloo Biofilter™ and other procedures.

Troubleshooting guides for the effluent pump system, the water sterilizer and the potable water and renovated water distribution pumps are also provided.

Part 3: Toronto Healthy Houses Occupant Guidelines

Part 3 provides advice for occupants of the Toronto Healthy Houses with respect to water use and protection of the biological water-treatment systems. It presents critical information on the lifestyles and household maintenance habits appropriate for living with self-sufficient potable and reclaimed water systems.

This section also emphasizes that occupants will have to change their lifestyles to develop the habits of conserving water and using appliances efficiently. In addition to providing examples of water conservation practices, it deals with drinking water safety and protecting the water systems from occupant abuse.

The following is a sample of some of the recommendations provided:

- Boil drinking water if there is ever any doubt about its safety.
- Refrain from using chemical household cleaners and other products that are toxic to human health or to the environment, or can harm the beneficial microorganisms in the system.
- Direct as many kitchen wastes as possible to a composter or garbage rather than washing them down the kitchen sink.
- Do not dispose of non-biodegradable substances down any drains.

The guide also identifies which commercial cleaners to avoid, suggests others that are safe to use, and recommends various homemade cleaning compounds. For outdoors, it recommends that the homeowners not use chemical sprays and pesticides to maintain the lawn and garden, and offers a list of non-chemical, environmentally friendly alternatives.

IMPLICATIONS FOR THE HOUSING INDUSTRY

The Commissioning Guide for the Toronto Healthy Houses Water Systems offers a detailed technical examination of the operation and maintenance of the potable water supply and wastewater renovation systems for the Toronto Healthy Houses.

It will be useful to architects and mechanical and plumbing contractors interested in understanding or developing innovative approaches to conserving water supplies, reducing contamination of waterways and eliminating the need for urban infrastructure in the form of water and sewer 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.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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