



Urban Flooding: Guidance for Homeowners and Renters

Cook County, IL, Flooding Mitigation Assessment Team
Guidance Document

November 2024



FEMA

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1. What You Will Learn When You Read This Guidance

When you read this document, you will learn about actions you can take as either a homeowner or renter to reduce the potential of flood damage to your residence. These actions are called “mitigation” because they will mitigate—reduce or lessen—the loss of life, injuries, and property damage that can happen during urban floods. The mitigation measures described include how to address sewer backup and surface flooding, actions that help reduce flood damage in your home, and how to protect equipment and appliances.

After you read a brief description of the 2023 storms and flooding in Cook County, you will also learn about:

- Lessons learned from prior urban flooding events (Section 3);
- Causes of urban flooding in Cook County (Section 4);
- Efforts to mitigate flooding in the Greater Chicago Region (Section 5);
- Suggestions to prepare before the next storm (Section 6);
- How your home can be assessed to identify flood risks (Section 7);
- Actions you can take to reduce flood damage (Section 8);
- Mitigating sewer backup (Section 9);
- Mitigating surface flooding (Section 10);
- Cleaning up after flooding and sewer backup (Section 11); and
- References and resources (Section 12).

2. 2023 Storms and Flooding

Heavy rainfall on July 2 and September 17, 2023, resulted in urban flooding across Cook County. The July 2 event caused flooding in neighborhoods to the west of downtown Chicago, including the City of Berwyn, the Town of Cicero, the Village of Oak Park, the Austin neighborhood of Chicago, and surrounding neighborhoods. Total rainfall on July 2 ranged from 1.5 to 9.1 inches, with a maximum rainfall rate of 3 inches per hour (Lincoln, 2023). Figure 1 shows the rainfall estimates on July 2. This led the governor to issue a state disaster proclamation which was followed by a presidential disaster declaration (DR-4728-IL).

The September 17 event caused flooding in neighborhoods south of downtown Chicago, including Calumet City, the villages of Burnham and Dolton, and surrounding neighborhoods. The maximum rainfall was estimated at 8.7 inches in a 24-hour period. Figure 2 shows the observed daily rainfall

totals for September 17. Following the governor’s disaster proclamation, the president declared the event a major disaster (DR-4749-IL).

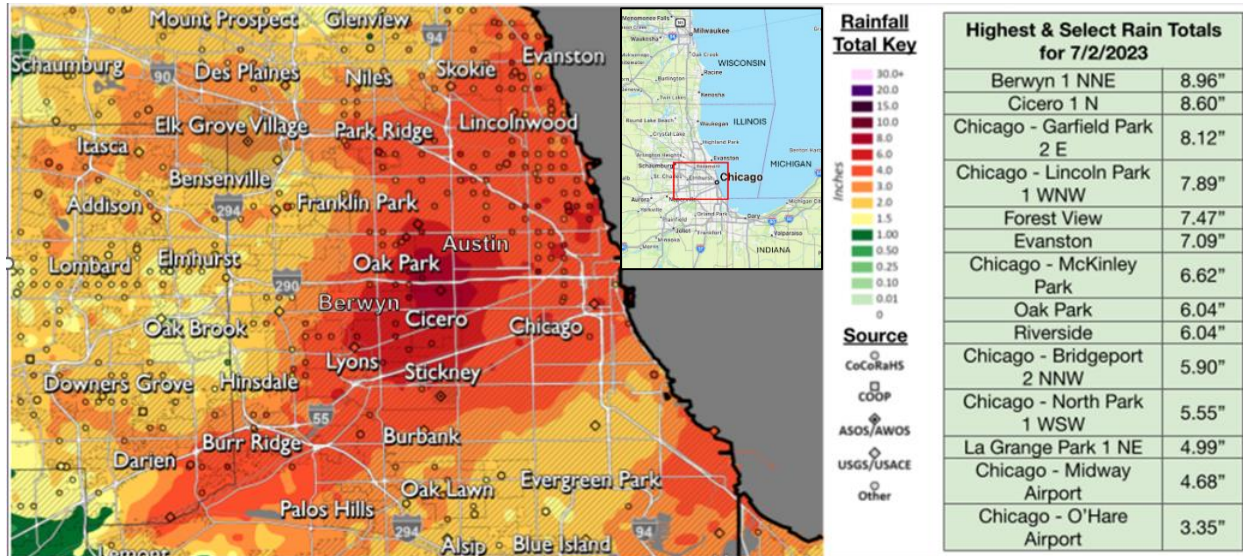


Figure 1. Rainfall Totals for July 2, 2023 (Lincoln, 2023)

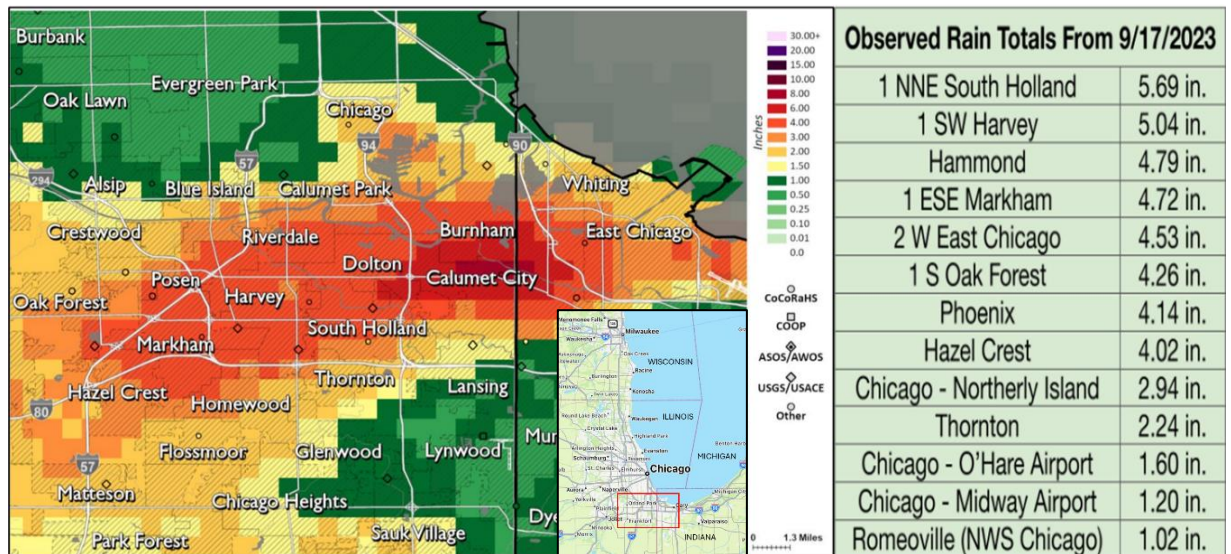


Figure 2. Rainfall Totals for September 17, 2023 (Lincoln, 2023)

Both events are estimated to represent a 0.2-percent-annual-chance of occurring (equivalent to a 500-year return period). Severe storms that produce very heavy rainfall might seem rare, but experts estimate that similar events could occur once or twice each decade somewhere in the Greater Chicago Metropolitan Area (Lincoln, 2023). Because all neighborhoods in Cook County could experience similar intense rainfall events, and since much of the area has similar topography and is similarly developed, urban flooding could affect other areas during future events that produce extreme rainfall. Therefore, it makes sense for homeowners and renters to maintain an awareness of

urban flooding risks and how they can affect their homes. This guidance offers suggestions to reduce future damage.

Storm Frequency

The frequency of storm events can be presented in two ways: A return period in years or a percent annual chance of exceedance. For example, a 100-year flood has a 1 percent annual chance of exceedance, while a 500-year flood has a 0.2 percent annual chance of exceedance. It is important to note that even if your community experienced a 100-year flood, that does not mean it will be another 100 years before the next flood. There is a 1 percent chance of a 100-year flood every year, so you could experience multiple 100-year or greater floods in 100 years, or possibly none at all.

FEMA flood maps typically show the areas that could be affected by 100-year and 500-year floods. Building codes and standards are moving toward designing buildings for more severe flooding than the 100-year flood.

Figure 3 shows the topography of Cook County along with streams and drainage channels. Elevations are given relative to the water level in Lake Michigan. The area in light green stretching from the shore of Lake Michigan almost to the western boundary of Cook County is all less than 50 feet above Lake Michigan. This area is therefore very flat, allowing rainwater to accumulate if the drainage system is overwhelmed. The areas in Cook County where the rainfall estimates exceeded 6 inches during the 2023 storms are highlighted in Figure 3. These are also the areas that experienced the most severe urban flooding and property damage. After the 2023 storms, FEMA sent a Mitigation Assessment Team (MAT) to survey damage in those areas.

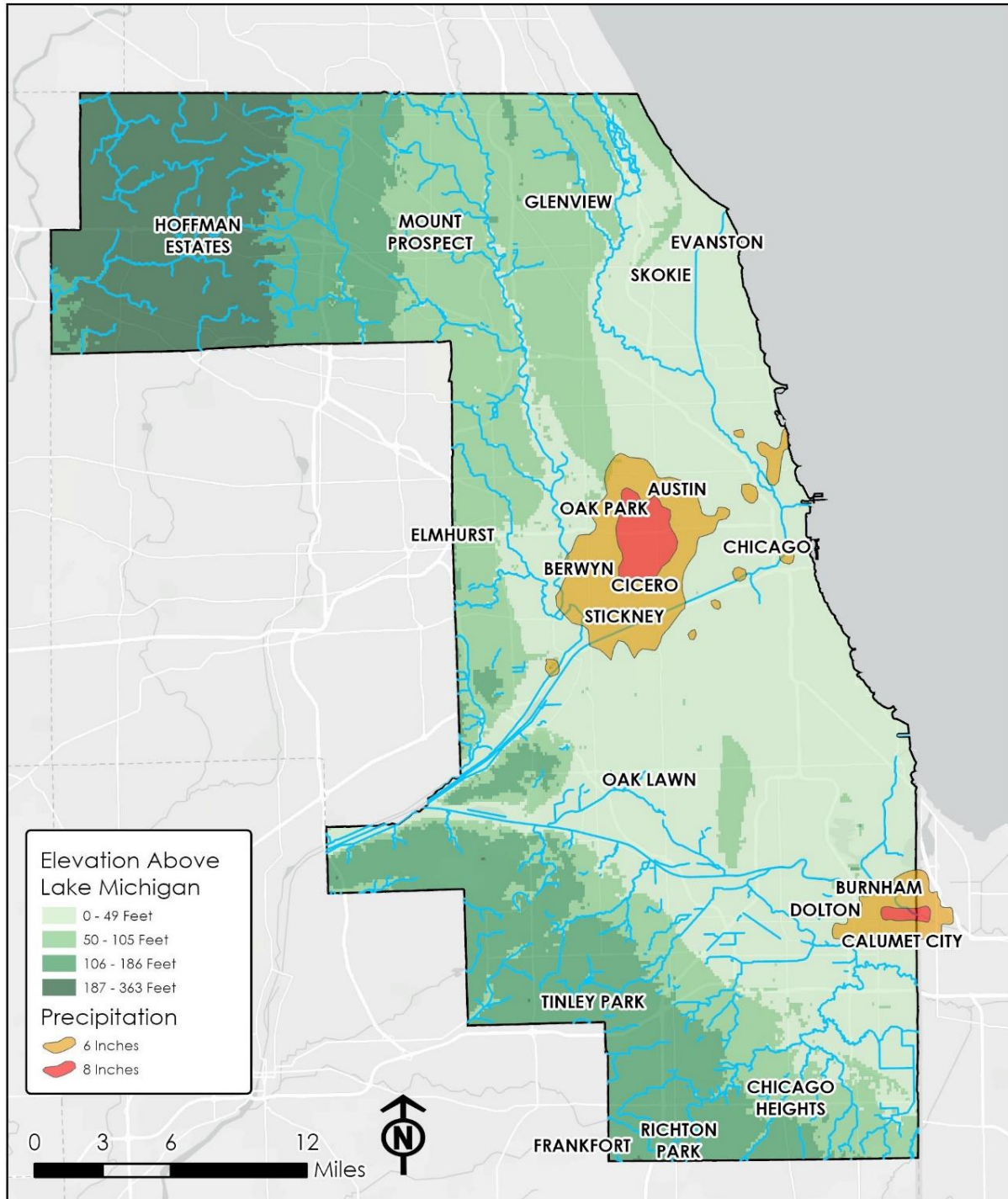


Figure 3. Topography of Cook County Showing Areas Where Heavy Rainfall Occurred on July 2 and September 17, 2023

3. Lessons From Past Urban Flooding Events

FEMA deploys MATs to conduct engineering analyses after a major storm or other natural hazard to assess damage to homes, businesses, critical facilities, government facilities, and other structures, and determine the causes of failures and successes. Based on their findings, the team will prepare recommendations regarding building codes and standards, building design issues, and best practices that communities and the construction industry can use to reduce damages in future disasters. FEMA's MATs investigate building performance for all natural hazards including earthquakes, hurricanes, tornadoes, winter storms, wildfires, and flooding. Recent MATs have investigated building performance for events similar to the 2023 flood events in Cook County. These include the following:

- In 2021, the remnants of Hurricane Ida struck New York City (NYC) and caused extensive street flooding in many neighborhoods. Many commercial buildings, multi-family buildings, and single-family homes with below-grade areas were flooded.
- In 2017, Hurricane Harvey stalled over Houston, TX, for nearly a week. In some areas, as much as 72 inches of rain were measured. The basements of many commercial buildings flooded, and many homes constructed with slab-on-grade foundations were damaged.

3.1. Hurricane Ida and Basement Flooding in NYC

Remnants of Hurricane Ida moved through the NYC Metropolitan Area on September 1, 2021, overwhelming local stormwater drainage and combined sewer systems. Significant urban flooding caused damage in many parts of the city. FEMA deployed a MAT to visit some affected areas and assess the damage.

During the storm, the peak rainfall intensity in Central Park was 3.15 inches per hour, with a total of 7.13 inches of rain over a 24-hour period. Nearby in Newark, NJ, a total daily rainfall of 8.32 inches was measured. NYC reported 13 fatalities attributed to the flooding, of which 11 were from drowning in basements of single- and multi-family residential buildings.

Heavy rainfall overwhelmed the stormwater drainage systems and caused significant flooding throughout NYC, including Queens, Brooklyn, the Bronx, and Staten Island. Queens, where most of the fatalities occurred, was particularly affected. In many areas, the city's combined sanitary and stormwater sewers were overwhelmed. Many older parts of those systems were designed to handle rainfall runoff from about only 2 inches per hour. Sometimes, surface water flowed toward buildings, entering the basements, cellars, and below-grade spaces of numerous homes, multi-family buildings, and commercial buildings. Some of these basements filled with water so rapidly that occupants had very little time to respond; many struggled to get out before the basements were fully flooded.

Basement Flooding Caution

If you live in a basement, garden apartment, or other below-grade space, you should be prepared to evacuate to a higher location whenever there is heavy rainfall. The rate at which a basement will flood depends on several factors. Sewer backup will be relatively slow because of the limited size of the sewer drainpipes. Surface flooding entering through depressed driveways, doors at the bottom of basement stairwells, or windows can be more rapid, taking just a matter of minutes to equalize with the water level outside. If an exterior wall of the basement collapses due to external water pressure, the basement can fill in less than a minute.

The MAT developed three reports and four fact sheets with information about the causes of basement flooding and how it can be mitigated. Residents and renters in the Chicago area may find these documents useful. The References and Resources section of this document lists the FEMA Hurricane Ida NYC MAT reports and fact sheets (FEMA P-2333), along with links to download the materials.

3.2. Hurricane Harvey and Flooding in Houston, TX

Hurricane Harvey made landfall over San Jose Island, just north of Port Aransas, TX, on August 25, 2017. At landfall, the storm was a Category 4 hurricane with estimated sustained winds of 130 miles per hour. Hurricane Harvey caused widespread damage to buildings, power distribution systems, and water utility services. Historically heavy rainfall caused extensive surface flooding and riverine flooding in southeastern Texas.

The damage caused by Hurricane Harvey flooding was extensive and significant. Flooding affected residential and non-residential buildings in areas mapped as floodplain, and many areas outside of those floodplains. In Harris County and its municipalities, including Houston, 22 percent of buildings experienced flood damage. Most of the damaged residences were slab-on-grade buildings, although some built on taller foundations were also damaged. Recently constructed houses suffered minor damage (mainly insulation and drywall), mostly because builders did not use materials that resist water damage.

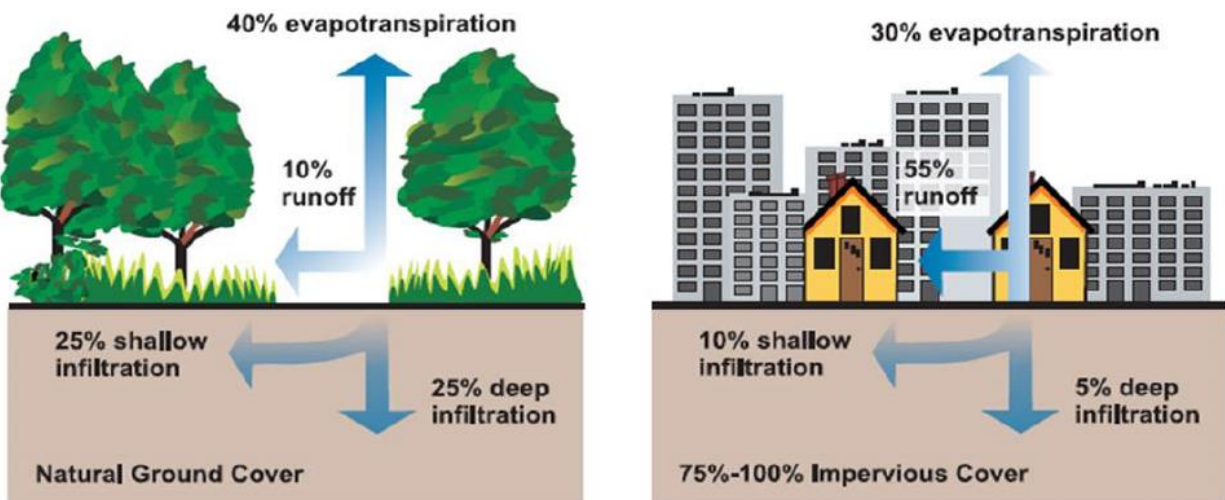
The MAT produced a report with many recommendations, including the use of flood damage-resistant materials for reconstruction and repairs. It also recommended that building owners install check valves or backwater valves to prevent wastewater from backing up into buildings when the sewer lines are overwhelmed. Residents and renters in the Chicago area may find these documents useful. The References and Resources section of this document lists the FEMA Hurricane Harvey MAT report (FEMA P-2022), along with a link to download the document.

4. Causes of Urban Flooding in Cook County

Most municipalities in Cook County rely on combined sewer systems to transport both sewage and stormwater to treatment plants. After treatment, the water is discharged into local waterways. Most municipal sewer systems were not designed to handle the runoff from very heavy and prolonged storms. That means parts of those systems are easily overwhelmed with high-intensity rainfall events. This is what happened during the July 2 and September 17 events.

4.1. Increasing Frequency and Intensity of Rain Events

During rain events outside of urban areas, the water is soaked up by the soil/ground, while the remainder runs off into streams, rivers, and lakes. But when rain falls in an urban setting with impervious surfaces, such as streets, parking lots, sidewalks, and building roofs, the majority runs off without soaking into the ground. Figure 4 illustrates how impervious surfaces alter the amount of rainfall that infiltrates into the ground, significantly increasing the amount of runoff.



Source: Federal Interagency Stream Restoration Working Group

Figure 4. More Impervious Surfaces Mean More Runoff

Urban areas have stormwater drainage systems in place to collect and remove stormwater runoff. However, these systems are typically designed to carry the runoff from a 2-year or 5-year rainfall event. In the Chicago area, those rainfall events are 1.43 to 1.80 inches per hour, compared to 3.07 to 3.87 inches per hour for 100-year and 500-year rainfall events, respectively (<https://hdsc.nws.noaa.gov/>). When more intense rainfall occurs over a short period, or sustained heavy rainfall occurs over a longer period, the drainage systems are often not capable of handling the runoff. Instead, stormwater accumulates in low-lying areas, resulting in urban flooding. Relatively flat urban areas are more likely to experience urban flooding because rainwater runs off more slowly than it does in hillier areas.

As the climate changes, storms that produce heavy and intense rainfall are expected to happen more often. They may also be more intense than experienced in the past. This means that future storms are more likely to overwhelm the existing stormwater drainage systems and combined sewer systems, leading to more frequent and more severe urban flooding.

4.2. Undersized Stormwater Drainage Systems and Surface Flooding

During the 2023 storms in Cook County, the runoff from heavy rainfall overwhelmed the stormwater drainage system in many areas. This resulted in the accumulation of surface water on roadways and sidewalks, particularly in lower-lying areas. In some places, the runoff overtopped curbs and entered building basements and below-grade areas.

Most urban stormwater drainage systems in the United States were not built to handle the amount of runoff from increasingly intense storms and associated heavy rainfall. Many systems are decades old and may not be well maintained. Upgrading undersized stormwater drainage systems is expensive and cannot be achieved quickly. Accumulating trash and leaves in gutters, storm drain inlets, and catch basins restricts stormwater flow and adds to surface water problems. This can block the flow of runoff, which sometimes prevents the water from draining away quickly.

4.3. Sewer Systems and Backup Flooding

According to the Metropolitan Water Reclamation District of Greater Chicago (MWRD), most local sewers in the Greater Chicago area were built over 100 years ago, well before wastewater treatment existed. Until the MWRD built intercepting sewers and treatment plants in the early part of the 20th century, local sewers flowed directly into waterways. Today, MWRD works to keep sewage from entering the waterways. However, most of the local sewers (especially combined sewers) must carry much more water today than they did when they were first put into service. That means it doesn't take much runoff to exceed their flow capacity, causing backups.

Sewer systems that serve most parts of Cook County are combined sewer systems. These systems combine sanitary sewage and rainfall runoff (stormwater) in the same pipes. Homes, businesses, and street drains are connected to the local sewers, which are owned and maintained by municipalities. Local sewers flow by gravity into the intercepting sewers owned by MWRD, which then convey the flow to MWRD water reclamation plants for treatment (Figure 5).

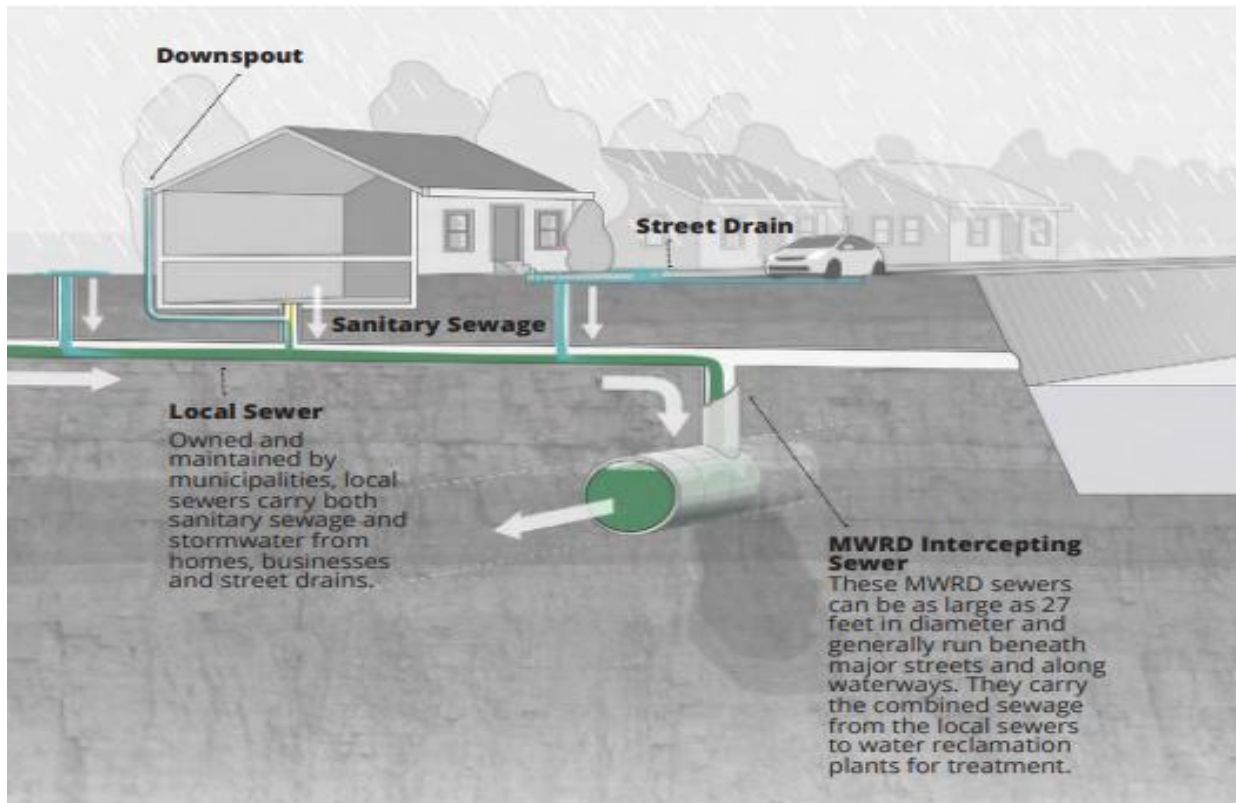


Figure 5. Combined Sewer System (Credit: MWRD)

During heavy rainfall, flooding, or when there is a blockage in the lateral connection pipes on private property or in the municipal sewer system, the sewage can start to flow back into basements through floor drains, toilets, sinks, or any other plumbing fixtures that connect to the sewer line. Backups are usually caused when there is not enough flow capacity at some point in the larger sewer system. Simply put, backups happen when the system cannot drain as quickly as it is being filled.

WHAT IS A LATERAL CONNECTION?

The pipe that connects your home to the local sewer system is called the lateral or lateral connection (Figure 6). Your lateral connection is usually 4 to 6 inches in diameter and made of clay, cast iron, or plastic, depending on the age of your building. **This lateral connection is your property, and it is your responsibility, or the responsibility of the building owner, to keep it in serviceable condition.** If your lateral connection is blocked, sewage may back up into your home, even when the local sewer system is flowing freely.

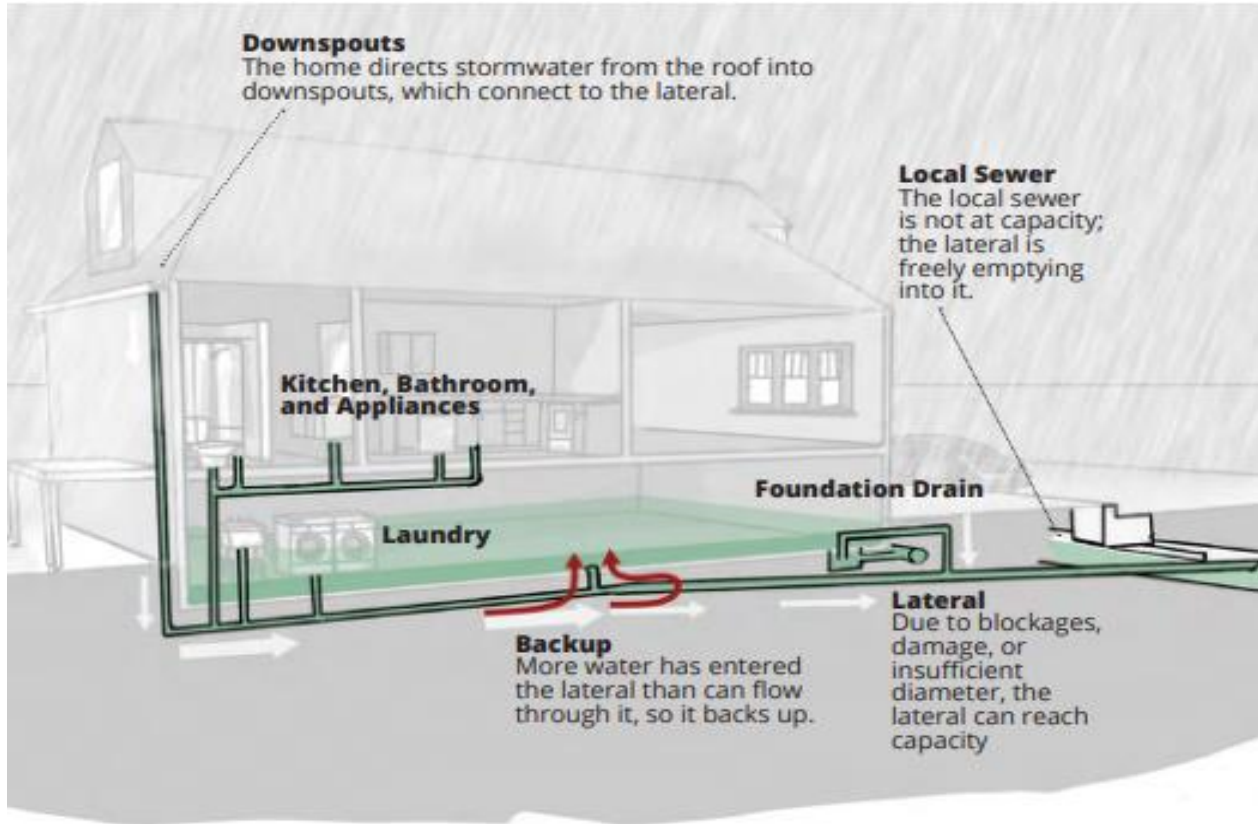


Figure 6. What is a Lateral Connection? (Credit: MWRD)

5. Efforts to Mitigate Flooding in the Greater Chicago Region

Cook County and some municipalities and organizations actively work on various strategies to reduce the impacts of flooding. These include construction of large-scale drainage and stormwater storage facilities, installation and improvement of local stormwater drainage systems, requiring new development projects to install separate sewer and stormwater systems, and encouraging nature based or green infrastructure. The objective of green infrastructure is to reduce runoff during rain events to minimize the amount of water that enters drainage and stormwater systems. Efforts to mitigate flooding will continue to be crucial as climate change and urban development pose ongoing challenges for urban stormwater drainage systems. FEMA provides funding opportunities for states and communities through the Building Resilient Infrastructure and Communities (BRIC) grants.

2024 Cook County Multi-Jurisdictional Hazard Mitigation Plan

The purpose of the [Cook County Hazard Mitigation Plan](#) is to:

- Ensure Cook County, Illinois, and the participating jurisdictions qualify for federal funding, before and after a disaster occurs.
- Identify common threats and hazards the County faces.
- Develop common mitigation strategies, ensuring a comprehensive and county-wide approach is used.
- Develop intergovernmental partnerships within the County.
- Gain public insight and share public information, increasing residents' knowledge and preparedness against the County's threats and hazards.

FEMA Funding Opportunities

FEMA provides funding opportunities for states and local communities through [BRIC](#) grants.

5.1. Sewer and Stormwater System Improvements

Some municipalities in the Chicago Metropolitan Area work to improve the performance of their combined sewer systems through regular maintenance. They identify and remove restrictions that can reduce the flow capacity. They also install larger storm drain inlets and pipes in areas that are known to have local drainage problems. Many municipalities also actively implement measures to reduce the amount of stormwater that enters their combined sewer systems. These include increased green space and permeable pavement to absorb rainwater and reduce the amount of runoff.

The Addison Creek Watershed flood reduction project is an example of a local effort to improve stormwater drainage and control flooding in communities along the creek. In June 2023, FEMA Region 5 awarded the MWRD a \$9.9 million grant to help fund the project. The MWRD will deepen, widen, and stabilize the lower reaches of the creek affected by the increase of impervious surfaces in the upper areas of the watershed (due to many years of urban development). Also, the higher capacity of the creek will accommodate higher runoff rates caused by climate change and warmer and wetter weather in the future.

Both MWRD and the City of Chicago require that developers of new housing and commercial projects install separate systems for sanitary sewerage and stormwater drainage. Sanitary sewers lead to wastewater treatment plants, while stormwater sewers discharge directly into waterways. Separated

systems are less likely to cause backup of sanitary sewage in buildings, but they can still experience surface flooding if the stormwater system is overwhelmed by runoff from intense storms and heavy rainfall. This is a key reason why municipalities encourage green infrastructure and other measures that reduce rainfall runoff. MWRD and the City of Chicago also require that new developments include stormwater detention systems to reduce the amount of runoff during heavy rainfall.

WHAT IS THE TUNNEL AND RESERVOIR PLAN (TARP) AND HOW DOES IT HELP EASE SEWER BACKUPS?

TARP, also known as “The Deep Tunnel,” was developed by the MWRD starting in 1972 and is anticipated to be completed in 2029 at a total cost of 4 billion dollars. It was funded by a combination of federal and state funds and property taxes based on assessed property value. TARP is a system of deep, large diameter tunnels and vast reservoirs as shown in Figure 7. The deep tunnels collect overflow water from local combined and sanitary sewer lines through dropshafts as shown in Figure 8. They carry the water to large reservoirs where it is stored until it can be pumped up to the water reclamation plants for treatment and discharged into local waterways.

The TARP system is designed to improve water quality in Chicago area waterways, and protect Lake Michigan from pollution caused by sewer overflows. In some areas, TARP helps reduce local flooding. All local combined sewer systems in the MWRD area of responsibility are connected to the TARP system, including over 90 percent of Cook County.

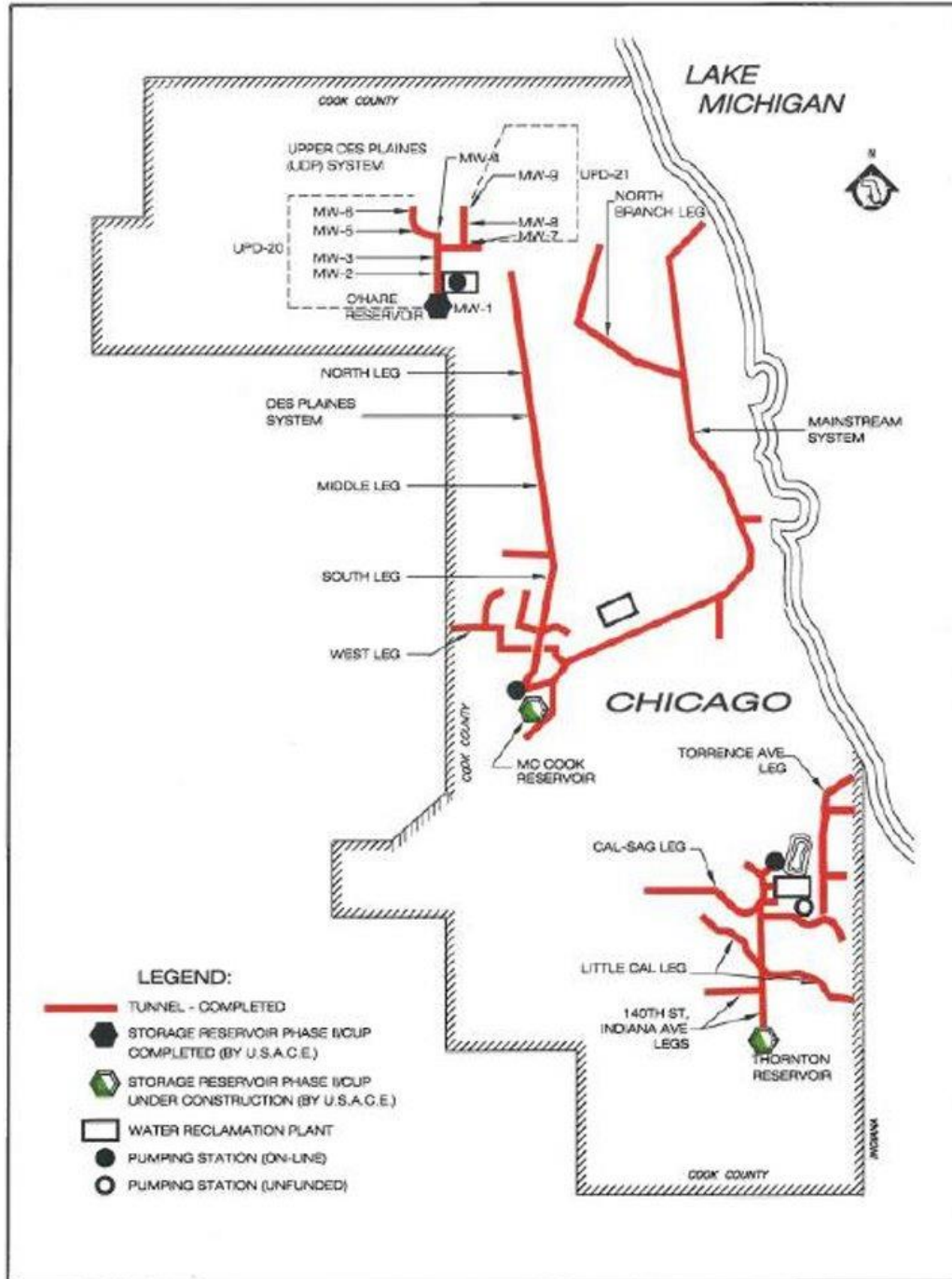


Figure 7. Map of MWRD TARP System

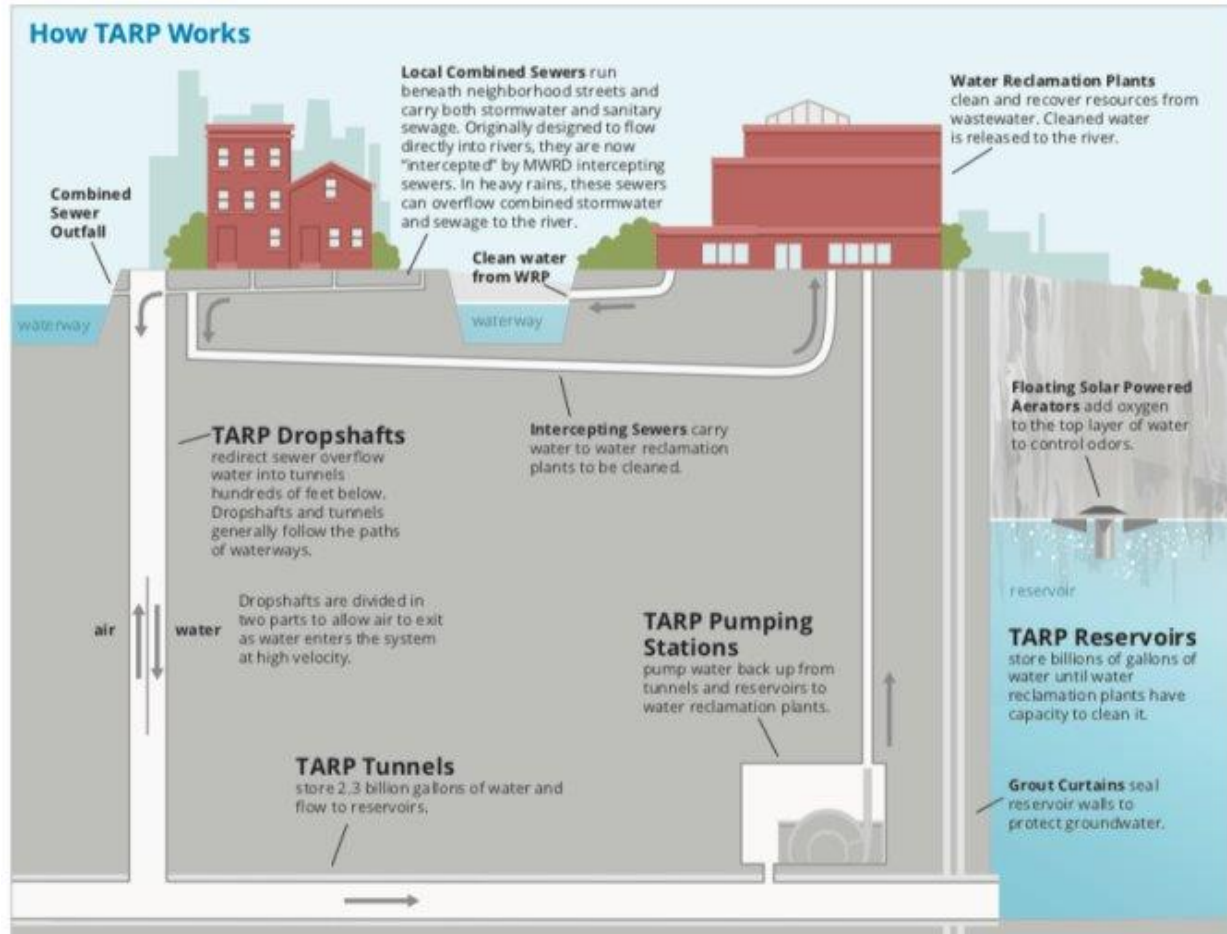


Figure 8. Schematic of TARP System Operation

TARP has the capacity to accommodate all but the most extreme and sustained rainfall events. However, there are times when combined overflows and sewer backups may occur because:

- Many municipal sewer systems reach capacity and are overwhelmed before the flows reach the TARP interceptors. This contributes to local sewer backup and local flooding.
- TARP can be overwhelmed if there are back-to-back heavy rainfall events without time to treat and discharge water from the reservoirs. Treatment of reservoir water must wait until after the rainfall ends because treatment plants are already busy with incoming wastewater. When the reservoirs are 100 percent full, it can take up to a week to process all the wastewater. Under extreme conditions, untreated sewage is released into Lake Michigan.

There appears to be a common misconception that TARP only serves parts of Cook County and is not relieving flooding in other areas. All municipalities in the MWRD service area are connected to the TARP system but limitations remain in the local collection systems that are connected to the TARP. The urban flooding experience in Cook County is more commonly the result of capacity limitations in local sewer systems, and not on the amount of stormwater and sewage that the TARP can store.

5.2. Nature-Based and Low-Cost Solutions

Nature-based solutions to reduce flooding are actions that use features of the land to manage rainfall runoff. Rain that falls on pavements, concrete surfaces, and building roofs runs off to streets and storm drains, instead of soaking into the ground. Nature-based solutions, sometimes called green infrastructure, can help keep runoff out of storm drains. This can benefit areas like Cook County, where many municipalities have combined sewer systems that transport both sewage and stormwater to treatment plants.

WHAT ARE SOME EXAMPLES OF ONGOING EFFORTS TO REDUCE FLOODING?

The City of Chicago, Cook County, and various municipalities and organizations in the Chicago Metropolitan Area have programs that support reducing flooding and stormwater problems. Only some of those initiatives are described here.

The Chicago-based Center for Neighborhood Technologies (CNT) manages the RainReadySM program to work with communities and property owners to implement improvements to address sewer backups, seepage and building dampness, and yard and street flooding.

- RainReadySM Home programs were established by the villages of Oak Park and Wilmette to provide RainReadySM Home assessments and matching grants to install rain gardens and other nature-based solutions.
- The Calumet Corridor project is a community-centered plan to reduce flooding in the corridor through coordinated investment in private homes, public spaces, and regional infrastructure. The CNT, with funding from Cook County, collaborates with the County and Greenprint Partners to implement green infrastructure projects in six RainReadySM communities in the Calumet Corridor: Blue Island, Calumet City, Calumet Park, Dolton, Riverdale, and Robbins.

RainReady Program

Learn more about RainReadySM actions homeowners can take and download fact sheets at <https://cnt.org/rainready/guidance>. Projects completed by the Center for Neighborhood Technologies illustrate the range of its support for communities and homeowners in the Chicago Metropolitan Area: <https://cnt.org/rainready/our-projects>.

The MWRD works with Chicago Public Schools to include green infrastructure principles and ideas as part of the “Spaces to Grow” program. Since 2014, 34 school site redevelopment projects have added permeable pavements and synthetic turf field systems with sand filters. These projects encourage infiltration of stormwater into the ground, which delays the flow of rainfall runoff to the streets and the combined sewer system.

The Village of Oak Park manages a Sewer Backup Protection Grant Program to provide financial assistance to homeowners who install systems to protect their homes from sewer backup during a heavy rain event. The objective is to offset a portion of the expense of modifying plumbing systems to prevent backflow when village sewers are at capacity. Eligible homeowners may qualify for a grant of 50 percent of the total cost of sewer backup prevention improvements (up to a maximum of \$3,500) for installing either an overhead sewer system or a backwater valve system. Oak Park residents can learn more by contacting the city at housing@oak-park.us or (708) 358-5410.

WHAT CAN HOMEOWNERS DO?

A good first step is to check whether your municipality has information and technical support to help you decide which actions you can take to reduce stormwater flooding. The Center for Neighborhood Technologies publishes guidance for homeowners, available online at <https://cnt.org/rainready/factsheets>. If you rent your home, you can take some of these measures on your own, but you should talk to your landlord about measures that affect the building.

- **Reduce your water use when severe storms are predicted.** If the water you use in your home drains to combined storm sewer systems, the less you use before, during, and after rain events, the less likely the sewers will overflow and back up into homes. Sign up to receive text alerts when heavy rains are forecast at <https://mwrld.org/community-action/overflow-action>.
- **Disconnect downspouts from storm drains.** Changing your roof downspouts to allow runoff to flow away from your building to grassy areas and plantings on your property keeps that water out of the combined storm sewer system. The less water in the sewers, the less likely there will be sewer backups in homes. Add rain gardens and bioswales made of porous soils with plants that absorb a lot of water to help runoff soak into the ground.
- **Direct downspouts to rain barrels,** Rain barrels capture rainwater from your roof to save it for later use to water your garden and lawn, or to wash your car. When you empty rain barrels before anticipated storms, you will capture more runoff, which could help reduce street flooding and reduce the likelihood that the combined storm sewer system will overflow and back up into homes. The MWRD Rain Barrel Program offers low-cost rain barrels to Cook County residents. Learn more and order your rain barrels at <https://mwrld.org/community-action/rain-barrels>.
- **Make driveways and parking areas soak up rainfall.** Changing concrete and asphalt surfaces to permeable pavement or other materials will allow rainwater to soak into the soil below. This can reduce some rainwater runoff, which can reduce street flooding.

6. Get Ready Before the Next Storm

Whether you are a homeowner or renter, you can do a number of things now to be better prepared for the next storm.

- **Monitor Weather Conditions.** Stay informed about weather conditions, especially when heavy rainfall is predicted. If you are expecting severe weather, you can take actions to reduce damage. Sign up to receive text alerts when heavy rain is forecast at <https://mwrdd.org/community-action/overflow-action>.
- **Family Safety.** Update your family emergency plan and make sure occupants of basements and garden apartments know to pay attention to storm warnings and evacuate before flooding occurs.
- **Make a Rainy Day Checklist.** Consider what you already know about how sewer backup flooding or surface water flooding can affect your home. If you have experienced flooding before, think about what got damaged and what you had to do to clean up and recover. Take time now to use what you know to make a checklist of things to do when severe storms are predicted. The checklist below is a starting point.

<i>Homeowner's Rainy Day Checklist</i>
<input type="checkbox"/> Check storm drain inlets in the street and clear leaves and trash so they can flow freely. Contact your local maintenance department if it looks like catch basins need to be cleaned out.
<input type="checkbox"/> Check floor drains in basements and outdoor stairwells, clear debris, and move anything that might block them.
<input type="checkbox"/> Move valuables and important papers to higher levels.
<input type="checkbox"/> Move clothing, bed linens, and other fabrics to higher levels.
<input type="checkbox"/> Move light furniture to higher levels or on top of counters and tables.
<input type="checkbox"/> Use heavy-duty plastic bags to protect things that can't be moved to higher levels.
<input type="checkbox"/> Check that you have enough cleaning supplies and disinfectants.

- **Install a Water Alarm or Sensor.** Install a flood sensor to detect sewer and stormwater backups and alert you when flooding occurs. Sensors should be placed in low areas near floor drains and plumbing fixtures that are at risk of sewer backups. Flood sensors and alarms can range from simple, low-tech alarms (sound only) to relatively hi-tech alarms (capable of communicating or sending alerts to phones). Sensors should be connected to the home's electrical system and have batteries to allow them to function when power is lost. Alarms and sensors will not stop sewer backup flooding, but they may help you limit damage to your property by giving you enough notice to move things that could be damaged.
- **Review Your Insurance Coverage.** Review your homeowner's or renter's insurance policy or call your agent to understand what coverage you might have for sewer backups and water damage. Consider additional coverage if available to cover those types of losses. Insurance is one way to protect yourself financially in the event of a sewer backup. Most insurance policies cover sewer

backup caused by blockage of lateral connection lines, but generally do not cover damage from sewer backups caused by flooding.

Check Out National Flood Insurance Program (NFIP) Flood Insurance Coverage

Property owners in communities that participate in the NFIP can purchase NFIP flood insurance policies. For example, all of Cook County and incorporated communities within the County participate in the NFIP, which means that all property owners can purchase NFIP insurance regardless of flood zone. Contact your insurance agent to find out more about the availability of NFIP flood insurance and coverage. Also, you can visit <https://www.fema.gov/flood-insurance> to learn about policies offered by the NFIP. NFIP policies generally cover damage to your building and systems caused by qualifying flood events. Separate policies are available for contents that may be damaged by flooding.

NFIP flood insurance policies offer limited coverage for basements. Learn more here: <https://www.fema.gov/fact-sheet/what-does-flood-insurance-cover-basement>.

7. Assess Your Home for Mitigation Opportunities

Before you consider how to mitigate or reduce flood damage, you need to know how water gets inside your home and how deep it might get.

7.1. How Does Floodwater Get Inside Your Home?

You may already know from experience how water gets inside your home. It may be sewer backup, or it may be surface flooding that comes from outside. Still, a good first step is to look at your home and nearby area to see what contributes to your flooding.

The checklist on page 21 identifies some key things to look for, but each building is different, and one checklist can't identify everything you should pay attention to. Start by reading the descriptions below to determine whether your home has a basement, is a garden apartment, or is built on a concrete slab foundation.

BUILDINGS WITH BASEMENTS

Many buildings in Cook County have basements or other below-grade areas. These areas are where equipment and appliances are commonly located, such as water heaters; furnaces; boilers; and washers, dryers, and freezers. Some of these below-grade areas, such as garden apartments (as defined below), are used as living spaces.

During extreme rainfall events, stormwater and sewage can back up into basement areas through the sewer drain lines. Although some buildings with basements may have sump pumps, those pumps are not designed to handle large amounts of water, nor will they work when electricity is off. You would need to add battery storage or a generator if you want the sump pump to work during a

power outage. Figure 9 shows details of a typical sump pit with submersible pump to drain water from a basement. Guidance on the safe use of generators is provided at <https://www.fema.gov/fact-sheet/use-generators-safely-home>.

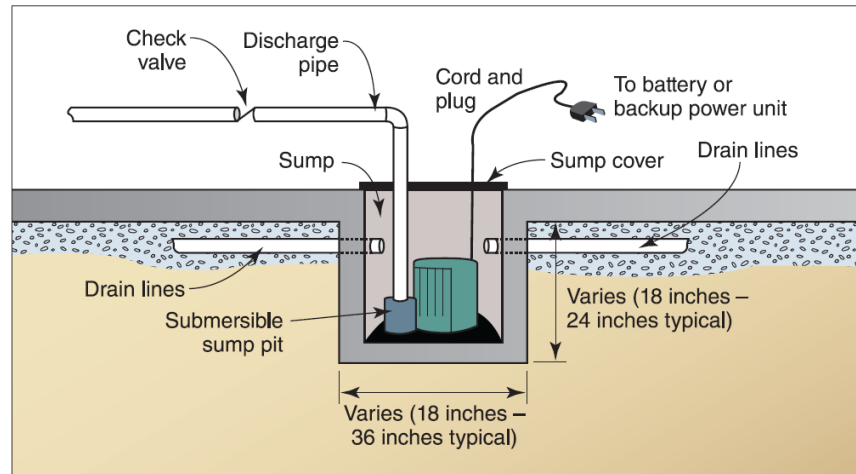


Figure 9. Typical Sump Detail (from FEMA P-936)

Stormwater may also enter basements through windows, air vents, and other openings that are close to the ground surface. Surface water may accumulate and flow over exterior stairway thresholds. Figure 10 shows how surface flooding entered a home through a small basement window that is only inches above the ground.



Figure 10. Single-Family Home Basement Exposed to Surface Flooding Through Window Openings

BUILDINGS WITH GARDEN APARTMENTS

Many multi-family residential buildings in Cook County have ground-floor apartments with direct access to the outside. These apartments may be called “garden apartments” or “walkout apartments.” Sometimes, the floors of the apartments are 2 to 4 feet below the exterior ground level.

Garden apartments are particularly vulnerable to both sewer backflow and surface water entry. Figure 11 shows a typical three-story multi-family residential building where the lowest level, or garden apartment, is set approximately 2 feet below grade.

Garden apartments typically have a number of points of possible entry of surface water, including the front and back doors, and windows that have sashes only inches above the ground. They may also be vulnerable to stormwater and sewage backup. Because the interior is fully finished, any water entry could damage flooring, wall materials, electrical outlets, furnishings, and personal items left below the exterior grade level. Garden apartments typically do not have sump pumps to remove water that leaks through the side walls.



Figure 11. Typical Multi-Family, Three-Story Building with Garden Apartment Below Ground Level

BUILDINGS WITH SLAB-ON-GRADE FOUNDATIONS

Many homes are built on concrete slab-on-ground foundations that rest on the ground. The top of the slab is often only a few inches above the exterior grade. When surface water is more than a few inches deep, it can flow through doorways or seep through wood-framed walls. Figure 12 shows a typical slab-on-ground foundation home where surface flooding was about 12 inches above the threshold of the door.



Figure 12. Surface Flooding was 12 Inches Above Door Threshold of This Slab-on-Grade House

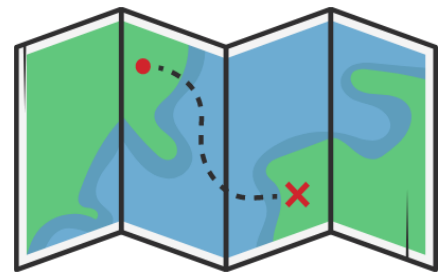
<i>Checklist to Identify How Water Gets Inside Your Home</i>	
<input type="checkbox"/> Are nearby street gutters and storm drain inlets blocked by trash and/or leaves?	If yes, check the city street sweeping schedule. Clean up trash and/or leaves before the next storm.
The next time it rains, watch where the runoff flows: <input type="checkbox"/> Could runoff flow toward your building? <input type="checkbox"/> Has your building had water in it before?	If the answer to either question is yes, look closely and answer the next questions about how water might get into your building.
Are there any obvious places where water could flow into your building? Answer the following questions:	Walk around your building, take notes on what you see, and take photographs. Use this checklist to identify possible problems.
<input type="checkbox"/> Are any windows, window wells, vents, exterior basement stairways, or doors to patios below the ground level or close to the ground?	Does it seem feasible to permanently block any opening where water can enter? Section 10 explains some options for doing this.
<input type="checkbox"/> Are the downspouts disconnected from the sewer drains and directed away from the building?	Redirect downspouts so that water drains away from the building.
<input type="checkbox"/> Look in all parts of your home that are below the ground outside, including basements and garden apartments. Can you see any cracks in the walls, the floor, or where the walls join the floor? Is there evidence of water seeping through cracks?	Cracks could indicate existing damage due to lateral earth pressure on the outside of the wall. Some older homes have unreinforced basement walls that can buckle or collapse. Solutions to these problems usually require the advice of an architect, engineer, or experienced contractor.
<input type="checkbox"/> Does your basement have a sump pump? Has water ever backed up through the floor drain? Does the sump pump have battery backup? Is there an alarm to warn you that the water level has risen above the top of the sump? Is the sump pump maintained annually?	Talk to an experienced plumbing contractor about whether a backflow preventer in the drain line would help.
Is your home lateral connected to a combined sewer? If so, answer the following question:	Make sure that the lateral is inspected regularly and cleaned of any tree roots, grease, or other objects that could block the flow and result in a sewer backup.
<input type="checkbox"/> Does the lateral have a check valve, gate valve, dual backwater valve, or overhead sewer to prevent sewer backup?	If yes, ensure that they are maintained annually. If no, consult a plumber about which sewer backup prevention system is best for your home.

7.2. How Deep Could the Water Get?

After you determine how water might get into your home, the next step is to estimate how deep the water could get the next time. The answer depends, in part, on whether your property is or is not in a mapped floodplain.

In Cook County, many low-lying areas and neighborhoods near rivers and streams are in flood hazard areas that are shown on flood hazard maps produced by FEMA. These maps can be used to determine the expected water depth for the 100-year flood. A larger area is not “in” the mapped floodplain but might still be subject to flooding from heavy rains, sewer backups, clogged street inlets, and stormwater runoff.

Municipalities regulate the mapped floodplain. That means you may need to get a floodplain management permit to do work if your home is in the mapped floodplain and also has had sewer backup flooding or surface flooding.



MY PROPERTY IS NOT IN A MAPPED FLOODPLAIN.

There is no one way to estimate how deep water might get in your home when the source is sewer backup or surface flooding. There are a few things to consider:

- If you had water in your home before, assume the depth of water you had before is the minimum likely depth, and add another foot or two.
- If the lowest floor of your home sits below the street curb, consider that stormwater could overtop the curb. That means you should use the height of curb above the floor as the approximate depth of water. If that's difficult to estimate, assume the depth is a foot or two above the floor.
- If your home has a basement, the depth of water could range from a few inches to several feet. There is no easy way to estimate, in part because it depends on the source of flooding. Sewer backup flooding could rise higher than a toilet or sink that overflows with sewage. Surface water flooding could fill a basement, depending on how long a storm lasts. You can assume the depth is 2 to 3 feet above the floor.
- If you live in a garden apartment, you could estimate that the water could get deeper than the height of the ground level outside of your windows.
- In all cases, you should anticipate that floodwater could be at least 2 to 3 feet deep.

MY PROPERTY IS IN THE MAPPED FLOODPLAIN.

You can enter your address online at <https://msc.fema.gov/portal/home> to find the FEMA flood maps for your location. If your home is in a mapped floodplain, and you experienced sewer backup or

surface flooding, then you should do two things to estimate the depth of flooding. First, look at the suggestions for homes that are not in the mapped floodplain. Given the expected increase in the number and severity of heavy rainfall events, you might decide it is beneficial to reduce your exposure to flooding caused by sewer backup or surface flooding, even though your home will still be vulnerable to flooding shown on the maps.

Next, you should learn more about what it means when your home is in the mapped floodplain. Visit your municipality's planning or building department to look at the floodplain maps and learn about requirements for permits. If your municipality has a floodplain administrator, this person can also help answer questions and advise on ways to mitigate flood hazards.

7.3. Wet Floodproofing

While it is not always possible to prevent flooding, there are some actions that you can take to minimize damage and speed up recovery when flooding occurs. These actions are called wet floodproofing.

WHAT IS WET FLOODPROOFING?

Wet floodproofing means using flood damage-resistant materials and construction techniques that intentionally allow floodwater to enter and flow into and out of your home without causing damage that requires more than cosmetic repairs. While the thought of allowing floodwater to enter your home sounds like a bad idea, there are situations where planning to get wet is better than doing nothing. You can read more about materials that resist flood damage by downloading FEMA Technical Bulletin 7, Wet Floodproofing Requirements and Limitations. Note that Technical Bulletin 7 has useful information that can apply to buildings in any location, even though it is written for buildings in FEMA-mapped floodplains.

Dry floodproofing may be an option for some buildings, although it is more difficult and expensive to implement. Dry floodproofing usually involves modification of building walls and special panels to install over doorways and windows. These measures typically are not used for residential buildings. FEMA P-936 provides information on floodproofing non-residential buildings.

HOW DO I WET FLOODPROOF MY HOME?

Wet floodproofing can involve modifying your home in several ways. It is important to note that by wet floodproofing, you are not making your home waterproof or reducing the chance that flooding will occur. It means taking practical action to reduce the amount of damage, which can lower the costs of recovery and speed cleanup. Because wet floodproofing is not an "all or nothing" approach, you can choose what works best for your home and you can take those actions in stages. Using even one wet floodproofing technique will be beneficial. Here are some common wet floodproofing actions:

- Use flood damage-resistant materials below the estimated flood level, in your basement, and on lower floors. These materials are described in Section 7.4.

- Elevate or relocate equipment, as described in Section 7.5.
- Have an electrician relocate electrical outlets higher above the floor to avoid water damage, minimize disruptions, and facilitate repairs.
- Seal potential openings for water to enter your basement, caulk windows, and make sure seals and weather stripping around doors is in good condition.
- Install a sump pump in the basement to remove accumulated water.

7.4. Use Flood Damage-Resistant Materials

Many materials in your home could be damaged when they come in contact with floodwater. Some materials that can be damaged include plaster, drywall, wood paneling, insulation, carpeting, wood flooring, and non-pressure treated wood and plywood. Consider the feasibility of removing these materials and replacing them with materials that are resistant to flood damage.

Flood damage-resistant materials are those that can be inundated by flood water with little or no damage. Using these materials can help reduce flood damage and facilitate cleanup to allow you to get back to normal as quickly as possible. Any material that does not soak up water and pollutants in floodwater can be used, including concrete, stone, masonry block, ceramic and clay tile, pressure-treated and naturally decay-resistant lumber, epoxy paints, plastics and resin products, composite materials, rubber or synthetic membranes, and metal. These materials are relatively easy to clean after floodwater has receded. You can read more about materials that resist flood damage by downloading FEMA Technical Bulletin 2, Flood Damage-Resistant Materials.

7.5. Elevate Equipment

Your home is served by appliances, mechanical, and electrical equipment that are critical to your safety and comfort, as well as the energy efficiency and performance of your home. This equipment might be located outside and inside areas of your home that are vulnerable to flooding, especially basements and garden apartments.

Typical equipment for homes and apartment buildings is not designed to be submerged in water or operate in the presence of water. In most cases, cleaning the equipment after flooding is not sufficient. The cost to replace equipment and appliances can be significant. One significant benefit of elevating equipment is that you won't need to take action when heavy storm activity is likely.

WHAT EQUIPMENT IS VULNERABLE?

Equipment that serves your home and appliances can be damaged when inundated by floodwater. The amount of damage will depend partly on the depth of flooding and the amount of time the equipment remains under water, but even a small amount of water can do damage. Often, the damage is so great that the only solution is replacement. The equipment you should think about includes:

- Furnaces, air handlers, and air conditioner compressors (Figure 13);
- Water heaters and water conditioning systems (Figure 14);
- Washers, dryers, and freezers (Figure 18); and
- Electrical components, including outlets and circuit panels.



Figure 13. Air Conditioner Compressor on Concrete Slab, Vulnerable to Flood Damage (Typical Installation Method Used in Many Parts of the Chicago Metropolitan Area)

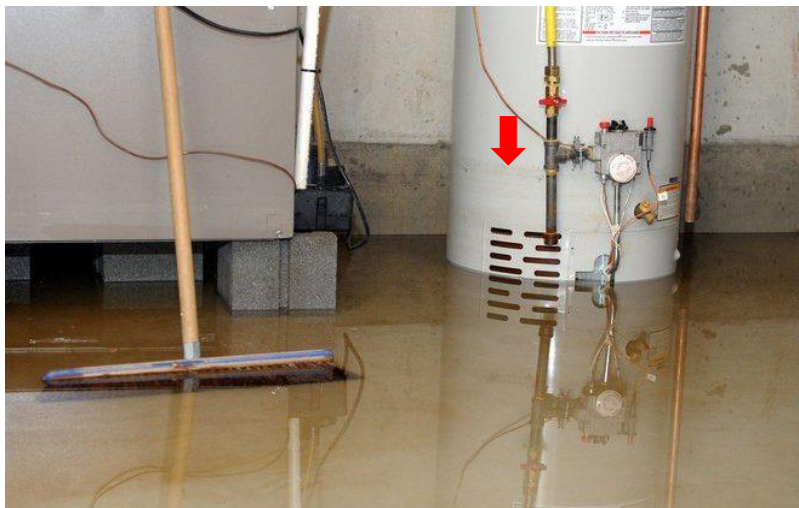


Figure 14. Water Heater in Basement Damaged by Surface Flooding (Water Depth Indicated by Staining on the Tank)

WHY ELEVATE EQUIPMENT, APPLIANCES, AND ELECTRIC OUTLETS AND PANELS?

- **Reduce Flood Damage.** Elevating equipment above potential flood levels can help protect them from direct contact with water. Floodwater can seep into appliances and systems, causing electrical malfunctions, corrosion, and irreversible damage.
- **Reduce Fire Risk.** If water gets deep enough to float equipment and appliances that are oil- and gas-fired, they can disconnect from the fuel source. That could mean oil and gas leaking into the home, which could lead to fire or explosion. Any electric equipment that gets submerged could be a fire risk if not inspected and cleaned or replaced before turning on the power.
- **Health and Safety.** Floodwater can be contaminated with various pollutants, including chemicals, sewage, and bacteria. When appliances and equipment are flooded, they can become breeding grounds for mold, mildew, and other harmful microorganisms. You reduce the likelihood of contamination by elevating equipment. Corrosion of electrical components, electric panels, and outlets can produce shocks or spark electrical fires. Elevating electrical components minimizes those risks.
- **Cost Savings.** Repairing or replacing flooded appliances and equipment can be expensive. You may avoid the cost of replacement by elevating equipment and appliances. In addition, avoiding flood damage can preserve the lifespan of the equipment, reducing the need for frequent repairs or replacements. Remember that manufacturer warranties may be void if appliances and equipment are submerged in water. This can compound the problem because defects may not be discovered until well after the flooding event.
- **Peace of Mind.** Knowing that your appliances and equipment in floodprone areas are less prone to flooding can reduce stress and anxiety when future storms are predicted. This allows you to focus on other important aspects of flood preparedness and recovery.
- **Insurance Requirements.** Some insurance companies encourage homeowners to take preventive measures against flood damage. If you elevate equipment, your home will be more resilient after future flooding, allowing you to recover more quickly. If you have an NFIP flood insurance policy, you may be eligible for premium discounts if you elevate equipment.

HOW DO I ELEVATE EQUIPMENT, APPLIANCES, AND ELECTRIC COMPONENTS?

The original placement of equipment, some appliances, and electric panels and outlets in and around your home was likely based on standard construction practices. Whether surface flooding or backup of stormwater and sewage might occur may not have been considered at that time. As a result, equipment and appliances are often located in areas where they will be exposed to floodwater, such as in basements or crawlspaces or at ground level outside the home. Elevating or raising equipment and appliances on platforms provides some degree of protection against flooding up to the level of the platform. Similarly, making sure electric panels are high enough and raising outlets can reduce damage and safety risks.

Protect Your Family and Your Investment – Get Permits and Hire Licensed Contractors

Some of the work necessary to elevate equipment, appliances, and electric components must be performed by qualified licensed contractors and technicians. Elevating some equipment requires changes in electric wiring and oil or fuel gas piping.

When you are ready to take action, be sure to check with your local permit office or building department to find out which permits are required. When you get a permit, the work will be inspected by building inspectors.

AIR CONDITIONER COMPRESSORS

The compressors for typical home heating and air conditioning systems usually rest on concrete slabs or pads. Ground-level platforms, even if a few inches tall, may not protect the equipment from floodwater. Wood platforms, masonry, or concrete pedestals (Figure 15a), and bracket mounts (Figure 15b) are different ways to raise compressors off the ground.

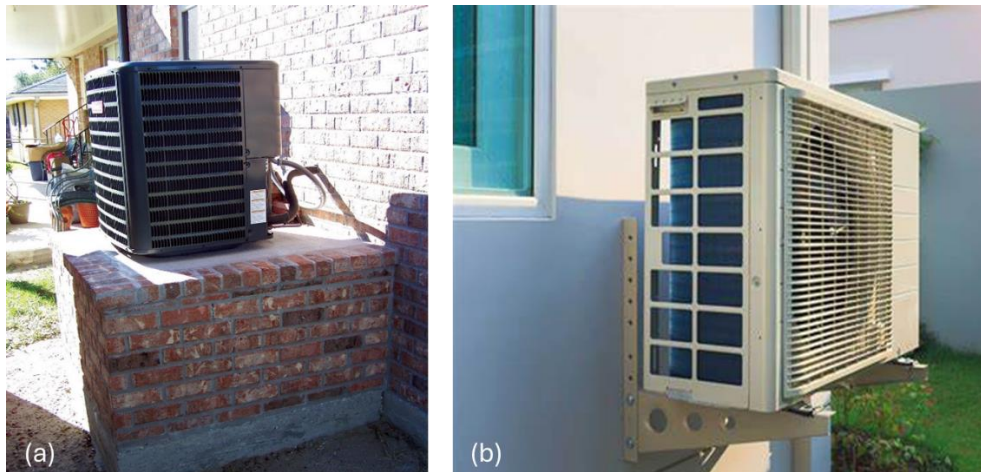
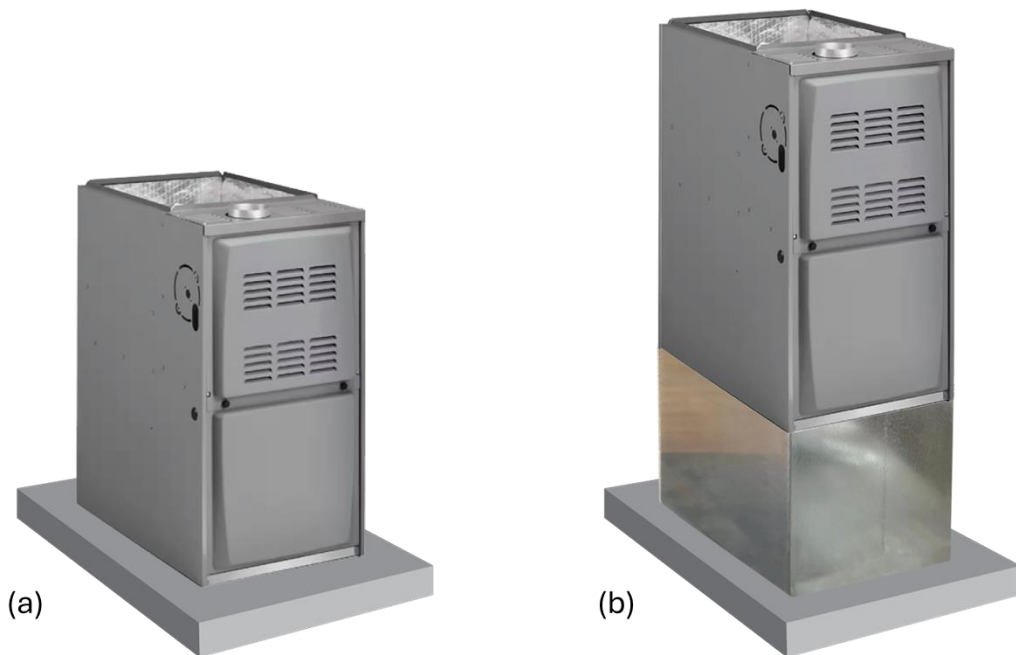


Figure 15. Air Conditioner Compressors Elevated (a) on a Pedestal, and (b) Using Wall Brackets

FURNACES AND BOILERS

Furnaces and boilers that are located in basements or crawlspaces may be susceptible to flooding, especially when they are installed directly on the floor. Furnaces and boilers may be elevated by using commercial furnace bases designed specifically for this purpose (Figure 16). Alternatively, on-site concrete or masonry pedestals can be constructed. In all cases, the equipment must be securely anchored to prevent movement. Some types of furnace units and air handlers may be suspended or hung from the floor joist framing in basement ceilings.



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Figure 16. Elevating Furnace from (a) Original Position on Shallow Pad to (b) Elevated Position on Metal Furnace Base

WATER HEATERS

Water heaters can be relocated to higher floors or elevated in their present locations by constructing platforms. All water heaters should be braced and strapped to the wall to prevent overturning or floating (Figure 17). There are some differences to consider based on the type of water heater:

- **Electric Water Heaters.** Elevating electric water heaters on platforms requires adjustments to the water supply and distribution pipes. Relocating heaters to a higher floor or attic requires plumbing and electrical work, as well as a method to drain the tank and prevent water damage from leakage.
- **Oil- and Gas-Fired Water Heaters.** Elevating oil- and gas-fired water heaters on platforms requires adjustments to the exhaust venting, the fuel supply piping, and the water supply and distribution pipes. That amount of work makes it more difficult to move them to higher floors.

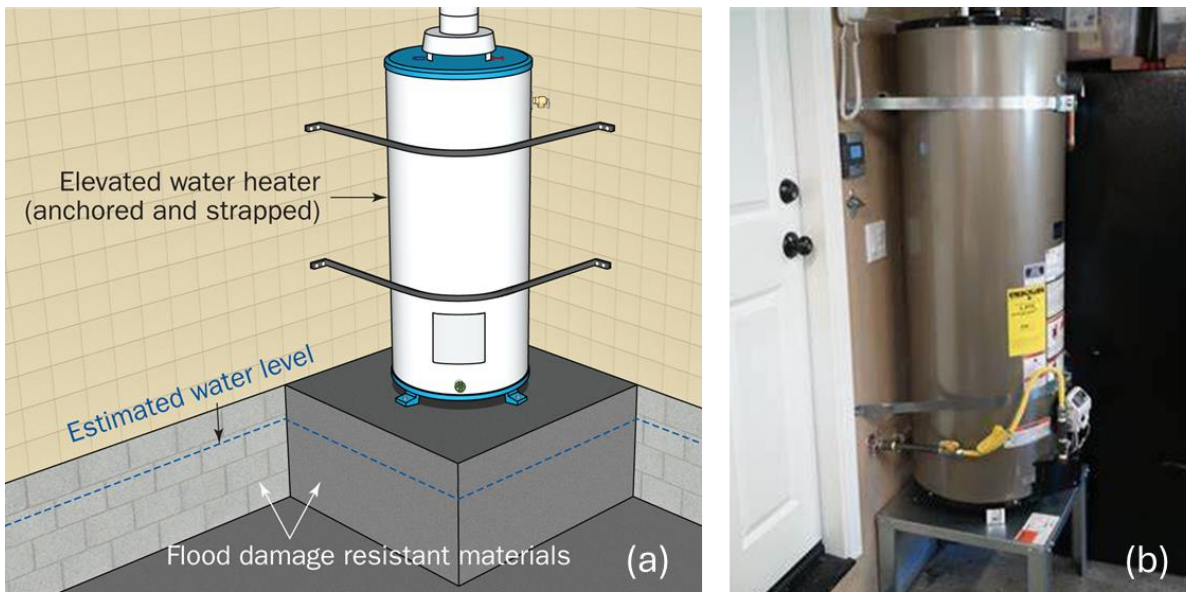


Figure 17. Water Heaters Elevated (a) on a Pedestal and (b) on a Platform with Bracing Straps Securing it to the Wall

ELECTRIC PANELS AND OUTLETS

Most homes have electric panels installed several feet above the floor, which means they are not vulnerable to low-level surface flooding and sewer backup flooding. However, if past flooding has damaged electric panels, or if the estimated depth of flooding could reach panels, they can be moved higher above the floor or to an upper level. This work must be authorized by permit and must be performed by a licensed electrician.

Electric outlets usually are less than 18 inches above the floor. Many older homes have outlets located in baseboards because it was easier to install the wiring along the floor than to open up the walls. If past flooding has damaged electric outlets, or if the estimated depth of flooding could reach outlets, they can be moved higher above the floor. This work must be authorized by permit and must be performed by a licensed electrician.

WASHERS, DRYERS, AND OTHER APPLIANCES

Many homes have washing machines, dryers, and freezers located in basements where they may be vulnerable to flooding. Relocating appliances to a higher floor may not be practical if space is limited in the living area. Even minimal elevation on risers or platforms provides some protection in low-level flooding situations. Risers are made by many appliance manufacturers. Permanent pads and platforms can be constructed to elevate appliances (Figure 18). Stacked bricks or blocks should not be used because they can shift and result in injuries or damage.



Figure 18. Washer and Dryer Elevated on a Wooden Platform (ASFPM, <https://www.reducefloodrisk.org/>)

8. Sewer Backup Mitigation

Homeowners who have experienced sewer backups during storms with heavy rainfall and flooding should get advice from a licensed plumber or your municipality's building department as to the best mitigation option to prevent backups. There are several options, but the best option for your home depends on a number of factors. It's also important to maintain the sewer lines you already have, including the lateral connection pipe that carries wastewater from your home to the municipal sewer line.

8.1. Maintain Your Plumbing and the Lateral Connection

Regular maintenance of your plumbing system, including the sewer lateral connection, can help prevent blockages and reduce the risk of sewer backups. Sewer lateral connections are described in Section 4.3. It's good practice to have a licensed plumber inspect and clean the sewer lateral from your home to the municipal system to remove debris and clear tree roots that may obstruct the flow (Figure 19). Many sewer laterals for older homes are made of clay or cast iron. If the inspection shows deterioration, the pipe can be replaced with modern materials that resist root intrusion, corrosion, and fractures.

Inside your home, keep basement floor drains clear of debris and obstructions. If a toilet, sink, or tub is slow to drain, the problem might be cleared with a plumber's snake. A plumber can snake drains from inside the house and from the cleanout access in the yard. If snaking doesn't solve slow drainage, the pipes beyond the reach of the snake are probably blocked, in which case the plumber should inspect the whole line.



Figure 19. Plumber Inspecting and Cleaning a Sewer Lateral

Be Aware of What Goes Down Your Drains!

Remind your household members about what should and should not be flushed down toilets. Don't flush objects, sanitary products, wipes, and excessive amounts of toilet paper. They can block your sewer pipes and lateral connection.

Don't pour grease, fats, and oils down your kitchen sink and don't grind meat and bones in your garbage disposal. Those materials can accumulate and clog the sewer lines. Dispose of them in your trash.

8.2. Install a Backwater Valve

Backwater valves are devices that allow wastewater and sewage to flow out of buildings but prevent flows from backing up into buildings during heavy rainfall and flooding situations when the municipal sewer mains are at capacity. Installing a backwater valve can be a very effective way to prevent sewer backup and protect your home.

Backwater valves typically are installed in the sewer lateral outside of buildings, in pits with access covers. Some valve types can be installed in basement floors, near where sewer lateral connections leave buildings. Plumbing permits are required for this work. The plumber will determine the best place to install a valve for your home and the appropriate type of valve. Remember, a backwater valve is part of the sewer lateral and therefore it is your property. It will not be maintained by the municipality. Depending on the type of backwater valve, you may be able to inspect and clean it every few years. For some valves, you will need to have a plumber inspect the backwater valve every couple of years to make sure it is still functioning correctly.

An Important Note About Water Use When Backwater Valves are Closed

When backwater valves close, water used inside your home will not drain out and could backup inside your home. When there is a risk of the sewer system becoming overloaded, such as during heavy rainstorms, avoid flushing toilets and using sinks, showers, the washer, dishwasher, and all other appliances that use water. The water will not be able to get past your backwater valve and will have nowhere to go except back into your home. It is also very important to disconnect your roof downspouts from the sewer lateral, as described in Section 5.2. A good way to know when to stop using water is to sign up to receive text alerts when heavy rains are forecast at <https://mwr.org/community-action/overflow-action>.

There are several types of backwater valves and many manufacturers. Three types of valves are described below. The types of valves include check valves, gate valves, and dual backwater valves.

CHECK VALVES

Check valves operate automatically without the owner having to do anything. Under normal conditions, they allow wastewater to flow from the home to the municipal sewer line. When flooding causes the flow to back up, a flap or other check mechanism in the valve is activated to prevent wastewater from flowing back into the home. Figure 20 illustrates a typical check valve.

A disadvantage of check valves is that they can be stuck open by debris and fail to operate. For this reason, check valves should be inspected every few years and cleaned, as necessary. You should be able to inspect your check valve and perform the cleaning and regular maintenance. Ask your plumber to give you maintenance instructions, such as how to flush the valve with water.

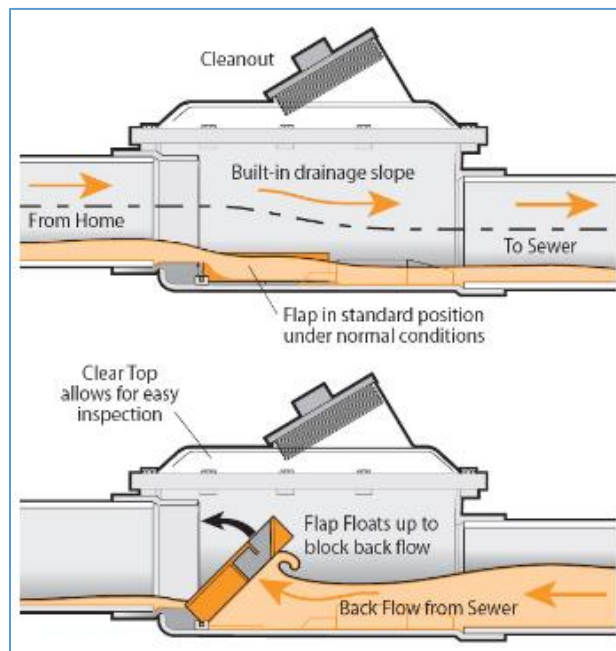


Figure 20. Typical Check Valve

GATE VALVES

Gate valves are manually operated, which means owners have to take action. They provide a better seal than check valves, and they are unlikely to be stuck open by debris. However, they are more expensive than check valves. Because owners must manually close them to be effective, gate valves don't provide everyday protection when you are not home or at night when you may not be aware that storms are expected. If you plan to be away for more than a day or two, you can shut the gate valve in case storms occur while you're gone. If you do this, you should also consider turning off the water supply to your home at the main shut-off. Figure 21 illustrates a typical gate valve.

Gate valves must be inspected and maintained periodically. To make sure they turn freely when needed, owners should open and close them occasionally. When you have a gate valve installed, ask your plumber to show you how to operate it and explain maintenance instructions.

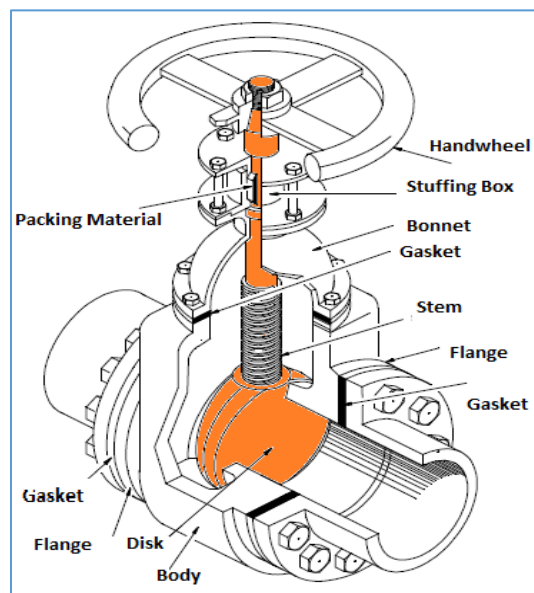


Figure 21. Typical Gate Valve (Credit: Slideshare.net)

DUAL BACKWATER VALVES

Dual backwater valves combine the benefits of check valves and gate valves. This type may be most effective in homes subject to repeated backflow flooding. Manually closing the gate valve when you're home provides the best protection, but when you're not home, the backwater check valve will automatically close. Dual backwater valve assemblies are usually installed outside the home in a valve pit. Figure 22 illustrates a typical dual backwater valve.

The inspection and maintenance of dual backwater valves is a combination of maintaining check valves and gate valves. When you have a dual backwater valve installed, ask your plumber to show you how to operate it and explain maintenance instructions.

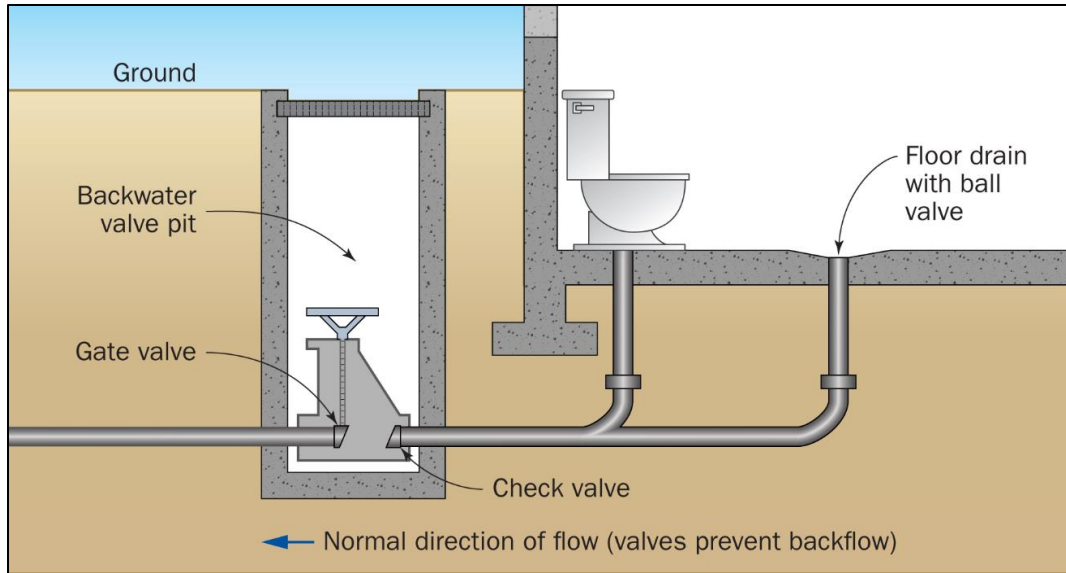


Figure 22. Typical Installation of a Dual Backwater Valve in an Exterior Pit

8.3. Install Overhead Sewers

An overhead sewer is a type of plumbing system used in buildings in areas with high water tables or where basement sewer backup flooding is common. The drains from toilets, sinks, showers, and washers located in the basement are directed to a sump pit that is usually under the basement floor. From there, an ejector pump pumps the wastewater up to the overhead sewer line, which usually runs along the ceiling. That sewer line connects to the sewer lateral connection, and the wastewater flows by gravity to the municipal sewer line. Figure 23 illustrates a typical overhead sewer installation.

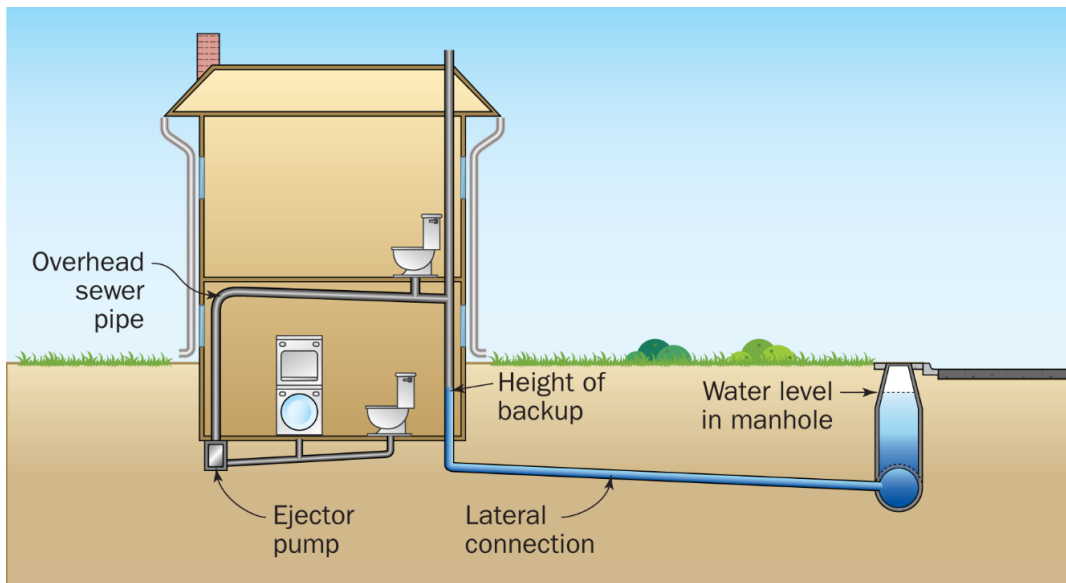


Figure 23. Typical Overhead Sewer System

Overhead sewer systems should be inspected periodically, and the ejector pump should have regular maintenance. When you have an overhead sewer installed, ask your plumber to show you how to operate it and explain maintenance instructions.

9. Surface Flooding Mitigation

Homeowners who have experienced surface flooding during storms with heavy rainfall and flooding should review Section 7 for guidance to determine how surface water gets to and into their buildings. There are several options to mitigate surface flooding, but the best option for your home depends on a number of factors, including whether your building has a basement, has garden apartments, or has a slab-on-grade foundation.

9.1. Keep the Surface Water Away From Your Building

The best way to keep surface water out of your building is to keep the water away from your building. Some options to consider include:

- **Regrade the Yard.** Change the shape of your yard to divert surface runoff away from and around the building. You will probably need to bring in some fill dirt. Be careful that the changes you make to your yard do not make your neighbor's surface flooding problem worse. Be sure to check with your local permit office and floodplain administrator before regrading and adding fill.
- **Build a Low Concrete Wall.** Build a low concrete wall around your garden apartment patio or at the top of exterior basement stairs. Be sure it is high enough that surface flooding doesn't overtop it. Enhance the wall with grading and plantings. Be sure to add a drain in the patio to capture rainfall and divert it to where your yard is lower than the patio.
- **Improve Street Drainage.** Talk to your local public works department to ask if the curb where water overtops can be raised so the runoff goes into the stormwater system instead of your yard.

9.2. Keep the Water Out of Your Building

Some options to consider that help prevent surface water from entering your building include:

- **Seal Cracks.** If there is evidence that water comes through cracks in walls, floors, and joints where walls meet the floor, seal the cracks. This work is usually done by specialty contractors who can also verify that the wall is adequate to resist any extra water pressure that might develop outside the wall.
- **Replace Windows with Higher Sills.** If surface water enters through windows that are low to the ground like the basement window shown in Figure 11, replace the windows. Replacement windows should be sized so the sills are at least 1 foot above the ground. Be sure the contractor fills in and waterproofs the former window opening below the new window.

- **Fill in Windows.** Unless they are necessary for emergency escape and rescue, you can remove low windows and permanently seal the openings by filling in with concrete or masonry. You should consult your building department to ensure that the windows are not required by the building code. If approved, this work should be performed by a licensed contractor.
- **Protect Windows and Window Wells.** Build barriers around low windows and extend window wells above grade. Be sure the barriers are sealed against the building, and that there is a drain in the bottom of the window well. Figure 24 shows raised window wells made of brick.



Figure 24. Raised Window Wells

- **Extend Vent Wells.** Figure 25 shows how basement air vents at grade level were retrofitted with extended vent wells that raise the lowest point of entry several feet above the ground.



Figure 25. Basement Vents Retrofitted by Extending Vent Wells Above Ground Level

- **Use Temporary Barriers Across Doors and Windows.** Temporary barriers are measures that are put in place when heavy rainfall events are predicted. They might be a good option if other mitigation options won't be effective, or you want something to reduce damage while you investigate permanent options. Temporary barriers probably are the best option for slab foundation homes where it is difficult to waterproof the entire exterior wall. A variety of temporary barriers are available from vendors. However, they are effective only when properly placed. For example, heavy plastic sheeting should be placed behind sandbags and the bags must be tightly stacked, as shown in Figure 26.

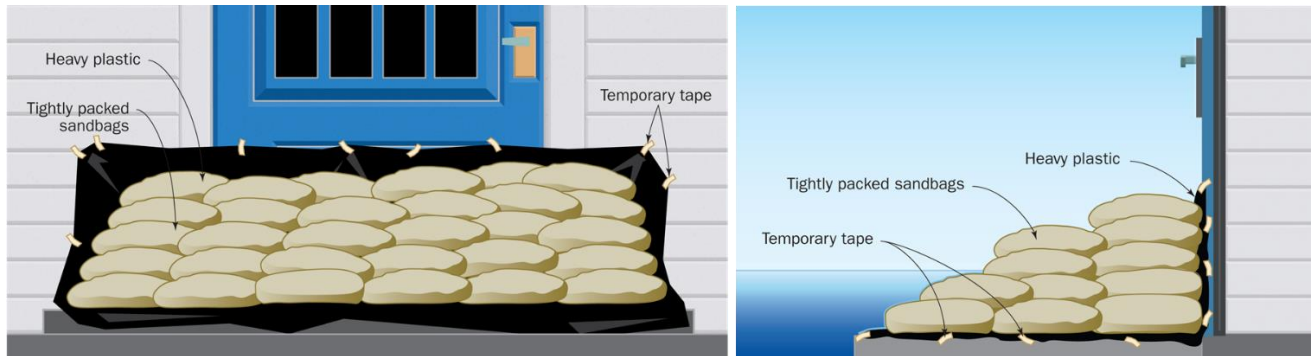


Figure 26. Sandbag Installation at Doorway

10. Cleaning Up After Flooding and Sewer Backup

If your home has flooded and the floodwater is beginning to recede, there are steps to take to ensure that your cleanup process is safe.

First, take photographs of the damage. Be sure to take close-up photographs of damaged equipment and appliances, noting how high the water was above the floor. If the water was surface flooding, take photographs to show how the water entered the building.

Next, call your insurance agent to file a claim and report the damage as soon as possible.

Homeowners insurance usually covers losses caused by wind, storms, or broken water pipes, but may not cover sewer backup and surface flooding. Some damage caused by surface flooding might be covered if you have a separate NFIP flood insurance policy. Ask your insurance agent about NFIP or private flood insurance policies available for homeowners and renters.

When events are declared disasters by the Governor or the President, be sure you register with the State and FEMA assistance offices.

10.1. Personal Health and Safety During Cleanup

Personal safety is always the highest priority during cleanup. Flood water and sewer overflows cause physical damage to buildings and contents. They also contain bacteria, fecal material, viruses, and other organisms that may cause disease. You should work fast because mold can form within 48

hours. The goal is to reduce the humidity and temperature as you proceed with cleaning and drying. If you do encounter extensive mold, use protective gear such as gloves, goggles, and N95 or N100 face masks.

Follow the steps below to protect your health and prevent infections during cleanup:

- Check for structural damage before re-entering your home. Look for cracks in walls and concrete floors. Do not enter buildings that appear to have structural damage. Instead, call your local building department and ask for a safety inspection.
- Look before you step. After a flood, the ground and floors are covered with debris, including broken glass and nails. Floors and stairs that were underwater and covered with mud can be very slippery.
- Keep power off at the main breaker until an electrician has inspected the electrical system for safety.
- Turn off the gas and be alert for gas leaks.
- Do not allow children to play in areas contaminated by sewage overflows.
- Minimize skin contact with sewer backflow water, especially cuts and sores. Keep them clean and covered.
- Wear long sleeves, long pants, sturdy shoes or waterproof boots, plastic or rubber gloves, and N95 or N100 face masks at all times.



- Rescue the most valuable items, but don't attempt to salvage belongings at the expense of your own safety.
- Keep contaminated objects, water, and your hands away from your mouth, eyes, and nose.
- Wash your hands often with soap and clean water or use an alcohol-based hand-cleaning gel.
- Do not eat or drink anything exposed to flood water. Use only bottled or disinfected water for drinking, cooking, toothbrushing, and bathing until you are sure the water supply is safe.
- Discard food exposed to contaminated water. If refrigerators and freezers have taken in water, discard all food. If water didn't get inside, but power was lost long enough for food to get warm or thaw, food that still has ice crystals may be refrozen, but you should discard all thawed foods.

Download and Read Cleanup Advice Before the Next Flood

The Illinois Department of Public Health has a helpful guide to assist you with the appropriate steps to protect your health and property. The guide can be found here:

<https://dph.illinois.gov/content/dam/soi/en/web/idph/files/aftertheflood-web.pdf>.

The U.S. Center for Disease Control and Prevention, and the U.S. Environmental Protection Agency guidelines for mold cleanup after floods can be found at:

<https://www.epa.gov/mold/homeowners-and-renters-guide-mold-cleanup-after-disasters>.

GENERAL CLEANING ADVICE

The following general cleaning advice may help prevent the transmission of disease and reduce property loss.

Cleaning Supplies and Tasks.

- Open windows, if possible, to ventilate and dry the area. Fans and dehumidifiers can be used to help with drying.
- Remove contents that were not affected by water.
- Scrub and wash hard contaminated surfaces and objects with warm, soapy water and disinfect with a bleach and water solution made of no more than 1 cup of bleach per 1 gallon of water. Bleach is not effective on porous materials and can corrode metal. For objects that would be damaged by bleach, use a non-chlorine home or laundry disinfectant.
- Discard porous materials and contaminated objects that cannot be thoroughly washed or laundered.
- Make sure to read and follow label instructions. Do not use ammonia. Mixing ammonia and bleach makes toxic vapors.
- Wash clothes exposed to flood water using warm, not hot, tap water with soap and laundry disinfectant.

Carpets and Rugs. Carpets and rugs that cannot be thoroughly dried and cleaned should be discarded and replaced. If only a small area of a carpet or rug was saturated, you may be able to thoroughly clean the affected area with a mild detergent. Some professional home cleaning services may be able to clean and disinfect carpets.

Floors. Concrete and tiled floors and hard surfaces should be cleaned with a bleach and water solution or a household disinfectant. Wood baseboards should be removed to dry and to allow walls to dry out. Floor materials that cannot be cleaned should be replaced using flood damage-resistant materials described in Section 7.4.

Walls and Insulation. Concrete or block walls can be cleaned with a bleach and water solution or household disinfectant. Paneling should be immediately cleaned and dried thoroughly. Most wallboards will need to be removed and replaced. Most insulation must be removed and replaced. You should replace wall coverings and insulation with flood damage-resistant materials described in Section 7.4.

Drapes and Furniture. A professional cleaner may be able to clean furniture and drapes. If flood water didn't saturate couch and chair upholstery, clean the legs with a bleach and water solution or a household disinfectant.

Basements. Pump out standing water and remove all debris. Wait to pump until surface flooding has stopped or receded below basement level. Pump only 1 foot of water each day to reduce the potential for basement wall collapse due to unbalanced water levels on the outside and inside of the wall.

Appliances and Water Heaters. Be sure the main power supply is off, and then unplug appliances that got wet. If the water didn't reach the electrical components, don't use the appliances until they have thoroughly dried out. Most appliances that had more than a few inches of water should be inspected by a qualified repair technician before using them. You may be advised to replace them, instead of cleaning.

Furnaces, Boilers, and Air Conditioner Compressors. Furnaces, boilers, and air conditioner compressors must be cleaned by licensed technicians before turning them on. You may be advised to replace them, instead of cleaning.

11. Glossary of Terms

Backup (sewer)	Occurs when sewage, or combined sewage and stormwater, flows backward into homes because the municipal sewage systems cannot carry all the wastewater, or there is a blockage in the sewer line.
Backwater valve	Device installed in sewer pipes and basement drains that allows wastewater and sewage to flow out of buildings but prevents flow from backing up into buildings during heavy rainfall and flooding situations when the municipal sewer mains are full. Backwater valves are a combination of a check valve and a gate valve.
Basement	Area of a building that is below the outside ground level on all sides.
Check valve	Device installed in sewer pipes and basement drains that allows wastewater and sewage to flow out of buildings but

	prevents flow from backing up into buildings during heavy rainfall and flooding situations when the municipal sewer mains are full. Check valves operate automatically.
Combined sewer system	Network of underground pipes that carry combined sewage flow and rainfall runoff (stormwater) to treatment plants.
Downspouts	Extensions of gutters that collect rainfall draining off roofs and direct the runoff to the ground or drains.
Dropshaft	Vertical shaft that transfers combined sewer flow from the near-surface combined sewer to the deep tunnels leading to reservoirs as part of TARP.
Dry floodproofing	Measures that keep floodwater out of buildings, including modification of building walls and special panels installed over doorways and windows.
Flood damage-resistant materials	Construction and finishing materials that can be inundated by flood water with little or no damage and are relatively easy to clean.
Floodplain	Any normally dry land that could be covered by water. Sometimes referred to as Special Flood Hazard Areas, which are areas subject to flooding by the 1-percent-annual-chance (100-year) flood that are shown on Flood Insurance Rate Maps produced by FEMA.
Garden apartment	Dwelling units that are below the outside ground level on one or more sides and that have direct access to the outside.
Gate valve	Device installed in sewer pipes and basement drains that allows wastewater and sewage to flow out of buildings but prevents flow from backing up into buildings during heavy rainfall and flooding situations when the municipal sewer mains are full. Gate valves are operated manually.
Grade	The surface of the ground. The term is used in “below-grade areas/spaces,” “at grade,” “above grade,” “slab-on-grade foundation,” and “exterior grade.”
Impervious surfaces	Surfaces that do not allow rainwater to soak into the ground, such as streets, parking lots, sidewalks, and building roofs.

Mapped floodplain	See Floodplain.
Mitigation	Actions that reduce or lessen property damage and loss of life and injuries.
Mitigation Assessment Team	Team of experts in building science and related disciplines deployed by FEMA to assess damage and make recommendations to mitigate future damage.
Overhead sewer	Type of plumbing system where the drains from toilets, sinks, showers, and washers located in the basement are directed to a sump pit where an ejector pumps wastewater to an overhead line. Because the overhead line is well above the exterior grade, it prevents sewer backup from entering the building sewer system.
Sewer backup	See Backup (sewer).
Stormwater system and stormwater drainage system	Network of gutters, swales, storm drain inlets, catch basins, and underground pipes that collect rainfall runoff (stormwater) and carry the runoff to rivers, reservoirs, or Lake Michigan. Also see “combined sewer system.”
Sump pump	Pump installed in a low spot or sump, usually in a basement, to collect water that may flow into the basement along various paths, such as down exterior stairwells, through low windows and air vents, or foundation cracks.
Surface flooding	Flooding that occurs when stormwater drainage systems are overwhelmed by runoff from intense storms and heavy rainfall.
Topography	The physical features of an area, usually referring to the shape of the land, including slopes, hills, valleys, and flat areas with little or no slope.
TARP	The MWRD system of deep, large diameter tunnels and vast reservoirs to collect overflow water from local combined and sanitary sewer lines and store it until it can be pumped to reclamation plants for treatment.
Wet floodproofing	Measures that allow water to enter buildings without causing damage that requires more than cosmetic repairs.

12. Acronyms

FEMA	Federal Emergency Management Agency
MAT	Mitigation Assessment Team
MWRD	Metropolitan Water Reclamation District (of Greater Chicago)
NFIP	National Flood Insurance Program
TARP	Tunnel and Reservoir Plan

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For More Information

See the FEMA Building Science Frequently Asked Questions at <https://www.fema.gov/emergency-managers/risk-management/building-science/faq>.

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