Issues with Arsenic Containing Wastes in Modern Landfills

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Topics

- Types of landfills
  - Regulations
  - Engineering Controls
  - Chemical environments
- Toxic chemicals in landfills
  - Concerns for the landfill operator
  - Lessons learned

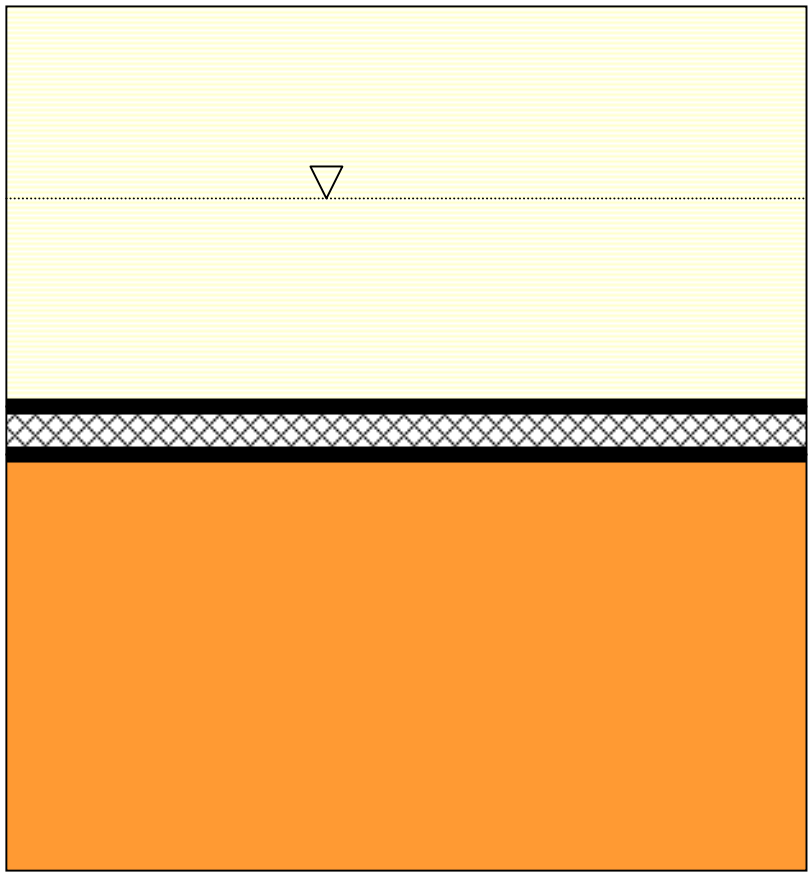
Types of Landfills

- Hazardous waste landfills
- Municipal solid waste landfills
- Other types
  - Construction and demolition debris
  - Industrial waste landfills

Hazardous Waste Landfills: RCRA Subtitle C Landfill (40 CFR 264)

Typical Subtitle C Liner

Double Liner



2 ft drainage material
Designed to maintain
less than 1ft head on liner

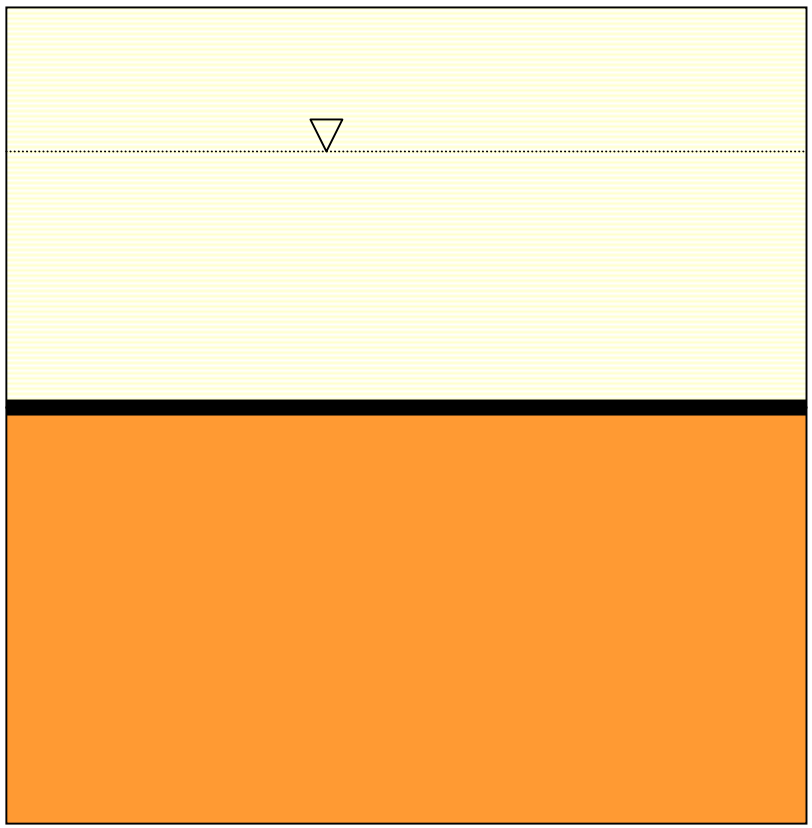
HDPE Geomembrane
Geonet
HDPE Geomembrane

3 ft compacted soil
K <= 10^{-7} cm/sec

MSW Landfills: RCRA Subtitle D Landfill (40 CFR 258)

Typical Subtitle D Liner

Single Composite Liner



2 ft drainage material
Designed to maintain
less than 1ft head on liner

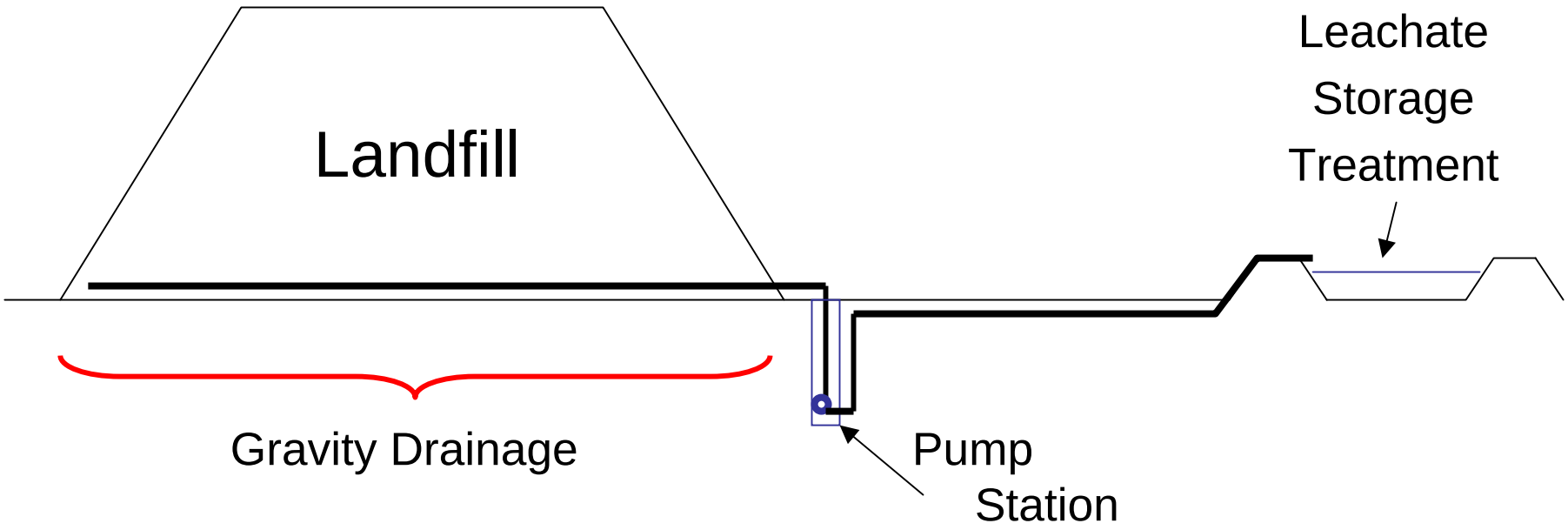
60 mil HDPE
Geomembrane

2 ft compacted soil
K <= 10^{-7} cm/sec

CP-563D
9ZW00149

DEERE
544H

Leachate is then sent to Treatment and/or Storage Facility

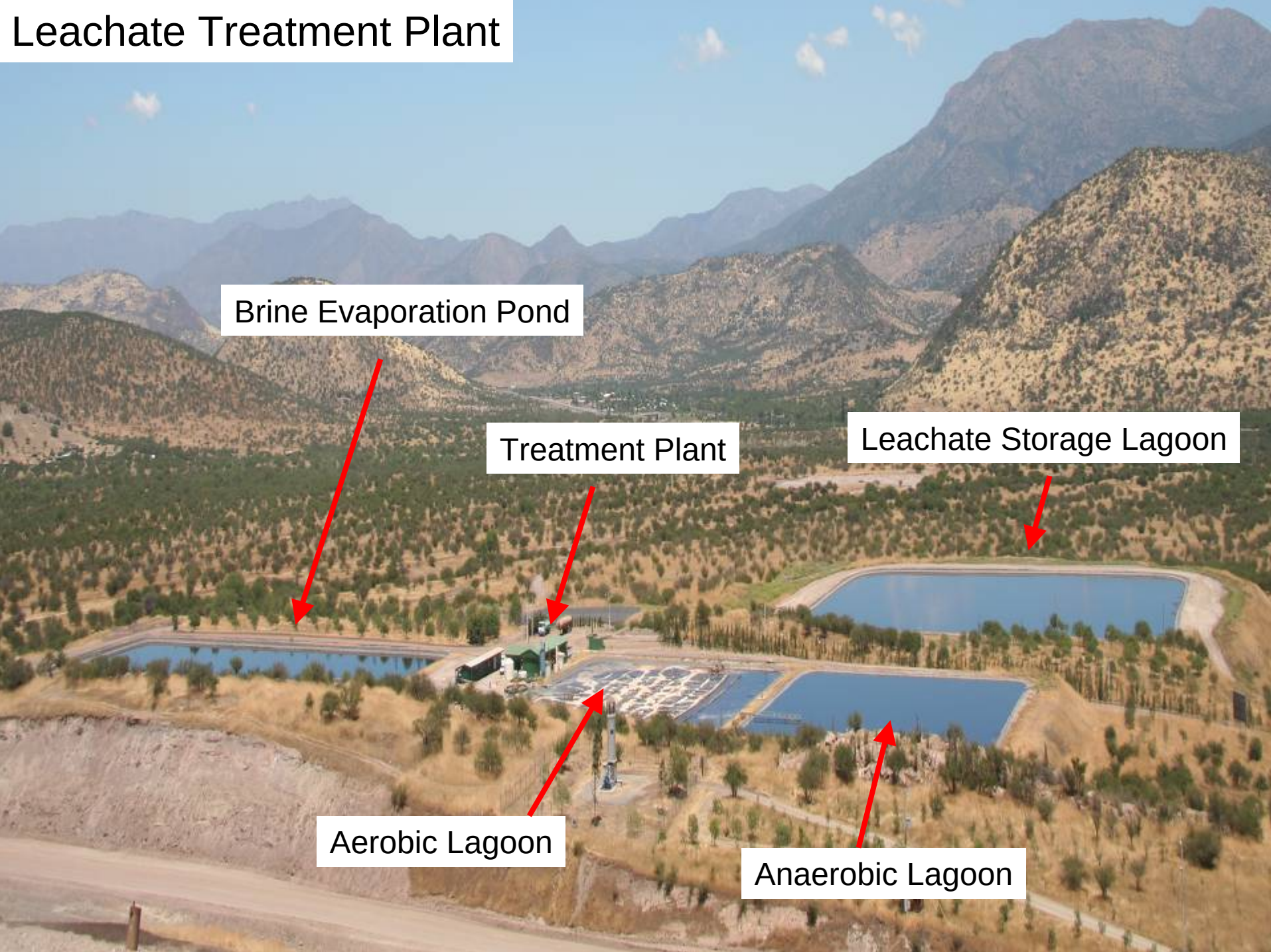


Lined Leachate Lagoon

Lined Leachate Lagoon

Leachate Storage Tank

Leachate Storage/Treatment Tanks


Leachate Treatment Plant
Brine Evaporation Pond
Treatment Plant
Leachate Storage Lagoon
Aerobic Lagoon
Anaerobic Lagoon

Aerobic Treatment Lagoon

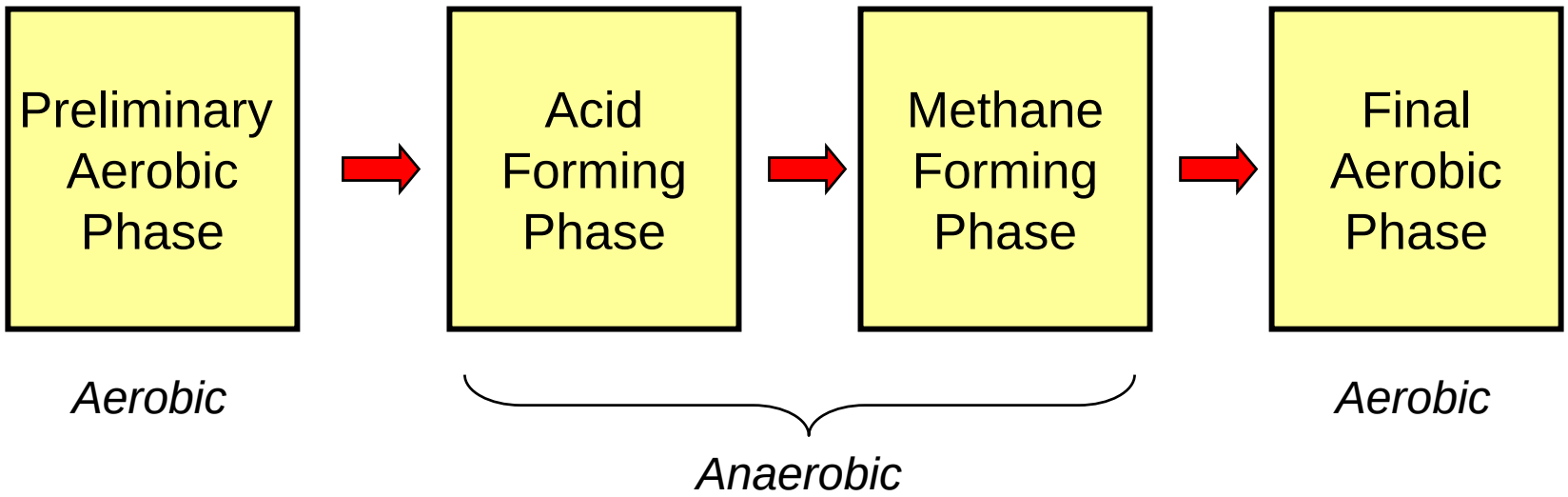
Reverse Osmosis Treatment

Leachate Treatment Using Wetlands

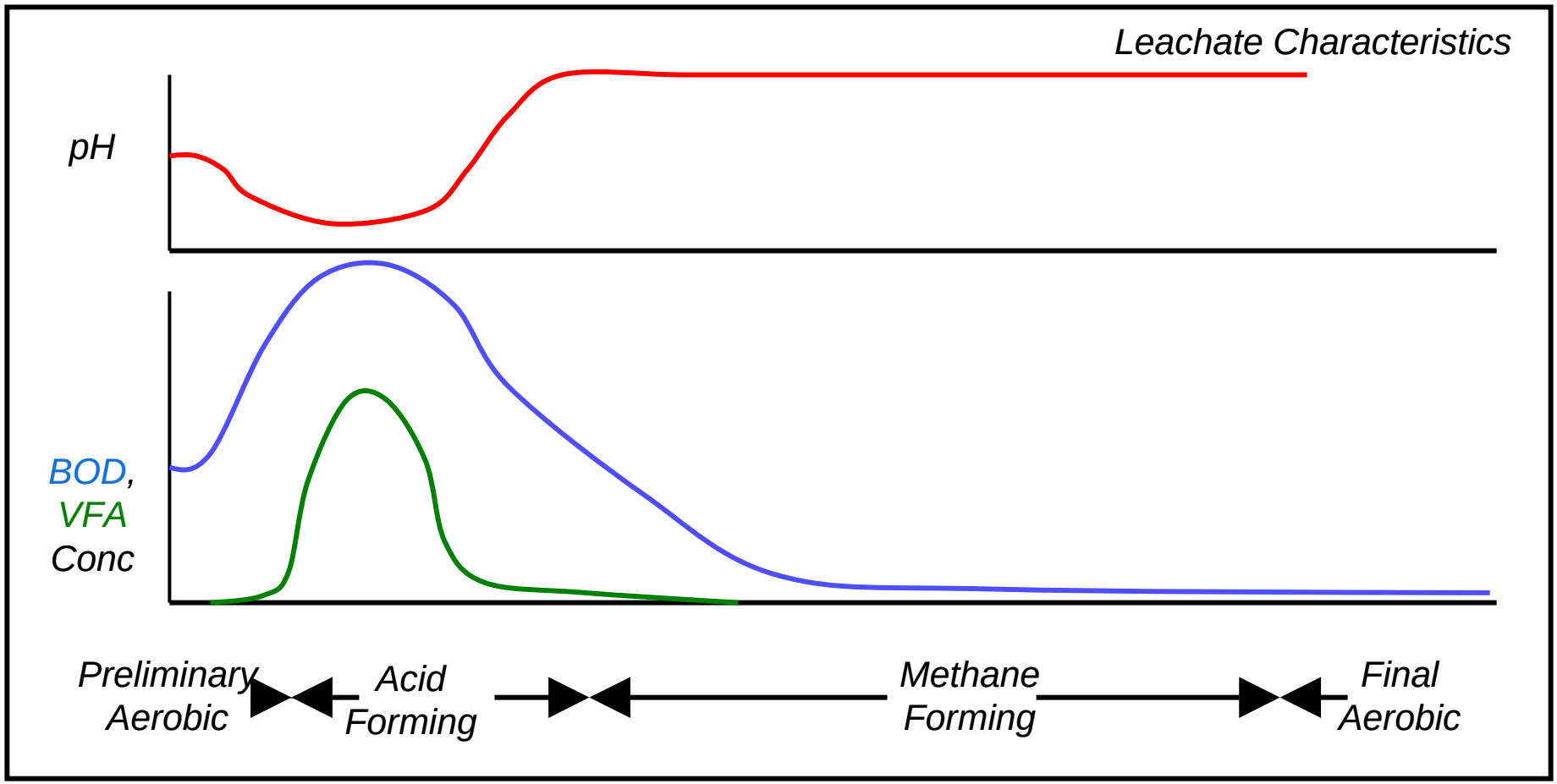
Leachate Recirculation to Landfill using Spray Irrigation

Leachate Recirculation to Landfill using Horizontal Trenches

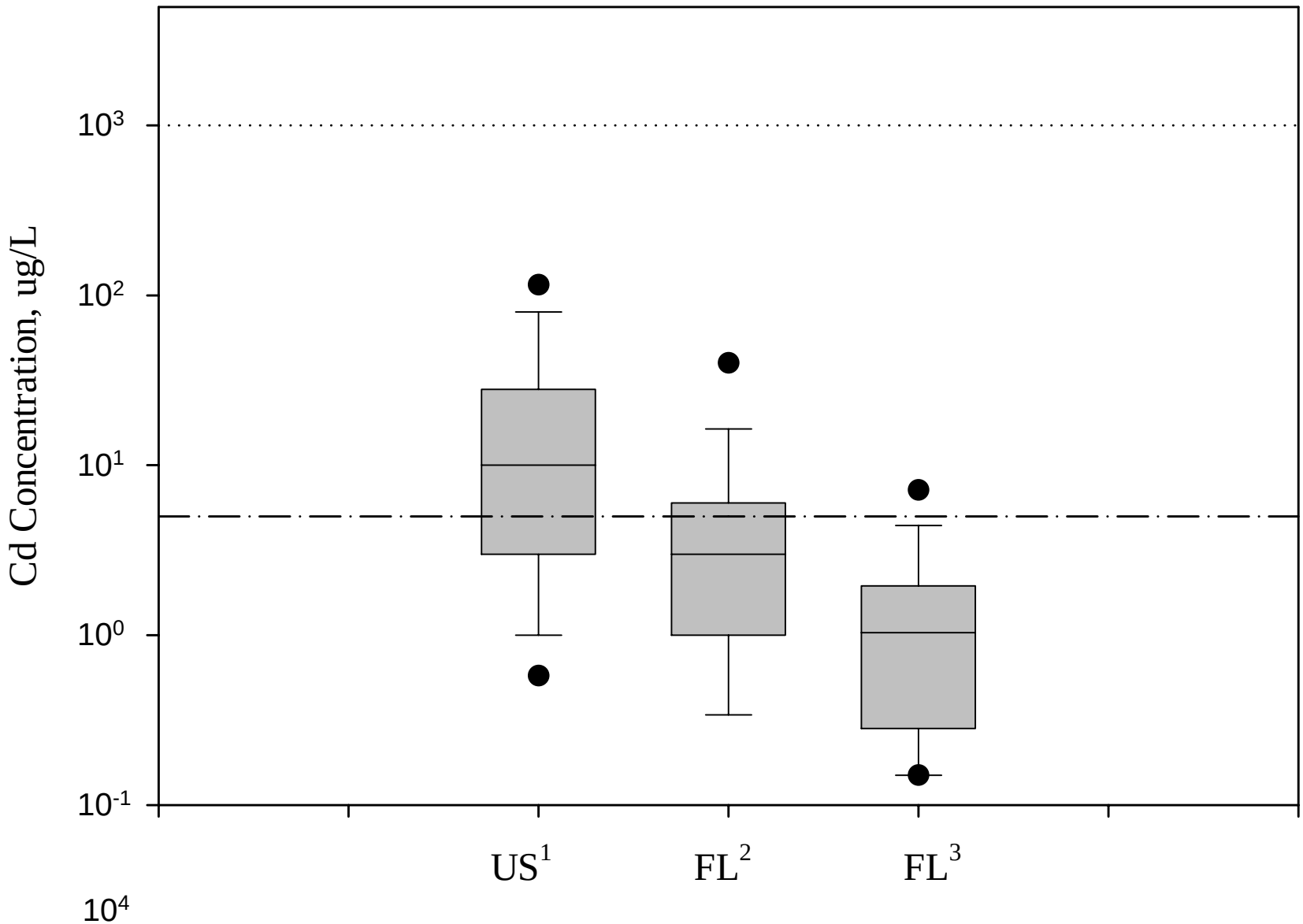
Waste Stabilization in MSW Landfills



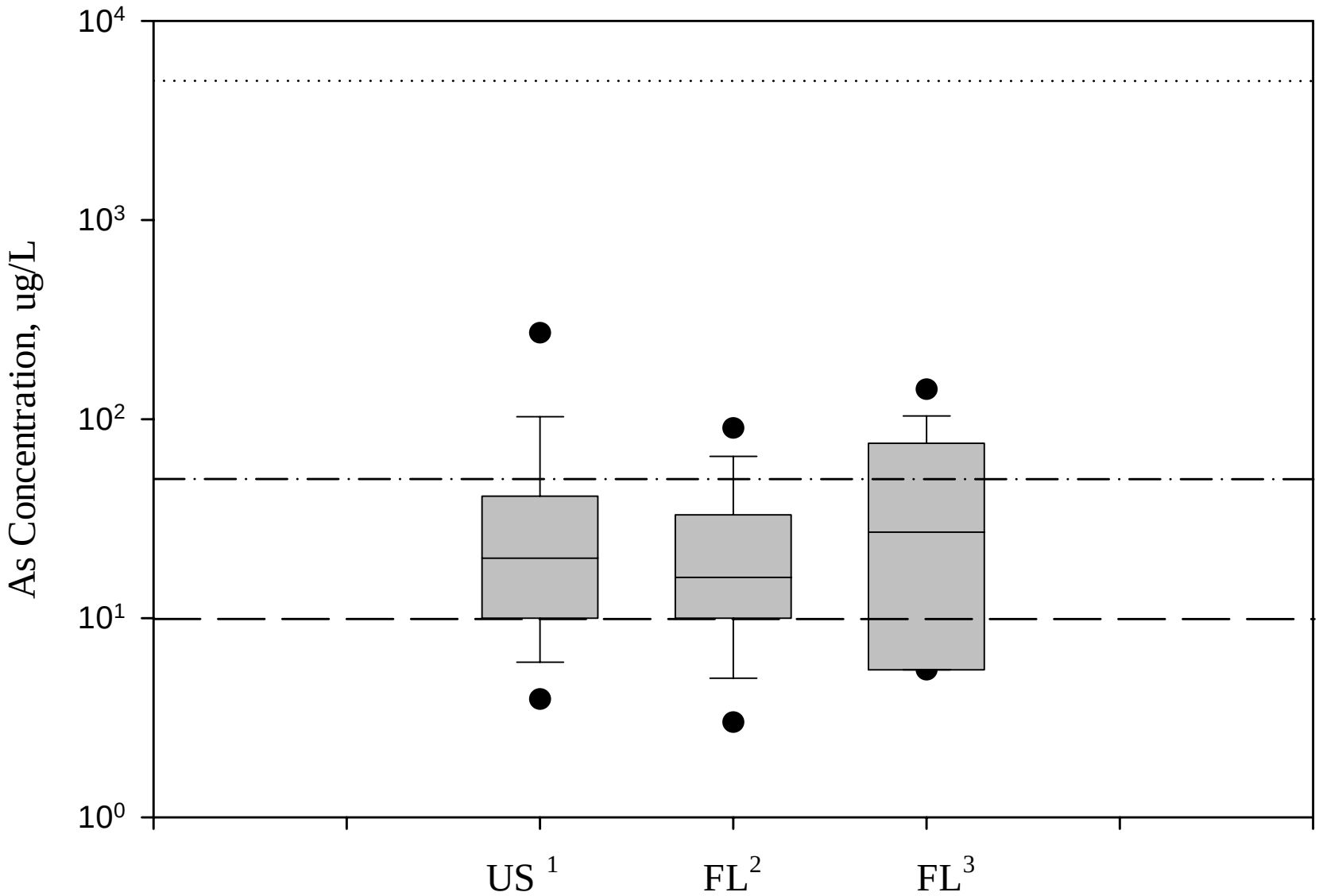
Waste Stabilization in MSW Landfills



Cadmium Concentrations in MSW Landfill Leachate



Arsenic Concentrations in MSW Landfill Leachate



Other Landfill Types

- Construction and demolition (C&D) debris landfills

- Industrial waste landfills

C&D Debris Landfill

Approximately ½ of states have liner requirements

Unlined Landfill for Hurricane Katrina Debris

Issues Facing Landfill Operators when Accepting Any Waste

- Is the waste hazardous or otherwise prohibited?

TCLP

- Is this waste a bulk liquid?

Paint Filter Test

What about wastes that may be legally disposed but do contained toxic trace constituents

Lead-Based Paint

Mercury Lamps

Treated Wood

Wood Ash

WTE Ash

Discarded Electronic Devices

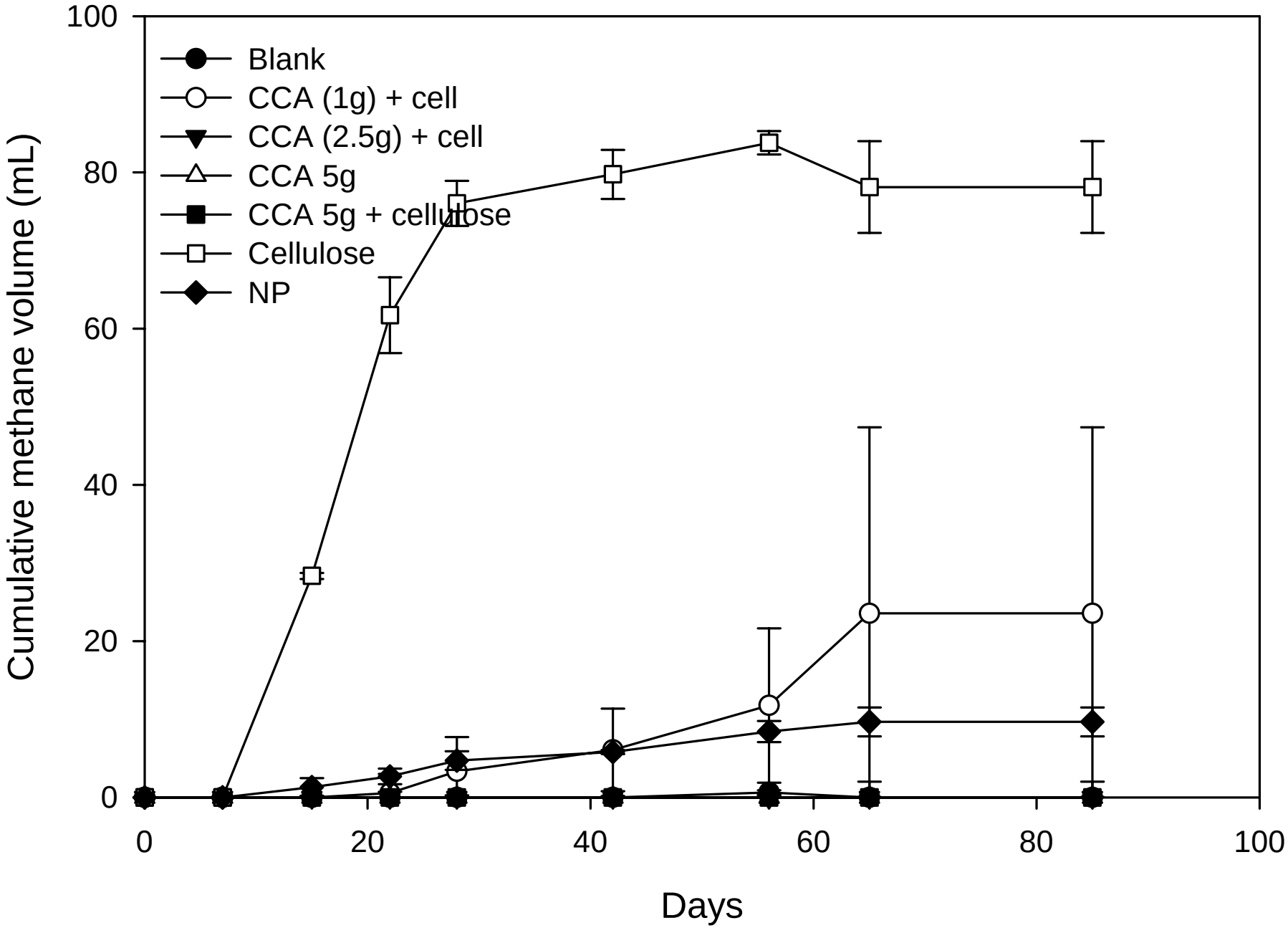
Drinking Water Sludge

If the waste is not hazardous, and the landfill is lined with the leachate going to a POTW, then why do we care?

Potential Problems Posed

- Impact on leachate quality
- Impact on gas quality (e.g., Hg)
- Impact on waste decomposition
- Long-term operation issues

Impact on Waste Decomposition



Implication of Elevated Leachate Concentrations

- Leachate concentrations can limit leachate management options
  - POTW pretreatment requirements

- Several sites in Florida encountered problems because of elevated concentrations of arsenic in the leachate

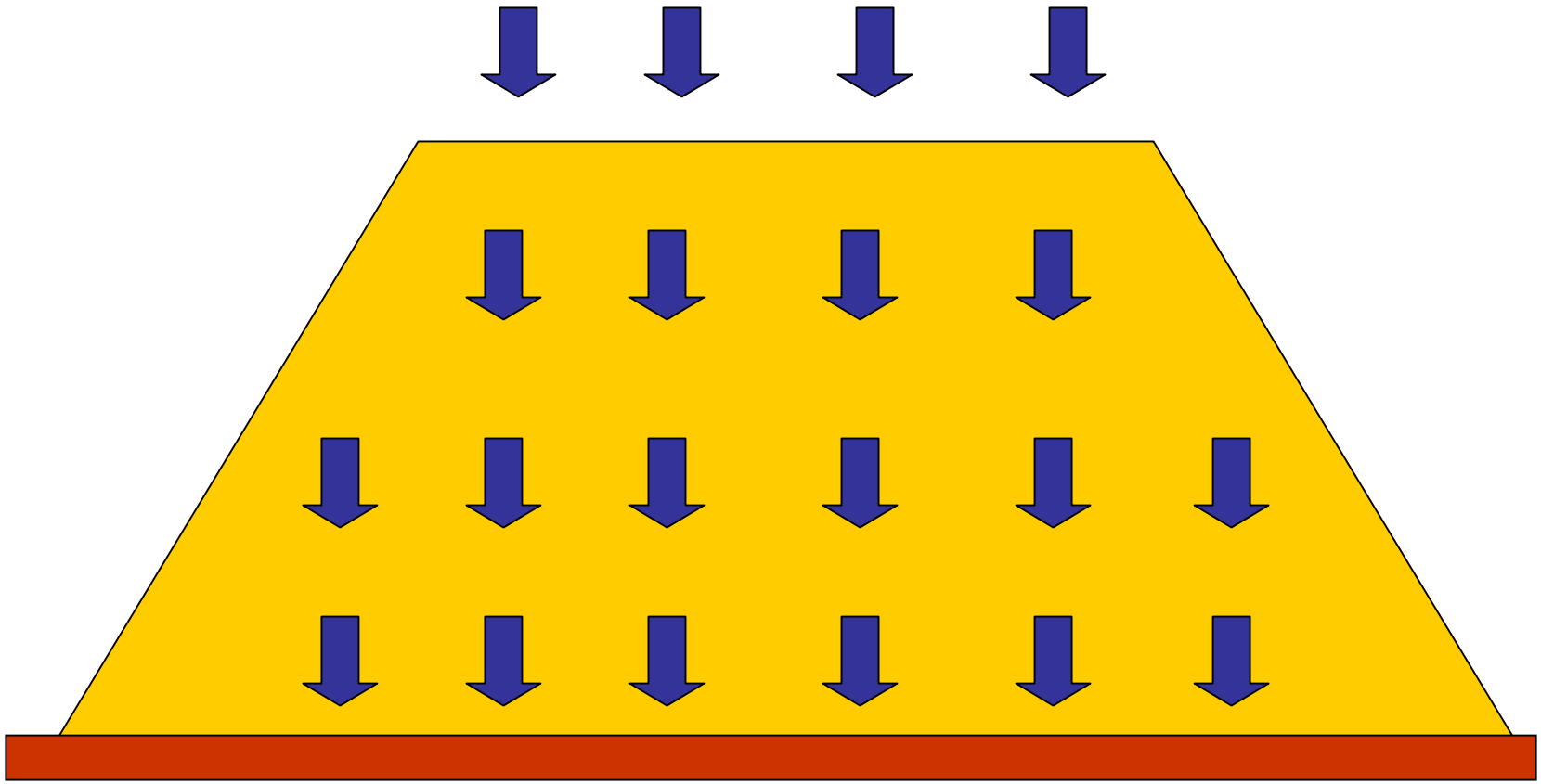
Factors to be Considered

- Leachability
- Rainfall and amount of leachate
- Fraction in the landfill

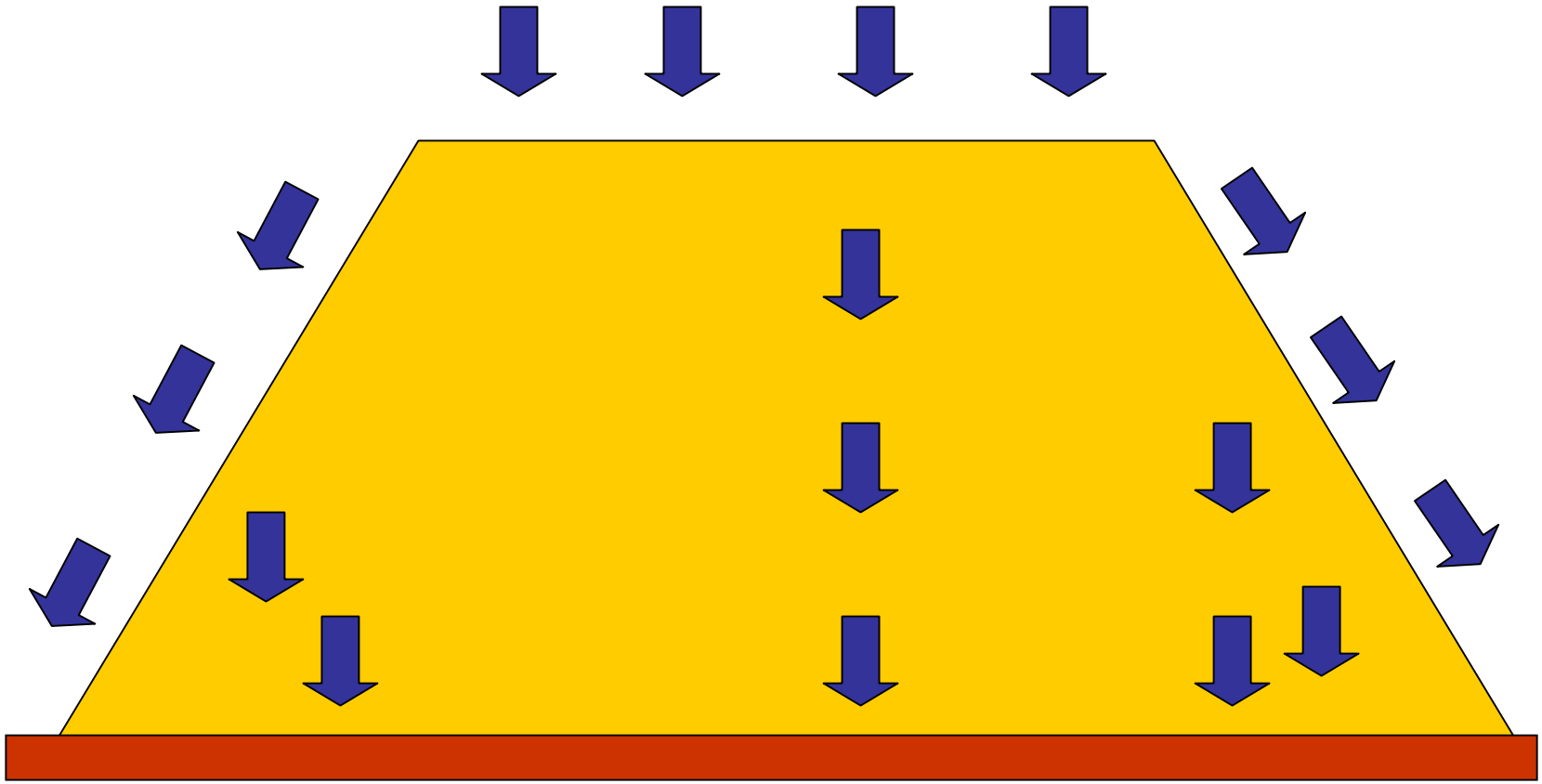
Important Point

- A majority of the waste in modern landfills stays dry

Incorrect Perception



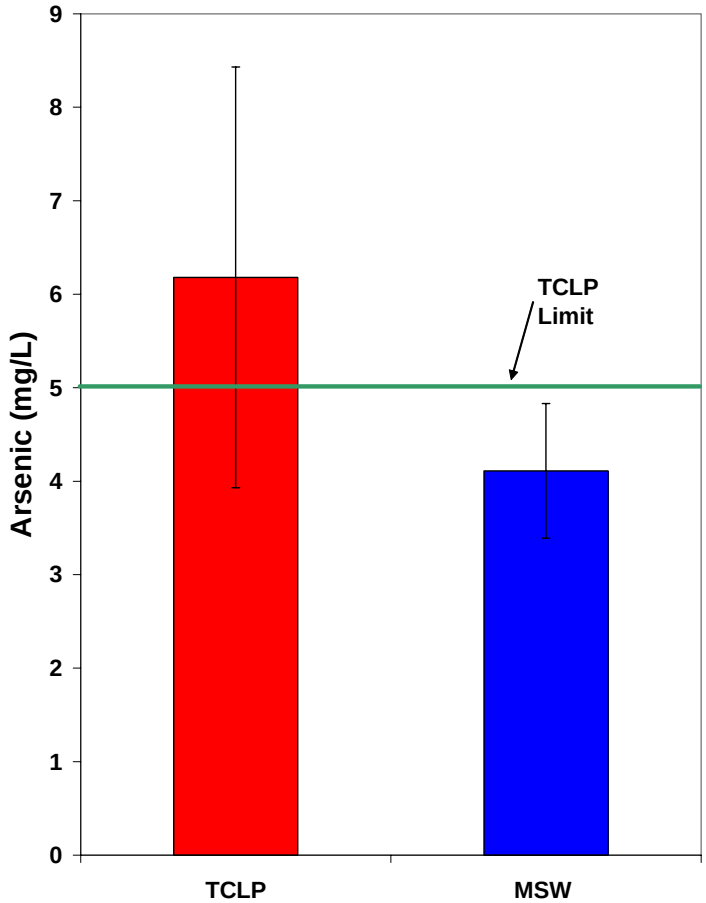
More Accurate Perception



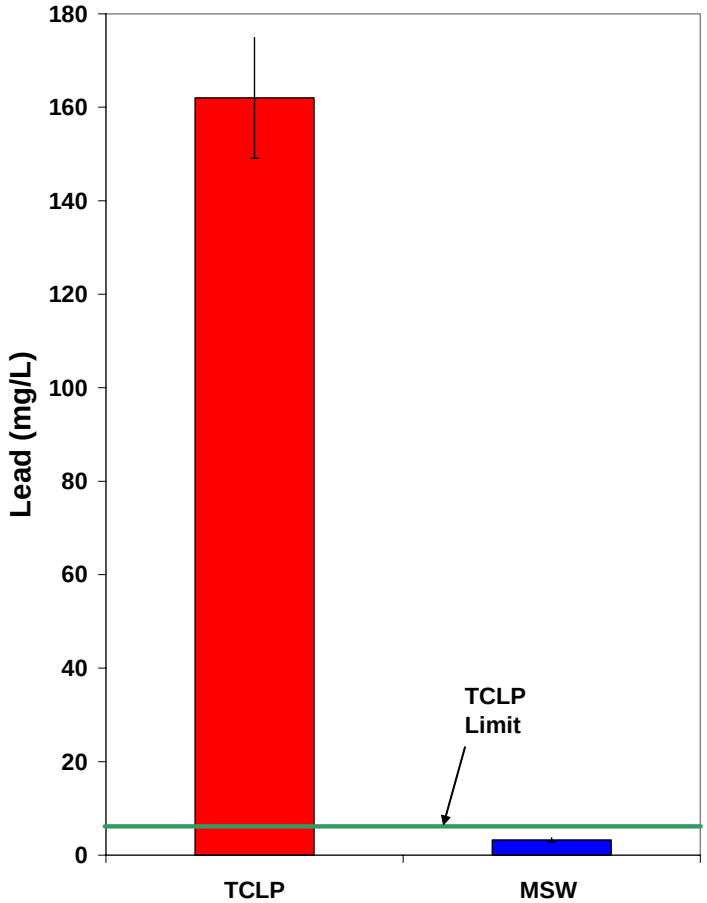
Concerns over Increased Chemical Concentrations

- Leaching tests such as TCLP can be conducted to assess potential problems
  - Several studies show that TCLP may not be reflective of leaching that will occur in a landfill for some wastes.
  - TCLP does not always under predict leaching.

Leaching in MSW LF Leachate



CCA-Treated Wood



Printed Wire Boards

Many Reasons for the Difference

- pH
- Leachate chemistry
- Redox conditions
- Interactions with waste and other chemicals in leachate
  - Precipitation
  - Sorption

Simulated Landfills

SPEED
LIMIT
5

WE
RECYCLE

CCA
Lead based paint
ACQ

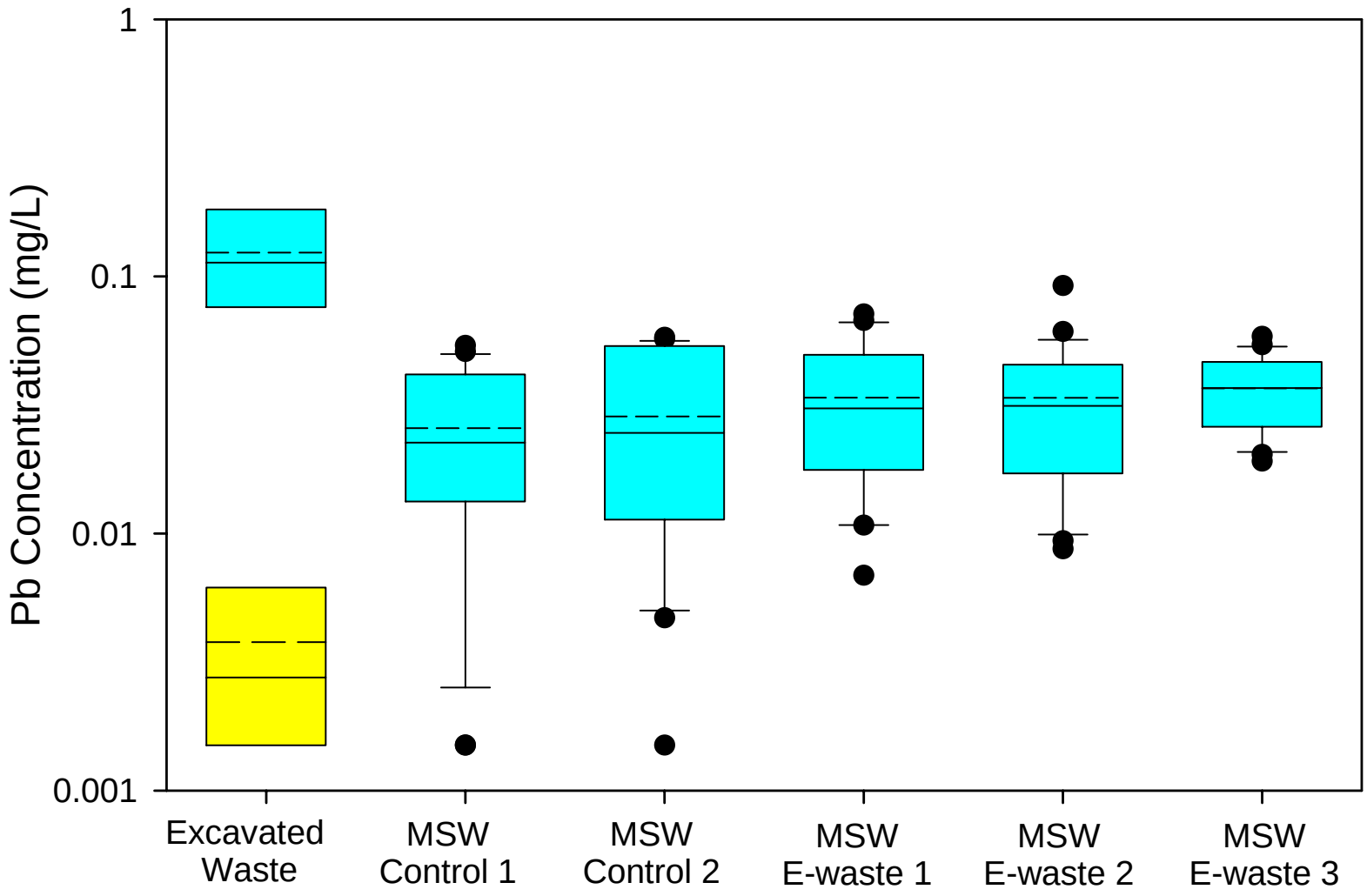
RECYCLING
000071

Cell Phones

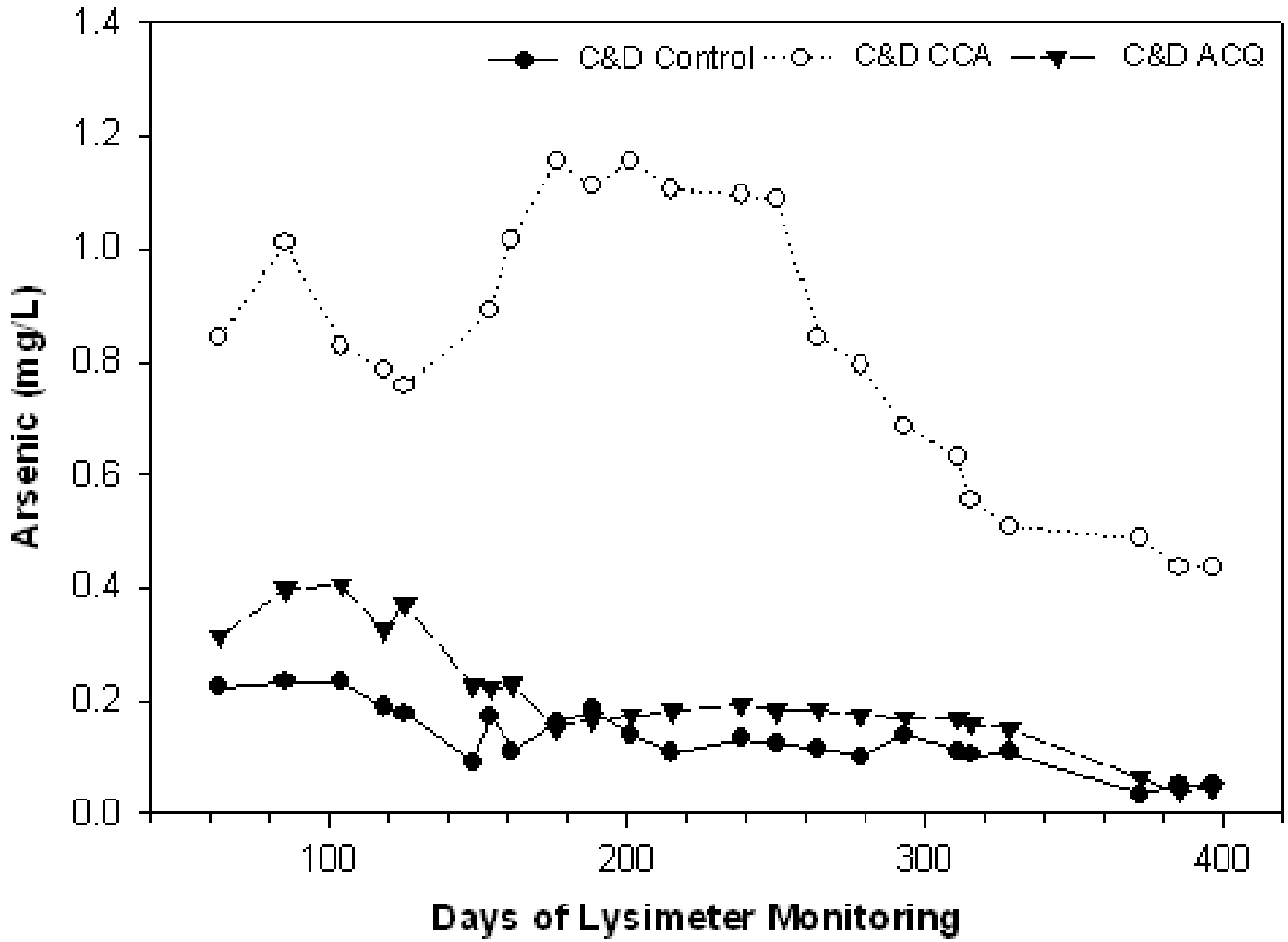
Water distribution system

Box Plot of Leachate Lead Concentrations

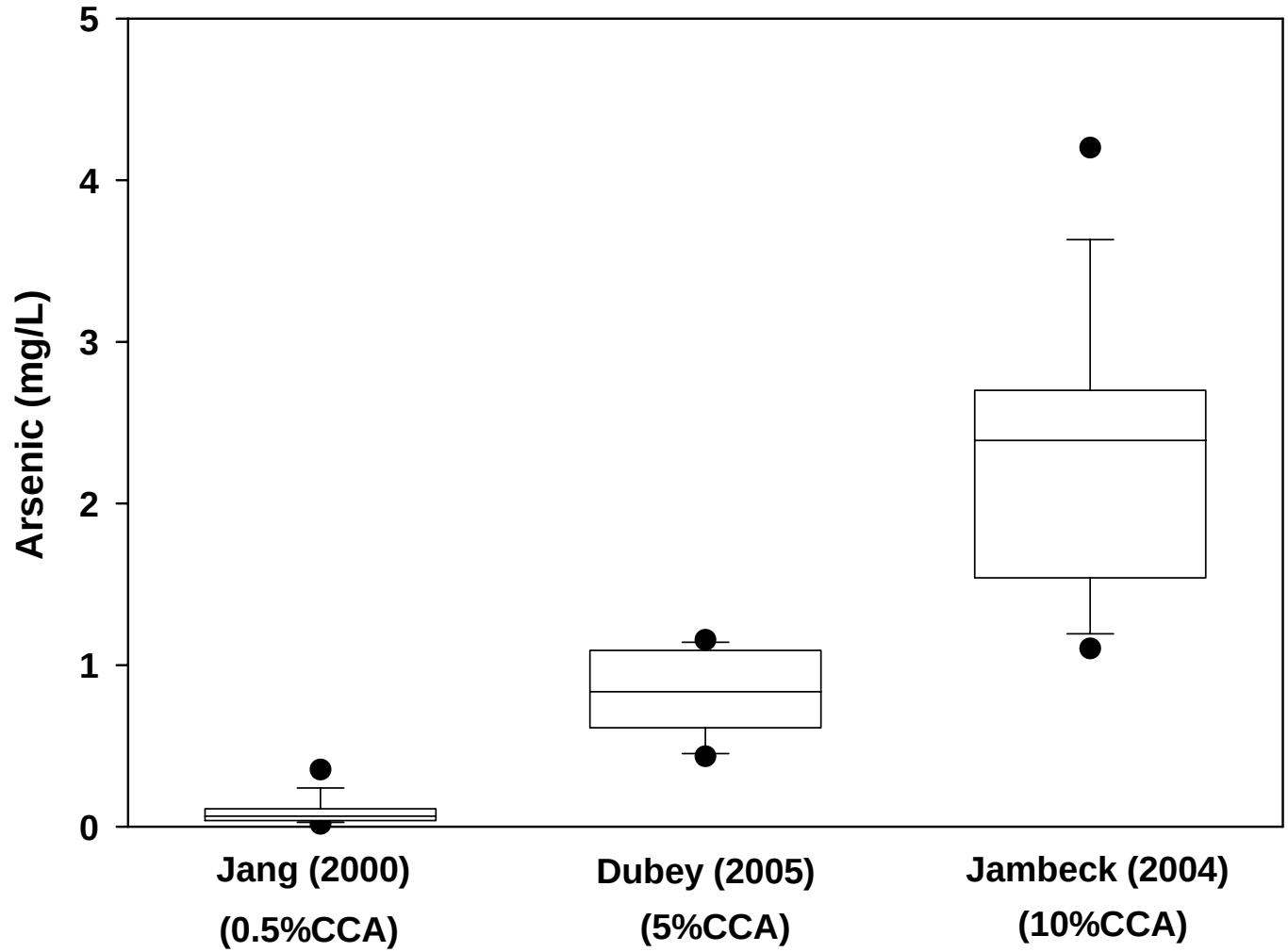
(Leachates with pH less than 7 in cyan, pH greater than 7 in yellow)



Arsenic vs. Time in C&D Lysimeter Leachate

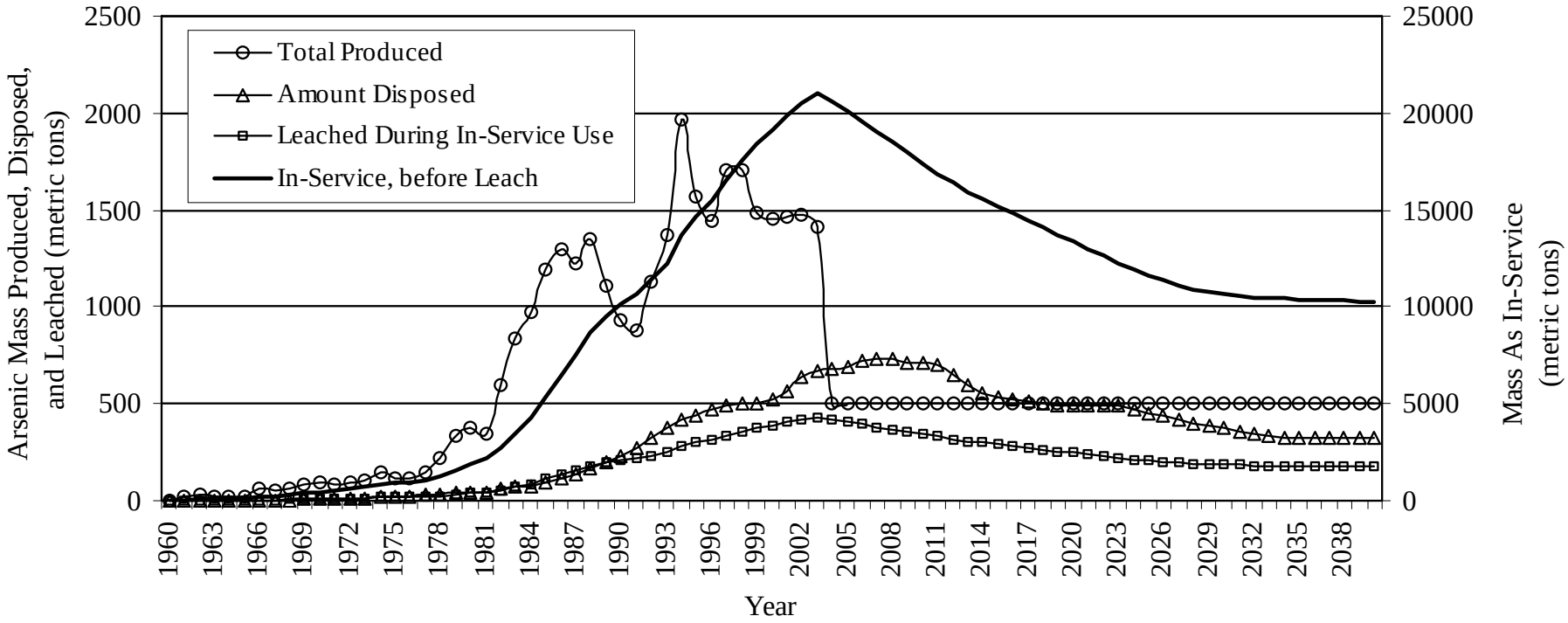


Arsenic Concentration in CCA Lysimeter Leachates from Three C&D Lysimeter Projects

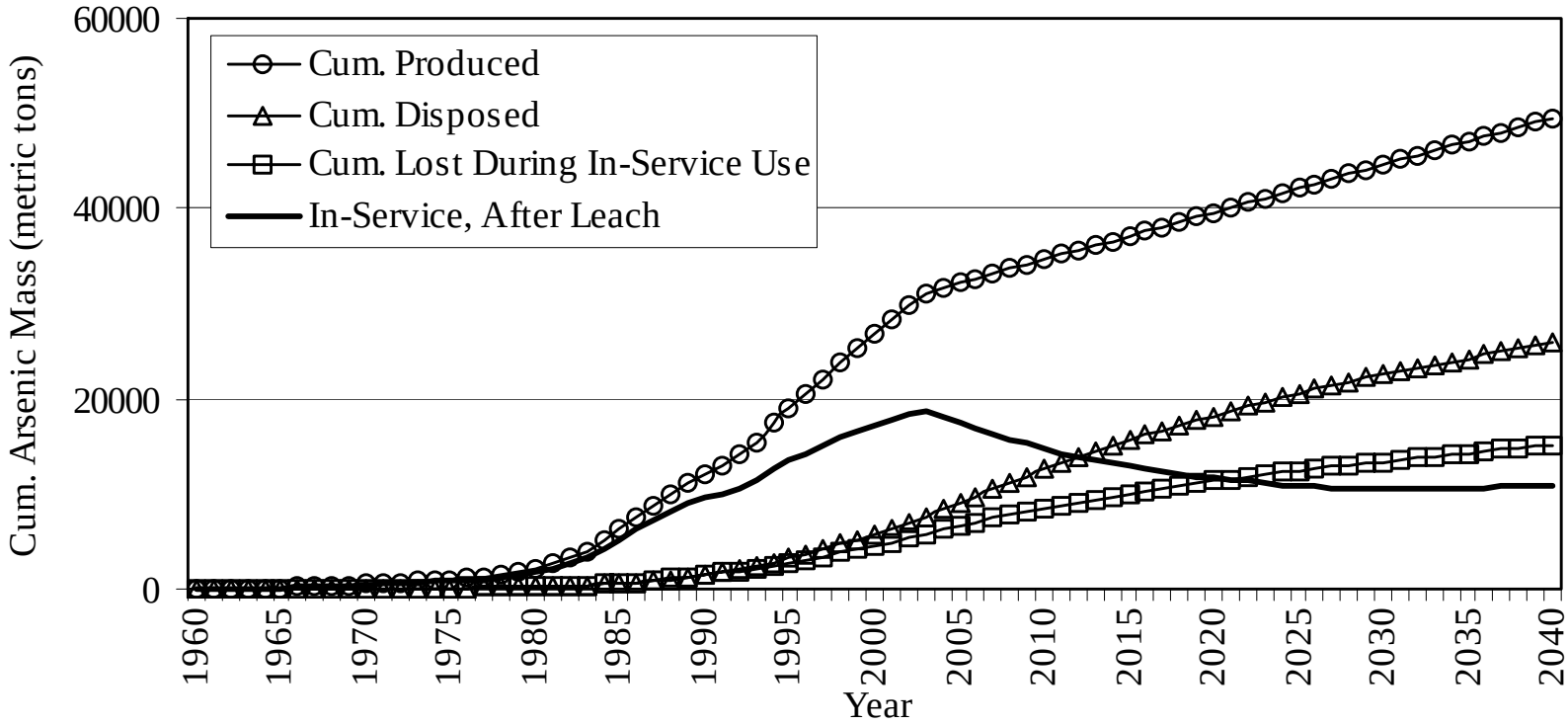


Current Situation with CCA-Treated Wood in Florida

- CCA-treated wood leaches enough arsenic to be characterized as a hazardous waste if not otherwise excluded in the regulations
- CCA-treated wood is currently allowed to be disposed in unlined C&D debris landfills in Florida
- The FDEP is developing new rules that would require unlined disposal facilities to identify and remove CCA-treated wood prior to disposal



Yearly mass of arsenic associated with the production, disposal, and in-service leaching of CCA-treated wood products imported to Florida. Amount of arsenic associated with structures in-service also shown for reference.



Cumulative mass of arsenic associated with CCA-treated wood production, disposal, and in-service leaching. The estimated amounts of arsenic associated with structures in-service also shown for reference.