Quantifying the Importance of Subsurface Flow Induced Erosion on Sediment Load to Streams

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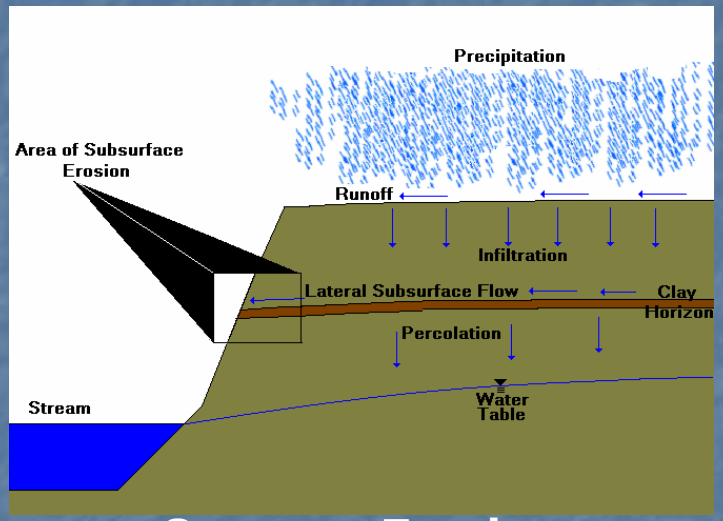
Introduction

- As much as 85% of sediment load in some watersheds is from the streambank
- Erosion primarily considered by fluvial/pore-water pressure mechanisms
- What potential role does subsurface flow play in this erosion process?



Seepage Erosion Conditions

Incised Stream in Mississippi

Seepage Erosion due to Lateral Ground Water Flow

Objectives

- Quantify soil/hydraulic properties, seepage flow, and seepage erosion at two field sites
- Simulate seepage erosion in the laboratory using two-dimensional soil lysimeters
  - Develop seepage erosion sediment transport model
- Develop integrated bank stability/riparian ground water flow model for predicting pore water pressure and seepage erosion

Bank Face after Collapse due to Seepage Erosion

Seepage Erosion - Little Topashaw Creek

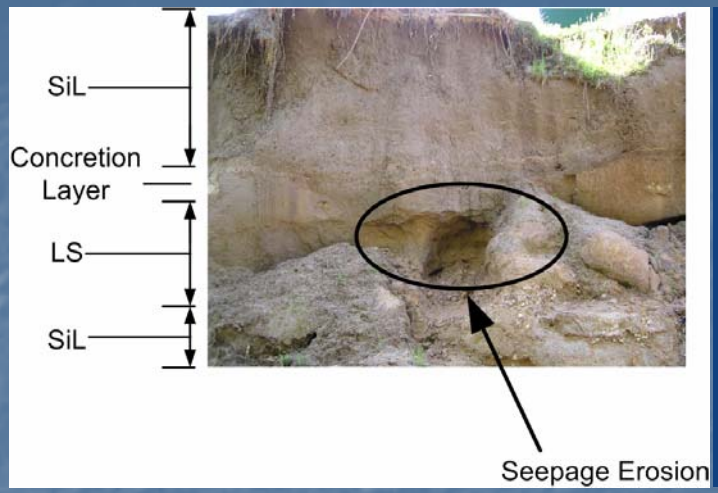
Bank failures from seepage erosion

Consolidated slump material

Seepage Flow / Sediment Measurements with Lateral Flow Collection Pans

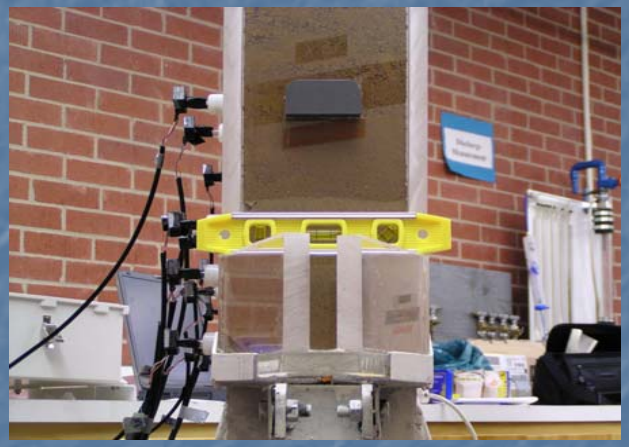
Wilson, G.V., R. Periketi, G.A. Fox, S. Dabney, D. Shields, and R.F. Cullum. 2007. Seepage erosion properties contributing to streambank failure. *Earth Surface Processes and Landforms* 32(3): 447-459.

Seepage Erosion – Goodwin Creek



Fox, G.A., G.V. Wilson, A. Simon, E. Langendoen, O. Akay, and J.W. Fuchs. 2007. Measuring streambank erosion due to ground water seepage: Correlation to bank pore water pressure, precipitation, and stream stage. *Earth Surface Processes and Landforms* 32(10): 1558-1573.

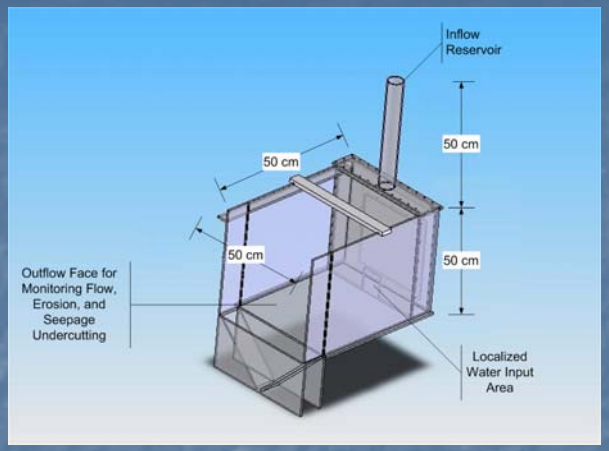
2-D Lysimeter Experiments

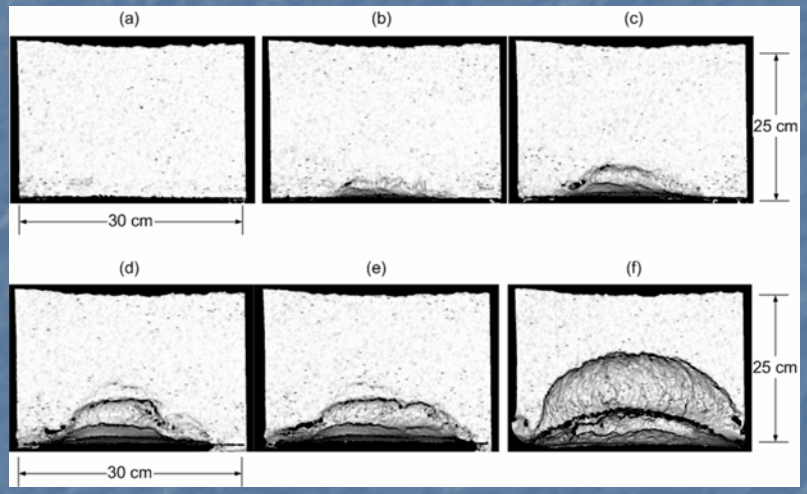


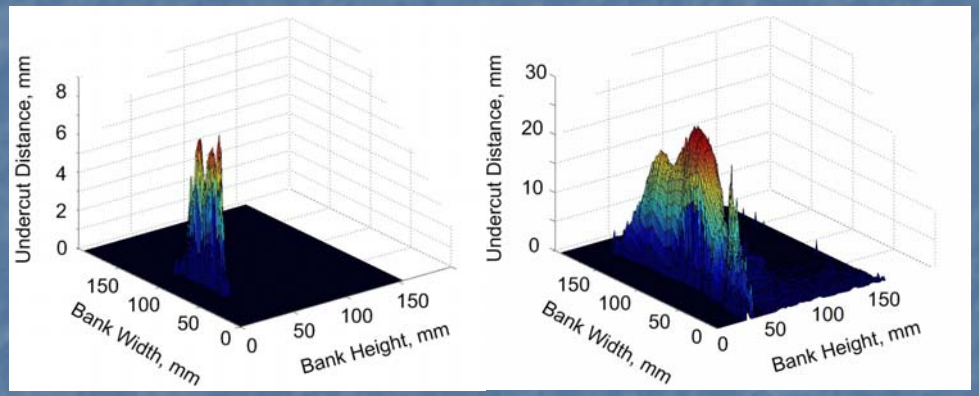
Fox, G.A., G.V. Wilson, R.K. Periketi and B.F. Cullum. 2006. A sediment transport model for seepage erosion of streambanks. *Journal of Hydrologic Engineering – ASCE* 11(6):603-611.

Fox, G.A., M. Chu-Agor, and G.V. Wilson. 2007. Erosion of Noncohesive Sediment by Groundwater Seepage Flow: Experiments and Numerical Modeling. *Soil Science Society of America Journal* 71(6): 1822-1830.

More Advanced 3-D Soil Block



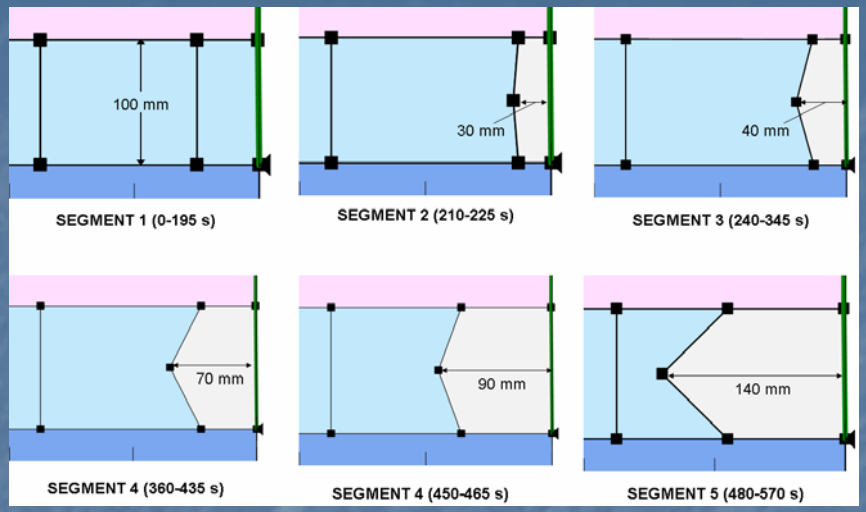




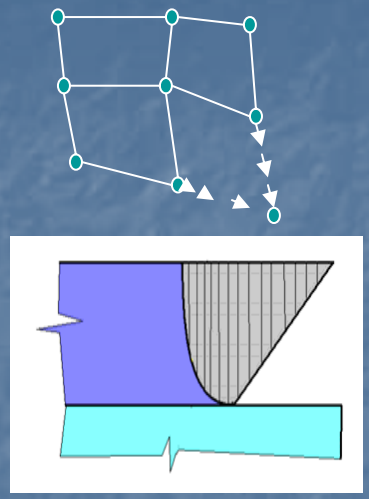
3-d Seepage Headcuts from the Digital Scanner

Agor, M.L., R. Cancienne, G.A. Fox, and G.V. Wilson. Seepage Mechanisms of hillslope, gully and bank failure: Tension failure and three-dimensional seepage erosion. In Review.

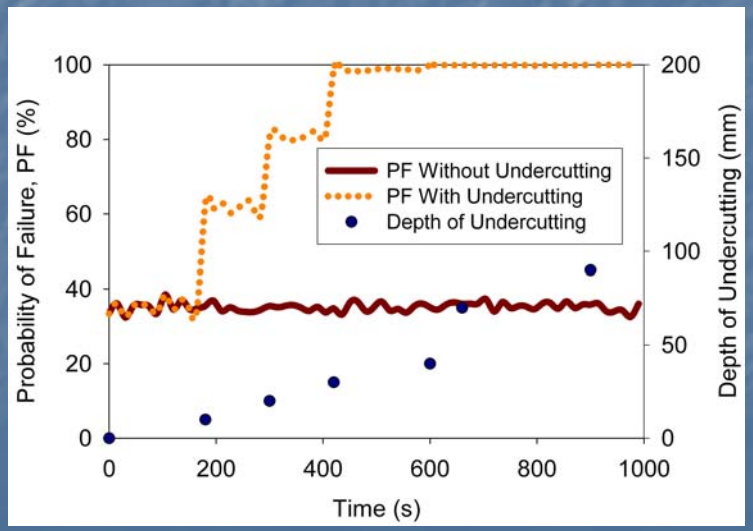
Integrated Stability/Flow Modeling



Measured Seepage Headcuts from Lysimeter Experiments



Adjustments to Numerical Models



Probability of Failure With and Without Seepage Undercutting

Chu-Agor, M., G.V. Wilson, and G.A. Fox. Numerical modeling of bank instability by seepage erosion undercutting of layered streambanks. In Review.

Impacts/Outcomes

- Journal Manuscripts:
  - Five (5) currently published in peer-reviewed journals
  - Two (2) in review
  - One (1) manuscript selected for “Promotion of Published Science”
  - One (1) manuscript awarded the 2007 ASABE Graduate Student Paper Competition Winner
- Student Education:
  - Three graduate students (2 Ph.D., 1 M.S.)
  - Two undergraduate research assistants
- Deliverable Product:

  An integrated bank stability/riparian ground water modeling package that will serve as a critical tool for stability analyses in stream rehabilitation

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