Modeling and Monitoring of Barrier Performance for the Planned Texas Low-Level Radioactive Waste Disposal Facility

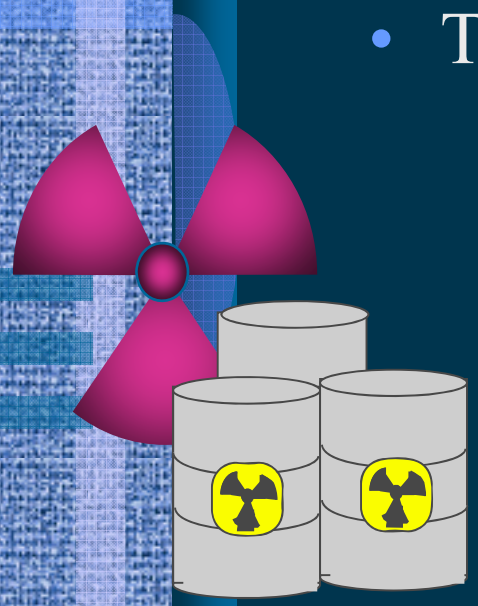
Susan Jablonski, P.E., Texas Commission on Environmental Quality

August 3, 2010 – NRC Barrier Workshop

Radiation Material Regulation

- There are three Texas state agencies and the federal government involved in the regulation of radioactive material and waste associated with possession activities

- Texas Radioactive Disposal Regulations:
  - Low-level radioactive waste disposal (LLW)
  - Mixed waste disposal - federal facility
  - Title II Uranium Tailings Impoundments
  - 11e(2) by-product material disposal
  - NORM disposal by deep well injection



New Policy: Privatizing Disposal

- Changes resulting from 2003 and 2007 Texas Legislation
  - House Bill 1567 – New State policy for LLW disposal
    - Privatization for disposal operations
    - Specific disposal criteria unique to Texas site
    - Waste disposal fees for State's General Revenue
    - Ability to condemn private mineral rights
    - Federal disposal facility could accept mixed LLW
    - Proposed site only in specific region of State

  - Senate Bill 1604 – Regulatory consolidation of radioactive waste management and disposal
    - Allow for 11e(2) by-product disposal at non-mining sites
    - Waste disposal fees for State's General Revenue
    - Establish statutory priorities for licensing actions

Siting Criteria

Location in Western Andrews County

Shaded Possible Counties for Site Identified Using:

- *20-inch Rainfall*
- *62 miles from Mexico*
- *Selected River Segments*

Texas LLW Disposal Licensing

- Two disposal facilities under one license
  - Texas Compact Waste Disposal Facility (CWF)
  - Federal Waste Disposal Facility (FWF)
- Breakdown of three planned disposal units
  - 30-acre CWF – Class A, B, and C LLW
    - Steel reinforced concrete canisters, void spaces filled with grout, with additional concrete barrier
  - 90-acre FWF – Class A, B, and C mixed LLW
    - Two FWF units – one in concrete canisters and barrier, and one for low concentration soil only
  - 3-acre area that is common to CWF and FWF

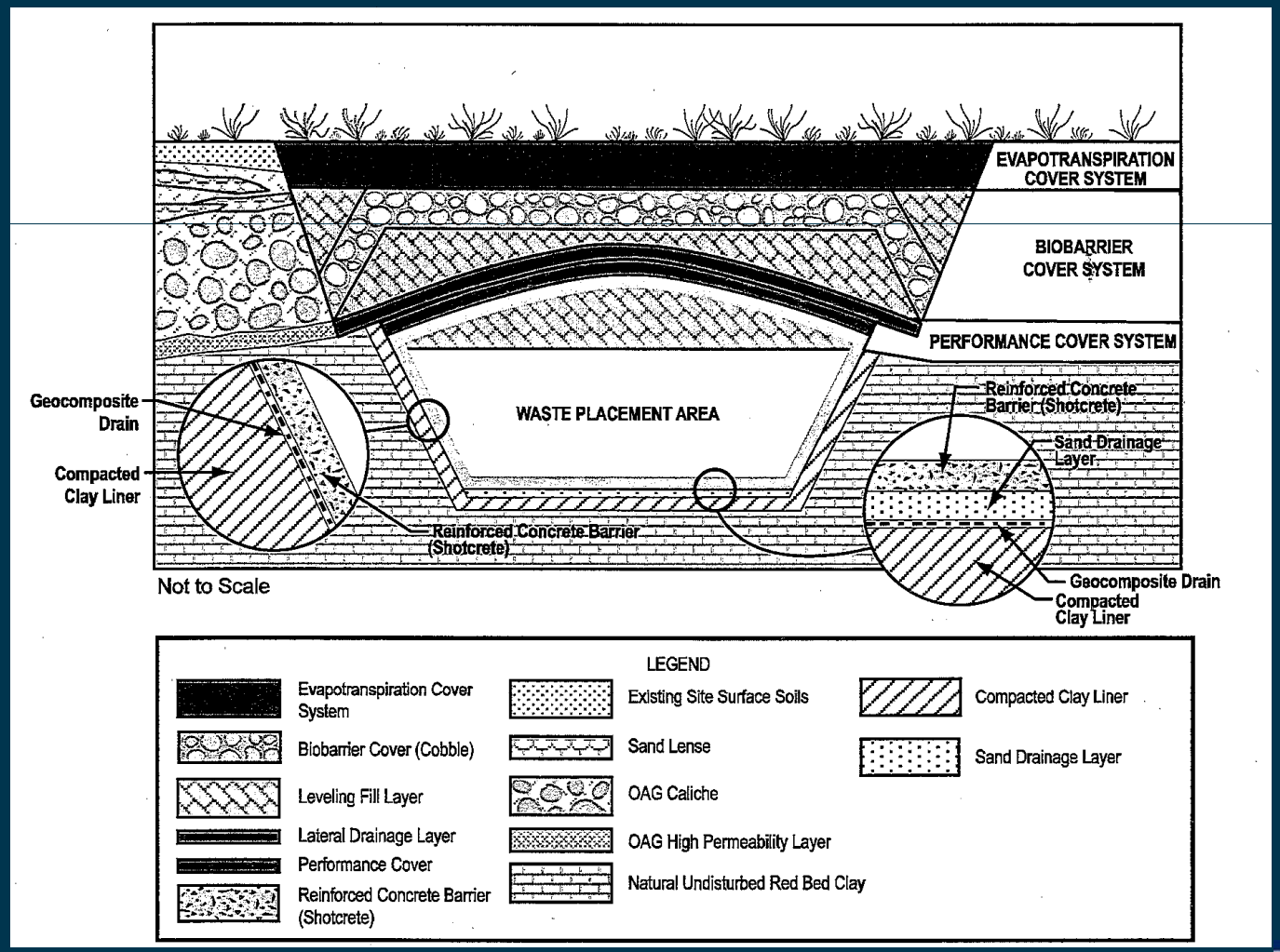
Planned Liner Design

- Below the additional concrete barrier, a leachate collection and removal system is planned to be utilized
- A leak detection system will also be in place for the FWF due to RCRA-waste
- Both facilities, CWF and FWF, will have neutron probes access tubes beneath these systems to run probes to monitor and detect moisture changes

Planned Cover Design

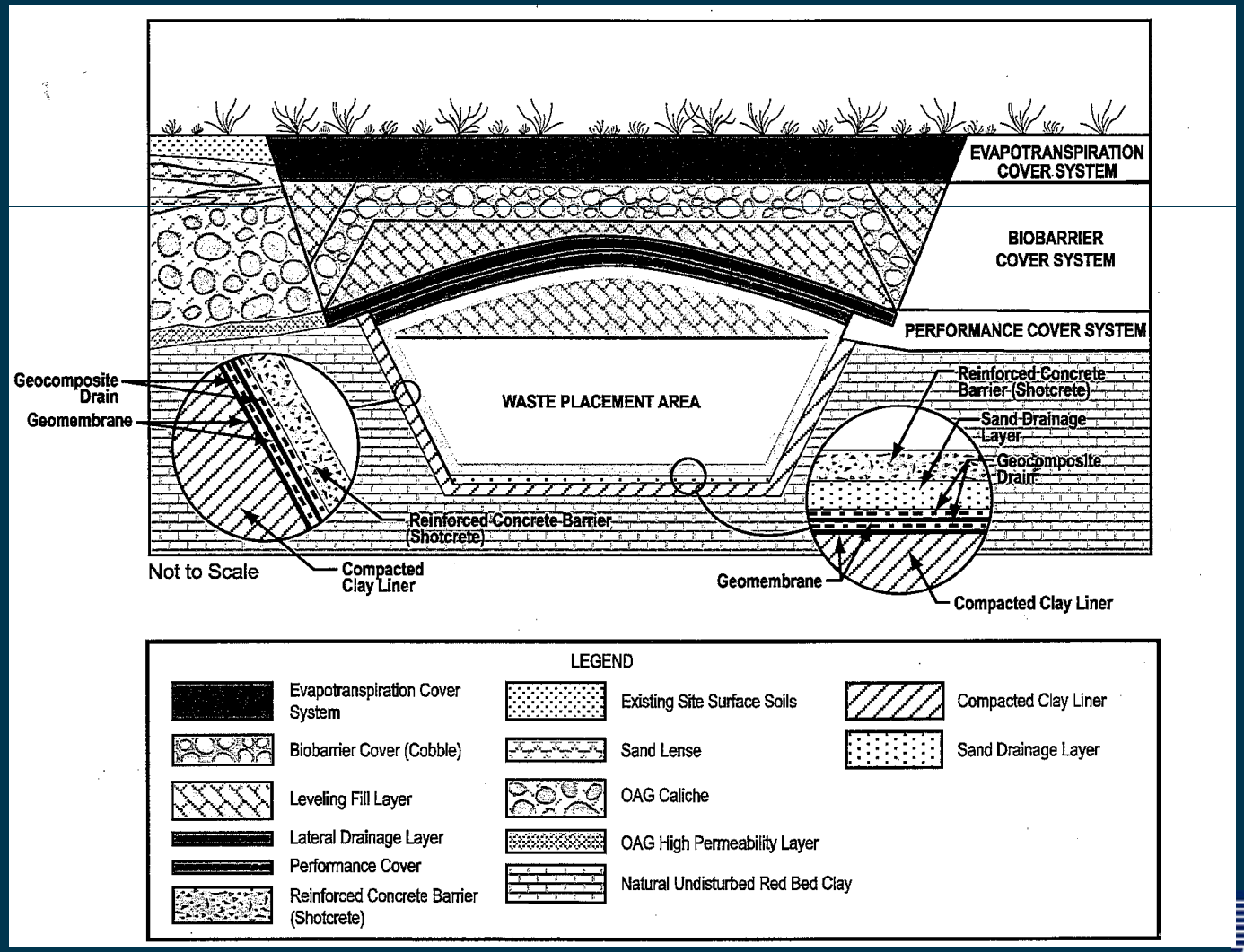
- The planned cover is planned to have three main components:
  - An evapotranspiration cover whose main purpose is to store stormwater within the soil pores in a manner which can then be available for evaporation or transpiration by vegetation
  - A bio-barrier to protect against inadvertent intrusion
  - A performance clay cover to hold or divert any remaining moisture

Planned CWF Cross-Section



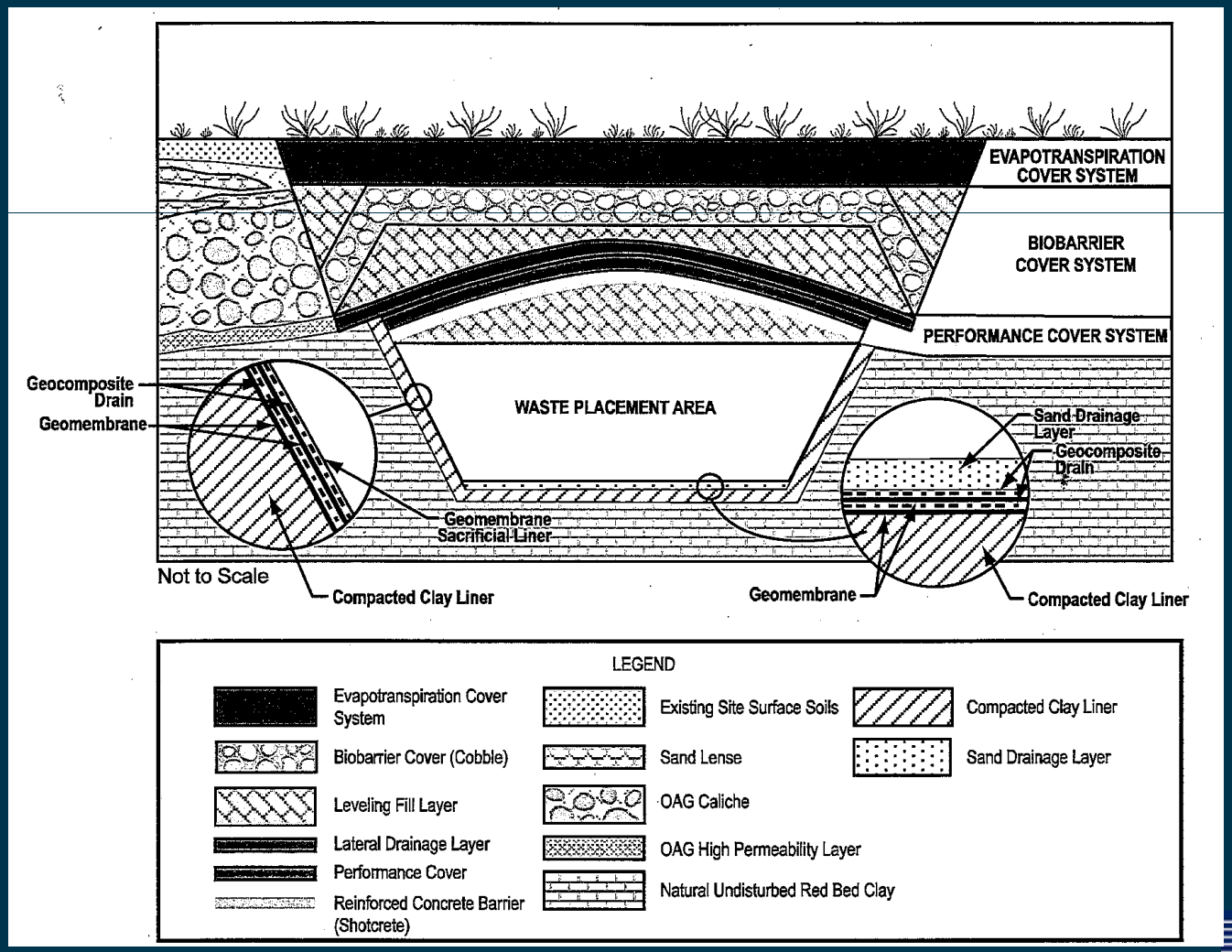
(Figure Taken from WCS License Application)

Planned FWF Containerized Unit Cross-Section



(Figure Taken from WCS License Application)

Planned FWF Soil Only Unit Cross-Section



(Figure Taken from WCS License Application)

Barrier Modeling

- Concrete canisters and the shotcrete barrier/liner were modeled using the finite element analysis structural mechanics code SAP (Structural Analysis Program)
- The static and dynamic soil-structure interaction of all the engineered components pertaining to the disposal facility were modeled using FLAC (Fast Lagrangian Analysis of Continua)

Barrier Modeling (cont.)

- The FLAC code was also used to model a slightly longer-term behavior of the disposal units
- The effects on the soil-structure interaction of the assembled system of natural and barrier components due to the degradation of the disposal canisters, caused by excessive weathering, chemical attack or poor quality control during their fabrication, was simulated

Infiltration Modeling

- HELP (Hydrologic Evaluation of Landfill Performance) was initially used in evaluating infiltration at the site
- This evaluation was later supplemented by the VS2DI (Variably Saturated 2 Dimension Infiltration) Code
- VS2DI can address the spatial and temporal variability of the cover materials

Erosion Modeling

- Long term performance of the erosional resistance of the barrier cover system was studied using the SWAT (Soil and Water Assessment Tool) code
- SWAT incorporates a more regional domain than either FLAC or VS2DI
- SWAT can generate climatic conditions over the longer periods of analysis

Performance Assessment Modeling

- RESRAD was utilized to date by licensee
- TCEQ Staff is developing an independent performance assessment model using GOLDSIM
- GOLDSIM will be able to model radiation dose incorporating results from SWAT and VS2DI as functions of time
- GOLDSIM can also simulate the release of contaminants due to random degradation of the canisters and barrier system

Performance Assessment Modeling (cont.)

- GOLDSIM can also model contaminant transport informed by results from POR-FLOW, a three-dimensional finite element multiphase flow and mass transport code
- GOLDSIM is ideal in running various simulations using the Monte Carlo technique

Monitoring Barrier Performance

- Additional site-specific data is needed in order to support and validate the parameters used in the various codes
- Pressure transducers and/or heat dissipation sensors will be used at the facilities to measure moisture content in the engineered cover and liner

Monitoring Barrier Performance

- Moisture profiles taken from the cover can be used to quantify infiltration through the cover
- Profile information can be used to validate or adjust the infiltration model accordingly
- Sensors beneath and adjacent to the disposal units can be used to inform whether saturation is present