Attacking Construction Site Stormwater on Three Fronts

Richard A. McLaughlin, Ph.D.
Professor and Extension Specialist

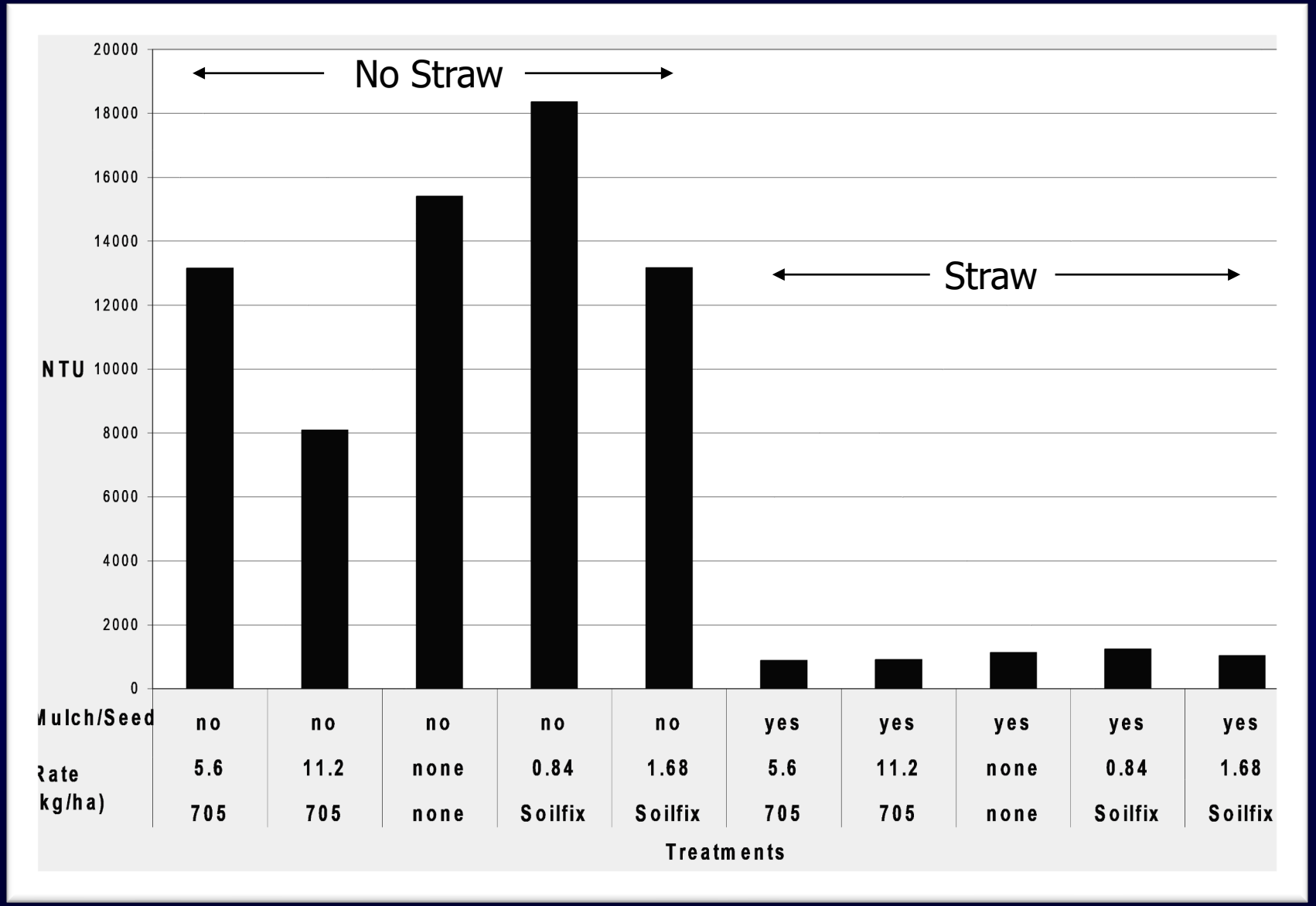
The Three Fronts

- Erosion: Keeping soil in place
- Sediment: Keeping sediment on site
- Turbidity: Reducing impacts of runoff on surface waters

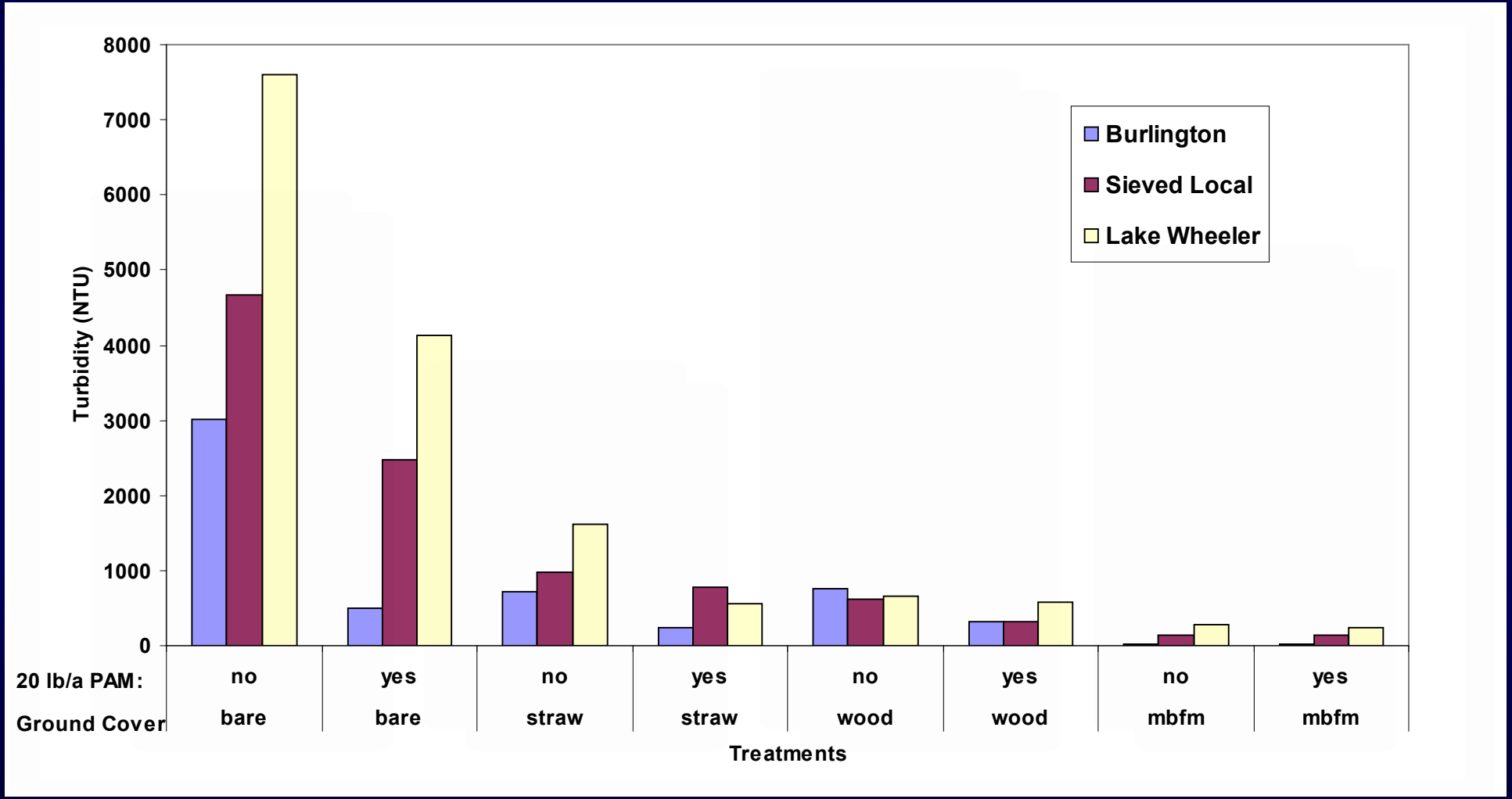
Ground Covers: Construction Site, Field, and Rainfall Simulator Testing

Controlling Erosion: Can Polyacrylamide Help?

Results: Need ground cover, more PAM



Rainfall Simulator: PAM (20 lb/acre) Reduces Turbidity for Most Groundcovers



More Mulch/PAM Tests

PAM Effects by Cover: Usually Large Turbidity Reduction

Cover	Sites	Erosion Rate Reduction
Straw	3	45-78%
Excelsior	2	51-69%
Wood Hydro	1	98%
Flexterra	1	20%

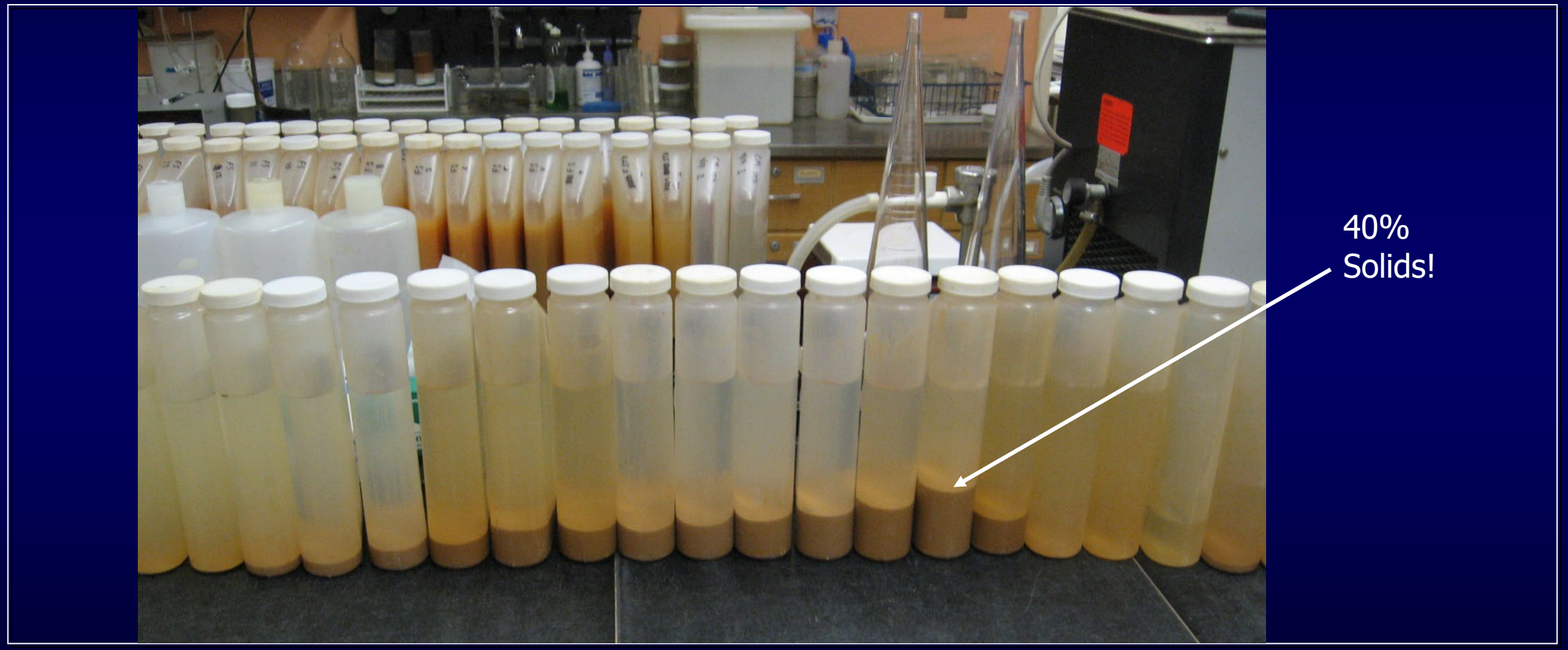
Straw vs Straw+PAM vs Hydromulches (5)

Final Results: Erosion

Treatment	Site 1, Kinston	Site 2, West Jefferson	Site 3, Garner	Site 4, Apex	Site 5, Holly Springs
			Total sediment loss (kg ha^{-1})		
Straw			3,685a	51bc	36b
Straw+PAM			1,261ab	29c	29b
SMM			959bc	N/A	35b
BFM			1,930ab	N/A	N/A
FGM			333c	164ab	N/A
WFM			N/A	237a	120ab
WCB			N/A	221ab	210a

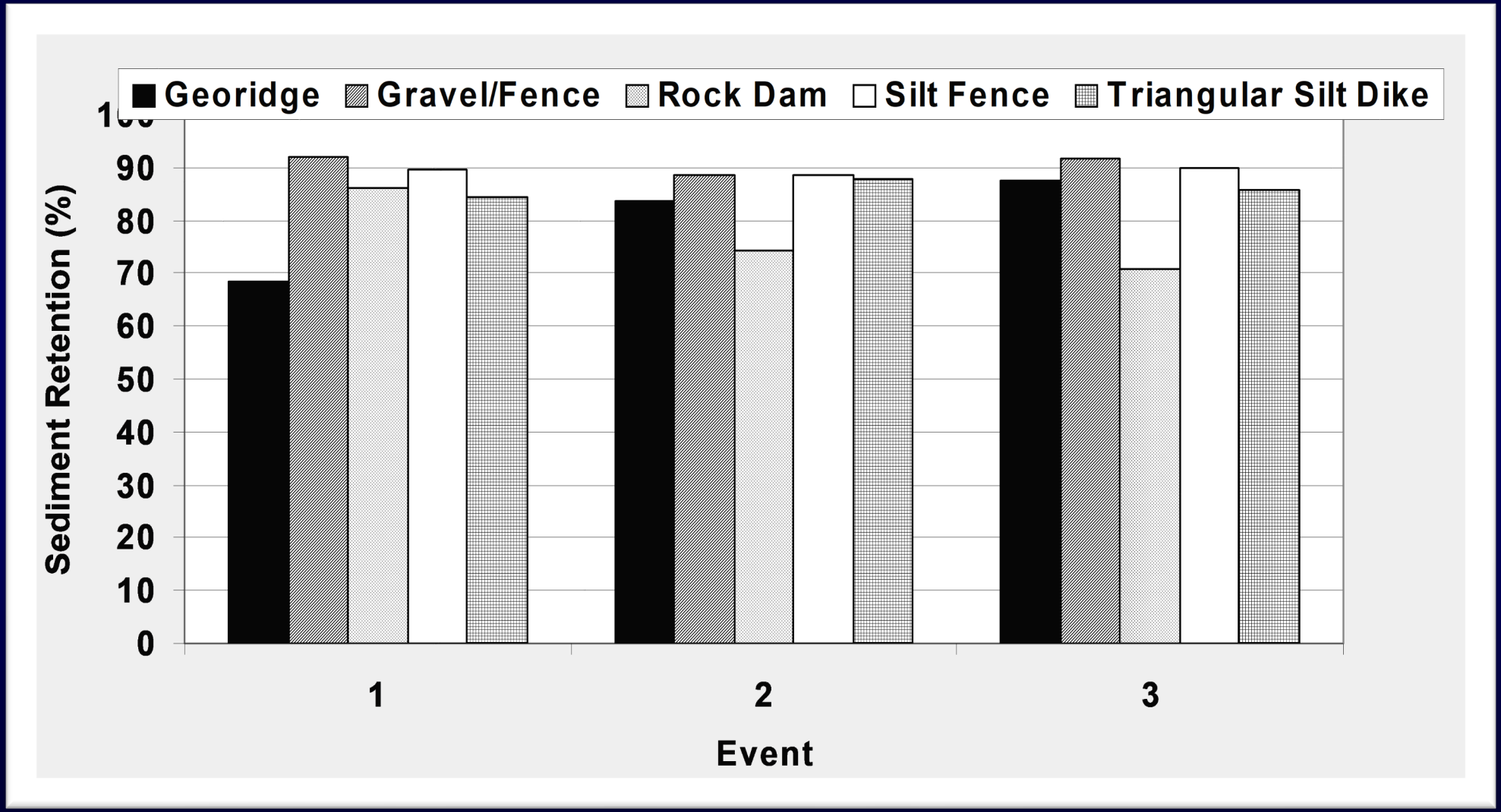
PAM=Polyacrylamide. FGM=flexible growth media. SMM=stabilized mulch matrix. BFM=bonded fiber matrix. WFM=wood fiber mulch. WCB=70:30 wood fiber/cellulose blend.

We've Got a Sediment Problem!
Typical Samples from Construction Site



Channel Grade Control: Prevent Ditch Erosion

Less Porous = Better Grade Control (sediment retention as indicator)

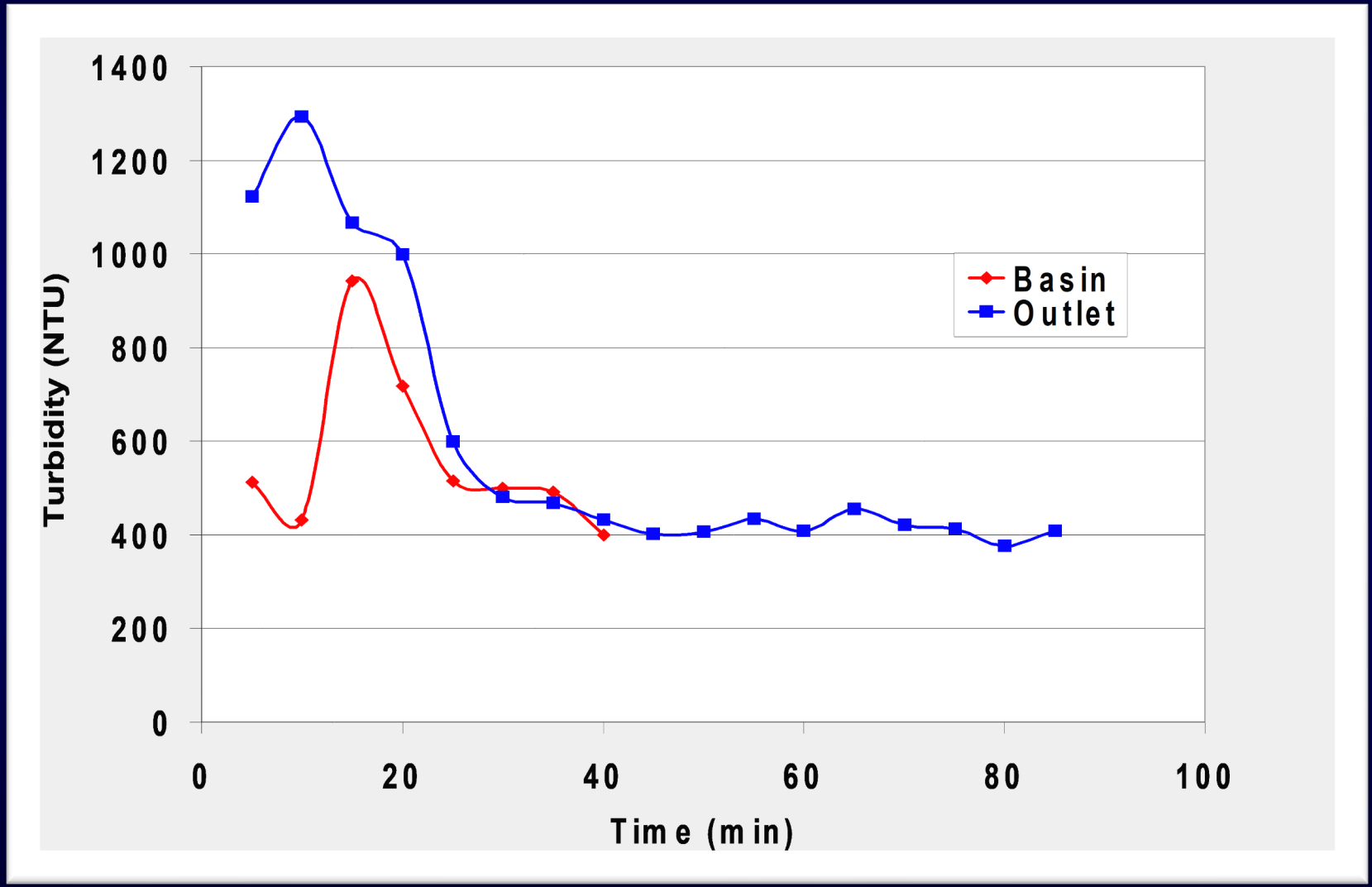


What About Those Sediment Basins?

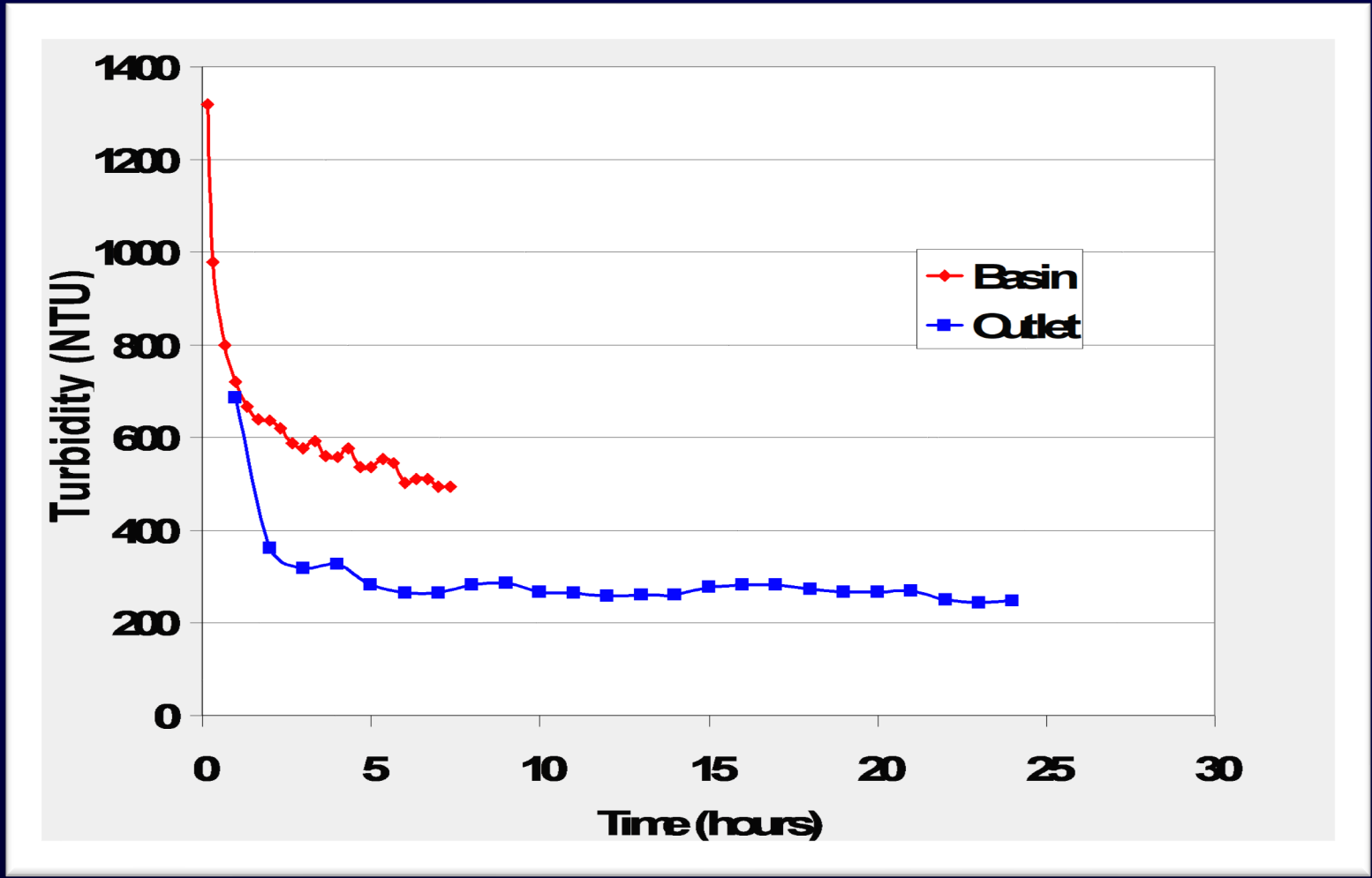
Old Way: Dig hole, rock pile at outlet

Time to do some design testing…

Rock Outlet: 50% Capture, No turbidity change

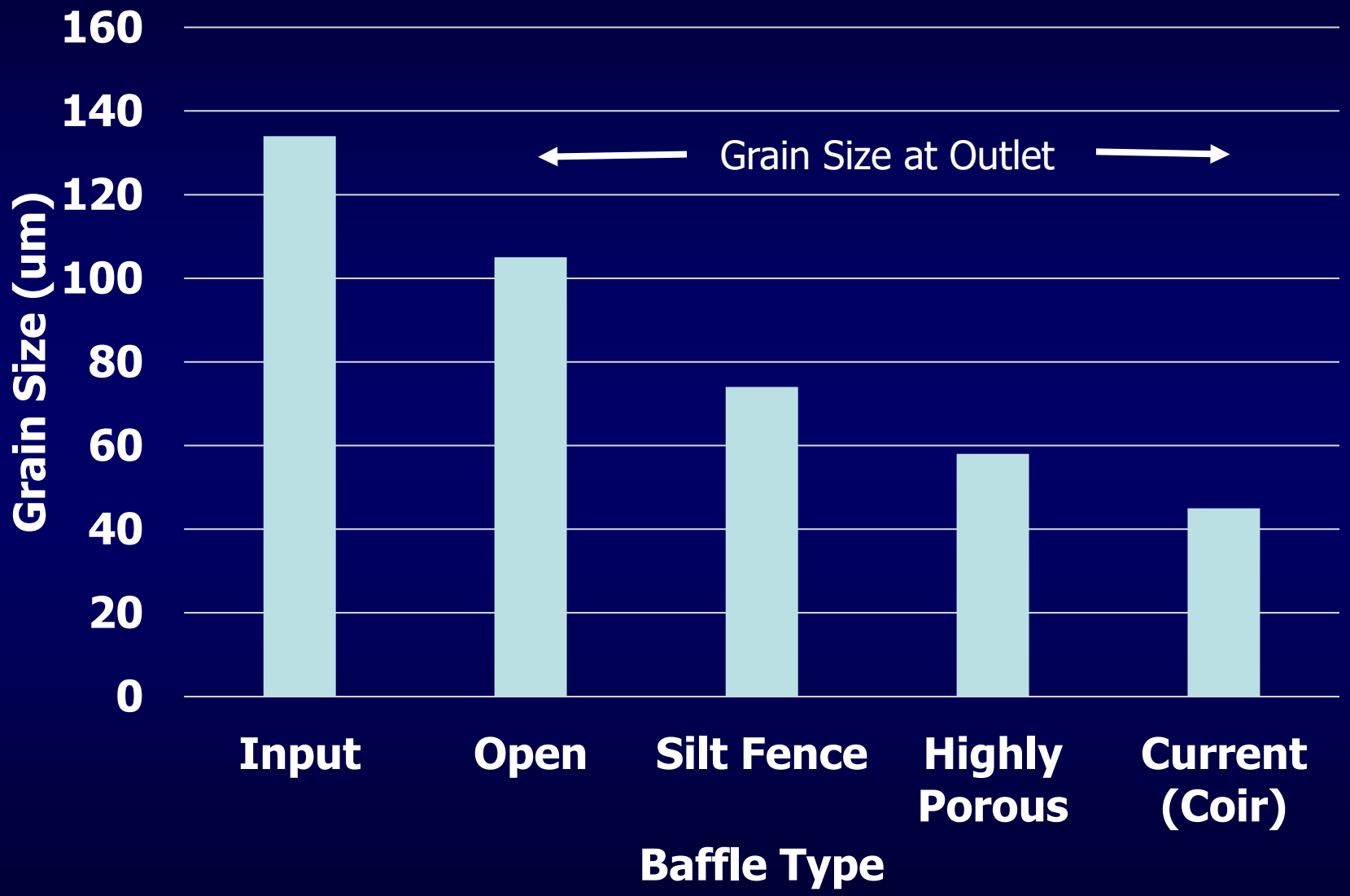


Surface Skimmer Outlet: Higher Sediment Capture, Lower Turbidity



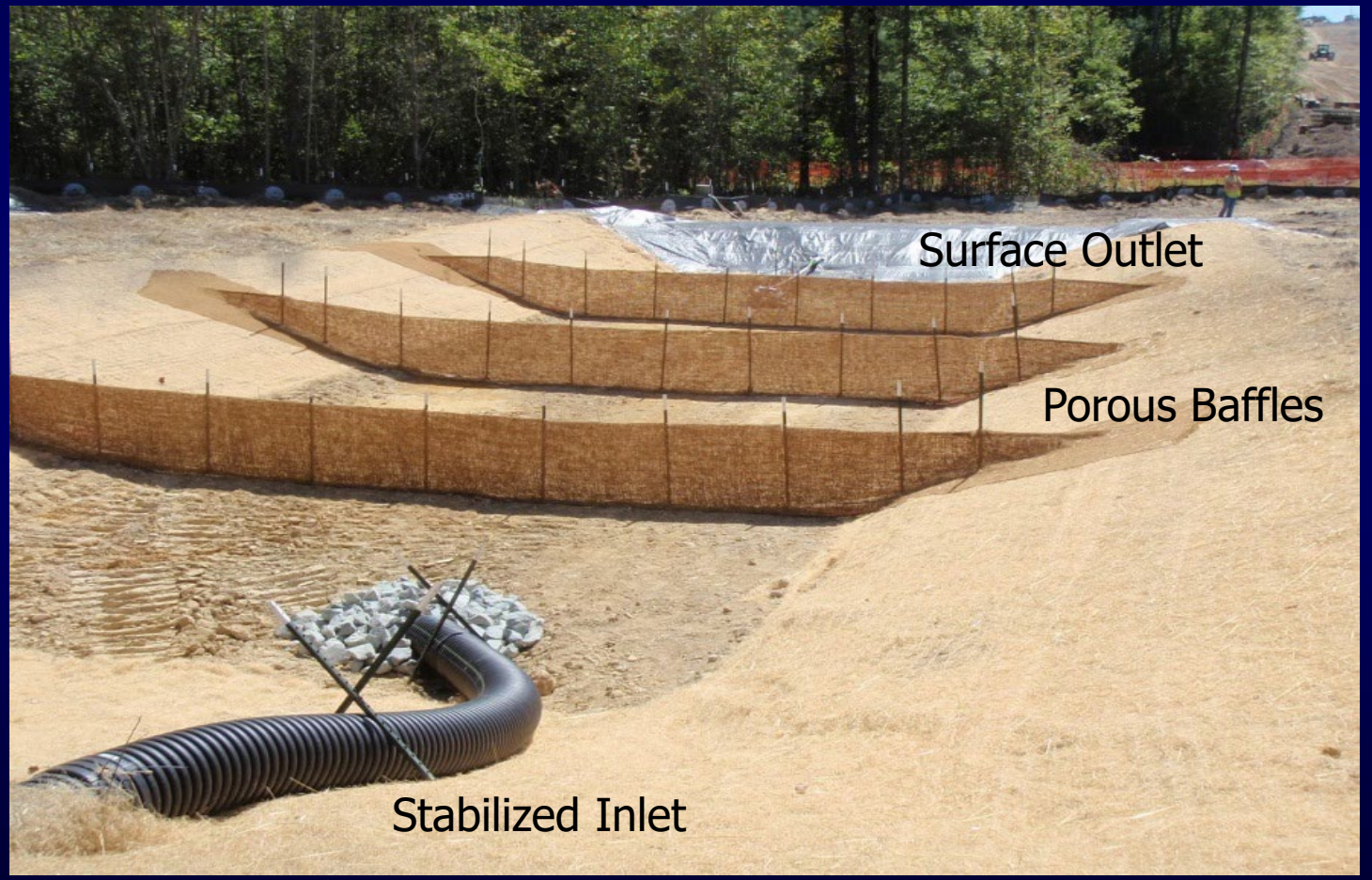
Can We Improve Basin Further: Baffle Testing

Effects of Baffles: Grain Capture Increase



Surface Outlet + Porous Baffles = >90% Capture

Finally: The Optimized Sediment Basin!

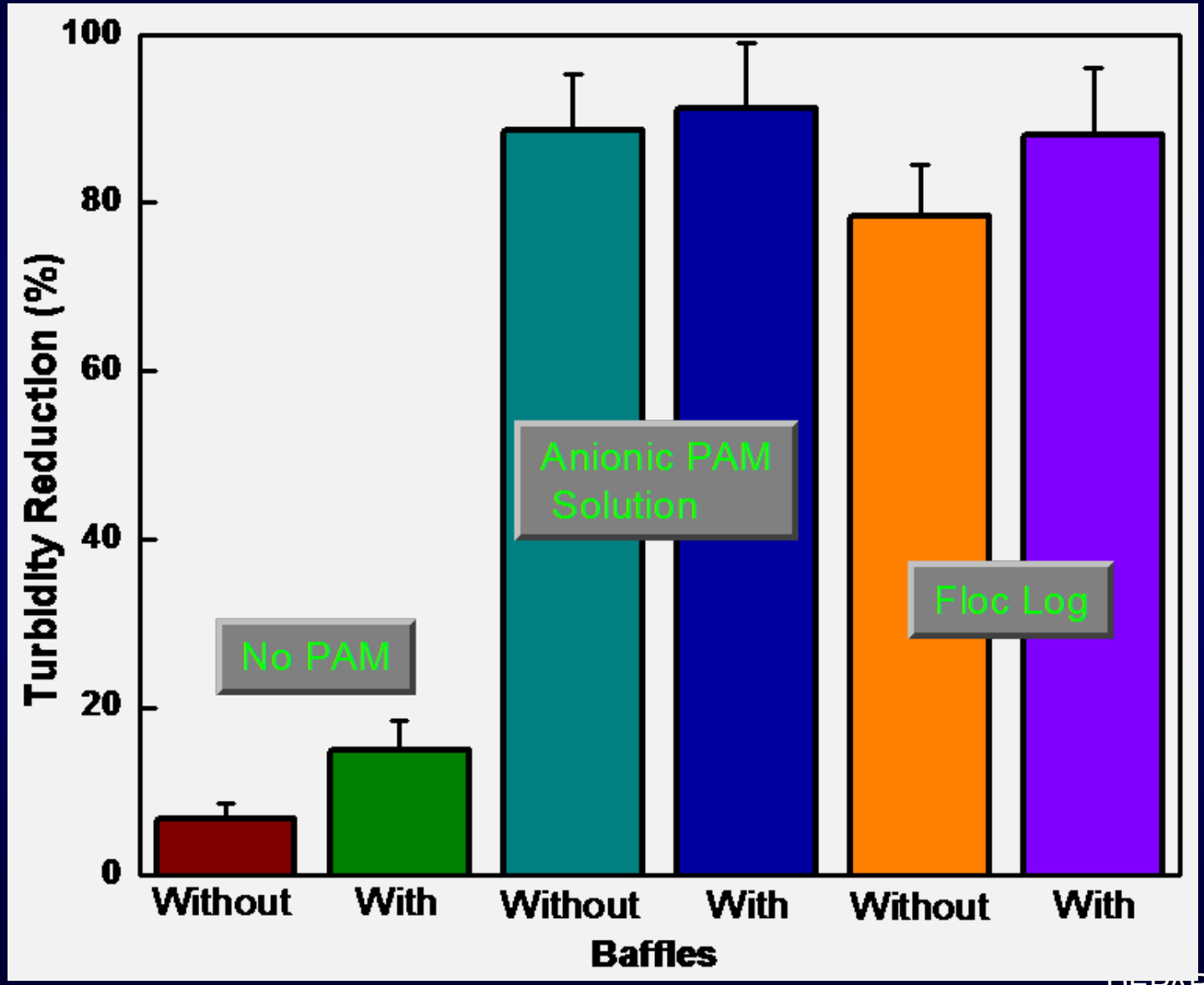


Turbidity Still a Problem…

Skimmer Outlet

Basin Design Effects with Flocculants

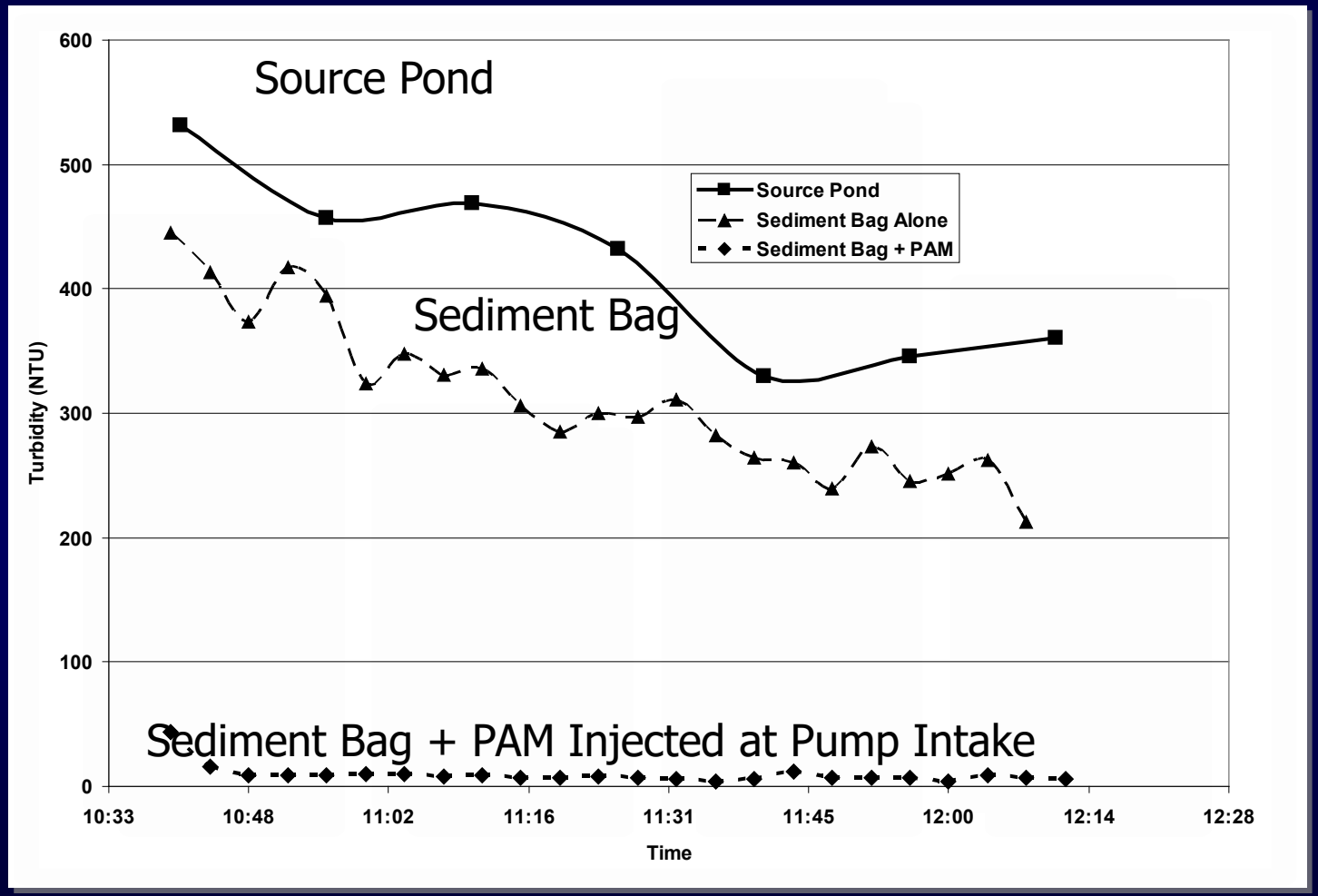
Dosing System: Solution vs. Solid Block



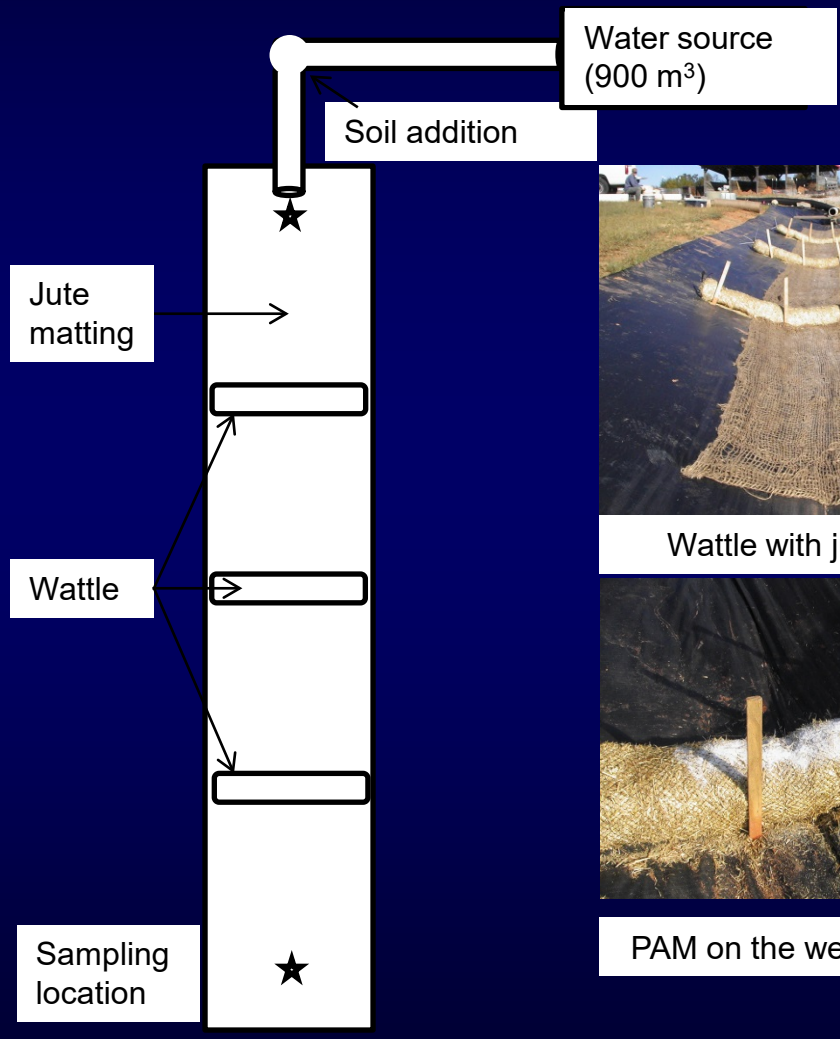
Sediment Bags and Flocculants

Can We Improve Effectiveness?

Sediment Bag and PAM



Testing Flocculation Methods



Wattle with jute matting

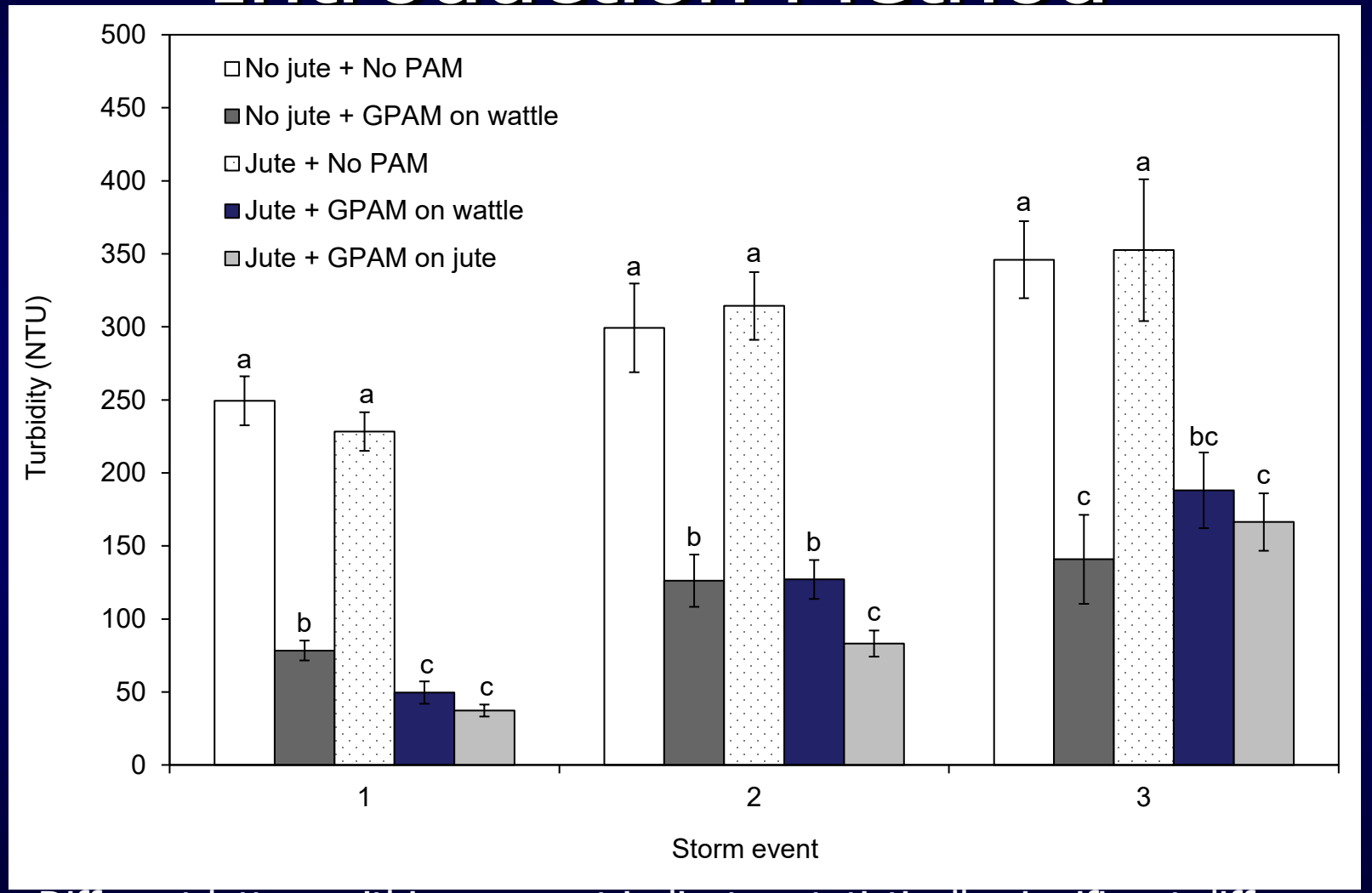
Wattle without jute matting

PAM on the weir of wattle

PAM on jute matting

Flocculant Added

Results: Turbidity Reduction Regardless of Introduction Method



Different letters within an event indicates statistically significant differences

DOT Multi-Chamber Basin to Capture Sediment and Reduce Turbidity

Lower Chamber: Turbidity Reduction

Upper Chamber: Sediment Capture

Successful Construction Site Water Quality Management

- Groundcovers reduce erosion by 90%, PAM will also reduce turbidity in runoff
- Sediment basins with stable inlets and sides, porous baffles, and surface outlets will capture 99% of sediment
- Turbidity can be controlled with proper introduction of flocculants in water conveyance systems

Thanks…

- Technicians, graduate and undergraduate students, post-docs for getting the research done!
- NCDOT field staff for getting us sites to do the testing
- NCDOT, NC Clean Water Management Trust Fund, and USDA NIFA for funding.

Contact: Rich McLaughlin (rich_mclaughlin@ncsu.edu)

Using Compost Post-Construction to Improve Soil Hydraulic Properties and Manage Nutrient Export

Christina N. Kranz
cnkranz@ncsu.edu

North Carolina Department of Transportation

NCDOT Highway Stormwater Program

NC STATE UNIVERSITY

Problems After Roadway Construction:

- Reduced infiltration
- Increased runoff
- Poor vegetation establishment, erosion, and reduced water quality

POTENTIAL BENEFITS OF COMPOST INCORPORATION:

- Increased water infiltration rate
- Increased water retention
- Increased vegetation establishment
- Low cost alternative to built structures

Limited work on optimum rate and depth of compost application for stormwater infiltration

STUDY OBJECTIVE: *determine effects of compost rate + level of compaction on infiltration*

Highly compacted

0% 10% 20% 30% 40% 50%

Medium

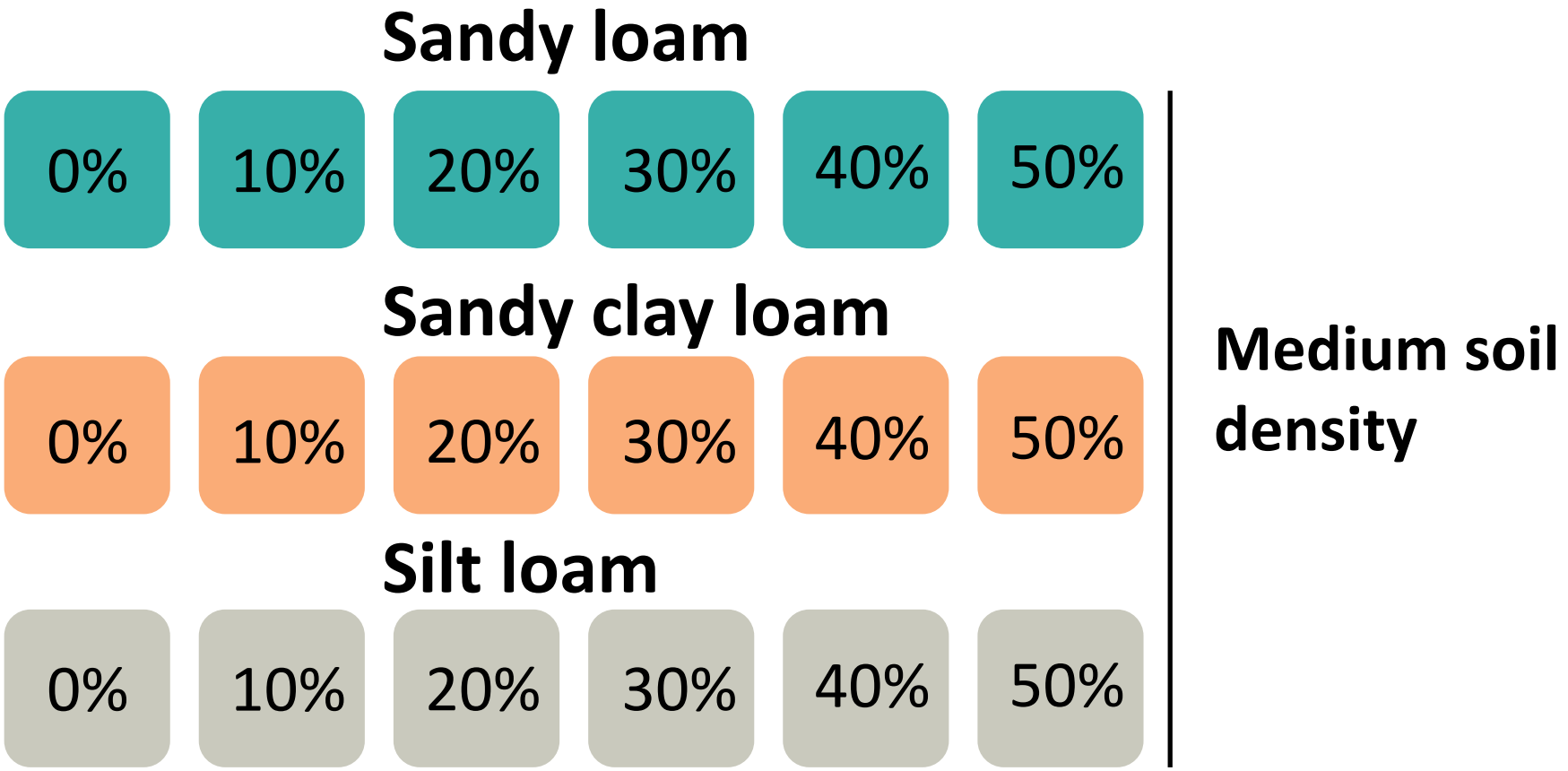
0% 10% 20% 30% 40% 50%

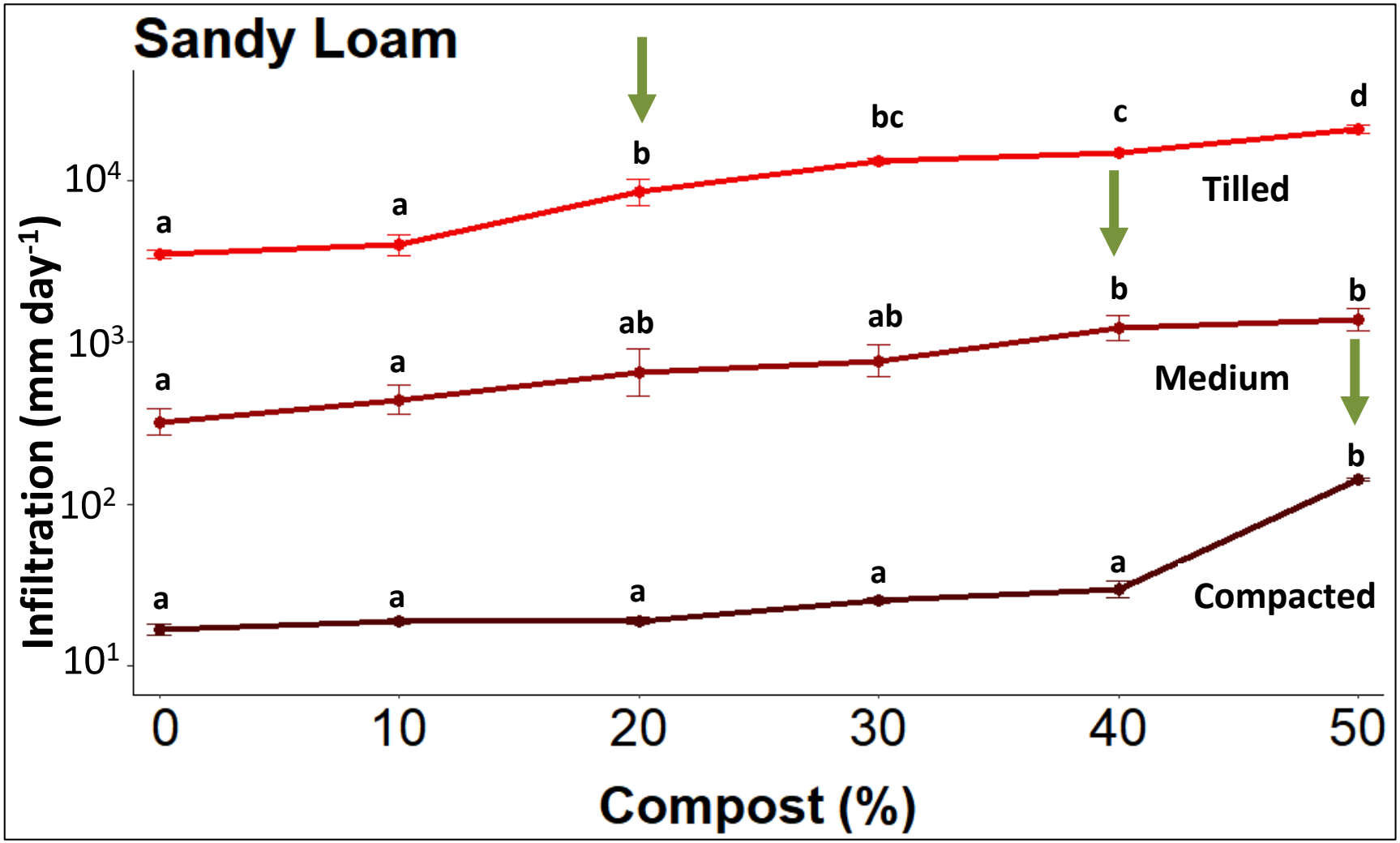
Tilled

0% 10% 20% 30% 40% 50%

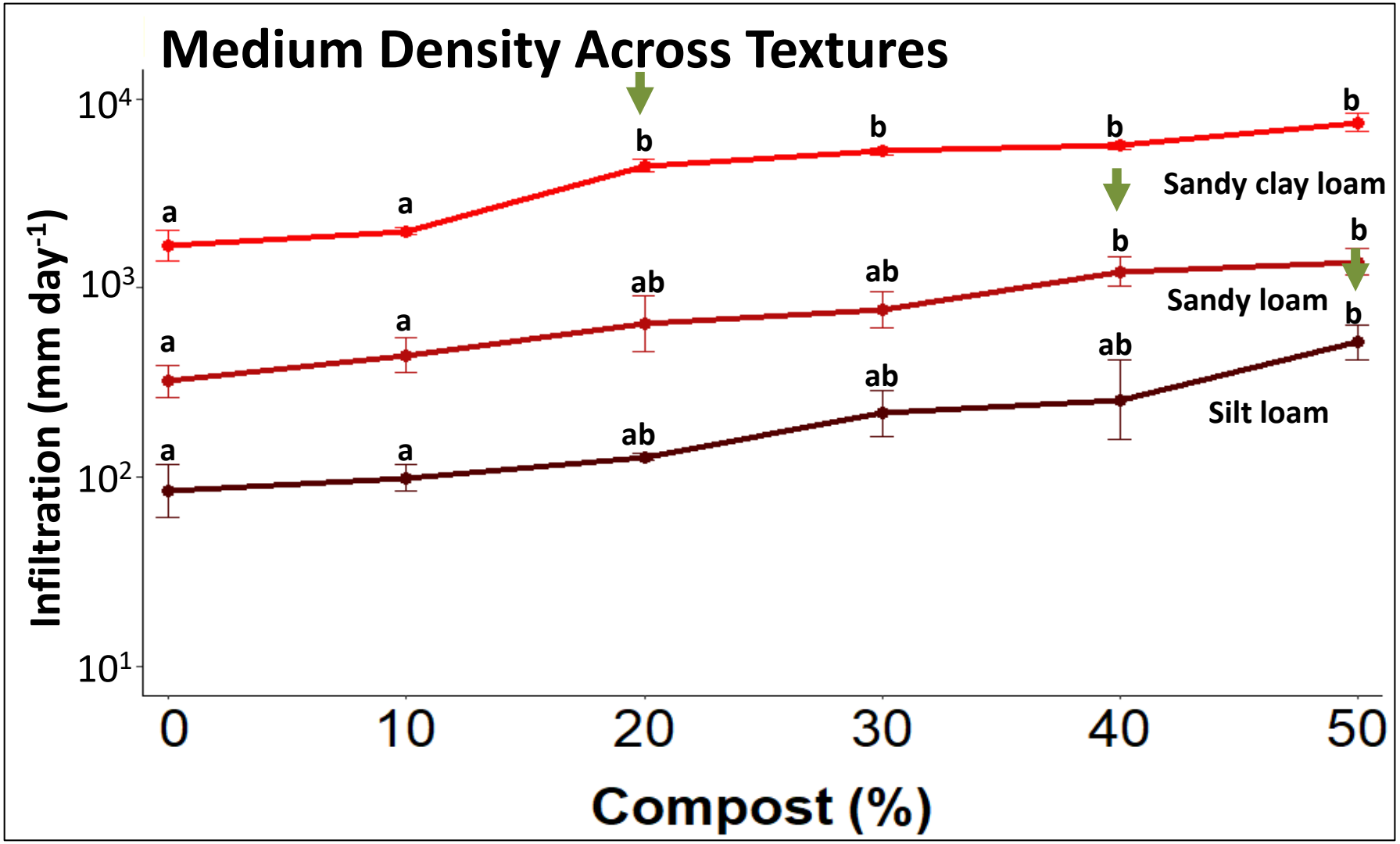
Sandy loam

STUDY OBJECTIVE: *determine effects of compost + soil texture on infiltration*





If the soil becomes compacted even at high rates of compost, the benefit of compost for increased infiltration is lost.



Soil texture alters rate of compost application needed to significantly increase infiltration in the soil.

STUDY TAKEAWAYS:

- Sandy soils need less compost to improve infiltration
- **Don't compact the soil after compost application**

LEACHING STUDY OBJECTIVE: *determine nutrient and heavy metal retention vs. losses from stormwater*

High flow rate

1.75 mL min^{-1}

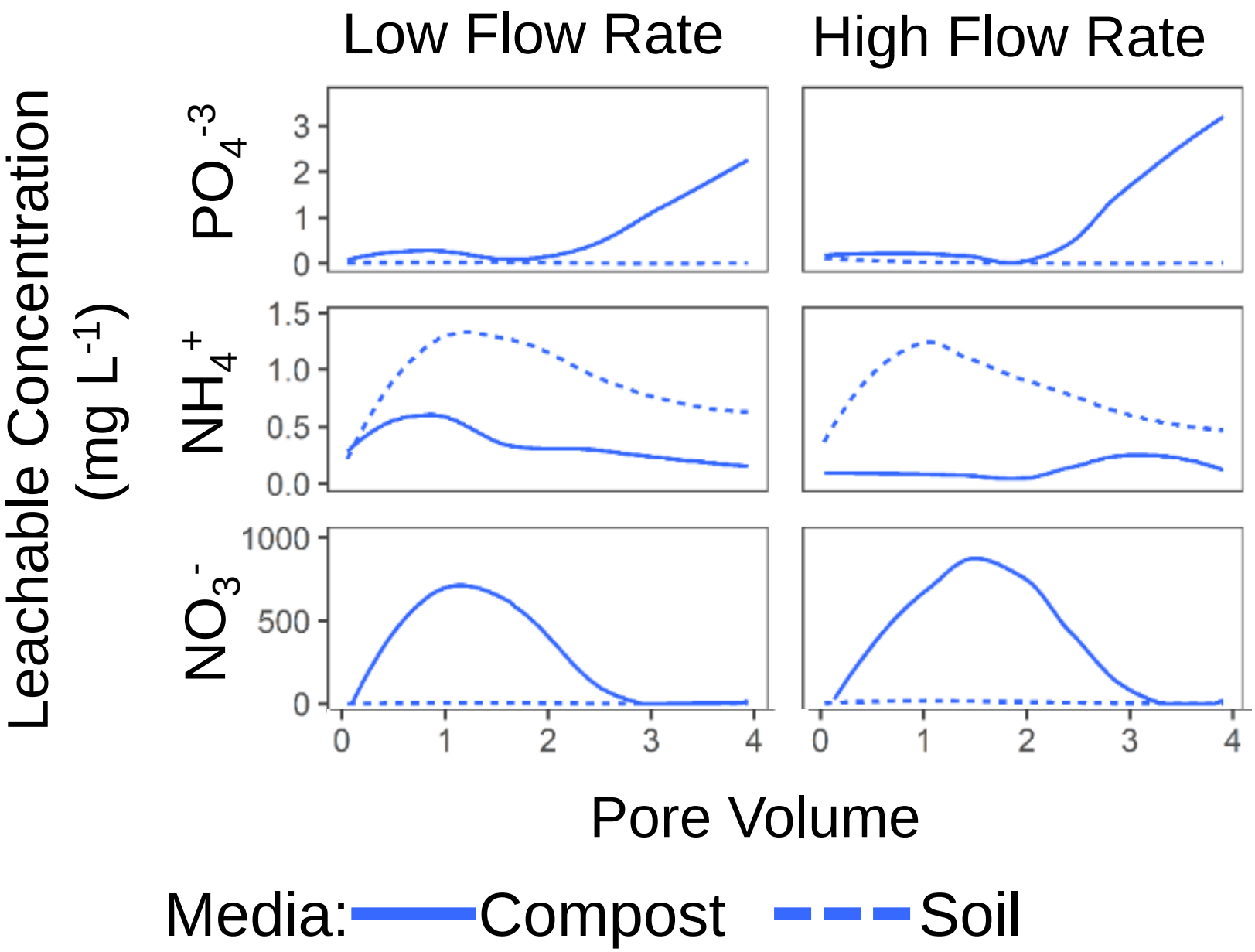
Soil Com

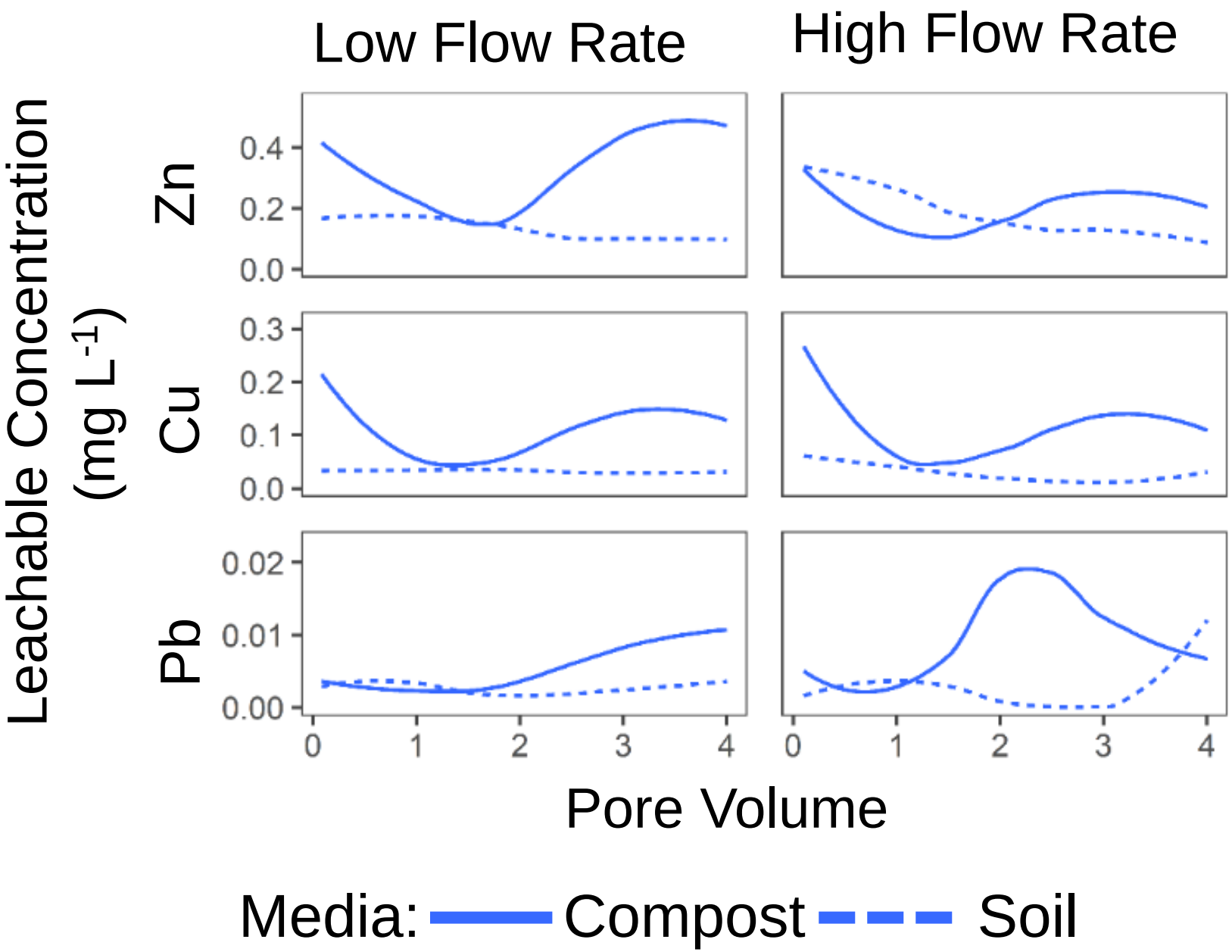
Low flow rate

0.18 mL min^{-1}

Soil Com

Nitrate, ammonium, phosphate, copper lead, zinc


Low Flow Rate
High Flow Rate
Leachable Concentration (mg L-1)
PO4-3
NH4+
NO3-
3
2
1
0
1.5
1.0
0.5
0.0
1000
500
0
0
1
2
3
4
Pore Volume
Media:
Compost
Soil


Low Flow Rate
High Flow Rate
Leachable Concentration (mg L-1)
Zn
Cu
Pb
0.4
0.2
0.0
0.3
0.2
0.1
0.0
0.02
0.01
0.00
0
1
2
3
4
Pore Volume
Media:
Compost
Soil

STUDY TAKEAWAYS:

- Constituents leach from the system at the same volume for both flow rates
- Faster flow rate exported more nutrients, except for the soil phosphate
- Flow rate may play an important role in the second flush

Acknowledgements

- North Carolina Department of Transportation
- Josh Heitman, Rich McLaughin, Amy Johnson, Grady Miller
- Erin Rivers, Adam Howard, Jamie Luther, Chris Niewoehner, Aziz Amoozegar