



HYDROSPHERE ENGINEERING

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Basement Flooding

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INTRODUCTION

Numerous residential and commercial buildings experience basement flooding. Type in “basement flooding” or “basement seepage” into an internet search and thousands of images are available for viewing. This educational note has been prepared to provide an overview of basement flooding and to provide guidance for those who wish to minimize future basement flooding.

GRAPHICAL RESOURCE

The Utilities Department of the City of Kingston, Ontario, Canada has prepared one of the better drawings showing the various components of the storm and sanitary sewer systems. A smaller version of that image has been reproduced below. To see the complete details of the drawing, perform an internet search on “basement flooding.”

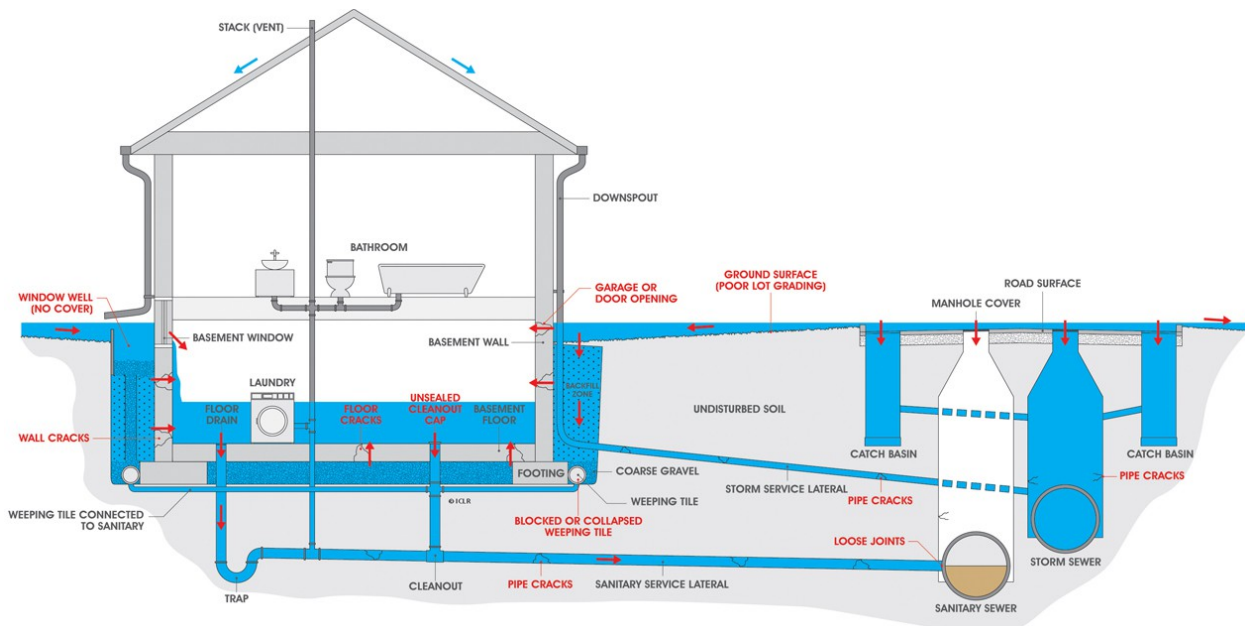


Image credit: Utilities Department, City of Kingston, Ontario, Canada

Basement Flooding (continued)

Most residential and commercial buildings constructed after approximately 1960 have been constructed consistent with the drawing above.

Plumbing fixtures (sinks, toilets, bathtubs and floor drains) are connected to the sanitary lateral, which is then connected to the municipal sanitary sewer.

Downspouts, foundation drains (labeled weeping tile in the Kingston drawing), yard drains and driveway drains are connected to the storm lateral, which is then connected to the municipal storm sewer. Foundations drains are either connected directly to the storm lateral or drain into a sump pit containing a sump pump, which discharges into the storm lateral.

DEFINITIONS

Basement flooding The rapid intrusion of water into a basement, occurring during a severe rainfall or snowmelt event. The water intrusion usually occurs in less than 4 hours, but often takes a long time to drain away. The water enters through the walls, the floor, the floor drain, plumbing fixtures or windows.

Basement seepage The long term intrusion of water into a basement through the walls or the floor. Mold and mineral deposits (efflorescence) are often visible and the walls, and the air in the basement often smells musty.

Sanitary sewer backup The condition where storm water runoff leaks from either the municipal storm sewer or the storm lateral into the municipal sanitary sewer or the sanitary lateral. The entry of the storm water runoff into the sanitary sewer causes the sanitary sewer to be overloaded, and to flow under pressure. The flow in the pressurized sewer (called surcharge) flows into the basements.

Storm sewer backup The condition where the precipitation event exceeds the capacity of the storm sewer. The excess storm water runoff causes the storm sewer to be overloaded, and to flow under pressure. The flow in the pressurized sewer (called surcharge) flows into the basements.

Basement Flooding (continued)

BASEMENT SEEPAGE

If basement seepage exists but basement flooding does not, it is most likely caused by the failure of the foundation drains around the perimeter of the house. The foundation drains are designed to collect ground water and to lower the ground water table to below the level of the basement floor. Some reduction in basement seepage may occur if the foundation drains are jetted, but basement seepage can be eliminated by the replacement of the foundation drainage system.

SANITARY SEWER BACKUP OR STORM SEWER BACKUP

To determine how to minimize basement flooding, it is important to know if the basement flooding is caused by sanitary sewer backup or storm sewer backup. Generally, if the water in the basement is clear, with minimal odor, and entered the basement through the walls, floors, sump pit or windows, it is storm sewer backup. Generally, if the water in the basement is discolored, with significant odor, and entered the basement through the floor drain, toilet, shower or bathtub, it is sanitary sewer backup.

On the Hydrosphere Engineering website, under the section entitled Technical Notes, is a basement flooding questionnaire. The questionnaire can be downloaded and can be utilized to determine the cause of the basement flooding. If you are a consulting engineering firm or a contractor, you are welcome to use the questionnaire, but give credit to Hydrosphere Engineering as the developer of the questionnaire.

WHY DOES STORM SEWER BACKUP OCCUR?

Storm sewer systems are designed with certain flow capacities. The flow capacities are often set by municipal standards. The municipal standards are minimum conditions which must be met by the land developer to have the plans for the construction approved. Municipal standards for storm sewers have been in place ever since separate storm and sanitary sewers were constructed.

Examples of a municipal standard for storm sewers:

- Outdated: The storm sewer shall flow full during the 2 year storm.
- Average: The storm sewer shall flow full during the 5 year storm.
- Good: The storm sewer shall flow full during the 10 year storm.

Most of the residences, which experience basement flooding, were constructed based on storms having an average return period of 2 or 5 years. The concept of the average return period is explained in the educational note "The 100 Year Flood", which can be found on the Hydrosphere Engineering website.

Basement Flooding (continued)

If the standard of “just full for the 5 year storm” was in place at the time your home was constructed, you accepted a risk of 1/5 or 20% that your basement would flood in any given year. This fact is seldom, if ever, revealed to prospective home buyers.

When a precipitation event exceeds the design standard (e.g. the 10 year storm occurs and the storm sewer was designed for the 5 year storm), basement flooding is likely to occur. Basement flooding is also likely to occur if, for some reason, the capacity of the storm sewer or the storm lateral have been reduced. Storm sewer capacity reduction can occur due to collapsed pipes, debris in the storm sewer, or downstream flooding conditions. Storm lateral capacity reduction can occur due to collapsed pipes or tree root intrusion into the lateral.

WHY DOES SANITARY SEWER BACKUP OCCUR?

During storm events, sanitary sewer backup occurs because storm water runoff leaks into the sanitary sewer or the sanitary sewer laterals. The leakage of storm water runoff from the storm sewer into the sanitary sewer enters the sanitary sewer through leaky pipe joints, unsealed manholes, and cross connections where downspouts, footing drains, or other storm water conveyance pipes are connected directly to the sanitary sewer. For many years, cross connections between the storm sewer and the sanitary sewer have been illegal. Historically, most of the leakage of storm water runoff into the sanitary sewer has been through cross connections. More recently, many of the cross connections have been eliminated, and storm water runoff enters the sanitary sewer through deteriorated pipe joints and leaky manholes in the sanitary sewer system. The deteriorated pipe joints have occurred over a long period of time. The repair of the deteriorated pipe joints can not be done by maintenance alone, but usually requires the municipality to undertake a capital improvement program.