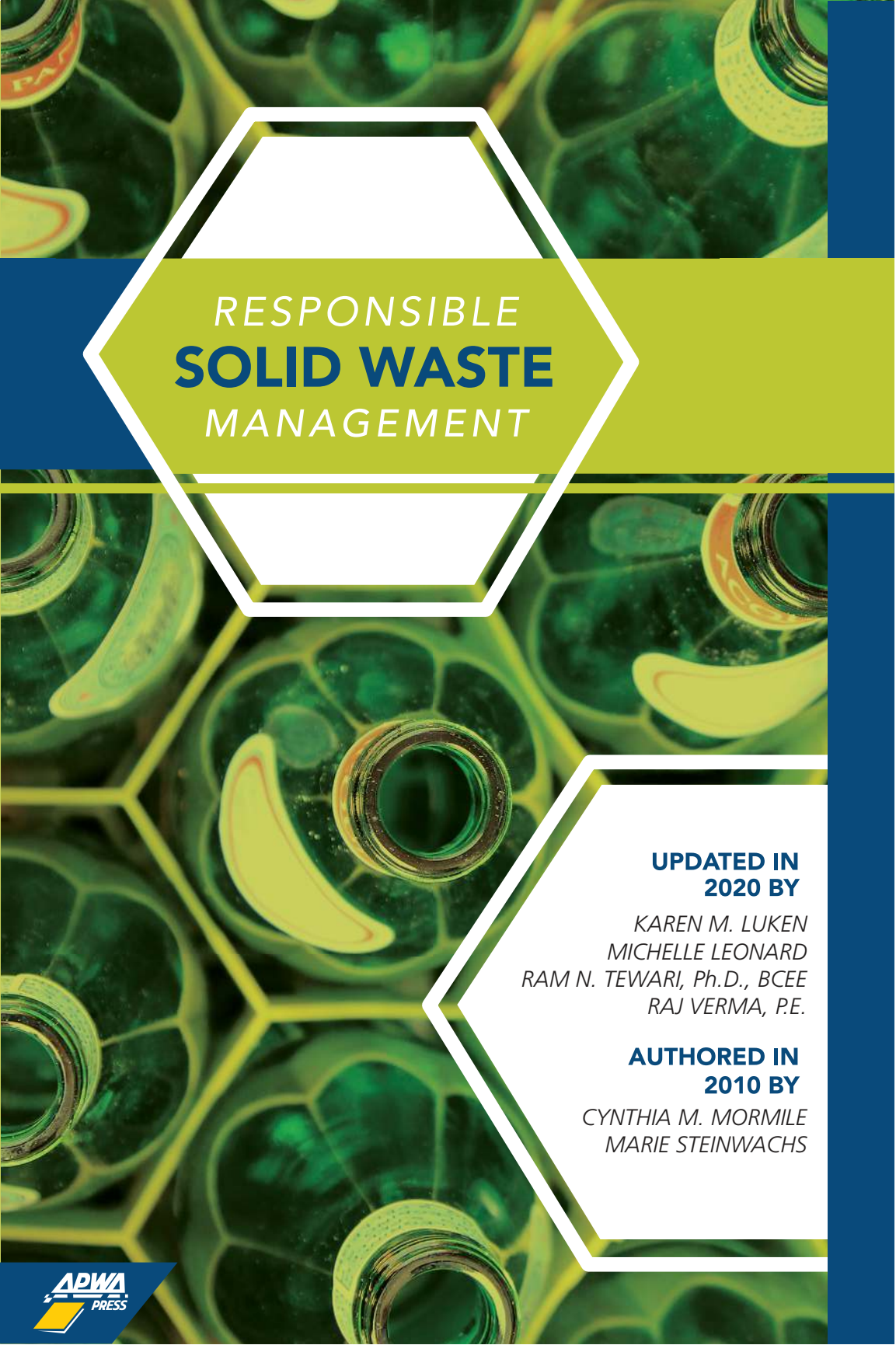

# RESPONSIBLE SOLID WASTE MANAGEMENT


**UPDATED IN 2020 BY**

*KAREN M. LUKEN*
*MICHELLE LEONARD*
*RAM N. TEWARI, Ph.D., BCEE*
*RAJ VERMA, P.E.*

**AUTHORED IN 2010 BY**

*CYNTHIA M. MORMILE*
*MARIE STEINWACHS*



APWA PRESS

# RESPONSIBLE SOLID WASTE MANAGEMENT


**UPDATED IN 2020 BY**

Karen M. Luken, CEO, Economic Environmental Solutions International (EESI), LLC
Michelle Leonard, Vice President, SCS Engineers
Ram N. Tewari, Ph.D., BCEE, Project Manager, Total Municipal Solutions, Inc.
Raj Verma, P.E., President, Total Municipal Solutions, Inc.

**AUTHORED IN 2010 BY**

Cynthia M. Mormile, Senior Project Manager at MSW Consultants, LLC
Marie Steinwachs, Technical Manager for Waste Diversion, Gainesville, FL




ISBN 978-1-60675-139-8
American Public Works Association
1200 Main Street, Suite 1400
Kansas City, MO 64105
Phone: 816-472-6100
www.apwa.net

# Introduction

Americans generate four to five pounds per day of municipal solid waste (MSW) on average, and this has been a consistent rate for several decades. In general, MSW generation increases during times of strong economic growth and decreases during times of economic decline. Over the last few decades, the generation, recycling, and disposal of MSW has changed substantially. Generation of MSW increased (except in recession years) from 88.1 million tons in 1960 to nearly 268 million tons in 2017.

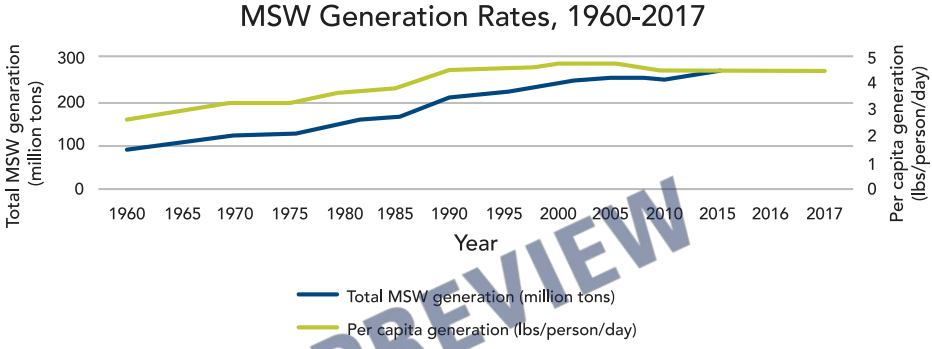




*Figure 1. U.S. EPA, 2017.*

The MSW generation rate in 1960 was just 2.68 pounds per person per day. It increased to 3.66 pounds per person per day in 1980 and by 2000, it reached 4.74 pounds per person per day. The MSW generation rate was 4.51 pounds per person per day in 2017, which was one of the lowest generation rates since 1990.

Over time, recycling and composting rates have increased from just over 6 percent of MSW generated in 1960 to about 10 percent in 1980 and by 2017, the U.S. recycling rate was over 35 percent. This increase is due to most states enacting legislation requiring local governments to prepare long-term strategies to reduce reliance on landfills.

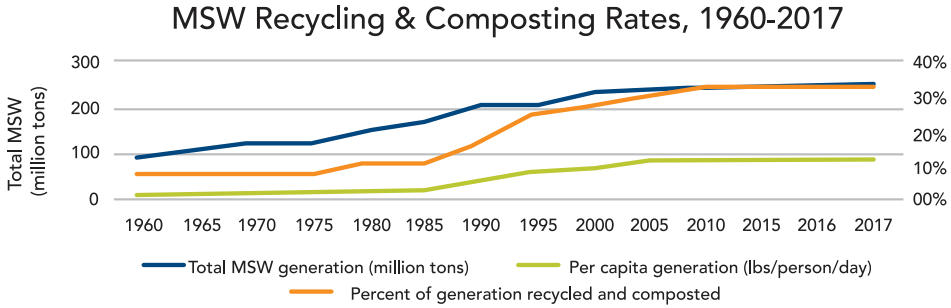


*Figure 2. U.S. EPA, 2017.*

The safe and efficient management of MSW is a basic responsibility of every community's leadership. In most cases, the responsibility lies with public works, health departments, or solid waste divisions. If not handled properly, MSW can negatively affect public health, welfare, and quality of life.

Federal and state regulations, as well as local laws, have been developed over the years to protect the air, water, and land from adverse conditions resulting from improperly managed MSW. Each community's governing authority must ensure that any MSW services, either publicly provided or privately contracted, comply with all applicable laws and regulations. Some states have regulations banning certain materials from landfills or incinerators. Thus, communities in these states must manage these materials in other ways, such as recycling or composting.



The concept of integrated solid waste management is increasingly being used by states and local governments as they plan for the future. This management practice includes the source reduction of certain MSW streams and the recovery of generated waste for recycling or composting. It also includes environmentally sound management through combustion with energy recovery and landfilling practices that meet current standards or newly emerging waste conversion technologies.

The U.S. EPA developed the MSW management hierarchy in recognition that no single waste management approach is suitable for managing all materials and MSW streams in all circumstances. The hierarchy ranks the various management strategies from most to least environmentally preferred. The hierarchy places emphasis on reducing, reusing, and recycling as key to sustainable materials management.

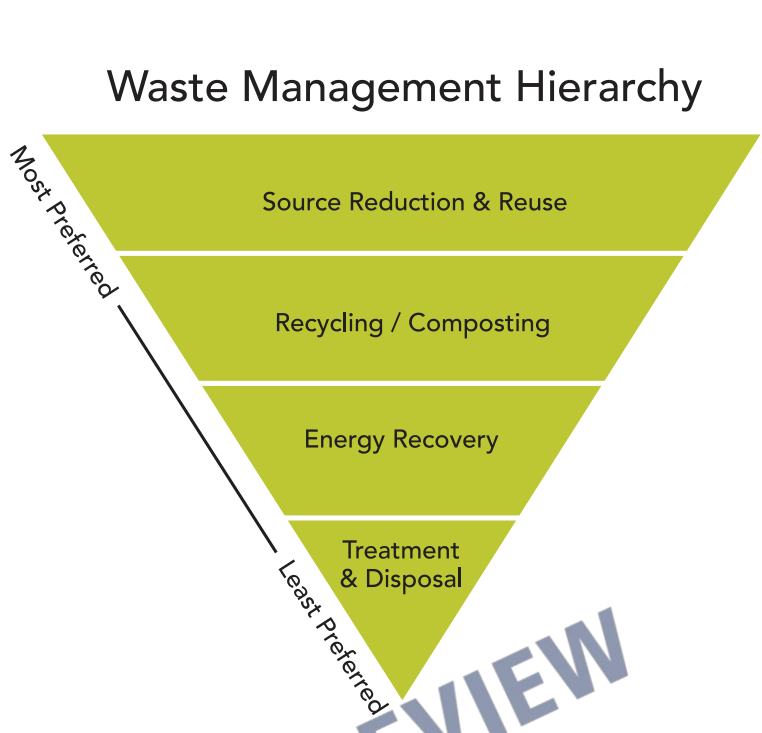


*Figure 3. U.S. EPA, 2017.*



As shown by Figure 3, there are multiple alternatives for managing MSW. A basic range of services includes garbage collection and disposal. A full range of services could include waste reduction education, recycling, yard and food waste (organics) composting, and generating energy from waste. Deciding the best overall service option for achieving MSW management goals is a significant responsibility. Consequently, a city should carefully evaluate options for their environmental impacts, community acceptance, and economic requirements.

Following is an overview of materials that comprise MSW, commonly employed management alternatives, and basic planning guidelines. Each aspect of a waste management system has to consider the community's unique set of regulatory, geographic, demographic, and financial circumstances. The common fact to all communities is that proper MSW management is a required service for maintaining a sanitary civilization.

## *Municipal Solid Waste Materials*

Most cities define MSW as everyday discarded items that are generated from households, commercial establishments and institutions. MSW streams can be subcategorized as garbage, recyclables, organics, hazardous waste, and special wastes.

• **GARBAGE.** Garbage is the mixed material commonly disposed of in sanitary landfills or incinerators. Often, a large percentage of this material could be recovered or recycled if separated and diverted from the mixed waste stream.

• **RECYCLABLES.** Recyclables include various fiber materials such as corrugated cardboard, chipboard/boxboard, newspapers, magazines, and various grades of office paper. Container materials such as aluminum cans, steel cans, glass, and various grades of plastic are also frequently recycled. Community recycling programs vary greatly according to availability of end markets and processing outlets, current market demands for recycled materials, and numerous factors affecting program costs (addressed later in this booklet).



• **ORGANICS.** Organics typically consist of yard trimmings and food scraps. Organics decomposing in a landfill contribute to the formation of the greenhouse gas, methane. In addition, organics can comprise in excess of 25 percent of MSW generated in cities. Therefore, many states and cities are targeting organics for recovery through composting and converting into energy via anaerobic digestion.

• **HOUSEHOLD HAZARDOUS WASTE.** MSW may include materials that would be considered hazardous wastes if they were generated by industry. However, households, farms, and some small businesses are permitted by law to dispose of their hazardous wastes in Resource Conservation and Recovery Act (RCRA) permitted landfills. Household hazardous wastes include the leftover or unusable portions of consumer products that are flammable, toxic, corrosive, reactive, or radioactive. The most common of these products are paint and home improvement products, oil and automotive supplies, pesticides and yard care products, household cleaning products, and pool and spa chemicals.

• *Universal waste* is a subcategory of hazardous waste, defined by 40 CFR *part 273 to include batteries, pesticides, mercury-containing equipment, and lamps.* Because these are widely generated wastes, the U.S. EPA developed special regulations to facilitate environmentally sound collection and proper recycling or treatment to reduce the quantity of these items going to municipal solid waste landfills or incinerators.

• *Special Wastes* are those that may be difficult to dispose because of size, components, or contents. Examples of these wastes include mattresses, appliances, and pharmaceuticals. Electronics are a rapidly increasing special waste stream, which are frequently referred to as e-wastes. Such items are often handled through special collection. Other wastes, such as asbestos and contaminated soil, often require distinctive disposal procedures with additional costs involved.



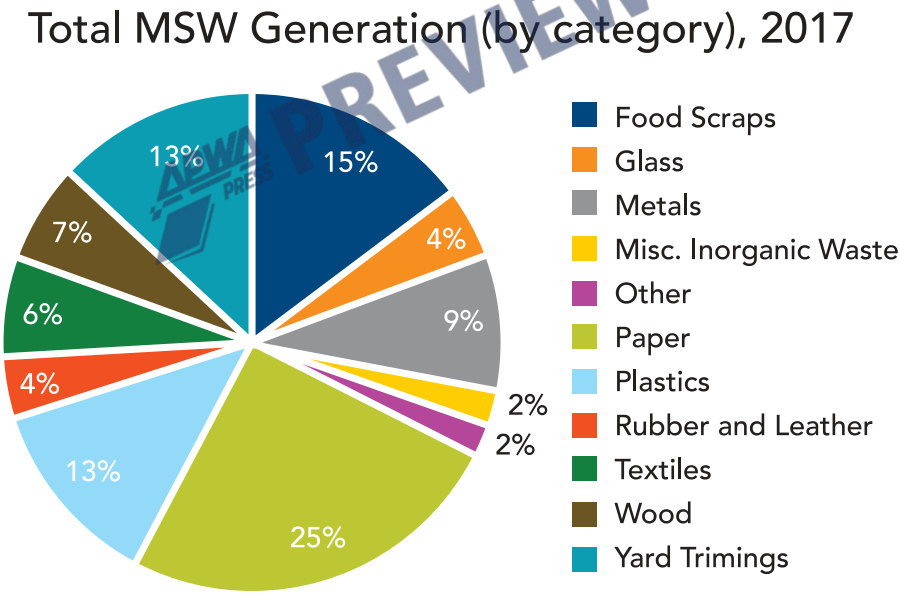


*Figure 4. U.S. EPA, 2017.*

Some pages are omitted from this book preview.

## PLASTICS TO FUEL

Plastics-to-Fuel (PTF) is an emerging technology that processes plastics. The plastic feedstock is heated in a vessel with a light industrial burner, depolymerizing the plastic as it transforms from a solid to a liquid to a gas. Through a combination of temperature and vacuum, the gases are pulled from the cartridge into a central condensing system where they are cooled and condensed into synthetic crude oil. Feedstock impurities are separated out into a char and the synthetic crude oil is transferred to an exterior tank ready for transport to a refinery. Liquid hydrocarbon oil produced can be refined into higher value products and requires less energy and processing requirements to be converted to plastics feedstock or to liquid fuels.

## SANITARY LANDFILLS

Materials not applicable to other recovery processes need to be disposed and, at this time, sanitary landfills are the most common method for disposal. Beginning in the early 1990s, government regulations have required more stringent requirements for landfills to help reduce their environmental impact. In addition to compaction and daily cover, modern landfills include the following environmental protection measures:



**ENERGY RECOVERY FROM LANDFILLED WASTE**

More communities are tapping landfill methane as an energy source. Minimum volumes of methane are required to make engery production feasible. EPA's Landfill Methan Outreach Program has assisted many communities in evaluating their landfills' energy potential.

**Visit epa.gov/lmop to learn more.**

- Siting restricted to locations that reduce the risk of impact to groundwater and surface water.
- Plastic and/or clay liners at the bottom of the landfill to trap "leachate" (liquids that are generated as waste decomposes or that flow through waste from rainfall) to prevent potential contamination to groundwater or surface water.

- Collection pipes and treatment systems for the leachate that collects on top of the liner.
- Gas collection systems to control the release of methane (which can cause explosions), odors, and other gasses that are generated when waste decomposes in a landfill. Landfill gas is typically vented, burned in flares, burned on-site to generate electricity, or cleaned and sold for use as a fuel similar to natural gas.
- Soil or plastic caps installed to prevent rainwater from contacting the waste.
- Testing of groundwater upstream and downstream of the landfill to determine if the landfill is contaminating the groundwater.
- Requirements to set aside money for long-term care of the site after it closes. Long-term care generally includes keeping the cap intact as the waste settles and the cap weathers, operating the gas collection system, and monitoring for groundwater pollution.



## Number of U.S. Landfill Facilities, by Region

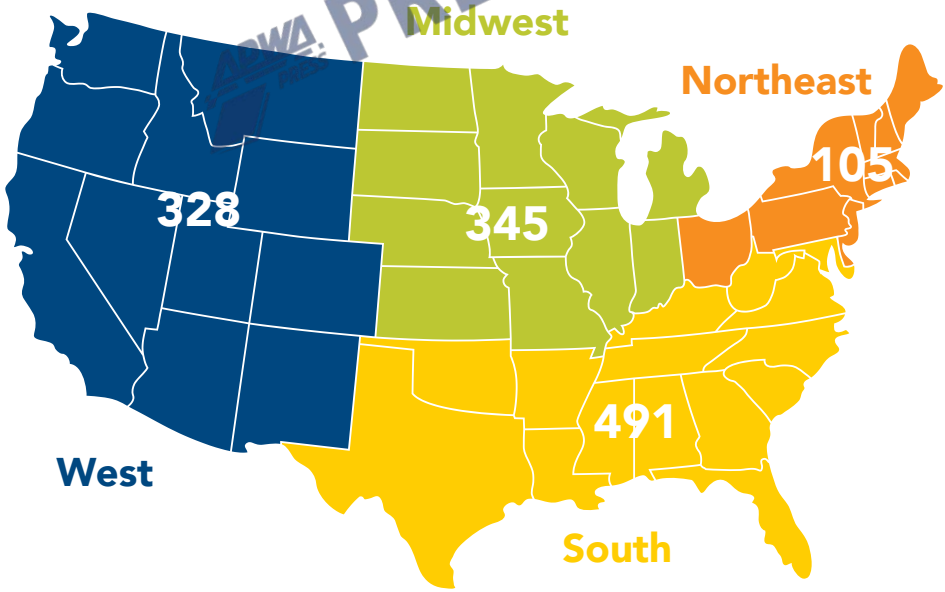


*Figure 6. Number of U.S. landfill facilities in 2017, by region.*
*("Waste Management in the United States – Statistics and Facts." T. Wang, Oct. 17, 2019.)*

### TRANSFER STATIONS

If geography and population prevent siting recovery or disposal facilities nearby a city, transfer facilities may be constructed to consolidate and further compact waste before transport. A transfer station is a light industrial facility where MSW is temporarily staged in the course of its eventual journey to the landfill or WTE facility. Typical activities at the transfer station involve the unloading of garbage trucks, pre-screening, and removal of inappropriate items such as automobile batteries, compacting, and then reloading onto larger vehicles, including trucks, trains, and barges to their final destination.

A transfer station can be a key component of cost-effective MSW transportation. By transferring MSW from local collection vehicles onto larger trailers or other transport modes such as barge and rail, the cost of transportation to distant disposal or final management sites can be significantly reduced, freeing collection-specific vehicles and crews to devote their time to actual collection activities.



Some of the main benefits of transfer stations include the following:

- They provide fuel savings, reduction in road wear, and less air pollution due to fewer vehicles being on the road.
- They provide trash and recyclable material drop-off location for citizens.
- They reduce traffic congestion in the community by transferring it onto larger vehicles.
- They reduce truck traffic and improve safety at the landfill or WTE facility.
- They provide the opportunity to screen incoming trash for such purposes as removing hazardous waste or recovering recyclables.

## *Public or Private Systems*

A community must decide whether to sustain its own MSW management program with internal resources or to contract the services to private companies. In many communities, a combination of public and private services is employed. In making this decision, the community must give consideration to demographics and geography, proximity to recycling end markets and existing waste management facilities, available funding sources, and the range and cost of commercial services.

Some pages are omitted from this book preview.

## *Vocabulary*

The following terms are commonly used in MSW management:

• **COMBUSTION –** The controlled burning of MSW to reduce volume and, commonly, to recover energy.

• **COMPOSTING –** The controlled microbial decomposition of organic matter (such as food scraps and yard trimmings) in the presence of oxygen into a humus- or soil-like material.

• **CURBSIDE COLLECTION –** A method of collecting materials at individual homes or places of business by municipal or private parties for transfer to a designated collection site or recycling facility.

• **DROP-OFF –** A method of collecting recyclable materials in which individuals transport the materials to a designated collection site.

• **HOUSEHOLD HAZARDOUS WASTE –** unwanted or unusable portions of consumer products that are flammable, toxic, corrosive, or reactive. These products include some paints and solvents, automotive products, cleaners, and pesticides.



• **INTEGRATED WASTE MANAGEMENT –** The complementary use of a variety of practices to handle MSW safely and effectively. Integrated waste management techniques include source reduction, recycling, composting, combustion, and landfilling.

• **LANDFILLING –** The disposal of solid waste at engineered facilities in a series of compacted layers on land and the frequent daily covering of the waste with soil. Fill areas are carefully prepared to prevent nuisances or public health hazards, and clay and/or synthetic liners are used to prevent releases to groundwater.

• **MUNICIPAL SOLID WASTE (MSW) –** Waste generated in households, commercial establishments, institutions, and businesses. MSW includes used paper, discarded cans and bottles, food scraps, yard trimmings, and other items. Industrial process wastes, agricultural wastes, mining waste, and sewage sludges are not MSW.

• **PRE-CONSUMER MATERIALS –** Recovered materials obtained from manufacturers.

• **POST-CONSUMER MATERIALS –** Recovered materials from a consumer- oriented recycling collection system or drop-off center.

• **RCRA –** (pronounced "rick-rah") the Resource Conservation and Recovery Act, a 1976 federal law, and amended in 1986, which gave EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous wastes.

• **RECYCLABLE –** Products or materials that can be collected, separated, and processed to be used as raw materials in the manufacture of new products.

• **RECYCLED CONTENT –** The portion of a product's or package's weight that is composed of materials that have been recovered from waste; this may include pre-consumer or post-consumer materials.

• **RECYCLING –** Separating, collecting, processing, marketing, and ultimately using a material that would have been thrown away.

• **REUSE –** The use of a product more than once in its same form for the same purpose or for different purposes, such as reusing a soft-drink bottle when it is returned to the bottling company for refilling or reusing a coffee can as a container for nuts and bolts.



• **SOURCE REDUCTION –** The design, manufacture, purchase, or use of materials to reduce the amount or toxicity of waste. Because it is intended to reduce pollution and conserve resources, source reduction should not increase the net amount or toxicity of wastes generated throughout the life of the product. Source reduction techniques include reusing items, minimizing the use of products that contain hazardous compounds, using only what is needed, extending the useful life of a product, and reducing unneeded packaging.

• **SOURCE SEPARATION –** Separating materials (such as paper, metal, and glass) by type at the point of discard so that they can be recycled.

• **TOXIC –** Ability (or property) of a substance to produce harmful or lethal effects on humans and/or the environment.

• **VIRGIN MATERIALS –** Resources extracted from nature in their raw form, such as timber or metal ore.

• **YARD WASTE –** The component of solid waste composed of grass clippings, leaves, twigs, branches, and garden refuse.

# RESPONSIBLE SOLID WASTE MANAGEMENT

AMERICAN PUBLIC WORKS ASSOCIATION

1200 Main Street, Suite 1400
Kansas City, MO 64105
816-472-6100