



Preferential Flow and P Transport

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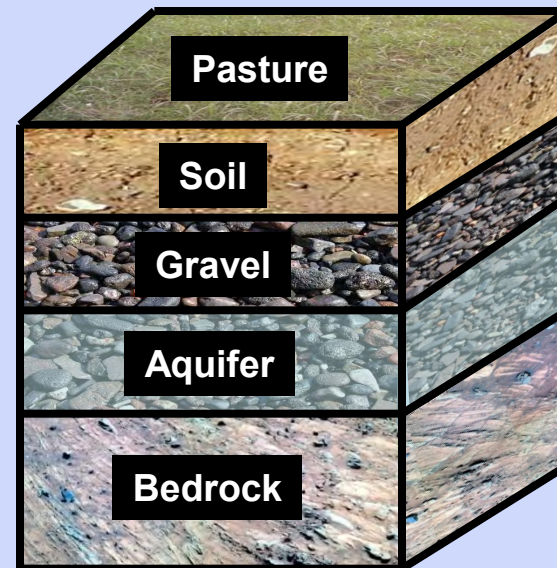
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Streambank Seeps from Preferential Flow Pathways in Alluvial Floodplains

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Associate Professor

Biosystems and Agricultural Engineering





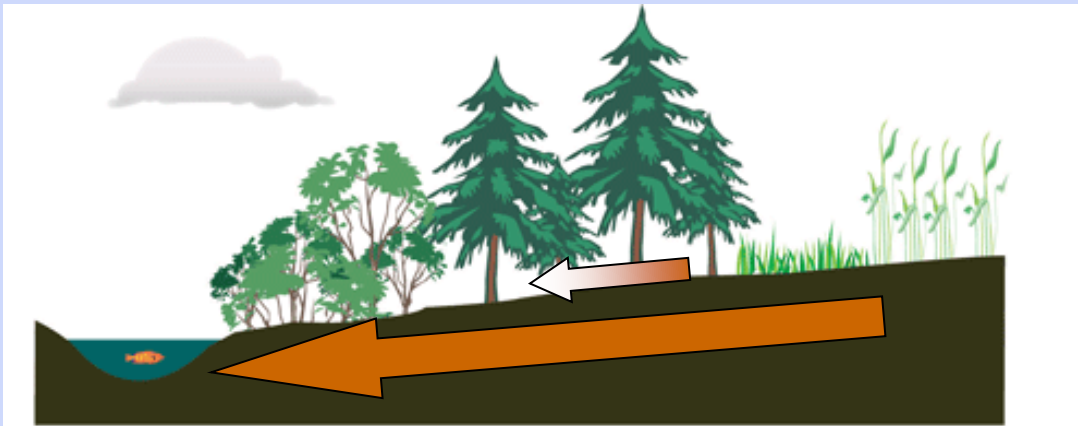
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Introduction

- Preferential Flow Paths (PFPs)
 - Subsurface transport
 - Bypass buffer strips
 - Excess P \rightarrow eutrophication





Ozark Geology

- Acidic erosion of limestone:
 - Caves, sinkholes, losing streams
 - Residuum of chert gravel



Honey Creek gravel bar



Coarse chert gravel



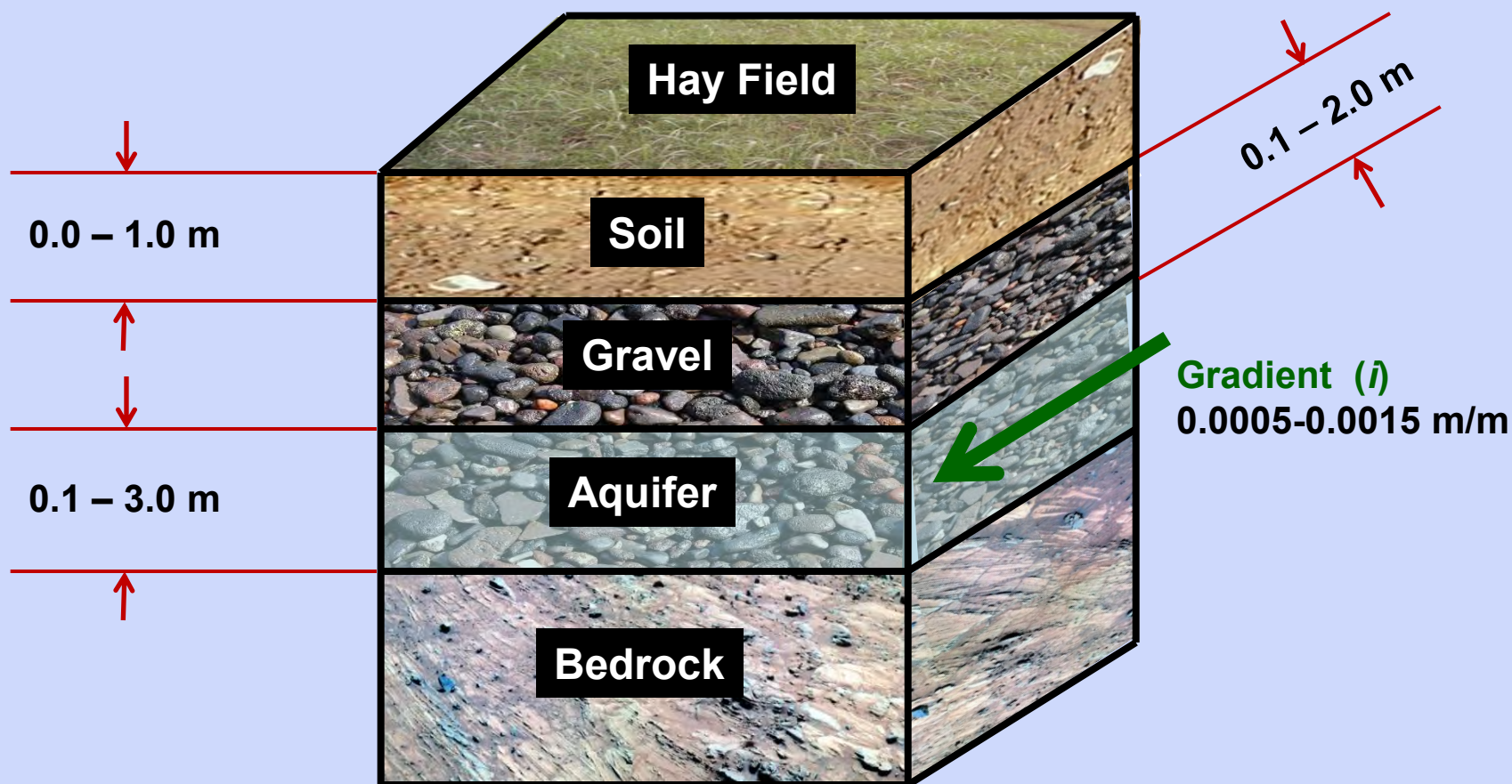
Barren Fork streambank: topsoil / gravel



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Typical Soil Profile for Floodplain Sites





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Trench Experiments

- Injection Tests
 - Rhodamine WT
 - P solution (KH_2PO_4)
- Demonstrated preferential movement of Rhodamine WT and P



Rhodamine injection into trench



Observation well sampling during tracer/P injection



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PFP Mapping

- Where are the PFPs?
- What are they?



Barren Fork study site



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Geophysical Mapping



Geometrics OhmMapper

- Lower precision
- High volume, mobile imaging
- ~40 m instrument length

AGI SuperSting (ERI)

- High Precision
- Time intensive, stationary imaging
- Variable electrode spacing





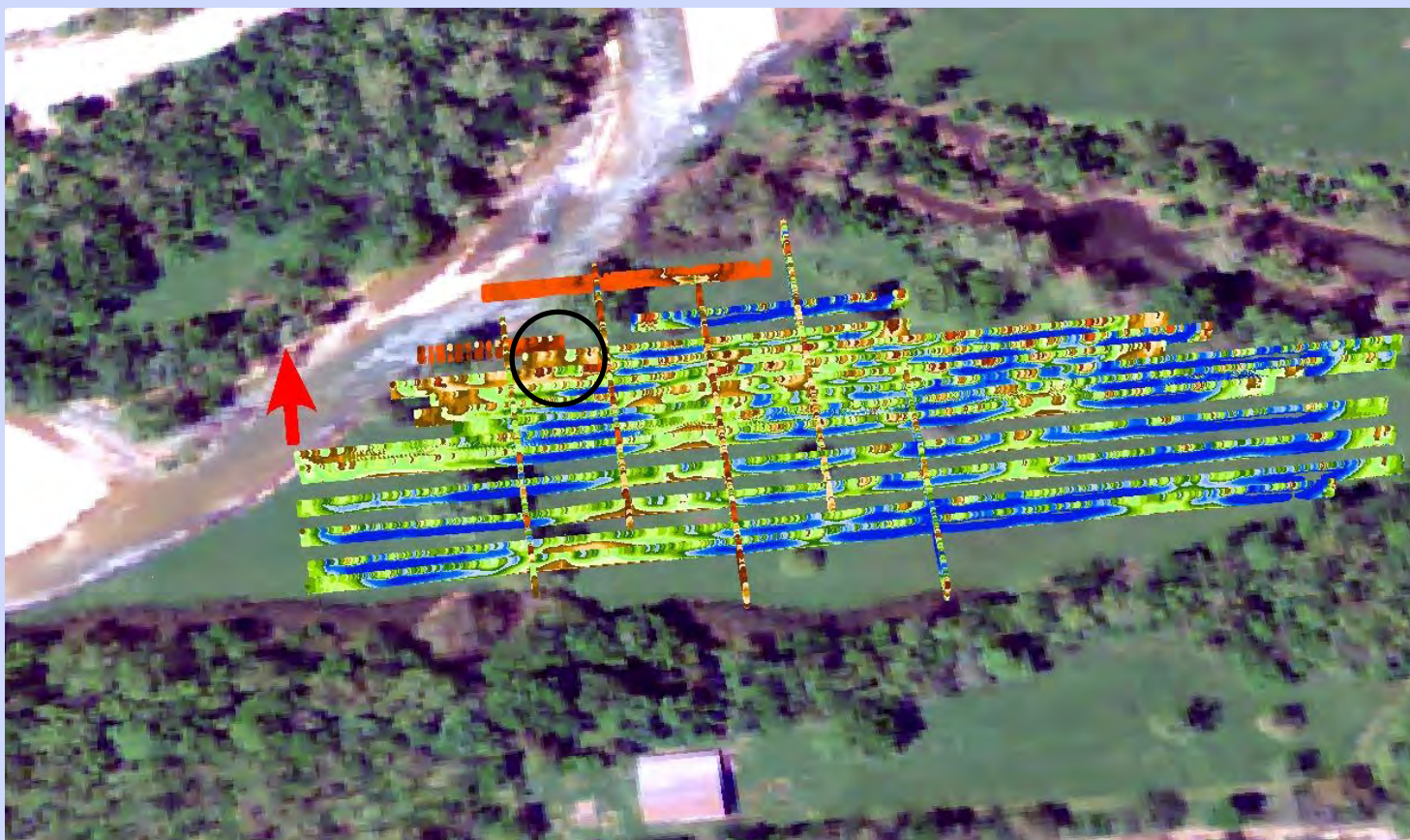
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Geophysical Mapping

- Texture of high and low resistivity suggests old channels
- PFP wells installed in area of high resistivity



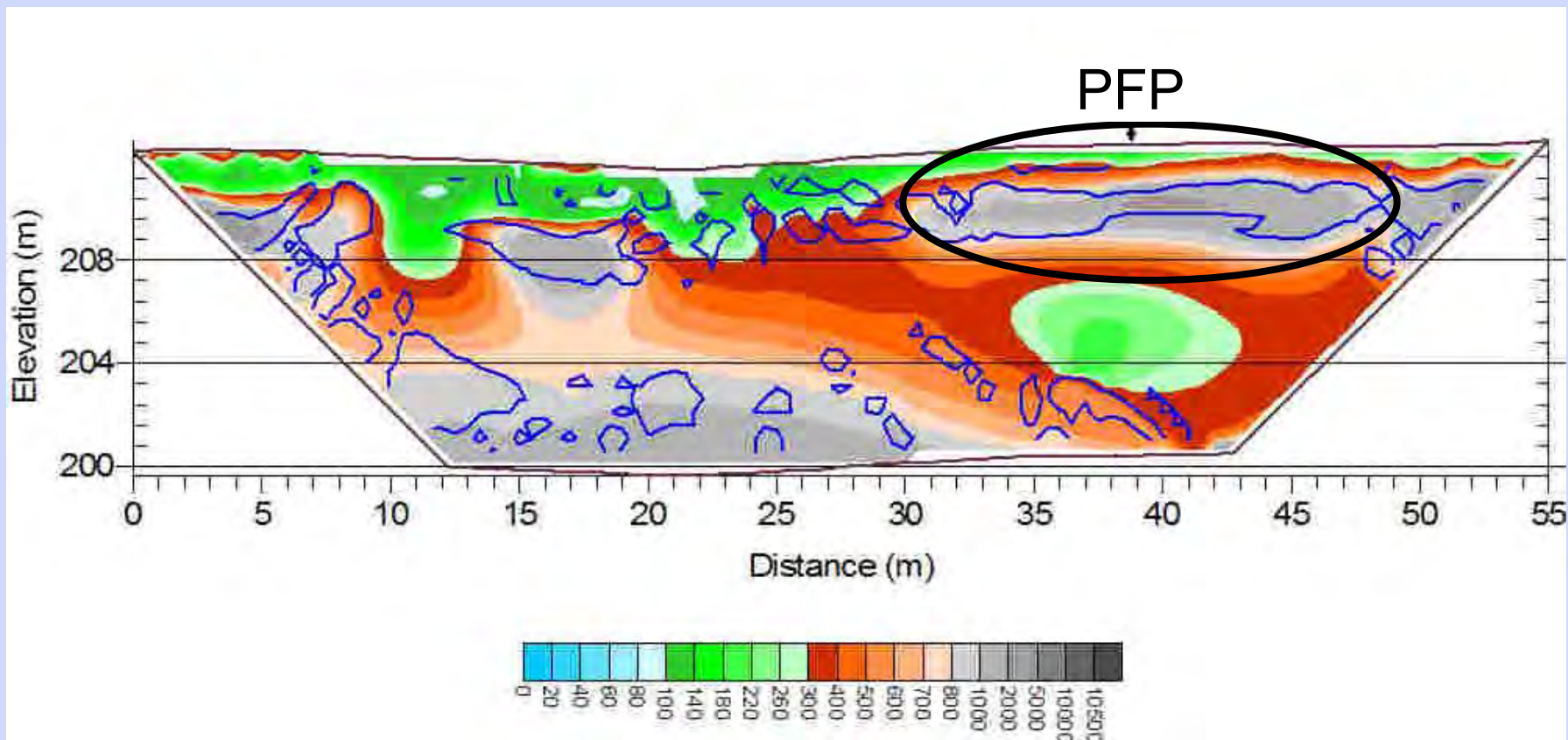


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P Transport Rate in PFP



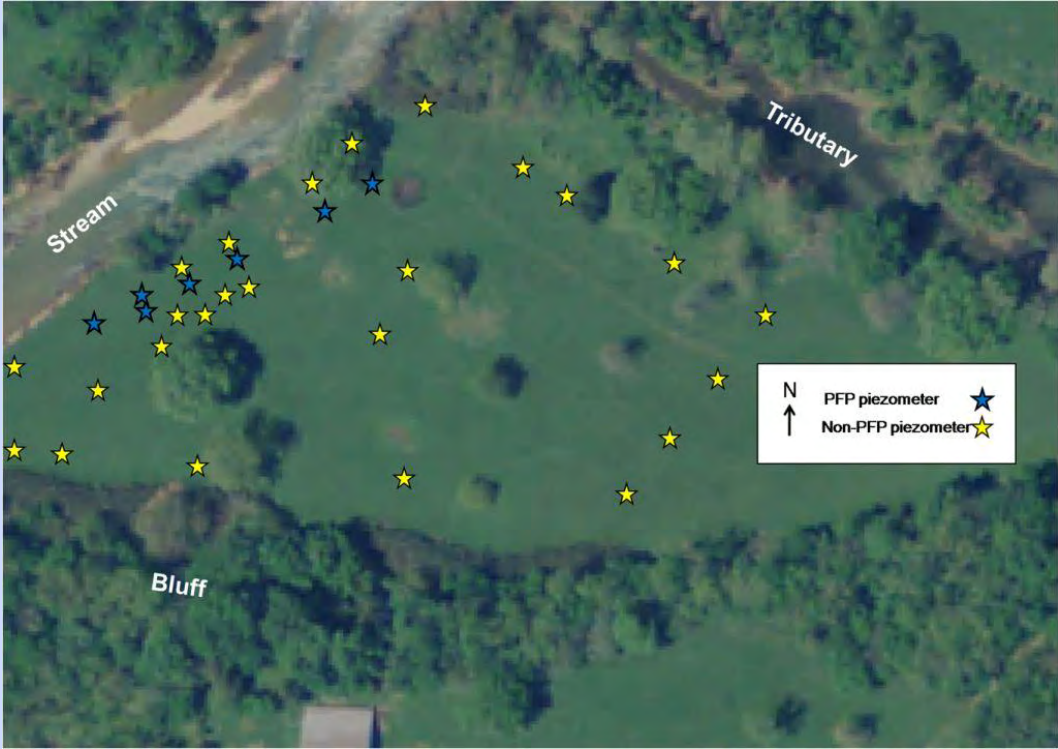


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Observation Well Networks

- Barren Fork Site:



- Each observation well instrumented with a data logger:
 - Water level and temperature data every 5 minutes

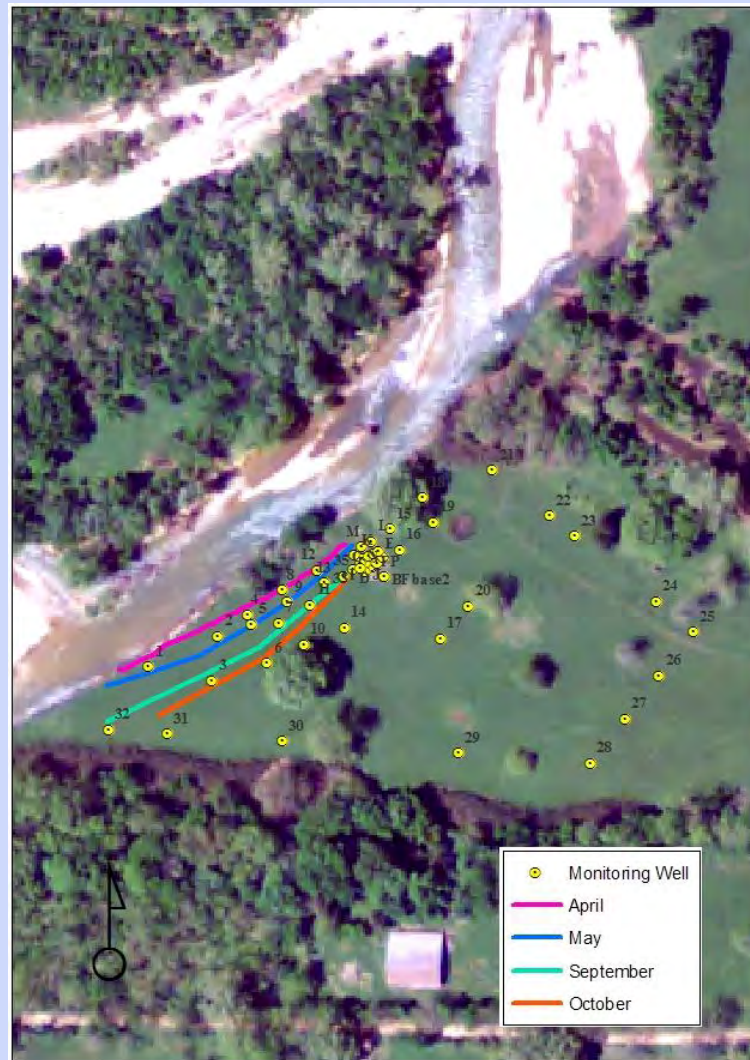


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Research Limitation:

Have you seen my well?



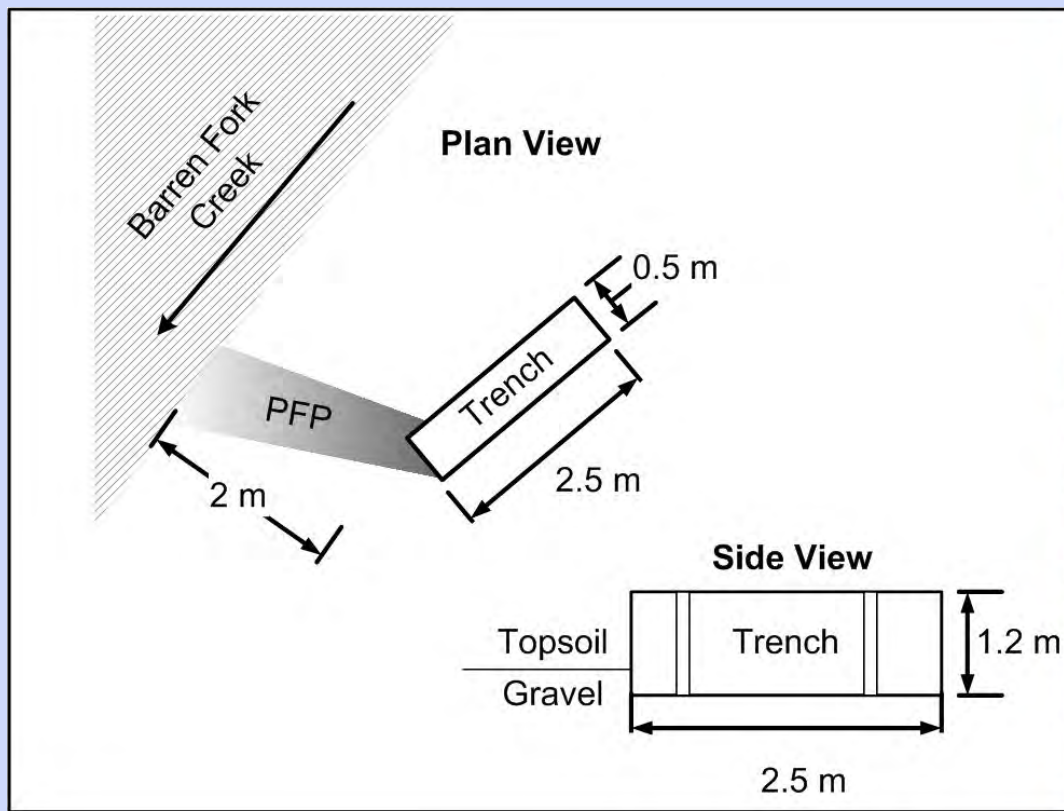


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A new opportunity!

Tracer Injection Tests and Seep Observations

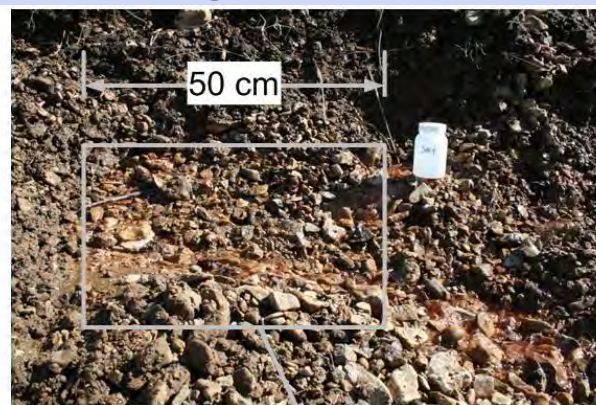




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Streambank Seepage



Streambank Seep Emerging from Bank and Entering the Barren Fork Creek

Observation Wells Approximately 2.0 m from the Trench

Clean, Coarse Gravel of Seep Surrounded by Gravel with Finer Particles





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Streambank Seepage

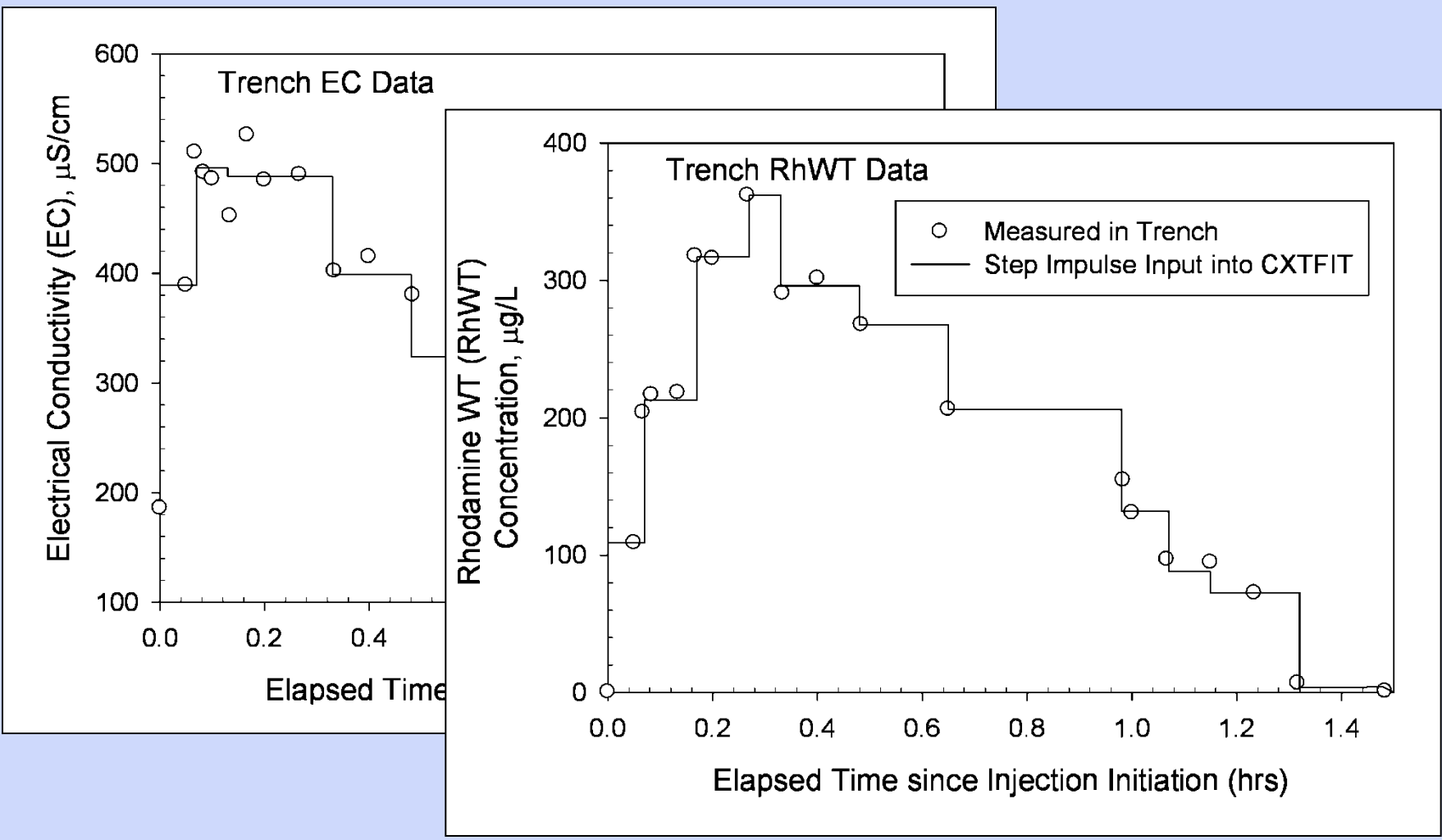




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Trench Solution



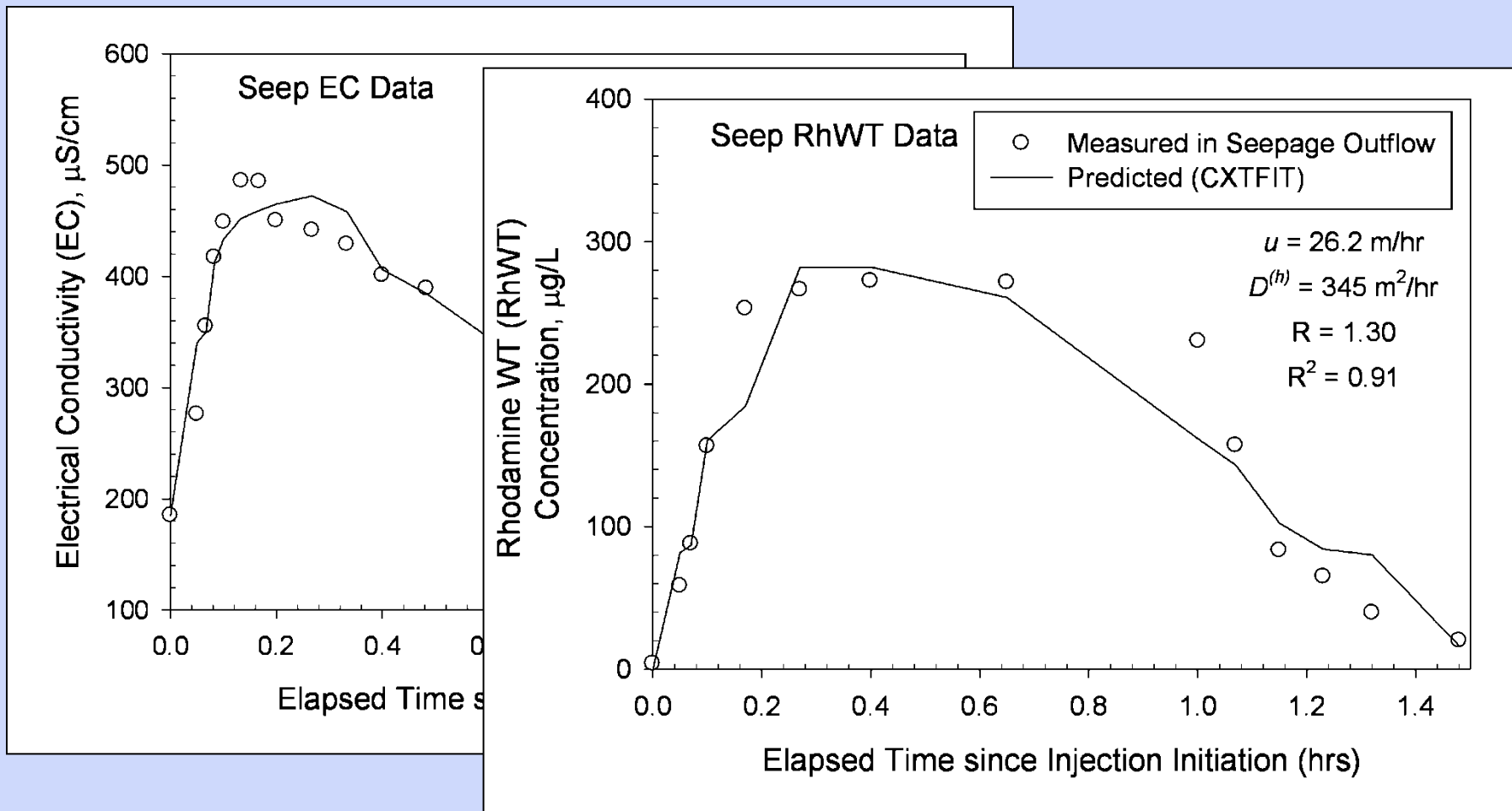


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Streambank Seepage





P Transport Rates

- Subsurface P Transport Rate (kg/yr)

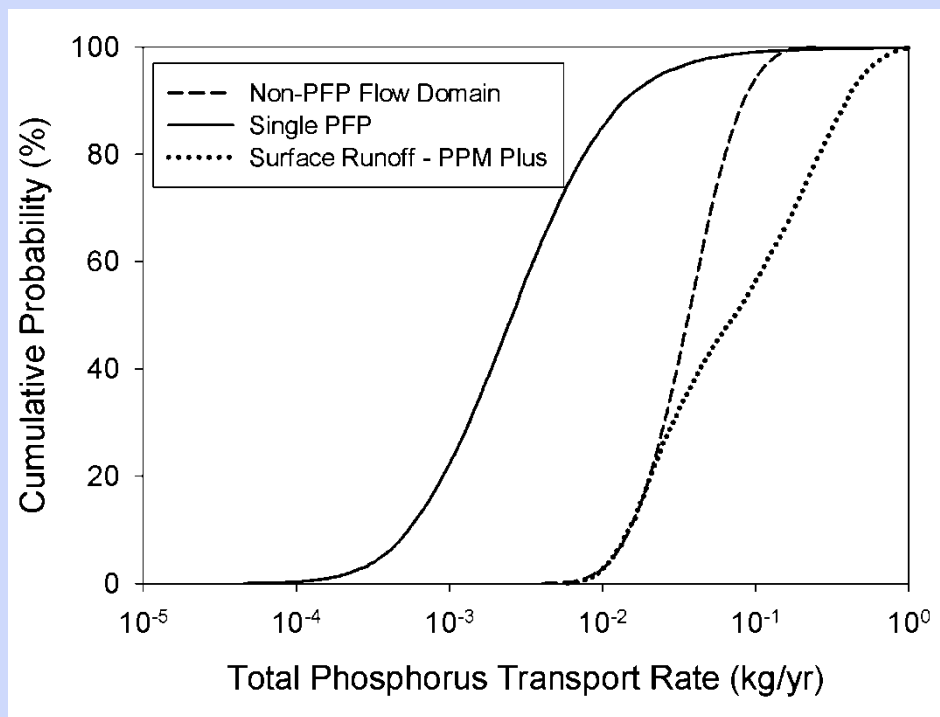
$$m_P = Q \times TP \times n_d$$

- Single PFP and non-PFP domain
- Monty Carlo analysis
 - Uncertainty in input parameters
- Surface P Transport Rate (kg/yr)
 - Surface runoff
 - PPM Plus (based on SWAT)
 - STP, slope, agricultural management



Subsurface v. Surface P

- From well managed (low STP), small (3 ha) floodplain sites...
 - Subsurface transport rates on the order of 0.05 kg/yr
 - Surface transport rates of 0.07 kg/yr





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Conclusions

- PFPs connected to stream:
 - Rapid transport of highly sorbing contaminant
 - P concentration in PFP mimicked P concentration in stream
- Subsurface P Load:
 - Significant compared to surface runoff P
- Floodplain management:
 - May require higher level of stewardship than upland areas
- Future Work:
 - P leaching through topsoil - USGS 104g Nationally-Competitive Grant



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USGS 104(g) Nationally-Competitive Grant



Research Website:

<http://biosystems.okstate.edu/Home/gareyf/AlluvialPTransport.htm>