



# What Are the Options For Waste Disposal?

**M**any cities have no controlled system for waste disposal. Waste is either burned in pits, dumped in random locations, or disposed of in uncontrolled dumps without any further management. All these actions harm public health and the environment. Controlled waste disposal can help improve and protect the health of local populations and preserve valuable environmental resources, such as groundwater and drinking water. You have two options for waste disposal: operate a properly designed, constructed, and managed landfill or burn the waste in a controlled facility that converts waste to energy. This fact sheet describes the dangers of open dumping and burning and explains procedures for proper landfill disposal and controlled burning. At the end of this fact sheet is an example of how using one of these options benefitted the Gaza Strip.

## **What Problems Can Uncontrolled Dumping and Burning Cause?**

Most uncontrolled dumps are many years old, having grown over time from small dumps to large, unmanaged waste sites. Uncontrolled dumps have significant environmental impacts. As the waste decomposes, it creates leachate—a mix of toxic and nontoxic liquids and rainwater—which may get into local water supplies and contaminate the drinking water. Uncontrolled dumps also release gases that are explosive and flammable. In some instances, waste is burned at these dumps, which poses a direct safety threat because of the danger of explosion. The air pollution created by burning harms local communities. Improper waste disposal also produces greenhouse gases (GHGs), which contribute to climate change. In contrast, properly designed, constructed, and managed landfills aim to prevent or minimize health and environmental impacts. They have liners and leachate collection systems that protect groundwater, and gas collection systems that contain or safely burn methane from landfills.

## Properly Designed, Constructed, and Managed Landfills

To protect human health and the environment, communities should discourage the use of existing open dumps and establish a managed site for solid waste disposal. Safe, well-controlled waste placement distinguishes a landfill from an open dump. If you want to provide a properly designed, constructed, and managed landfill in your community, you can either convert an existing uncontrolled dump or construct a new landfill.

## Converting Existing Open Dumps to Properly Designed, Constructed, and Managed Landfills

Existing open dumps can be converted to landfills in three phases:

**Phase 1: Convert open dumps to controlled dumps.** The steps involved in this phase include: (1) covering exposed wastes with soil, sand, or clay; (2) installing passive gas vents to safely control methane emissions; (3) establishing rules for onsite scavenging or wastepicking; and (4) organizing wastepickers into recycling groups.

**Phase 2: Convert controlled dumps to simple landfills** During this phase, basic engineering techniques are gradually employed to stabilize the waste and control environmental releases. The waste is spread and compacted in layers and leachate is collected. At this point, scavenging or wastepicking activities should be confined to areas of the landfill away from compaction areas and heavy equipment.

**Phase 3: Transition from simple landfills to properly designed, constructed, and managed landfills.** Activities during this phase include: (1) developing formal engineering designs; (2) providing daily onsite management by trained workers; (3) placing waste in small working areas with daily cover; (4) collecting and burning landfill gas; and (5) installing liners and piping to collect and treat leachate.

## Establishing a New Properly Designed, Constructed, and Managed Landfill

The process of developing a properly designed, constructed, and managed landfill can be divided into four steps:

**Step 1: Selecting the site.** Several factors should be considered when selecting a site for a landfill:

- **Geological factors.** Landfills produce leachate when waste is exposed to rainwater while it is decomposing. If leachate leaks out of the landfill, it can contaminate groundwater and drinking water. To protect local water supplies, the site must have a geology that naturally prevents or limits the release of leachate to the environment. For example, locating the landfill in an area with clay soils—through which water cannot flow—will provide this protection.
- **Distance to the location of the waste.** The farther a landfill site is from the point where the waste is generated and collected, the more waste transport costs. It is generally most cost-effective to use a site a relatively short distance away.
- **Landfill capacity.** Determine how many years the landfill will be able to accept waste. Calculate the volume (or capacity) of the landfill by using the following factors: amount of waste generated per person per year, population size, anticipated population and economic growth, and the number of years the landfill will be in operation.
- **Areas to avoid.** Landfills should not be located near airports, schools, drinking water sources, or flood-prone areas.

### Step 2: Gaining public acceptance.

Residents who live near the chosen landfill site may have concerns about its environmental and health impacts. You can increase public acceptance by educating local residents and business owners about how the landfill will benefit the community (e.g., by improving public health and safety, creating local jobs, and stimulating economic development). You also can describe what steps will be taken to protect public health and the environment.

**Step 3: Designing the landfill.** Design requirements for a properly designed, constructed, and managed landfill include the following (see Figure 1):

- **Liners.** Liners are used to prevent leachate from entering groundwater by keeping fluids within the landfill area. Liners must be made of relatively impermeable material such as compacted soil or clay, synthetic materials (e.g., plastic), or a composite of earthen and synthetic materials. They are placed in the bottom of a new landfill before disposing of any waste. Liners are important for landfills located on sandy or other soils through which water can easily flow.
- **Leachate collection and treatment.** In a properly lined landfill, leachate accumulates within the landfill. Therefore, the landfill should include equipment to collect and divert the leachate from the landfill and treat it. Perforated piping, for example, can be installed to collect the leachate and divert it to a nearby treatment facility (similar to a water treatment facility). Treated leachate can then be safely released to the environment.
- **Gas collection and treatment.** Bacteria that are naturally present in landfills produce methane as they decompose and break down the waste. Methane poses a danger because it is explosive and can start fires. In addition, methane from landfills and other sources is harmful to the atmosphere and climate because it is a greenhouse gas. Therefore, monitoring the amount of and controlling methane is very important. Typically, a system is installed to monitor, collect, and burn the gas. In some instances, power stations can collect the gas and use it to generate electricity.

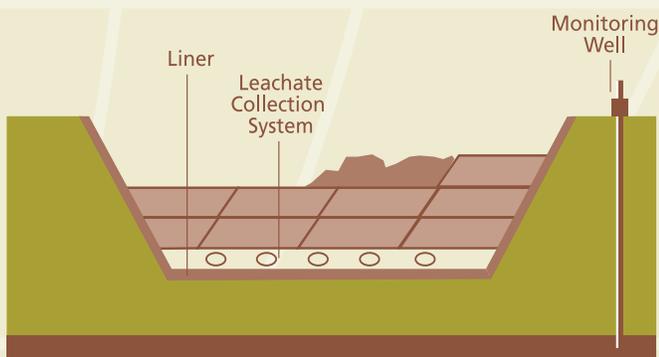
- **Site access.** Access to the landfill must be strictly controlled to prevent injury or illegal dumping. This can be done by building a fence around the site.

**Step 4: Operating the landfill.** A trained landfill manager should be hired to properly operate and manage the site. Before any waste is disposed of, the manager should develop a plan to serve as the operational guide for the site. It should specify, in detail, where on the site waste is to be placed, how the site will be operated, at what points the garbage will be covered by soil, and how environmental problems (e.g., animals, litter, fires, gas, leachate) will be addressed. The plan also should provide details of equipment, materials, and staff needed to operate the site; list the environmental agency's required monitoring and reporting activities; and clearly describe when and how each part of the site will be covered and maintained once it has reached its capacity.

### Burning Waste in a Controlled Facility

Combustion, or the controlled burning of waste at high temperatures to produce steam and ash, is another waste disposal option and an alternative to landfilling. Waste combustion reduces the volume of solid waste to be disposed of by approximately 90 percent. This is especially attractive in crowded cities that do not have enough land available for landfills. In addition, solid waste can provide a continuously available source for generating energy through combustion. When steam-driven turbines convert the thermal energy from combustion into electrical energy, the process is called "waste-to-energy" (WTE). Steam or hot water produced during combustion also may be sold directly for industrial processes or space heating, or it may be used to generate chilled water for air conditioning. Selling the recovered energy or water in one of these forms helps offset the high costs of construction and operation of waste combustion facilities, but it does not cover them entirely.

**Figure 1—Cross-Section of a Typical, Properly Designed, Constructed, and Maintained Landfill**



Waste combustion, however, has significant disadvantages. Constructing a WTE facility requires large amounts of money. The combustion process also creates air pollution, ash, and waste water, all of which must be properly managed using technical monitoring, containment, and treatment systems. If these byproducts are not controlled, harmful pollutants will be released into the environment. Operators of these facilities must be well-trained and certified to ensure proper management. You must also find disposal options for waste that cannot be burned.

## CASE STUDY

### CONVERTING OPEN DUMPS INTO PROPERLY DESIGNED, CONSTRUCTED, AND MANAGED LANDFILLS IN GAZA

**T**he German Agency for Technical Cooperation (GTZ) recently assisted the Solid Waste Management Council of the Gaza Strip in closing down a number of open dumps and building a properly designed, constructed, and managed landfill. The first step in constructing a landfill was to assess soil and groundwater conditions at several potential locations. Two important site selection criteria were soil with enough clay content to serve as a natural barrier to leachate and a site away from major drinking water sources. Once the team found a site, it hired local contractors to prepare the landfill site and cover the surface with an asphalt liner. It then built a storage pond and installed drainage pipes that carry leachate into the pond. Since Gaza has no municipal wastewater treatment facilities to treat the leachate, the team installed pumps and a sprinkler system that recirculates the leachate back to the landfill, allowing it to evaporate. The team considered recirculation to be a reasonable option because it did not expect the region's dry climate to generate much leachate and anticipated most of the leachate would be managed through evaporation. However, the storage pond and pumping system were later enlarged to handle larger-than-expected leachate levels.

Once the landfill was in operation, they closed the open dumps, controlled access to the new site and began transfer of waste into the new landfill. The team expects the landfill to last for approximately 13 years. As the team closes filled sections of the landfill, it covers the area with compost generated from digging up and screening organic material from older sections of the landfill. The compost serves as a cost-effective final cover that helps break down the methane as it leaves the landfill surface. The compost also supports vegetation that grows on the landfill surface, which helps reduce the flow of leachate. The project is a successful example of an upgrade of disposal standards. For more information on the Gaza landfill project, visit the Swiss Agency for Development and Cooperation Web site at <[www.skat.ch/ud/swm/swm.htm](http://www.skat.ch/ud/swm/swm.htm)>.

#### DEFINITIONS

**Combustion:** Refers to controlled burning of waste to reduce waste volume and perhaps to generate energy.

**Impermeable:** The property of a material or soil that does not allow the movement or passage of water.

**Leachate:** A mix of toxic and nontoxic liquids and rainwater created in the landfill environment that may pose a threat to local ground-water supplies.

**Methane:** Also called natural gas, methane is generated when waste in a landfill decomposes. It makes up approximately 50 percent of the gases emitted from landfills.

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