ENVIRONMENTAL GEOTECHNICS

MKAJ 1083

TOPIC 3: TYPES AND COMPONENT OF SANITARY LANDFILL

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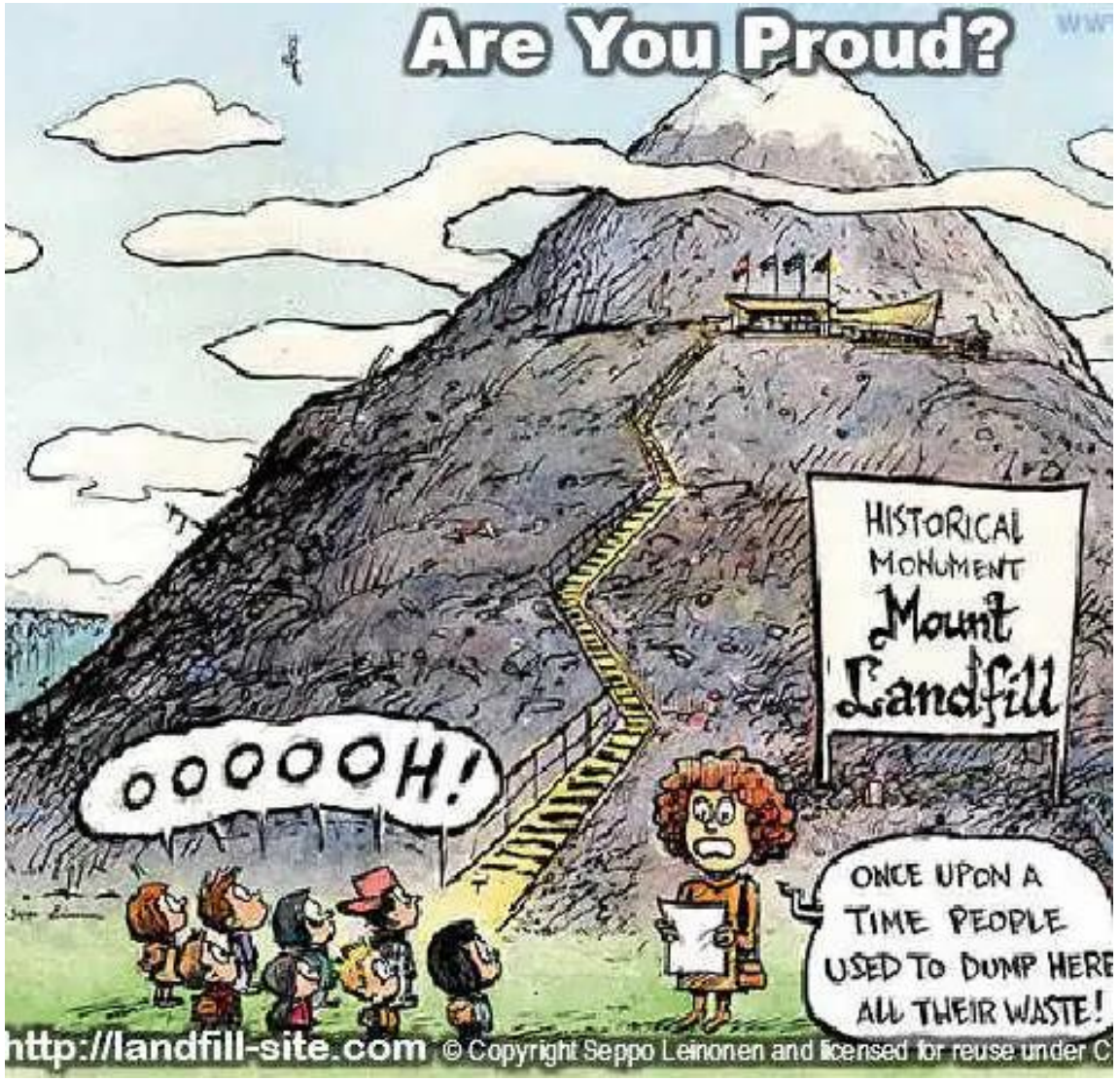
SANITARY LANDFILL

- A sanitary land fill is a waste disposal location where layers of compressed garbage is covered with layers of earth.
- When the facility reaches the end of its life and is full, a cap is used to close the top of site.
- Sanitary land fills are among the most popular methods for disposing of waste, although they have some serious disadvantages.



CLASSIFICATION OF SANITARY LANDFILL LEVELS

Level 1

Controlled tipping

- Waste is dumped on the landfill in a controlled manner and leveled, soil cover is laid periodically

Level 2

sanitary landfill with a bund and daily cover soil

- Sanitary landfill is provided with waste retaining structure, clearly defined cells and surface water drainage, soil cover is laid daily

Level 3

sanitary landfill with leachate recirculation system

- Sanitary landfill is provided with leachate collection and recirculation systems to recirculate the leachate back into the solid waste for further decompose to improve leachate quality

Level 4

sanitary landfill with leachate treatment facilities

- Improvement to Level 3 where landfill is provided with lining and leachate treatment system

LANDFILLING PROCESS

Waste Transport Vehicle

Weighbridge Entry

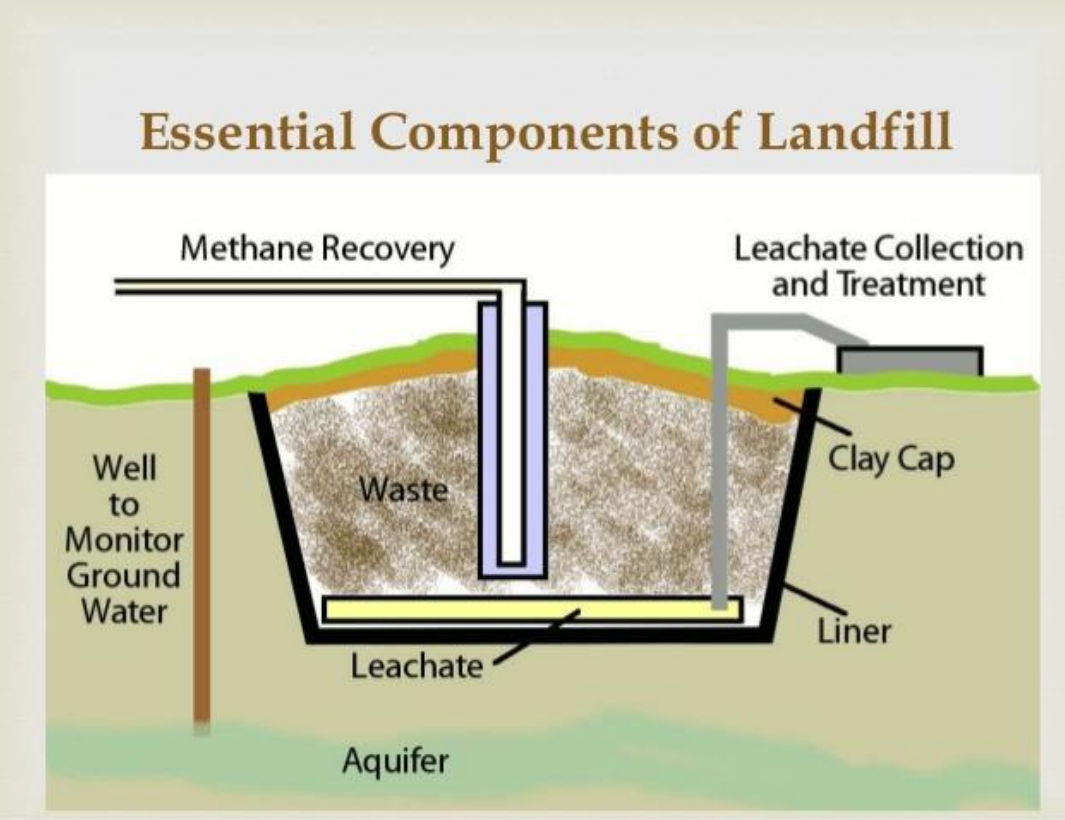
Unloading

Speading the wastes and Plattening the landfill

Soil covering

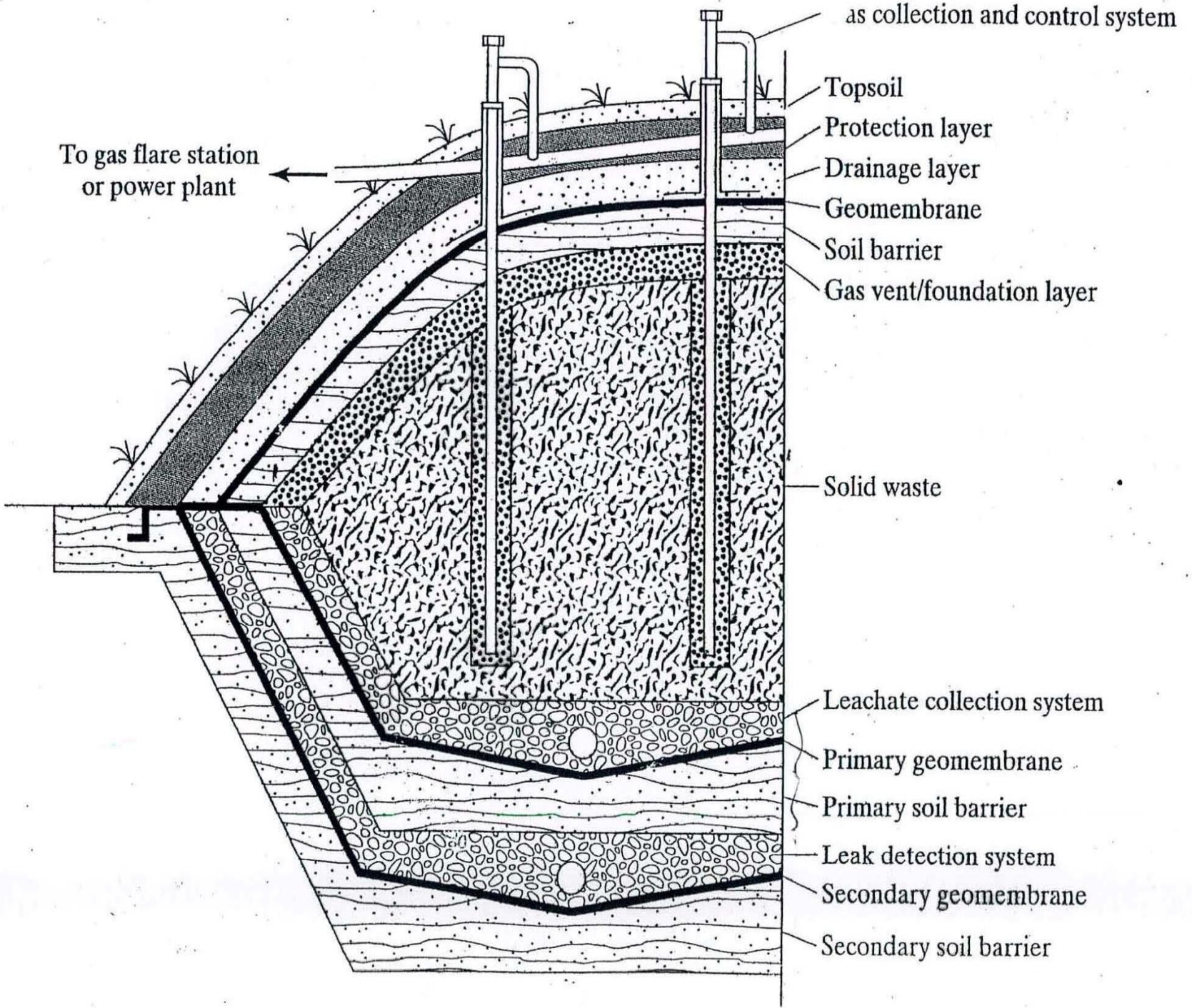
Car Wash and Exit

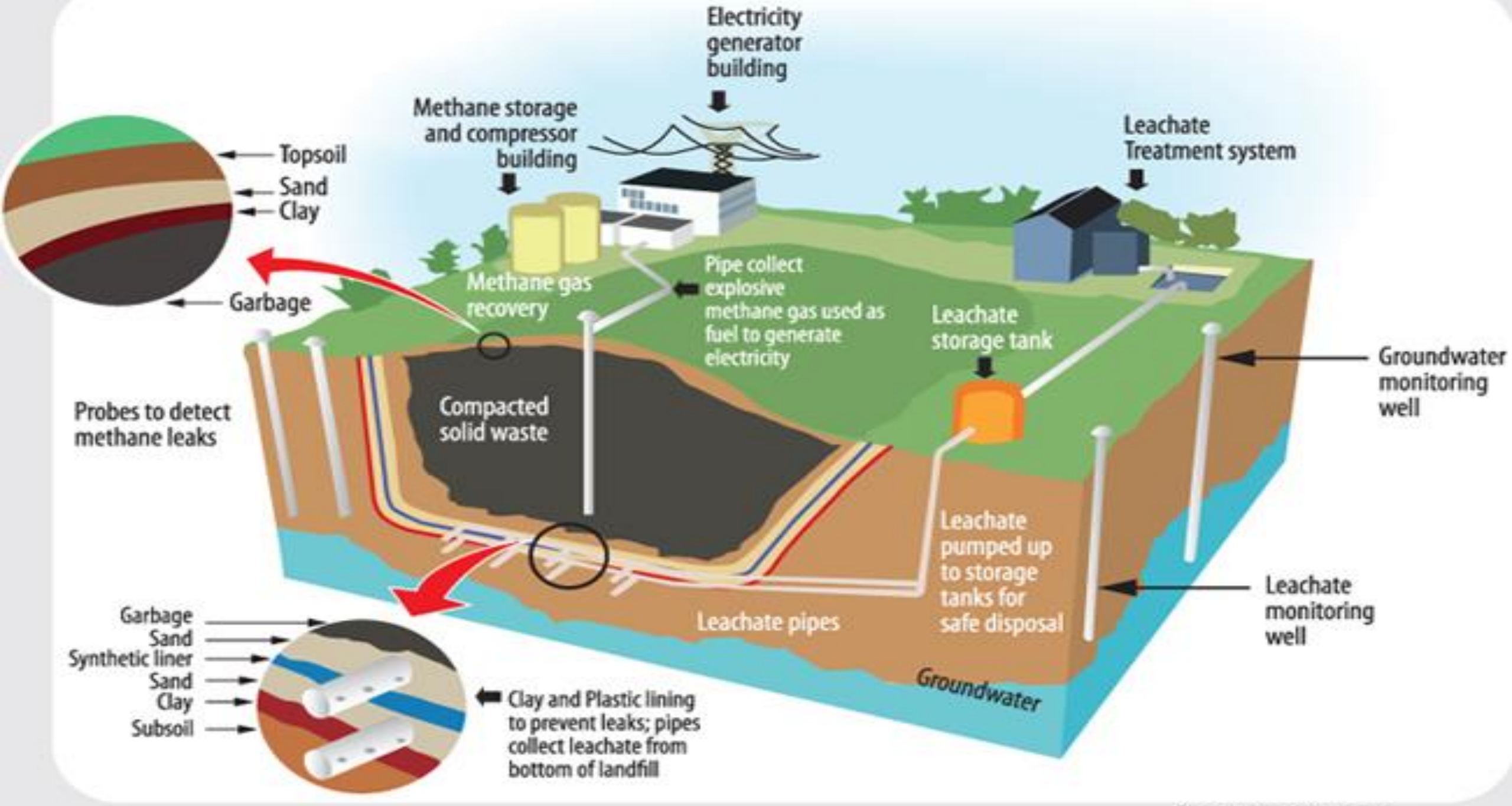
SANITARY LANDFILL: COMPONENTS



1. Waste retaining structures
2. Stormwater drainage facilities
3. Leachate collection facilities
4. Liner facility
5. Gas venting facility
6. Leachate treatment facility
7. Cover soil

MSW LANDFILL CONTAINEMENT SYSTEM





Garphic: Manoj Nishantha

- To store the solid wastes in a safe manner and to prevent overflow or collapse of the landfilled wastes.

- To reduce the amount of leachate by preventing stormwater from surrounding areas from flowing into landfill sites as well as to immediately discharge stormwater dropped within the landfill site.

3. LEACHATE COLLECTION FACILITIES

- To collect the generated leachate from the landfill site, chanelling it to a pre-determined treatment facility before discharging to the environment.

3. LEACHATE COLLECTION FACILITIES

3.1 Design Flow and Cross-sectional Area

Determine the leachate collection capacity ***based on leachate volume*** calculated by taking into account factors such as climatic and topographic conditions.

$$Q = (C / 1000) \cdot I \cdot A$$

3.2 Loading Conditions

Leachate collection pipes ***must be designed to withstand different loading condition***s (vertical and lateral) due to earth and waste pressures.

4. LINER FACILITY

- To prevent pollution of public water bodies or groundwater by leachate discharged *from the landfill* site
- To prevent increase in leachate volume caused by inflow of *surrounding groundwater into the landfill* site.
- It is necessary to consider structural characteristics of the liner.
- Consists of underground water drainage facility
- Can be classified into :

1. Vertical liner - drainage facility for groundwater is not required.
2. Surface liner - drainage facility for groundwater is required.

1

2

3

4. LINER FACILITY: INSTALLATION

4

5

6

4. LINER FACILITY: INSTALLATION

8

7

4. LINER FACILITY: INSTALLATION

5. GAS VENTING FACILITY

- Need to install gas venting as gas generated continuously during operation and after closure of landfill.
- To prevent adverse impacts due to released gasses
- To accelerate decomposition of organic materials thus promoting the stabilization of sanitary landfill site.
- To remove gas from landfill layers into atmosphere

6. LEACHATE TREATMENT FACILITY

- To purify the leachate collected so that the leachate will not pollute the environment after discharged
- Consists of leachate collection facility, leachate control facility, leachate transport facility, leachate treatment facility and leachate discharge facility.
- To mitigate fluctuation of leachate volume so as to ensure leachate treatment facility functions effectively

6. LEACHATE CONTROL PARAMETERS

- Volume of leachate generated:

$$Q = (C/1000) \times I \times A$$

@

$$Q = (1 / 1000) \times I \times (C1A1 + C2A2)$$

Where;

Q = leachate volume, m3/day

I = rainfall intensity, mm/day

C = leachate coefficient

A = landfill area, m2

A1 and A2 = ongoing and completed sectioned landfilling, respectively

7. COVER SOIL

Use permeable and porous type for daily cover to ensure easy spreading and compaction of waste.

Low permeability soil and suitable for plants should be applied for final cover.

Thickness of daily soil cover varies from 15 cm – 50 cm depending upon type of waste

Slope of soil cover 20o – 30o while on plain areas gradient of 2 – 3% are acceptable.

LANDFILL CONTROL FACILITIES

Waste inspection and measurement

Monitoring

Site office

Safety measures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TOPIC 4: LINER CLASSIFICATION (COMPONENT & SYSTEM)

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LINER: COMPONENTS

- **Soil (earthen) liners**

- Made of natural inorganic clays or clayey soils (CH, CL and SC) to achieve low in situ hydraulic conductivity

- A minimum thickness of 2 ft (600 mm) soil liners having a hydraulic conductivity of no more than 10-7 cm/s is typical.

- **Geomembranes (flexible membrane liners)**

- Virtually impermeable to liquids if intact

- A minimum thickness of 1.5 mm geomembrane is typical.

- **Geosynthetic clay liners (GCLs)**

Relatively thin (4 – 6 mm) clay (bentonite) layer contained by two (upper and lower) geotextiles or bonded (by adhesive) to a geomembrane

- **Vertical cutoff walls**

May be installed in older landfills with no liners or base leachate collection system to restrict leachate release to the environment.

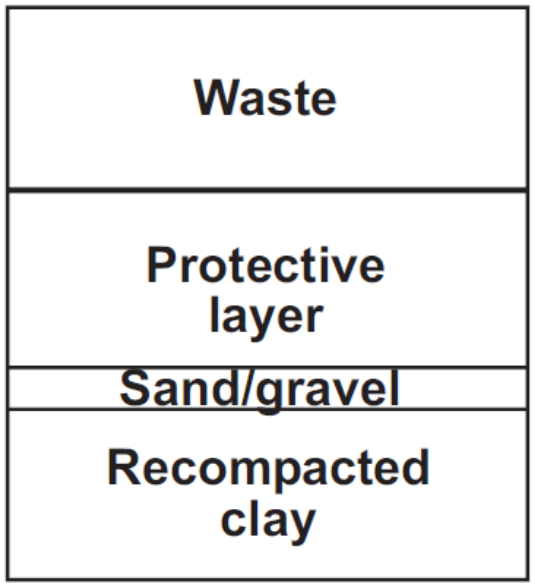
Single-Liner System

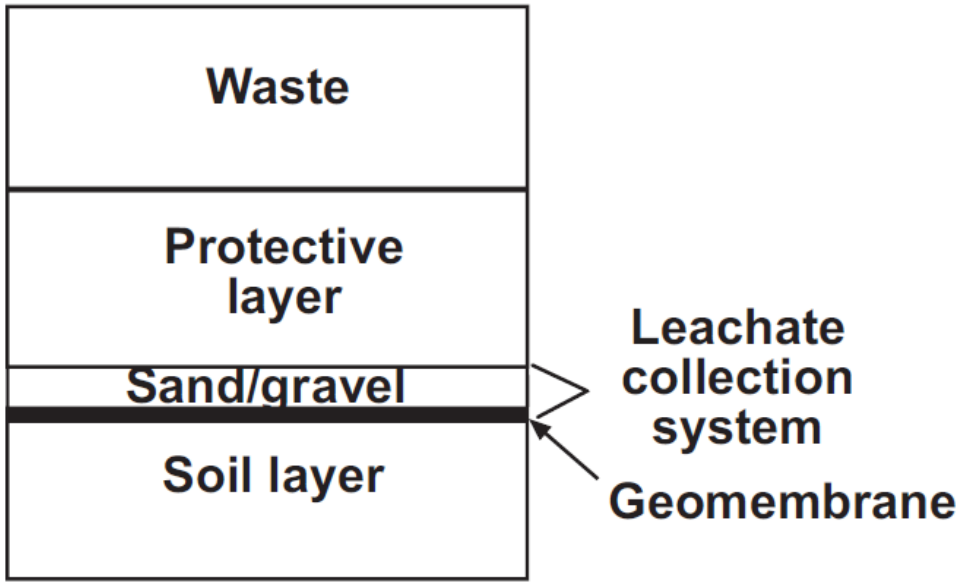
Composite-Liner System

Double-Liner System

SINGLE LINER SYSTEM

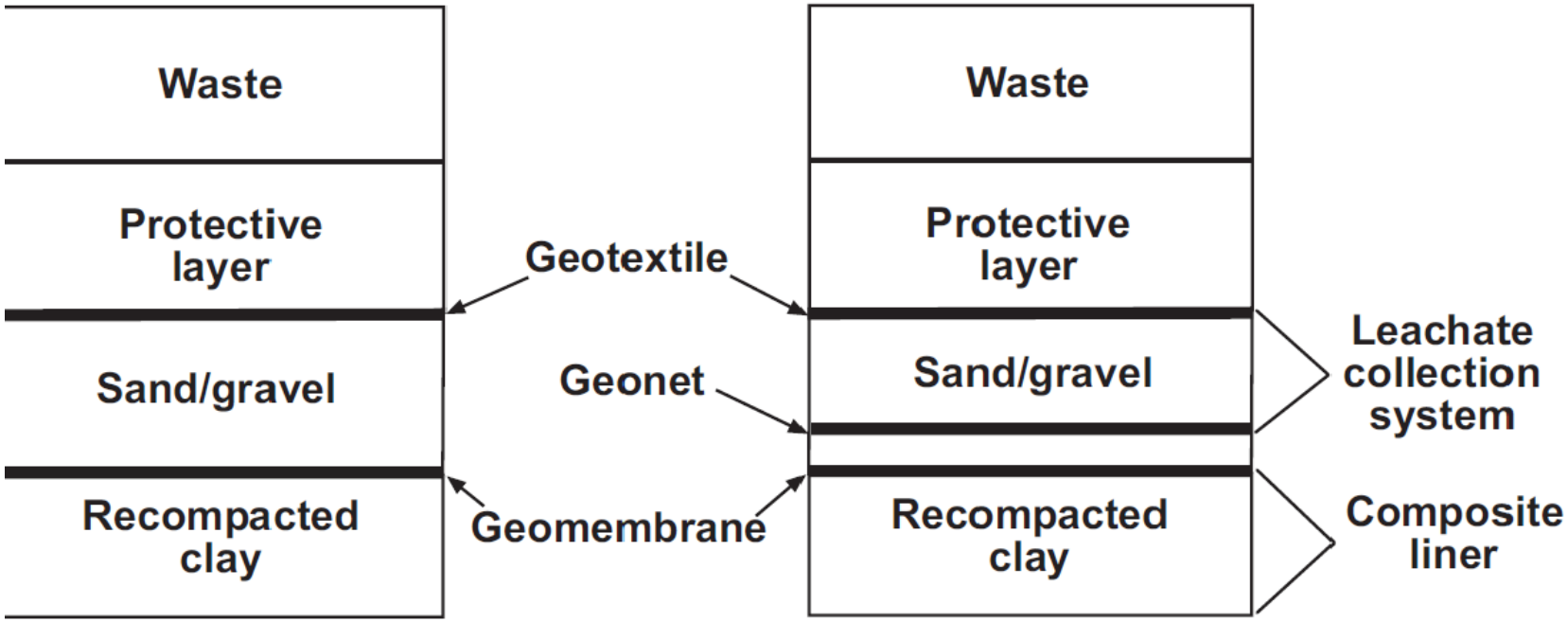
- Single liners consist of a clay liner, a geosynthetic clay liner, or a geomembrane.
- Sometimes used in landfills designed to hold construction and demolition debris (C&DD).
- These landfills design for C&DD are not constructed to contain paint, liquid tar, municipal garbage, or treated lumber; consequently, single-liner systems are usually adequate to protect the environment.
- Cheaper to build and maintain than other landfills





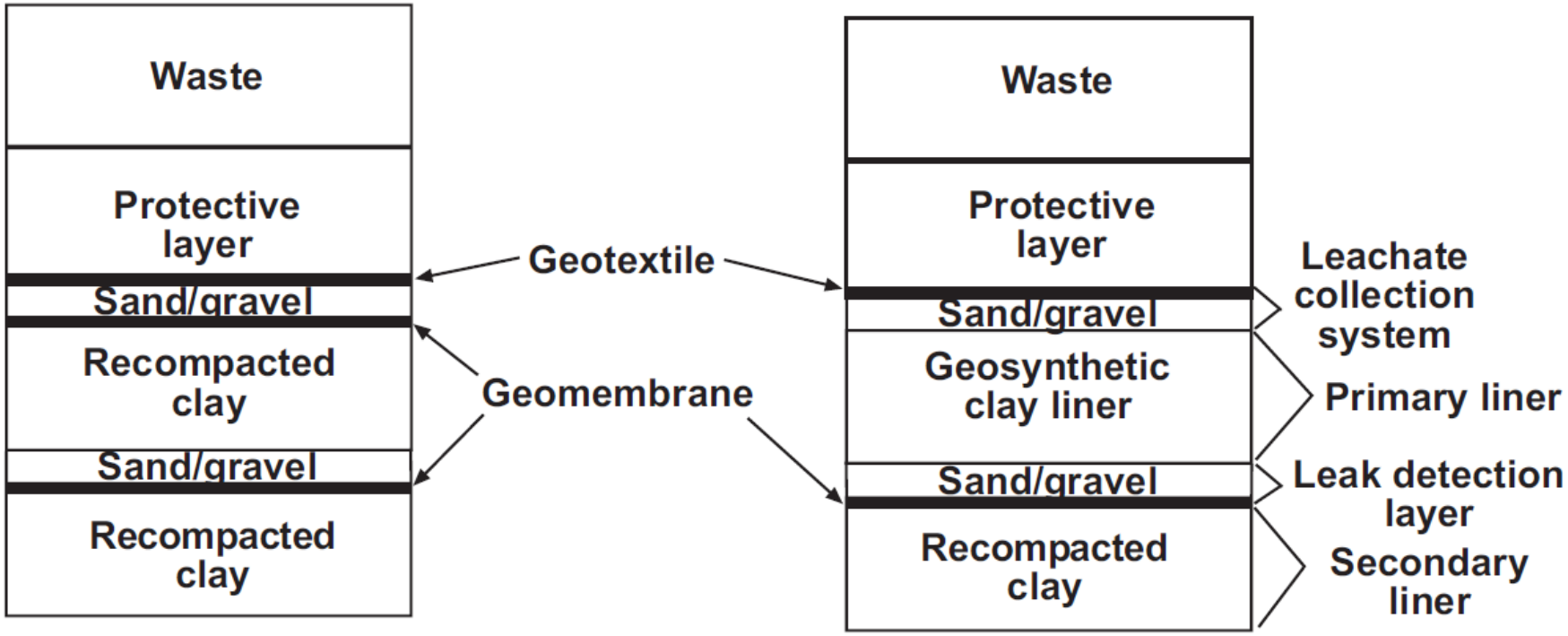
COMPOSITE LINER SYSTEM

- consists of a geomembrane in combination with a clay liner.
- more effective at limiting leachate migration into the subsoil than either a clay liner or a single geomembrane layer.
- required in municipal solid waste (MSW) landfills
- may also accept C&DD debris, but not hazardous waste



DOUBLE LINER SYSTEM

- consists of either two single liners, two composite liners, or a single and a composite liner.
- The upper (primary) liner usually functions to collect the leachate, while the lower (secondary) liner acts as a leak-detection system and backup to the primary liner.
- Normally used in some municipal solid waste landfills

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