25th Annual Conference

Valuing Water

Economics, Ecology, & Culture

Evaluating BMP selection and placement in intermittent channels in Fort Cobb watershed

Preliminary Research

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USDA United States Department of Agriculture

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Introduction:

- Main cause of water quality impairment in the USA is due to Non-Point Source Pollution
- Contamination of surface water and groundwater also puts drinking water resources at risk
- Erosion contributes a majority of the total sediment loads into the watershed
- Sediment from intermittent streams and gullies degrades water quality

Introduction:

- Reducing rill erosion and amount of upland sediment loading to and erosion in ephemeral channels
  - Changing tillage systems
  - Replacing cover crop with grass
  - Avoiding overgrazing
  - Conservation tillage
  - grassed waterway
  - Pond
  - buffer strip
  - small check dam
- Reducing streams and waterways erosion
  - stream bank stabilization techniques

Problem Statement:

- The Fort Cobb Reservoir and contributing streams are impaired water bodies → listed on Oklahoma 303(d) list as not meeting water quality standards

- Fort Cobb Lake is impaired by turbidity and phosphorus

- Too much sediment in water leads to taste and odor problems, reduced aquatic animal food, increased dredging cost.

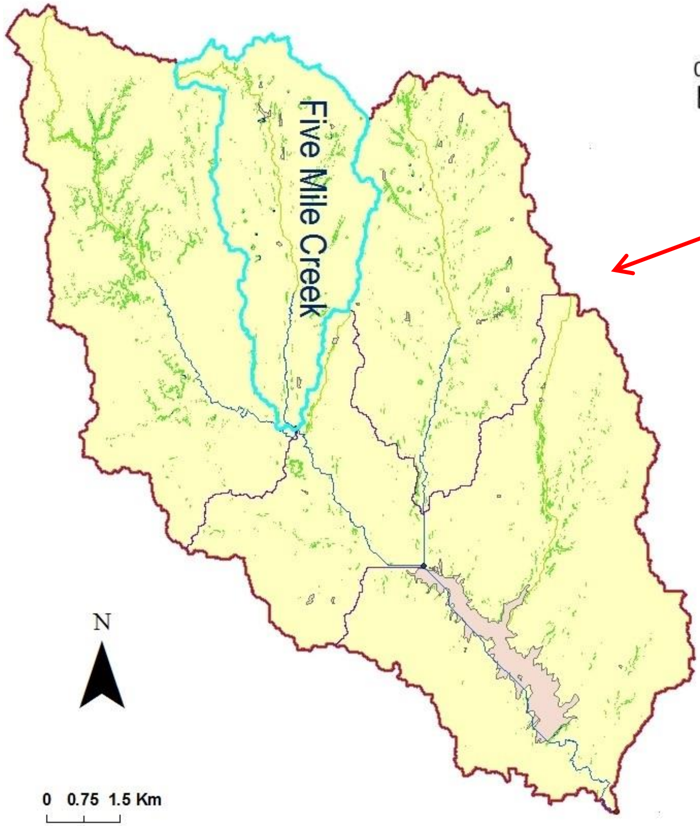
Problem statement:

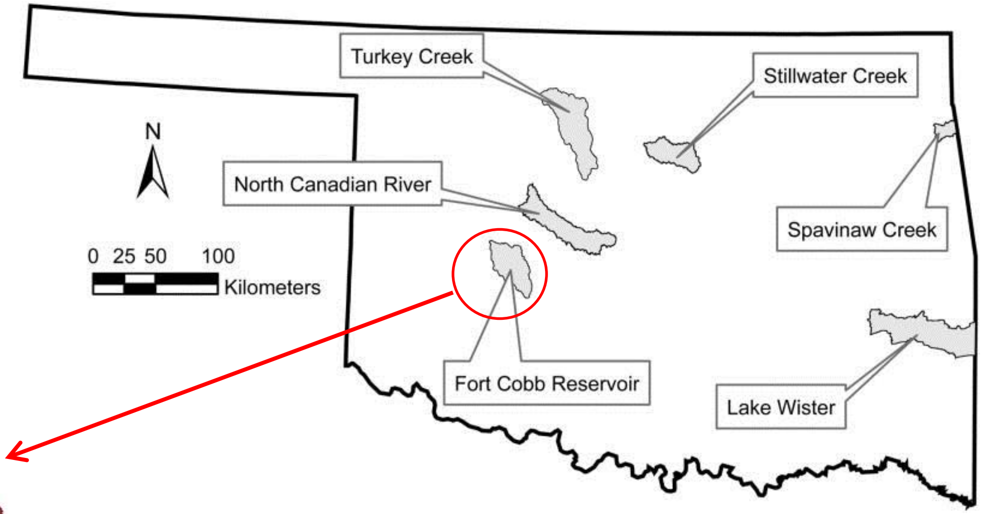
What conservation practices can efficiently reduce sediment loads in the Fort Cobb watershed?

- ✓ <u>BMPs in intermittent streams and gullies</u>

Study Area:

- Basin area is 314 square miles
- Reservoir is 4,100 acres





Objectives:

The overall purpose of this study is to evaluate BMP selection and placement in intermittent channels in the Fort Cobb watershed to stabilize them and reduce erosion

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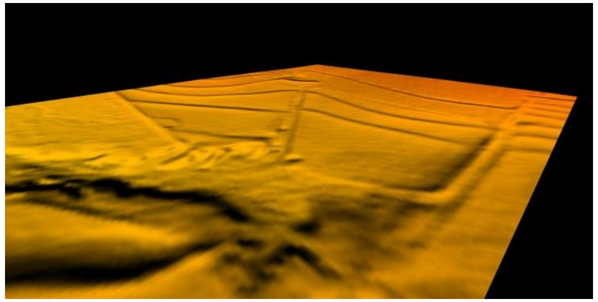
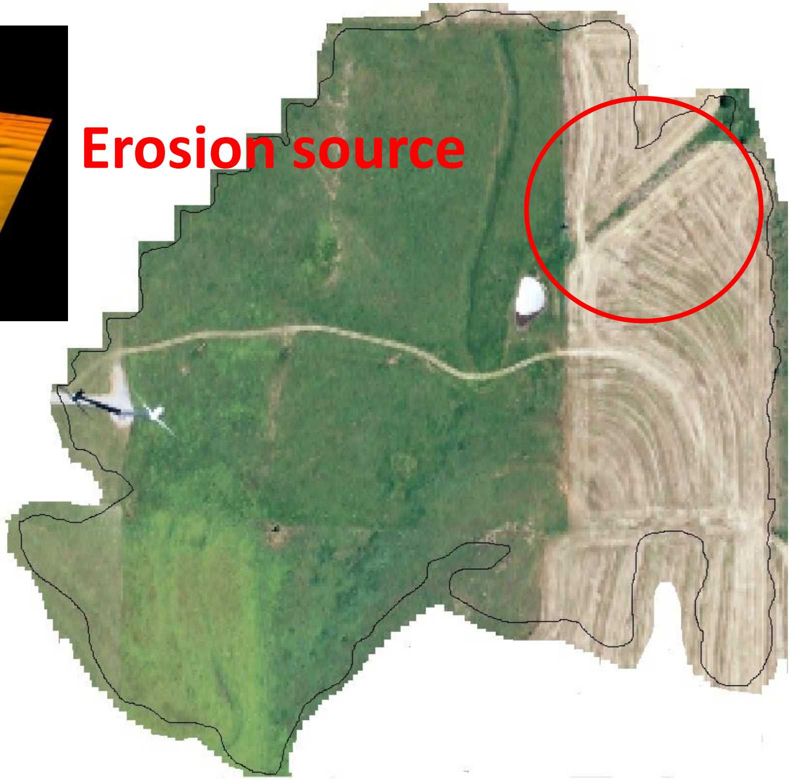
Methodology:

Areas of visible erosion along intermittent channels are located from 1-meter NRCS photographs.





Methodology:

Considering Grassed Waterway

Methodology:

Grassed Waterways:

- Increasing soil cohesion and roughness
- Enhancing water infiltration
- Trapping eroded sediment
- Helping in preventing the development of rills gullies in the fields
- less costly to implement
- being purposely established in the lowest part of the landscape

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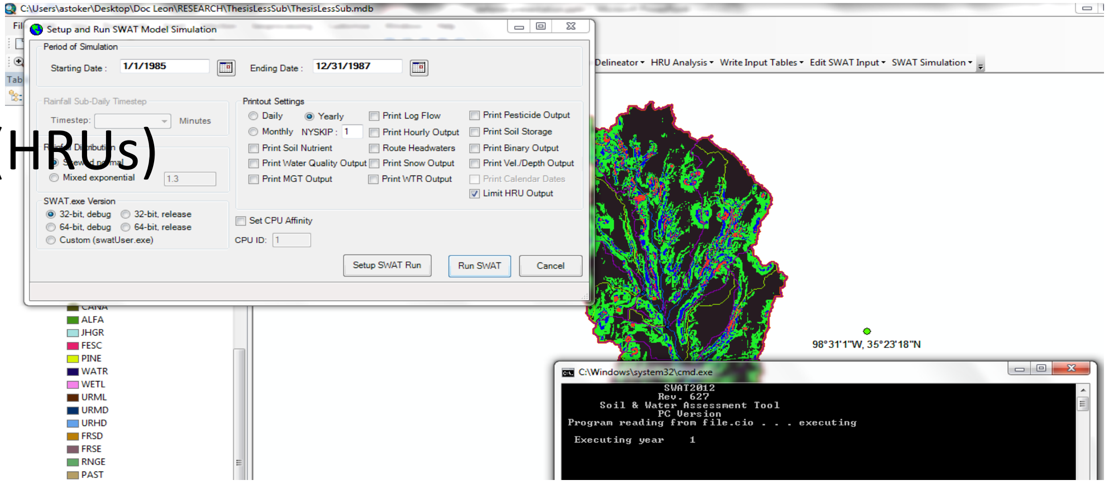
Methodology:

SWAT output has been used to estimate the amount of water and sediment leaving fields, entering the drainage system and reaching the site.

Objective is to expand on the analysis of erosion in the intermittent channels.

- SWAT Model:

Five Mile Creek → 13 sub-watersheds → 971 (HRUs)



Conservation tillage as baseline in the model

Simulation from 1990 to 2010

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Methodology:

For designing grassed waterway:

Storm event: 10-year, 24-hr rainfall → 5.5 inches

Storm event: 2-year, 24-hr rainfall → 3.5 inches

$$\text{RunOff(in)} = 5.5 \times \frac{mean\ runoff}{mean\ precipitation}$$

<u>Travel time and velocity in sheet and channel flow:</u>

$$T_c = T_{t1} + T_{t2} + T_{t3} + \ldots T_{tn}$$

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5} S^{0.4}}$$

$$V = \frac{(r)^{2/3}(s)^{1/2}}{n}$$

T_c = time of concentration

T_t = travel time (h)

n= Manning's roughness coefficient

L= sheet flow length (ft)

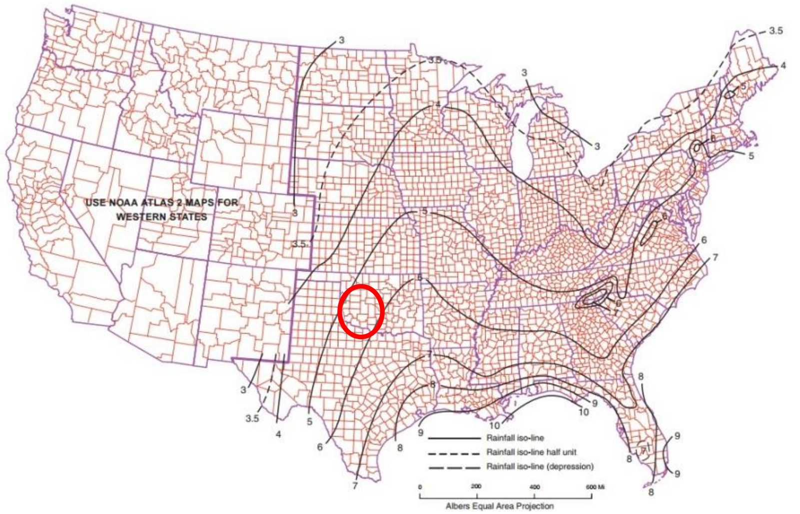
P2= 2-year, 24-hour rainfall (in)

S= slope of land surface (ft/ft)

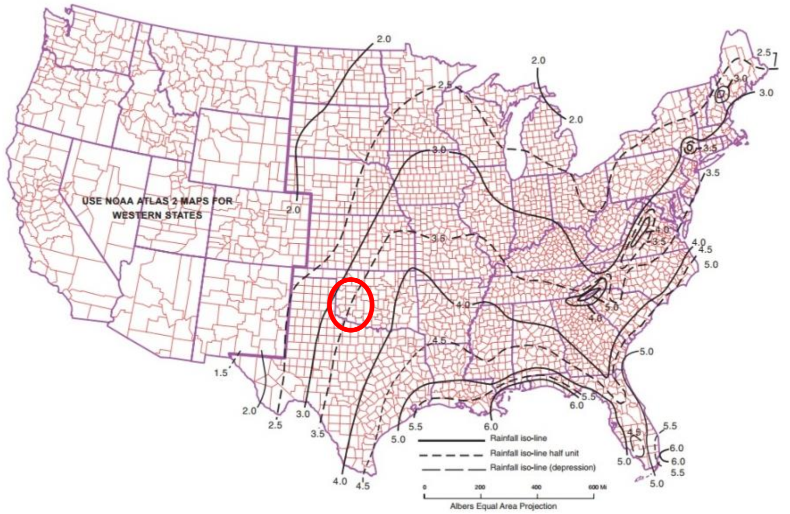
V= average velocity (m/s)

r= hydraulic radius

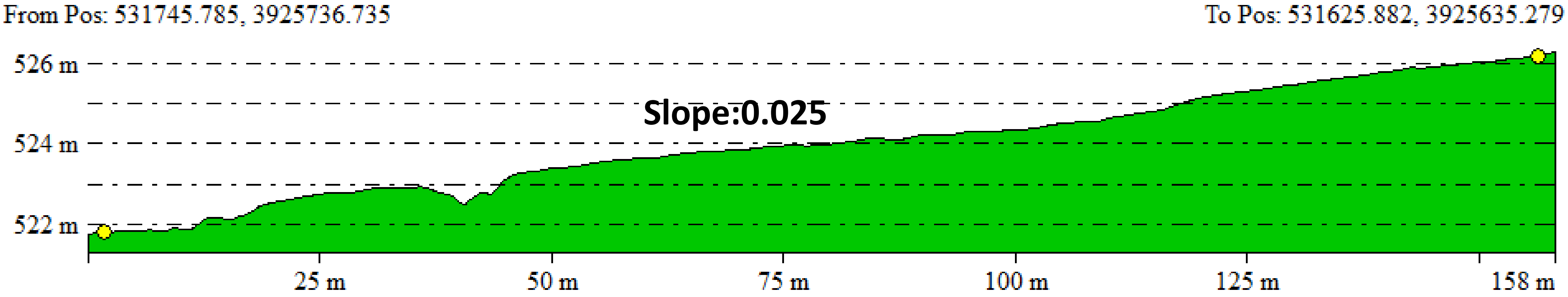
10-year 24-houre Rainfall (inches)



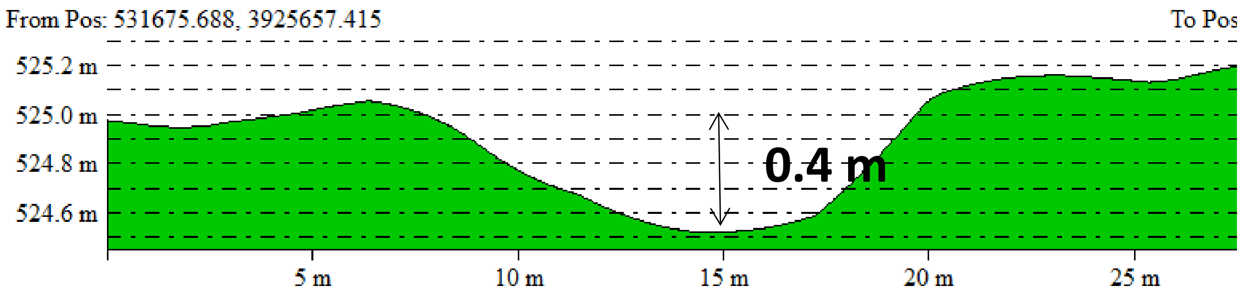
2-year 24-houre Rainfall (inches)

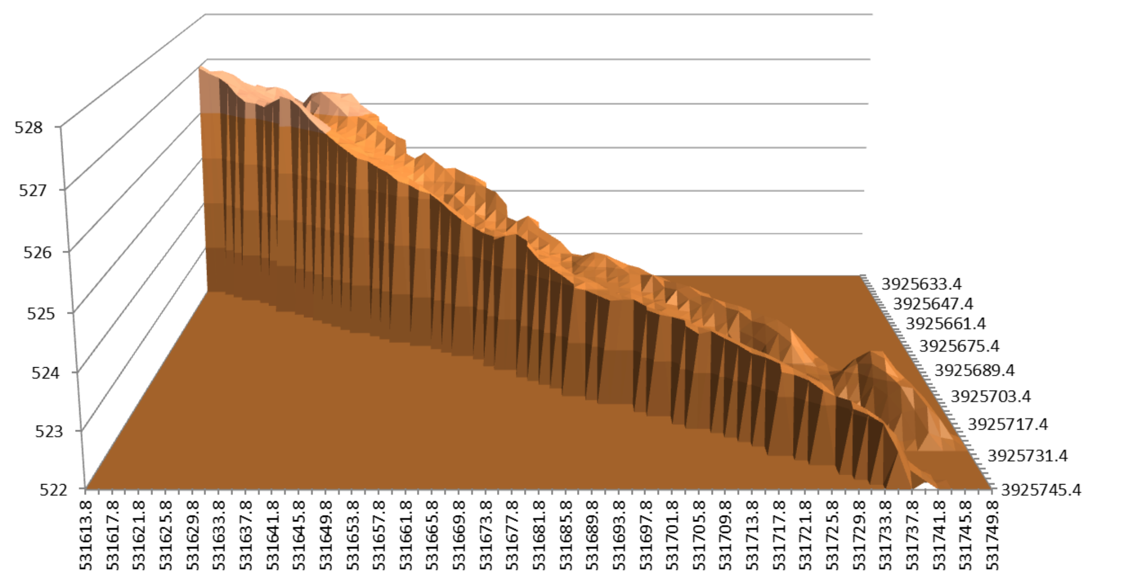


Profile of gully to be grassed:



Cross Section in the beginning point of the gully:





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Results are Incomplete

More work is required because runoff using curve number method overestimates gully size, while preliminary SWAT runoff appears too low

Incorporate erosion and sediment transport

Future research:

- Testing the effectiveness of BMPs like ponds, and buffer strips in reducing erosion by simulation given the volume and timing of water and sediment reaching the selected area.
- Testing the interaction between BMPs on field surfaces via SWAT and in-channel BMPs.
- Analyzing each BMP's ability to capture sediment and further reduce channel erosion given the timing and level of peak flows.
- Determination of the most cost effective set of BMPs on land surface and in channel.

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Queries…

Any questions?

Thank you!