Measuring Streambank Erosion Bank Profiles to more Robustly Estimate Recession Rates and Calibration of the AnnAGNPS-CEAP Model

Clare Prestwich, P.E. [1]

&

W. Barry Southerland, Ph.D.[2]

Water Quality and Quantity Technology Team
NRCS -West National Technology Development Center

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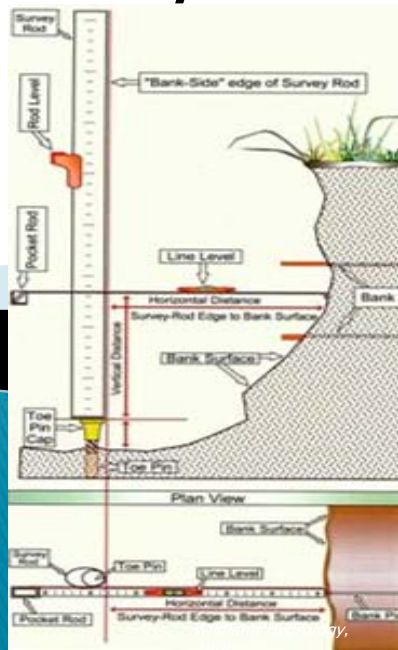
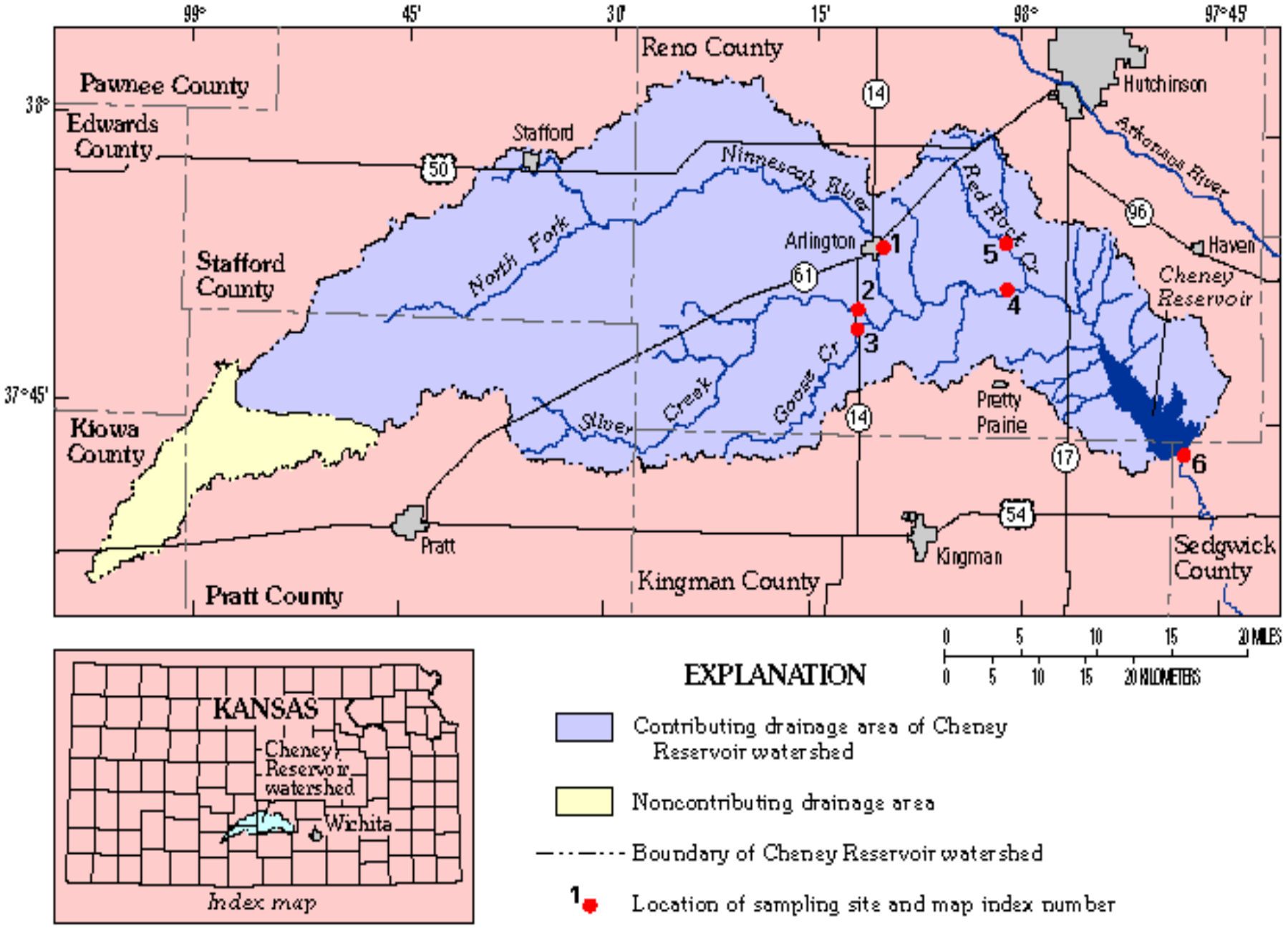
United States Department of Agriculture
NRCS Natural Resources Conservation Service



Setting

- The Cheney Lake Watershed
  - 989 square miles That drain into Cheney Lake reservoir.
  - Source of municipal and recreation water for the city of Wichita.
  - Sediment load from watershed negatively impacting water quality and causing accelerated aggradation of reservoir.
  - 1994 selected as a special emphasis watershed for the Conservation Effects and Assessment Project (CEAP).
  - 1996 USGS installed 5 sediment load samplers on various stream in the watershed
  - These gages have been continuously collecting annual suspended load measurements for the watershed since installation.

Cheney Lake CEAP Watershed Location



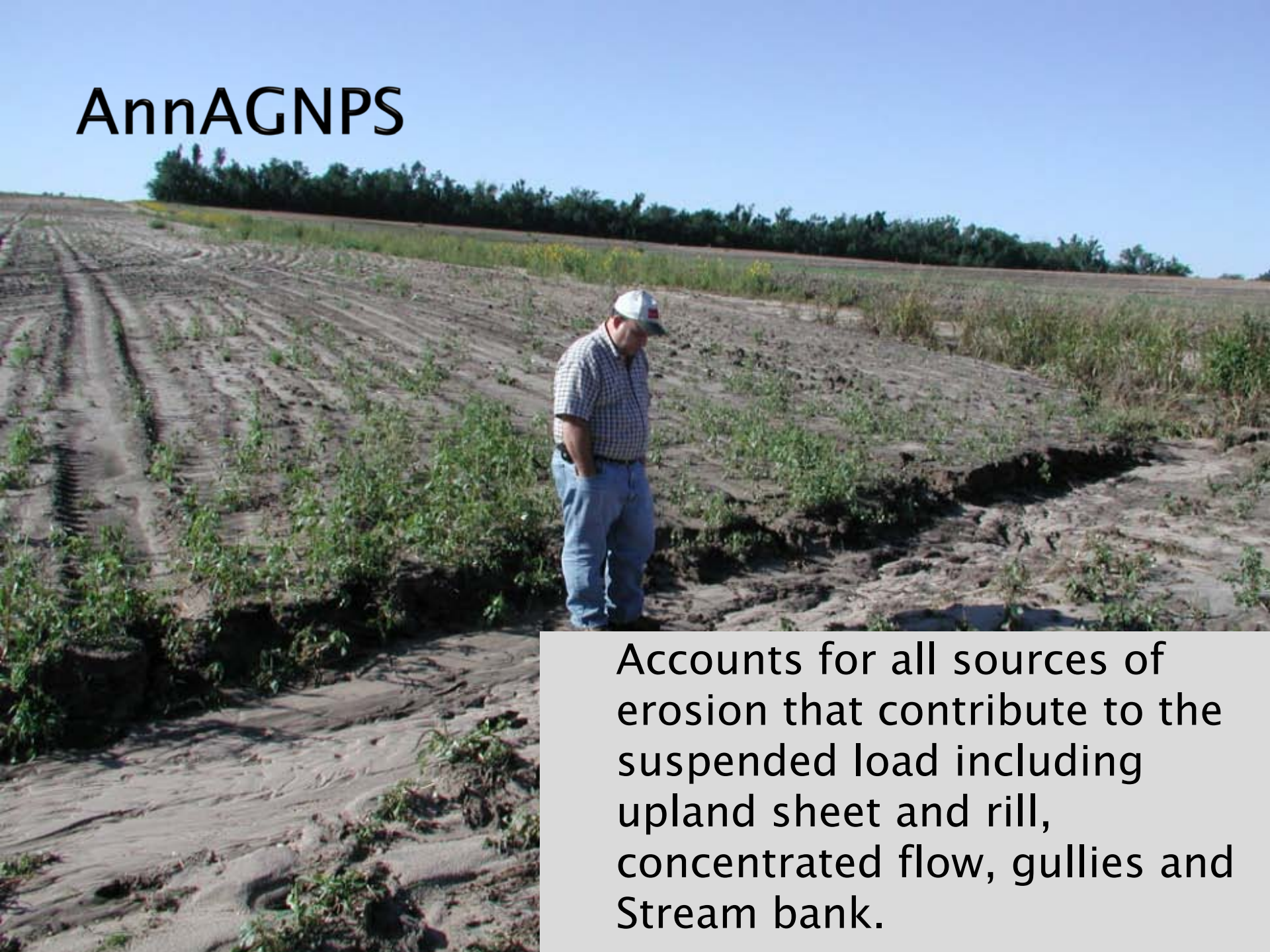
CEAP

- The purpose of the CEAP is to evaluate the effectiveness of applied conservation practices from the various Farm bill/NRCS programs
  - CRP
  - EQUIP
  - WRP
  - WHIP
- Part of the CEAP process is to use models to evaluate the effects of conservation practices on surface runoff and erosion. AnnAGNPS is being used on this project.

AnnAGNPS

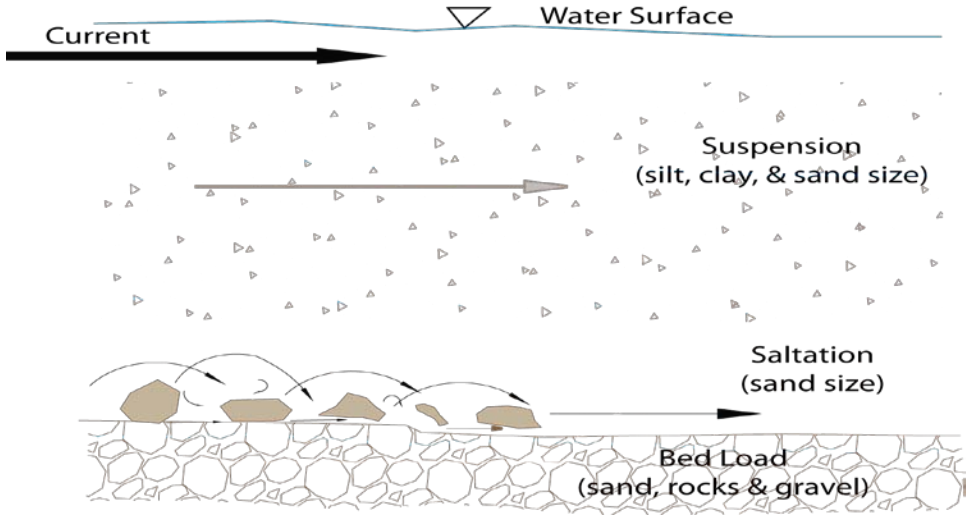
- Annualized Agricultural Non-Point Source model (AnnAGNPS)
  - is a continuous-simulation, multi-event modification of AGNPS

AnnAGNPS



Accounts for all sources of erosion that contribute to the suspended load including upland sheet and rill, concentrated flow, gullies and Stream bank.

- To calibrate the model the portion that come from each source needs to be known.
- Stream sediment is divided into the following
  - Wash load
  - Stream bed load
  - Suspend load



- Need to determine portion of suspend load that comes from streambanks

Project

- Objectives
  - Parse out the suspend sediment contribution (i.e. Ag and streambank)
    - Characterize streambank erosion from both perennial and intermittent seasonal streams
      - Field assessment of key selected areas
      - Use orthophotography to assess areas not field inventoried
  - Develop regional streambank lateral recession curves
  - Provide conservation planning resources for developing priorities and treatment measures for streambank erosion

Partners

USDA-NRCS-WNTSC- Water Quality and Quantity Technology Development Team

Cheney Lake Watershed Company

Reno Conservation District

USDA-NRCS Water Resource Center- Little Rock, Ark.

Other Shareholders and Landowners

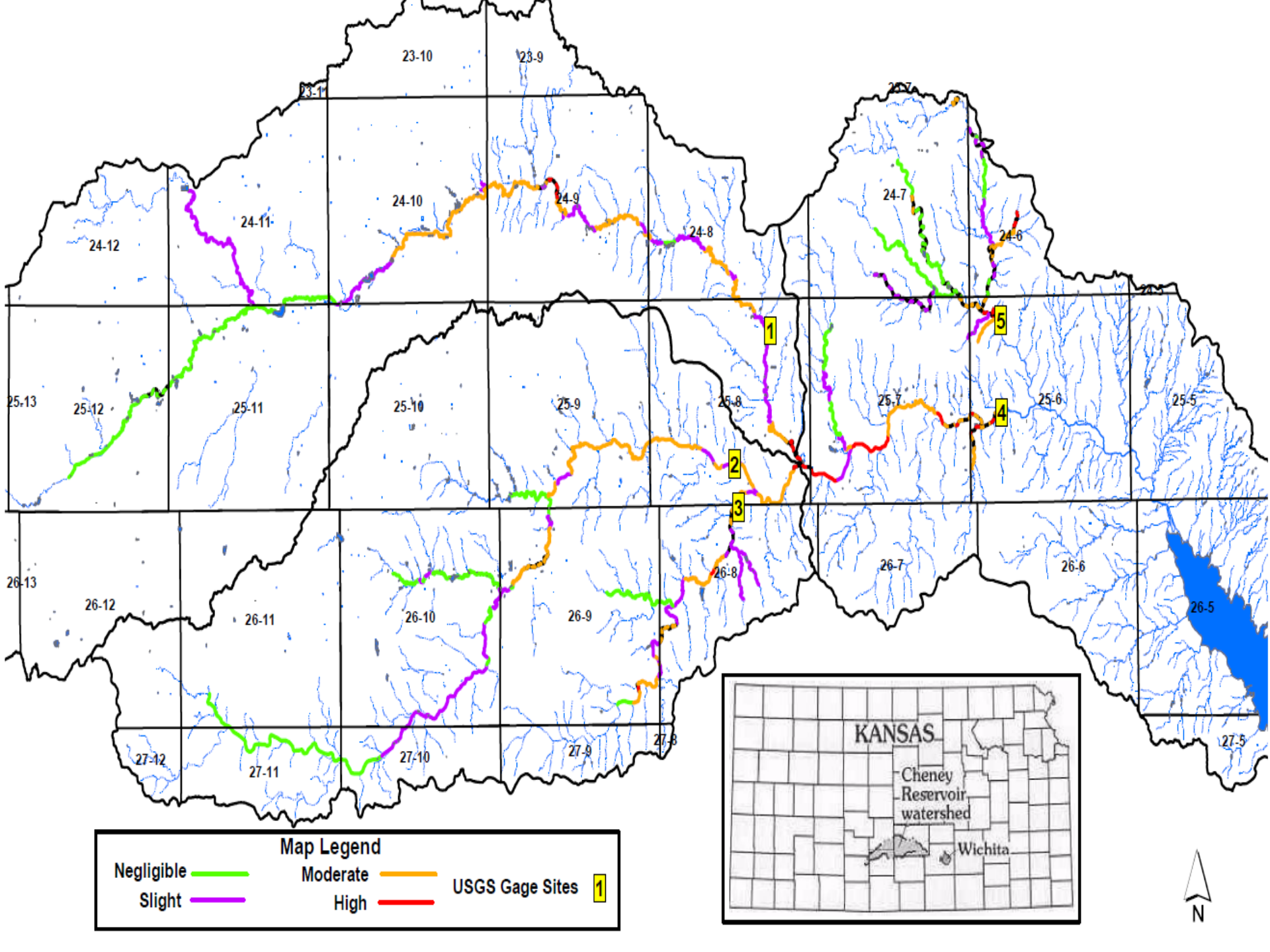
Share holder Involvement & Feedback

Methods

- Major Stream Course streambank conditions were delineated into four categories
  - Severe, moderate, slight, negligible (later extreme was added)
- 186 miles of stream above the 5 gauging stations
- 41 miles (22%) were directly measured in the field and evaluated for
  - length
  - height
  - annual recession rate
  - textural classification
  - Schumm Channel Evolutionary Stage
  - geomorphic stream type

Method

- Areas not direct field measured were evaluated using the ARCGIS orthophotography (2006)
  - While helpful, direct field measure was of more use
  - Most of the areas were later ground truth and it was determined that majority of the remaining area was rated negligible to slight
- All Streambanks were assigned an erosion Characterization and condition class


23-10
23-9
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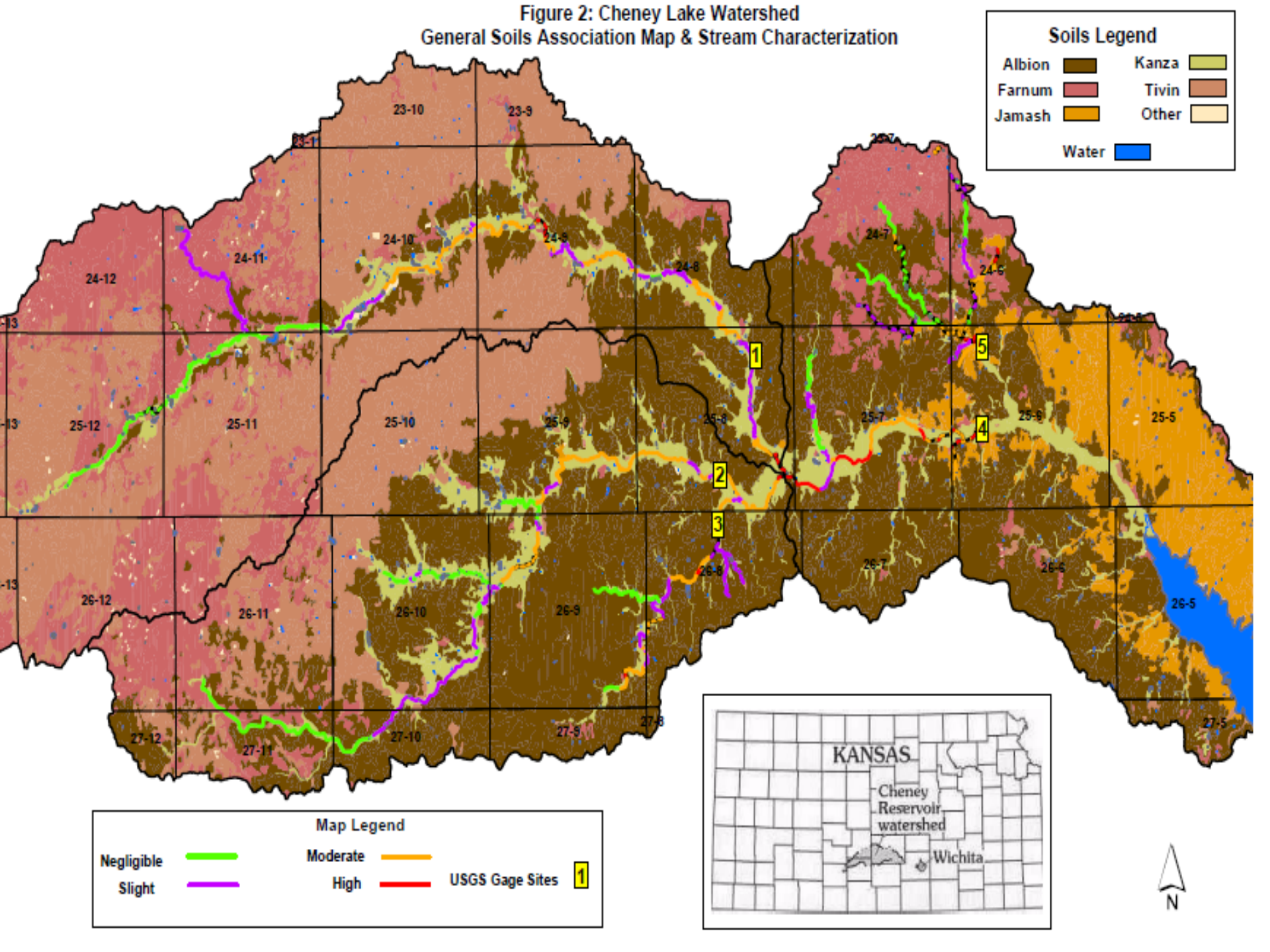
26-5
27-12
27-11
27-10
27-9
27-8
27-5
1
2
3
4
5
Map Legend
Negligible
Slight
Moderate
High
USGS Gage Sites
1
KANSAS
Cheney
Reservoir
watershed
Wichita
N

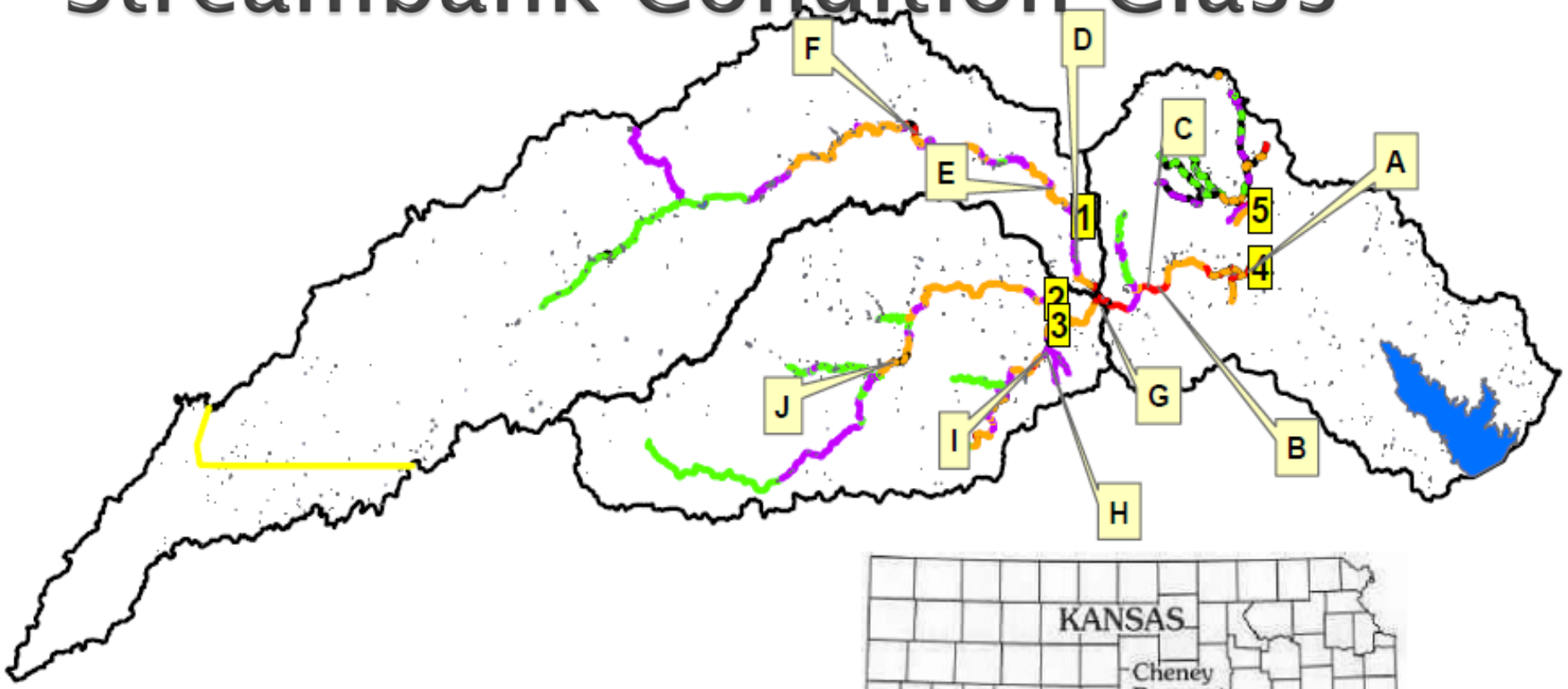
Figure 2: Cheney Lake Watershed
General Soils Association Map & Stream Characterization



Methods

- Further subsample of the condition classes was selected for lateral recession measurement using bank pins

Bank Pin Sites, Gage Sites and Streambank Condition Class

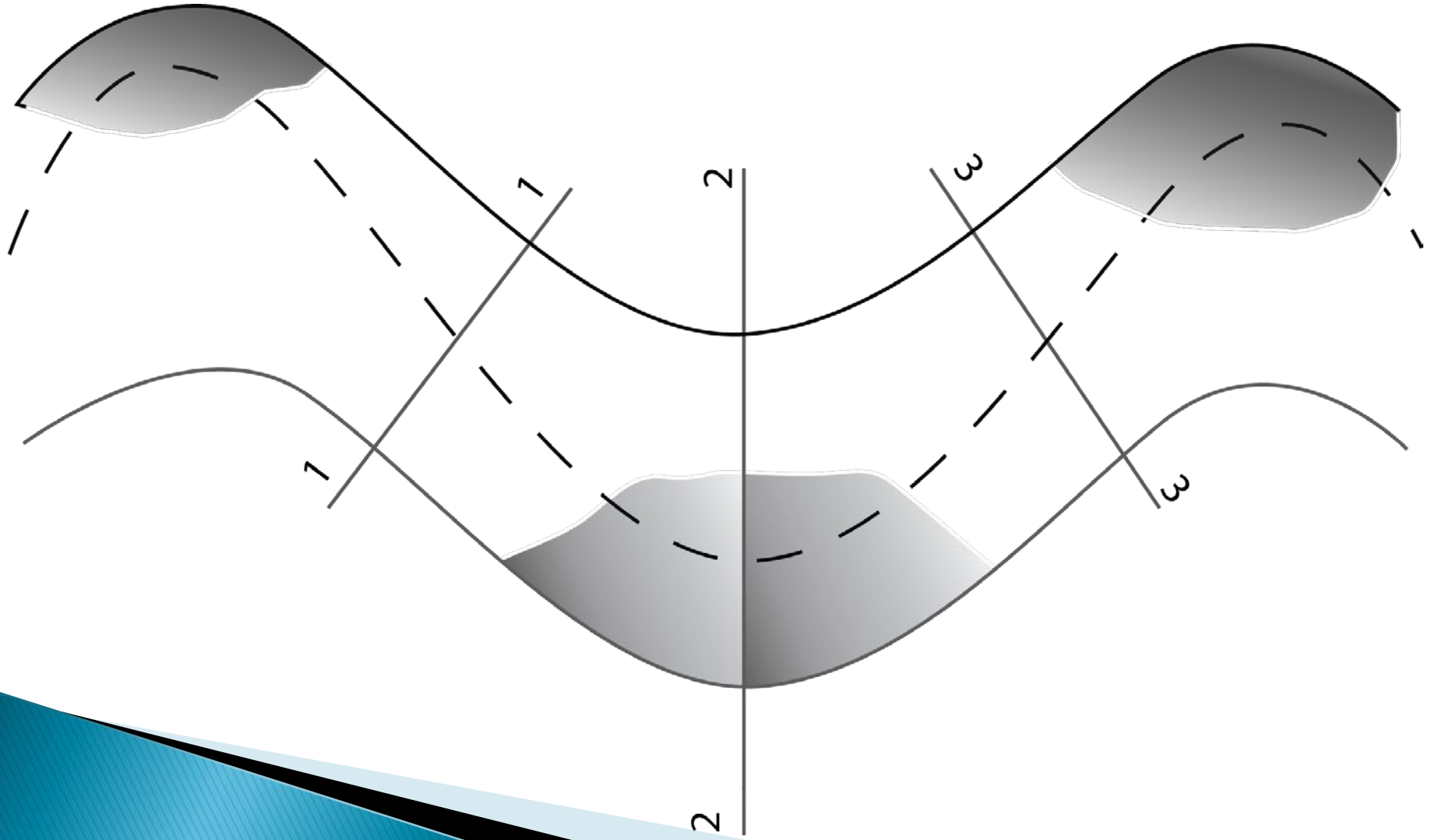


Map Legend

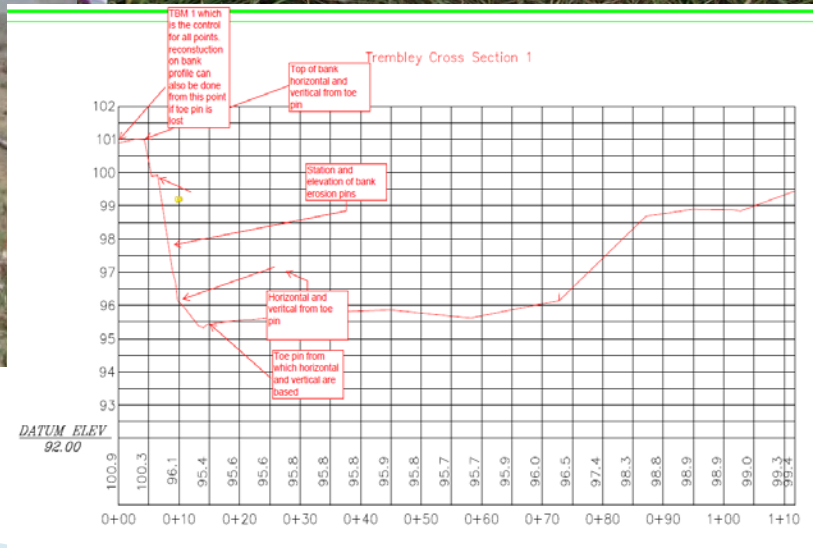
Negligible — Slight — Moderate — High

USGS Gage Sites 1

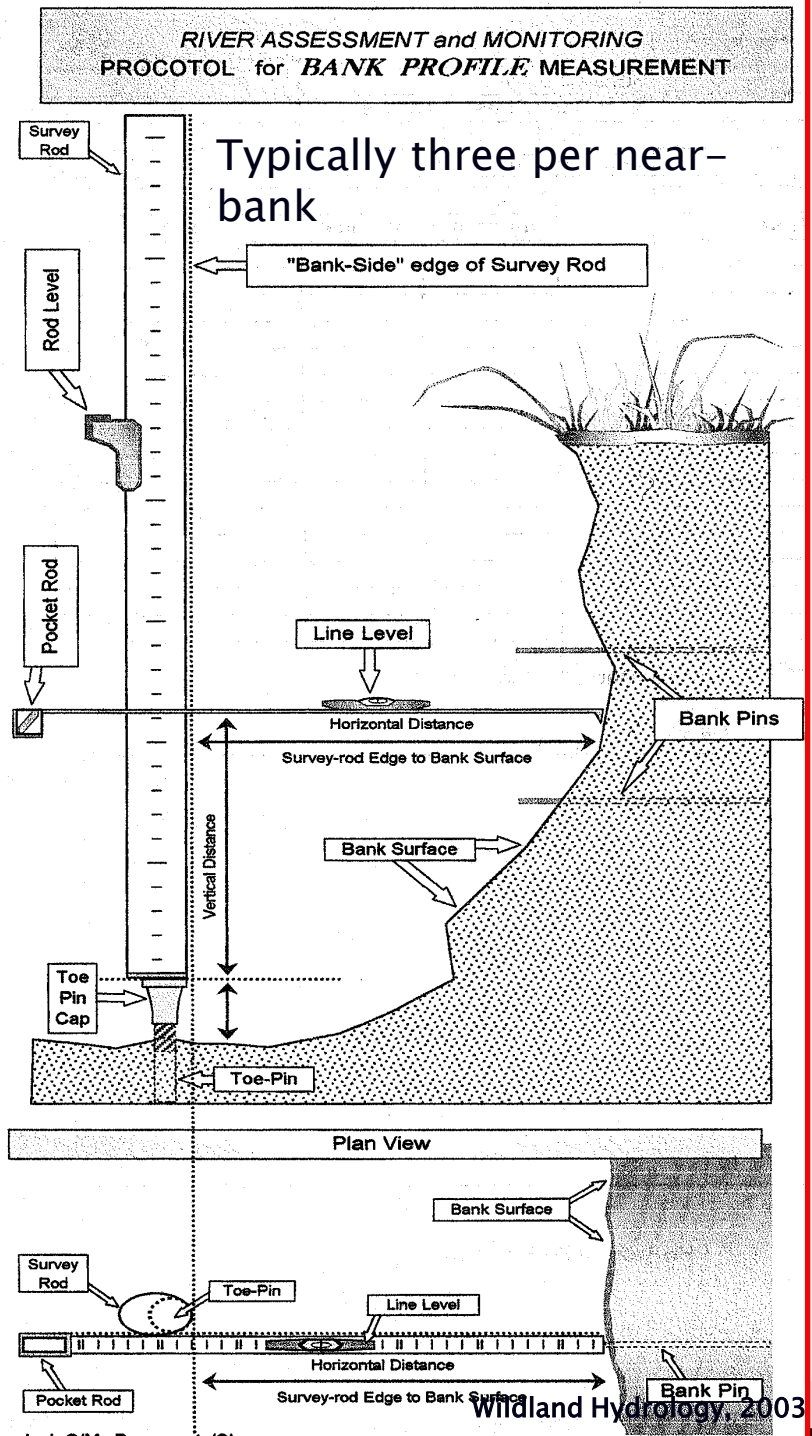
Three sets of pins at each sight



Cross Sections with permanent Bench marks



Bank pins installed



Measurement of bank profiles.

Real-time validation of bank loss (recession). Validation! and Calibration!

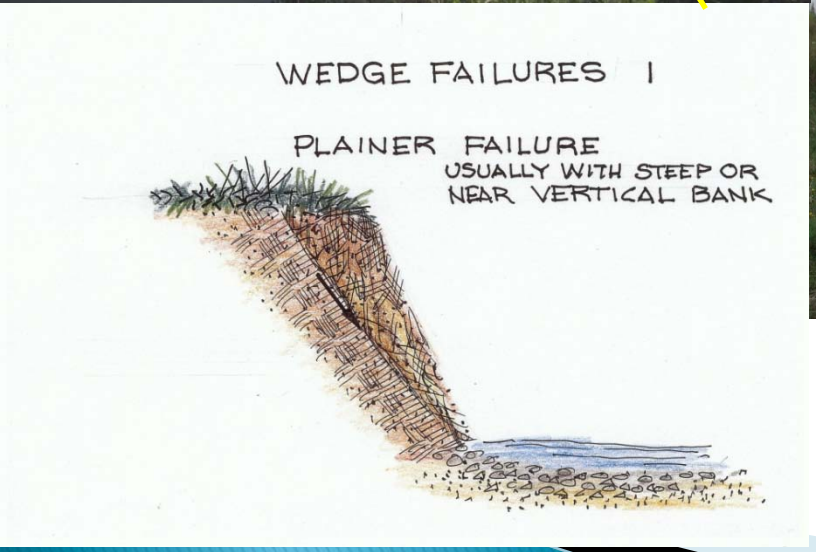
Add **representative** streambank distance on profile and toe to bankheight to derive volume. If representation is in question, add more bank profiles!

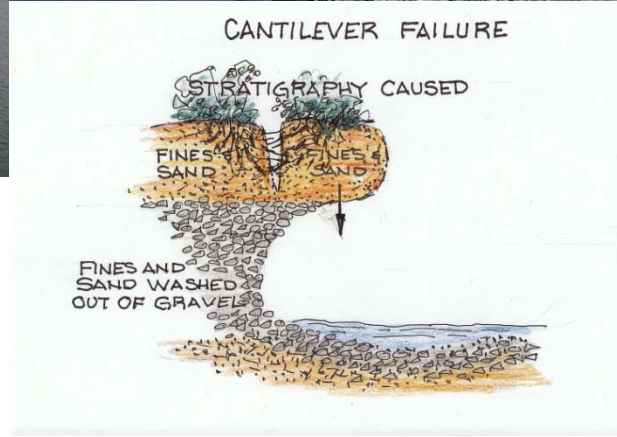
Range of Data was collected

Field Data Gathered

- Streambank erosion pin measurements and bank profile form and measurement.
- Morphometry of dimension (cross-sections, long profile, and pattern.
- Particle size distribution- bed and banks
- Bank Erodibility Hazard Index rating/scoring
- Bank erosion pins reset annually for 5 years
- Shear plain length assigned to pin set
- Floodplain connectivity – bank height ratios
- Mechanism of failure, Geom. Classification, transition state and Schumm CEM stage

Mechanism of Bank Failure





Silver-BradshawChilds.xlsm - Microsoft Excel

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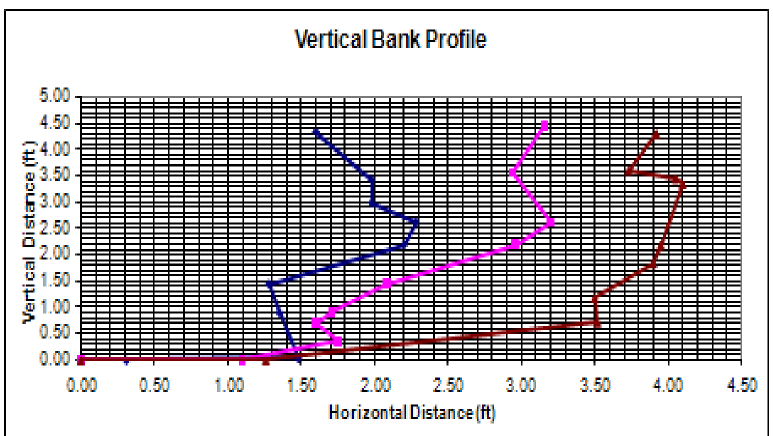
Bank Profile Worksheet

Stream:	Silver	Observers:	
Location:	Bradshaw-Childs	Date:	
Cross-section:		BEHI adjective:	
RB	RB	NBS adjective:	
Toe pin station:	#1	Predicted erosion (ft):	
Toe pin elevation (ft):		Measured erosion (ft):	

Date:	8/22/2007	Initial profile		Date:	9/9/2008	Cycle event 1 profile	
Horizontal	Vertical	Notes	Pin	Horizontal	Vertical	Notes	Pin
1.60	4.32			3.16	4.45		
1.98	3.41		✓	2.94	3.56		✓
1.98	2.98			3.20	2.61		
2.28	2.62			2.96	2.19		✓
2.20	2.19		✓	2.08	1.45		
1.28	1.45			1.71	0.90		✓
1.35	0.91		✓	1.60	0.70		
1.48	0.04			1.75	0.36		
0.31	0.00			1.10	0.00		
0.00	0.00			0.00	0.00		



Recess by Rate

	Recession Rate based on Polyginal Area		Recession Rate based on pins
	Area (sqft)	Rate (ft/event)	Rate (ft/event)
Event 1	3.46	0.78	0.69

Bank Profile Worksheet

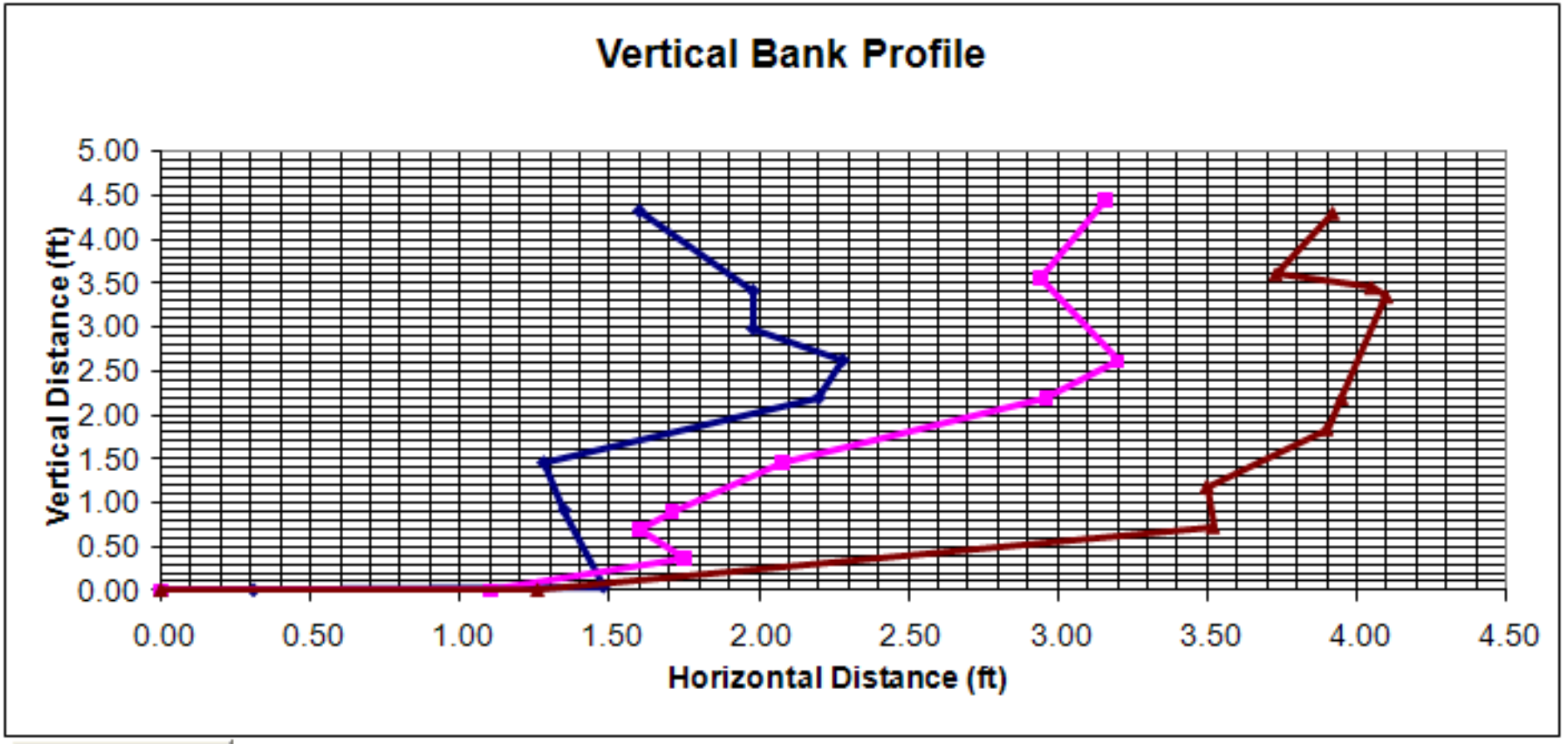
Stream:	Observers:
Location:	Date:
Cross-section:	BEHI adjective:
Bank:	NBS adjective:
Toe pin station:	Predicted erosion (ft):
Toe pin elevation (ft)	Measured erosion (ft):

Date:	8/1/2009	Cycle event 2 profile		Date:	8/12/2010	Cycle event 3 profile	
Horizontal	Vertical	Notes	Pin	Horizontal	Vertical	Notes	Pin
3.92	4.30		✓				
3.73	3.60						
4.05	3.45						
4.10	3.35		✓				
3.95	2.19						
3.90	1.84						
3.50	1.18		✓				
3.52	0.72						
1.26	0.00						
0.00	0.00						

Date:		Cycle event 4 profile		Date:		Cycle event 5 profile	
Horizontal	Vertical	Notes	Pin	Horizontal	Vertical	Notes	Pin

Date:		Cycle event 6 profile		Date:		Cycle event 7 profile	
Horizontal	Vertical	Notes	Pin	Horizontal	Vertical	Notes	Pin

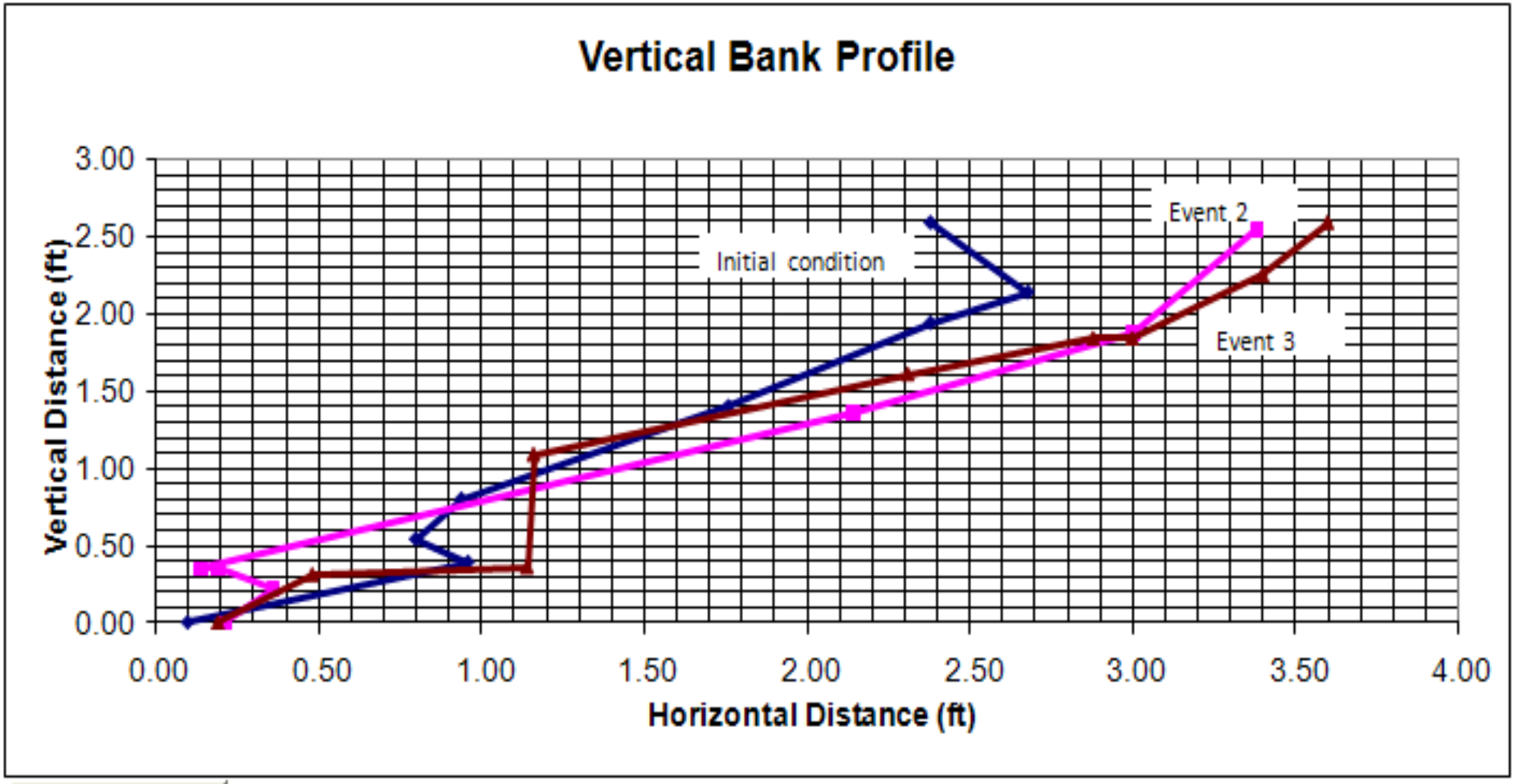
Silver Creek condition class – Severe



Recession Rate

	Recession Rate based on Polyginal Area		Recession Rate based on pins
	Area (sqft)	Rate (ft/event)	Rate (ft/event)
Event 1	3.46	0.78	0.69
Event 2	4.42	1.03	1.30

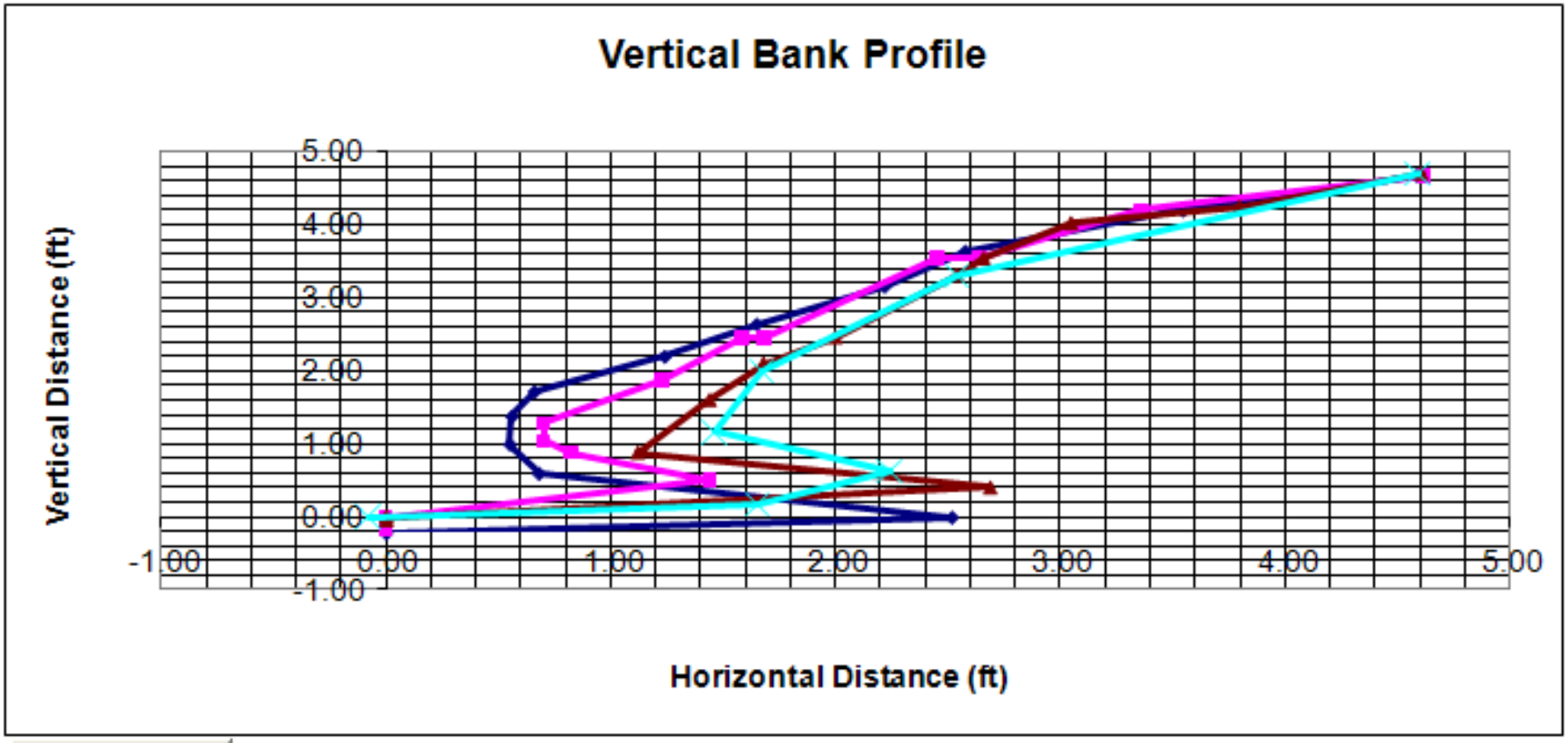
Goose Creek condition class – Moderate



Recession Rate

	Recession Rate based on Polyginal Area		Recession Rate based on pins
	Area (sqft)	Rate (ft/event)	Rate (ft/event)
Event 1	0.48	0.19	0.11
Event 2	0.12	0.05	0.21

Goose Creek Condition Class – Slight



Recession Rate

	Recession Rate based on Polyginal Area		Recession Rate based on pins
	Area (sqft)	Rate (ft/event)	Rate (ft/event)
Event 1	0.22	0.05	0.08
Event 2	1.71	0.36	0.63
Event 3	0.76	0.16	0.15

Questions

- Thanks