Quantifying Stored Sediment in Southwest Wisconsin Stream Channels

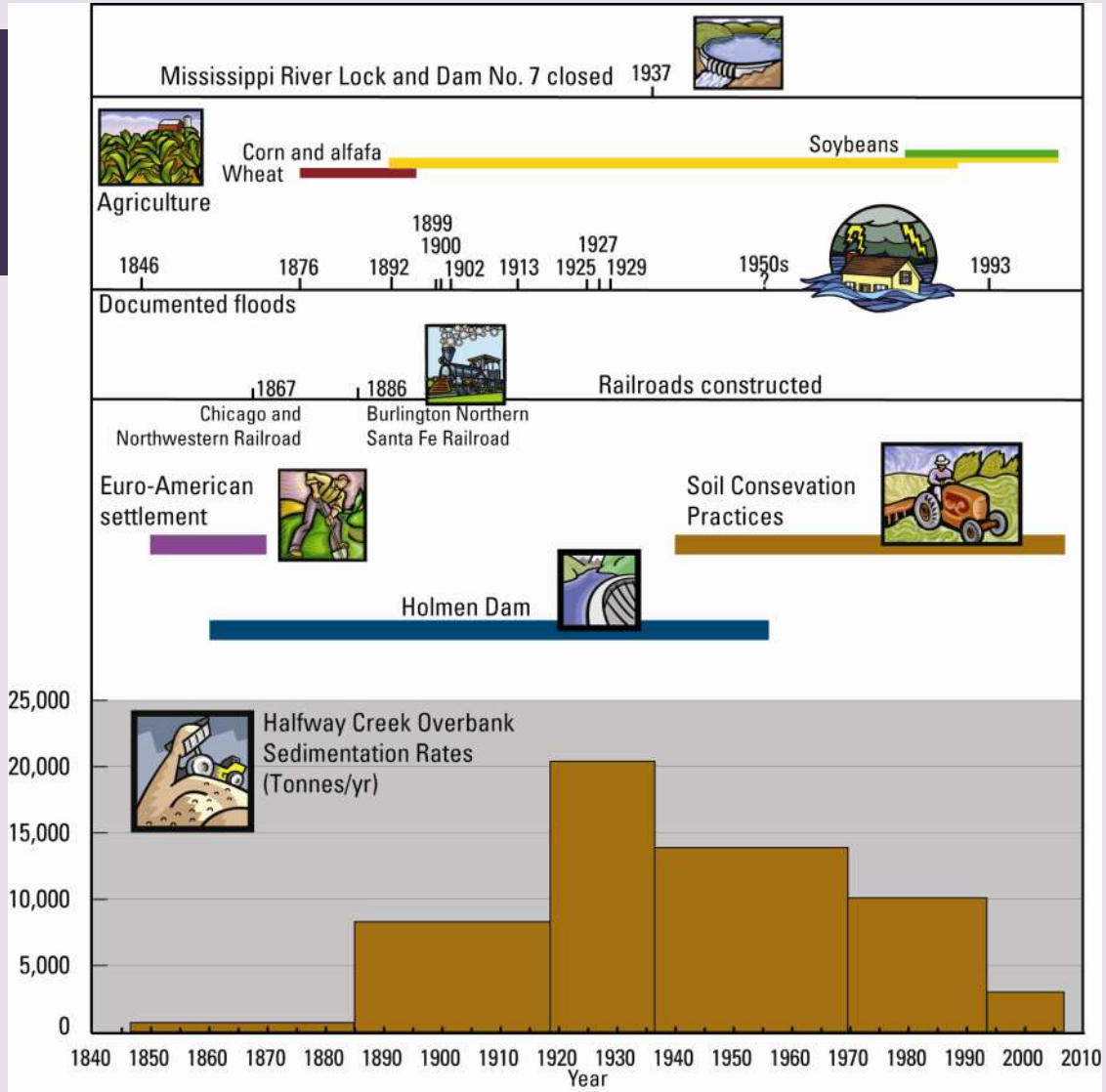
Robert Hansis
Faith Fitzpatrick

March 5, 2012 Minneapolis, MN

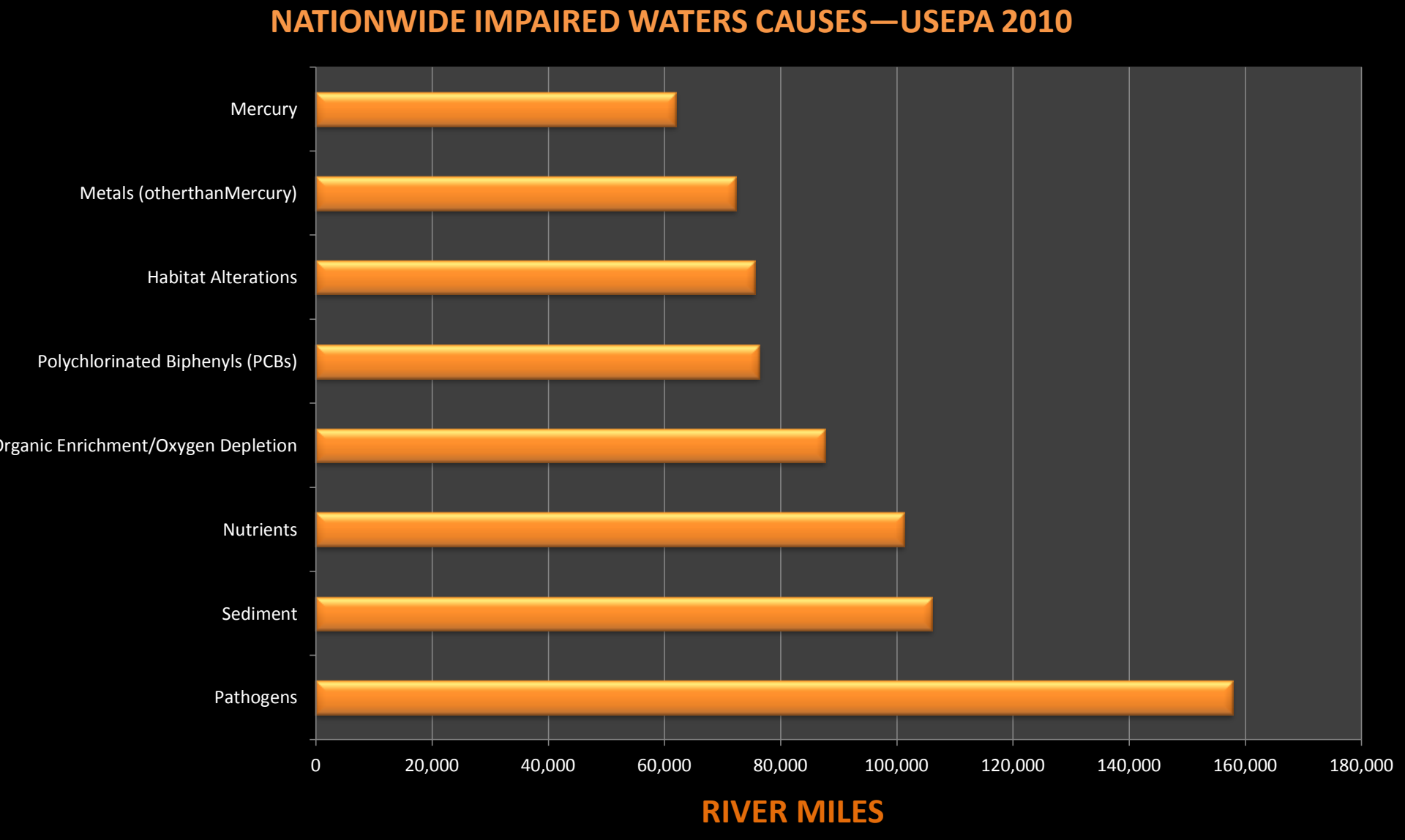
USGS

Historical sedimentation (and erosion) rates have decreased by an order of magnitude over the last 75 years because of widespread adoption of soil conservation practices

WI Driftless Area
Upper Mississippi River
Halfway Creek
(Fitzpatrick, et al. 2009)



Fluvial sediment is a national and global challenge



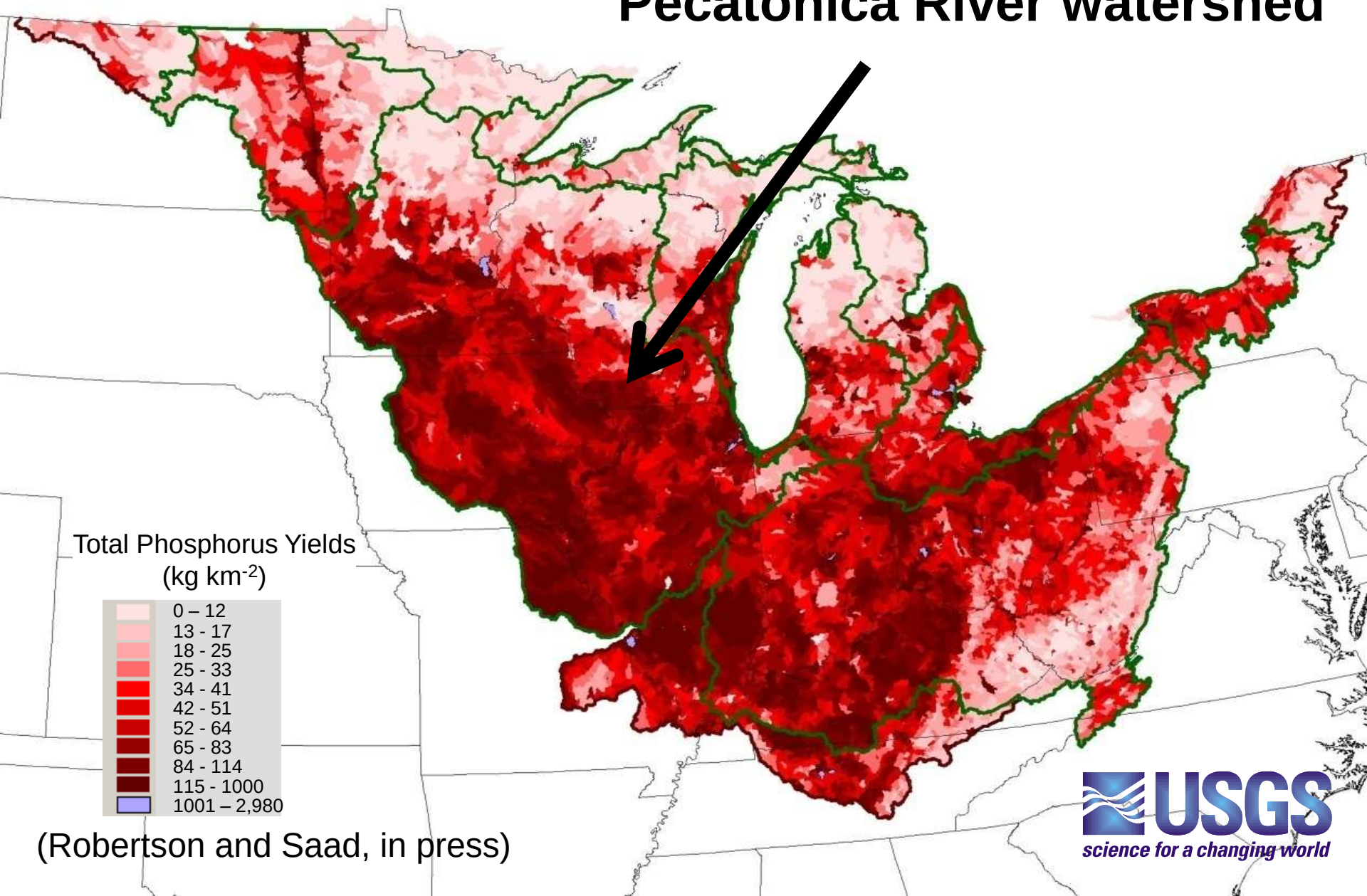
World Water Assessment Programme | Side publications series | SCIENTIFIC PAPER

United Nations Educational, Scientific and Cultural Organization
World Water Assessment Programme
UN WATER

The Sediment – Phosphorus connection:

SPARROW Total Phosphorus Yields

Pecatonica River watershed

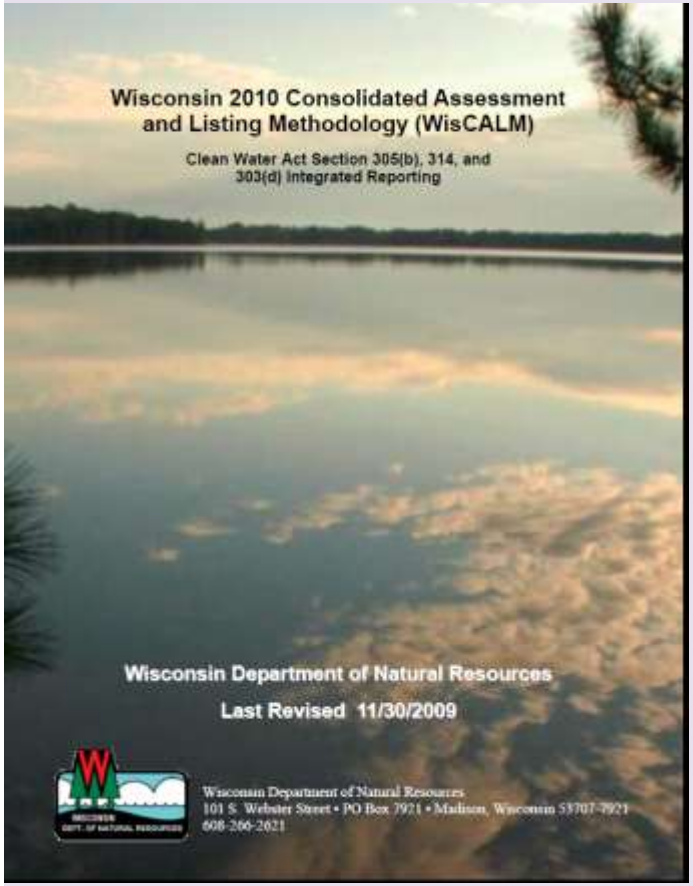


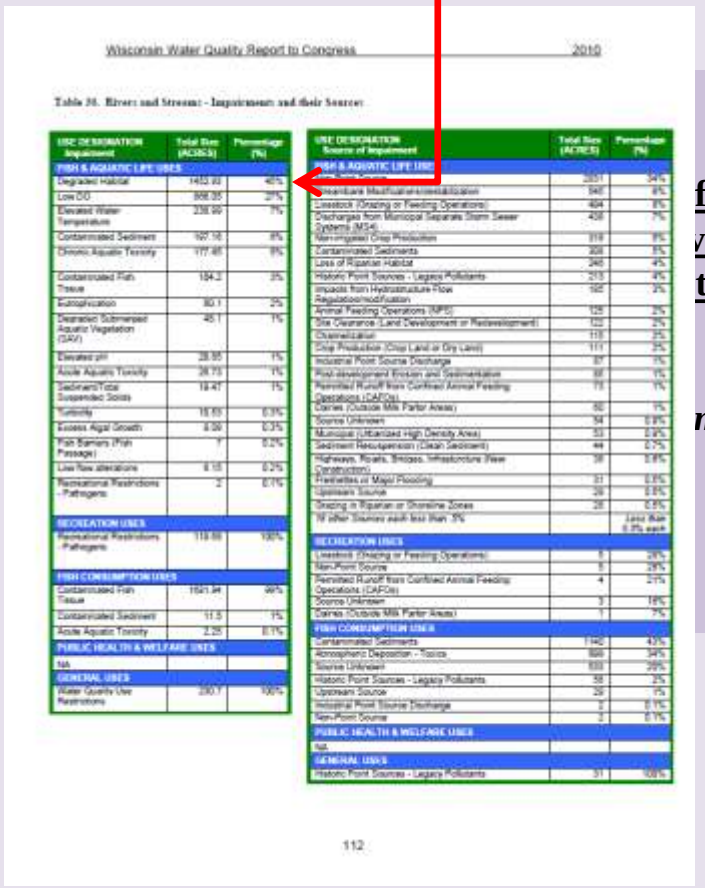
(Robertson and Saad, in press)

USGS science for a changing world

Siltation causes biological impairments

45% of stream impairments are habitat losses due to sedimentation





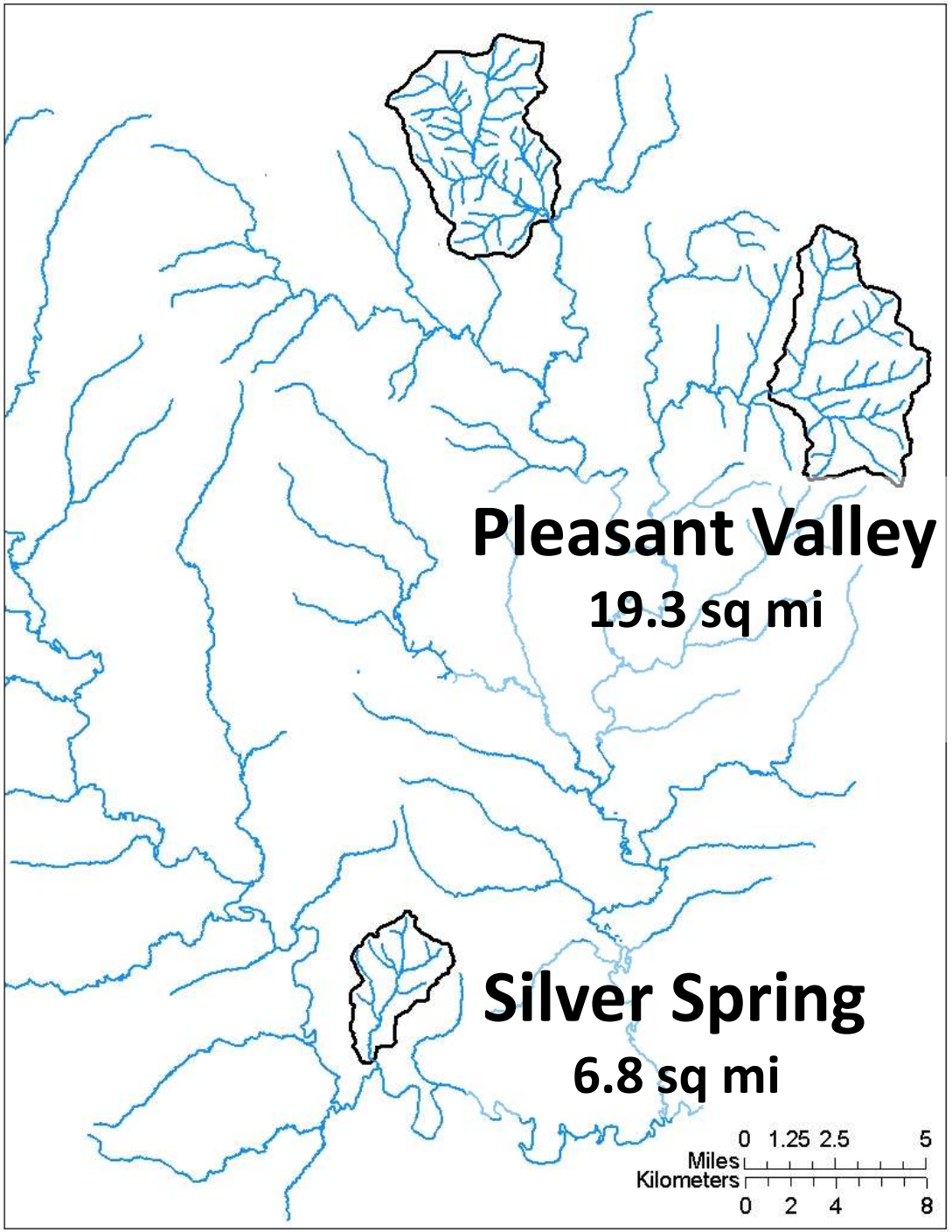
for
ve
t

ments)


VOLVO


VOLVO

STUDY LOCATION



Connecting Field to Stream Transport of Sediment

Identify watersheds that are major contributors

Target areas

Inventory major sources and sinks

Upland versus stream corridor

Photo Credit: WDNR (right); Rebecca Carvin (left)

Connecting Field to Stream Transport of Sediment

Identify watersheds that are major contributors

Target areas

Inventory major sources and sinks

Upland versus stream corridor

Target best management practices in areas with high losses

Stream corridor rehabilitation

Soil conservation

LAG TIME?

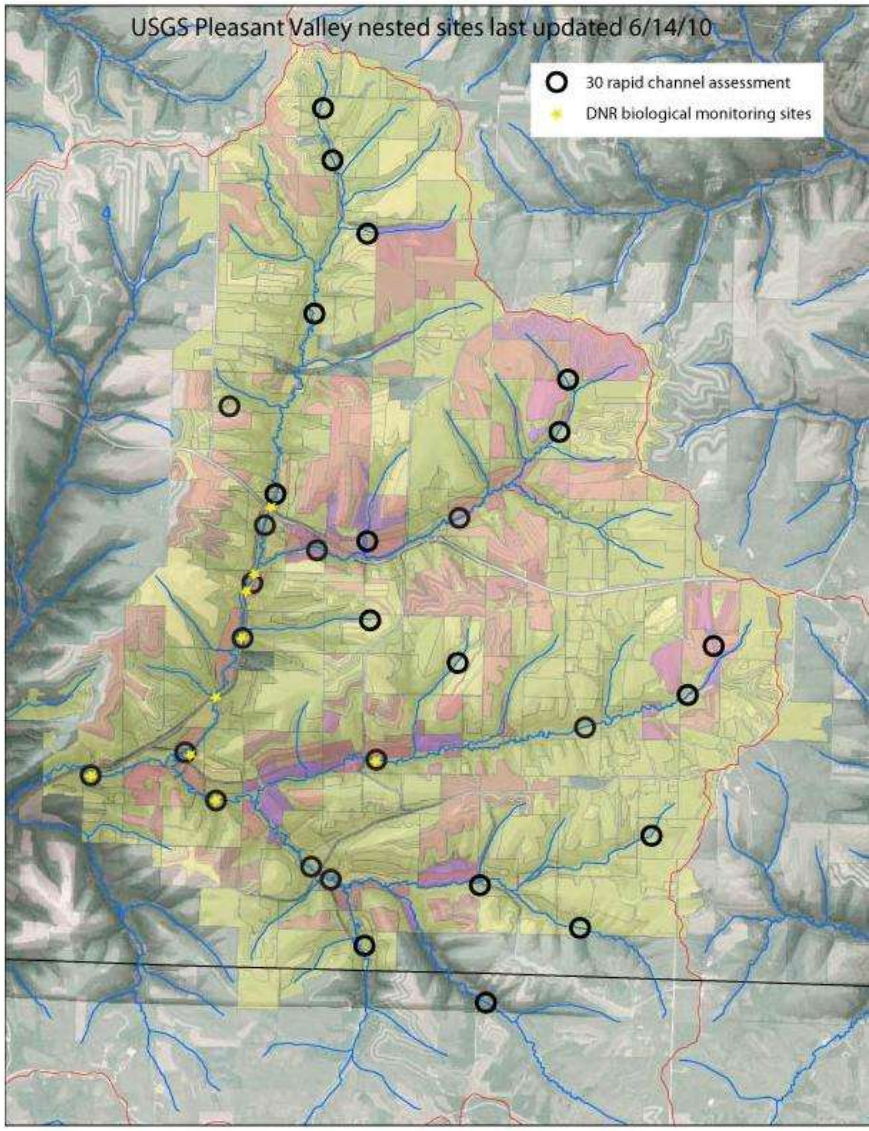
Evaluate effectiveness

geomorphology, water chemistry, habitat, biological response

Photo Credits: Rebecca Carvin (top), Mark Godfrey (middle), WDNR (bottom)

Upper Pecatonica Pleasant Valley Nested Design Baseline Assessment and Monitoring

- 30 total sites (2009)
  - Ephemeral and perennial throughout watershed
  - Rapid channel/sediment stability assessment
  - **Quantitative measurements of eroding banks and fine sediment deposition**
  - Low-flow discharge measurements
- 15 nested sites (2009-11)
  - Modified pebble counts
  - Bank, streambed, and soil samples for particle size, total P, organic matter, and radioisotopes
- 10 nested sites
  - Channel cross sections (2010-11)
  - Historical macroinvertebrate, fish, and habitat surveys (2008-10)
  - Resurveys of fine sediment deposition using updated mapping techniques (2011)
- 6 nested sites (2010+)
  - Walling suspended sediment tube samplers for event based sediment fingerprinting
- 1 streamgage at outlet (2006+)
  - discharge, total P and suspended sediment loads



SILVER SPRING CREEK RAPID CHANNEL ASSESSMENT

Stream Name: Silver Spring

Date: 6-2-15

Location Description: Bell Farm

Field Crew:

Weather: Clear, Partly Cloudy, Sunny, Rain, Snow, Windy, Breezy, Air temp: 70

River Stage: Low, Normal, Flood, Falling, Rising, Stable, Low, Stable, High, Not Determined

GPS Waypoint Upstream: SS1

GPS Waypoint Downstream: SS2

Habitat Type

T5 W=56

T4

T3

T2

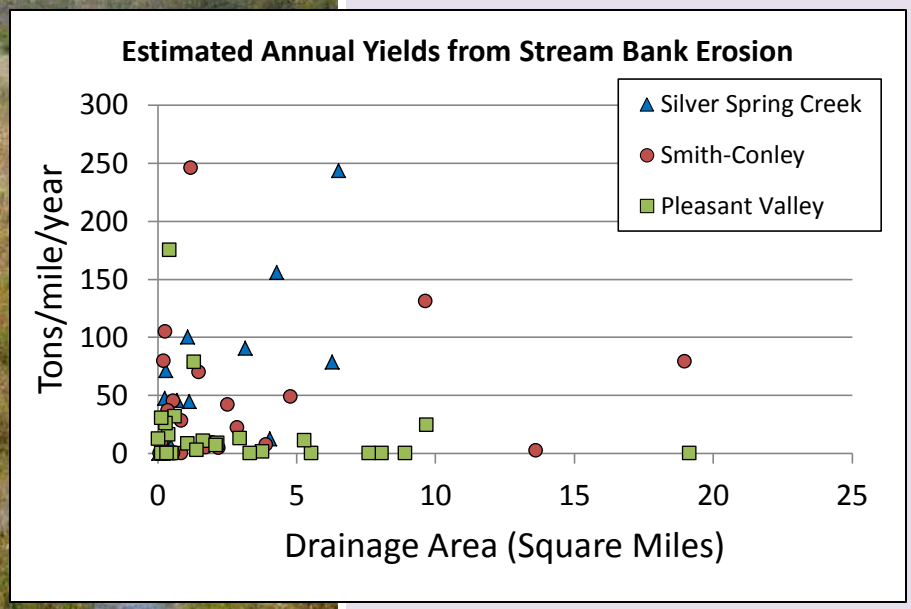
T1

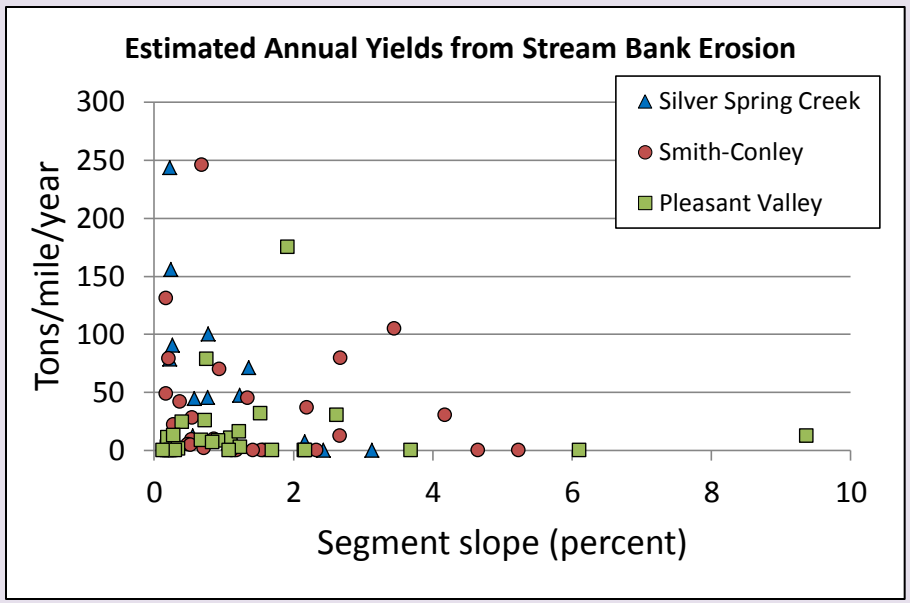
559

558

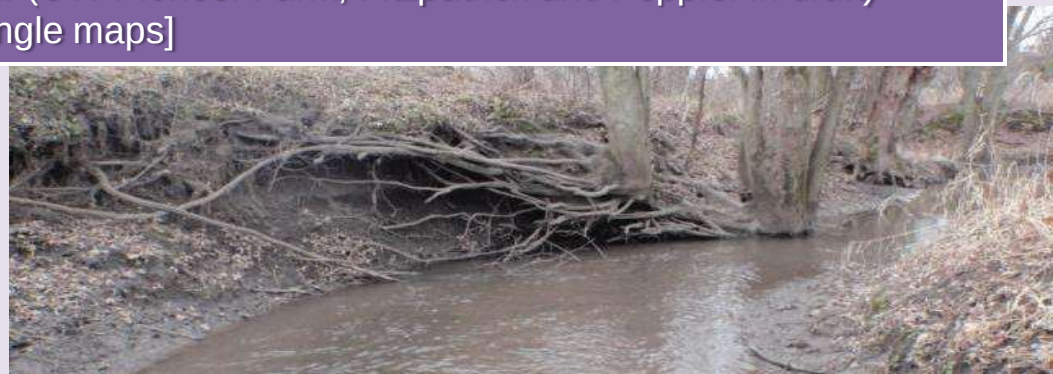
7' dia

Bank Erosion Preliminary Sediment Yields by Drainage Area and Slope





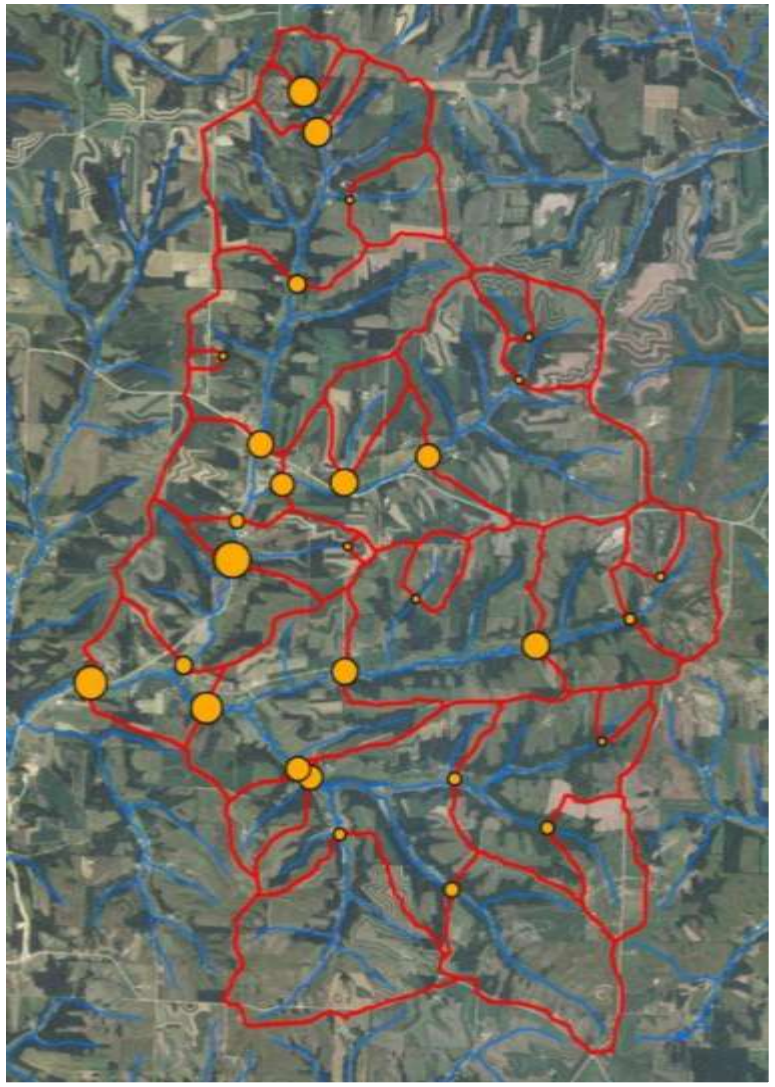
[Yields based on:
* surface area of bank erosion measured during 2009-10 rapid channel assessments
* estimated mean annual retreat rate = 0.13 ft/year (UW Pioneer Farm; Fitzpatrick and Peppler in draft)
Segment slopes measured from 1:24,000 quadrangle maps]



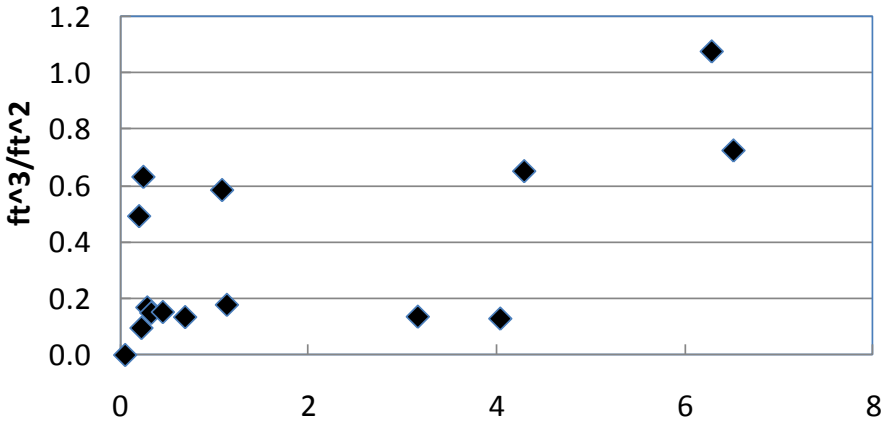
USGS

Fine Sediment Deposition
Highly variable within watersheds

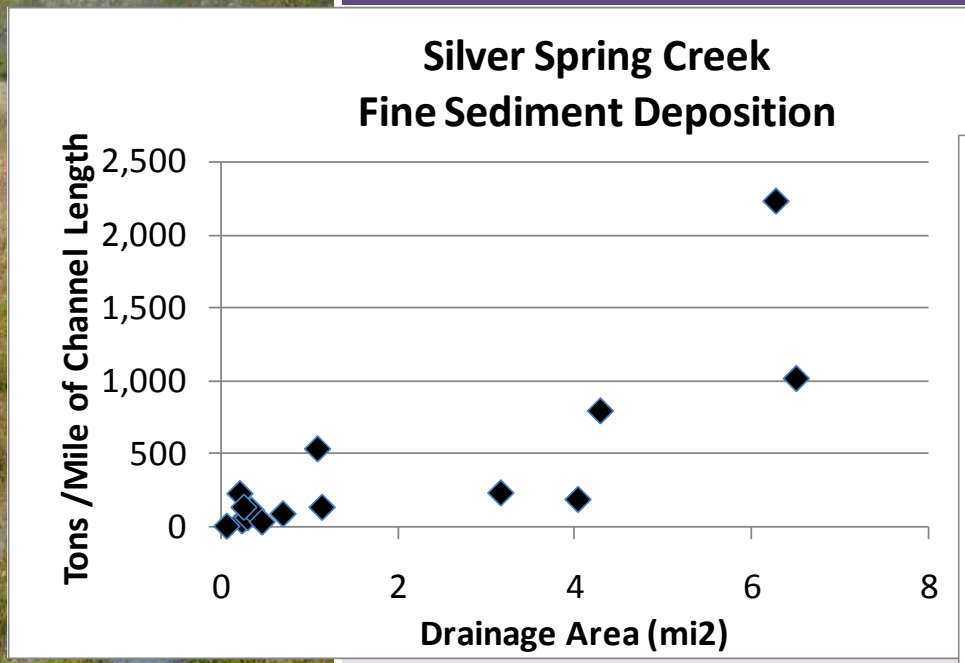
PLEASANT VALLEY
Rapid Channel Assessment
2009
Fine Sediment Deposition
(Average = 0 to 0.54 ft^3/ft^2)

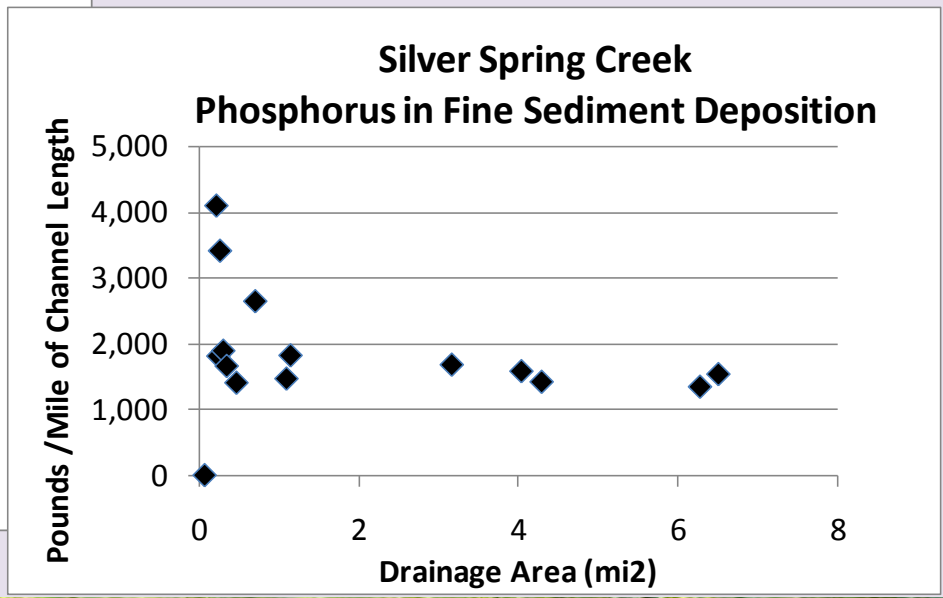


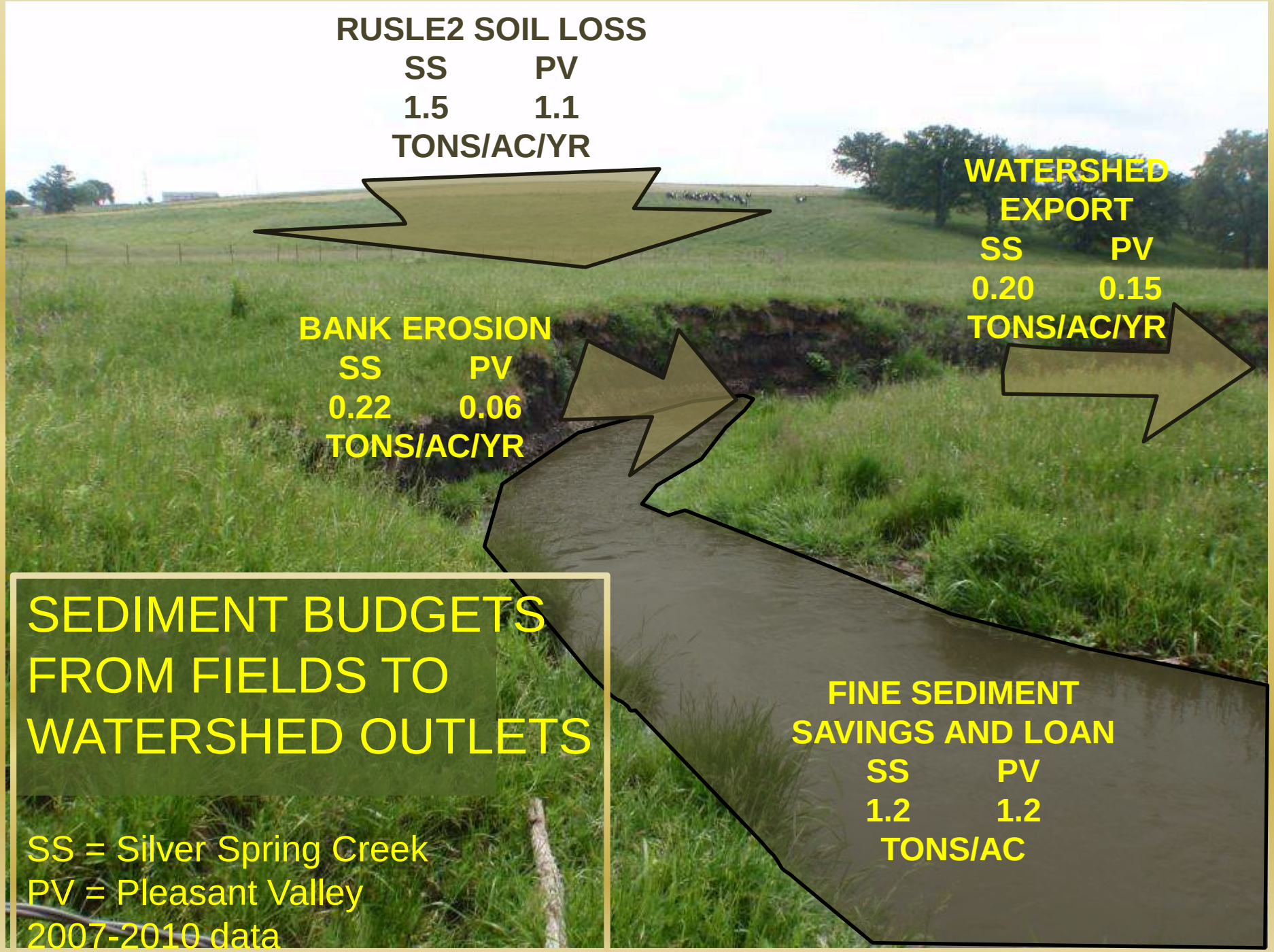
SILVER SPRING CREEK
2010 Fine Sediment Deposition



Fine Sediment Depositional Areas
Sediment and Phosphorus "Savings and Loan"



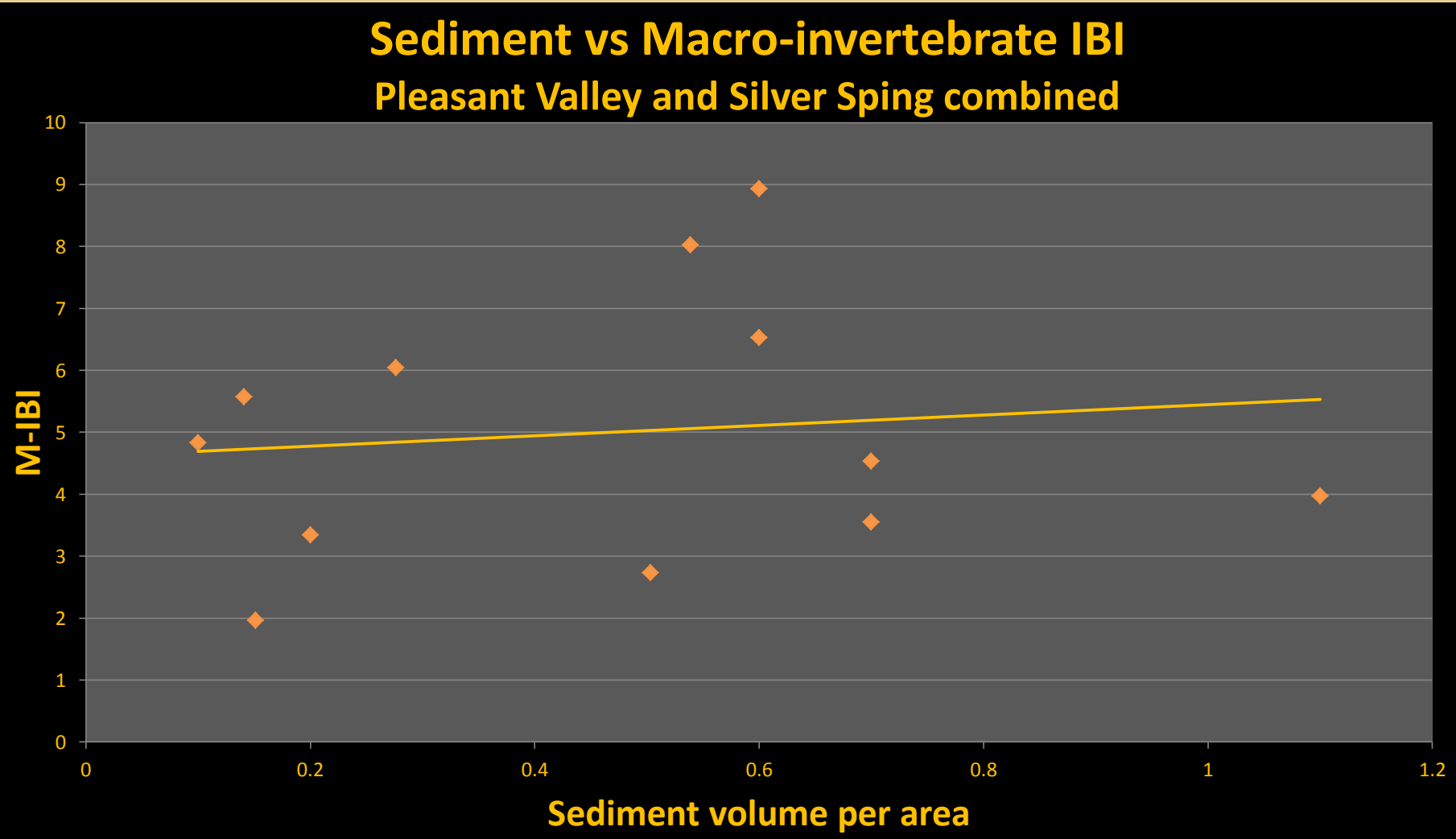




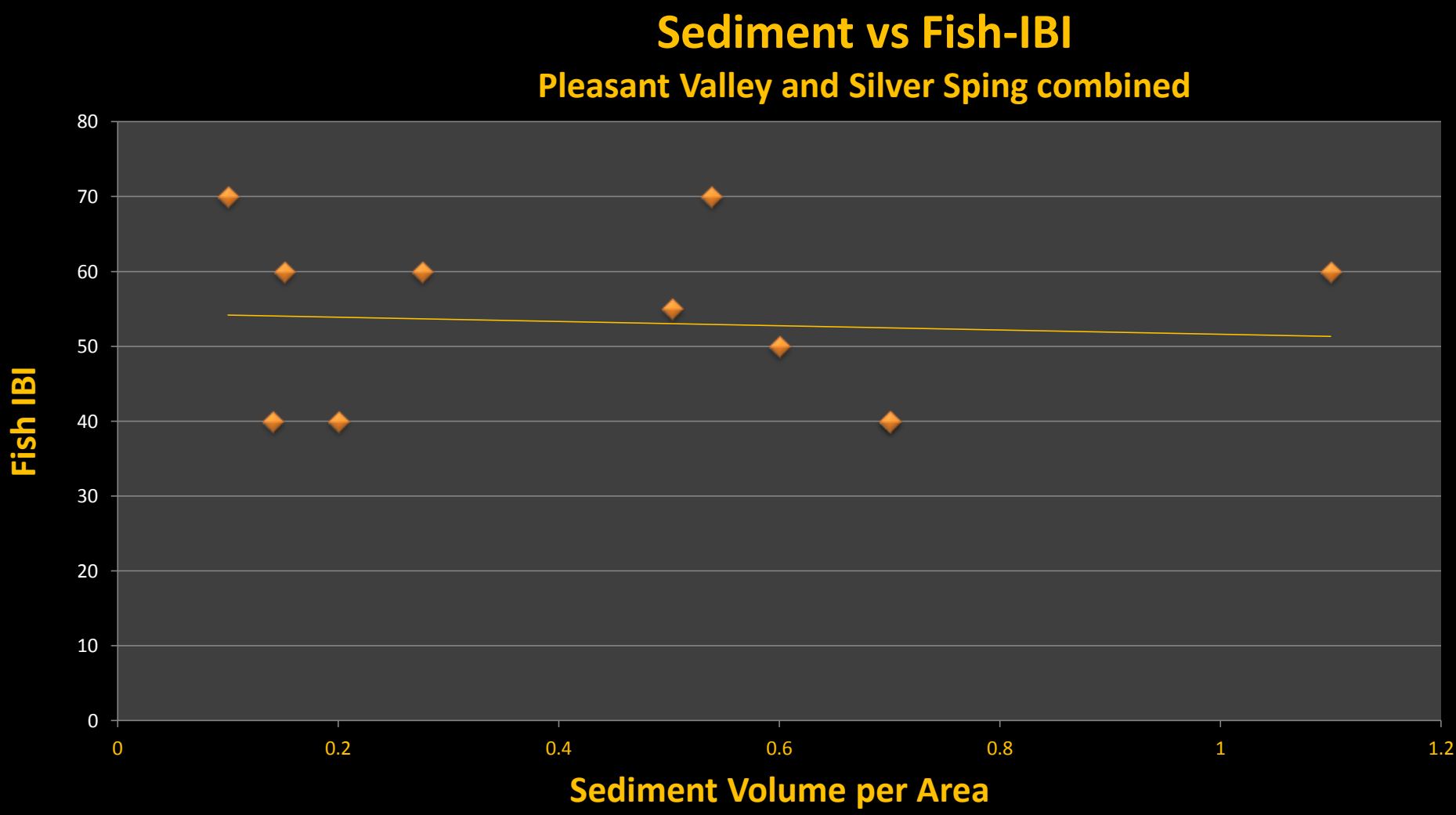
SEDIMENT BUDGETS FROM FIELDS TO WATERSHED OUTLETS

SS = Silver Spring Creek
PV = Pleasant Valley
2007-2010 data

Factors other than fine sediment influence stream biological health



Factors other than fine sediment influence stream biological health



IS TRAPPING A SOLUTION?

USGS

Conclusions

- Fine sediment deposition in channels is an important source of sediment and nutrients in Driftless Area streams and should be included in sediment budgets
- Bank erosion is also a significant contributor to sediment and nutrients, but its importance varies from site to site
- Quantification of in-place sediment along with bank erosion (and overbank sedimentation) helps managers partition resources between upland practices and stream restoration techniques
- Quantification of channel sources and sinks help determine the lag effects from field-scale best management practices to improvements in aquatic biological integrity

STUDY PARTNERS AND FUNDING

- Dane County, Land Conservation Division
- Lafayette County, Department of Land Conservation
- Iowa County Land Conservation Department
- Green County Land Conservation Department
- University of Wisconsin-Madison
  - Biological Systems Engineering
  - Soil Science
  - Nelson Institute of Environmental Studies
  - Agricultural and Applied Economics
  - Civil and Environmental Engineering
- University of Wisconsin-Extension
- U.S. Geological Survey
- Natural Resource Conservation Service
- Wisconsin DNR
- Wisconsin DATCP
- The Nature Conservancy
- Monsanto Corporation
- McKnight Foundation
- USDA Cooperative State Research, Education, and Extension Service

Robert Hansis
Madison, WI
rhansis@tds.net
[608] 957-6440

Faith Fitzpatrick
USGS Wisconsin Science Center
fafitzpa@usgs.gov
[608] 831-3818