

Wastewater Management Update - Liquid Level and Moisture Monitoring

- Liquid Level Monitoring in Selected Dispersal System Trenches
- Moisture Level Monitoring in Adjacent Soil
- Robert Rubin, Professor Emeritus, NCSU – BAE,
- NC Onsite Conference,
24 – 26 April, 2006



Dispersal Options

- Trench Characteristics
- Pressure vs. Gravity
- Bottom area vs. sidewall

Drainfield Products

- Gravel
- Expanded polystyrene
 - Triangular configuration
 - Horizontal configuration
 - Single bundle
- Fiber wrapped pipe
- Chamber



Test System

- Assess performance of traditional options under controlled conditions in NC
- Design IAW State Rule – area reductions as allowed in rule
 - 25% for Chamber
 - 25% for Some EPS
 - 10” Fiber-wrap equivalent to 30 inch trench

Test System Design

- Commercial facility
- 8 employees
- 25 gallons per employee per day
- Small apartment over garage
- Flow measured between 200 and 240 gal/day
- Pressure manifold to gravity lines

Site

- Wagram Soil – deep, well drained loamy sand
- Design loading: 0.5 gal/sq. ft./day
- Area required: $200 \text{ gpd} / 0.5 \text{ gal/sq ft/day} = 400 \text{ square feet}$
- 1200 gal. Septic tank and pump tank required to lift to soil treatment area
- Pressure manifold

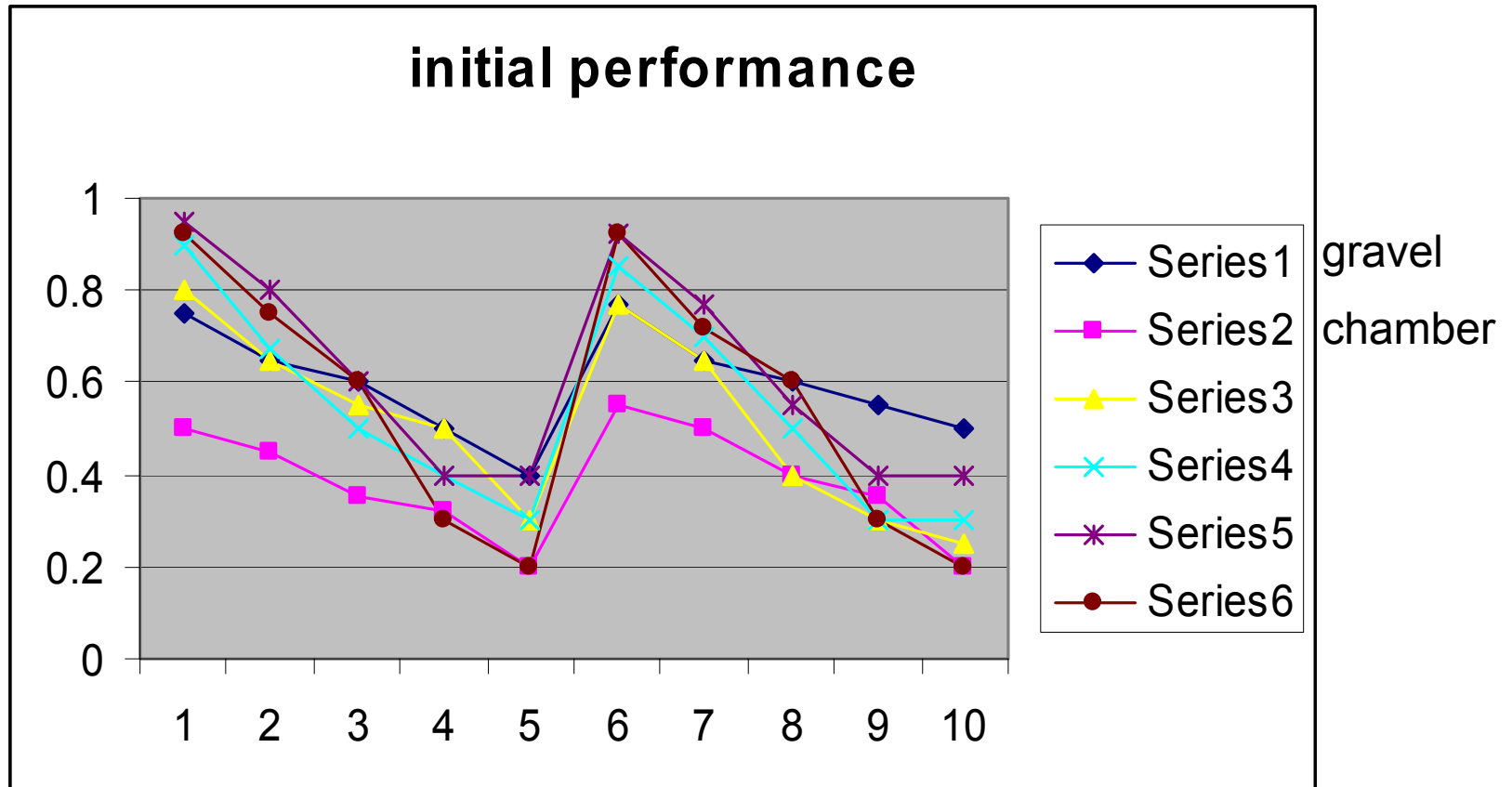
Options

- 30" x 30" gravel @ 20 ft
- Chamber with 25% reduction or 15 ft
- EPS 1, EPS 2 with reduction or 15 ft
- Large Diameter Fiber wrap (10") and EPS 3 with 25 feet of trench
- 2 experimental designs

Monitoring

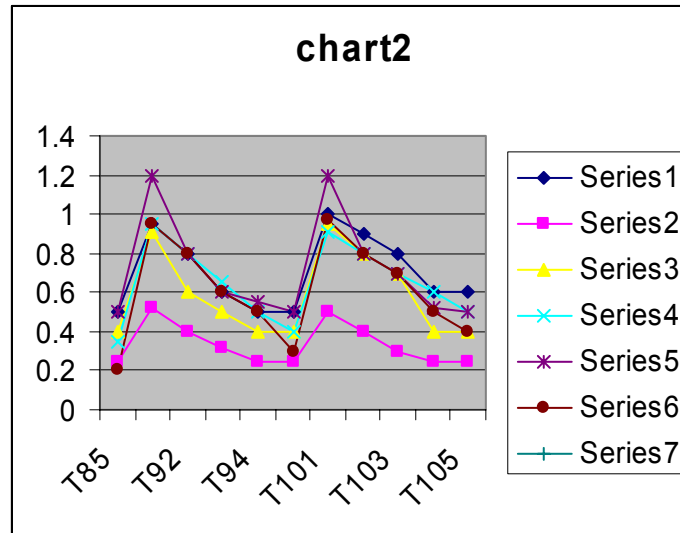
- Liquid levels @ 60 % length (10 to 15 feet from inlet)
- Moisture tension – Irrrometer Watermark_{tm} indicators
- Liquid levels monitored monthly 4 hours following dosing event
- Moisture levels monitored monthly 4 hours following dosing event

Detail (initial)

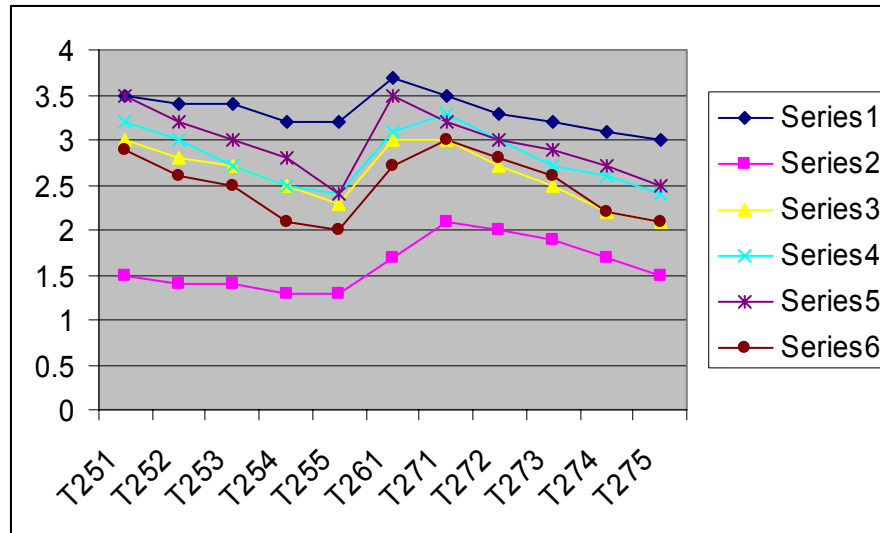


Range at maximum = 0.5 to 1"

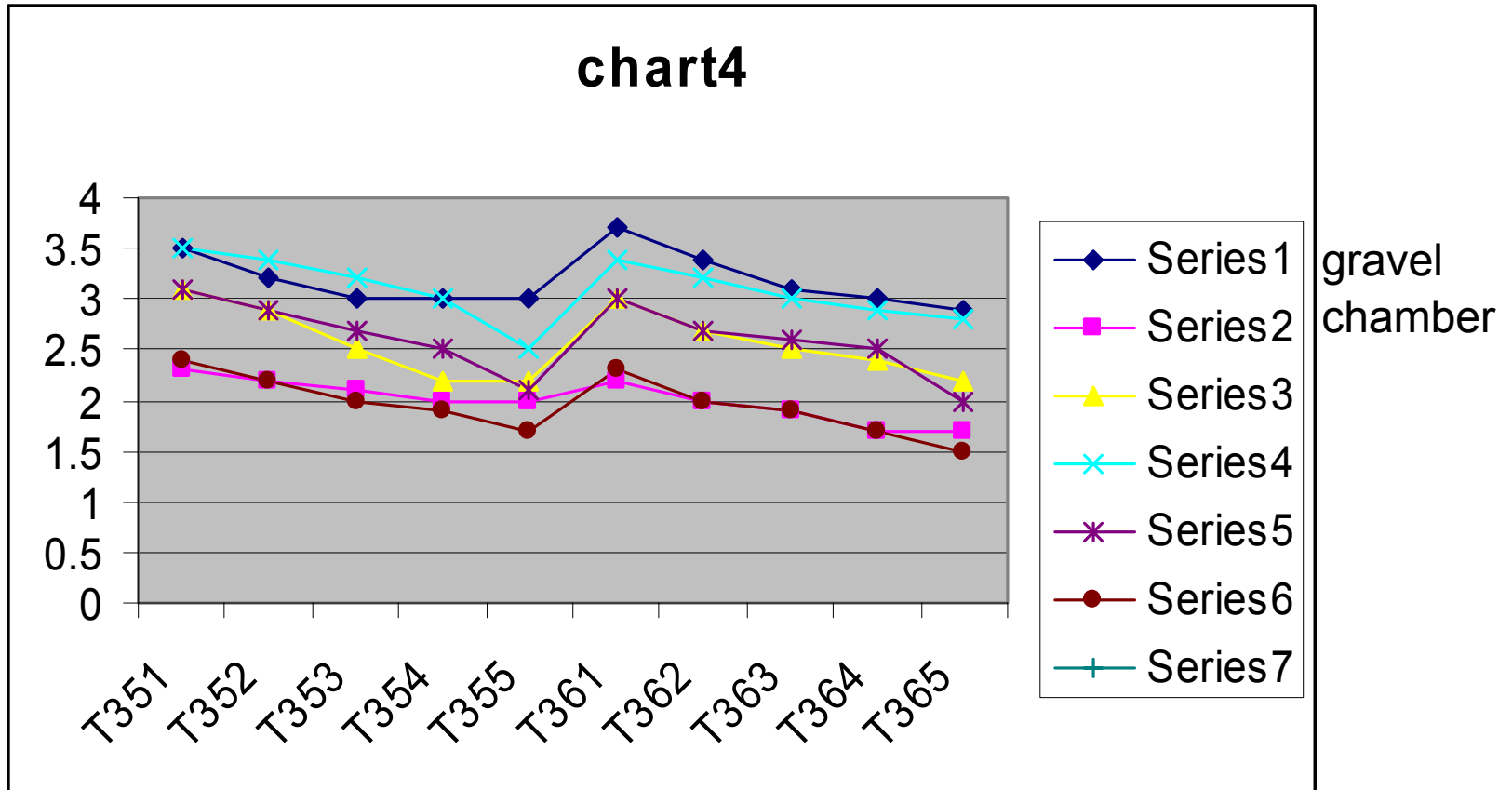
9 months



next



36 months



Range at maximum = 2.1 to 3.7"

Range at minimum = 1.5 to 3"

Continued monitoring

- Liquid levels stabilized for over 9 additional months
- Dry weather may be skewing results

Mr. Darcy

- Area critical
- 25 ft trench has 53 feet of sidewall
 - 53×0.08 ft (height of water column in trench) = or 4 sq ft area
- 20 foot trench has 45 feet of sidewall or 2 sq ft area
- 15 feet EPS trench has 35 feet of sidewall and approx. 35×0.08 ft or 2.8 sq ft area
- 15 feet Chamber has 36 feet of sidewall and approx. 36×0.03 ft = 1.1 sq. ft. area
- VERY QUICK AND VERY DIRTY!!!
- ILLUSTRATIVE ONLY

Permeability measured

- 2.2 to 2.4 inches per hour at installation
- $2.3 \text{ inches/hr} \times 24 \text{ hr./day} = 4.6 \text{ feet per day}$
- $1.1 \text{ ft sq (chamber)} \times 4.6 \text{ ft per day} = 5.06 \text{ cu. ft./d}$
- This is adequate (more than) to accommodate the 25 gal or 25 gal/7.48 gal/ft cu 3.3 cubic feet of water per trench...

Moisture

- 8 measures
- Bottom (4" and 8")
- Bottom/Side 4" and 18"
- Side
- Topsoil
- 1 is saturated
- 100 is dry

Moisture Distribution – 20” Gravel (Typical)-END VIEW

soil	surface		4-6”		12-15”		42”
40-50							50
gravel	G	G					
gravel	G	G	12-15		30-40		
G	G	G					
1-4			2-8		20-30		
8-12			2-10		25-30		

25 ft @10" Fiber Wrap (typical)- END VIEW

Soil	Surface						
30							50
FWP							
FWP	FWP	12-15		35-40			
FWP	FWP						
FWP							
2-4		4-5		25-30			
5-8		4-8		30-35			

25' EPS 1201 (typical)-END VIEW

Soil	Surface						
40							50
FWP							
FWP	FWP	10-12		35-40			
FWP	FWP						
FWP							
2-4		4-5		25-35			
5-8		4-8		30-35			

15" 1203 EPS (Typical)-END VIEW

soil	surface		4-6"		12-15"		42"
40-50							50
EPS	EPS	E					
EPS	EPS	E	12-15		30-40		
EPS	EPS	E					
2-4			2-8		20-30		
6-10			2-10		25-30		

Moisture Distribution – 15' 1203 T – END VIEW

soil	surface		4-6"		12-15"		42"
40-50							50
1203T							
1203T	T		18-25		30-35		
1203T	T	T					
1-4			1-6		15-25		
8-12			2-8		20-30		

Moisture Distribution – 15’ Chamber – END VIEW

soil	surface		4-6”		12-15”		42”
40-50							50
Chamber	C						
Chamber	C		15-18		25-35		
Chamber	C	C					
1-4			1-4		25-30		
8-12			2-10		20-30		

NC I and E

- Infiltration rate
- 4 soil groups
- Storage volume
- Stress response (H)
- Geometry
- Structural's
- Ponding
- Air exchange (Fick)
- Biomat character
- Leachate in trench and to GW
- Dose/rest influence
- Reactivity of media
- Backfill
- Distribution system
- Interface
- Installation requirements
- Longevity
- BOD loadings (ft²)

Regional cooperation ?

- WERF
- Subscribers?
- Select Similar Soil and Site Conditions
- EPA support
 - DSAC formed
 - Southeast Regional EH Supervisors
 - National Interest
 - NSF

Conclusions

- Limited reliability – demonstration
- Capacity of trench system not exceeded
- Gravel trench first to pond – (8 – 9 months)
- Others in 15 to 20 months
- Moisture distribution suggests little difference, slight indication of “wicking” in open-top systems