# ENV 107:
# Introduction to Environmental Science

Lectures 12

Solid Waste Management

# Waste

- Any unwanted or discarded material from residential, commercial, industrial or agricultural activities that may cause environmental problems

- Waste and its management is a problem in both urban and rural areas

# Solid Waste

- Waste material that cannot be easily passed through a pipe
- Comprises a very wide range of materials that come from a variety of sources
- When solid wastes accumulate, water may pass through and pick up soluble components; as a result, the distinction between solid and liquid waste may become blurred

# Liquid Waste

- One that can be passed through a pipe i.e. sewage or watery mud
- May become separated or concentrated into a more solid form as a result of treatment procedures or natural settling processes

# Waste Sources

- The principal sources of solid waste are **agriculture and mining**

- More than half of all solid waste is generated by agricultural sector, which includes farms, orchards, ranches and animal feedlots

- Second largest solid waste generator is mining
  - Waste occurs as discarded piles of waste rock; most of this material is disposed of at the mine site
  - Another major component of solid mine waste is tailings- slags and sludge left over after processing

- Other industries also generate solid waste in the form of paper, cardboard, scrap metal, wood, plastics, glass, tires, and rags
  - Many industrial waste materials are potentially reusable or recyclable

- Some waste from stores, offices, and small industries is set by the side of the road and collected along with residential waste. Together they comprise **municipal solid waste,** the smallest but fastest-growing source of solid waste

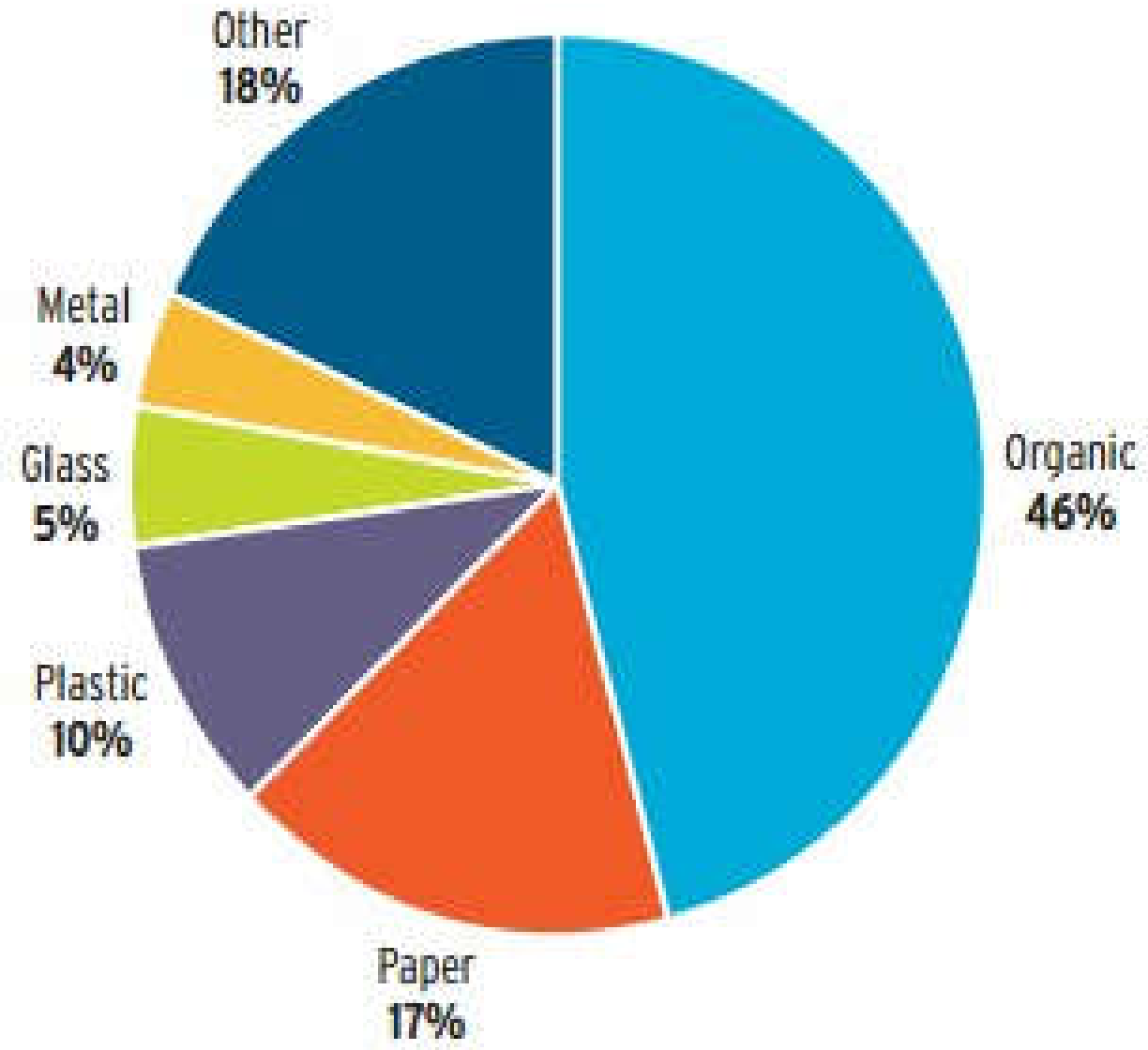
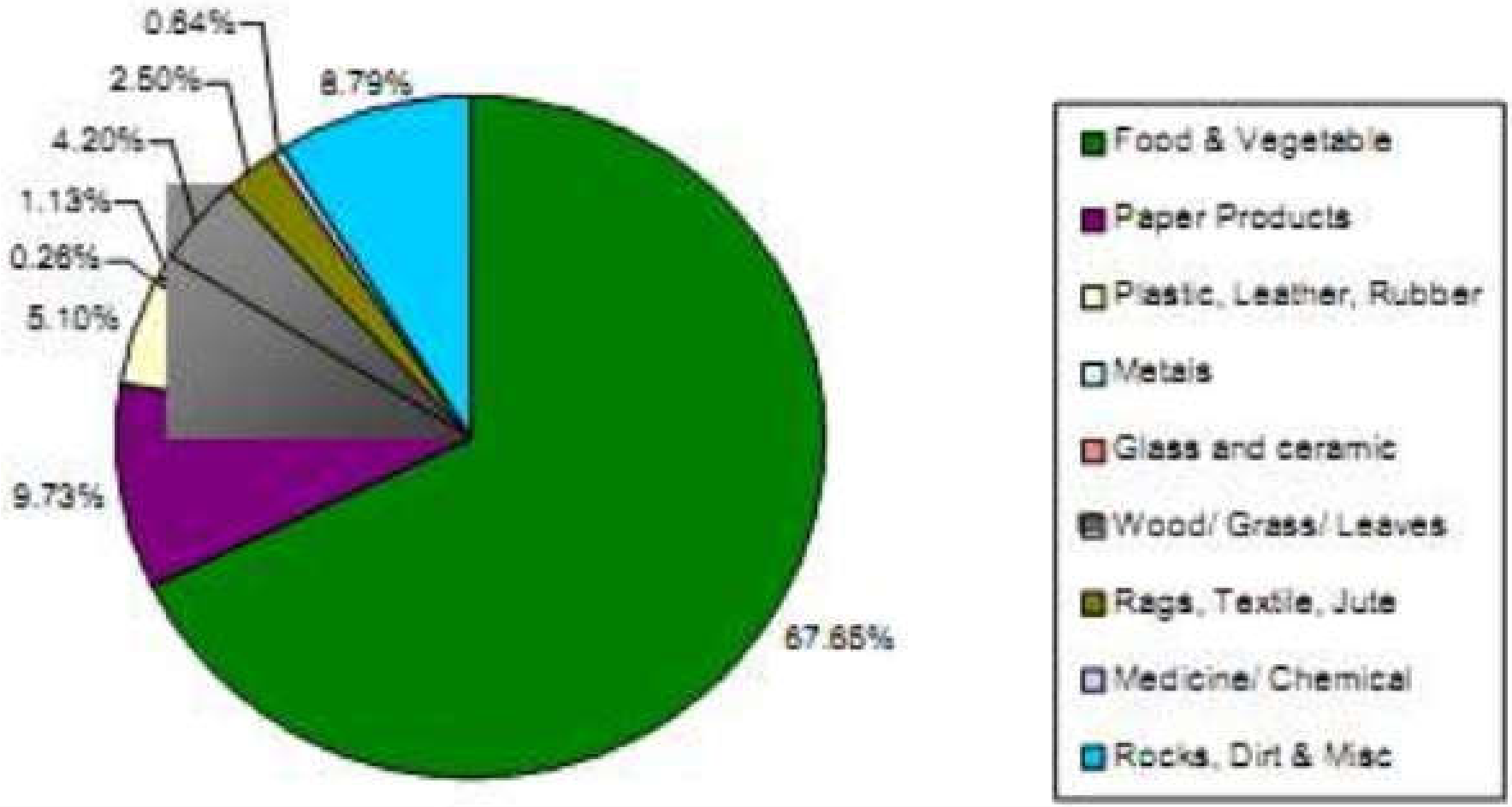


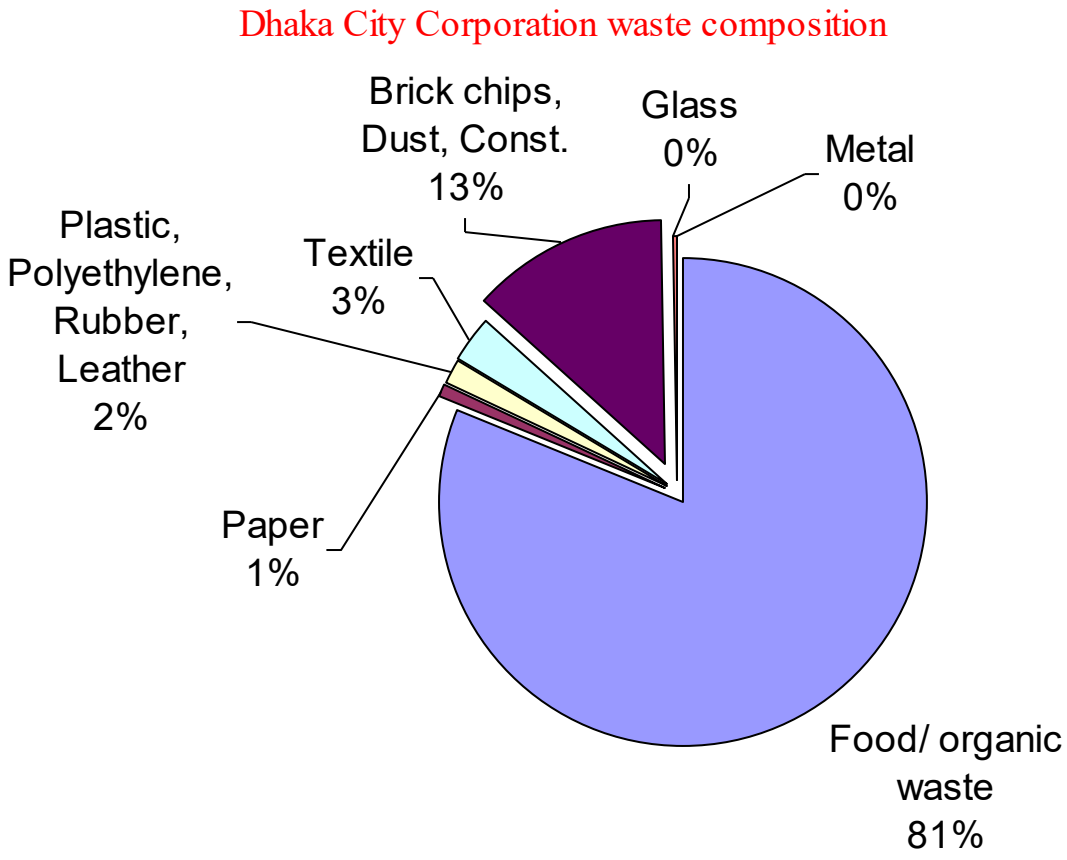

**FIG. 7**
**Global Solid Waste Composition**

# Major Sectors of Waste




**Major Sectors of Waste in Bangladesh**

# Composition of Municipal Solid Waste in Dhaka




**0.56 kg/ca/day**

# Early Concepts of Waste Disposal

- Early concept of waste disposal was “dilute and disperse”
- Factories were located near rivers- easy disposal of waste into the river
- With a few factories and sparse population, volume of waste produced was relatively small- dilute and disperse seemed to remove the waste from the environment
- As industrial and urban areas expanded, the concept of dilute and disperse became inadequate
- “Concentrate and contain”- a new concept on managing materials and eliminating waste; but not always achieved

# Modern Trends

- Environmentally preferable concept is to consider wastes as resources out of place
- Economically feasible to reuse and recycle more resources
- Waste, if produced, would be a resource to be used again
  - This is referred to as the “Zero waste” movement
- Waste from one part of the system would be a resource for another part
- In developing countries, waste management programs involve simply moving waste from one site to another and not really managing it; this is a problem

# Integrated waste management

- The major concept of IWM is **3Rs**:
  - Reuse
  - Reduce
  - Recycling
- At least 50% reduction of solid waste can be achieved through
  - Better design of packaging to reduce waste (10% source reduction).
  - Establishment of recycling programs (30% reduction), and
  - Large-scale composting programs (10% reduction).

# 3Rs - Reduce, Reuse and Recycle


- Reduce the amount of garbage generated. Make sure that whatever is being thrown is being done so after it has been used and refused to the maximum extent possible. Consuming fewer resources and this process greatly reduces the garbage.
- Reuse: Reuse everything to its maximum after properly cleaning it.
- Recycle: Keep things which can be recycled to be given to rag pickers or waste pickers.

# Waste Management Plan

- Defined as a set of management alternatives which combine different strategies to properly reduce and/or dispose off waste

The steps of Integrated Waste Management are:

- Sorting
- Storage
- Collection of Waste
- Disposal of Solid Waste

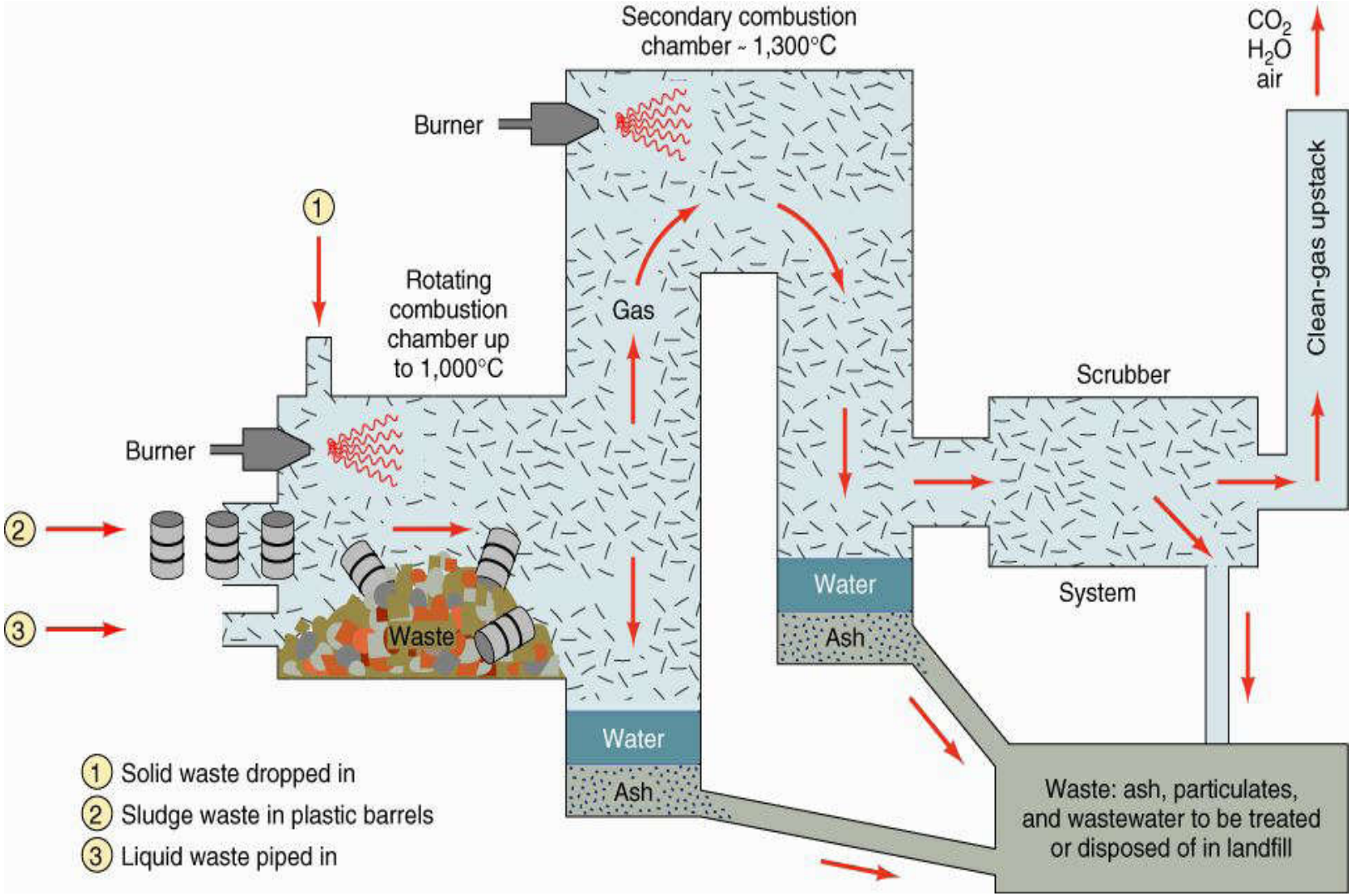
- Solid disposal processes include:
  - Composting
  - Incineration
  - Open Dump
  - Landfill

# Composting

- Process in which organic materials such as lawn clippings and kitchen scraps decompose to a rich, soil-like material
- Disadvantage: necessity to separate organic material from other waste
- Probably economically advantageous only when organic material is collected separately from other waste

# Incineration

- Burning of refuse in a specially designed facility
- All incinerators, even modern ones, generate residual ash, which may contain toxics
- Some incinerators use the heat they generate to produce electricity
- Modern incineration facilities have special devices in smokestacks to trap pollutants, but it's expensive. Plants themselves are also expensive




Botkin and Keller
Environmental Science

# Open Dump

- In the past, solid waste was usually accumulated in open dumps, where the refuse was piled up without being covered or otherwise protected

- Although open dumps have been closed in recent years and new open dumps are discouraged, many are still being used worldwide

- Dumps have been located wherever land is available, without regard to safety, health hazards and aesthetic degradation

- Common sites are natural low areas, such as swamps or floodplains; and hillside areas above or below towns

- Sometimes refuse is ignited and allowed to burn or leveled and compacted

- Generally open dumps:
  - create a nuisance by being unsightly
  - provide breeding grounds for pests
  - create a health hazard
  - pollute the air, groundwater and surface water

- Fortunately, open dumps are giving way to the better planned and managed landfills

# Open Dumping

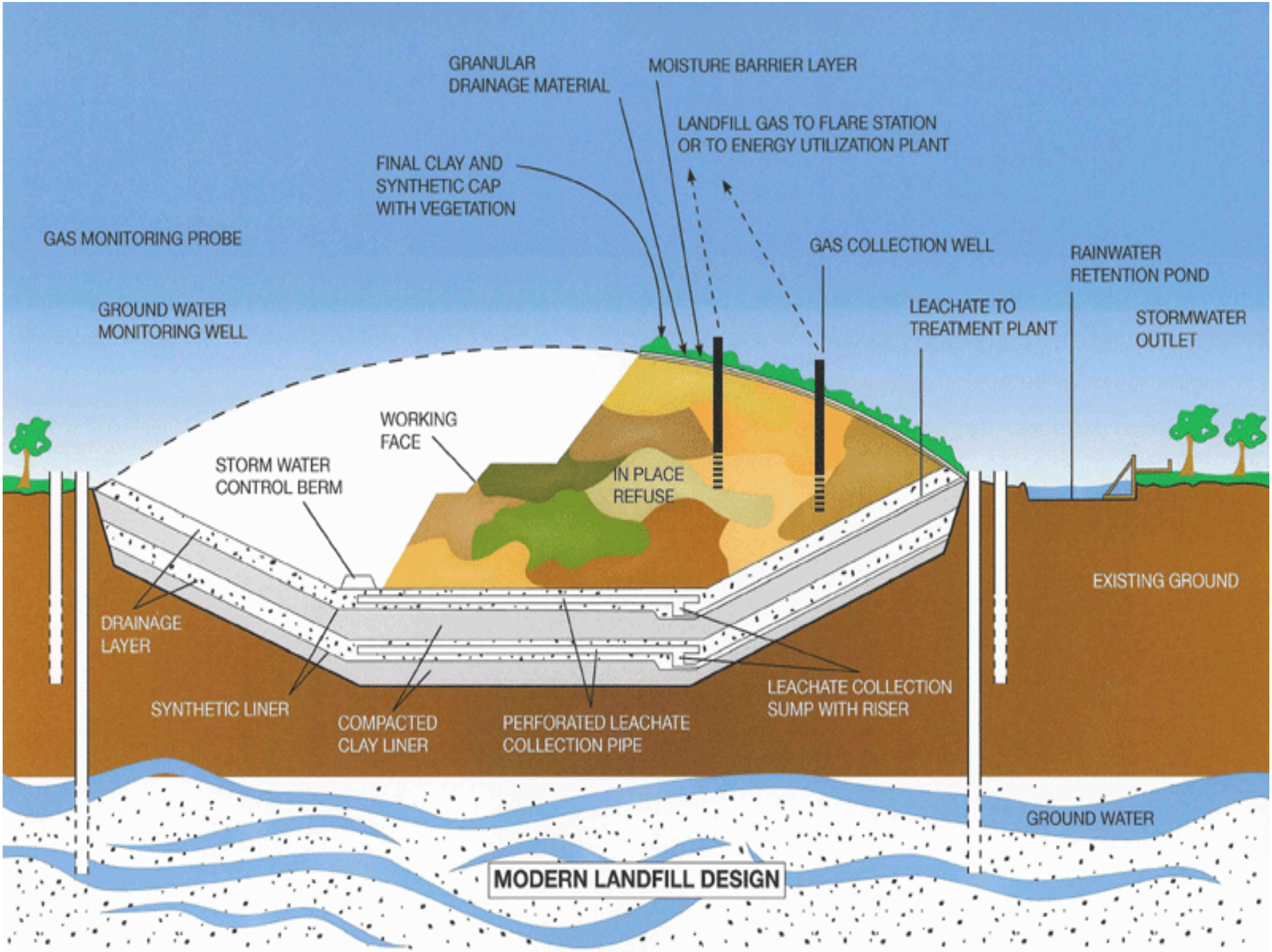
# Landfill

- Waste disposal sites that are engineered and monitored to contain wastes within the site
- Typical procedure is to compact waste as much as possible and regularly cover it with a compacted layer of soil and/or clay
- Soil layer isolates the waste from birds and rodents and prevents some infiltration by precipitation
- Hazard of landfill: Leachate
  - Noxious, mineralized liquid forms and mixes with groundwater

- Modern landfills are engineered to include multiple barriers (double-lined) i.e.
  - clay and plastic liners to limit movement of leachate
  - surface and subsurface drainage to collect leachate
  - system to collect methane gas produced as waste decomposes
  - groundwater-monitoring to detect leaks or leachate below and adjacent to the landfill

# Modern Engineered Sanitary Landfill

- Engineered sanitary landfills are closed dumps which need to control possible effluents:
  - Leachate
  - Methane
- Installation of impermeable liners at the bottom and on the top to stop any migration of leachate and gases.
- Installation of leachate and gas collection pipes
- Collection of leachate and gas for treatment
- Construction of barrier walls if needed
- Environmental monitoring


GRANULAR
DRAINAGE MATERIAL
MOISTURE BARRIER LAYER
LANDFILL GAS TO FLARE STATION
OR TO ENERGY UTILIZATION PLANT
FINAL CLAY AND
SYNTHETIC CAP
WITH VEGETATION
GAS MONITORING PROBE
GAS COLLECTION WELL
RAINWATER
RETENTION POND
GROUND WATER
MONITORING WELL
LEACHATE TO
TREATMENT PLANT
STORMWATER
OUTLET
WORKING
FACE
STORM WATER
CONTROL BERM
IN PLACE
REFUSE
EXISTING GROUND
DRAINAGE
LAYER
SYNTHETIC LINER
COMPACTED
CLAY LINER
PERFORATED LEACHATE
COLLECTION PIPE
LEACHATE COLLECTION
SUMP WITH RISER
GROUND WATER
MODERN LANDFILL DESIGN

# Management Strategies

- **National 3R Strategies:** The national 3R goal for waste management is to achieve higher levels of waste reduction, reuse, and recycling

**Objectives of the National 3R Strategy:**

- Address the key issues of waste management
- Define the roles of various actors
- Guide the creation of enabling conditions for success