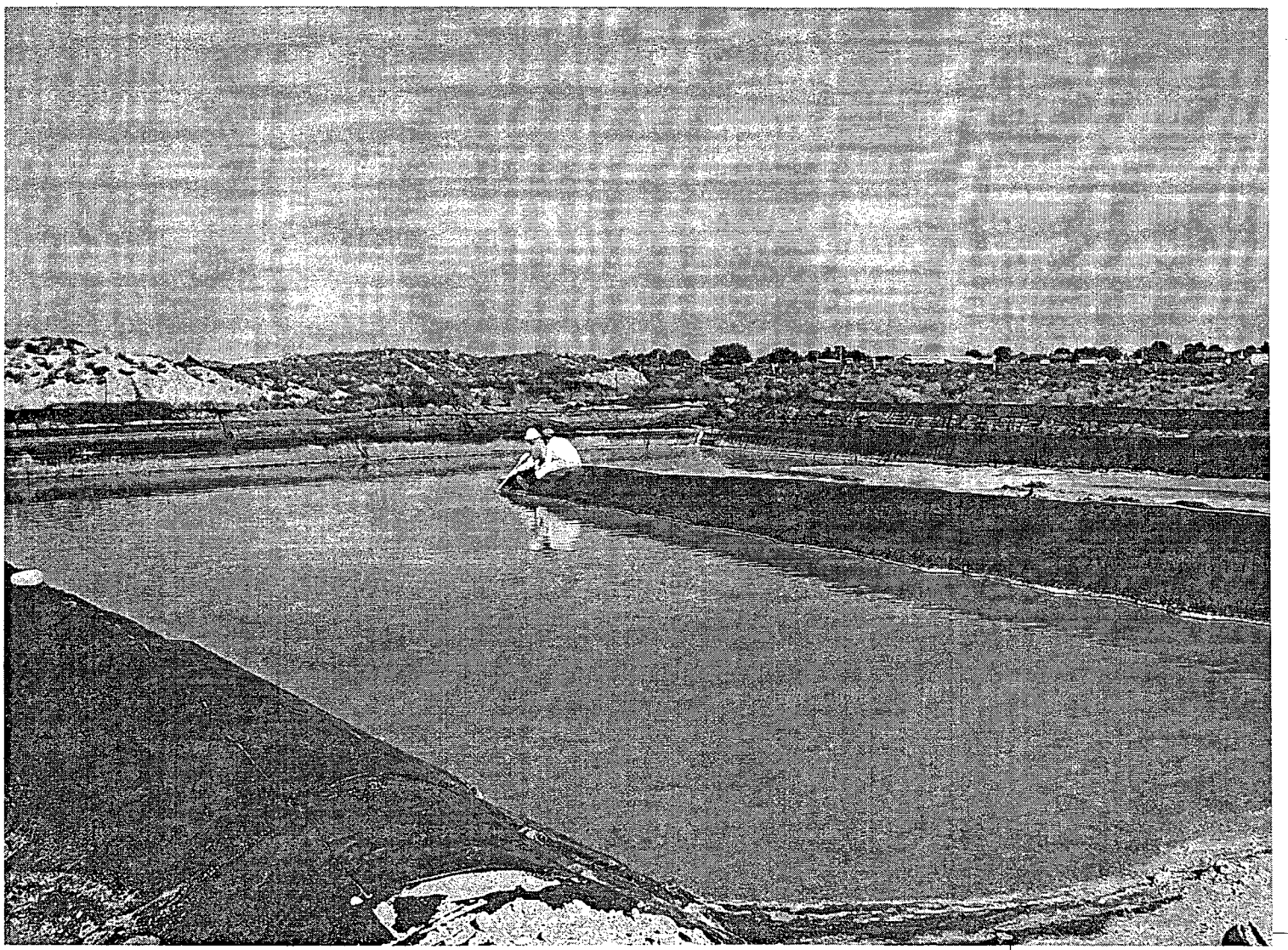
CASE NO. 14015
OCD EXHIBIT 9

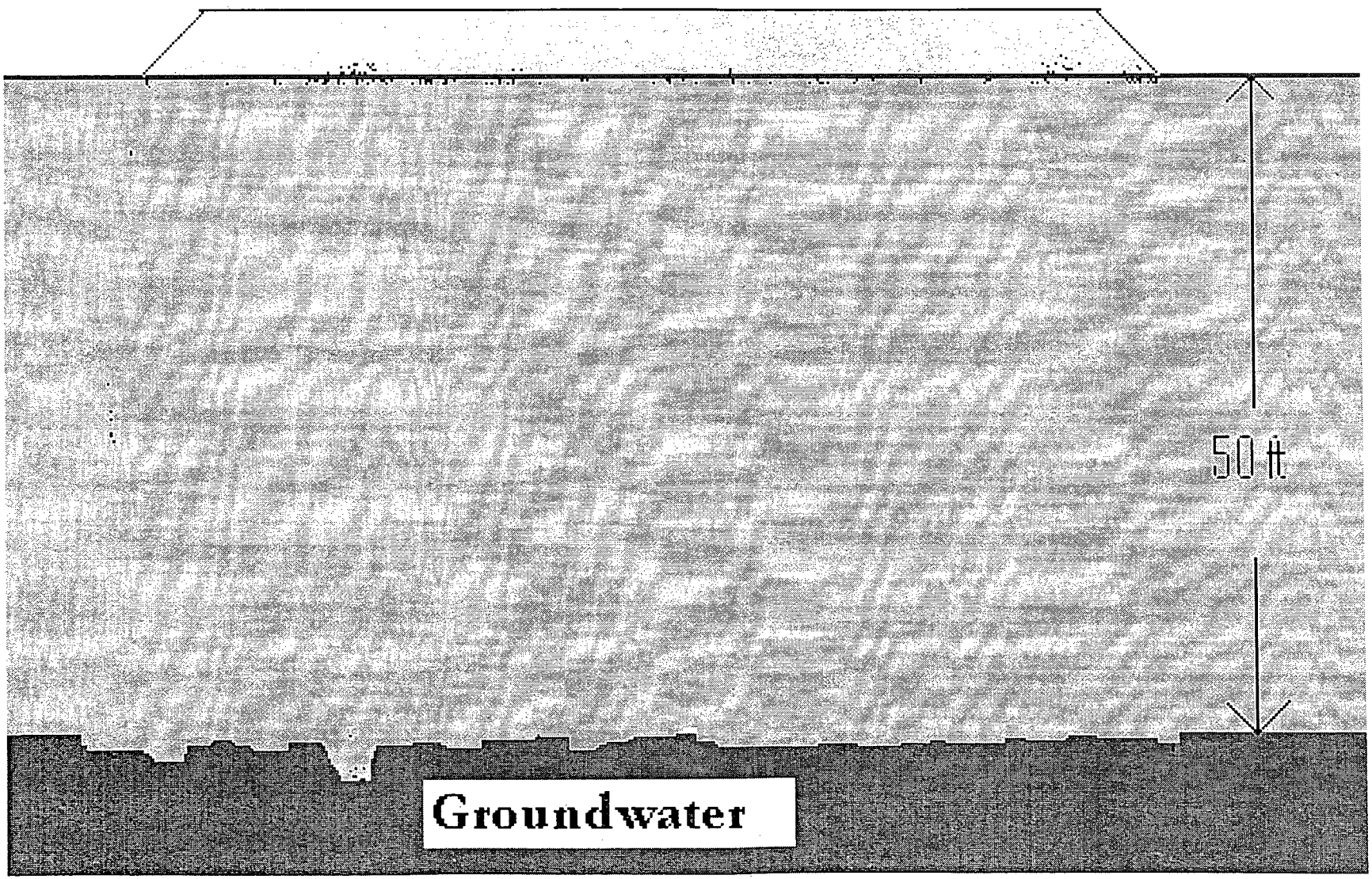
New Siting Requirement
No Pits within 50 ft of Groundwater

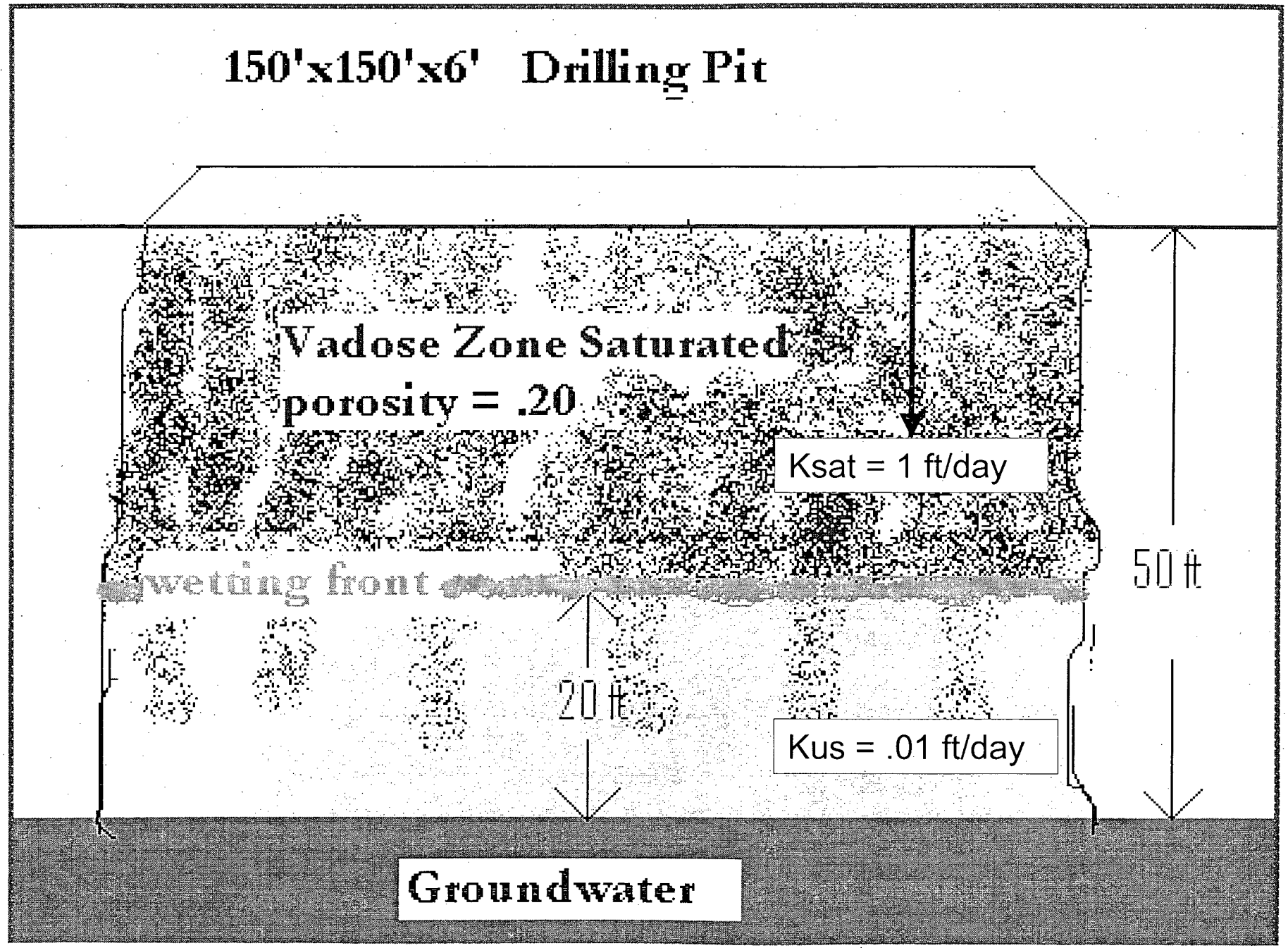


Pit Failure Scenario

- Drilling pit catastrophic liner failure
- Vadose zone as a *temporary* Safety Net
- Basic hydrology principals and practices

150'x150'x6' Drilling Pit




150'x150'x6' Drilling Pit
Vadose Zone Saturated
porosity = .20
Ksat = 1 ft/day
wetting front
50 ft
20 ft
Kus = .01 ft/day
Groundwater

K (cm/s)	10^{2}	10^{1}	10^{0}= 1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}
K (ft/day)	10^{5}	10,000	1,000	100	10	1	0.1	0.01	0.001	0.0001	10^{-5}	10^{-6}	10^{-7}
Relative Permeability	Pervious					***Semi-Pervious***			Impervious				
Aquifer	Good					Poor			None				
Unconsolidated Sand & Gravel	Well Sorted Gravel		Well Sorted Sand or Sand & Gravel			Very Fine Sand, Silt, Loess, Loam							
Unconsolidated Clay & Organic					Peat		Layered Clay			Fat / Unweathered Clay			
Consolidated Rocks	Highly Fractured Rocks				Oil Reservoir Rocks			Fresh Sandstone		Fresh Limestone,		Fresh Granite	

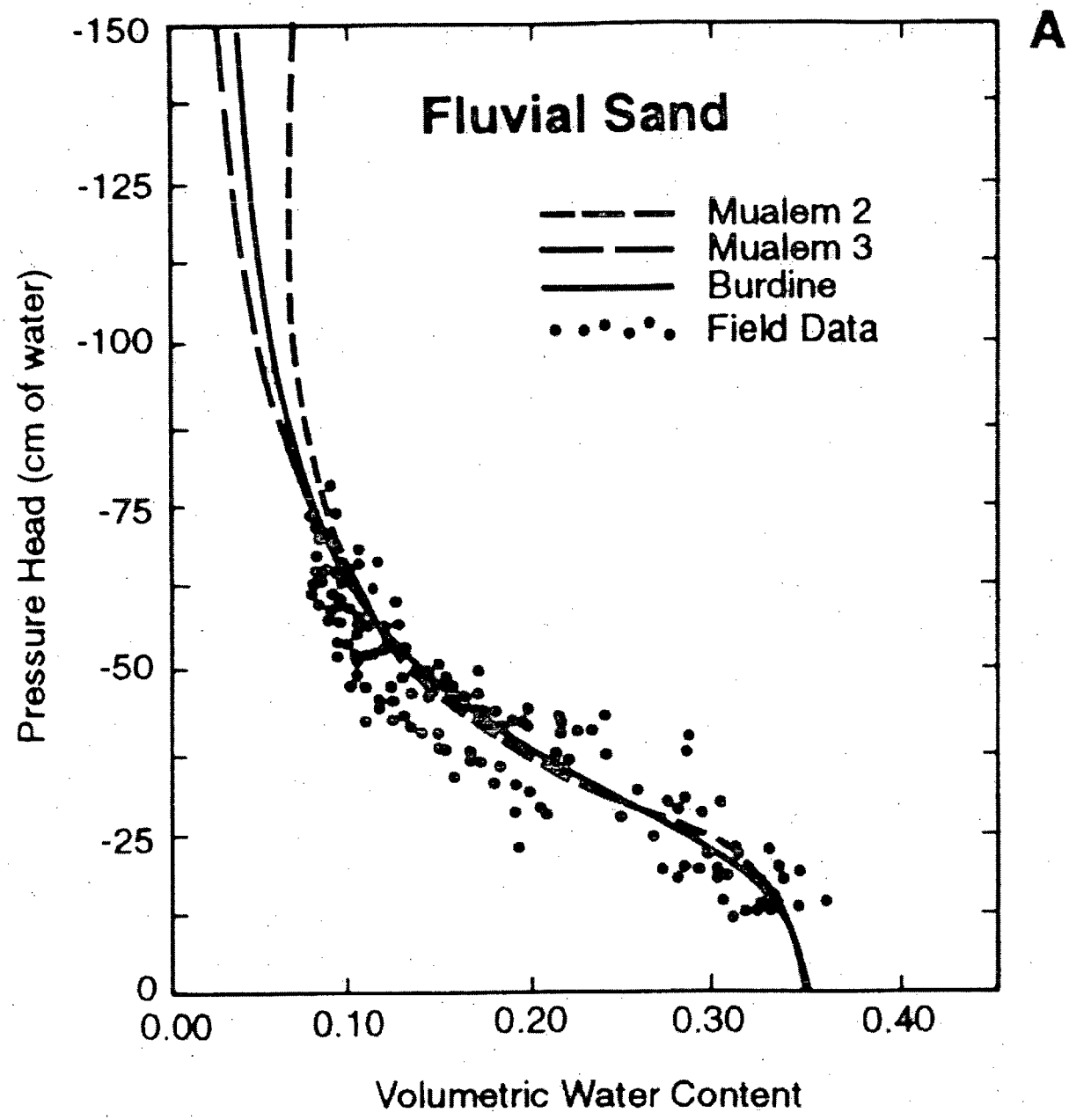
Porosity Ranges for Sediments

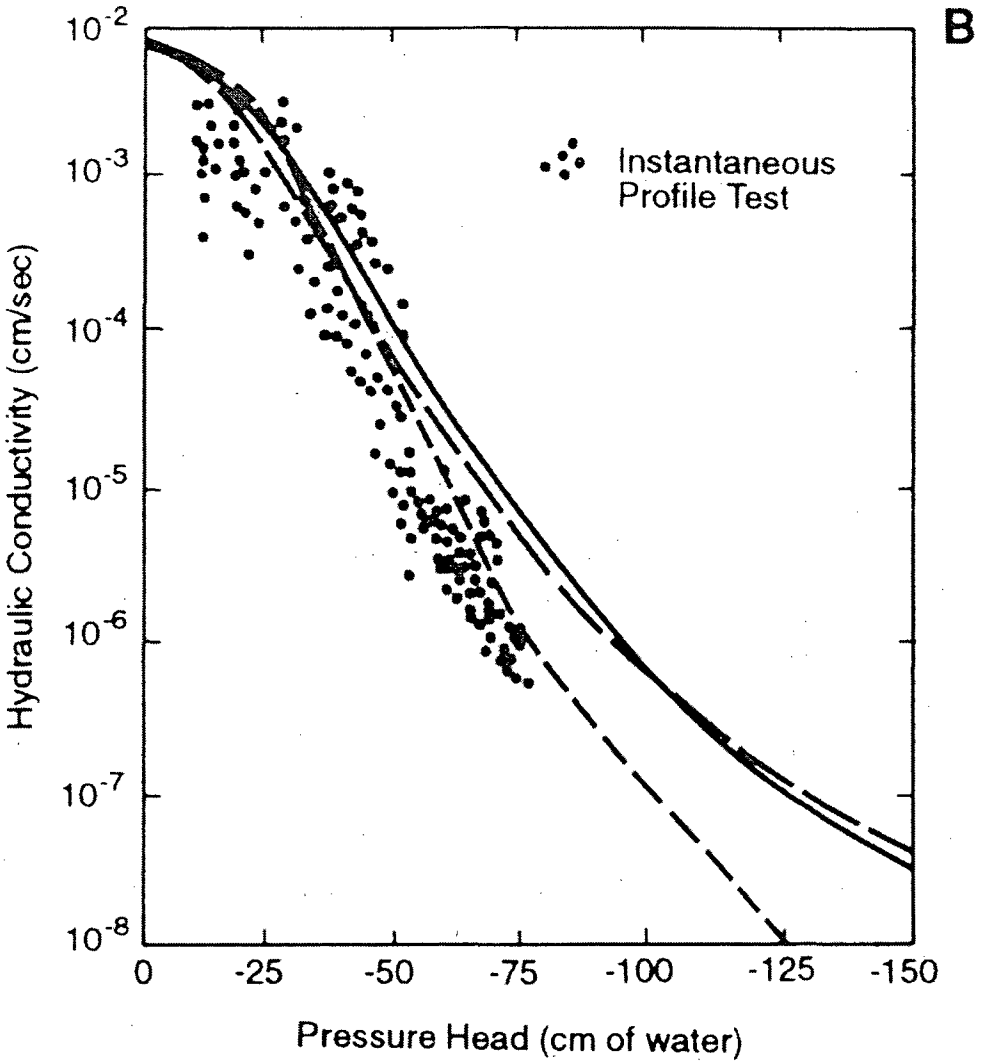
Material	Porosity (%)
well-sorted sand or gravel	25-50
sand and gravel, mixed	**20**-35
glacial till	10-20
silt	35-50
clay	33-**60**

(Based on Meinzer (1923a); Davis (1969); Cohen (1965); and MacCary and Lambert (1962) as quoted by C.W. Fetter [2])

Permeability for Sediments

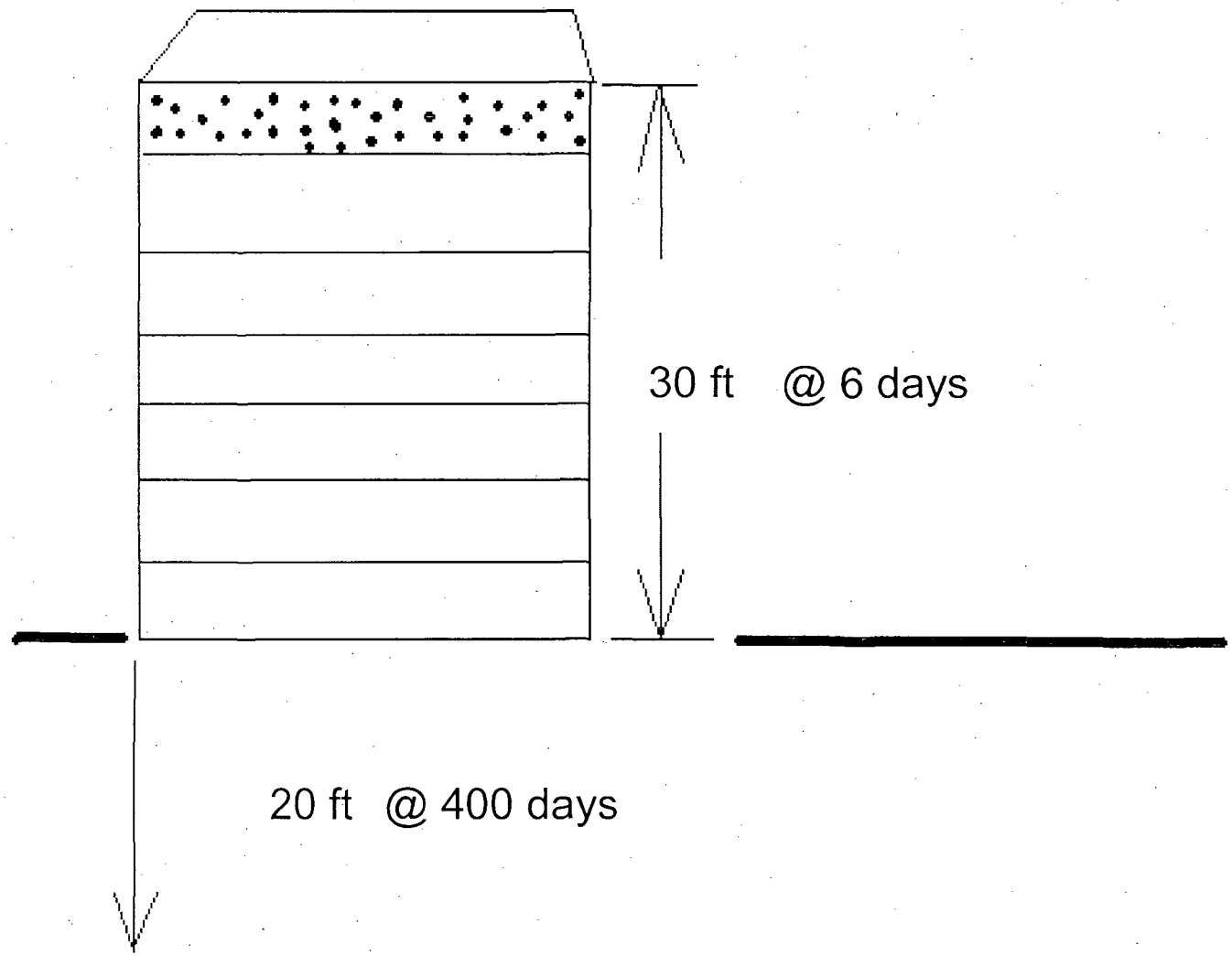
Material	**Permeability or Hydraulic Conductivity** (cm/s)
well-sorted gravel	10^{-2} to 1
well-sorted sands, glacial outwash	10^{-3} to 10^{-1}
silty sands, fine sands	10^{-5} to 10^{-3}
silt, sandy silts, clayey sands, till	10^{-6} to 10^{-4}
clay	10^{-9} to 10^{-6}
(C.W. Fetter [2])	


A
Fluvial Sand
Mualem 2
Mualem 3
Burdine
Field Data
Pressure Head (cm of water)
-150
-125
-100
-75
-50
-25
0
0.00
0.10
0.20
0.30
0.40
Volumetric Water Content



(A) Field-measured soil-water retention data (from tensiometers and neutron probes) and nonlinear least-squares fits with SOHYP. (B) Field-measured and calculated hydraulic conductivity. (From Stephens, 1992. With permission.)

Estimated time of fluid movement



Time Calculations of Fluid Movement

- **$Q = KiA$** **$V = (K^* I)/\eta$**
- How long would it take for fluid to reach 30 feet in saturated zone with Ksat = 1 ft/day and I = 1?
- V = {[1 ft/day * 1] / 0.2} = 5 ft/day
- V = 5 ft/day
- It would take **6 days** at 0.2% porosity with a conductivity of 1 ft/day to reach 30 feet below the bottom of the pit.
- How long would it take the fluid to reach 20 feet below the 30 feet barrier?
- V = {[0.01 ft/day * 1] / 0.2} = 0.05 ft/day
- V = 0.05 ft/day = 0.6 inch/day = 20 days/foot
- It would take **400 days (1 year and 35 days)** for the fluid to move 20 feet below the 30 feet barrier in an unsaturated zone with a conductivity of 0.01 ft/day and a porosity of 0.2

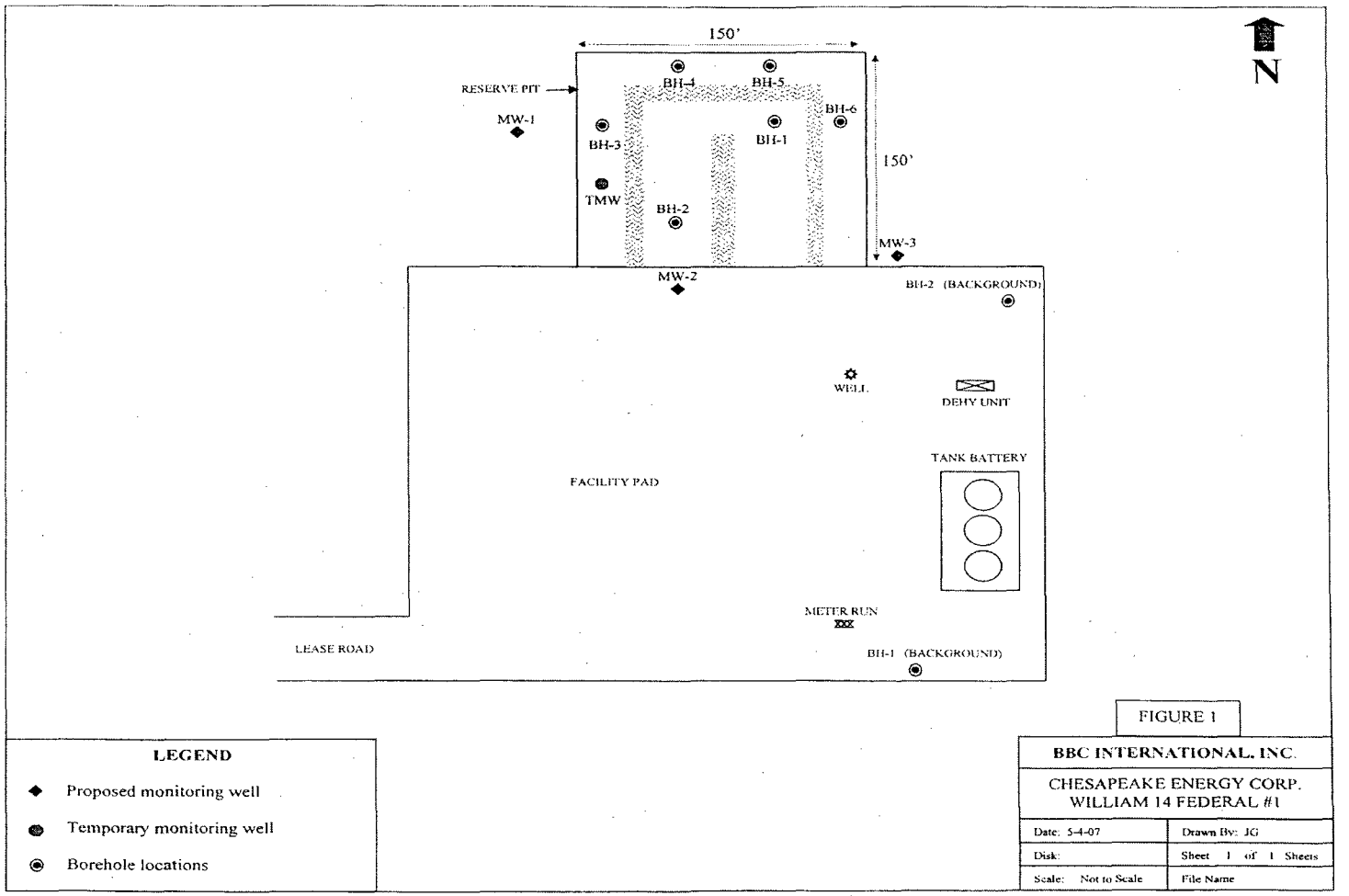
Real time example where the 50 foot safety net provided some protection-

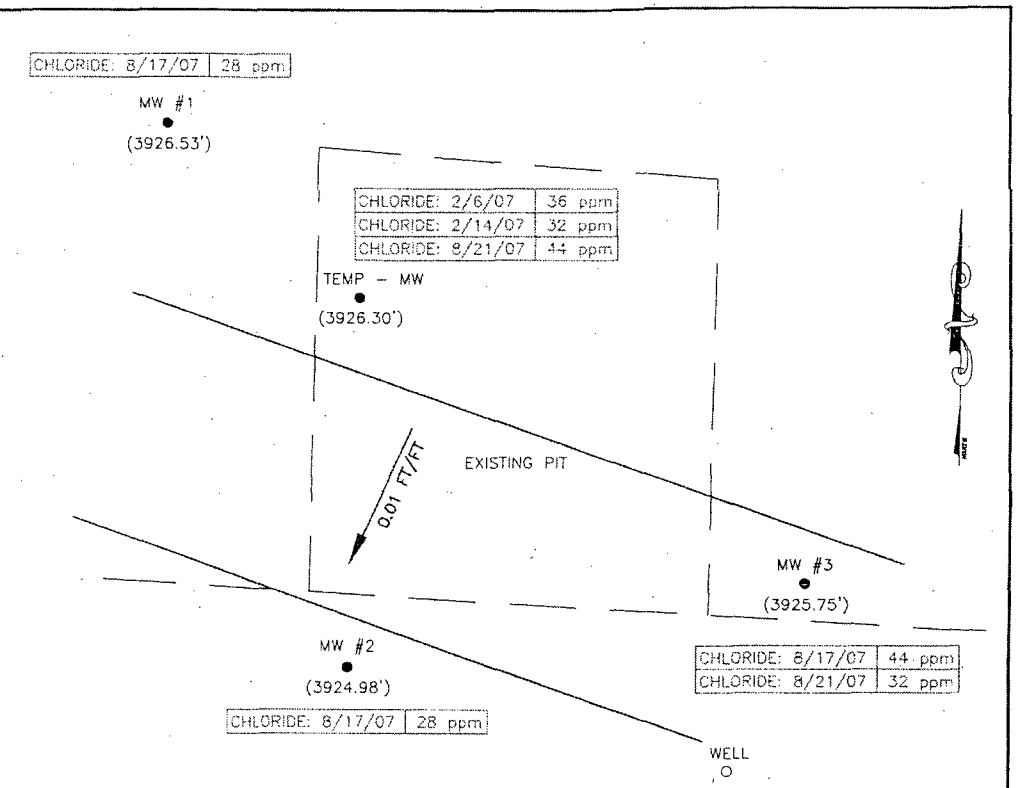
Table 2
Chesapeake/Williams 14 Federal #1
Lea County, New Mexico
Boreholes Soil Samples
Sampled on 8/10/05 and 8/11/05

	Chloride Analysis (mg/kg)					
Depth (ft), BPB	BH-1	BH-2	BH-3	BH-4	BH-5	BH-6
0-1	2260	4540	775	3430	4410	832
5-6	3360	794	336	7060	8890	841
10-11	4620	2530	524	1970	6510	429
15-16	3100	1060	451	1620	3550	113
20-21	1110	529	561	44.5	2360	14.3
25-26	1220	795	691	14.8	2090	8.76
30-31	797	603	1010	12.3	901	12.1
35-36	788	1220	2310	12.4	197	57.9
40-41	1790	1770	5010	12.1	60.2	11.1

BPB - Below Pit Bottom

Groundwater depth 50-60 ft- Slight impact





WELL	COORDINATES	ELEVATIONS
MW #1	736151.4 N 790786.1 E	NATURAL GROUND - 3981.05' TOP OF PVC - 3984.13'
MW #2	735948.7 N 790853.7 E	NATURAL GROUND - 3979.23' TOP OF PVC - 3982.60'
MW #3	735979.4 N 791023.5 E	NATURAL GROUND - 3979.60' TOP OF PVC - 3982.60'
TEMP MW	736086.5 N 790858.1 E	NATURAL GROUND - 3971.33' TOP OF PVC - 3972.88'

50 0 50 100 FEET

Scale: 1"=50'

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BBC INTERNATIONAL, INC.

CHESAPEAKE WILLIAMS 14 FEDERAL No. 1
SECTION 14, TOWNSHIP 15 SOUTH, RANGE 35 EAST,
N.M.P.M., LEA COUNTY, NEW MEXICO

Survey Date: 9/5/07		Sheet 1 of 1 Sheets	
W.O. Number: 07.11.1235		Drawn By: L.A.	
Date: 9/14/07	DISK: CD#6	07111235	

"*50 Foot to Groundwater Justification*"

- Task Force non consensus - values ranged from 2 feet to 100 feet
- 50 feet has been an established ranking criteria since 1993
- 50 feet appeared in the non-vulnerable criteria R-7940
- New Part 36 SWMF uses 50 feet as a siting criteria for Ponds
- OCD District policies uses 50 feet as a dig & haul scenario
- 50 feet will provide industry the continued use of pits
- Will not overburden existing closed-loop systems
- New prescriptive pit design and installation requirements
- New Liner requirements minimum of 20 mil
- New Required Monitoring Requirements
- **50 feet provides a *safety net* in case of pit liner failures**

"Conclusions"
The case for 50 foot separation

- Rule requires stringent prescriptive controls
- 50 foot separation is widely used
- 50 foot requirement would cover most sensitive areas such as river bottoms
- Rule requires de-watering in 30 days and closed in ~~3~~ 6 months
- All pits will require sampling in vadose zone

50 foot separation?

Does Not

Provide Long Term Protection of Groundwater If a source is available

50 foot separation?

Should Provide Short Term Protection of Groundwater if new prescriptive methods are employed!