Using Fallout Radionuclides to Track Sediment Movement within an Agricultural Watershed

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Introduction

- Sediment: Important non point source pollutant
  - Impacts
    - Off-site
      - Increased turbidity
      - Reduced light penetration
      - Particulate bound nutrients
      - Aesthetics
    - On-site
      - Depletion of nutrient rich soils

Sediment Control

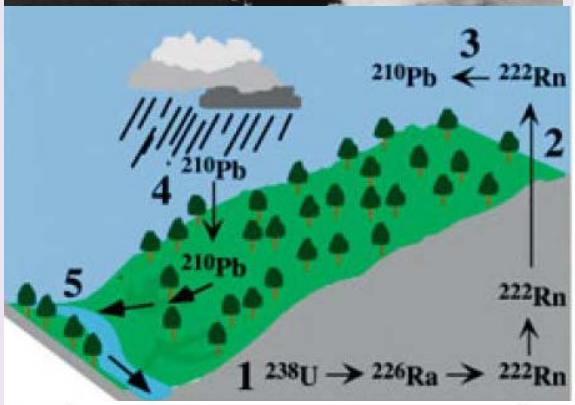
- Implementation of best management practices (BMPs)
  - In past four decades **little or no improvement** in NPS-Watershed projects (Meals et al., 2010)
  - **No effect of conservation practices** detectable across 133 agricultural watershed across the U.S (Sprague and Gronberg 2012)
- Possible reason
  - Changes in water quality lag behind the implementation of conservation practices
  - Conservation practices not working

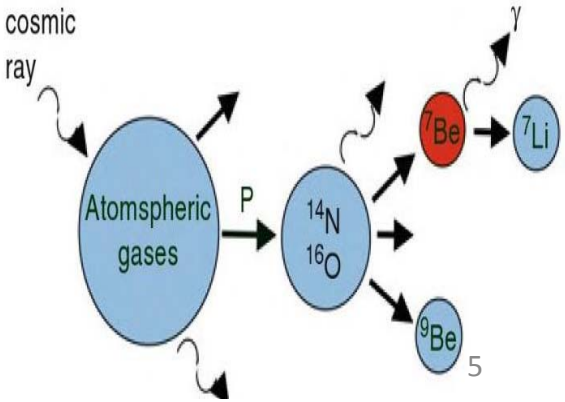
Sediment Control

- Lag time between BMP implementation and measurable change in water quality
  - Better understand in-stream sediment processes
  - Watershed models lack in-stream sediment transport data
- Sediment Fingerprinting techniques
  - Use of fallout radionuclides to understand in-stream sediment processes

Atmospheric Fallout Radionuclides

- Anthropogenic
  - Cesium-137 (^{137}Cs)
    - Half life = 30.2 years
- Natural
  - Lead-210 ($^{210}Pb_{xs}$)
    - Half life = 22.3 years
  - Beryllium-7 (^{7}Be)
    - Half life = 53.3 days



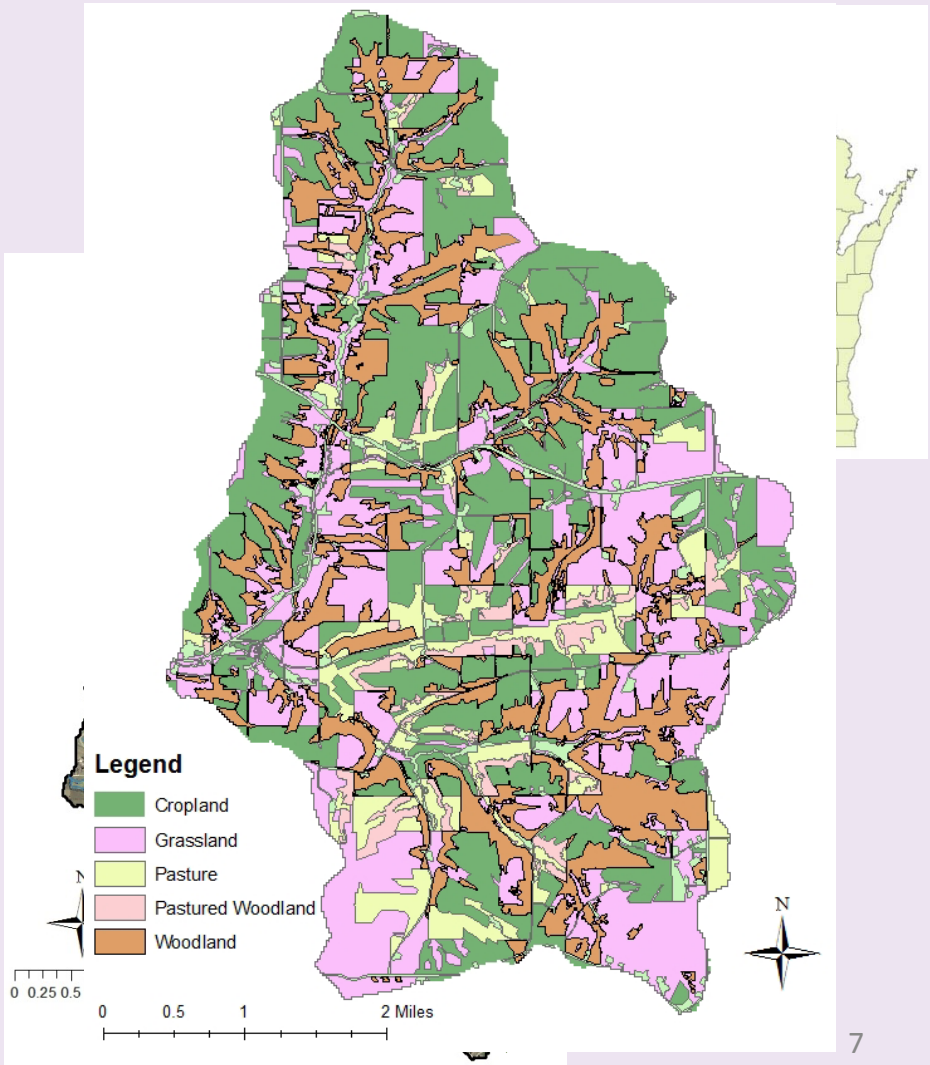


Objectives

- To determine in-stream sediment transport parameters
  - Sediment Age
  - Percent New Sediment
  - Sediment deposition/resuspension rates
- To determine relative contribution from different sources to in-stream suspended sediments

Project Site

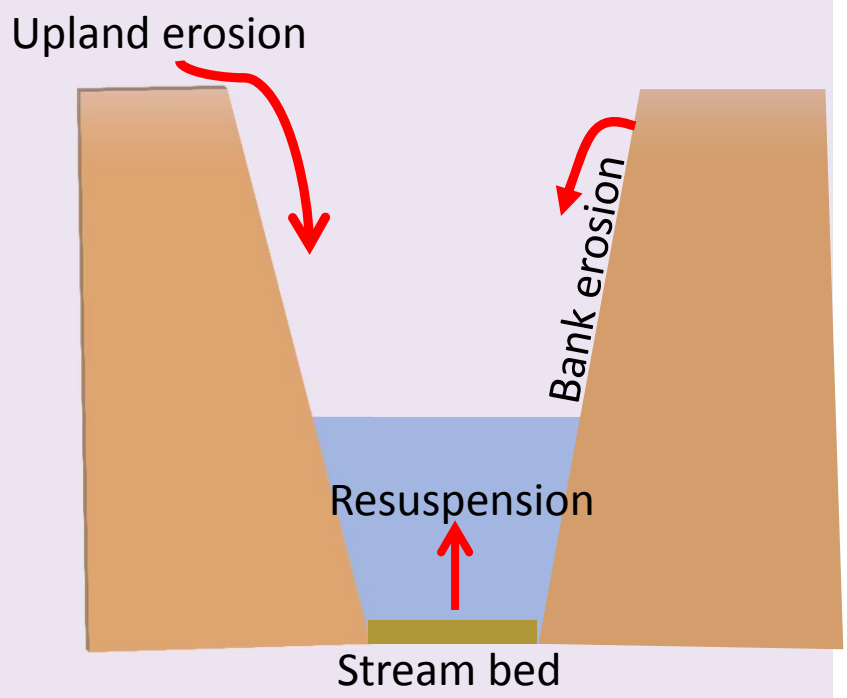
- Pleasant Valley Watershed
- Dominant land uses are:
  - Cropland
  - Pasture
  - Forest
  - Grassland
- Area ~19 sq miles
- Average slope is 11%
- Silt loam soils



Methods

In-stream Sediment Transport Parameters

- Uplands
  - ➢Croplands
  - ➢Pastures
- Channel
  - ➢Stream Banks
  - ➢Stream Beds



Methods

In-stream Sediment Transport Parameters

- Stream bed deposition/resuspension rates were determined following method of Fitzgerald et al. (2001) and Walling and Quine (1990).
- Sediment age and percent new sediment were determined following method of Matisoff et al. (2005).
  - Sediment Age: Time elapsed after the sediment was tagged with the ^{7}Be by the precipitation.
  - Percent New Sediment: Provides information on the relative dilution of the ^{7}Be-rich sediments with the ^{7}Be-dead sediments.

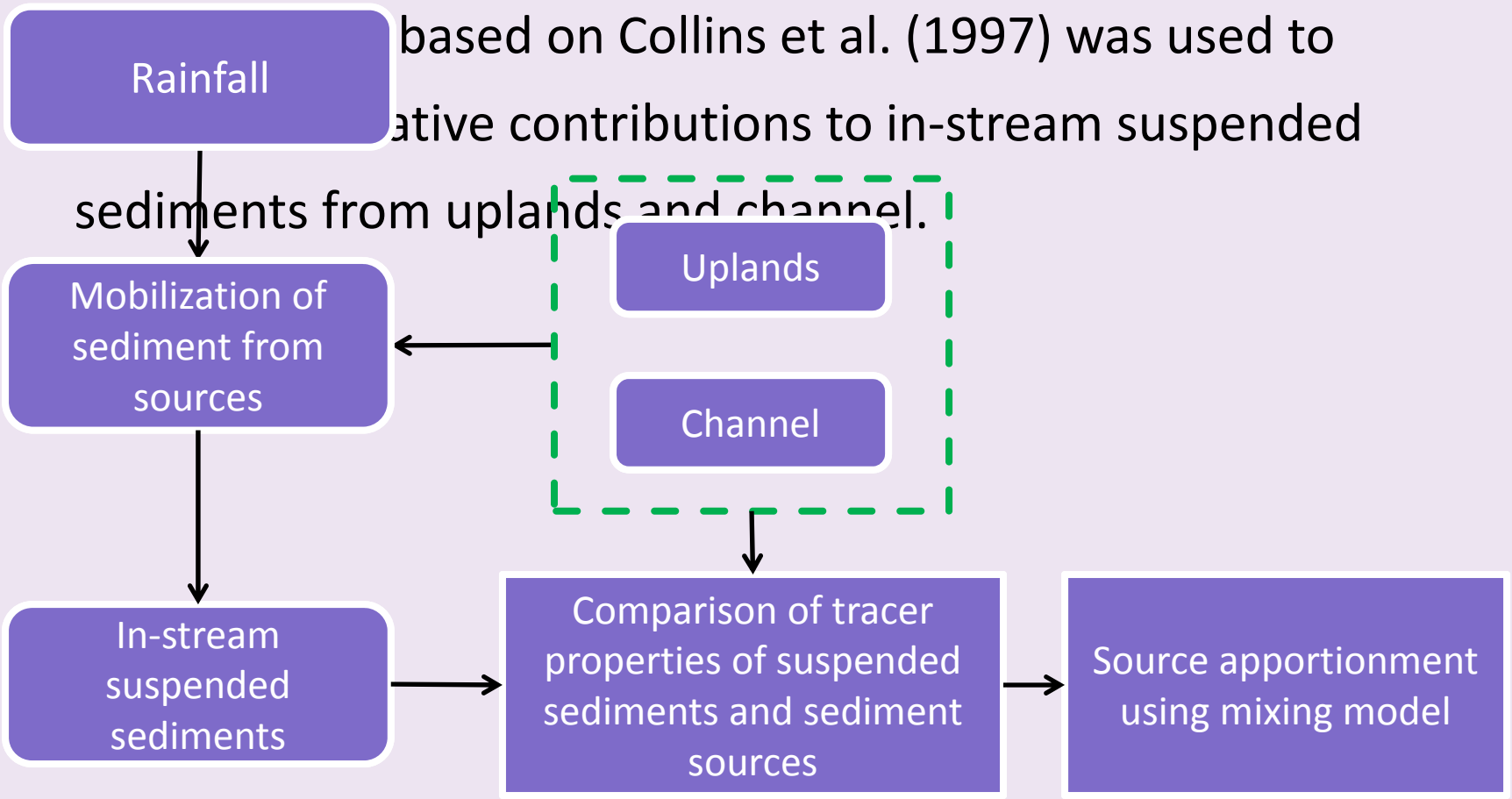
Methods

Suspended Sediment Sources

based on Collins et al. (1997) was used to

ative contributions to in-stream suspended

sediments from uplands and channel.



Methods

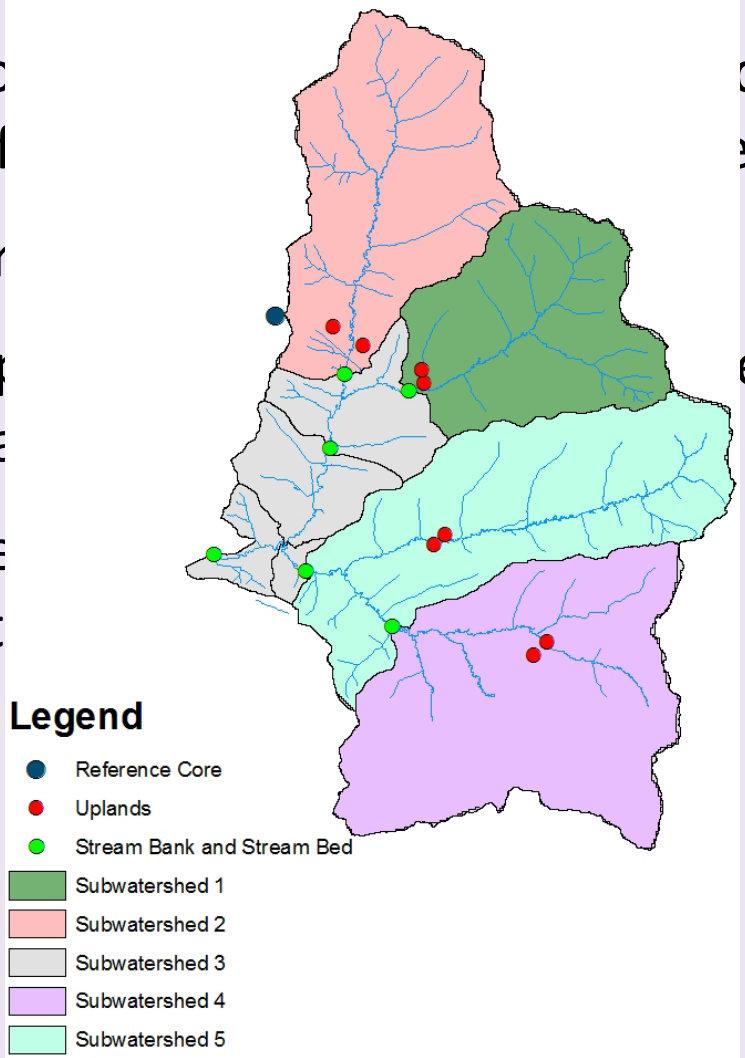
Rainfall Event Sampling

- Rainfall Events:
  - Storm 1
    - 0.5 inches of rainfall fell over period of 4 hour
    - 21st September, 2012
  - Storm 2
    - 2.3 inches (0.42 inches+1.9 inches) of rainfall over 39 hour
    - 13th and 14th October, 2012

Methods

Soil Cores Sampling

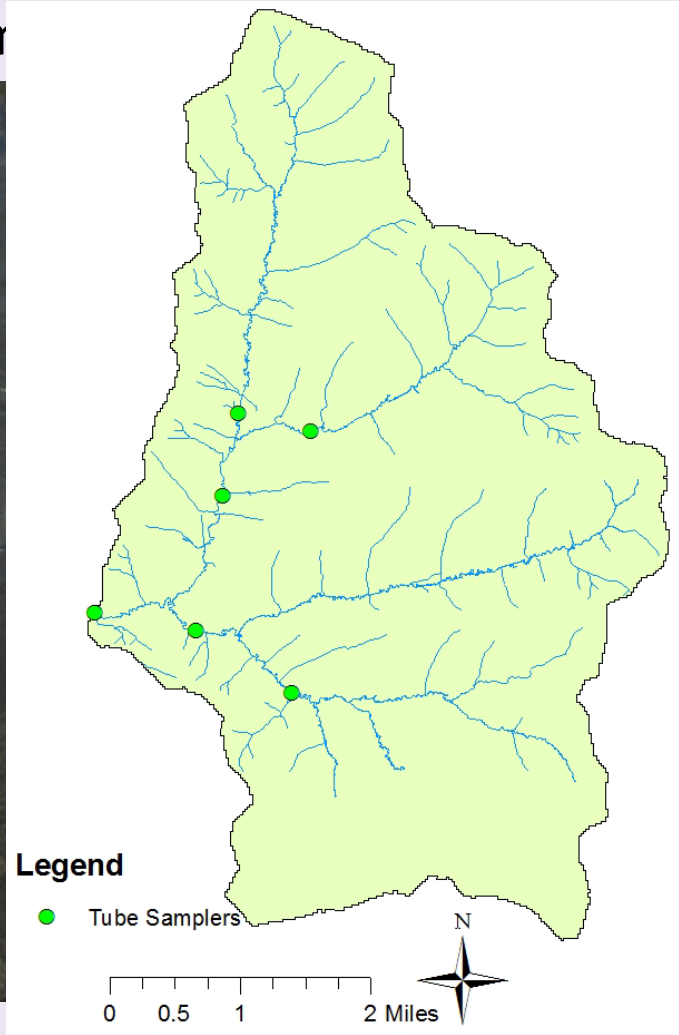
- Soil cores fro d stream bed were collected bef ent.
- All cores wer
- Rainfall samp et at two different sites within a
- Soil cores we from stream bed and reference sit

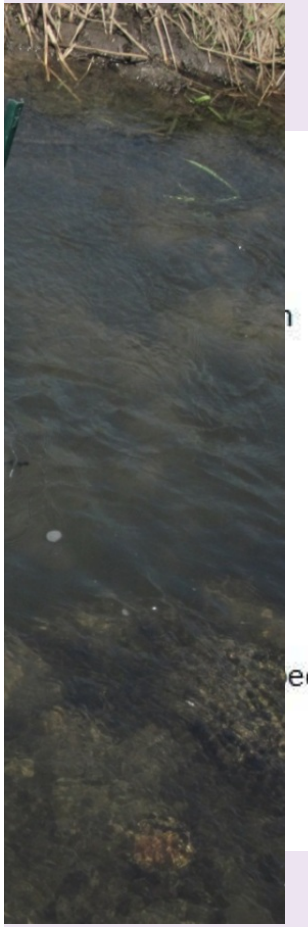


Methods

Suspended Sediment Collection

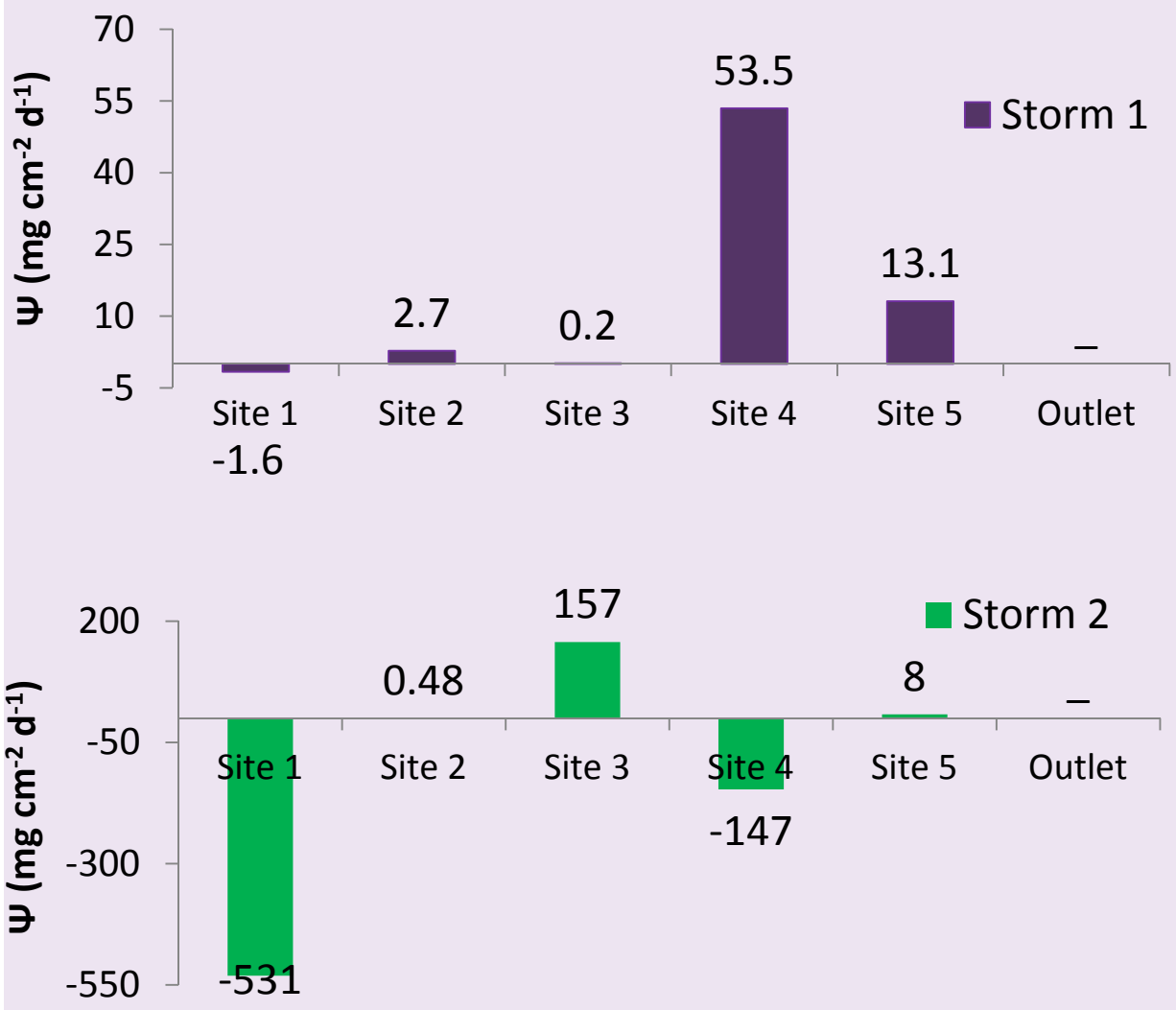
- Phillip's tube sam
  - ➢ Fou

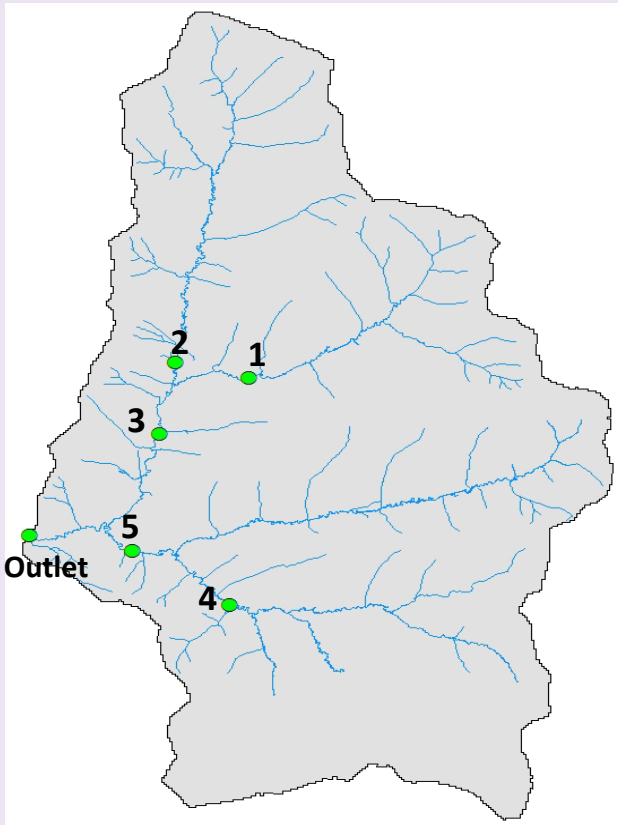




Results

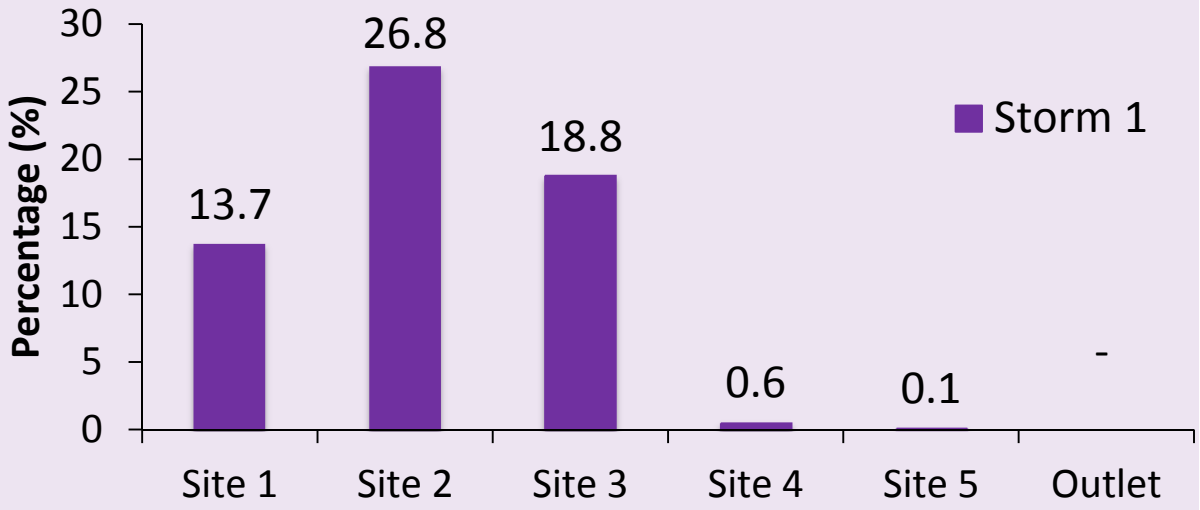
Stream Bed Flux Rates

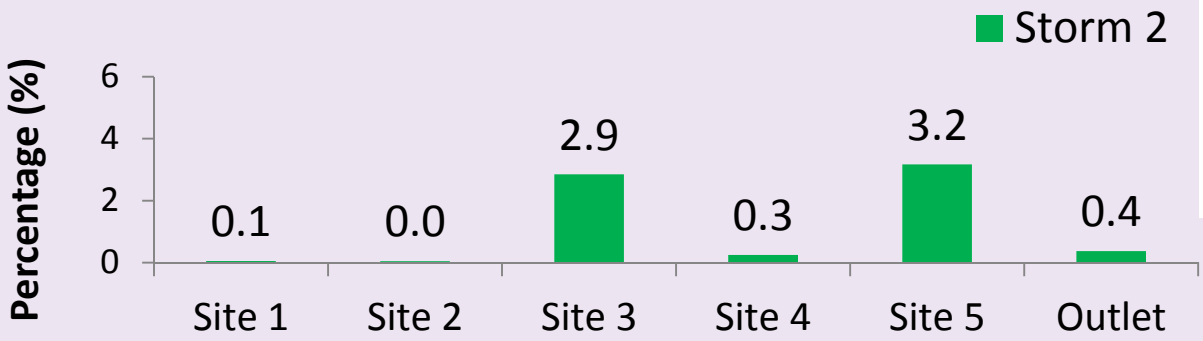


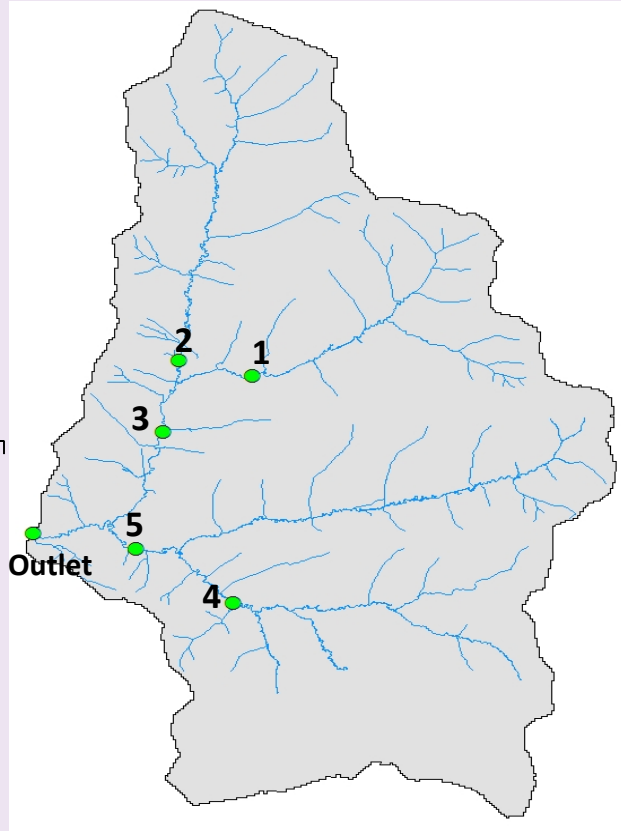


Results

Percent New Suspended Sediments

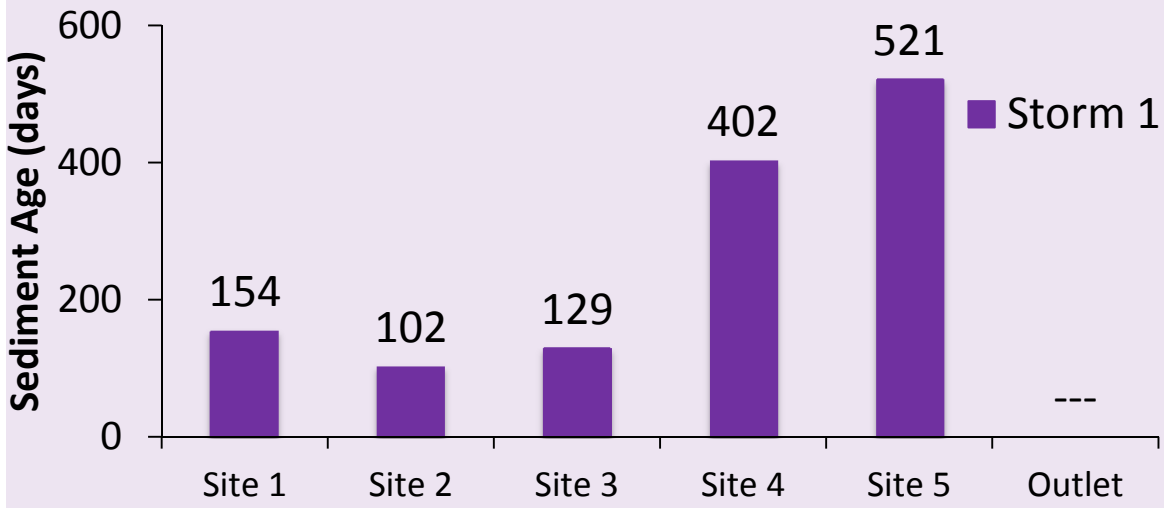


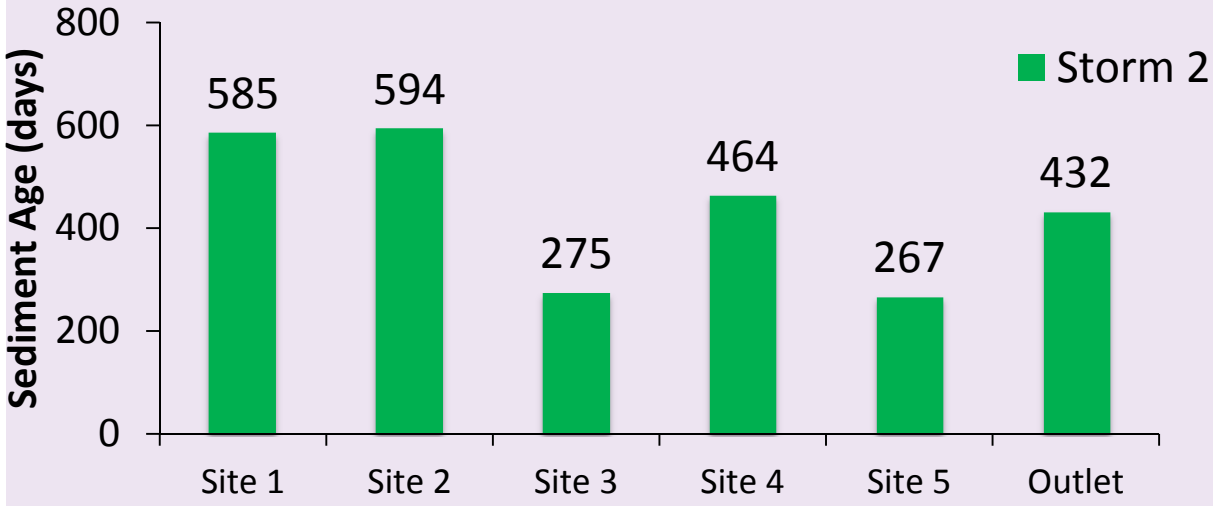


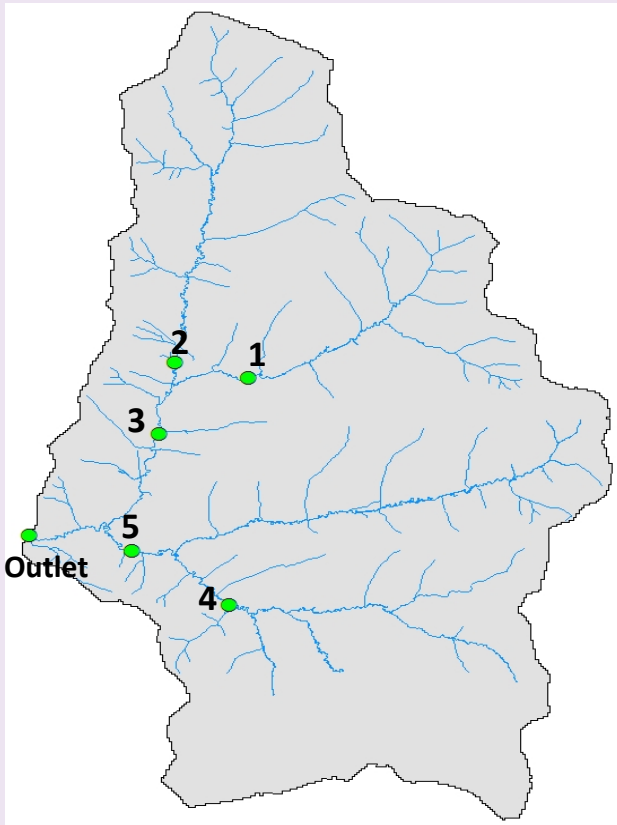


Results

Sediment Age

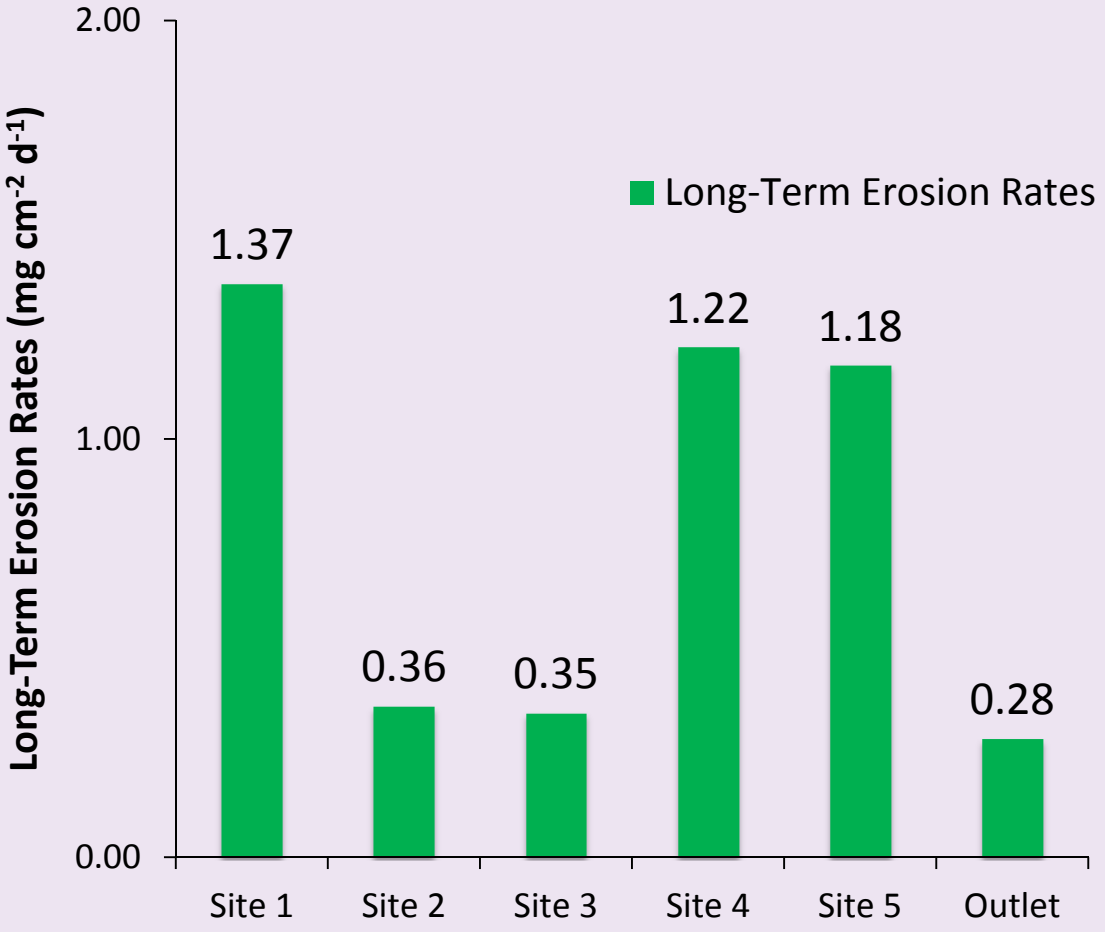


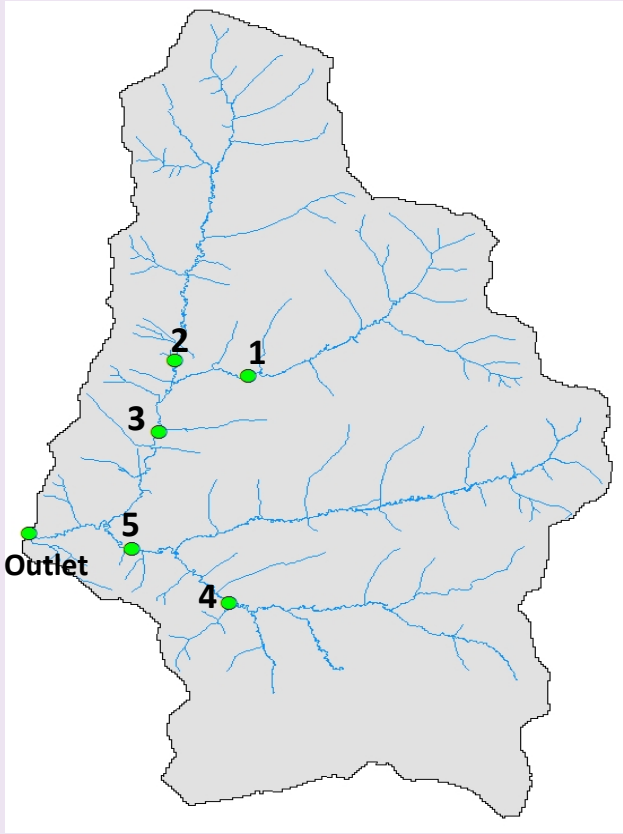




Results

Long-term Stream Bed Erosion Rates

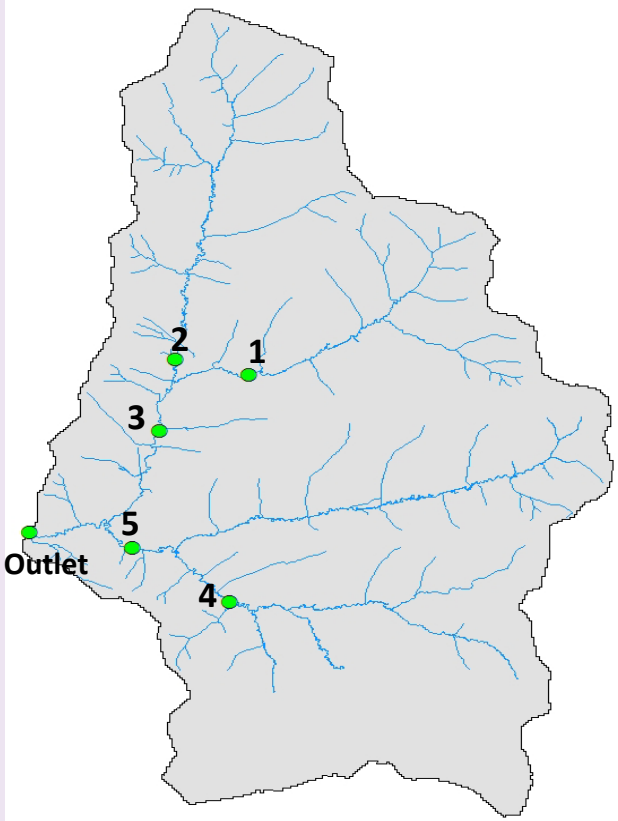




Results

Relative Contribution to In-stream Suspended Sediments

- Storm 1
  - ➢ Channel sources contributed more than 90% to in-stream suspended sediments at all sites.
- Storm 2
  - – At all sites except site 5, channel sources contributed 100% to in-stream suspended sediments
  - – At site 5 croplands contributed 52% to in-stream suspended sediments



Conclusions

- Channel sources (stream bank and stream bed) are the dominant contributors to in-stream suspended sediments.
- Stream bed can act as depositional or erosional as a function of rainfall event.
- Stream beds are eroding on a long-term scale.
- Minor contributions from uplands during smaller rainfall event.

References

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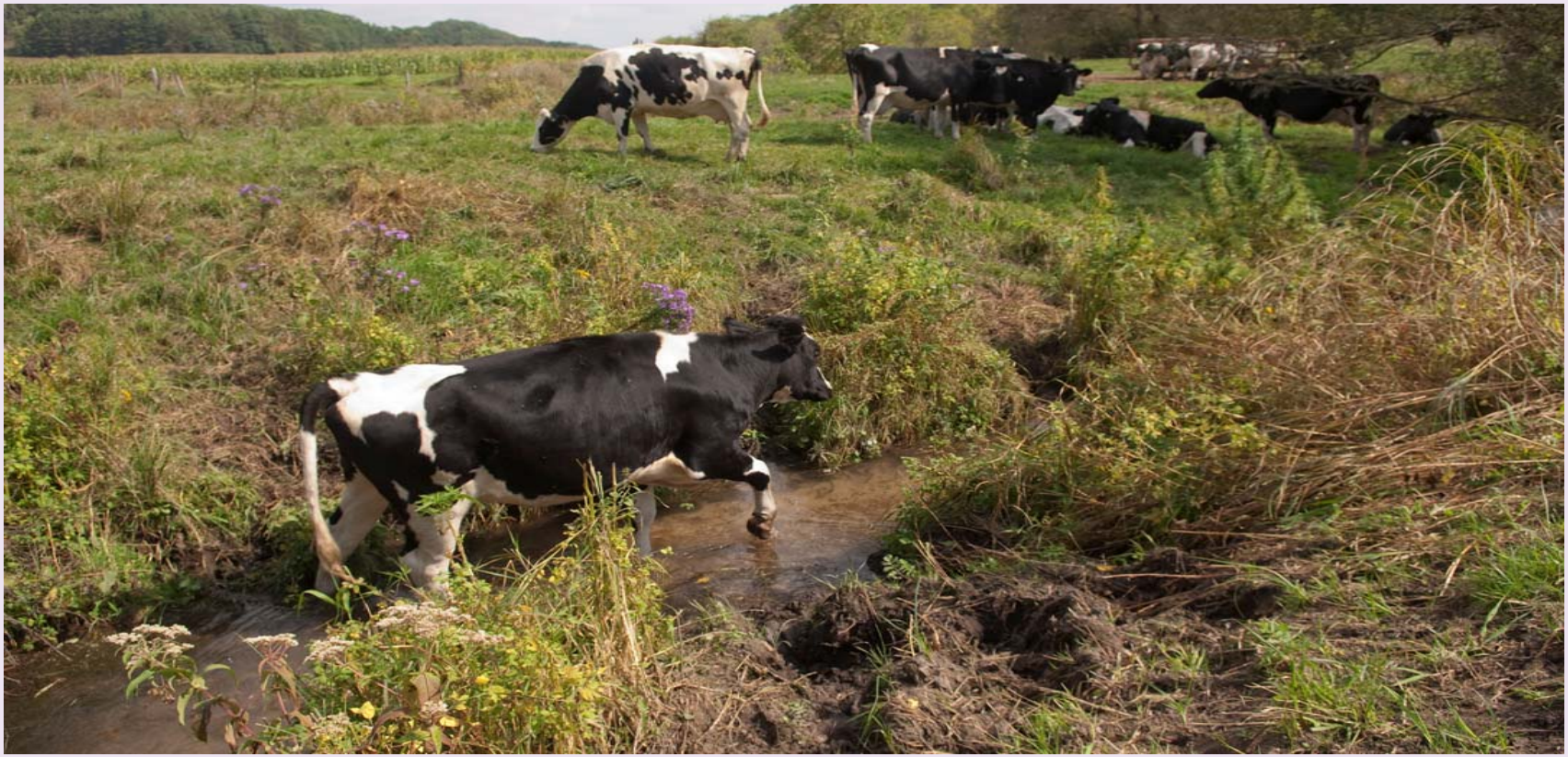
Thanks you!



Questions?