Overview of Engineered Barrier Performance and Regulatory Compliance Criteria

Jacob Philip, David Esh

US Nuclear Regulatory Commission

jacob.philip@nrc.gov, david.esh@nrc.gov

Workshop on Engineered Barrier Performance

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Overview

- Background/References
- Experiences
- Recent Research
- Goals

Background

- Engineered barriers are used in a variety of NRC regulated activities.
- Engineered barrier performance can be important for compliance with regulatory criteria.
- NRC has developed guidance for staff and licensees to facilitate design and review of engineered barriers.
- Experience with engineered barriers has been mixed.

Key Guidance Documents

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Reference	Area	Date Issued	Section	Topics
NUREG-1757	Decommissioning	Sept 2006	Vol 2, Section 3.5	All engineered barriers Risk-informed
NUREG-1854	Incidental Waste	Aug 2007	4.3.2	Covers, cements Risk-informed
NUREG-1620	Uranium Mill Tailings	June 2003	All	Geotechnical Erosion protection Radon mitigation
NUREG-1388	LLW	Dec 1989	All	Environmental Monitoring
NUREG-1623	Erosion Protection	Sept 2002	All	Erosion protection
NUREG-1573	LLW	Oct 2000	All	LLW PA Methodology

Low-Level Waste

- Early designs did not perform as expected (e.g., bathtub effect)
- Relatively simple designs employed
- Field-scale experiments prior to implementation were limited
- Limited in-situ monitoring performed
- Performance at arid sites has been good

Mill Tailings

Primary Functions of Covers at Mill Tailings Sites:

- Provide sufficient protection to limit radioactive releases (radon emissions, groundwater pathway)
- Provide long term stability
- Minimal maintenance design

Mill Tailings

- Tailings overlain by engineered cover that includes a radon barrier
- Radon standard met after construction, not aware of subsequent problems
- Groundwater performance mixed, but not necessarily related to cover

Mill Tailings

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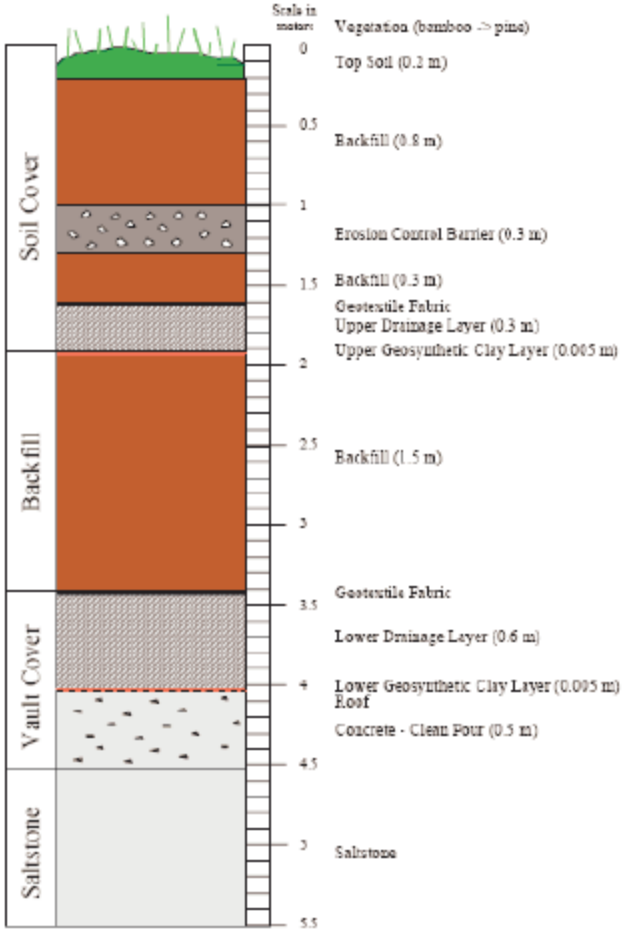
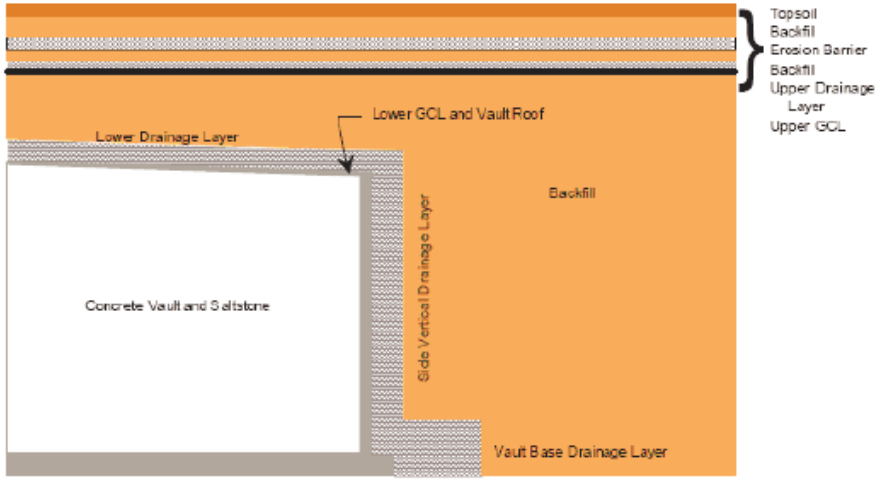
Incidental Waste

- Designs are yet to be implemented





Recent U.S. NRC Research (1/2)

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US ARMY CORPS OF ENGINEERS, Vicksburg, MS

***Effectiveness of Clay Soils in Engineered Covers* (2005-2007)**

- **Cracking in clay soils is diverse along surface and migrates downward**
- **Cracks do not heal with time**
- **Hydrologic models cannot predict permeability changes due to cracking**
- **Numerical model developed to predict cracking behavior of clay soils from tensile stresses induced by cracking**

Recent U.S. NRC Research (2/2)

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UNIVERSITY OF WISCONSIN, Madison, WI

***Effectiveness of Engineered Covers: Implications for PA* (2006-2009)**

- **Engineering properties of compacted soils, particularly low permeability clay soils, do not retain "as built" properties**
- **The effectiveness of geosynthetic materials sometimes used in conjunction with soils in covers is varied:**
  - **Geosynthetic clay liners (GCL) worked adequately under certain conditions**
  - **Geosynthetic drainage layers (GDL) performed well**
  - **Geomembranes (GM) performed in accordance with manufacturer specifications for the product**

Current U.S. NRC Research

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UNIVERSITY OF WISCONSIN, Madison, WI

Influence of Coupling Erosion and Hydrology on the Long-term Performance of Engineered Covers **(2009-2012)**

Work Scope of Project

- **Literature Review on Erosion Control: Identifying Pertinent Models to Predict Erosion/Hydrological Performance of Covers**
- **Comparisons of Model Predictions with Field Data**
- **Evaluating Erosion Control Strategies**

Clay Cracking Video (USACE, Vicksburg, MS)
(Click twice to play)

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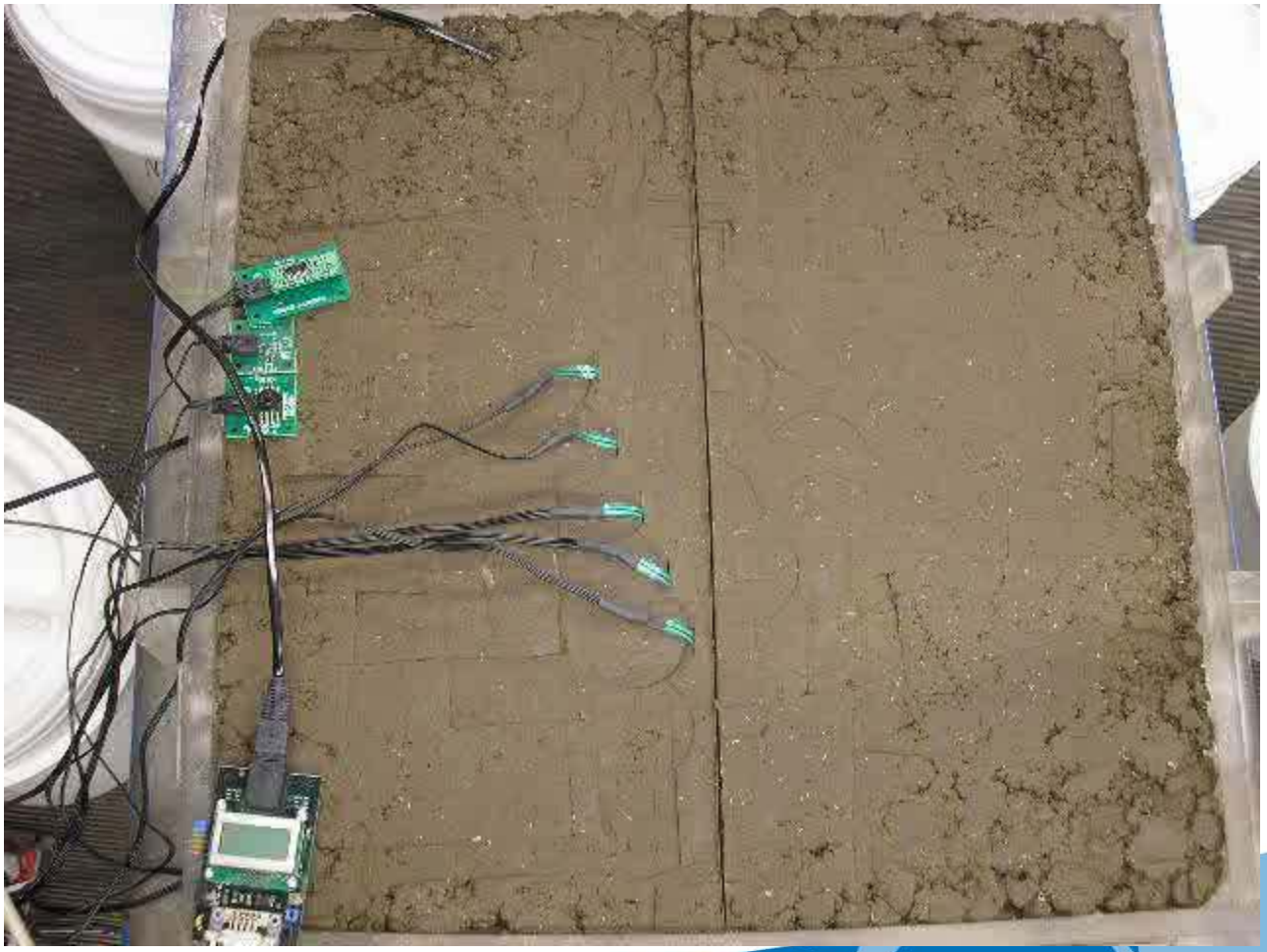

Goals

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- Identify relevant research to improve the review and assessment of engineered covers.
- Identify gaps in current understanding or existing guidance.
- Identify opportunities for collaboration and synthesis of experiences.