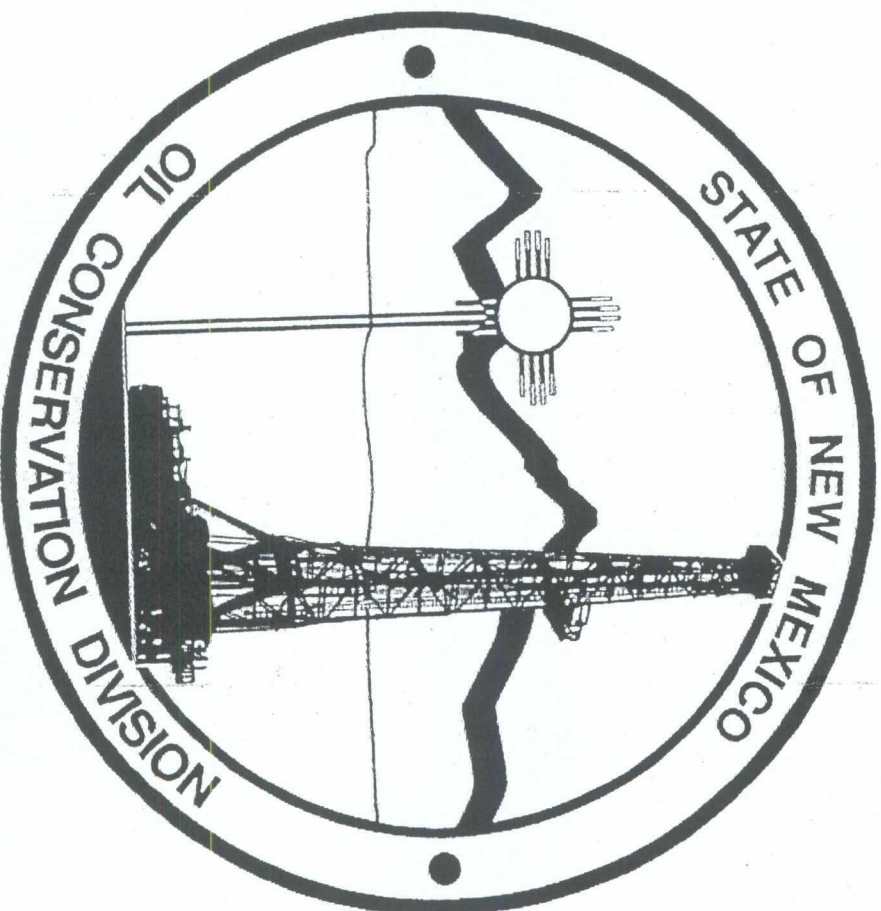




CASE NO. 14292
OCD EXHIBIT 8





Trench Release Modeling for the Permian Basin

Conducted by

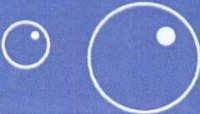


Environmental Bureau
Oil Conservation Division

New Mexico Energy, Mineral and Natural Resources Department



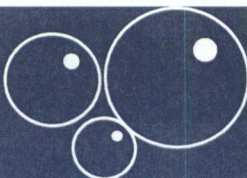
Predictive Models



– Hydrologic Evaluation of Landfill Performance (HELP) Model

- Water balance model with several computer codes including: run-off, evaporation, transpiration, soil water storage, etc.
- Developed by the U.S. ACE for the U.S. EPA

– Multimedia Exposure Assessment (MULTIMED) Model

- Pseudo two-dimensional computer codes including: vadose zone and aquifer transport
 - Developed by the U.S. EPA
- 

Predictive Models

- **HELP Model**

- Uses actual daily weather data
- Determination of release rates at the bottom of unlined pits and lined trenches
- One of the most accurate predictors of release rates from waste disposal areas
- Used by other States and industry


- **MULTIMED Model**

- Use of HELP's output for the input of the most sensitive parameter (i.e., the infiltration rate)
- Determination of release concentrations over time in the aquifer
- A conservative predictor of release concentrations and times

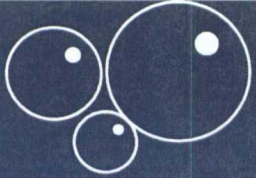


HELP Conceptual Model (inputs)

- Weather data

- Daily precipitation
 - Daily temperatures
 - Daily solar radiation indexes
 - Daily evaporation indexes
- 

- Soils data

- Number of layers
 - Type of layer
 - Layer thickness
 - Soil type
 - Soil porosity
 - Soil field capacity
 - Soil wilting point
 - Soil initial moisture
 - Soil saturated hydraulic conductivity
 - Quality of liner installation
 - Type of cover material
 - Slope of cover material
- 

HELP Conceptual Model (inputs)

- One set of weather data* for 50 years (1951 - 2000):
 - Permian Basin** (Hobbs at an average precipitation of ~16"/y)

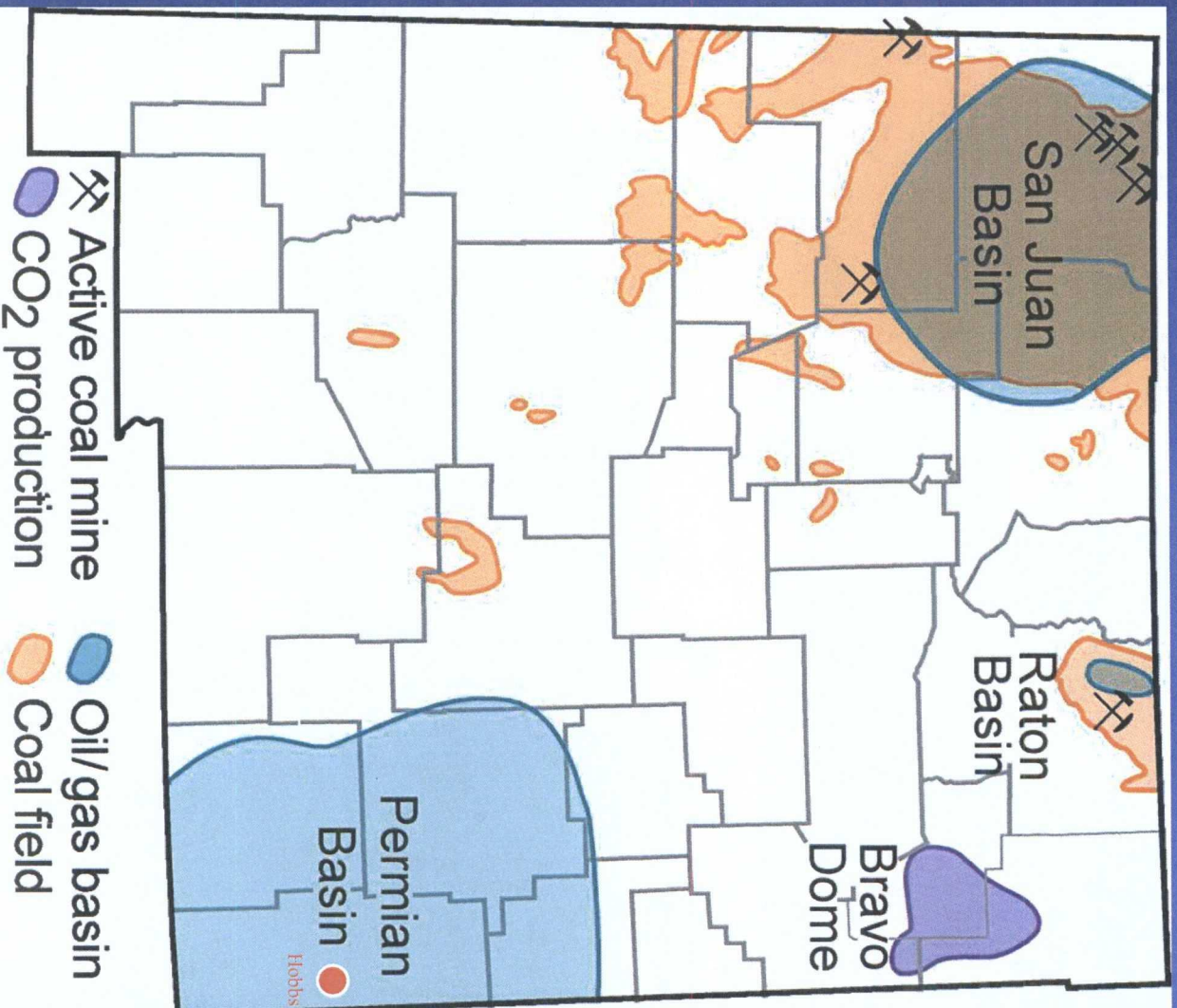
*Climate data™ by Hydrosphere Data Products, Inc. (data obtained from National Climate Data Center)

**The Permian Basin having pit contents with the higher chloride concentrations in New Mexico as demonstrated through the chloride sampling results below:

(excerpt from Case # 14015, OCD Ex. 16)

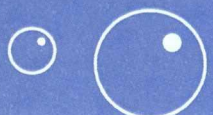
OCD SAMPLING RESULTS FOR SOLID/SLUDGE PIT CONTENTS				INDUSTRY COMMITTEE SOLID/SLUDGE PIT CONTENTS TOTAL FRACTION				OCD SAMPLING RESULTS FOR LIQUID PIT CONTENTS				INDUSTRY COMMITTEE SOLID/SLUDGE PIT CONTENTS SOLUBLE FRACTION ANALYZED AFTER TCLP			
MAX NW	MAX SE	UNITS		NW MAX	SE MAX	UNITS		MAX NW	MAX SE	UNITS		NW MAX	SE MAX	UNITS	
5,290.0	226,000.0	mg/Kg		15,000.0	420,000.0	mg/Kg		7,810.0	244,000.0	mg/L					

Conceptual Models Weather Data

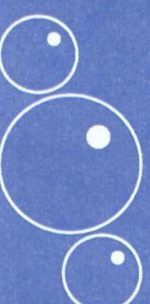




HELP Conceptual Model (inputs)

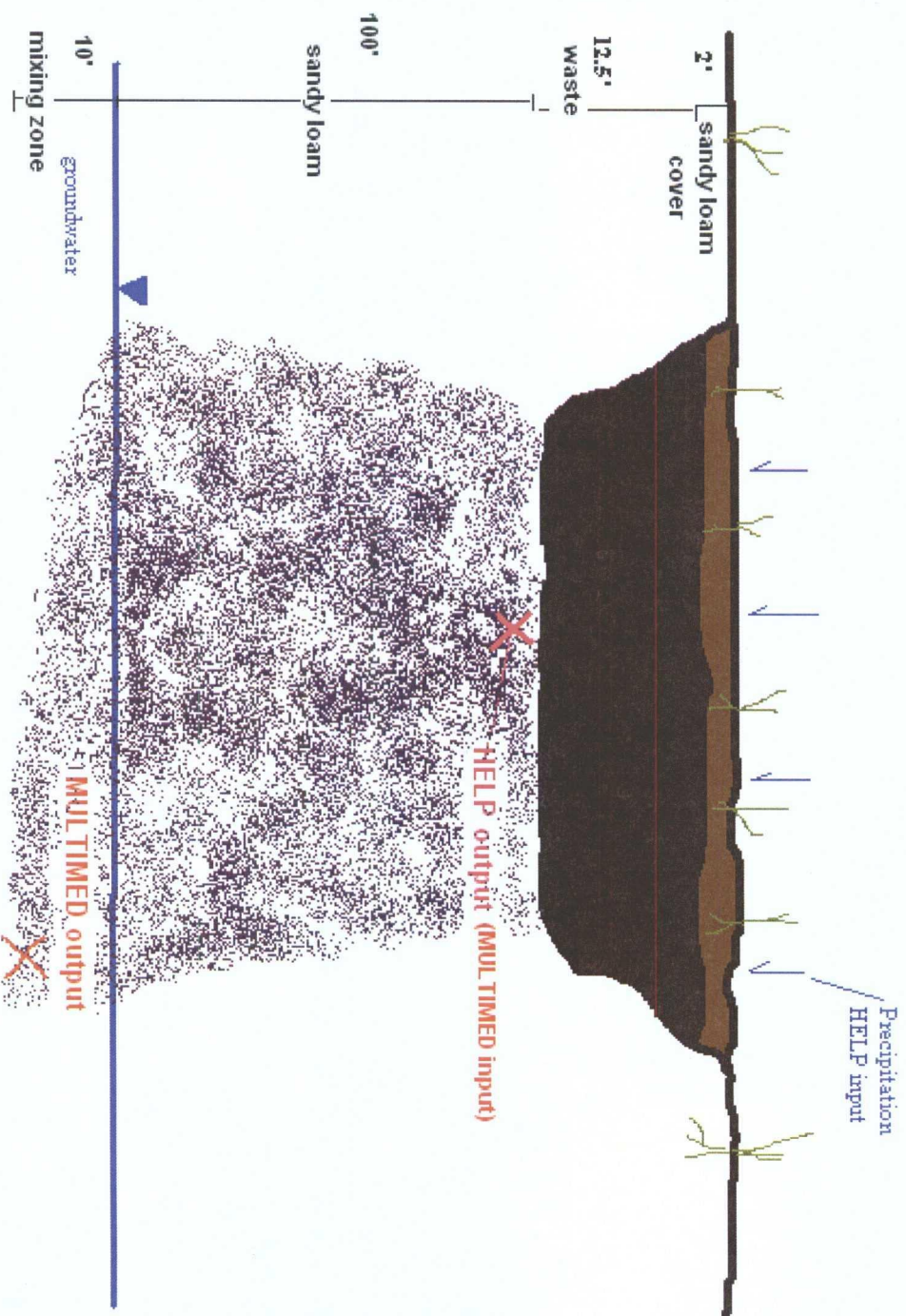
- A release from an unlined pit
 - 2 feet of soil cover (with poor vegetation)
 - Waste
 - A release from an on-site trench burial
 - 4 feet of soil cover (with poor vegetation)
 - Liner* on top of the waste
 - Waste
 - Liner* at the bottom (and sides) of the waste
- 

*assuming the liners are installed in accordance with Part 17



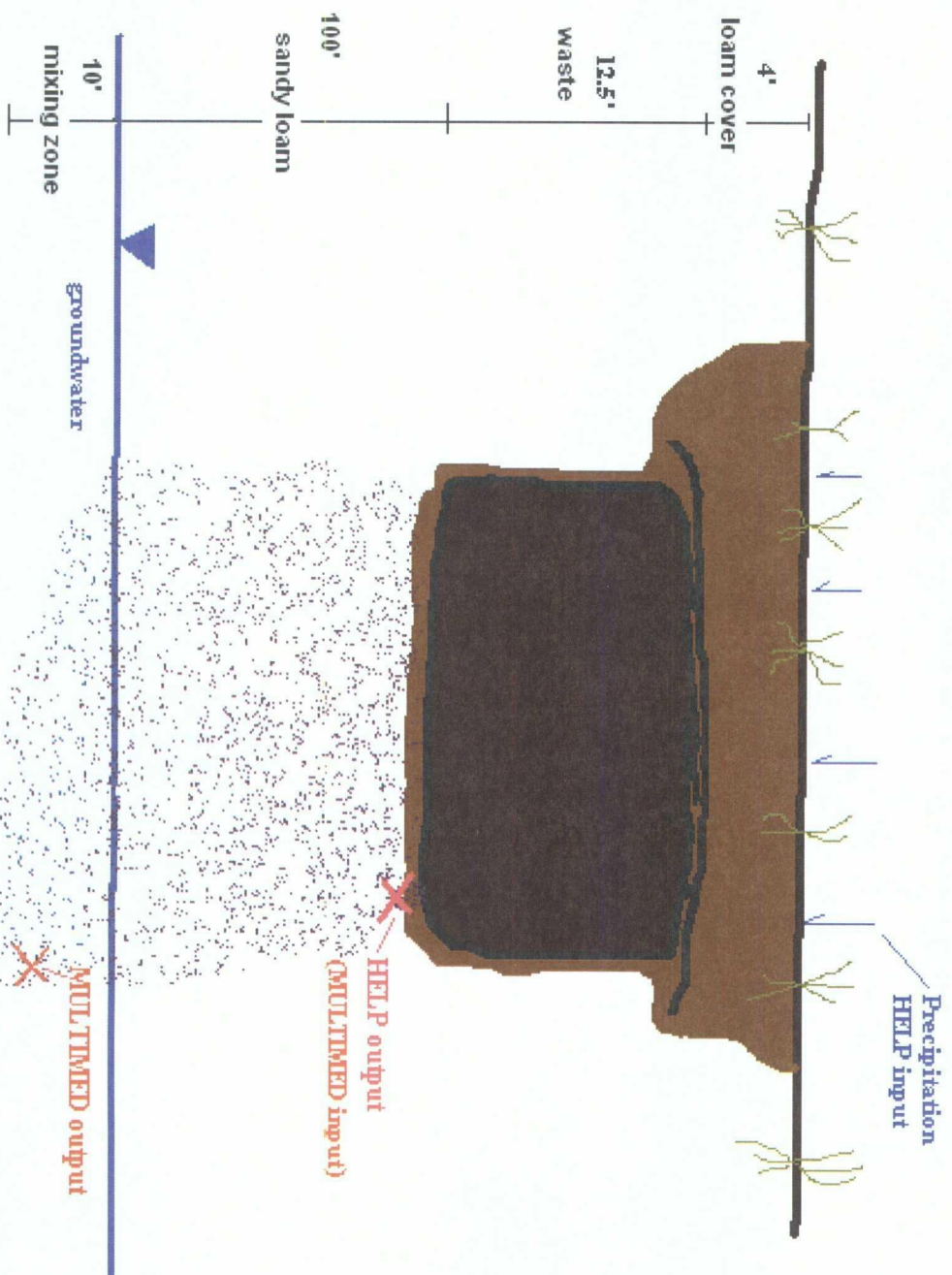
Conceptual Models

Unlined Pit



Conceptual Models

On-site Trench Burial





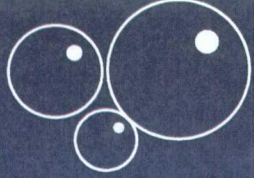
HELP Conceptual Model (outputs)

- Annual average of release rate:
 - at the bottom of an unlined pit (“**Unlined Pit**”) (Permian Basin: 1.2”/y); OR
 - through the bottom of a well installed liner of an on-site trench burial (“**Good Liner**” in accordance with Part 17) (Permian Basin: 0.09”/y);
- This output was used for the input value for the infiltration rate in the MULTIMED model.



MULTIMED Conceptual Model (inputs)

- Source specific variables
 - Infiltration rate
 - Initial concentration
 - Area of waste disposal unit
 - Duration of pulse
 - Vadose Zone variables
 - Thickness
 - Saturated hydraulic conductivity
 - Effective porosity
 - Residual water content
 - Longitudinal dispersivity
 - Percent organic matter
 - Bulk density of soil
 - Biological decay coefficient
- 
- 

- Aquifer specific variables
 - Mixing Zone
 - Well distance from site
 - Effective porosity
 - Bulk density
 - Thickness
 - Conductivity
 - Gradient
 - Longitudinal, transverse, vertical dispersivities
- 

MULTIMED Conceptual Model (inputs)

- Infiltration Rate
 - Output from HELP model
- 100' feet of vadose zone (bottom of trench to groundwater)
 - Including type of soil
- 10' Mixing Zone
 - Based on OCC Final Deliberations regarding Part 17
- Chloride concentration of release
 - For the Permian Basin using 60,000 mg/L initial concentrations

MULTIMED Conceptual Model (inputs)

- Chloride concentration of release
 - 3,000 mg/L Synthetic Precipitation Leaching Procedure (SPLP) chloride concentration (proposed amendment to rule) would include the reasonable maximum chloride concentrations that occur in pit contents in New Mexico (with allowable stabilization).
 - 3,000 mg/L chloride concentration using the SPLP is equivalent to 60,000 mg/Kg in trench contents because that procedure requires a 1:20 dilution (trench contents : leaching solution) and chloride is very soluble.
 - 60,000 mg/Kg in trench contents may be the equivalent of up to 240,000 mg/Kg chloride concentration in the initial pit contents because the pit contents can be mixed 1:3 with clean soils (for legitimate stabilization), which reduces the chloride concentration by 4X (i.e., from 240,000 mg/Kg to 60,000 mg/Kg)
 - 60,000 mg/Kg chloride concentration in the “stabilized” trench contents equates to 60,000 mg/L in the leachate.

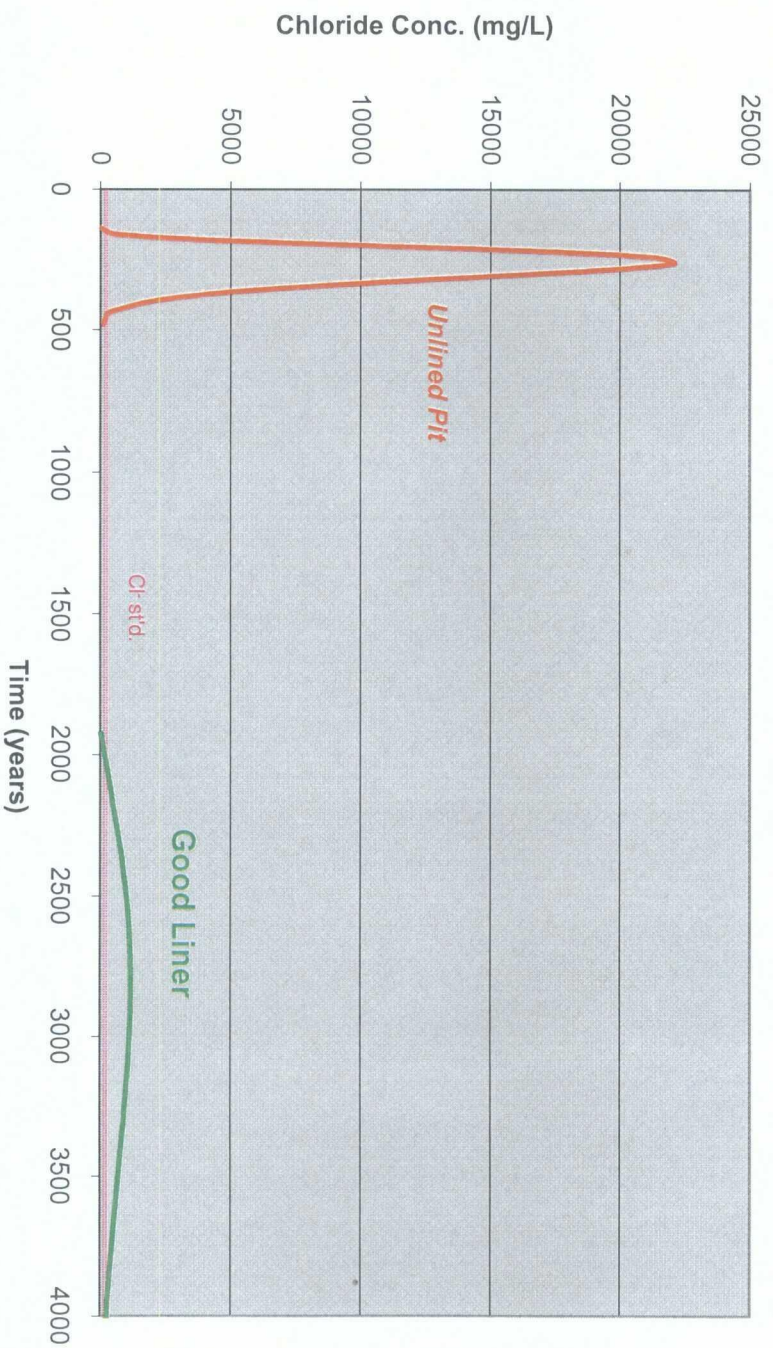
OCD SAMPLING RESULTS FOR SOLID/SLUDGE PIT CONTENTS				INDUSTRY COMMITTEE SOLID/SLUDGE PIT CONTENTS TOTAL FRACTION				OCD SAMPLING RESULTS FOR LIQUID PIT CONTENTS				INDUSTRY COMMITTEE SOLID/SLUDGE PIT CONTENTS SOLUBLE FRACTION ANALYZED AFTER TCLP			
MAX NW	MAX SE	UNITS		NW MAX	SE MAX	UNITS		MAX NW	MAX SE	UNITS		NW MAX	SE MAX	UNITS	
5,290.0	226,000.0	mg/Kg		15,000.0	420,000.0	mg/Kg		7,810.0	244,000.0	mg/L					

MULTIMED Conceptual Model (outputs)

- Chloride concentration over time in the groundwater that is 1 meter from the downgradient edge of the trench


Modeling Results

Permian Basin On-site Trench Burial
(60,000 mg/L Initial Conc.)





Modeling Results (summary)

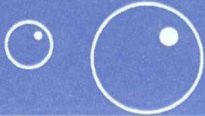

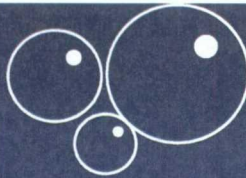
- After ~2,000 years the groundwater standard for chloride will be exceeded if the trench contents has a chloride concentration of 3,000 mg/L (SPLP).
- 

- The chloride concentration will peak at ~1,250* mg/L in groundwater with a 10' mixing zone.

*assuming 50 mg/L chloride background concentration in groundwater




Conclusion

- On-site trench burials with a chloride concentration of 3,000 mg/L (SPLP) or less in the trench contents will be protective of human health and the environment given the siting, design and construction, operational, and closure requirements of Part 17.
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References

- U.S. EPA, 1997. Hydrologic Evaluation of Landfill Performance (HELP) Model, version 3.07
 - U.S. EPA, 1994. Hydrologic Evaluation of Landfill Performance (HELP) Model, Engineering Documentation of Version 3
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 - U.S. EPA, 1991. Multimedia Exposure Assessment Model (MULTIMED), version 1.01
 - U.S. EPA, 1990. Multimedia Exposure Assessment Model (MULTIMED) for Evaluating the Land Disposal of Wastes – Model Theory, by Salhotra, et al.
 - U.S. EPA, 1990. A Subtitle D Landfill Application Manual for the Multimedia Exposure Assessment Model (MULTIMED), by Sharp-Hansen, et al.
 - U.S. EPA, 1993. User Manual Supplement: Using MULTIMED to Evaluate Subtitle D Landfill Designs, by T. L. Allison
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• end slide show