

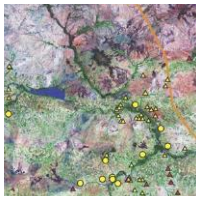


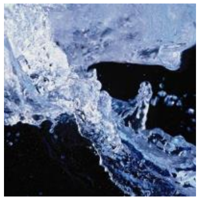

Effectiveness of Buffers Installed at Targeted Critical Drainage Areas in Minnesota

John Hanzas[1], Ronald Struss[2], Michael Mueth[3], Bruce Drager[3]

ACS/IUPAC Fall Meeting, San Francisco, California

August 11, 2014

1. Stone Environmental, Inc., 2. Minnesota Department of Agriculture 3. Monsanto Company

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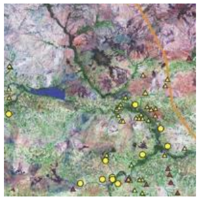
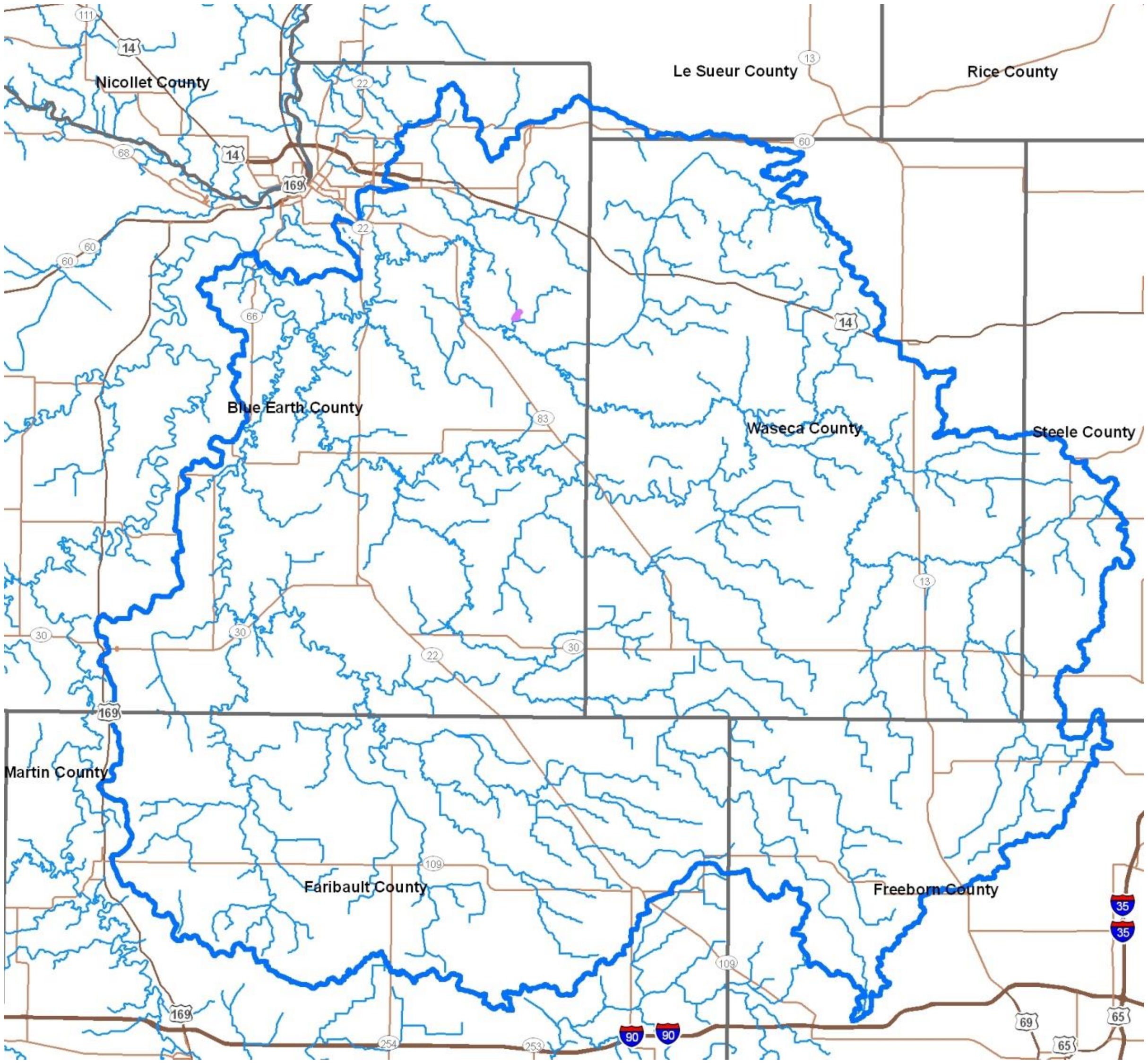
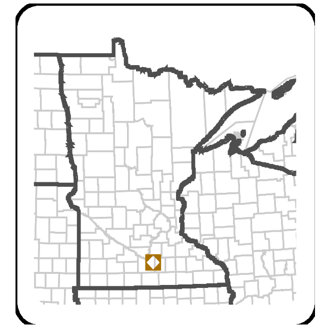




Introduction





- The Le Sueur River watershed
- Southeast of Mankato, MN
- Flows into the Blue Earth River and then into the Minnesota River
- Impaired for sediment, nutrients, and in 2008 for acetochlor

SWAT Modeling

MDA commissioned Study:

Evaluation of Best Management Practices (BMPs) in Impaired Watersheds Using the SWAT Model
Authors: Solomon Folle, Brent Dalzell, & David Mulla

http://www.mda.state.mn.us/en/protecting/cleanwaterfund/cwfresearch/swatmodel.aspx

Goals:

1. Accurately predict sediment, nutrient, and pesticide runoff losses in the Le Sueur River watershed;
2. Identify and prioritize critical sub-watersheds and evaluate the importance of managing them;
3. Evaluate the effectiveness of various best management practices

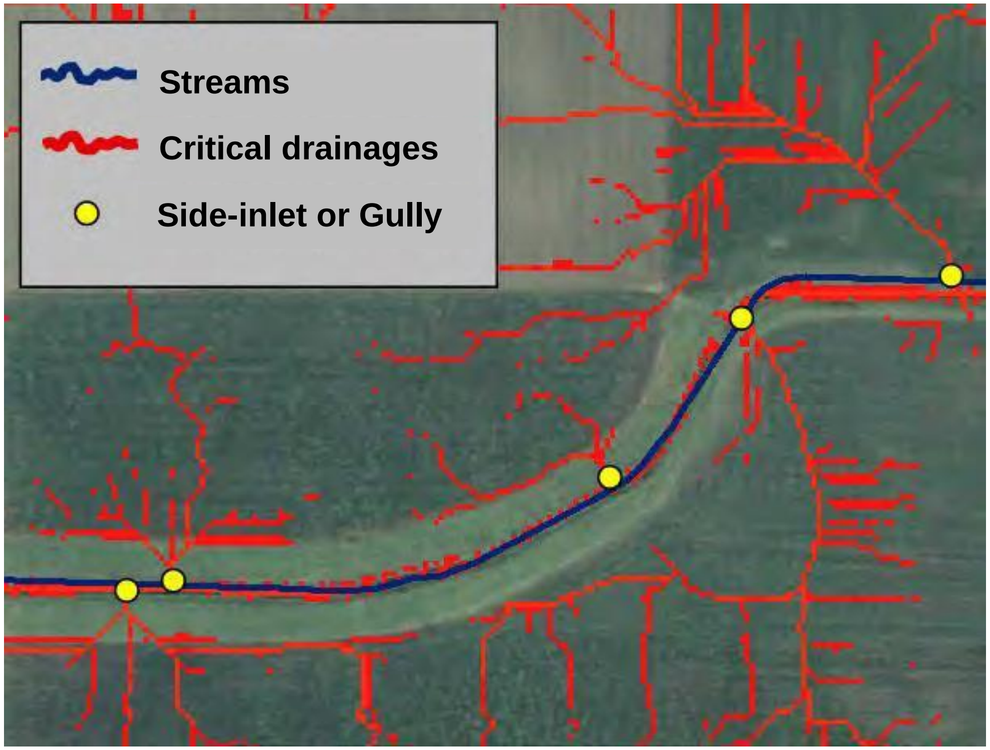
LiDAR Mapping

Targeting Best Management Practices (BMPs) to Critical Portions of the Landscape: Using Selected Terrain Analysis Attributes to Identify High-Contributing Areas Relative to Nonpoint Source Pollution

http://www.mda.state.mn.us/protecting/cleanwaterfund/cwfresearch/targetingbmps.aspx

Project Managers: Adam Birr and Barbara Weisman
Report authors: Jake Galzki, David Mulla, Joel Nelson, and Shannon Wing

- BMPs targeted at critical drainage points (yellow circles) can maximize benefits to water quality and funding used for conservation.



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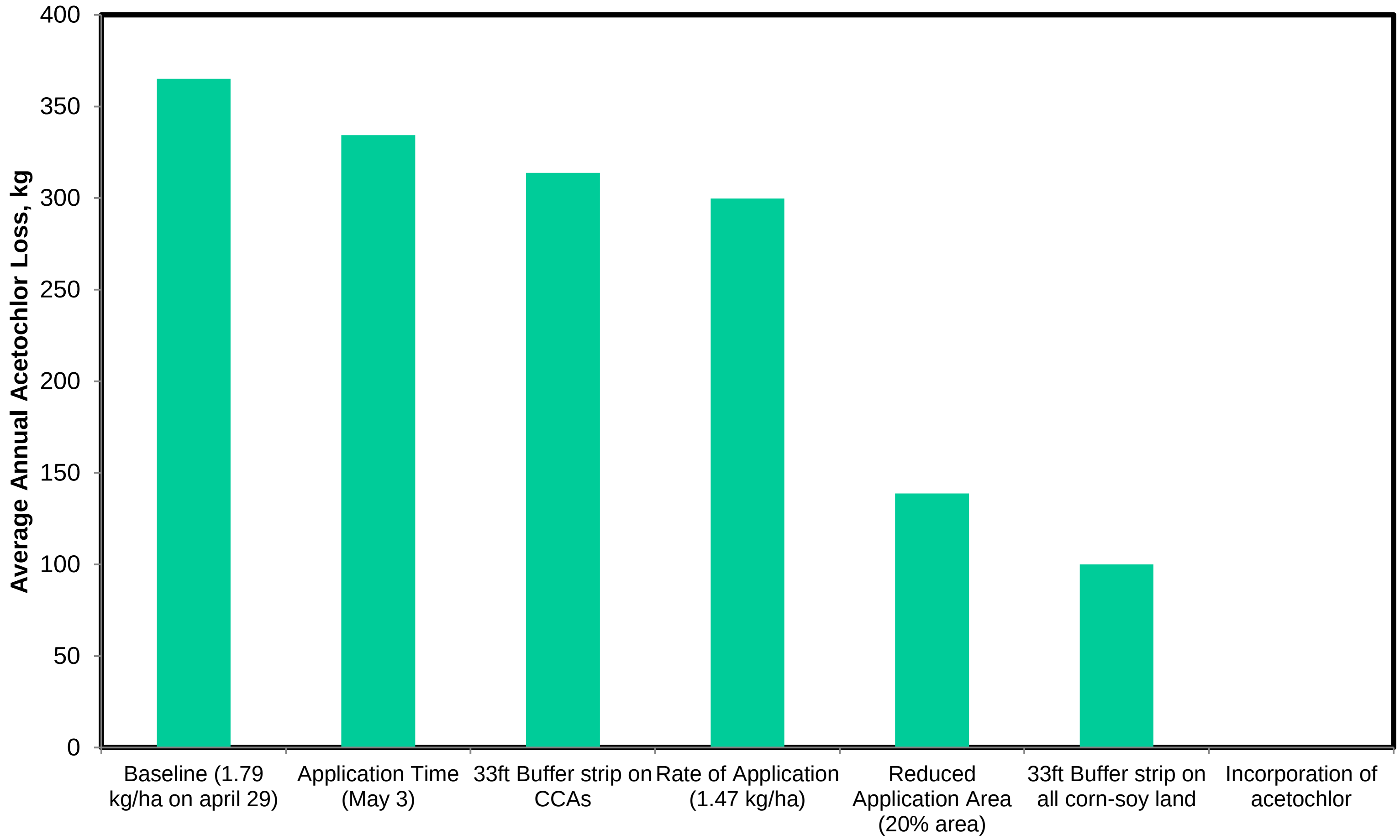
SWAT Modeling



- SWAT model predicts that installing a 33-foot buffer at all critical drainage areas would reduce acetochlor losses in runoff by 14%.

Best Management Practices

- Evaluating an MDA best management practice (BMP) for Acetochlor.
- BMP #4: "For Surface Water protection: Evaluate surface drainage patterns in your field and install filter strips and establish buffer zones for streams, sinkholes and tile inlets."

The BMPs are provided as a series of options. Producers, crop consultants and educators should select options most appropriate for a given farming operation, soil types and geography, tillage and cultivation practices, and irrigation and runoff management. The MDA encourages development of Integrated Weed Management Plans for every Minnesota farm (see "Additional Information and References" for more information). **Always read the product label. Label use requirements and application setbacks are legally enforceable.**

Water Quality *Best Management Practices* for *All Agricultural Herbicides*

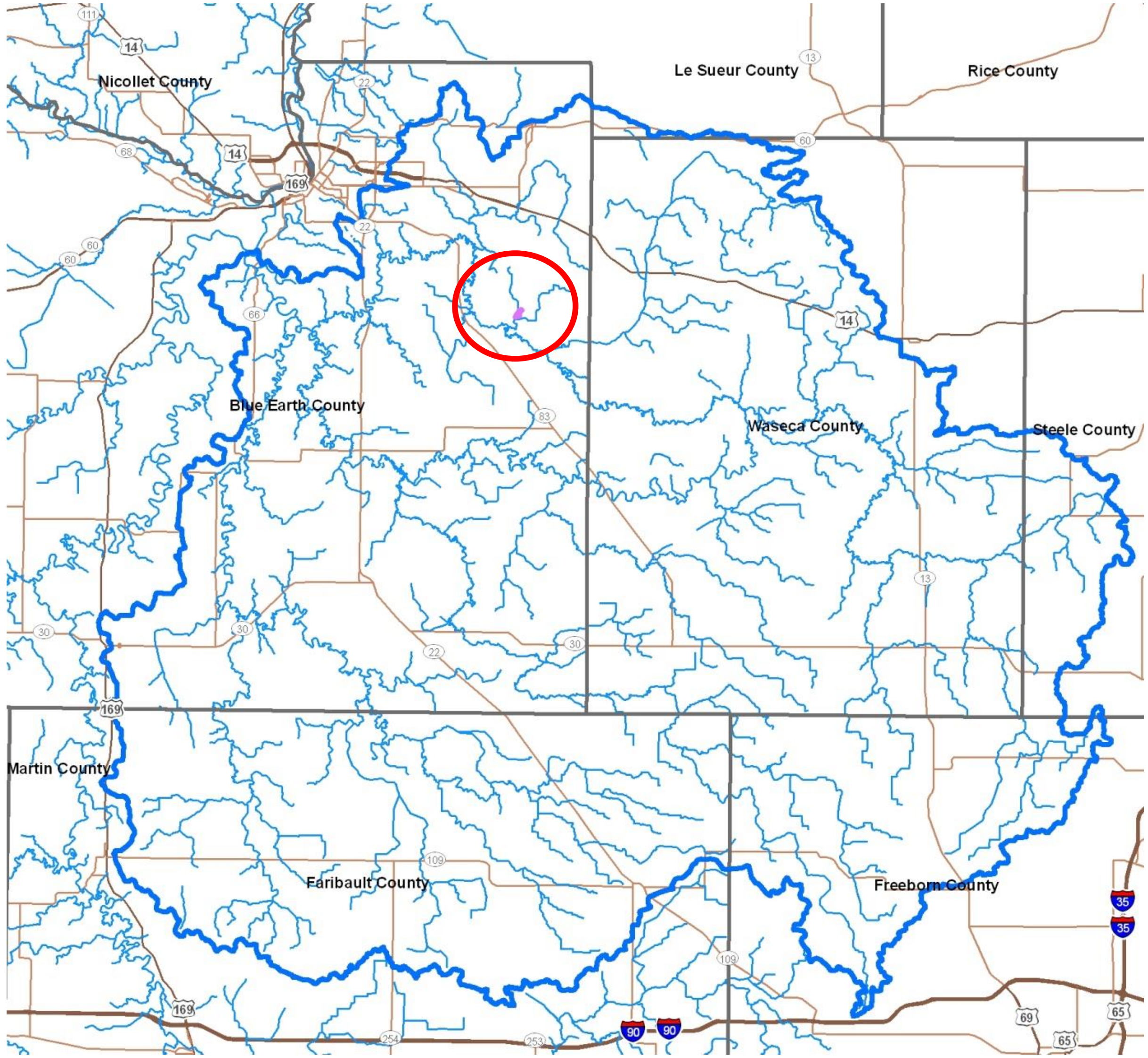
Core Practice*	Description	Benefit
1. Scout fields for weeds and match the management approach to the weed problem.	Scout for weeds, then map infestations throughout the year. Determine whether weed control will result in significant crop yield benefits. Carefully match weed control options – including non-chemical control – to weed pressures. Use herbicides only in situations where they are necessary and will be cost-effective. Use herbicides with long-lasting effect ("residual control") only in fields that have high densities of target weeds or in fields where weed information is lacking (e.g., newly rented or purchased acres). Consider post-emergent weed control alternatives.	Responding accurately to specific weed pressures, using post-emergent control and using alternative chemical and non-chemical (e.g., cultivation) controls can lower costs and prevent water resource impacts.
2. Evaluate reduced or split herbicide application rates.	Evaluate a reduced-rate herbicide program. Banding – especially in ridge-till rotations – can significantly reduce herbicide costs. Use split applications to reduce the amount of herbicide loss in runoff during early spring rains. Consider using the lowest label rate in a "rate range." Start on a small area to test what works best on your farm. Scout fields for weed escapes and be prepared for follow-up weed management including post-emergent herbicide application, rotary hoeing, or inter-row cultivation.	In many cases, banding and a carefully planned reduced-rate herbicide program can result in effective weed control, reduced costs, and a reduction in herbicide loss to the environment.
3. *For Surface Water protection:* Soil incorporate herbicides.	Evenly incorporate herbicides to the depth recommended on the product label. Improper incorporation, excessive crop residues, or poor soil tilth may result in erratic, streaked or otherwise unsatisfactory weed control. Combine soil incorporation of herbicides with another tillage operation to avoid additional field passes and loss of crop residue.	Incorporated herbicide is less vulnerable to being lost in runoff and reaching nearby streams, lakes and surface tile inlets.
4. *For Surface Water protection:* Evaluate surface drainage patterns in your field and install filter strips and establish buffer zones for streams, sinkholes and tile inlets.	Work with crop consultants and other ag professionals. Study Natural Resources Conservation Service (NRCS) listings for herbicides and soil properties that can lead to herbicide losses in runoff to surface waters (rivers, streams and lakes). Consider herbicides that NRCS lists as having low loss ratings for runoff from your soils, or consider non-chemical weed control methods in sensitive areas. Then, in addition to required label setbacks or buffers, install vegetative filter strips and establish buffers along vulnerable surface waters, karst features, tile inlets and sinkholes.	Filters and buffers reduce field runoff and setbacks eliminate applications where losses are most likely. Reducing use of herbicides known to move to surface water reduces the potential for surface water contamination.

Buffer Effectiveness Study

- **Study Objective:** To quantify the effects of vegetative buffer strips at side-inlet drains on acetochlor concentrations in runoff.
- Side-inlet drains are culverts installed in fields to drain water through ditch berms created by the straightening of county ditches.

Study Location

- Within the Le Sueur River Watershed
- Blue Earth County
- 10 miles southeast of Mankato



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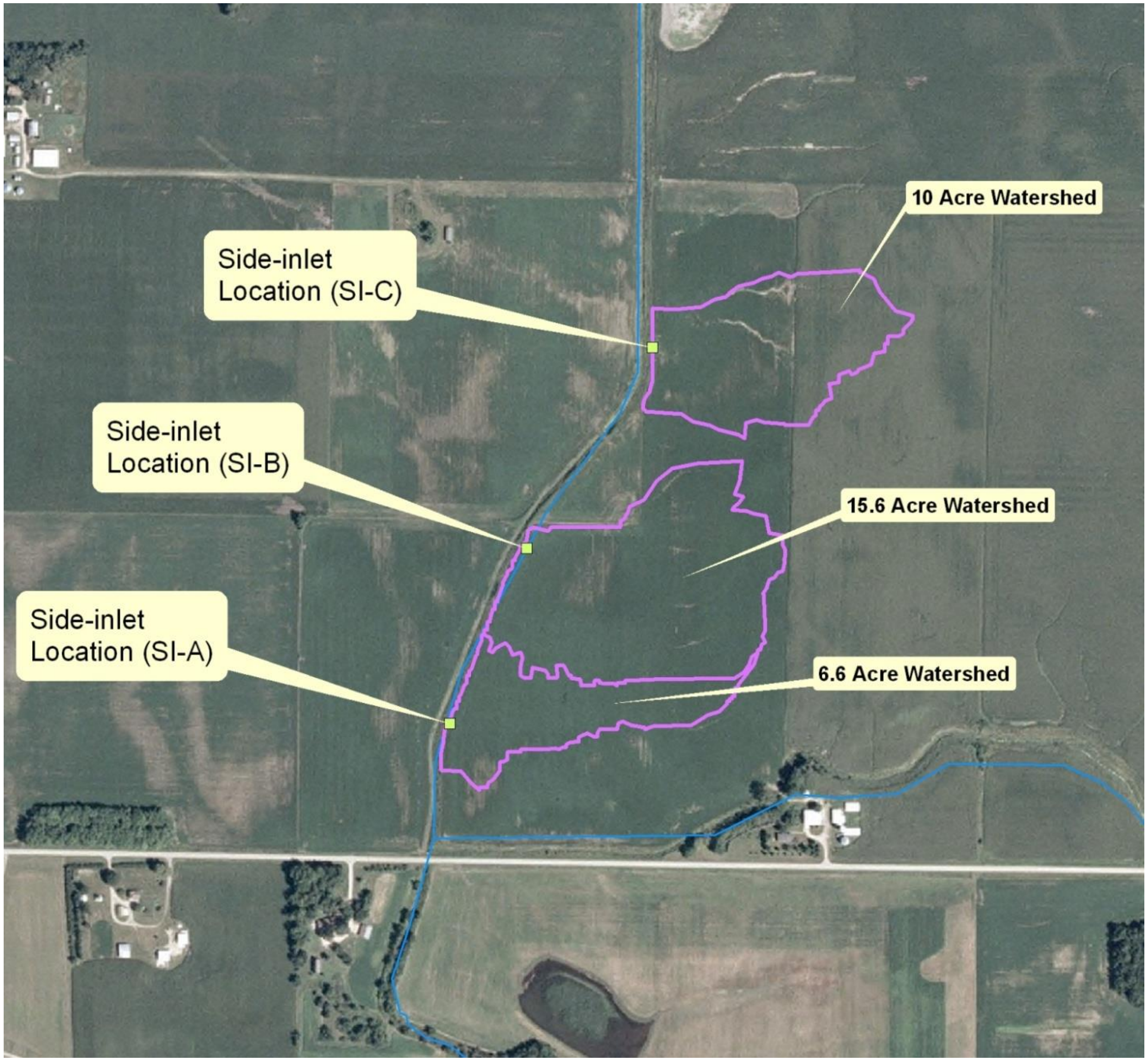
Project Approach – Paired Watershed Study Design

- Two periods during the study – calibration and treatment
- Calibration phase – collect data on rainfall, runoff flow, and mass transport of acetochlor, sediment and nutrients
- Statistically evaluate collected data to determine if the calibration was sufficient to measure the effect of the treatment
- Treatment phase – plant grass buffer around the side-inlet and continue to collect data to quantify its effectiveness

Study Watersheds



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Study Watersheds

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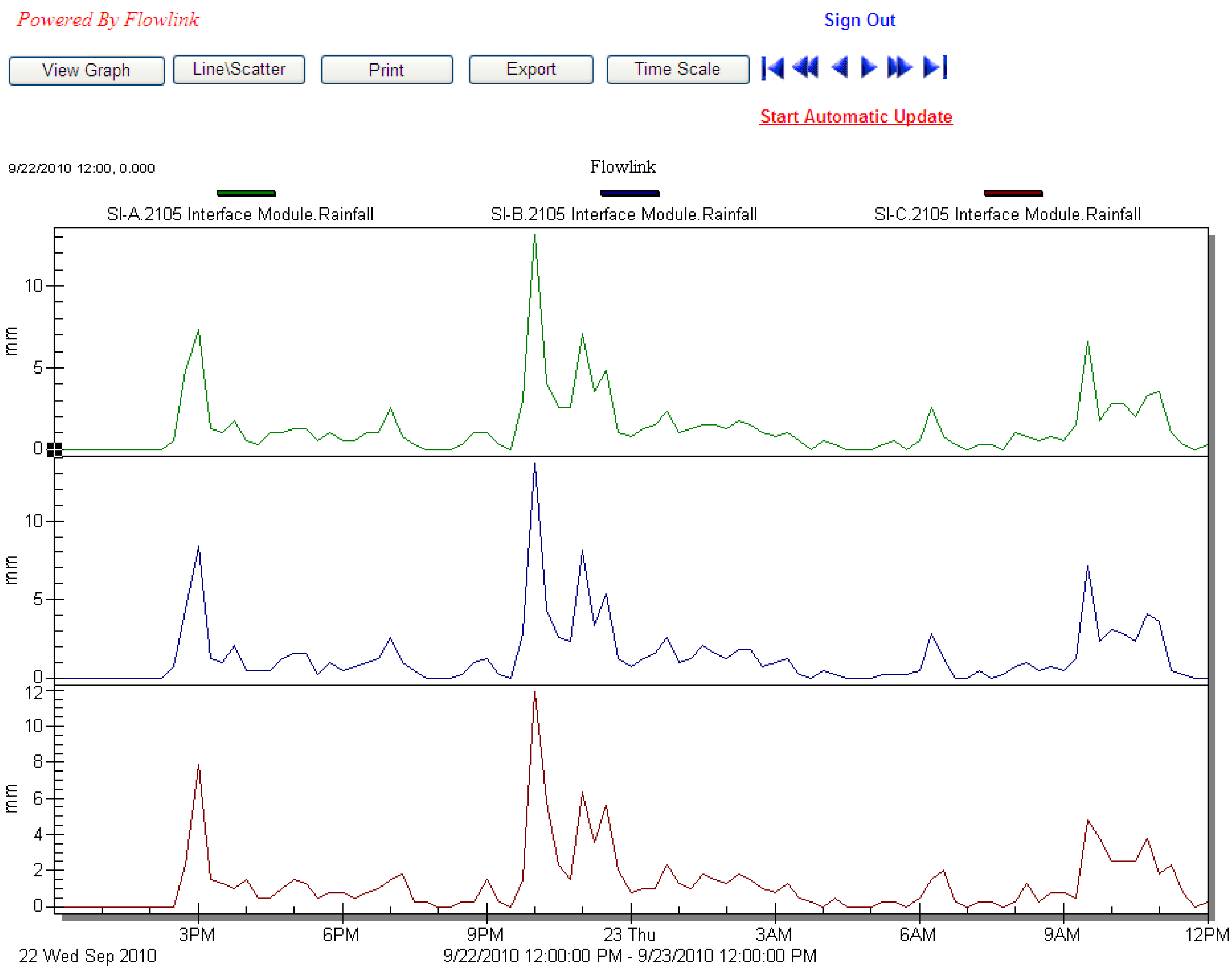
Water Quality Data Collection

Water Quality Data Collection

- Data is displayed on website in near-real time.

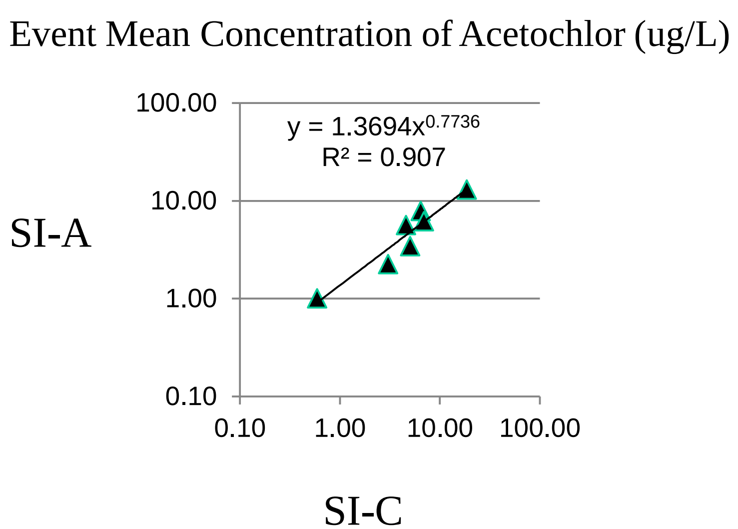


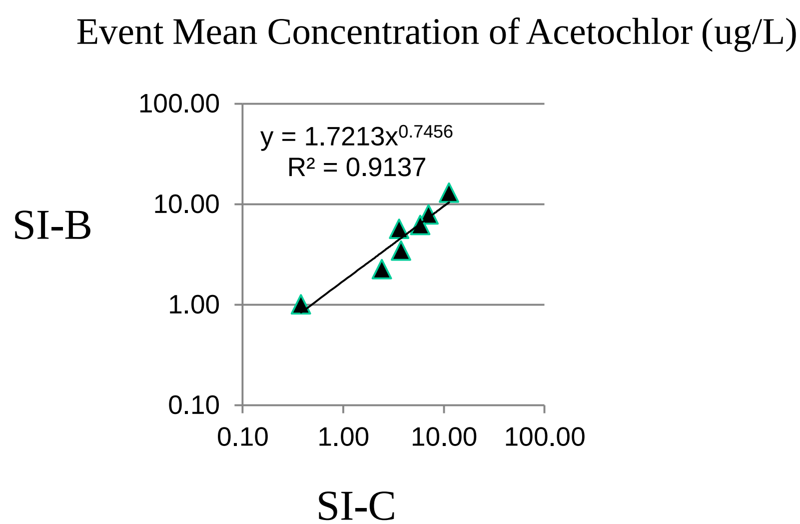
Data Collection — 2010 Season Statistics

- Total season rainfall (April – October): ~35 inches
- Seven full runoff events (runoff from all three watersheds)
- Total rainfall from runoff events (June 17 – September 2): ~11 inches
- 347 samples collected and analyzed from seven runoff events
- 9.9 million liters of flow or 2.6 million gallons or 2.86 inches
- ~19,000 grams of acetochlor applied to the watersheds
- ~70 grams of acetochlor exported from the watersheds
- 0.37% of applied chemical exported from the watersheds
- Runoff event on June 25 moved the most chemical at ~30 grams

Statistical Analysis of Water Quality Data for Calibration

- Strong paired regression relationships were obtained for all variables with SI-C as control site and SI-A and SI-B as treatment sites; r2 values ranged from 0.89 to 0.97
- Analysis of regression error suggests that a paired watershed analysis with at least 7 post-treatment events monitored would be able to detect a low percent difference between phases. The more post-treatment events monitored, the better the level of change detection.





Buffer Establishment—Sept. 8, 2010

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- Seeded, raked in, protected with erosion control matting.
- NRCS-recommended grass species used:

  Timothy – 0.5 lbs.

  Smooth Bromegrass – 2.0 lbs.

  Slender Wheatgrass – 2.0 lbs.

  Alslike Clover – 0.5 lbs.

  Perennial Ryegrass – 1.0 lbs.

  Winter Wheat – 5.0 lbs.

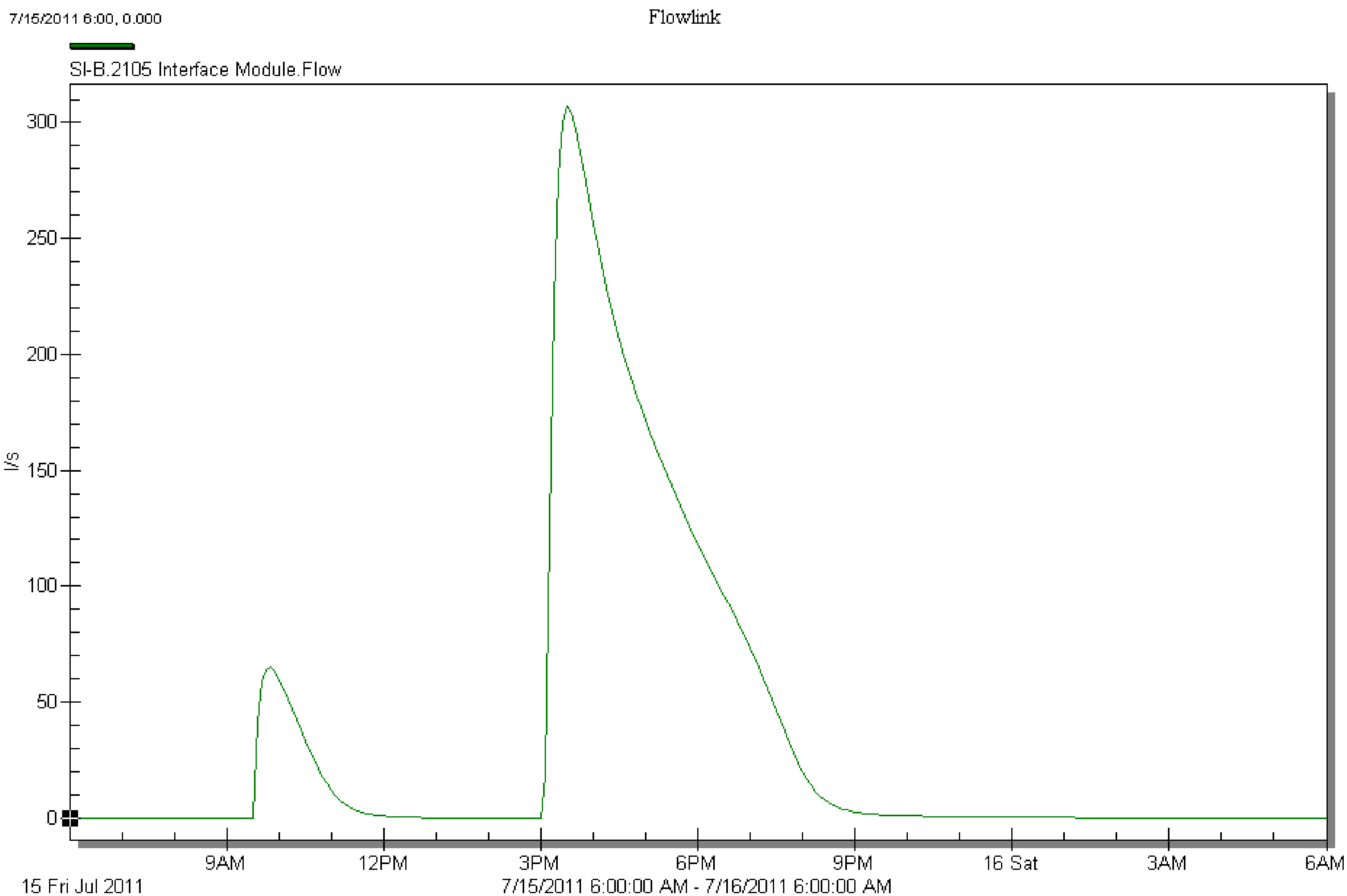
- October 7, 2010: buffers show good germination

Buffer Establishment—June 13, 2011

Buffer at SIA looking north

Buffer at SIB looking south

2011 Runoff Event Hydrographs



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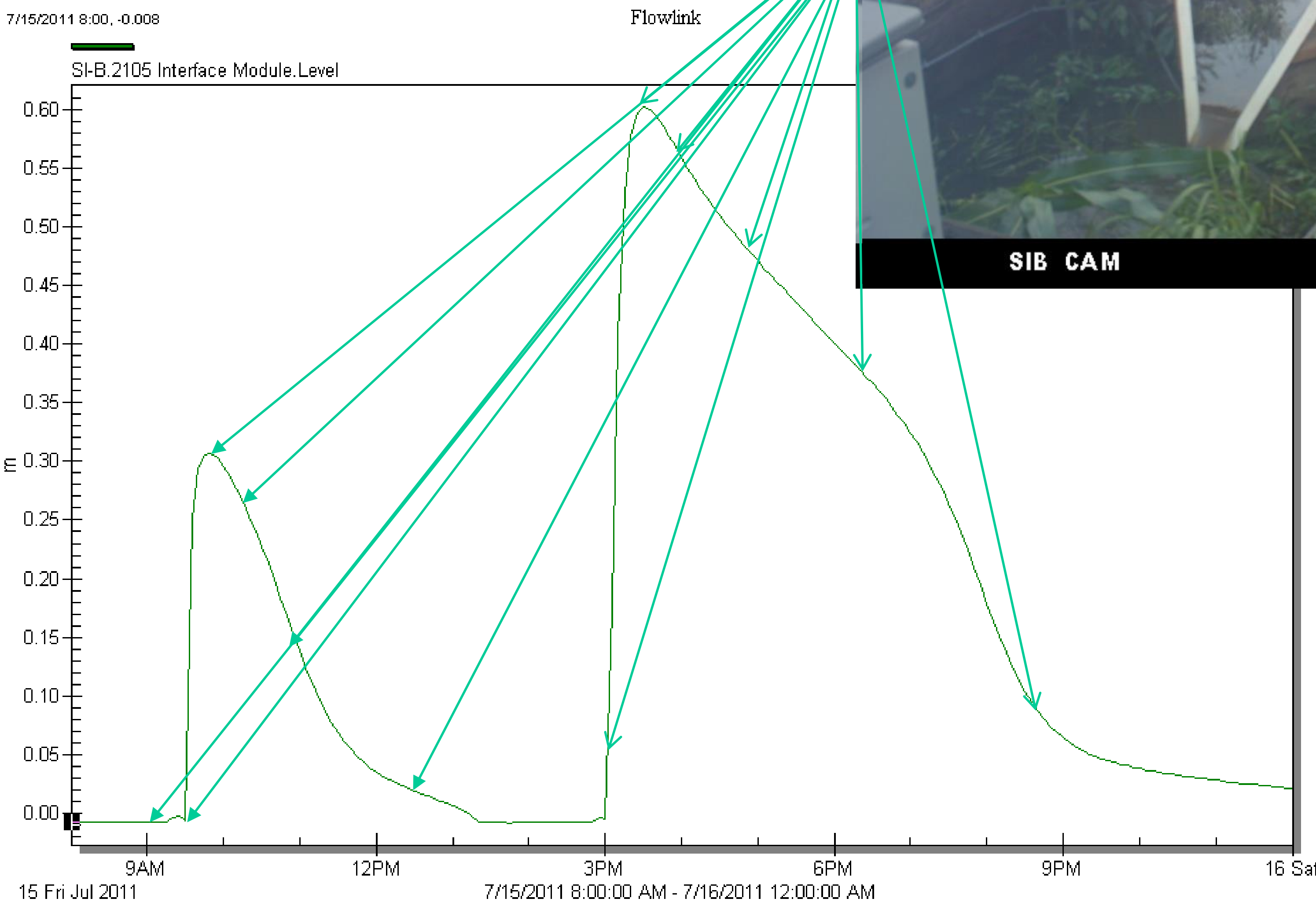
Event 3: July 15, 2011
09:00 – 13:30

Event 4: July 15, 2011
15:00 – 24:00



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2012, 2013, 2014

- No runoff events in 2012; USDA classified the time period from June to October as one of “extreme drought”. Our sites received 3.36 inches of rain during this period.
- Two runoff events in 2013
- Three runoff events so far in 2014 but residue and statistical analysis could not be completed yet.

Results

- Based on the 4 events analyzed we cannot conclude anything regarding reduction of acetochlor
- We can conclude based on ANCOVA that both mean the highest instantaneous flow rate (Qp) observed during an event and the percent of rainfall volume expressed as runoff (C) are lower during the treatment phase.

Acknowledgements

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THANK YOU!