

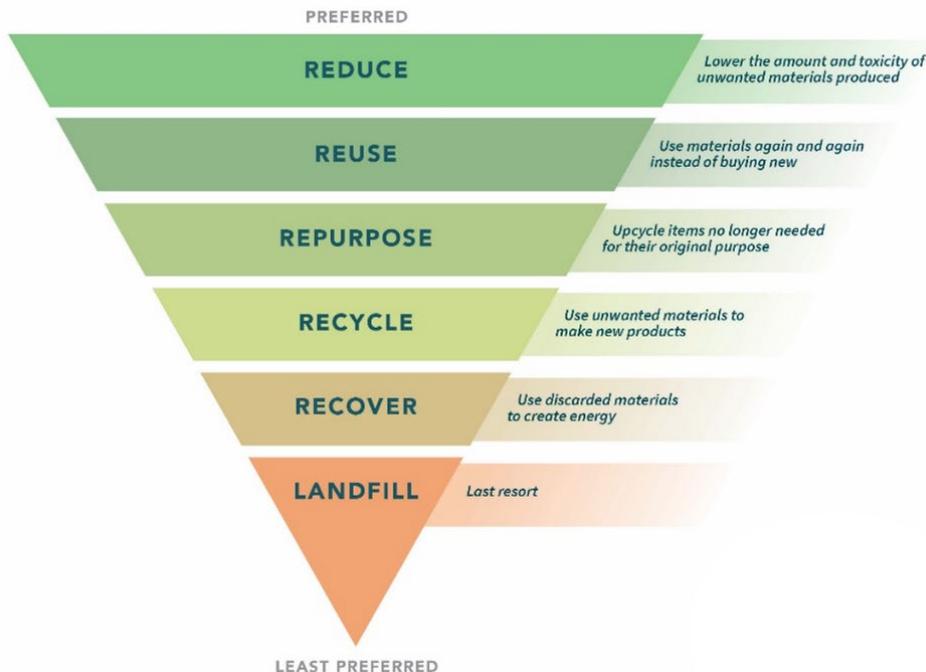


HOW LANDFILLS WORK

MICHIGAN'S SOLID WASTE DISPOSAL REGULATIONS

Michigan first enacted solid waste regulations in 1965, establishing operating standards to prevent nuisance conditions. Prior to that, places accepting **municipal solid waste** or garbage had no standards and were commonly called dumps. Dumps were often built in low-lying areas and wetlands without any precautions to protect public health and our natural resources. In 1978, the solid waste regulations were amended to establish siting, design, and monitoring requirements. Periodically thereafter, updates to the statute and rules have been made to provide for additional protections where needed and to encourage safe use of unwanted materials.

Today's landfills are entirely different than the old dumps. They are engineered structures, built into or on the ground, designed to hold and isolate the waste from the environment and personal exposure. There are different kinds of landfills subject to different regulations administered by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and the United States Environmental Protection Agency (U.S. EPA). A few examples include hazardous waste, municipal solid waste, industrial waste, and construction and demolition landfills.



Although landfilling waste materials is the least preferred option in the [waste disposal hierarchy](#) (left), landfills are an important part of an **integrated waste management system**. They are also the most common place for disposal of municipal solid waste.

MICHIGAN'S DISPOSAL STATISTICS

In Michigan, about 80 to 85 percent of all municipal solid waste is landfilled in the state's 45 **permitted and licensed** [municipal solid waste landfills](#). Only about 20 percent is recycled. In [2021](#), 39,882,943 cubic yards or 13,294,314 tons of municipal solid waste generated in Michigan were disposed of in Michigan's municipal solid waste landfills.



FROM YOUR HOME TO THE LANDFILL

When you think about garbage, you often think about a [garbage truck](#). Depending on the landfill's size, as many as 300 trucks may come every day. Some come from up to 50 to 70 miles away. Why? Well, municipal solid waste landfills are difficult to locate as well as expensive to build and operate. There are fewer municipal solid waste landfills today than in the past, but they are larger and accept waste from greater distances.

There are, of course, different types of garbage trucks that hold different amounts of municipal solid waste. The truck that comes through your neighborhood can hold anywhere from 12 to 14 tons of waste. How much is that? Well, on average, this type of garbage truck can pick up waste from about 800 to 850 homes. When the truck is full, it heads to the landfill. At the landfill, the truck drives onto a scale and is weighed on its way in, way out, or both. The truck carefully drives to a specific area of the landfill and dumps or "tips" its load. Then it leaves and drives to another neighborhood to repeat the process.

LANDFILL BASICS

The solid waste regulations established siting and design criteria, as well as construction, operation, maintenance, closure, post closure, and **financial assurance** requirements for Michigan's municipal solid waste landfills. Some basic parts of a landfill include:

1. THE LINER SYSTEM

The **liner system** is designed to keep waste from getting into the environment – particularly groundwater that we often use for drinking water. From the bottom up, the liner system includes:

- a) A secondary (bottom) **composite liner** made of two feet of compacted clay or a manufactured equivalent liner and a 60-mil plastic liner (about the thickness of a penny). The secondary liner is not required if the site already has at least 10 feet of natural **low permeability clay**.

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- b) A **drainage layer** if the site does not include at least 10 feet of natural low permeability clay. The drainage layer is part of the landfill's **leak detection system** and is also called the secondary **leachate** collection system. It is designed to detect and remove any liquids that leak through the primary liner. The drainage layer resembles a plastic mesh and is a synthetic material called a **geocomposite** that is specifically designed for landfills.
- c) A primary (top) composite liner made of two feet of clay or a manufactured equivalent and a 60-mil plastic liner.
- d) A **leachate collection system** that collects and removes rainwater that contacts the waste and liquids released by the waste as it **decomposes**.
- e) A protective layer that prevents the liner and leachate collection system from being damaged. This layer is often made of 2 feet of sand.



2. CELLS

Cells are specific areas where the waste is placed in the landfill, then compacted or crushed.

3. STORM WATER DRAINAGE SYSTEM

The **storm water drainage system** collects rainwater that falls on both final closed and temporarily covered parts of the landfill. The **storm water** drainage system may include plastic drainage pipes and ditches that collect and move the rainwater to a storm water storage pond for water that has not contacted the garbage.

4. LEACHATE COLLECTION SYSTEM

The **leachate collection system** collects liquids released from the decomposing waste and any rainwater that contacts the waste. Leachate forms when water in the waste works its way through the landfill much like water percolating through coffee grounds. As the water moves through the garbage, it picks up contaminants. So, leachate is collected, removed, treated, and discharged after treatment under a permit issued under the **Clean Water Act** and Michigan's water resources protection statute and rules. Leachate levels in the landfill are routinely monitored to ensure the leachate collection system is working properly

5. GAS COLLECTION SYSTEM

A **gas collection system** collects landfill gas created naturally by the decomposing garbage. As bacteria in the landfill break down garbage, **landfill gas** is created. The landfill gas is about 50 percent methane and 50 percent carbon dioxide, with very small amounts of other air pollutants. Landfill gas is actively collected from municipal solid waste landfills using a series of pipes installed throughout the landfill. Some landfills vent the gas to the atmosphere or burn it through a flare. A flare looks like a huge lighter. Many Michigan municipal solid waste landfills collect the gas and burn the methane in large engines to power a generator and produce electricity or they use it to replace natural gas for heating. Permits for landfill gas collection systems and flares are issued under the **Clean Air Act** and Michigan's air pollution control statute and rules.

6. FINAL COVER SYSTEM (OR CAP)

The final cover system or cap is placed on the municipal solid waste landfill when it stops accepting waste and closes. From the bottom up, the final cover includes:

- a) 18 inches of clay or a manufactured equivalent, such as a geocomposite clay layer, which has a layer of bentonite between two fabric liners that swells when in contact with liquid and prevents the liquid from moving through the liner.
- b) A 40-mil plastic liner, about the thickness of a dime.
- c) 2 feet of protective soil.
- d) 6 inches or more of topsoil to support native shallow rooted plants such as grasses and wildflowers.



The cap seals the waste from air and reduces the amount of water getting into the landfill. It also prevents pests (birds, rats, mice, flying insects and so on) from getting into the waste.

7. ENVIRONMENTAL MONITORING SYSTEM

The **environmental monitoring system** consists of monitoring points to monitor groundwater, storm water, and air.

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- a) A **groundwater monitoring program** is required to protect groundwater. Groundwater is evaluated to determine where it flows, and monitoring wells are installed upstream and downstream of the groundwater flow around the landfill. The wells are sampled on a regular basis for contaminants typical of landfill leachate like lead, cadmium, chromium, and common volatile organic compounds like benzene, methylene chloride, tetrachloroethylene, toluene, and xylene. These results are compared to previous results and other wells, then analyzed statistically to determine whether a release from the landfill has been detected.
- b) A **storm water monitoring program** is required for storm water areas with the potential to be impacted by a release of leachate. The landfill's storm water monitoring program designates specific locations in the drainage ditches and storm water ponds where samples are to be collected. Like groundwater, the surface water in these locations are sampled and tested on a regular basis for contaminants found in the leachate.
- c) Air monitoring is required for most sites that have a landfill gas collection system. A **gas monitoring system** is used to evaluate the landfill gas collection and control system and ensure it is operating properly. **Gas monitoring wells** in the soil are also monitored around the landfill for methane to detect and prevent the migration of landfill gases below the ground.

WHAT HAPPENS EVERY DAY AT A LANDFILL

TIPPING

Waste is dumped (or tipped) into an open area of the constructed landfill called a **cell**. Municipal solid waste landfills almost always have one cell open at a time to accept waste. At the same time, another cell is being built so it is ready when the current cell becomes full. The daily operation at a municipal solid waste landfill includes the tipping of waste into a specific area of the landfill, called the **working face**, followed by compaction or crushing of the waste and covering it with soil at day's end.

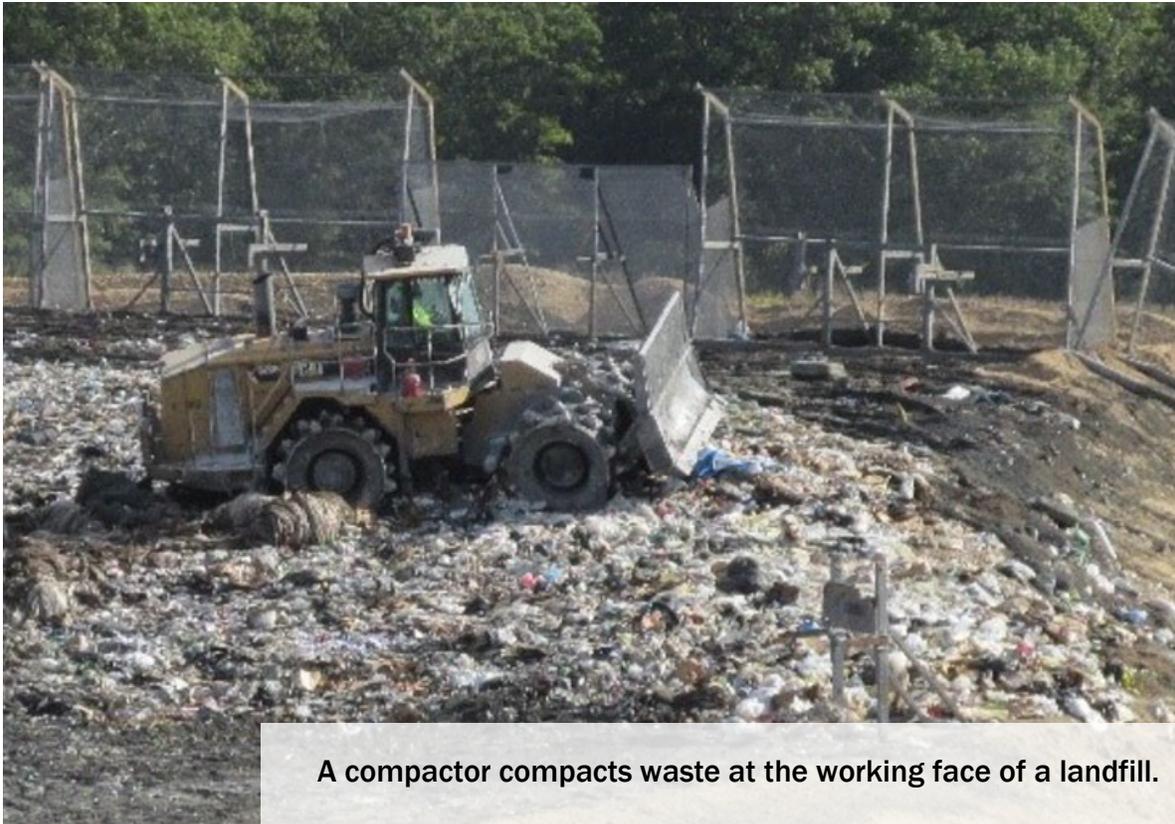


Tipping operation at a landfill

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COMPACTING

Space is money. Garbage is compacted or crushed to save space. You may have seen the giant tractor with spiked wheels that goes back and forth over the garbage. Well, that's a compactor. It weighs over 100,000 pounds. The compactor makes three to five passes over the garbage to crush as much garbage into the space as possible. On average, about 1,300 to 1,600 pounds of garbage can be compacted into one cubic yard (3 feet x 3 feet x 3 feet) of space. The landfill puts as much waste as possible into each cell, making them last longer and reducing the need for additional landfills to be built.



A compactor compacts waste at the working face of a landfill.

COVER

At the end of the day, the working face of the cell is covered with a layer of soil or other cover material to minimize odor and pests, as well as to prevent litter. This is called **daily cover**. Rather than making a big pile of waste in the cell, waste is typically placed in 8 to 10 feet thick layers called **lifts**. A lift will start at one end of the cell and, as days go by, will work its way across the cell to the other end. Much like the blocks in a pyramid, as each lift reaches the end of the cell, a new higher lift is filled in the other direction until the other end of the cell is reached. This process continues until the cell reaches its designed **grade** (slope) and height allowed under the permit issued by EGLE. The three-step process (tipping, compacting, covering) is repeated over and over until the cell is filled.

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GENERAL MANAGEMENT

Each day, landfill workers perform housekeeping tasks to make sure the landfill continues to function properly. This includes items from inspections of wells, pumps, and flares, to watering onsite roads for dust control to sweeping interior roads to ensure mud and dirt are not tracked out of the facility.

INTERIM COVER

Lifts where waste will not be placed for 90 days or more or that will be part of the outer constructed edge of the landfill are covered by 1 foot of compacted soil to prevent storm water from contacting the waste. This is called **interim cover**. The interim cover is covered with native shallow rooted plants such as grasses and wildflowers and maintained until the **final cover** system is installed over the area. The storm water that is shed from the interim cover is directed to storm water ponds which are monitored to ensure that no waste or leachate has impacted the storm water prior to it going off-site.



Monitor Well at Landfill

OVERSIGHT

EGLE is highly involved in the regulation of landfills. This oversight includes review and approval (**permitting and licensing**) of the landfill design, monitoring, and operations plans to ensure human health and the environment are protected as provided under our environmental regulations. It also includes inspections of the installation of monitoring systems and construction of landfill cells and pollution controls. EGLE also inspects each facility at least 4 times per year to ensure operational standards are followed. Each municipal solid waste landfill is required to submit environmental monitoring data. EGLE reviews the data and compares EGLE results with all historic data to ensure that the data is valid. EGLE staff also respond to complaints and concerns that members of the public submit.

THE LIFE EXPECTANCY OF A LANDFILL

The life of a municipal solid waste landfill depends on the size of the facility, the disposal rate, and the compaction rate. All municipal solid waste landfills in Michigan are permitted to accept a specific volume of waste. Municipal solid waste landfill operators strive for the maximum compaction rate possible to save space and minimize cost of building new landfill cells. Given these considerations, the average life expectancy could be anywhere from 30 to 50 years.

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WHEN A MUNICIPAL SOLID WASTE LANDFILL CLOSES

When a municipal solid waste landfill is full, it is closed with a final cover that includes the clay layer, a plastic liner, and a soil layer discussed earlier. Even though the facility is closed, the responsibility of the landfill operator does not end. Municipal solid waste landfill owners must set aside money (called financial assurance) for the final cover system and ongoing maintenance of the landfill after closure. Operators must continue to pump the leachate, test the groundwater, inspect the cap, repair any erosion, fill low areas due to settlement, maintain vegetation and prevent trees from growing. Why no trees? Trees have roots and roots can tear the liner in the final cover system. Municipal solid waste landfills must be monitored for at least 30 years after they close.



Closed landfill with final cover in front of the active landfill

WHERE TO LEARN MORE ABOUT SOLID WASTE LANDFILLS

Visit [Michigan.gov/SolidWaste](https://www.michigan.gov/SolidWaste) to learn more about solid waste and materials management in Michigan.

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