

EchoHaven Water Conservation Measures

The EchoHaven project is a new, one-storey, 225 m² (2,425 sq. ft.), single-family detached home in a new development in northwest Calgary, Alberta. As a winning project in the CMHC EQuilibrium™ Sustainable Housing Demonstration Initiative, Echo-Logic Land Corporation designed and constructed this home to be healthy and comfortable to live in, reduce energy use to a minimum, produce on-site renewable energy, conserve resources, have low environmental impact and be marketable. One of the key features that help conserve municipal water resources is the innovative use of non-potable water in combination with water-efficient fixtures and on-site conservation practices, highlighted in this EQuilibrium™ Housing InSight.

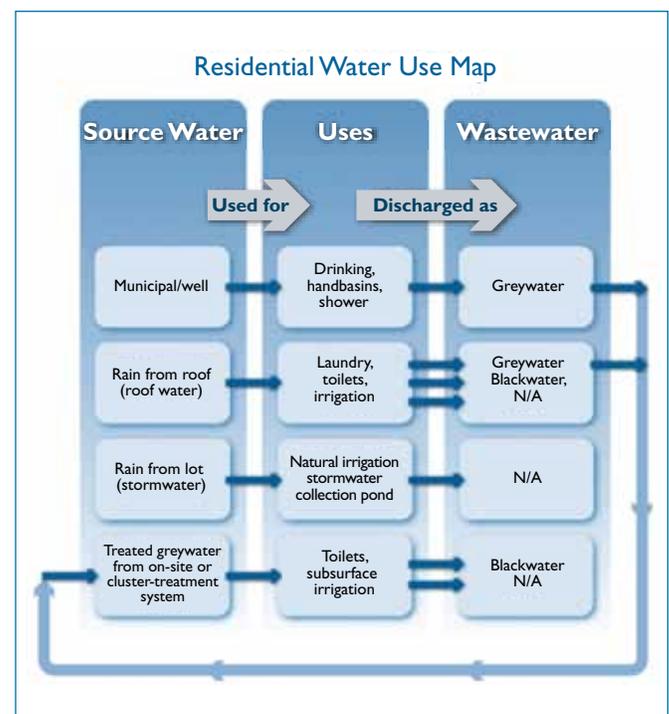
Overview

EchoHaven is intended to be a sustainable community at Rocky Ridge in northwest Calgary. The planned small neighbourhood of 25 homes will focus on quality of life, while maintaining a minimal environmental footprint. As part of its efforts to reduce municipal water use, the subdivision implemented bylaws that will require the houses in the EchoHaven development to harvest rainwater for non-potable purposes both inside and outdoors. In addition, the EchoHaven condominium association intends to treat greywater on the site of the subdivision and use this for outdoor irrigation. Furthermore, all stormwater will be captured and stored within the community thus mitigating the need for connection to city stormwater infrastructure.

The houses in the EchoHaven development will be constructed to use municipal water, rainwater and greywater as source waters for different uses. While rainwater reuse has been approved, the greywater reuse option is on hold pending regulatory approval.

The key features of the EchoHaven water conservation and management plan are:

- rainwater harvesting system supplying water for non-potable uses (toilets, outdoor watering and laundry);



- permeable driveway paving to infiltrate stormwater;
- landscaping with native plants to reduce irrigation;
- water-efficient fixtures and appliances to reduce water use; and
- potential reuse of greywater for subsurface outdoor irrigation.

Technical Specifications

Rainwater harvesting system

Rainwater is harvested from the roof (roof water) of the house and directed to a 6,000-litre (1,320-imp. gal.) cistern buried under the driveway. A filter component, utilizing coarse and fine filters, is used at each of the three downspout locations (figure 1). Rainwater is then directed through a PVC pipe buried below grade to the cistern tank. If more rainwater is collected than the cistern can hold, the overflow is directed to the stormwater collection pond southeast of the house (figure 2).

The cistern is constructed of stacked open web crates that are made from recycled plastic (figure 3). The boxes are wrapped in a seam-sealed, 40-mil PVC membrane (figure 4) surrounded by geotextile, which prevents the surrounding soil bed from entering the tank and protects the waterproof liner. Ten centimetres (4 in.) of Type II Expanded Polystyrene (EPS) then covers the boxes. Geogrid is used above the cistern to improve the structural integrity of the soil under the driveway and spread vehicle load.



Figure 1 Filter component at downspout

The rainwater is pumped from the cistern with a self-priming pump (with a built-in pressure tank) that is capable of drawing water from a well depth of 8 m (26 ft.). The water is then directed through a 5-micron particulate filter and ultraviolet (UV) disinfection system to the toilets, outdoor hose bibs and washing machine (figure 5).

When there is no water in the cistern, the system automatically switches over to municipal water stored in a 200-litre (44-imp. gal.) tank. An air gap between the municipal water supply pipe and storage tank is used to prevent backflow and eliminate the possibility of cross-contamination of municipal water.

Greywater collection system

The EchoHaven EQuilibrium™ demonstration house is plumbed for both greywater and blackwater discharges. Greywater is discharged from domestic activities such as laundry and bathing, whereas blackwater (sewage) is discharged from toilets. The greywater system is designed to carry greywater from each home offsite to a communal treatment plant. It is anticipated that the communal EchoHaven greywater treatment plant will be installed when regulation permits its use. The greywater treatment plant will be designed to meet the provincial wastewater effluent quality standards or better. If permitted, the treated greywater will be used for on-site irrigation and groundwater recharge, and possibly used later for in-home reuse, such as toilet flushing.



Figure 2 One of three stormwater collection ponds for the EchoHaven development



Figure 3 Crate assembly to form cistern cavity under driveway



Figure 4 Cistern in cavity, wrapped and seam-sealed



Figure 5 Mechanical room components of rainwater collection system

Permeable driveway paving

Permeable pavers are used on the driveway to absorb and filter stormwater runoff which can become contaminated with dirt, salt, vehicle leaks, etc. This is part of the overall strategy to eliminate the need for municipally connected stormwater drainage infrastructure, and reduce potential contamination of waterways.

The permeable driveway is made of interlocking pavers on a compacted gravel base. When it rains or snows, water can pass through the spaces between the interlocking pavers, significantly reducing the amount of runoff. Below the pavers, the gravel base, followed by a second layer of crushed aggregate, filters the water to remove contaminants and suspended solids.

Landscaping

In the proposed community design, the EchoHaven team has tried to preserve the natural landscape and use existing vegetation as much as possible. All additional vegetation is native or near-native species indigenous to the Rocky Ridge area. Selecting plants that are adapted to the local climate significantly lowers watering requirements compared to non-native plants and helps ensure longevity. Native vegetation also provides food and habitat for local wildlife.

Water-efficient appliances and fixtures

The following fixtures and appliances were used in the constructed house to reduce water consumption:

- low-flow fixtures throughout and aerators on kitchen and laundry room sinks;
- low-flow, dual-flush toilets;
- water-efficient dishwasher and washing machine with consumption of 12.6 litres (2.8 imp. gal.)/cycle and 5.9 litres (1.3 imp. gal.)/cycle, respectively; and
- condensing clothes dryer (the reclaimed water is used for watering plants).

In addition, to reduce the amount of water that goes down the drain while occupants wait for hot water, all supply lines were insulated. The supply runs were configured to be as short as possible by locating plumbed facilities in close proximity to each other as well as to the supply source.

Implementation Considerations

Rainwater harvesting system

Applicable provincial codes and regulations in the province of Alberta permit the use of rainwater for flushing toilets and urinals, as well as landscape irrigation.

Rainwater can also be used for laundry; however, city regulations prohibit the use of combined hot municipal water and rainwater. In order to utilize rainwater in the washing machines, owners will only be able to use cold water for clothes washing. This will allow for the use of rainwater and save energy but might not be desirable for all homeowners.

The EchoHaven rainwater system is designed to minimize any potential health risk. Roof water can contain low levels of contaminants and pathogens from leaf litter, airborne contaminants, rodents, and insects; however properly treated rainwater can be used for all purposes. To further heighten health and environmental protection, the following measures were implemented:

- The rainwater is used for non-potable purposes only.
- The cistern is sealed and below ground, preventing insect entry and minimizing potential for mosquito-borne diseases.
- The house is dual-plumbed for non-municipal and municipal source water and greywater and blackwater wastewater. The separation of pipes ensures that there is no cross-contamination.
- There is a backup municipal water supply to ensure that essential services are provided when there is inadequate rainfall to meet demand or if the rainwater harvesting system malfunctions.
- The rainwater from the cistern passes through a 5-micron particulate filter and, finally, a UV disinfection system before use. The particulate filter removes soil or sand particles from the water, while the UV filter inactivates harmful micro-organisms that the water may contain.
- An access hatch was installed at the northwest corner of the cistern tank to allow for access to intake sensors (used for determining if the system should switch to potable water make-up due to low rainwater levels) and cleaning.

Greywater collection system

Although the municipality does not currently permit the use of greywater systems, the EchoHaven team felt confident that the domestic use of reclaimed greywater would be allowed in the near future and thus installed the required infrastructure within the house at the time of construction. Installing the greywater plumbing as a retrofit if the regulations are eventually changed would significantly increase the cost of the system.

Current municipal regulations do, however, allow the use of reclaimed greywater for non-domestic purposes (that is, irrigation and groundwater recharge). The EchoHaven development will be able to more fully capitalize on their infrastructure investment when regulations permit and the plant is built.

Cost Implications

Rainwater collection system

The size and cost of a rainwater harvesting system will depend on a variety of factors, including roof area, number of occupants, rainwater uses and the efficiency of the associated appliances (laundry, toilets). The approximate cost of all materials, equipment and labour was \$12,000. Operational expenses are limited to roof and water quality maintenance. Other expenses include the energy required to run the UV treatment system and the pumps, replacement of filters and UV light bulbs and maintenance of the pumps.¹

Water-efficient appliances and fixtures

Water-efficient appliances may have slightly higher capital costs but use less water, resulting in a positive return on investment over the lifespan of the appliance. Appliances that also conserve hot water generate both energy- and water-consumption savings.

¹ Rainwater Harvesting Design & Costing Tool developed by *Connect the Drops*: <http://connectthedrops.ca/drupal/resources>

Technology Benefits

Water savings

The EchoHaven team expects that the combined water-conservation measures will reduce municipal water consumption by 72 per cent compared to a typical Calgary home. Each home is expected to save 106,000 litres (23,316 imp. gal.)/year, or 2.6 million litres (583,000 imp. gal.)/year for 25 homes.

Occupant health and comfort

The EchoHaven team paid particular attention to ensuring sufficient water quality through a variety of measures outlined in this EQuilibrium™ Housing InSight.

Summary

The EchoHaven house demonstrates that municipal water consumption can be reduced through a variety of measures. These measures range in cost, effectiveness and ease of implementation. Rainwater harvesting can significantly decrease potable water consumption for non-potable domestic use (flushing toilets, washing clothes and irrigating lawns). The rainwater collection system, permeable driveway, stormwater collection ponds and soil infiltration measures can decrease stormwater runoff considerably. As a result, no infrastructure is needed to convey stormwater to municipal infrastructure, decreasing costs to the City and potential pollution of waterways. Water-efficient appliances, faucets and insulating hot-water piping will also contribute to the reduction of municipal water consumption. Additional savings can be expected with the future use of the greywater system.

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For more information about this project and other EQuilibrium™ Housing projects, visit the CMHC website at www.cmhc.ca or www.equilibriumhousing.ca.

EQuilibrium™

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The national EQuilibrium™ Sustainable Housing Demonstration Initiative, led by Canada Mortgage and Housing Corporation (CMHC), brings the private and public sectors together to develop homes that address occupant health and comfort, energy efficiency, renewable energy production, resource conservation, reduced environmental impact and affordability.

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EQuilibrium™ Housing combines a wide range of technologies, strategies, products and techniques designed to reduce a home's environmental impact to an absolute minimum. At the same time, EQuilibrium™ Housing also features commercially available, on-site renewable energy systems to provide clean energy to help reduce annual energy consumption and costs.

EQuilibrium™ Housing InSight

EQuilibrium™ Housing InSight publications present specific housing design strategies and technologies implemented in EQuilibrium™ Housing demonstration projects.

CMHC

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