Institute for Catastrophic Loss Reduction

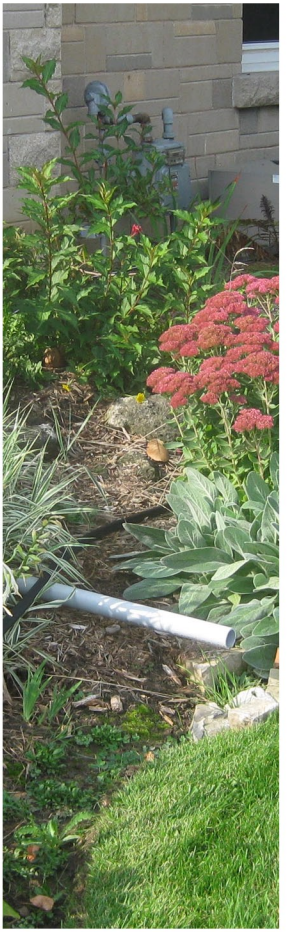
Building resilient communities

Designed for safer living®

Focus on

Sump pump systems

Designed for saver living® *is a program endorsed by Canada's insurers to promote disaster-resilient homes*



About the Institute for Catastrophic Loss Reduction

The Institute for Catastrophic Loss Reduction (ICLR), established in 1997, is a world-class centre for multidisciplinary disaster prevention research and communication. ICLR is an independent, not-for-profit research institute founded by the insurance industry and affiliated with Western University, London, Ontario.

The Institute's mission is to reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters.

ICLR's mandate is to confront the alarming increase in disaster losses caused by natural disasters and to work to reduce disaster deaths, injuries and property damage. Disaster damage has been doubling every five to seven years since the 1960s, an alarming trend. The greatest tragedy is that many disaster losses are preventable. ICLR is committed to the development and communication of disaster prevention knowledge. For the individual homeowner, this translates into the identification of natural hazards that threaten them and their home. The Institute further informs individual homeowners about steps that can be taken to better protect their family and their homes.

Focus on
Sump pump systems

Hundreds of thousands of Canadian homes have sump pump systems, installed either during initial construction or retrofitted after-the-fact as a need became clear. Hundreds of new sump pump systems come on line across Canada every year.

Sump pumps provide an effective means of pumping foundation drainage away from homes. But sump pump systems are reasonably complicated and can cause a significant amount of water-related damage if they are not set up properly and if they are not inspected and maintained on a regular basis.

This booklet will explain what sump pump systems are, what they do, how they can fail, and how they should be tested and maintained. The booklet will also provide advice on what to consider when having a sump pump system installed, or when replacing an old pump.

Figure 1: *Sump pump retrofit in Burlington, ON (Source: Institute for Catastrophic Loss Reduction)*

What are sump pumps and what do they do?

There are three major ways that water can enter a home's foundation drains (aka weeping tiles, weepers, footing or perimeter drains):

1. Via downspouts (aka roof leaders) that are connected to the home's weeping tile;

2. Via water seepage down through the backfill zone;

3. Via the water table

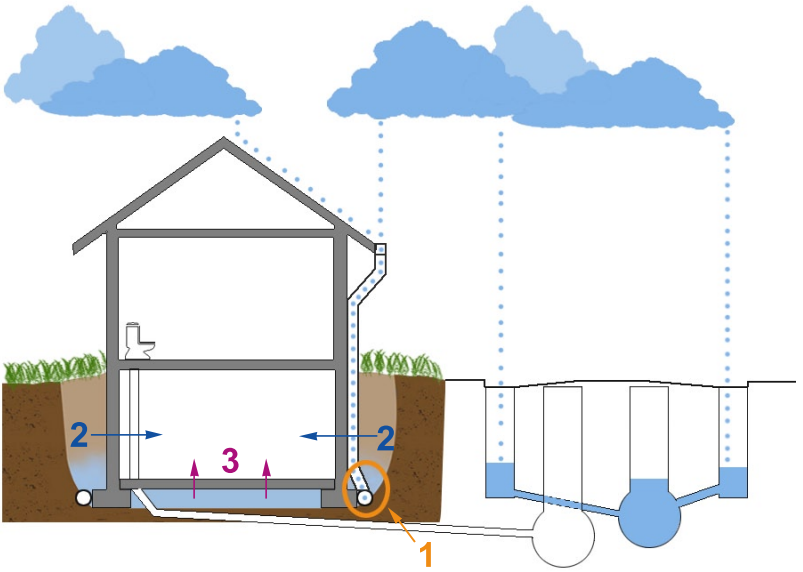


Figure 2: *Three major ways that water can enter a home's foundation drains. (Source: Institute for Catastrophic Loss Reduction)*

Sump pumps are typically installed where gravity drainage to municipal stormwater management systems is not practical. There is a subsequent need to remove water from around the home's foundation and pump it safely away from the structure.

Sump pumps are often retrofitted in after construction when chronic dampness or basement flooding prompts the homeowner to take mitigative action by severing the homes foundation drains and directing the water to a sump pit. Homeowners who have foundation drains that connect to a municipal sanitary or combined sewer system (as opposed to a storm system) are often encouraged to severe these drains and run them to a sump (connection of foundation drains to sanitary systems is normally

discouraged as unnecessary water in the sanitary can overwhelm the system, causing basement flooding and inundation at water treatment plants). Additionally, retrofitting sump pump discharge lines into a sanitary system is also usually prohibited by municipalities and may result in a fine.

Sump pumps are quite common in rural areas of Canada, where there may not be a municipal storm and/or sanitary sewer system. In rural areas, foundation water is typically pumped to the surface of the lot, to a dry well or seepage pit, or to a drainage ditch beside the roadway.

Pedestal Pump

Submersible pump with 2-pole mechanical switch (float)

Submersible pump with tether float

Figure 3: *Various types of sump pumps. (Source: Zoeller Pump Company)*

Connection of foundation drains to sanitary vs sump pump system

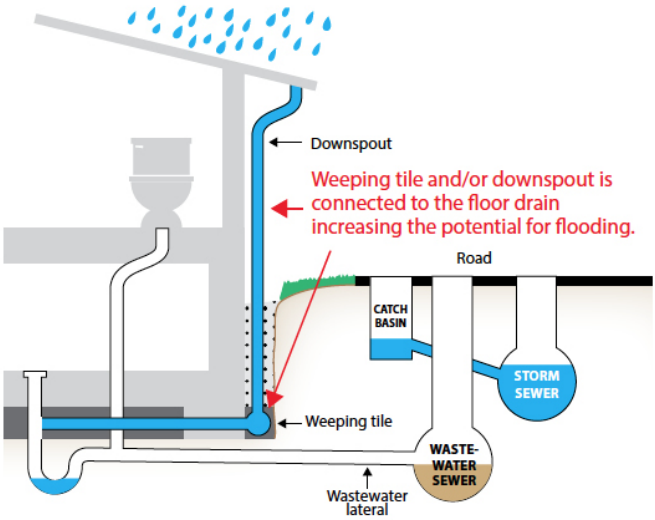


Figure 5: *In the vast majority of cases, foundation drainage to sanitary systems should be avoided. (Reproduced and/or adapted with the permission of the Regional Municipality of Halton)*

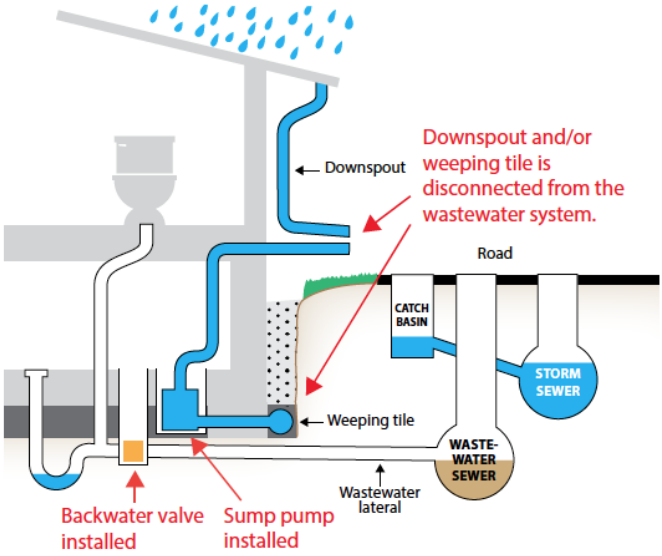


Figure 6: *Proper use of a sump system to pump foundation drainage to the surface of the lot. (Reproduced and/or adapted with the permission of the Regional Municipality of Halton)*

How do sump systems work?

Water enters a home's weeping tiles through one of - or a combination of - the three ways noted in figure 2. This water flows into the home's foundation drains and, eventually, into the sump, which is a pit or hole located in the lowest part of the basement floor.

Once the water rises to a certain height, raising a float on the pump or triggering a diaphragm, the pump will turn on, bringing the water up through the discharge pipe and out of the house to the lot surface or into storm systems via an exterior standpipe.

It is imperative that a one-way check valve be installed on the discharge line so the water being ejected from the sump pit doesn't surcharge - or re-enter - the pit when the pump turns off. Surcharging sump water can lead to a surplus of water in the sump pit, causing it to overflow onto the basement floor.

Sump pumps and backwater valves

Where a home's foundation drain (aka perimeter drain or weeping tiles) is connected to the building's sanitary sewer connection (as opposed to the storm sewer connection), the installation of a backwater valve on a sanitary lateral without severing the foundation drain and connecting them to a sump or storm connection could cause a basement to flood during a severe rain event. This 'self flooding' is caused when the flap of the backwater valve closes during a rain event, trapping water from the foundation drain behind – or 'upstream' – of the valve (keep in mind that while the flap in the valve is closed, the floor drains and weeping tiles in behind the backwater valve are being filled with water from connected downspouts and from showers, dishwashers, etc). This trapped water will have no place to go and, if there is enough of it, it will enter the home's basement via floor drains or below grade fixtures like sinks, toilets, showers, washing machines and the like.

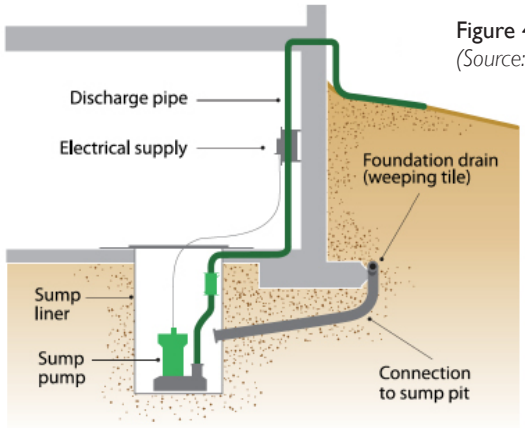


Figure 4: *How do sump systems work? (Source: City of Moncton)*

Lack of a check valve may also result in critical damage to the sump pump motor. Check valves have been known to fail over time, so it is recommended that these valves be clamped – and not glued – into place in case the valve needs to be replaced.

It is also imperative that the sump water be ejected away from the home's foundation, a distance from the backfill zone (i.e. the area of loose soil located immediately beside the home, between the foundation wall and the edge of the excavation originally dug to construct the home) but not onto neighbouring properties. Homeowners should also guard against directing sump pump discharge onto patios and walkways, which could result in icing during colder months, creating a slip/fall hazard. Discharge lines also should not be directed onto reverse slope driveways, as the water may re-enter the home's foundation drains and, eventually, sump pit, causing the sequence to repeat over and over (a problem known as 'recycling').

Roadside drainage ditches and check valves

In rural Canada where storm sewer systems are often nonexistent, it is common for sump pump outlet pipes to be directed to drainage ditches running alongside roadways.

During wet-weather months, it is common for these ditches to be filled with water. If the height of the water in a ditch exceeds the level of the outlet pipe, water can re-enter the pipe, flow back into the home and overwhelm the sump pit. This common problem illustrates the further value of installing an inexpensive one-way check valve to prevent water from re-entering the sump pit.

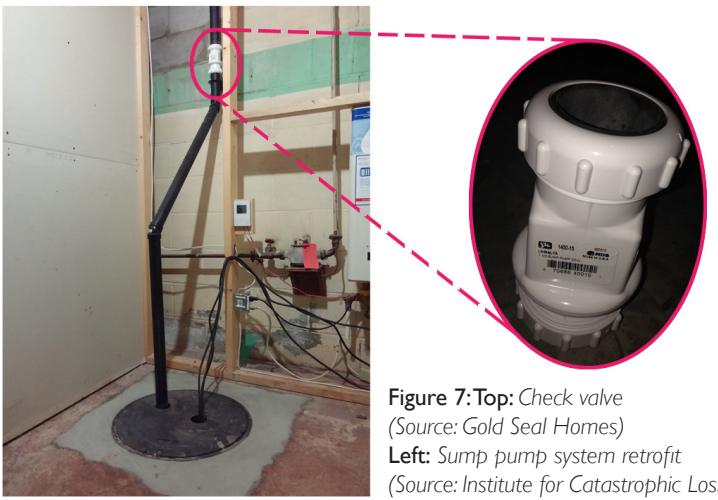


Figure 7: Top: *Check valve (Source: Gold Seal Homes)*
Left: *Sump pump system retrofit (Source: Institute for Catastrophic Loss Reduction)*

Sump pump configurations

	Main Pump	Secondary Pump	Backup Pump
Average rainfall	Yes	No	No
Severe rainfall	Yes	Yes	No
Power failure	No	No	Yes
Main pump failure	No	Yes	Yes
Main and secondary pump failure	No	No	Yes

Figure 8: *Where a sump pump system is rarely or only occasionally needed, a primary and secondary pump configuration will likely suffice. If, however, a sump pump system is often or always needed, particularly where the water table is high, a primary, secondary and backup pump configuration is recommended (Source: Institute for Catastrophic Loss Reduction)*

How do sump pumps most often fail?

Being fairly sophisticated mechanical/electrical devices, sump pumps can fail - and when they do - the damage can be significant, particularly if the problem is not caught early and the basement in question is well appointed.

Most sump pump system failures fall into one of three categories: failure of the float/switch, failure of the pump itself, and failure of the electric power supply to the pump.

Sump pump floats/switches commonly fail in one of two ways. First, an obstruction may prevent the float from rising and falling freely, inhibiting the pump from operating properly - a common problem with submersible pumps with arm-activated tether floats. Oftentimes, the 'obstruction' is the side of the sump pit wall. Merely turning the pump or moving it away from the sump wall will allow the float to move freely. Second, a hole in the float will cause it to fill with water, preventing it from rising and triggering the pump motor. In this case, the float or the entire pump unit should be replaced immediately.

Pumps themselves commonly fail in one of three ways. First, while a non-working pump may indicate a problem with the power supply, it may also be the result of a blown pump motor. This would require that the pump be repaired or replaced as soon as possible. Second, if the pump is making an odd sound, it may be close to failing. Common issues here include a broken or blocked impeller (impellers are sometimes made of plastic) or

a broken seal in the pump motor. Oil in the sump pit is a tell-tale sign that the pump's seal is broken. In either case, the pump should be repaired or replaced immediately. Finally, debris in the sump pit may block the screen at the bottom of the pump, preventing it from working properly or causing it to fail outright (a common issue with pedestal style sump pumps). The screen under the pump should be cleared on a regular basis. It is best that the pump be raised a few centimetres off the bottom of the basin to help prevent debris from entering the pump intake. Home improvement stores commonly sell PVC grates designed for this purpose.

Finally, pumps often fail due to issues associated with the electrical power supply. The sump pump should be supplied by a 15 amp, 110 volt three-pronged grounded receptacle, which should be located close enough to the pump that it can be directly plugged into it without need of an extension cord. Problems with blown fuses/thrown circuit breakers will also prevent the pump from working. The pump should run completely on its own circuit. Where there are two pumps, both should be on their own circuit as a failsafe measure.

How should sump pumps be tested?

Methods for testing sump pumps may vary depending on the type of pump and manufacturer, so it is imperative that the owner's manual be consulted before running a test.

Some manufacturers recommend testing the pump once a year, while others recommend testing the pump every two or three months. ICLR recommends that sump pumps be tested regularly - as often as every month or two, particularly where water tables are high - as a pump failure can cause a great deal of damage, particularly if a basement is finished.

Testing sump pumps generally involves a simple three step process:

1) Ensure power is running to the pump. This involves simply listening to the pump to ensure that it turns on and off and doesn't make any improper sounds.
2) Pour enough water into the sump pit to trigger the float or diaphragm. This could involve bringing a garden hose in from a basement window or using a bucket and filling the pit until the pump is triggered. Ensure the water raises the float or triggers the diaphragm and turns the sump pump on. The same should be done for the secondary backup pump.

3) Check the pump discharge line. Go outside to where the discharge pipe exits the foundation to ensure that water is flowing out of the home. In regions where the ground may freeze and where snow and ice may accumulate, the discharge line should be raised above the ground to prevent freezing and blockage from ice.

Figure 9: *Sump pump discharge.*
(Source: Institute for Catastrophic Loss Reduction)

What if the sump pump isn't working?

If the sump pump isn't working:

- Check the pump for any debris that might be blocking the pump intake (e.g. gravel) and clear it. Clear the screen at the bottom of the pump of any debris (this is particularly important for pedestal style pumps). Try the pump again to ensure it is working properly, repair or replace the pump if it is not.

- Listen for strange noises coming from the motor, such as grinding. If the pump is making strange noises, the impeller may be blocked by debris or may be broken (some impellers are made of plastic). Repair or replace the pump immediately.

- Check for oil in the sump pit. Discovery of oil could indicate a failed pump seal. If you find oil, repair or replace the pump immediately.

- If the activation switch for the pump works on a ball float, check if the float is moving freely and is not restricted.

- Ensure that the float is not rubbing against the side of the sump pit wall (this is particularly common with ball floats that operate on an arm, rather than those that rise and fall vertically, though they can become blocked as well).

- Ensure the float isn't full of water, which could indicate that a leak or hole exists. Replace the float if possible, or the entire pump if necessary.

Sump pump replacement tips

Some sump pump manufacturers, plumbers and others recommend a minimum 1/3 horsepower pump motor, however upgrading to a 1/2 horsepower pump will improve performance for only a small difference in price (though this may be unnecessary if the home's sump pump system is rarely needed). Ultimately the size of the pump needed depends on how much sump water has to be moved and how often, and the distance it needs to be pumped in order to eject it from the house (i.e. the 'head'). Thus, the gallons per hour (GPH) rating of the pump is a more important measure of pump performance than is horsepower. Often a table on the sump pump's packaging will indicate what size pump to purchase given the number of gallons per hour and distance to be pumped.

Further, the pump should be able to pass 'large' gravel of up to 10mm (1/2 inch) in diameter. Submersible pumps, while normally having a shorter lifespan than pedestal pumps, are usually able to eject larger debris, while pedestal pumps usually cannot.

It is imperative that the pump meets such criteria as the CAN/CSA 22.2 No 108 'Liquid pumps' standard.

Other considerations

Sump pits with screwed down tops

Sump pits with screwed or bolted down tops have several benefits:

- They keep small children and pets out of the sump pit
- They keep debris out of the sump pit
- They help prevent overflow of water from the pit into the basement of the home
- They help keep radon out of the home
- They are more attractive
- They are quieter
- They are more energy efficient, as positive pressure/ warm air does not get forced under the home and into the weeping tile system - a major source of air loss with unsealed pits.

Back-up pump

Having a backup sump pump in the event the primary pump fails or is overwhelmed can prevent significant water damage from occurring. Backup pumps can sit in the sump pit beside the primary pump, and be wired/ plumbed and ready to go should the primary pump stop working or need assistance. Backup pumps can also be set up to run simultaneously with the main pump should the primary pump be unable to keep up during a heavy rainfall or snowmelt event. A good practice is to raise the secondary pump a few centimetres above the primary pump so in times of minor water seepage, only one pump will activate.

Radon

According to the Canadian Mortgage and Housing Corporation, radon is a radioactive gas that is colourless, odourless and tasteless. It is formed by the breakdown of uranium, a natural radioactive material found in soil, rock and groundwater. When radon escapes from the ground into the outdoor air, it is diluted to low concentrations and is not a concern. However, radon that enters an enclosed space, such as a home, can sometimes accumulate to high levels, contaminating the air. According to the CMHC, sealing a sump pit will reduce both radon entry into a home and reduce the risk of injury to small children. Sumps can be fitted with an airtight cover. If the sump also acts as a floor drain, a special trap can be added to the airtight cover.

A popular option is to install a backup pump that runs off the home's potable water supply (see the following section for more information).

Back-up power

One of the main reasons sump pumps fail is from lack of power, either to the pump, the entire house or to a wider area. Storms and power failures often go hand-in-hand, meaning a pump can fail just when the homeowner needs it most. There are three primary sources of backup power for sump pumps.

Battery back-up systems run on automotive or 12 volt deep cycle marine batteries and will run the sump for several hours depending on the amount of water and height or distance pumped. Often, battery backup kits for sump pumps will include a number of accessories including a trickle charger and check valve. Some manufacturers recommend that the battery be replaced every two to three years.

Potable water-based systems will run a sump pump using the home's drinking water supply should the electrical power supply to the primary pump be disturbed for any reason. These pumps require a minimum water pressure to operate effectively and, thus, may not be suitable for homes running on well systems or where municipal water pressure is low. Manufacturer's recommendations should be consulted before purchasing such a unit.

Finally, the sump pump can be run off an emergency generator, either directly or by wiring the generator into the home's service panel. Generators that run on fossil-based fuels (such as gasoline or diesel) should never be operated inside a home, as the carbon monoxide they produce can be deadly. All manufacturer's instructions should be followed closely.

Figure 10: *Battery back-up pedestal sump pump (Source: Zoeller Pump Company)*

Sump pump alarms

Audible sump pump alarms will alert the homeowner should water in the sump pit rise to a higher-than-usual level. This will allow the homeowner to take action to prevent basement flooding, like install an emergency backup pump or hand-bail the sump pit.

Figure 11: *Sump pump alarm. (Source: Zoeller Pump Company)*

An alternative to an audible alarm, which are only helpful if the homeowner is home when it goes off, are wireless Internet alarm systems that will send a text message to a number of wireless devices advising of an impending problem with water levels in the sump pit. These devices are helpful, as the homeowner needn't be home to receive a warning.

Glossary of key terms

Backfill zone: The area of loose soil located immediately beside the home, between the foundation wall and the edge of the excavation originally dug to construct the home. See page 4.

Backup pump: A secondary pump (or where there are three pumps, a primary and a secondary – a third pump) designed to be used when main pump(s) fail. See page 13.

Backwater valve: (sometimes referred to as a backflow valve): A device that is placed in the sewer lateral that helps to prevent water from backing up from the municipal sewer into the basement.

Battery backup: A secondary power source using an auto or deep cycle marine battery to run a sump system should there by an interruption in the primary power supply. See page 14.

Check valve: A plumbing fitting that, in this context, allows water to flow through it in only one direction, preventing the water from re-entering the sump pit once it has been pumped out. See page 8.

Discharge pipe: The pipe which conveys water from the sump pit to the exterior of the structure and onto the lot surface or into a dry well.

Downspout: A vertical pipe that conveys roofwater from eavestroughs to either weeping tiles if the downspout remains 'connected', or to the lot surface if it has been 'disconnected'.

Dry well: An underground cistern or structure that is designed to hold and slowly discharge stormwater runoff.

Floor drain: A plumbing fixture found in the lowest floor of a structure, mainly designed to remove any standing water near it.

Footing drain: (See Weeping tiles)

Foundation drain: (See Weeping tiles).

Groundwater: Water that is contained within soil and between rocks below the earth's surface.

Head: Describes the maximum height and overall distance that the sump pump must move the discharged water.

Outlet: (See Discharge pipe)

Pedestal pump: A sump pump in which the pump motor is mounted above the sump pit. See page 5

Perimeter drains: (See Weeping tiles)

Primary pump: The main, or first, pump intended to respond in order to remove water that has collected in the sump pit.

Pump float: Devices which are used to automatically turn a sump pump on when the sump pit is filled to a preset level.

Pump impeller: A fan- or screw-like device within the sump that pushes the water out through the pipe. Impellers can be made of metal or plastic.

Pump switch: (See Float)

Roof leader: (See Downspout)

Sanitary sewer system: An underground sewer-pipe that is designed to convey only sanitary sewage.

Secondary pump: Where there are three pumps (a main, a secondary and a backup), the secondary pump is the second pump intended to respond should the primary pump be overwhelmed and need assistance. Where there are only two pumps, this would be deemed a backup pump.

Storm sewer system: An underground sewer-pipe that is designed to convey only stormwater flows.

Submersible pump: Unlike a pedestal pump, a submersible pump sits at the bottom of the sump pit, often entirely under water. The sump motor is encased in a waterproof housing, with the pump itself at the bottom of the unit and the discharge outlet pipe near the top. A flat screen or grate often covers the bottom of the pump to keep out debris. When the pump is triggered, water is sucked up through this grate and routed out of the structure via the discharge pipe. See page 5.

Sump: The pit in the basement floor that collects water from the home's weeping tiles.

Sump liner: (See Sump)

Sump pit: (see Sump)

Sump pump: A device, whether a pedestal pump or a submersible pump, that is placed into the sump pit to pump weeping tile discharge out of a structure's basement.

Sump pump alarm: A device that produces an audible alarm to warn a resident if water in the sump pit is reaching a higher-than-usual level, meaning a basement flood may be impending. See page 15.

Water table: (see Groundwater)

Water-powered backup pump: An emergency sump pump that runs off the building's potable water supply. See page 14.

Weeping tiles or weepers: A series of tiles or a perforated pipe located along the bottom of a building's foundation that is used to collect and drain groundwater away from the building.

Checklist to purchase a sump pump system

Feature	Minimum requirement	Model	Model	Model
Horsepower (hp)	rated 1/3 hp			
Pump capacity (gallons per min.)	specific to each home			
Pump head (sump level to pipe exit from home)	approx. 10 to 12 ft. (3.04 to 3.65 m)			
Solids handling	allows stones up to 0.4" to pass			
Discharge line size	1.25" (31.75 mm) pipe			
Check valve	recommended Code A-2.4.6.3			
Back-up system / alarm	recommended			
Warranty	generally 1-2 years			
Approved by Canadian Standards Association	recommended			

Figure 12: *Sump pump system checklist (Source: City of Moncton)*

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