

This presentation was developed under the auspices of the CIWMB (now CalRecycle) for specific technical training purposes and is posted as a reference document for the local government and CIWMB staff who attended this training. It is not intended to stand alone as informational or training material.

If you require assistance in obtaining access to this presentation, call the Public Affairs Office at (916) 341-6300 or contact [Mike Wochnick](#).

# **SITE INVESTIGATIONS, SETTLEMENTS AND FOUNDATIONS**

**R. Jeffrey Dunn, PhD, PE, GE  
Solid Waste Practice Leader  
KLEINFELDER**

**CIWMB PCLU Workshop  
Ontario and Stockton, California  
February 15 and 28, 2006**

**K L E I N F E L D E R**

**> EXPECT MORE**

# Site Investigations

- Catalog site conditions and constraints
- Investigate
  - Extent of waste - horizontal and vertical
  - Existing cover quality
  - Landfill gas occurrence
  - Contamination occurrence and extent

K L E I N F E L D E R

> EXPECT MORE

# Extent of Waste

- Review of historic records
  - Site maps and plans
  - Original grading plan
  - Fill sequencing plan
  - Existing topography and utilities
  - Previous uses and topography

K L E I N F E L D E R

> EXPECT MORE

# Extent of Waste

- Drilling
- Trenching, particularly at perimeter areas
- Cone penetrometer testing (CPT)
- Geophysical techniques

K L E I N F E L D E R

> EXPECT MORE

# Existing Cover

- Thickness and nature of cover
- Barrier layer
  - Soil or geosynthetic materials
  - Hydraulic conductivity
  - Depth to barrier layer.

# Settlements

- Foundation soils - use conventional geotechnical approaches
- Waste
- Cover
  
- Monitor site specific settlements - now!!

K L E I N F E L D E R

> EXPECT MORE

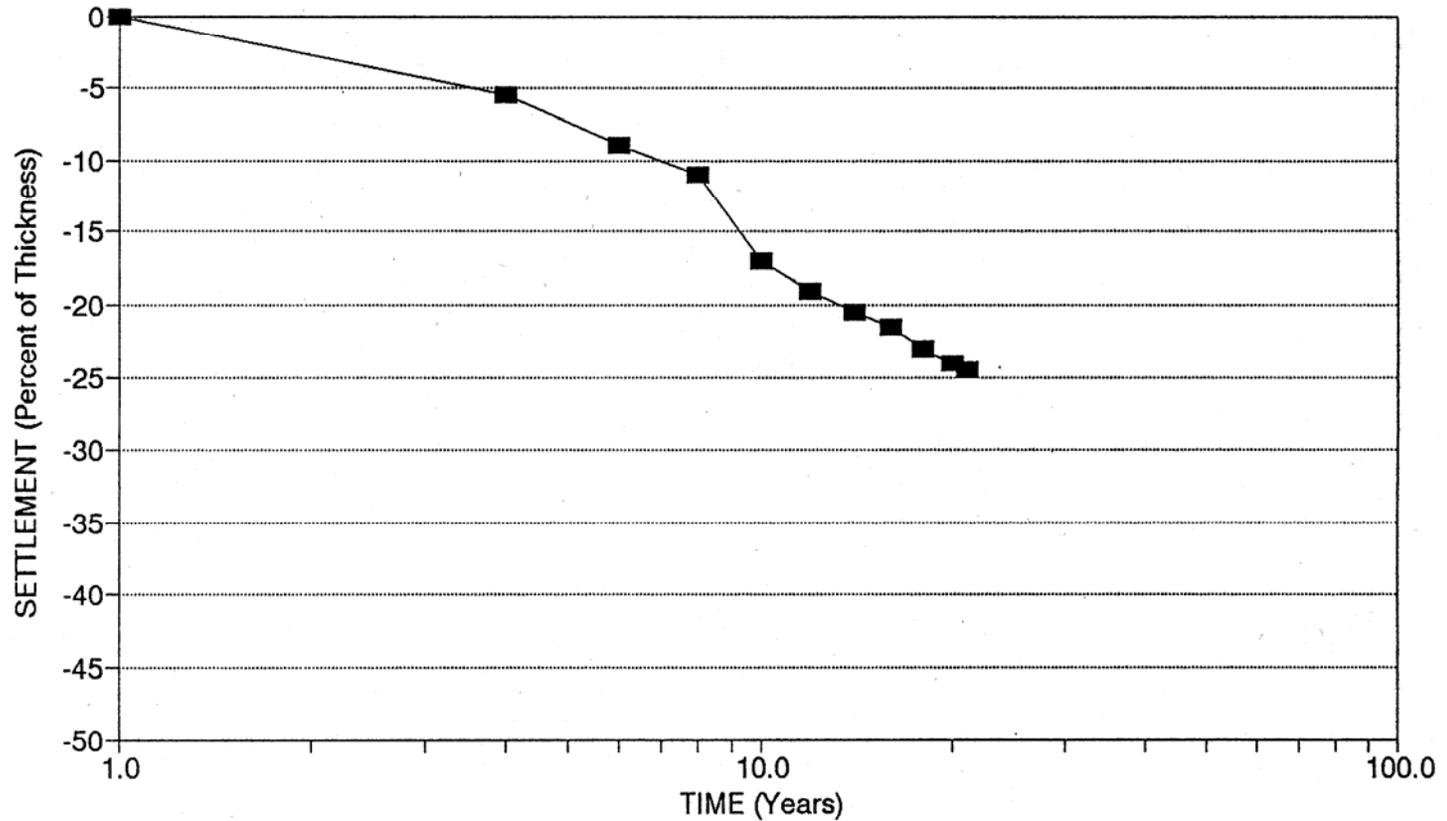
# Waste Settlements

- Mechanisms
  - Mechanical Compression
  - Raveling
  - Physical-chemical change
  - Biological decomposition
- Very large and long-term

K L E I N F E L D E R

> EXPECT MORE

# SURFACE SETTLEMENTS AT MISSION CANYON LOS ANGELES COUNTY, CALIFORNIA



—■— Monument 113

Reference: Donald P. Coduto and  
Hutric, 1990

K L E I N F E L D E R

> EXPECT MORE

# Settlement Mitigation

- Just about impossible to totally eliminate
- Mitigation techniques
  - Enhanced decomposition
  - Supplemental compaction of thin layers
  - Surcharging, with monitoring
  - Dynamic compaction
  - Grouting or fly-ash injection.

K L E I N F E L D E R

> EXPECT MORE

# Foundations

- Only lightly loaded structures on shallow foundations
- Limits
  - Wood frame construction
  - 2 to 3 stories max

K L E I N F E L D E R

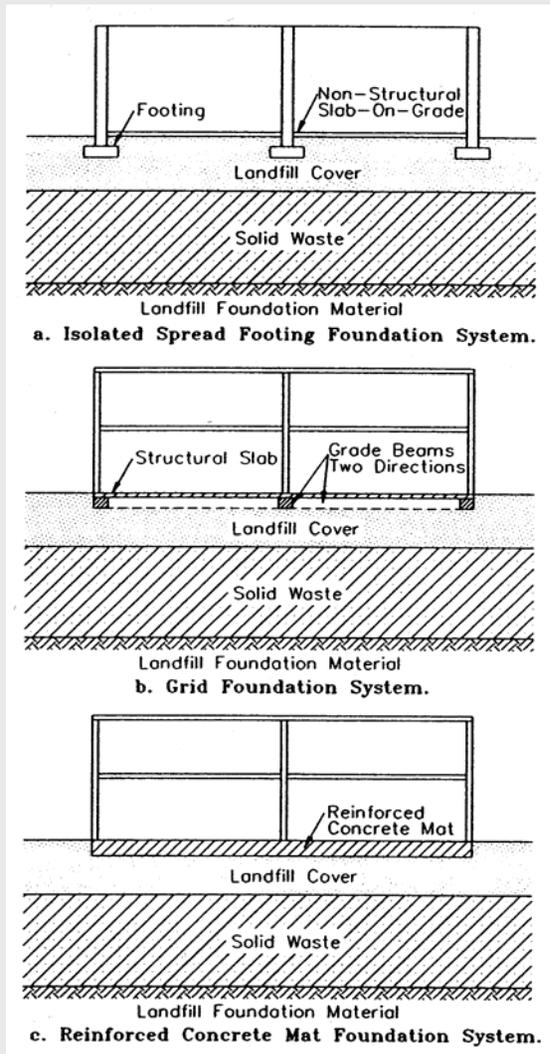
> EXPECT MORE

# Shallow Foundations

- Spread footings
  - Inexpensive
  - Prone to differential settlements
- Grid system
- Mat foundation

K L E I N F E L D E R

> EXPECT MORE



K L E I N F E L D E R

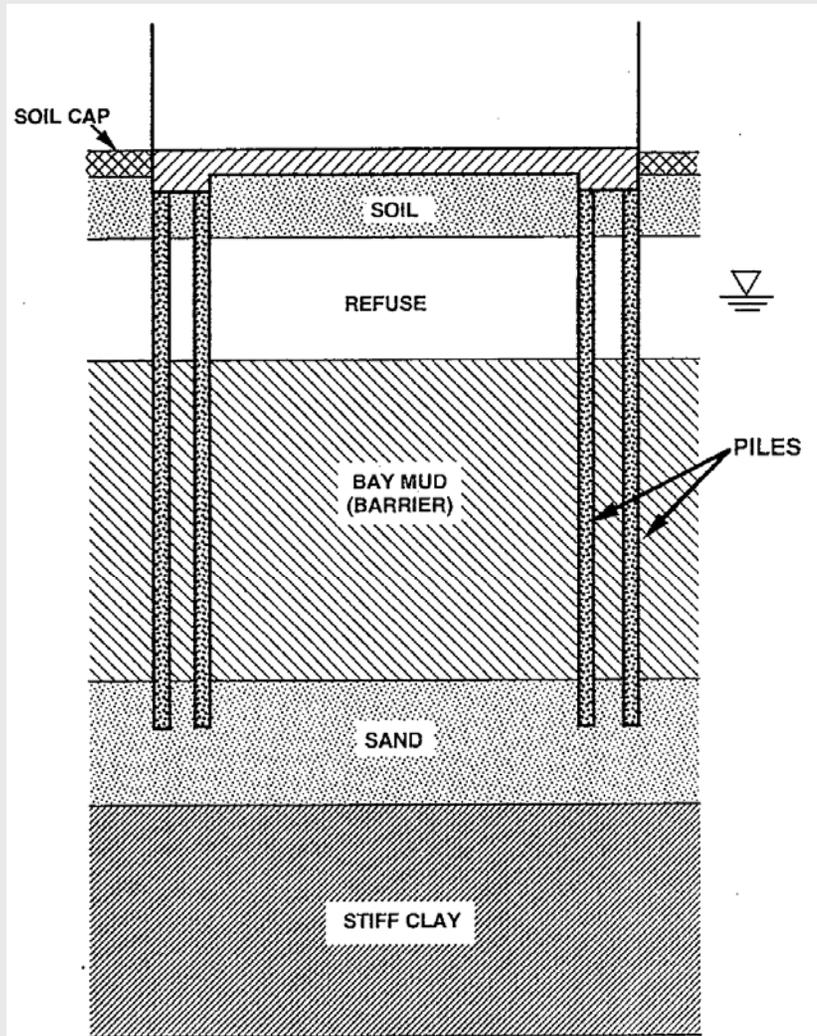
> EXPECT MORE

# Deep Foundations

- Driven piles are widely favored type
  - Pre-cast pre-stressed concrete piles
  - Steel H-piles
  - Steel pipe piles
- Drilled foundations rarely used
  - Caving potential and need for casing
  - Waste disposal

K L E I N F E L D E R

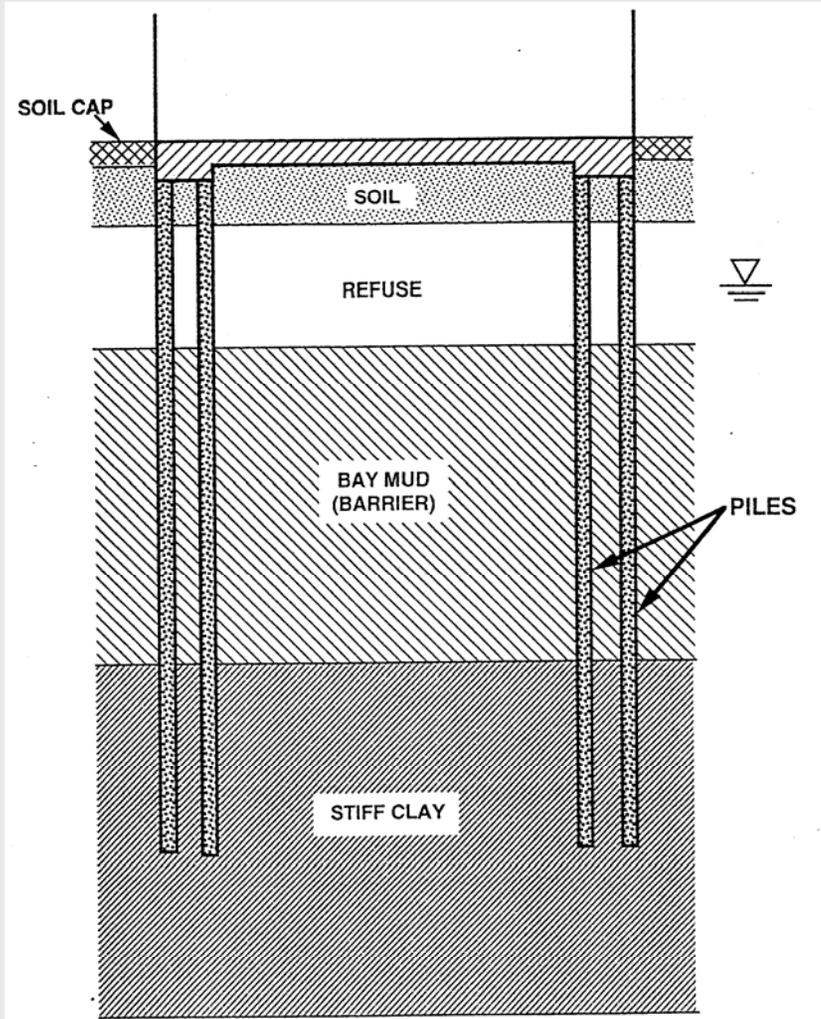
> EXPECT MORE



END-BEARING PILE FOUNDATION THROUGH  
LANDFILL WITH NATURAL SOIL BARRIER

K L E I N F E L D E R

> EXPECT MORE



FRICION PILE FOUNDATION THROUGH LANDFILL WITH NATURAL SOIL BARRIER

K L E I N F E L D E R

> EXPECT MORE

# Deep Foundations

## Design Considerations

- Pile capacity – vertical and lateral
- Downdrag loads due to waste settlement
- Constructability and construction impacts
- Corrosion resistance
- Environmental protection and maintenance of waste containment

K L E I N F E L D E R

> EXPECT MORE

# Downdrag Loads

- Due to settlement of waste and overlying layers
- Add load to pile that decreases net carrying capacity

K L E I N F E L D E R

> EXPECT MORE

# Downdrag Mitigation

- Pre-drilling or spudding of the piles with a steel mandrel
- Pre-drilling or spudding of the piles with bentonite slurry backfill in hole
- Installation of outer casing, “double-pile” system
- Friction reducing coatings such as bitumen installed in a pre-existing hole

K L E I N F E L D E R

> EXPECT MORE

# Constructability and Construction Impacts

- Obstructions in waste
- Pushing wastes below pile tip
- Disposal of wastes and or bentonite removed from pre-drilled holes

K L E I N F E L D E R

> EXPECT MORE

# Corrosion Resistance

- Concrete piles – Use resistive cements or modify mix design
- Steel piles – Use thick structural section, cathodic protection, or corrosion resistant steel
- Coatings of pile or reinforcement
- Casing or encasement through corrosive layer

K L E I N F E L D E R

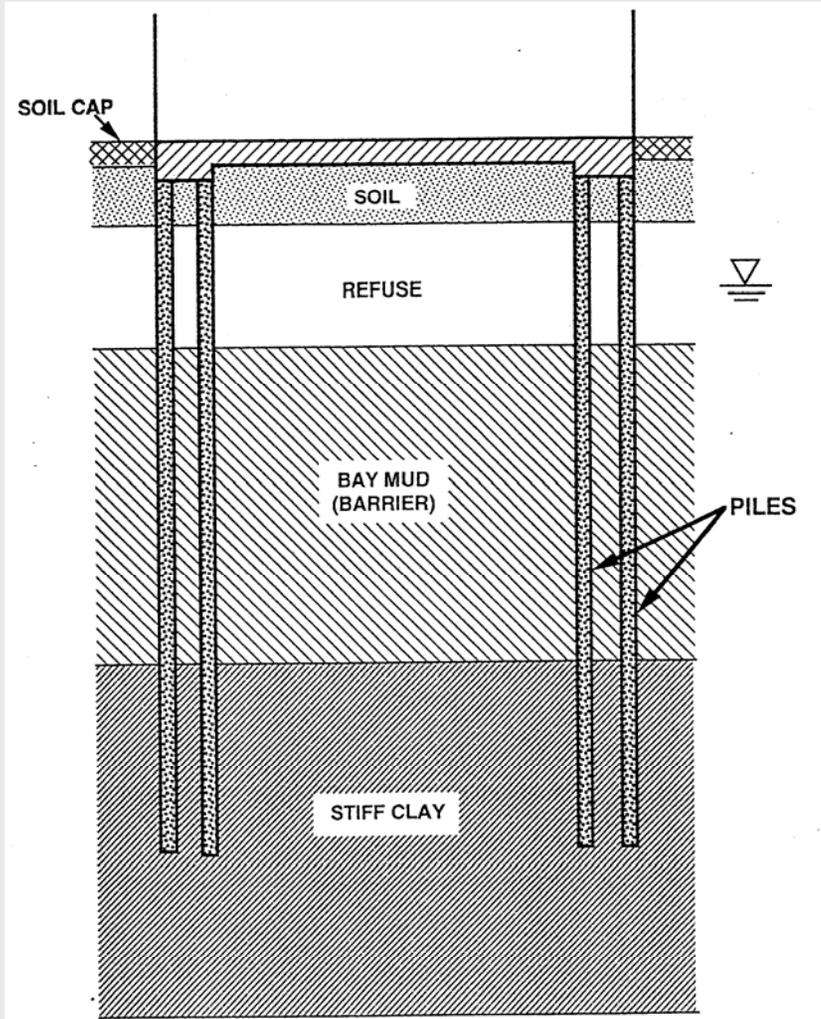
> EXPECT MORE

# Environmental Considerations

- Maintain containment of wastes
- Pile caps must “tie-in” to final cap
- Foundations cannot increase leachate migration

K L E I N F E L D E R

> EXPECT MORE



FRICION PILE FOUNDATION THROUGH LANDFILL WITH NATURAL SOIL BARRIER

K L E I N F E L D E R

> EXPECT MORE

# Questions?

K L E I N F E L D E R

> EXPECT MORE