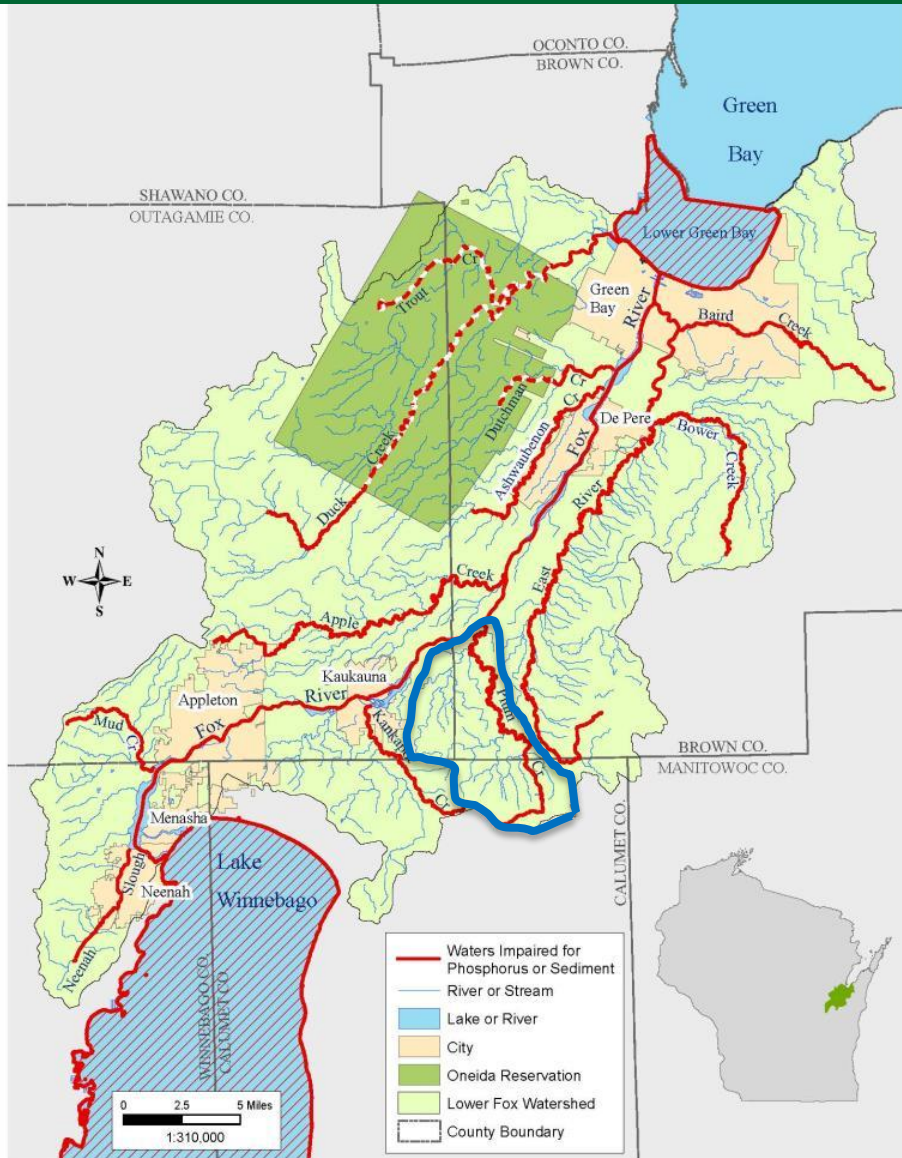


DEVELOPMENT OF A WATERSHED MODEL TO ASSESS ALTERNATIVE MANAGEMENT STRATEGIES IN AN AGRICULTURAL WATERSHED VULNERABLE TO HIGH SEDIMENT AND P RUNOFF



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Map of Lower Fox River Basin and Green Bay



The Mouth of the Fox River. April 12, 2011

Credit: Steve Seilo

27 Impaired Water Body Segments by Phosphorus and/or Sediment

Approved TMDL 2006-2012

Water Quality criteria:

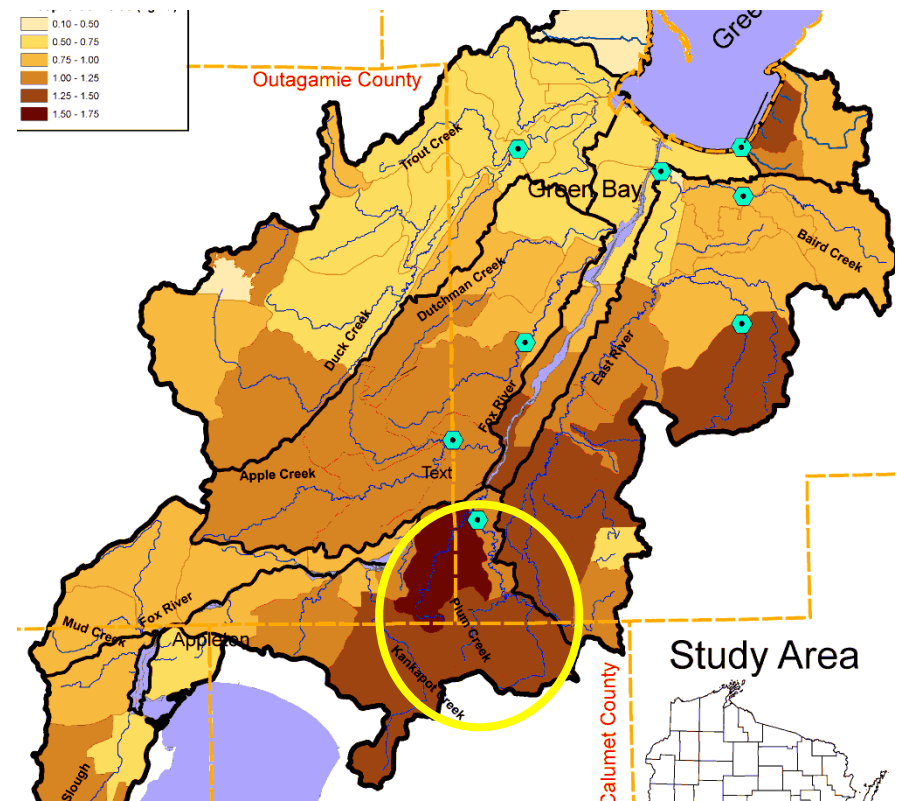
Lower Fox River: 0.10 mg/L TP

Tributary Streams: 0.075 mg/L TP

Source: TMDL Plan, WDNR 6/2010; 12/2011

Plum Creek

- Highest P and TSS contributor per unit area to the Lower Fox River (>93% nonpoint)
- Major reductions needed
 - **70% TSS** of baseline
 - **77% TP** of baseline

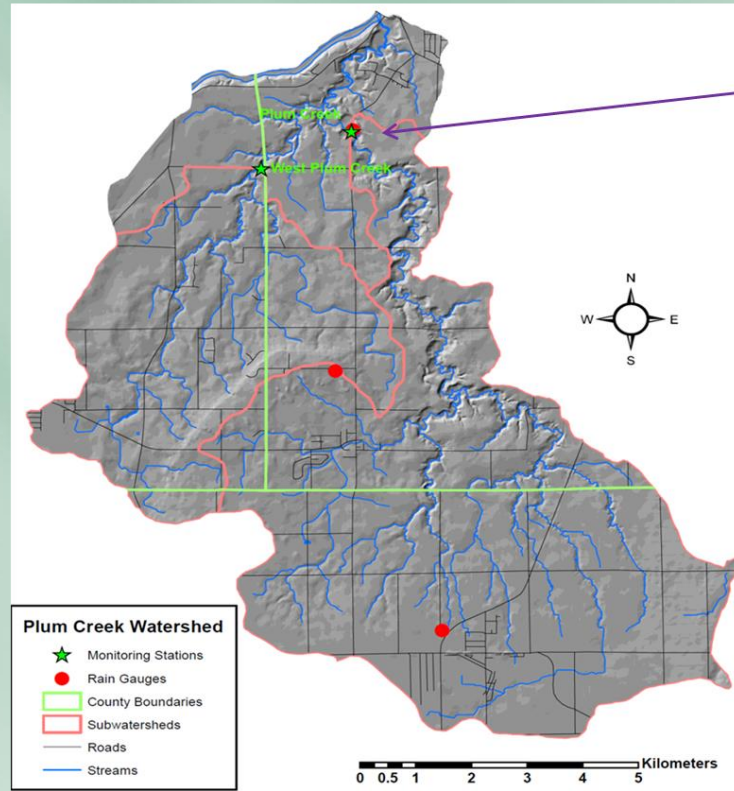


APPROACH

- **Soil Water Assessment Tool (SWAT)** model to assess water quality and hydrologic response under **various climate and alternative land use/management** conditions in the West Branch subwatershed (33.7 km²) of Plum Creek.
- Water quality data collected primarily at the **Main Branch** (58.6 km²) subwatershed monitoring station in Water Years 2011 and 2012 are being used to calibrate the model (>400 total samples).
- **WY 2013 data from the Main Branch and near-instantaneous loads from the West Branch station will be used to validate the SWAT model.**
- West Branch loads: based on correlations between **discrete constituent concentrations and continuous turbidity** observations ($R^2 > 0.97$, $p < 0.0001$).
- This presentation focuses on model development, calibration and validation aspects of the overall study.
- Application of the model to development of effective and efficient alternative land management strategies for the West Plum watershed is planned.



Land management and water quality in West Plum watershed.

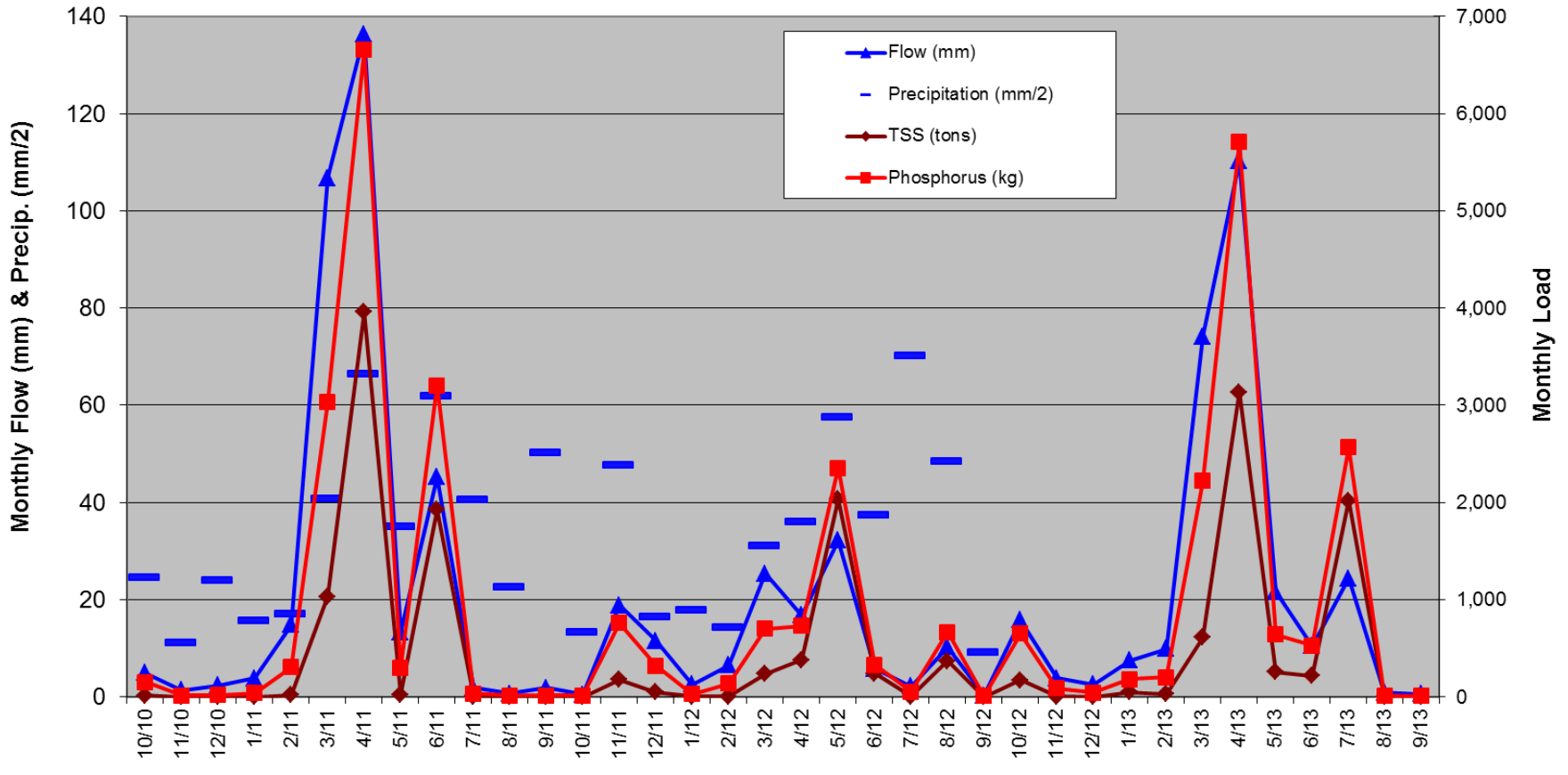


**Figure 2: UWGB/USGS
Main Plum Creek
Monitoring Station**

- Stage measurements
- Flow measurements
- Automated Event Sampler
- Manual Low flow samples
- Analyzed for TP, DP and TSS
- Loads (daily → annual)

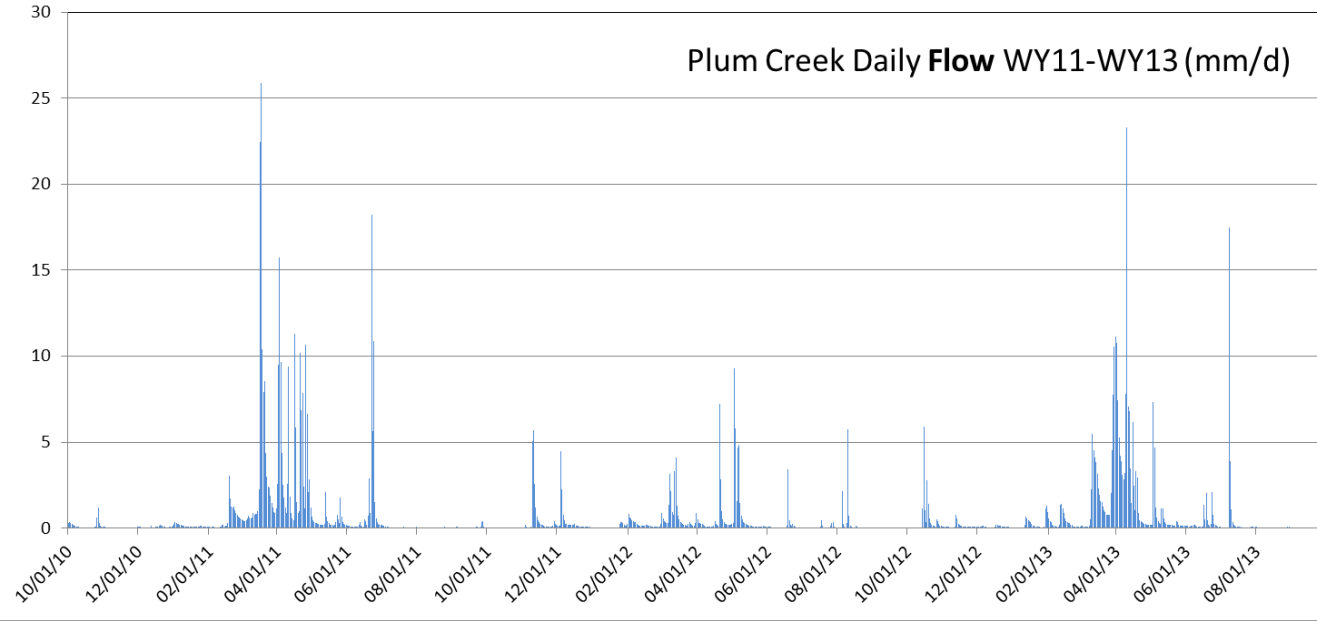


Monthly Flow, TSS and Phosphorus Loads at Plum Creek: WY 2011-2013



	Flow (mm)	Sed (ton)	P (kg)
PLUM Creek at USGS Station			
WY2011	333	6,979	13,804
WY2012	133	3,509	6,122
WY2013	282	6,504	12,868
yields (ha)		1.042	2.011

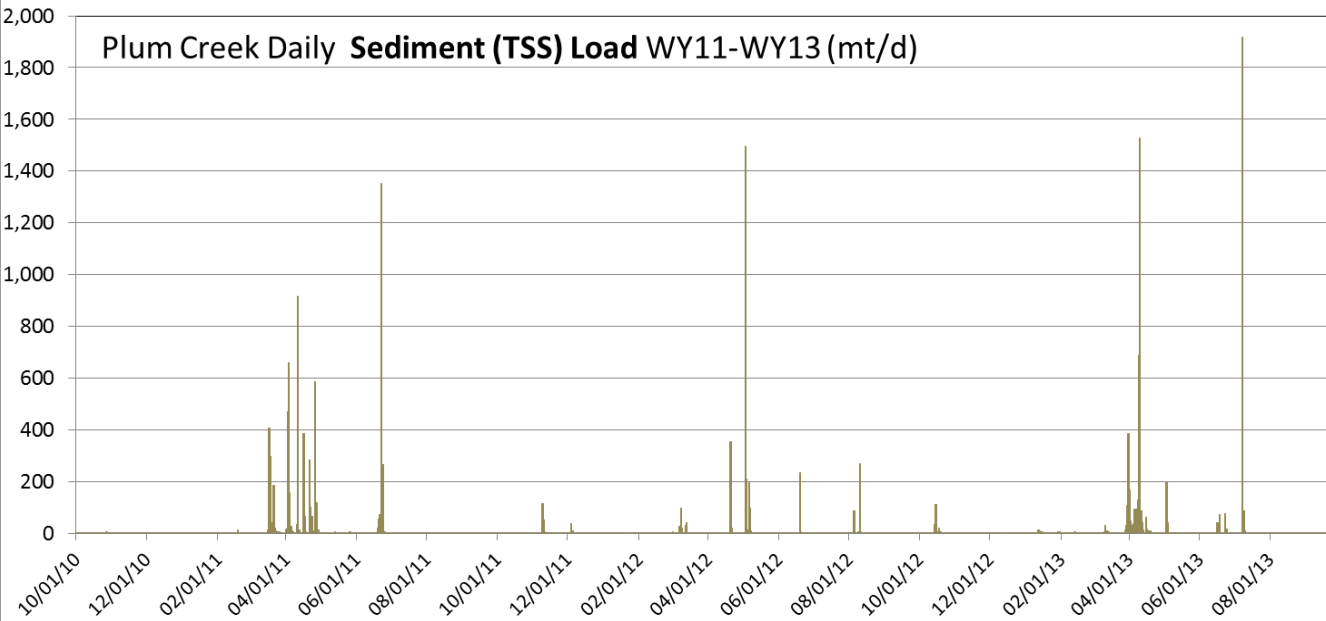
Plum Creek Daily **Flow** WY11-WY13 (mm/d)

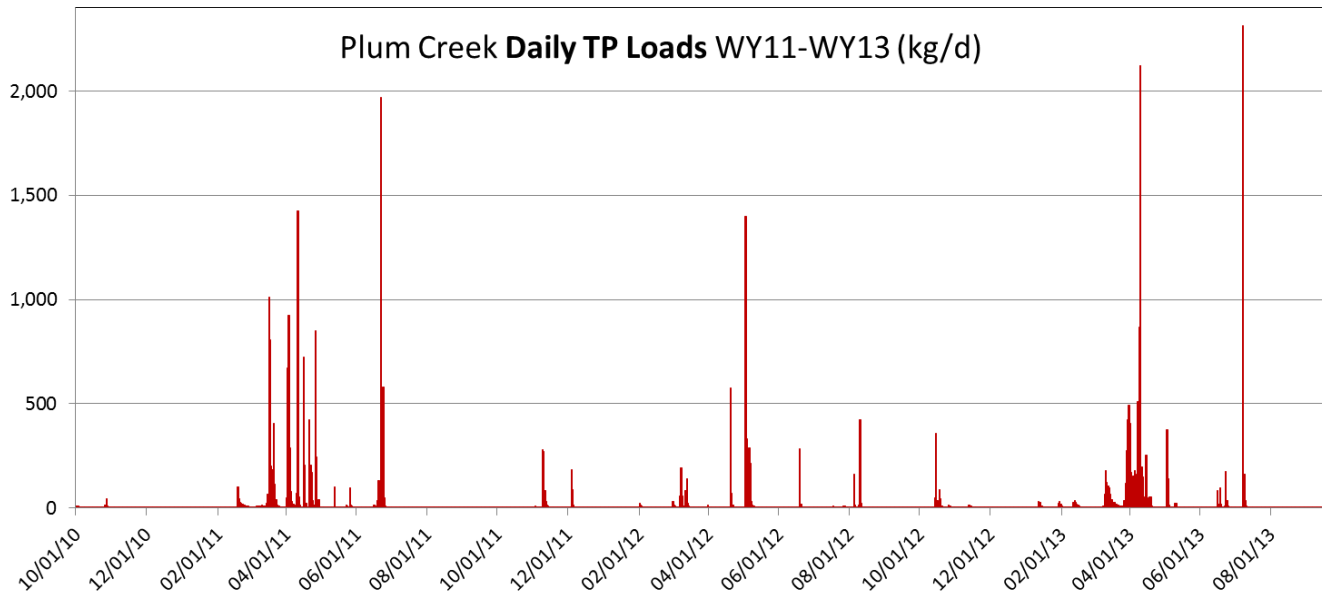
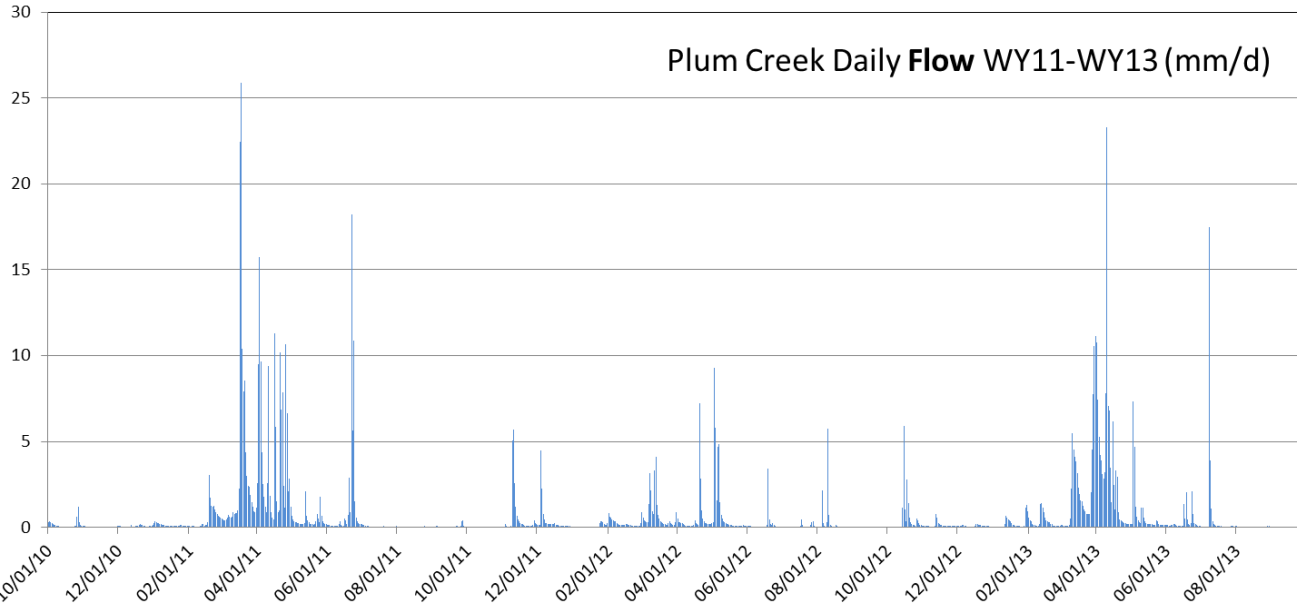


Daily TSS Loads Plum Creek 2011 - '13

- 5 days in 3 yr w/ ~1,000,000+ kg

Plum Creek Daily **Sediment (TSS) Load** WY11-WY13 (mt/d)

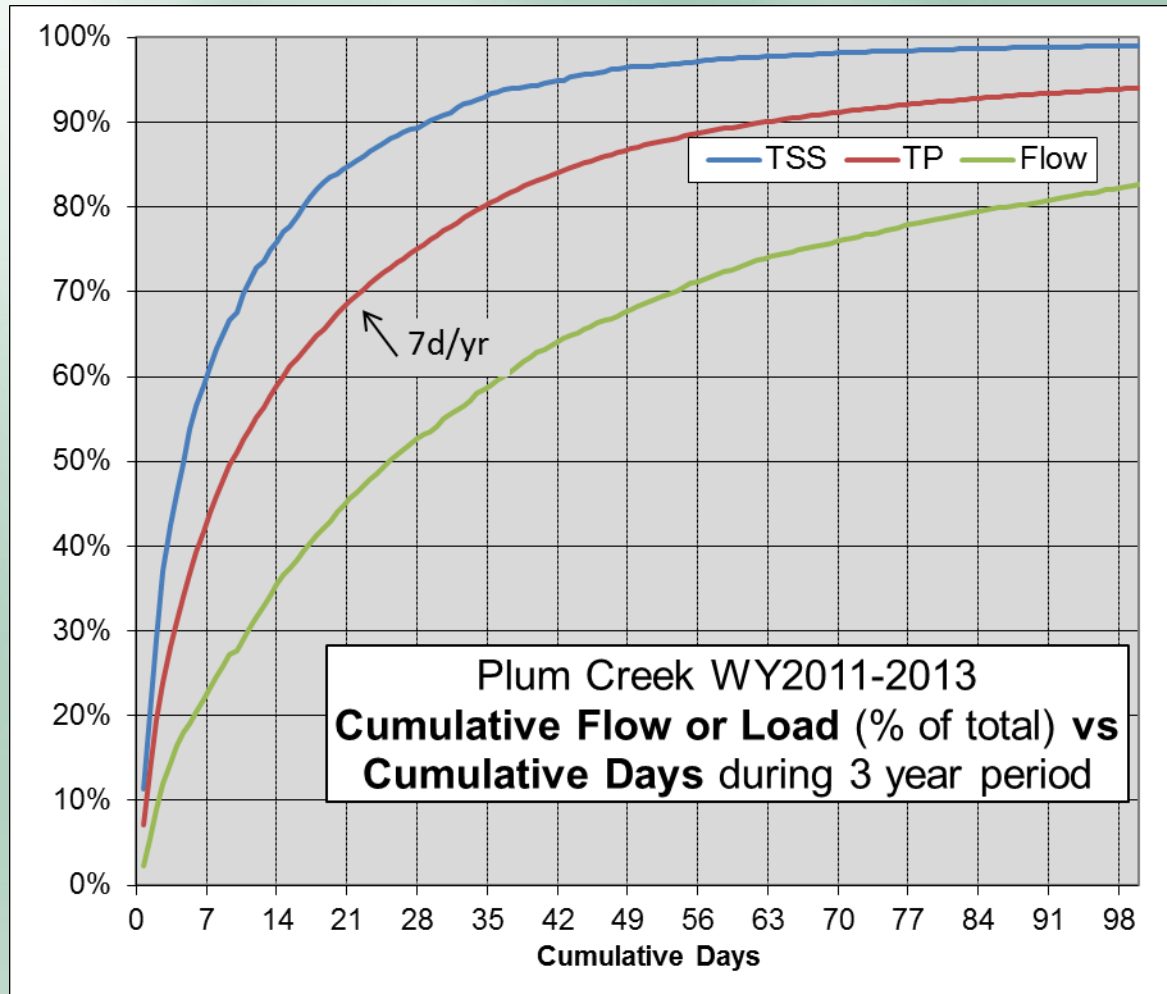




Daily TP Loads Plum Creek 2011 - '13

- 6 days in 3 yr w/
~1,000 kg





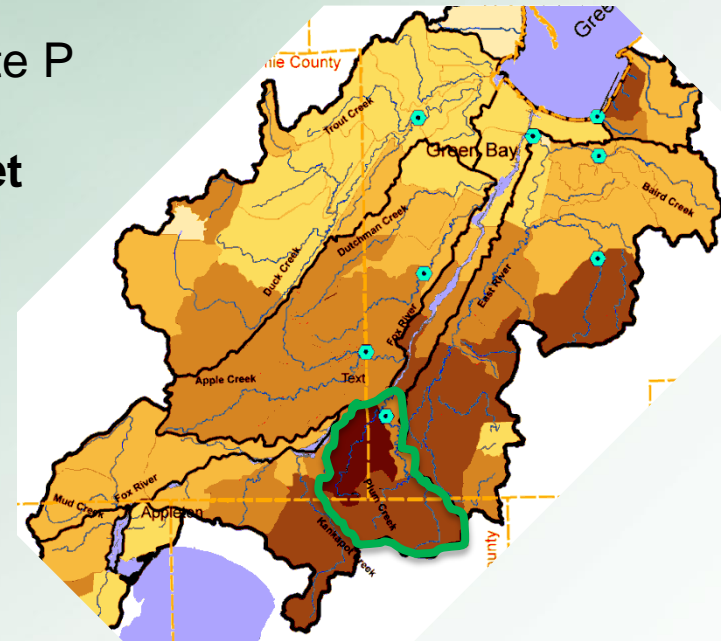
- ~68% of annual TP load occurred in 7 days/yr (~4 events)
- 85% of annual TSS load occurred in 7 days/yr



PLUM CREEK WY LOADS AND TMDL TARGETS

	WY 2011	WY 2012	TMDL Baseline	TMDL Targets
Extrapolate to Entire Watershed				
TSS Load (metric ton)	14722	7402	5460	1610
TP Load (kg)	26701	11842	14310	3262
DP Load (kg)	7544	3548		

- WY12 loads about ½ of WY11 and WY13
- About 30% of load was as DP → 70% was particulate P
- **Average TSS & TP load was >7 times TMDL target**
- Plum Creek Load
= >20% of ALL Point Source Loads in Fox-Wolf
= >30% of ALL Point Source Loads in LFB





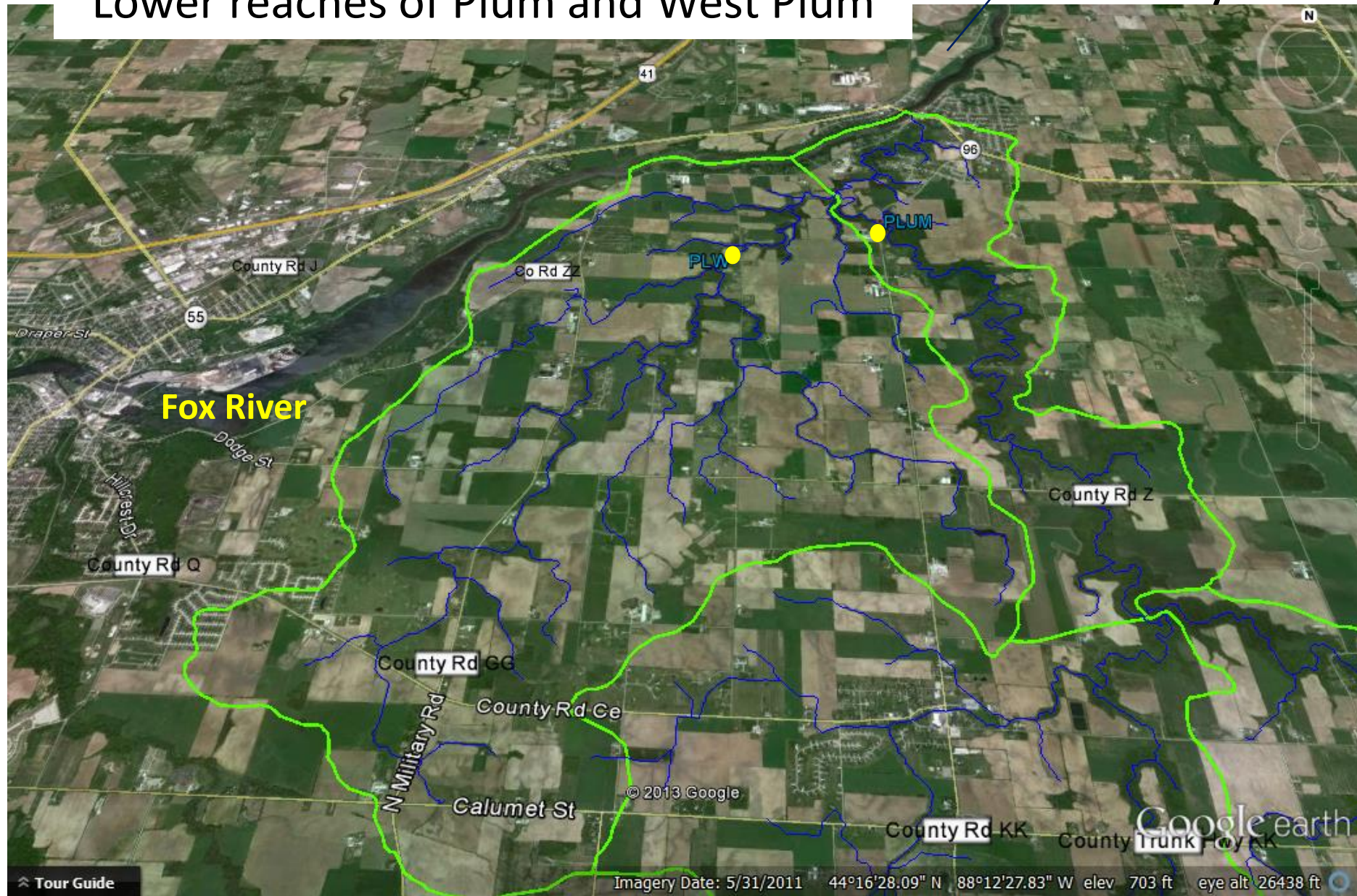
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Lower reaches of Plum and West Plum

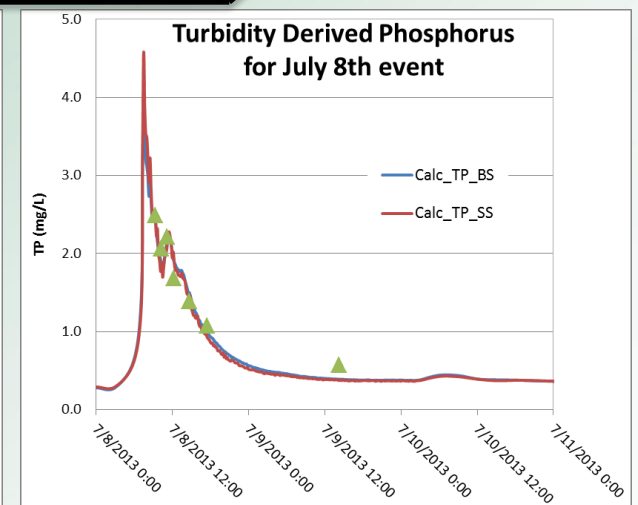
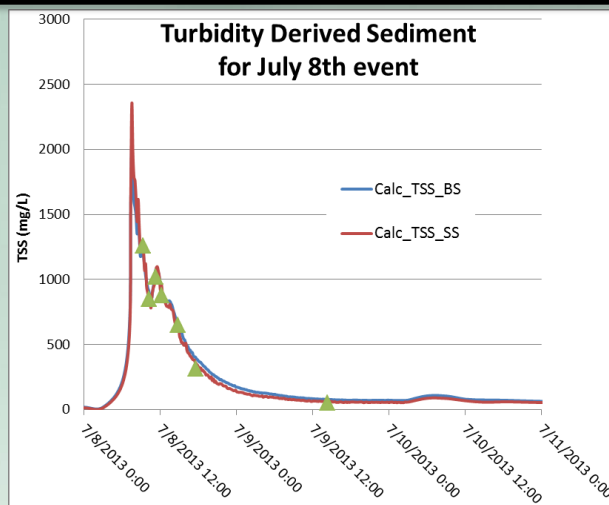
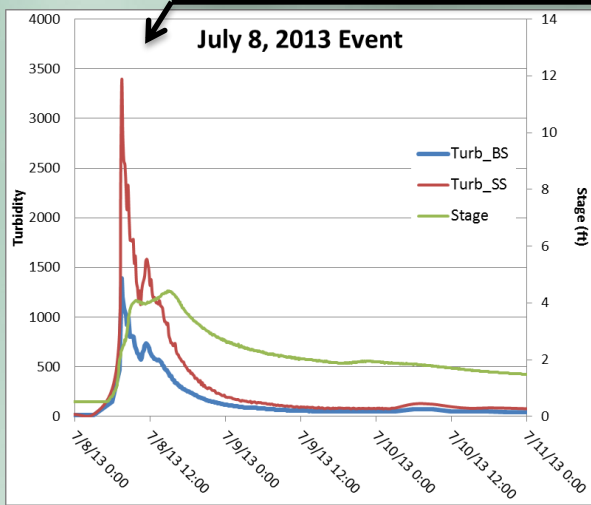
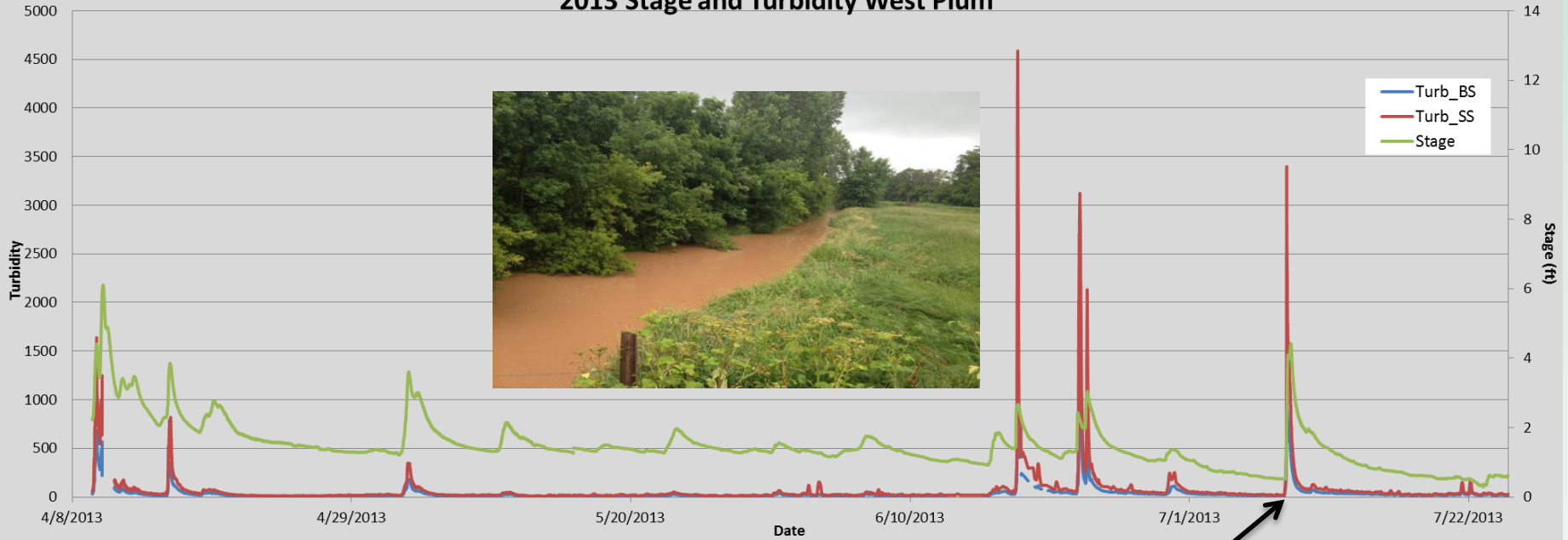
to Green Bay



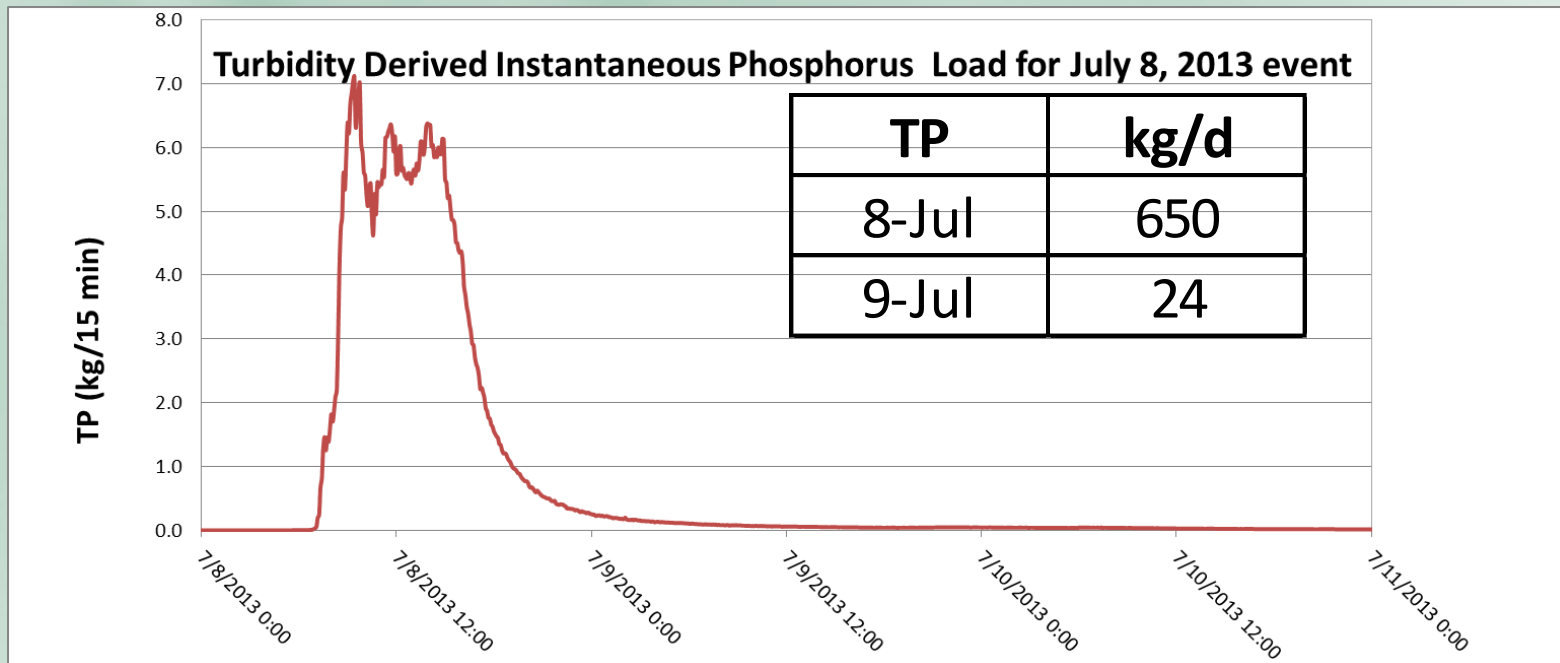
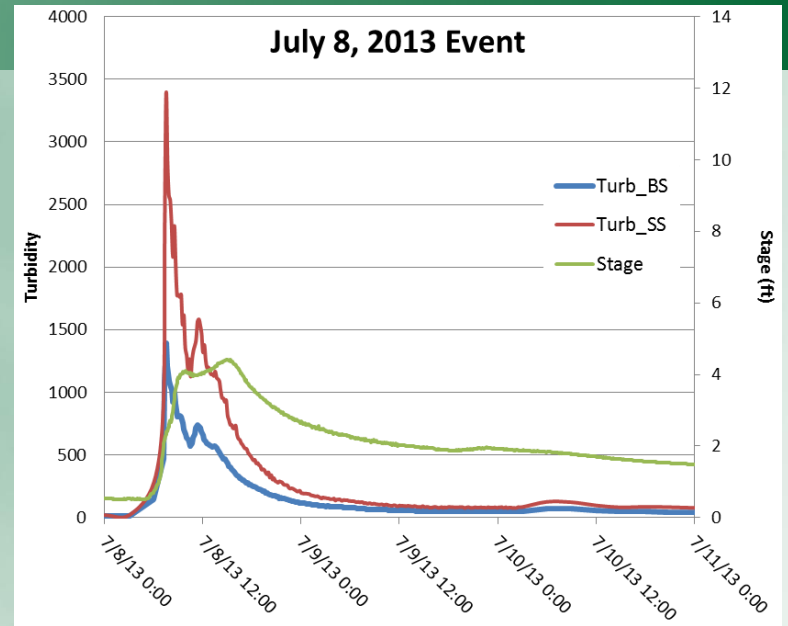
Tour Guide

© 2013 Google Imagery Date: 5/31/2011 44°16'28.09" N 88°12'27.83" W elev 703 ft eye alt 26438 ft

2013 Stage and Turbidity West Plum

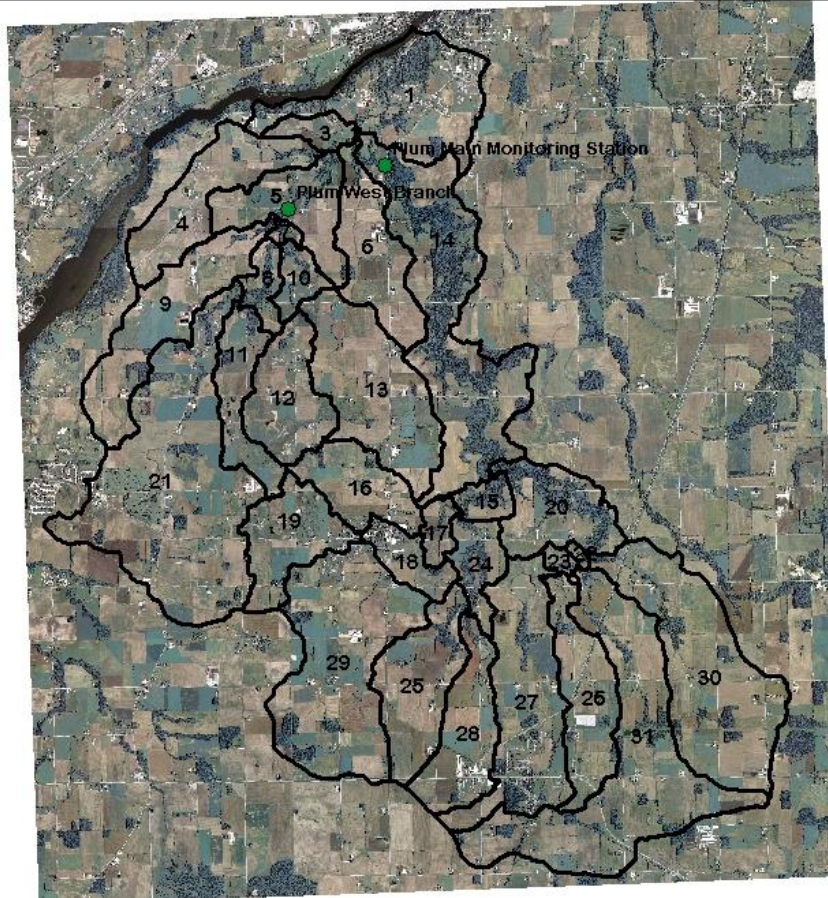


WEST PLUM



PLUM CREEK SWAT MODEL

31 SUB-WATERSHEDS

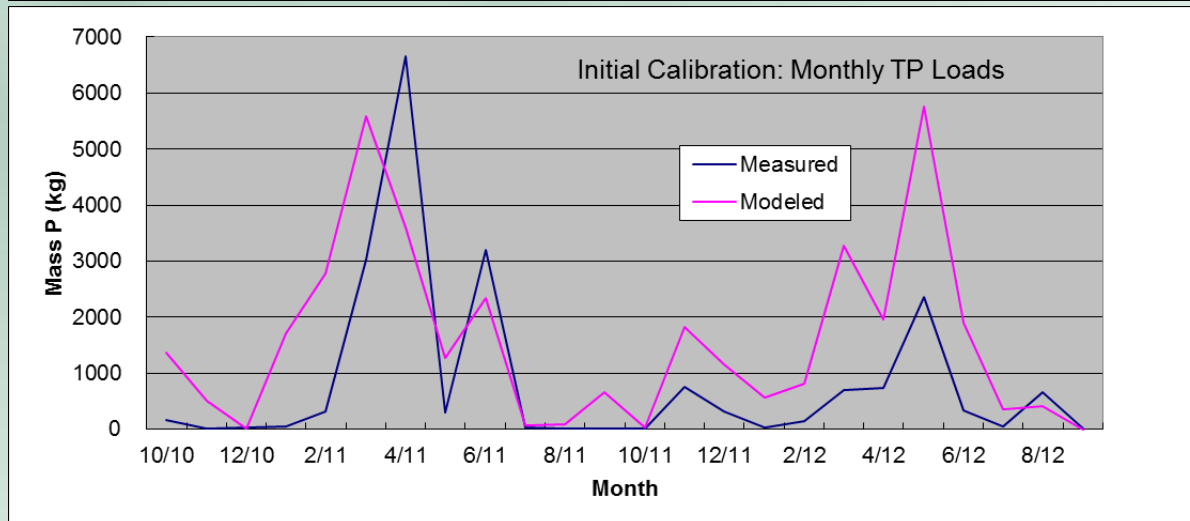
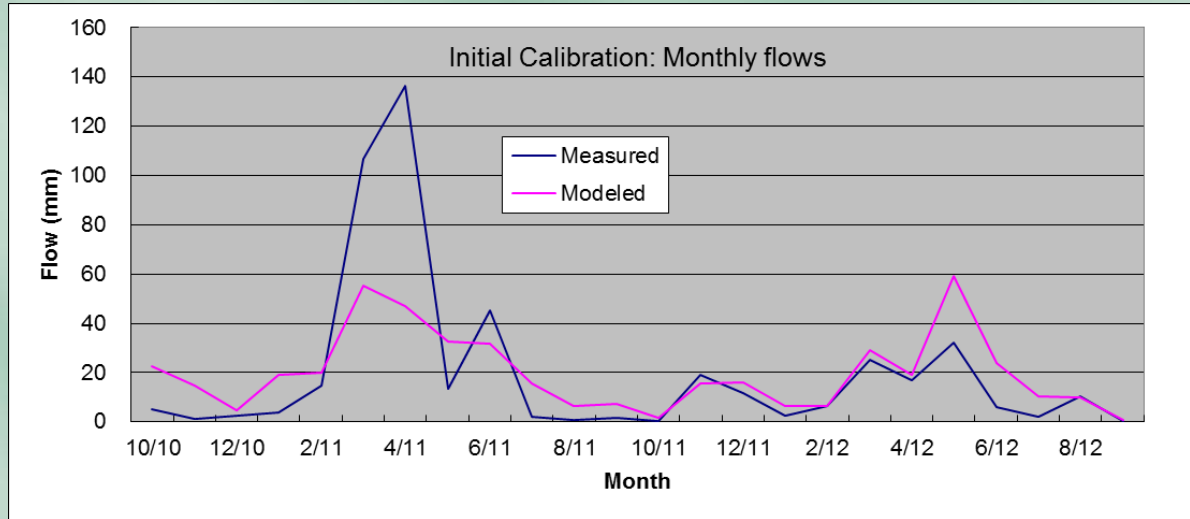


Primary Hydrologic Response Units (HRUS)

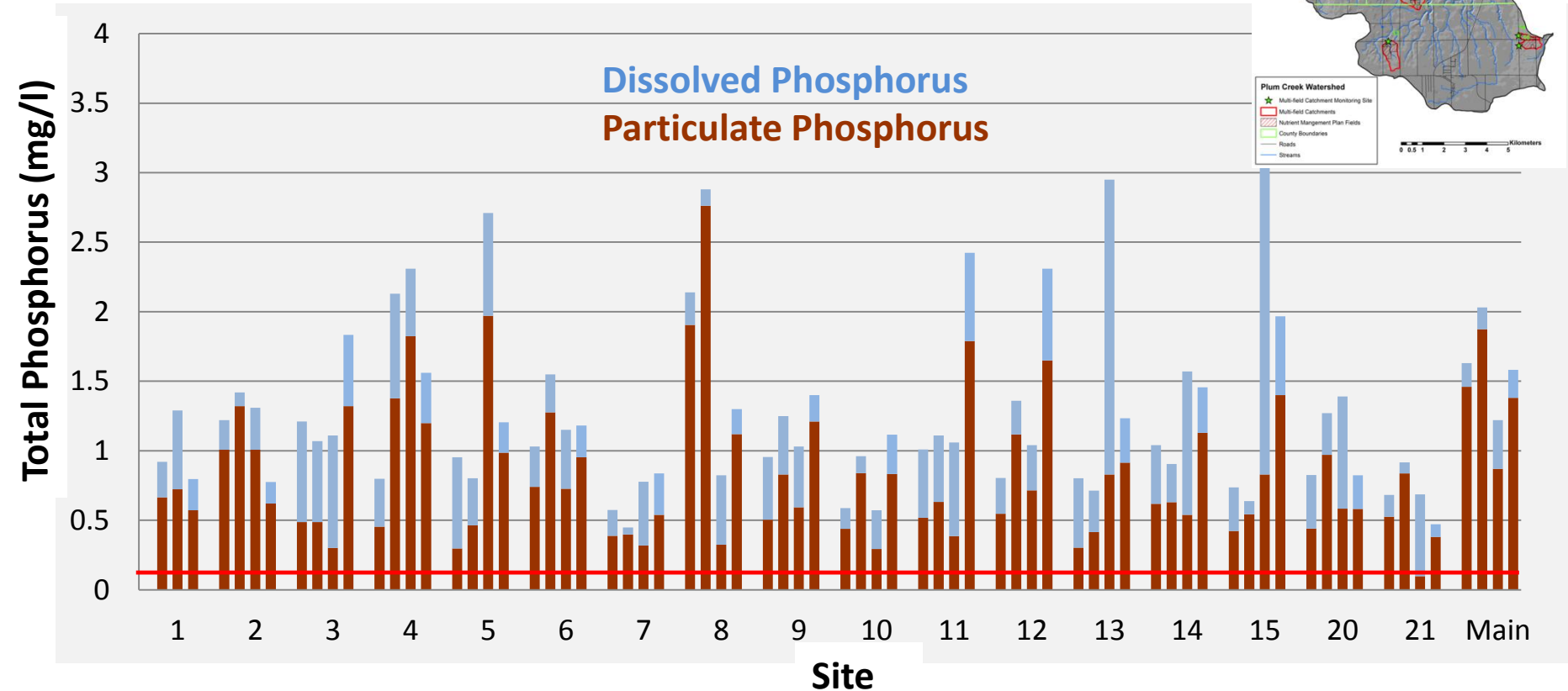
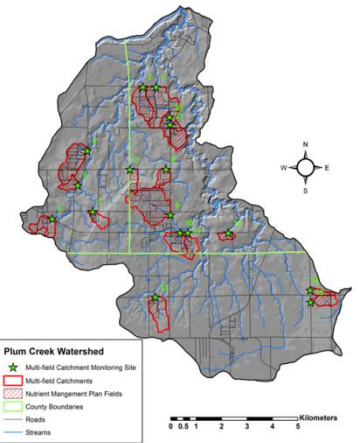
- Agriculture – Dairy 6 year rotation (corn-grain, winter wheat, corn-silage, 3 years alfalfa) **~55%**
 - 1 Conventional tillage practice (CT)
 - 2 Mulch-till (MT30)
 - 3 Ridge-till or no- till (NT)
- Agriculture – Cash Crop 3 year rotation (2 years corn-grain, soybean) **~21%**
 - 4 Conventional tillage practice (CT)
 - 5 Mulch-till (MT30)
 - 6 Ridge-till or no- till (NT)
- Non-Agriculture **~24%**
 - 7 Urban (Low density)
 - 8 Forest
 - 9 Wetland
 - 10 Grassland
 - 11 Rural Residential
 - 12 Golf Course
 - 13 Barnyard
 - 14 Farm Building Lot
 - 15 Quarries



INITIAL SWAT MODEL OUTPUTS



Source area P Concentrations

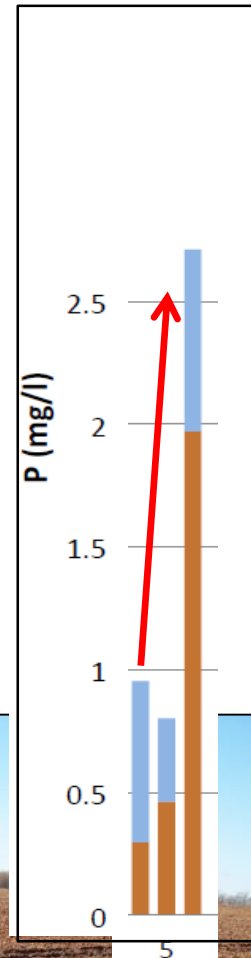
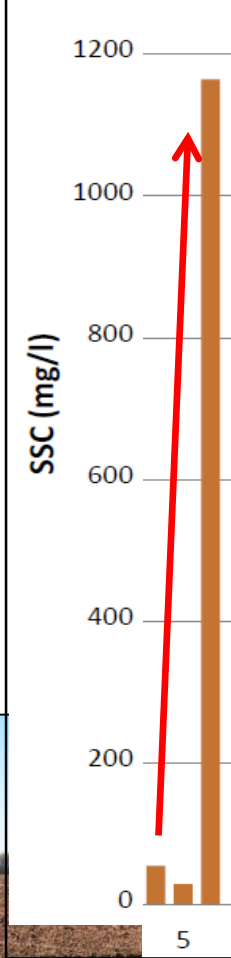


- Variation among sites and events (n= 67)
- TP Median = 1.03 mg/L
- Only 2 samples < 0.5 mg/L TP

MFC 5 – Spring 2011
High Cover



MFC 5 – Fall 2011
Low cover



SUMMARY

- Loads highly event driven and exceed TMDL goals by many fold.
- Turbidity derived SSC and TP loads look promising for estimating loads.
- Need to manage landscape to reduce vulnerability and maintain resilience against large rain eventsall the time.
- Initial SWAT model developed. Next steps: analyze BMPs, landuse change needed to be move towards goals.





Our knowledge of some event loads are significantly limited!



www.uwgb.edu/WATERSHED

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Lower Fox River Watershed Monitoring
Program
Natural & Applied Sciences Dept.
University of Wisconsin-Green Bay



Cooperators

- UW-Green Bay, UW-Milwaukee
- NOAA; US Geological Survey
- WDNR
- Arjo Wiggins Appleton Ltd
- GBMSD, Oneida Tribe of Indians
- 11 High Schools
- US Environmental Protection Agency

THE LOWER FOX RIVER



watershed
monitoring
program