Hydrology, Hydraulic, and Sediment Transport Characterization and Management Considerations

Natural Stream Design Workshop
OSM – Mid-Continent Region

May 18, 2011

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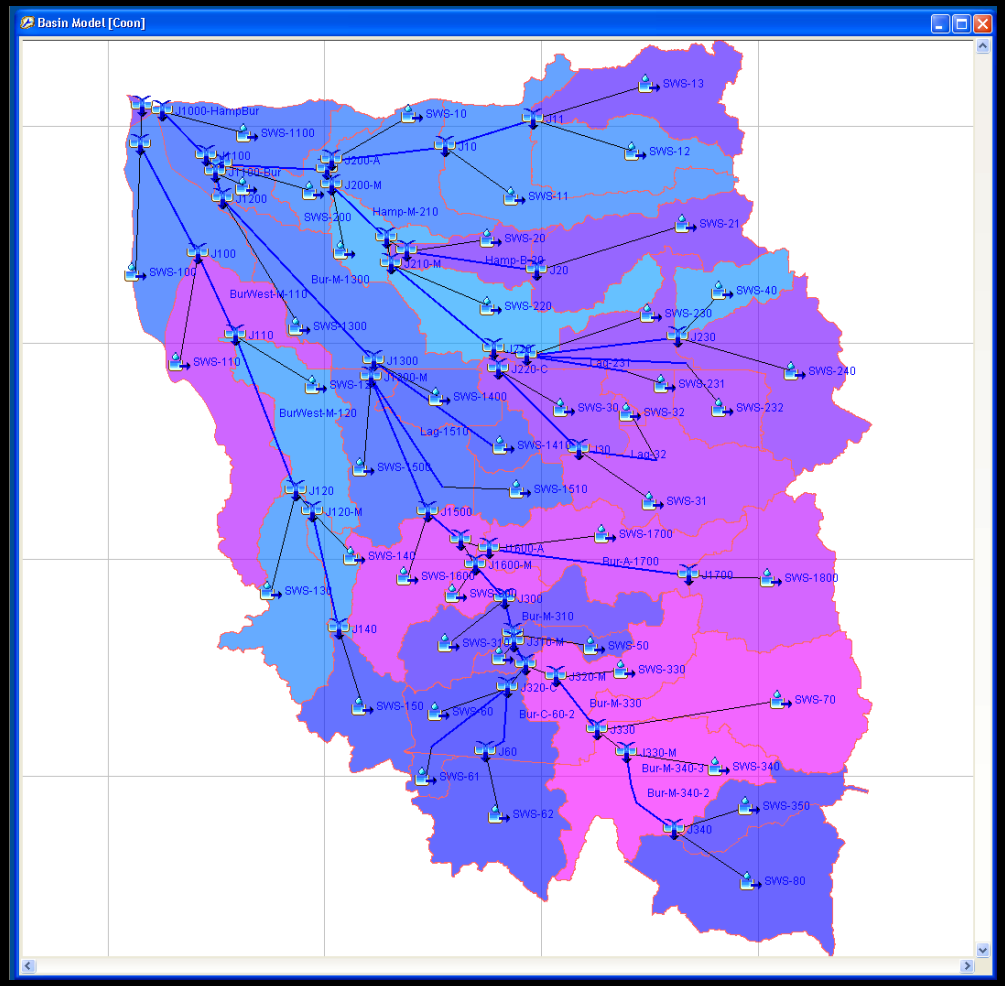
USGS
science for a changing world

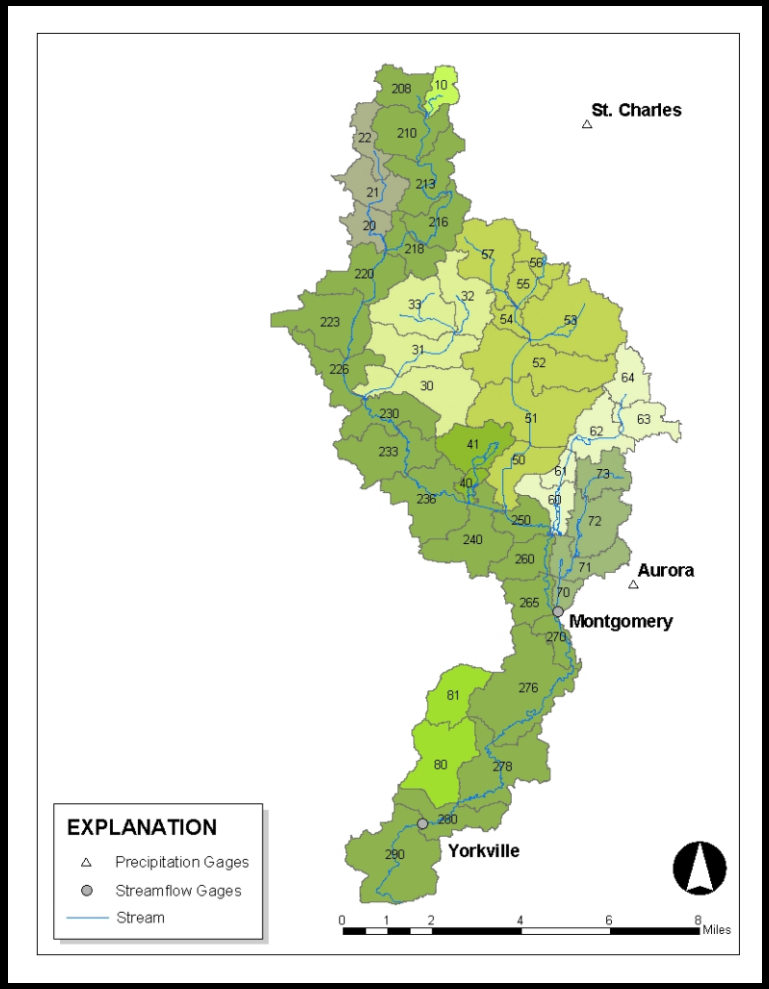
Outline

- **Hydrology**
  - What flows are likely?
  - Impact from changes to the landscape?
- **Hydraulics**
  - Flooding impacts upstream or downstream?
- **Sediment Transport**
  - Sediment continuity?

Hydrology – Modeling Option

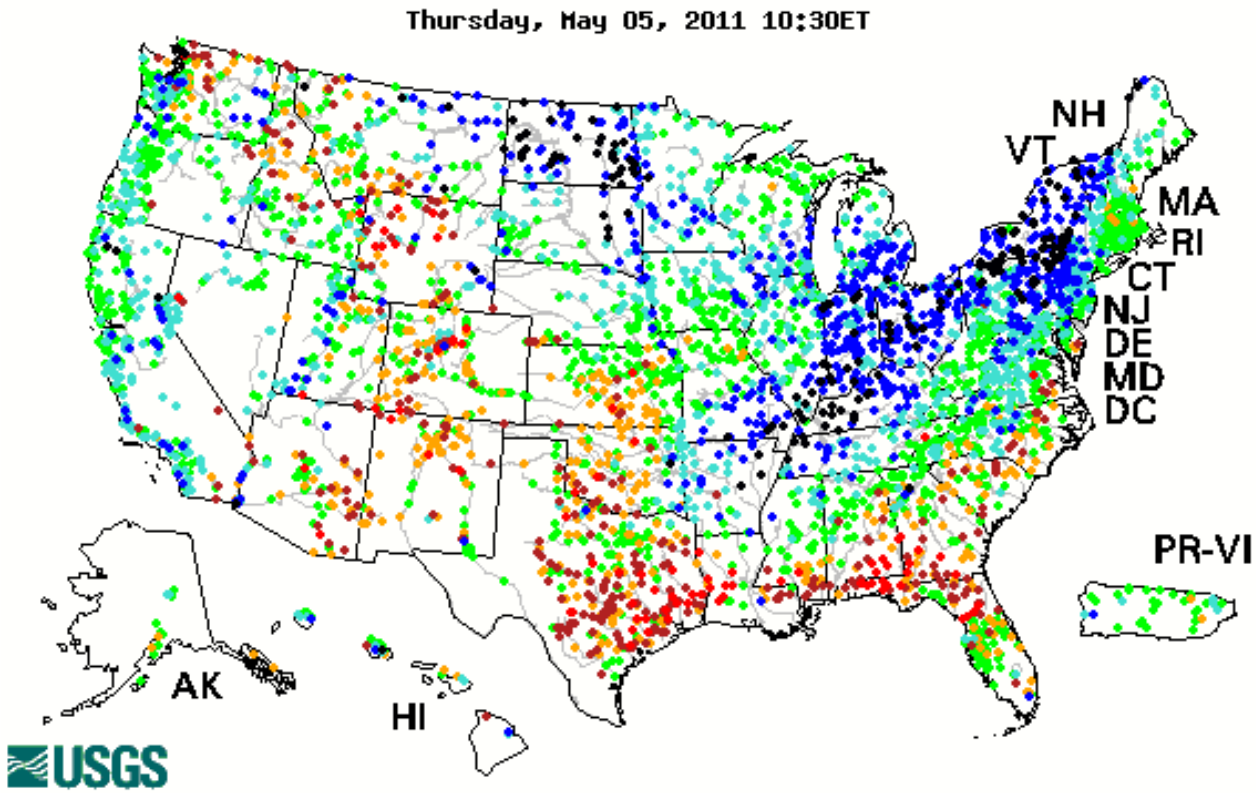


Coon Creek Hydrologic Model: HEC-HMS



Blackberry Creek Hydrologic Model: HSPF

USGS Stream Gage Network



Choose a data retrieval option and select a location on the map

List of all stations in state, State map, or Nearest stations

Explanation - Percentile classes						
Low	<10	10-24	25-75	76-90	>90	High
	Much below normal	Below normal	Normal	Above normal	Much above normal	

USGS StreamStats Web Application

- What—
  - *Estimate of streamflow peaks (e.g. 100-year flood flow)*
  - Delineates watershed boundaries
  - Determines a limited number of basin characteristics
    - e.g. drainage area, slope, soil permeability

- Could be much more—
  - *Estimate channel dimensions*
  - Simulate hydrographs
  - Determine more basin characteristics (percent urban)
  - Estimate flow duration curve and effective discharge

USGS

Welcome to StreamStats

Best viewed in Internet Explorer 5 or above
Screen resolution of 1024x768

Home

News

StreamStats Description

Ungaged Sites

Data-Collection Stations

StreamStats Limitations

State Applications

USGS Station Statistics

User Instructions

Definitions

Basin Characteristics

Streamflow Statistics

StreamStats Fact Sheet

Frequently Asked Questions

Talks and Other Info

Contact StreamStats Team

Current Streamflow Conditions

StreamStats is a Web-based tool that allows users to obtain streamflow statistics, drainage-basin characteristics, and other information for user-selected sites on streams. StreamStats users can choose locations of interest from an interactive map and obtain information for these locations. If a user selects the location of a U.S. Geological Survey (USGS) data-collection station [illegible] tabase. If a user se[illegible]c Information System[illegible]rmines the bounda[illegible]ics of the drainag[illegible]nflow statistics for the site. The results are presented in a table and a map showing the basin outline. The estimates assume natural flow conditions at the site. In the past, it could take an experienced person more than a day to estimate this information for an ungaged site. StreamStats reduces the effort to only a few minutes.

streamstats.usgs.gov

Separate applications have been established for each state that has implemented StreamStats. The state applications provide access to all of the functionality that is available for the state. The State Applications link at the left provides access to the individual applications. In addition to the state applications, a separate application has been established for serving information for USGS data-collection stations throughout the Nation. The USGS Station Statistics link to the left provides access to this application.

Some StreamStats options will not work in Netscape. The application continues to be improved and expanded. Please continue to come back to this page to see future enhancements. Contact us if you have any questions.

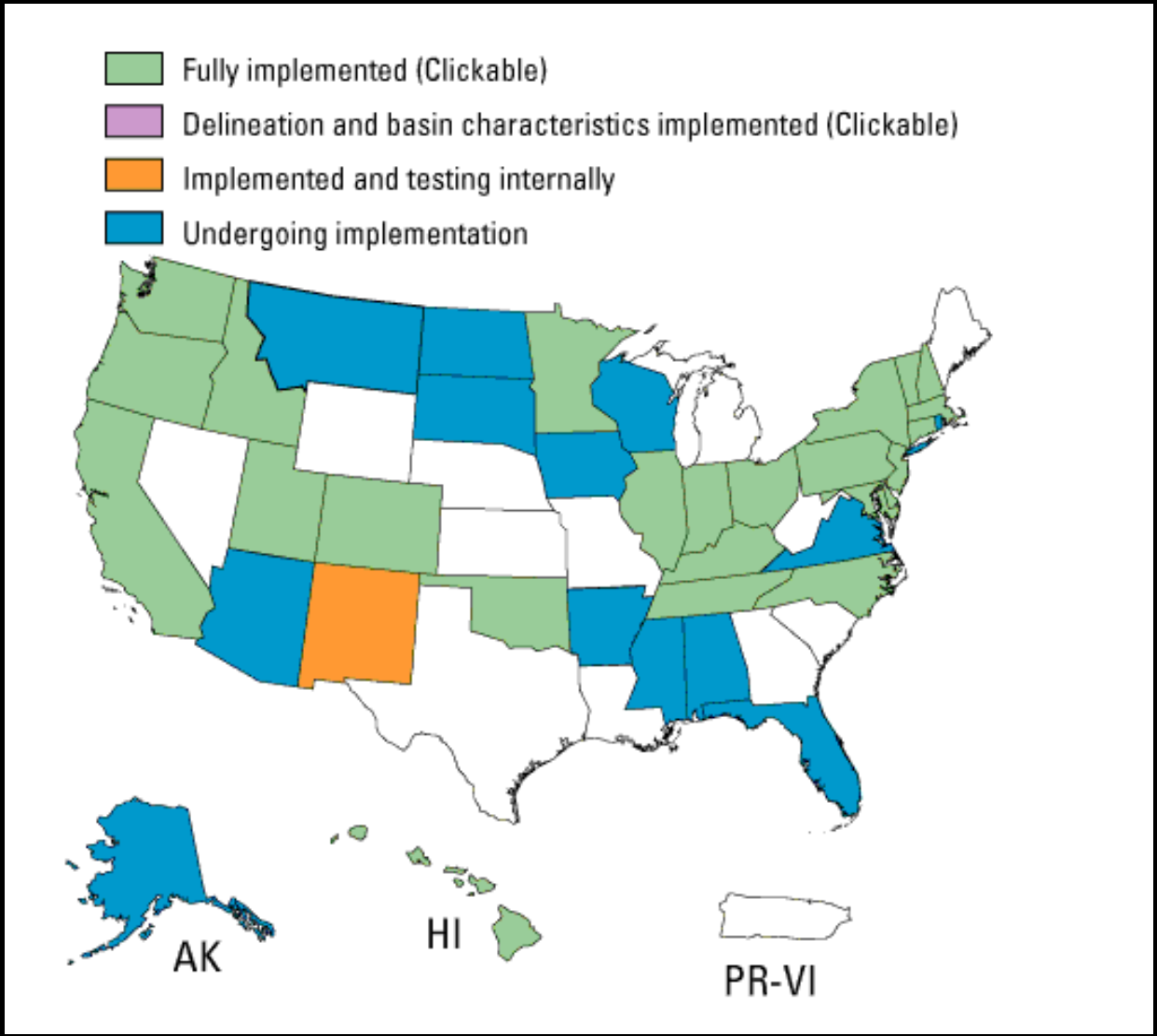
Users should familiarize themselves with StreamStats Description, Instructions, and Limitations (using the links on the left) before utilizing the application.

The StreamStats Web application provides access to automated procedures and very large, complex data sets. These data sets are known to contain occasional errors. Users are hereby advised to carefully check all results for accuracy and to exercise their own professional judgment in evaluating the appropriateness of the results for their application. Basin delineations in particular frequently have been found to be erroneous. The Web site provides tools and base maps useful for verifying the accuracy of the basin delineations.

The U.S. Geological Survey expressly disclaims responsibility for damages or liability that may arise from use of these data.

National StreamStats Status

(each state is developed and funded separately)

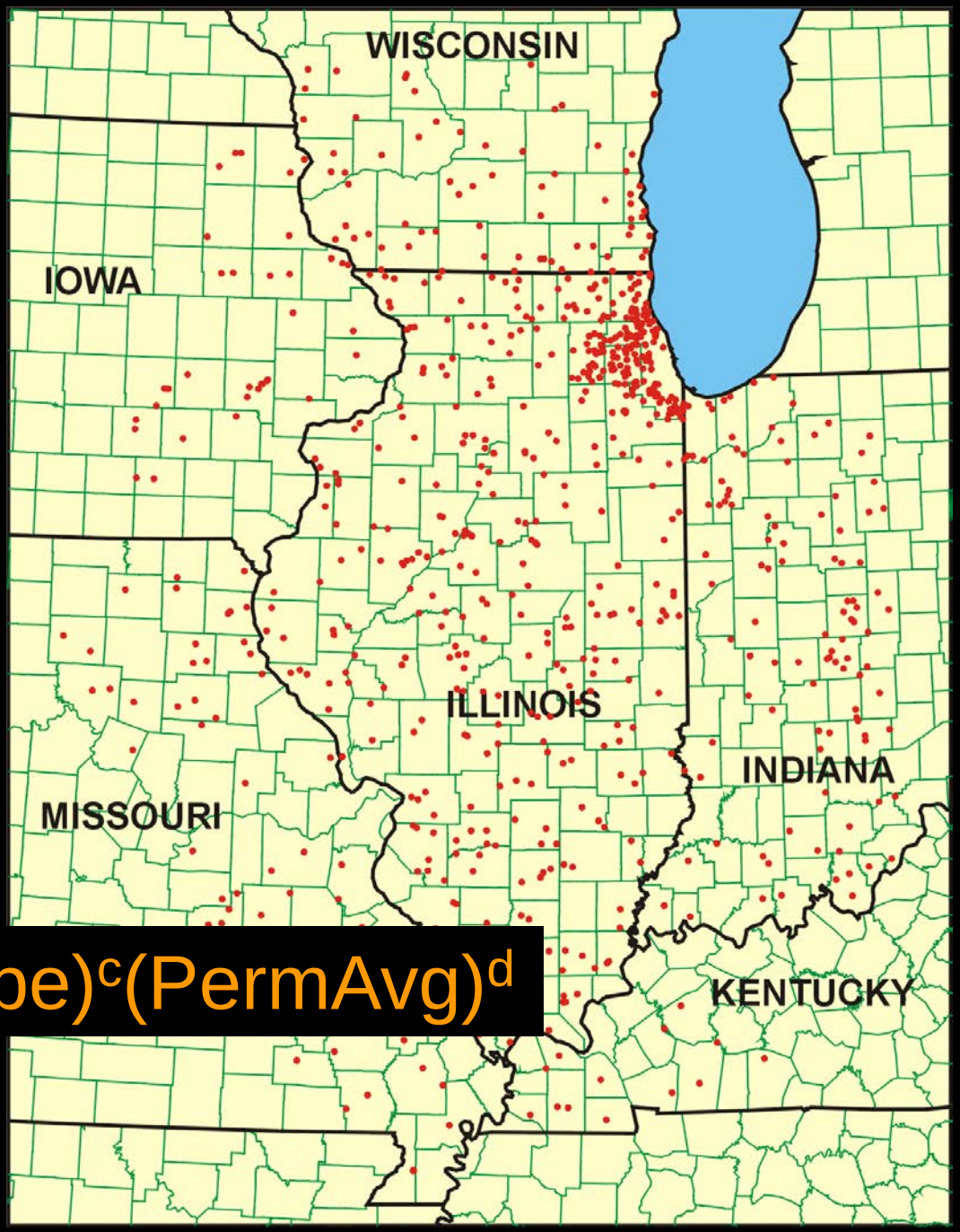


USGS

USGS Streamflow Statistics

Ungaged sites:

Regression equations relating the characteristics of the curve to basin characteristics.



$$Q_{100} = a(\text{Area})^b(\text{Slope})^c(\text{PermAvg})^d$$

USGS

USGS IL StreamStats - Windows Internet Explorer

http://streamstats.usgs.gov/ilstreamstats/index.asp

File Google Search Sign Convert Select

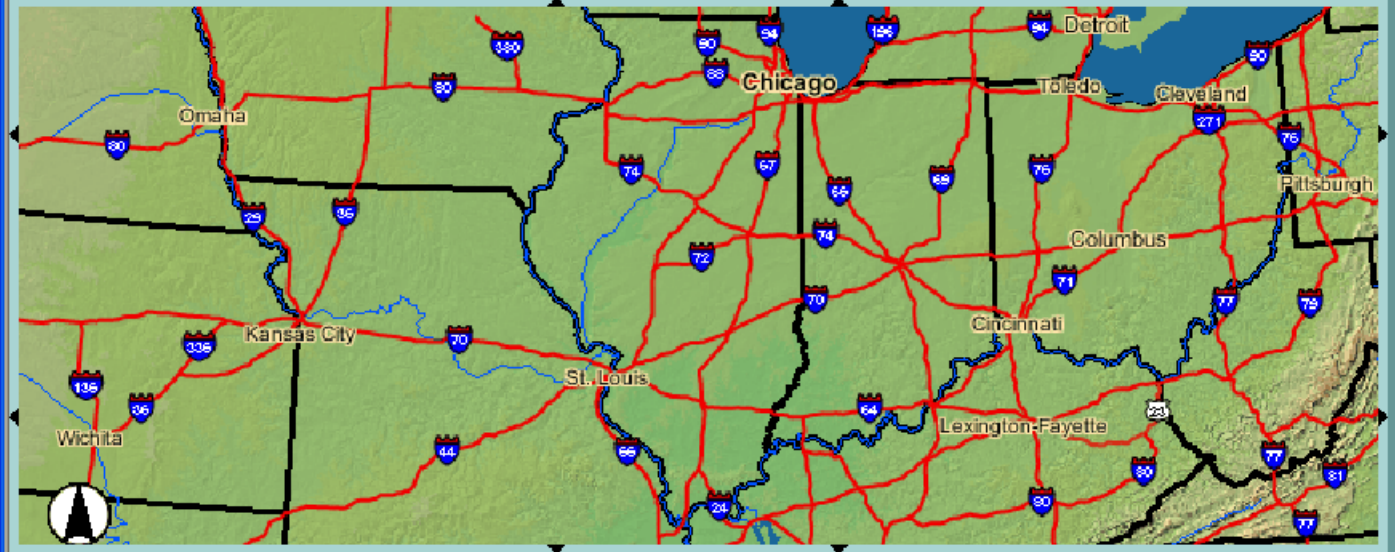
USGS IL StreamStats

Page Tools

USGS

Illinois StreamStats

ZoomIn ZoomOut Pan GetInfo FullExtent LastExtent Basin EditBasin FlowStats BasinChar ClearBasin Download GageInfo Print Help



USGS

Scale 1:9293680

+ Scale -

Zoom To: lat/long GO

	Degrees	Minutes	Seconds
Latitude:	40	0	0
Longitude:	89	0	0

Map Layers | Locator Map

- BASE LAYERS
- WATER
- POLITICAL

Refresh Map Reset Layers

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U.S. Department of the Interior | U.S. Geological Survey
URL: http://streamstats.usgs.gov/ilstreamstats/
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Page Last Modified: September 17, 2007

Streamstats Status News

FIRSTGOV.gov

TAKE PRIDE IN AMERICA

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Internet 100%

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http://streamstats.usgs.gov/ilstreamstats/index.asp

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USGS IL StreamStats

Page Tools

USGS

Illinois StreamStats

ZoomIn ZoomOut Pan GetInfo FullExtent LastExtent BasinDelineation EditBasin FlowStats BasinChar ClearBasin Download GageInfo Print Help

USGS

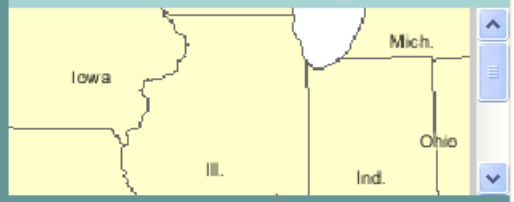
Scale 1:10000

+ Scale -

Zoom To: lat/long GO

	Degrees	Minutes	Seconds
Latitude:	39	27	55
Longitude:	88	13	49

Map Layers | Locator Map



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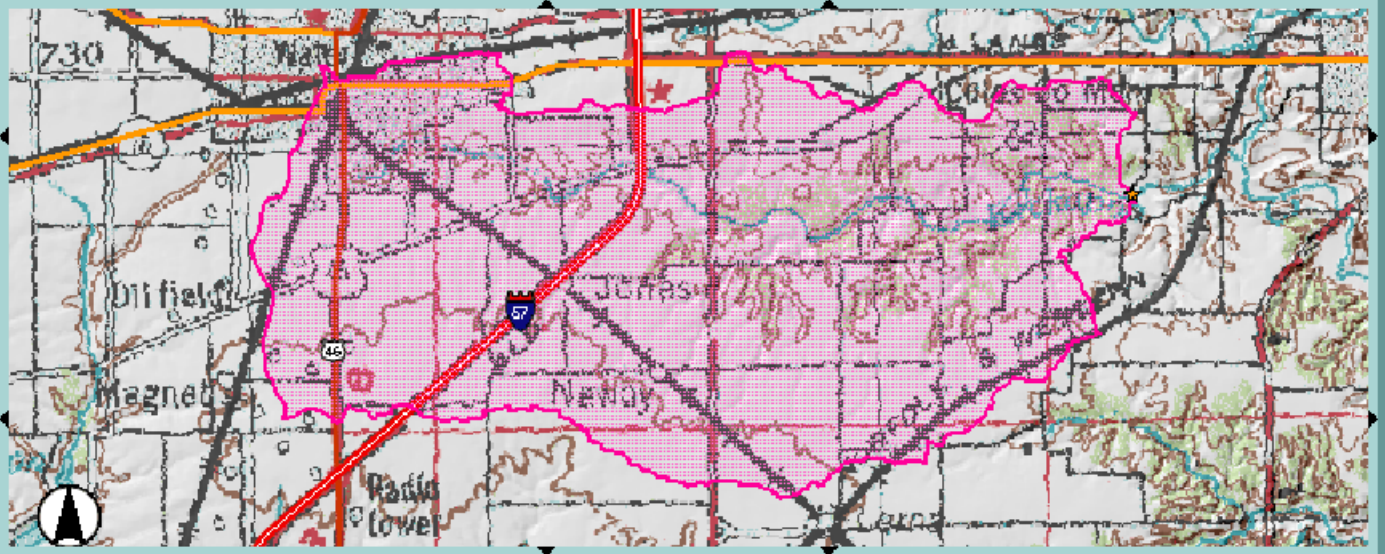

USGS

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+ Scale -

Zoom To: lat/long GO

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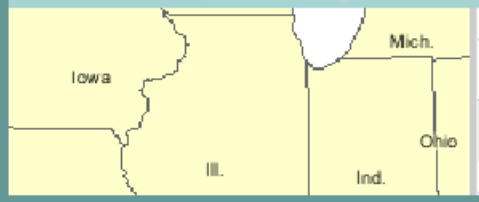
Latitude:	39	27	55
Longitude:	88	13	49

Map Layers Locator Map



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Internet 100%

http://streamstats.usgs.gov/ - Streamstats Ungaged Site Report - Windows Internet Explorer

File » Google Search » Sign Convert Select

Streamstats Ungaged Site Report

Date: Thu Apr 30 2009 20:55:40
Site Location: Illinois
Latitude (NAD83): 39.4652 (39 27 54)
Longitude (NAD83): -88.2302 (-88 13 48)
Drainage Area: 27.7434 mi2

Peak Flow Basin Characteristics

100% Regions 5 AMS (27.743 mi2)

Parameter	Value	Min	Max
Drainage Area (square miles)	27.743	0.03	9554
Stream Slope 10 and 85 Method (feet per mi)	9.184	0.81	317
Average Soil Permeability (inches per hour)	1.392	0.3	8
Region 5 Indicator (enter 1) (dimensionless)	1	0	1

Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
Peak-Flow Statistics					
PK2	1290	40	2.7	693	2390
PK5	2330	40	3.2	1250	4350
PK10	3100	42	3.9	1620	5910
PK25	4130	44	4.7	2080	8190
PK50	4940	47	5.2	2410	10100
PK100	5760	49	5.6	2720	12200
PK500	7790	55	6.2	3400	17800

Outline

- Hydrology
  - What flows are likely?
  - Impact from changes to the landscape?
- Hydraulics
  - Flooding impacts upstream or downstream?
- Sediment Transport
  - Sediment continuity?

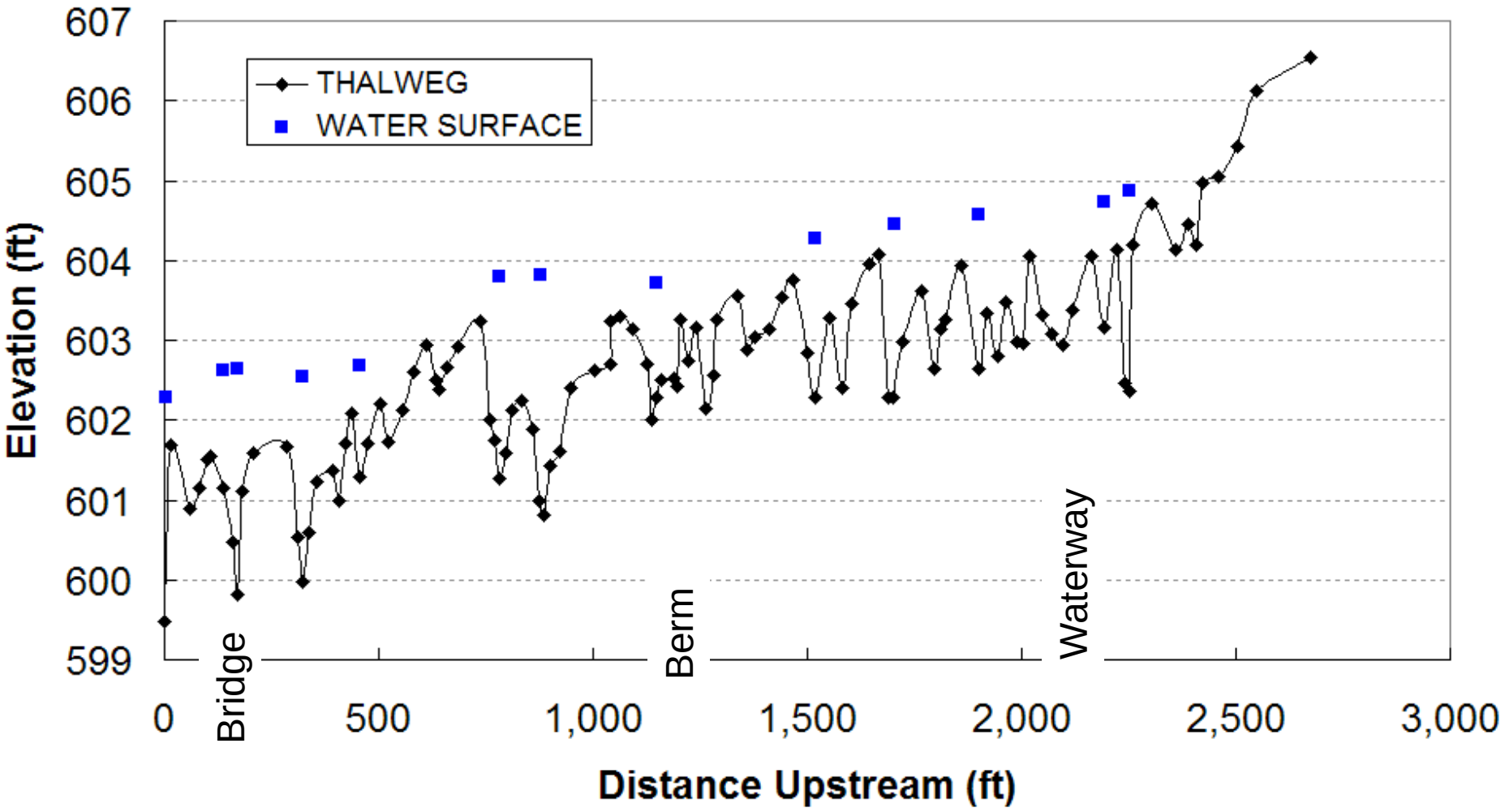
Channel and Floodplain Survey

367 points in one day

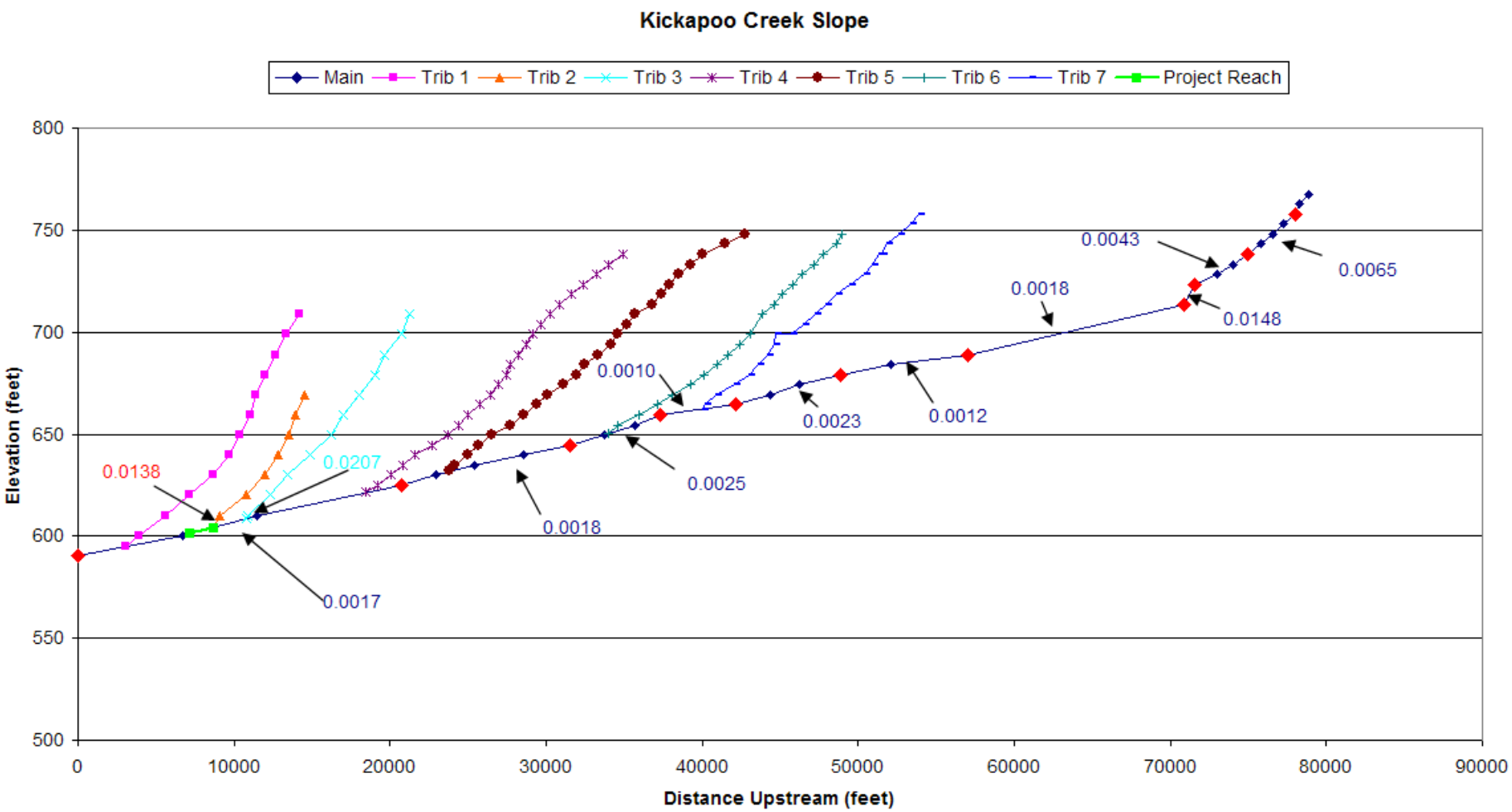
Thalweg Survey

-Slope

-Indication of Existing Conditions

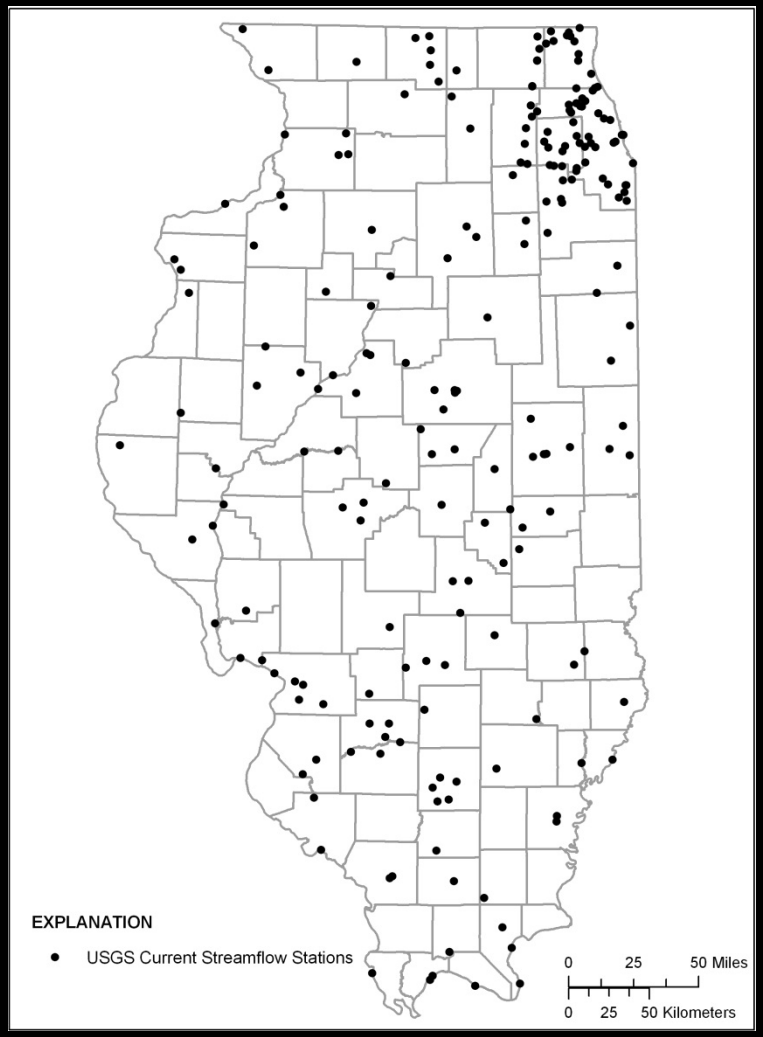


Valley Slopes – Main Channel and Tribs

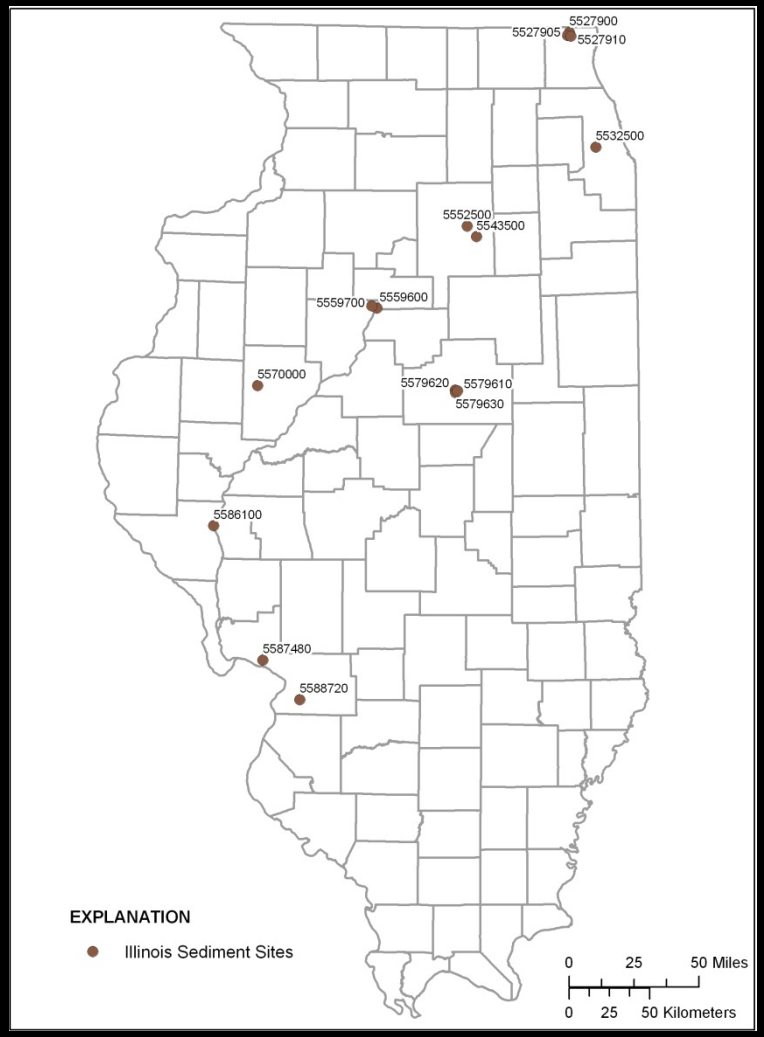


Current USGS Network

Streamflow (>180)

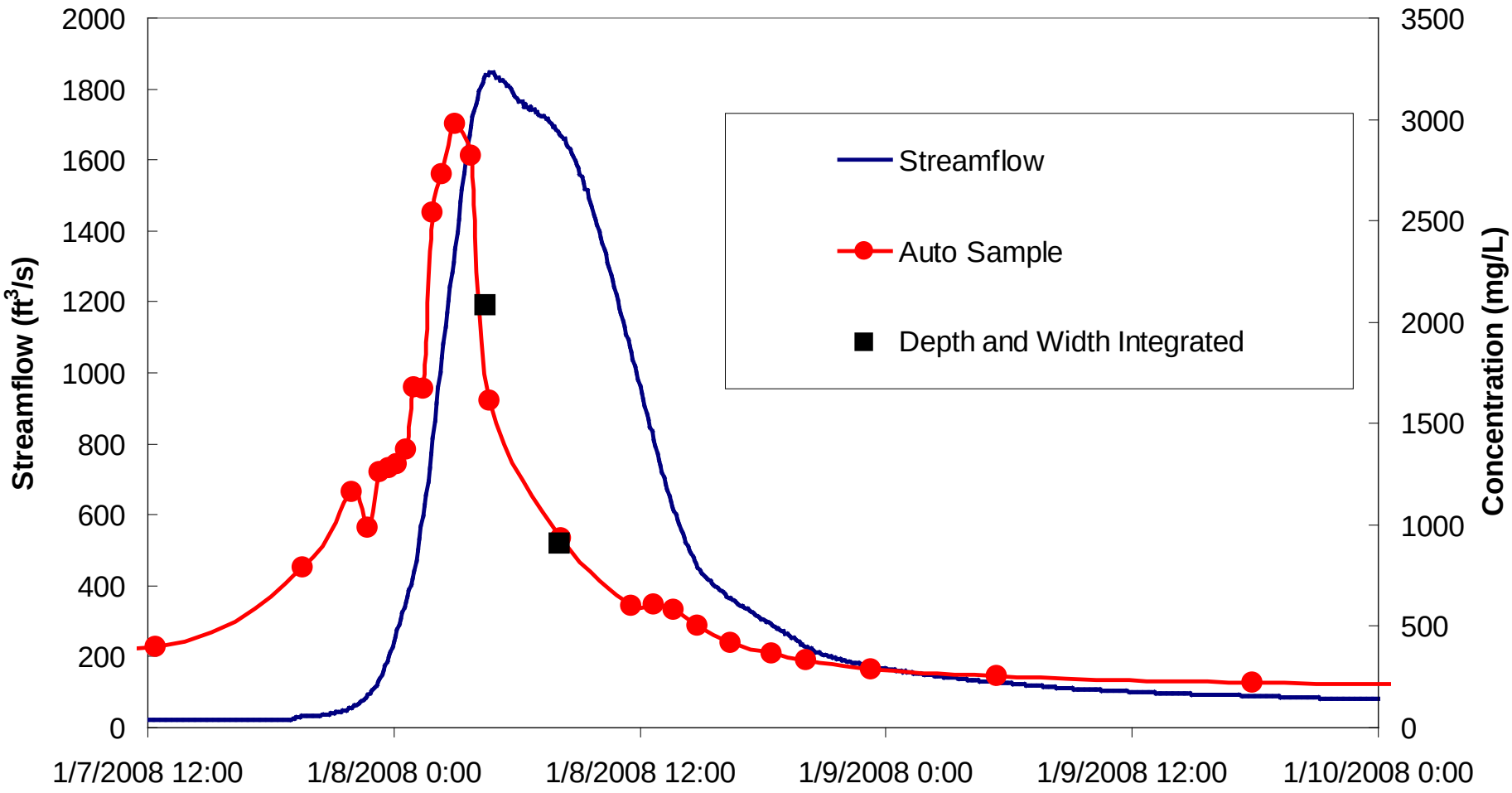


Sediment (15)

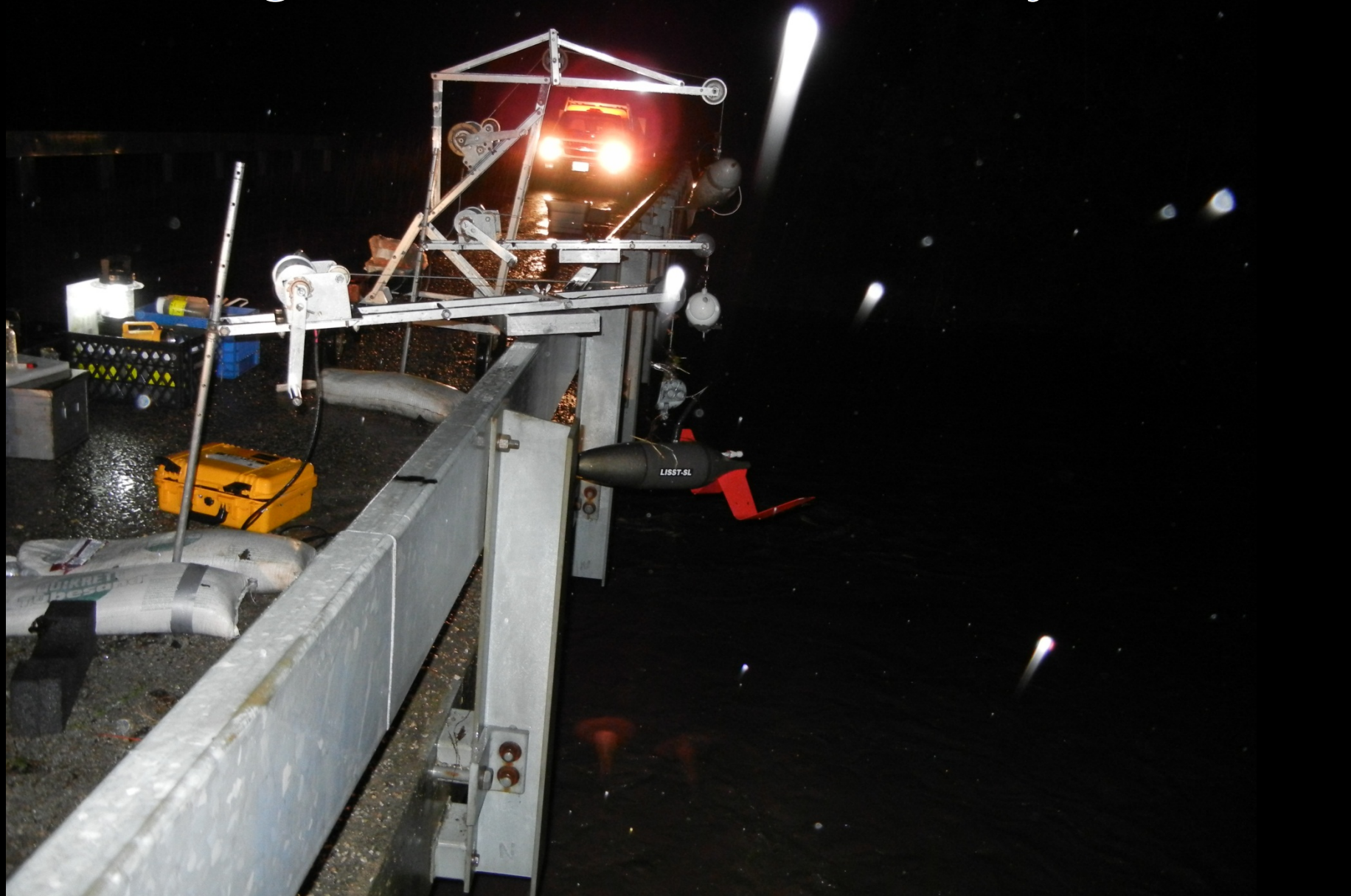


Lane (1955) - $Q_s D_{50} \alpha Q_w S$

Streamflow and Sediment Concentration Monitoring



Storms only occur at night, weekends, or holidays

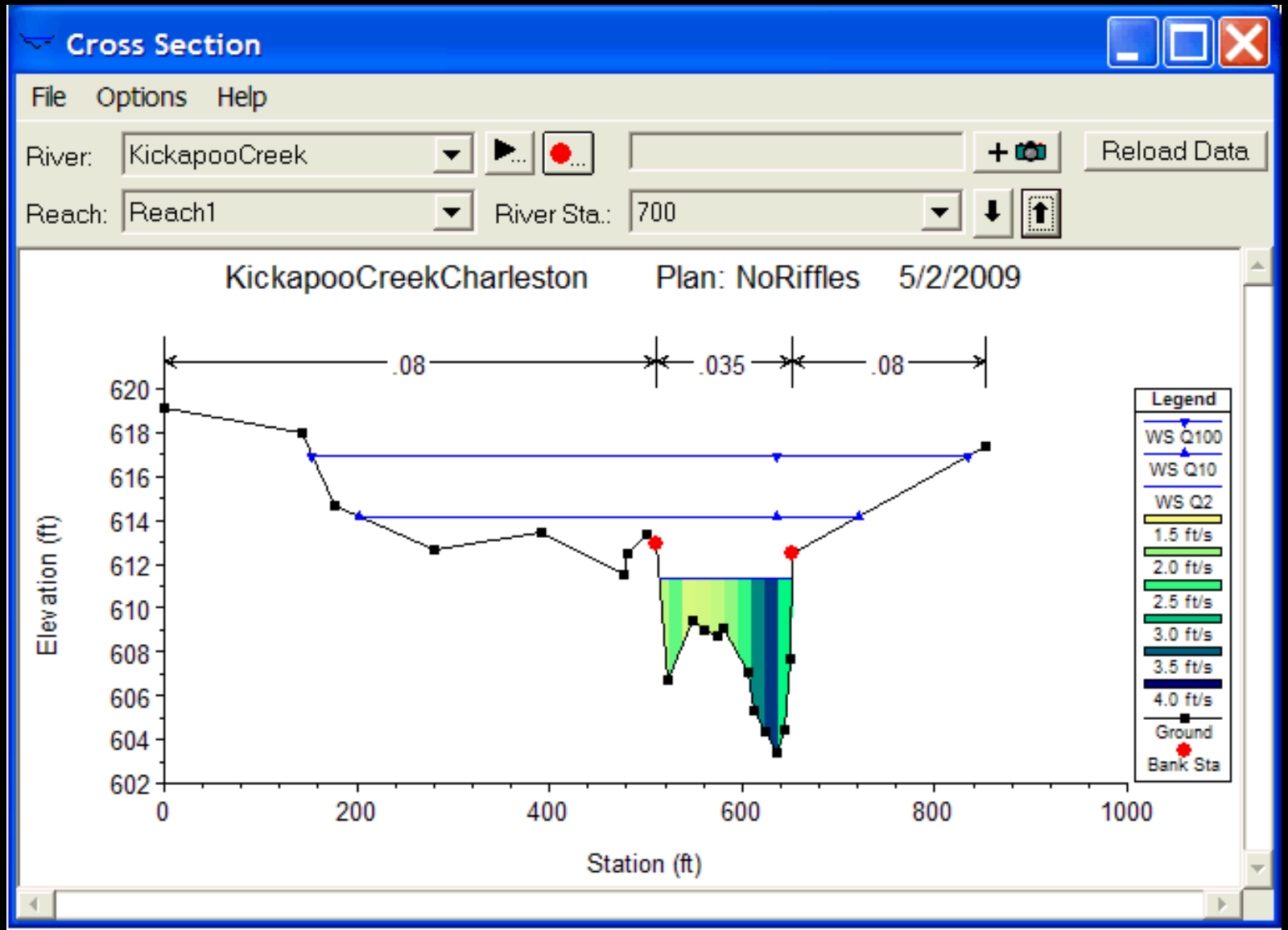


Hydraulic and Sediment Modeling

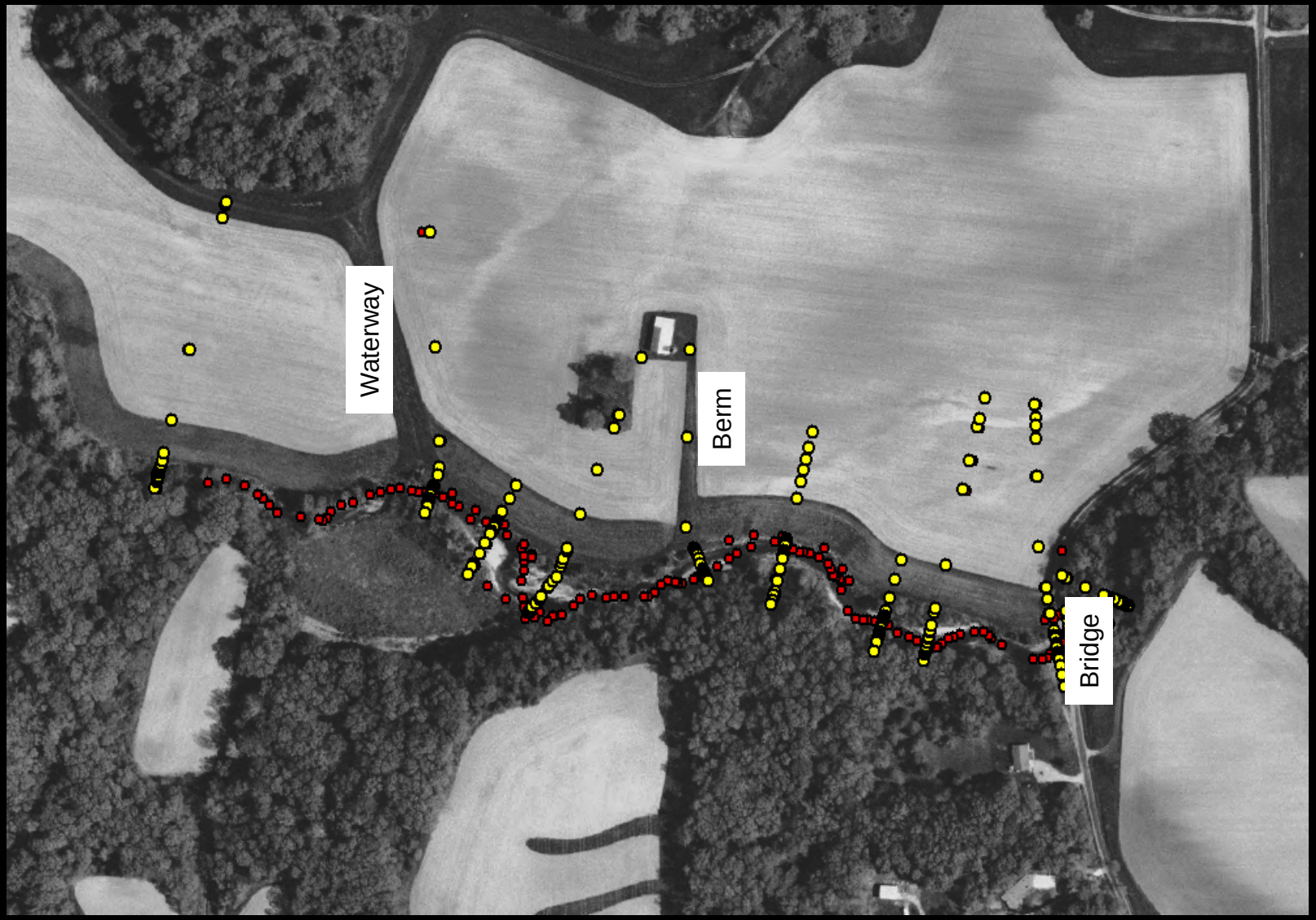
- When to use:
  - Concerns with upstream and downstream influences (i.e. reach approach needed)
    - Flat – backwater on riffles and/or deposition
    - Steep – could erode pools too deep – stability problems
- Models becoming much easier and cheaper to use and visualize results

Hydraulic and Sediment Modeling

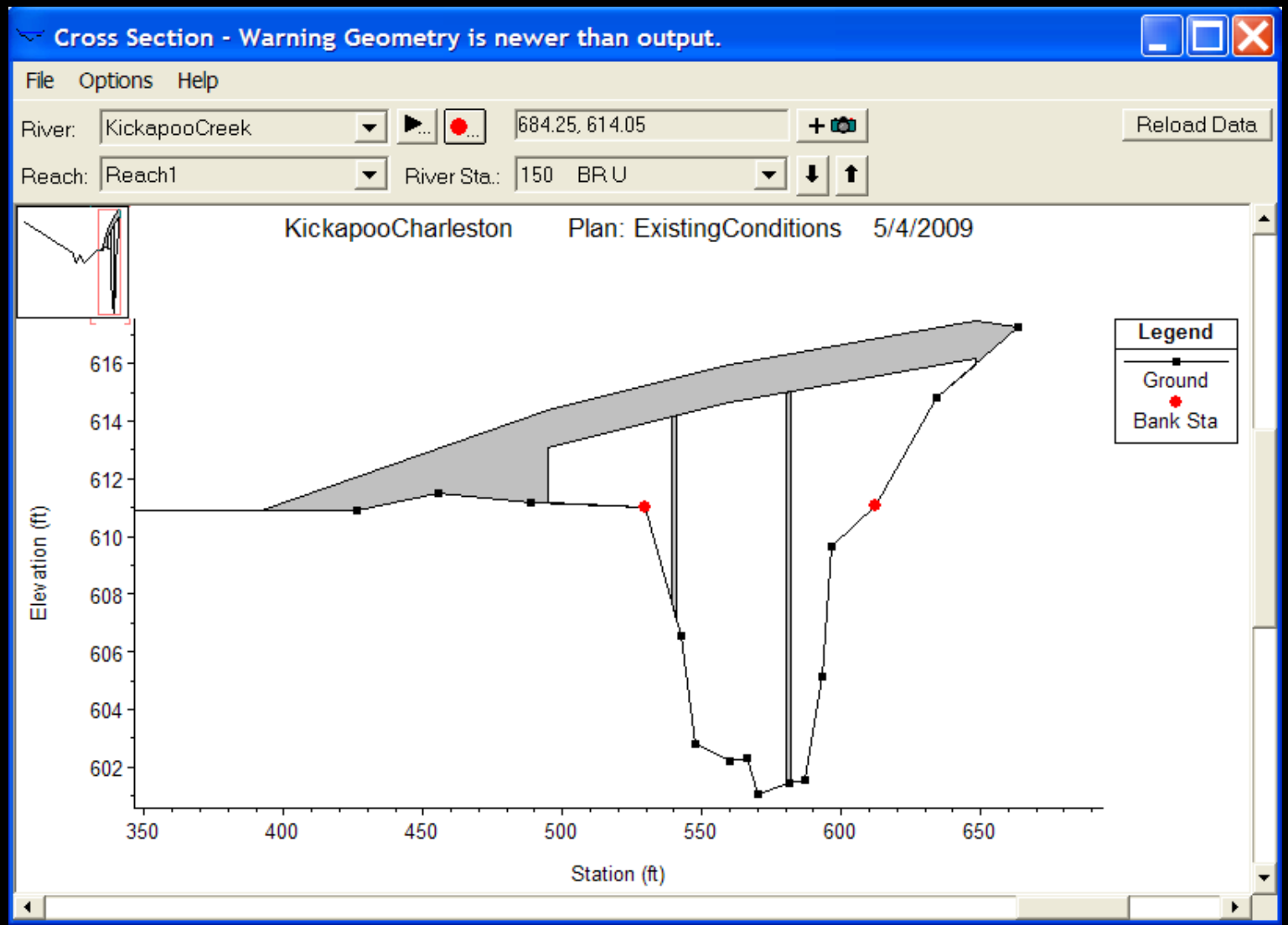
using HEC-RAS 4.0



Channel and Floodplain Survey

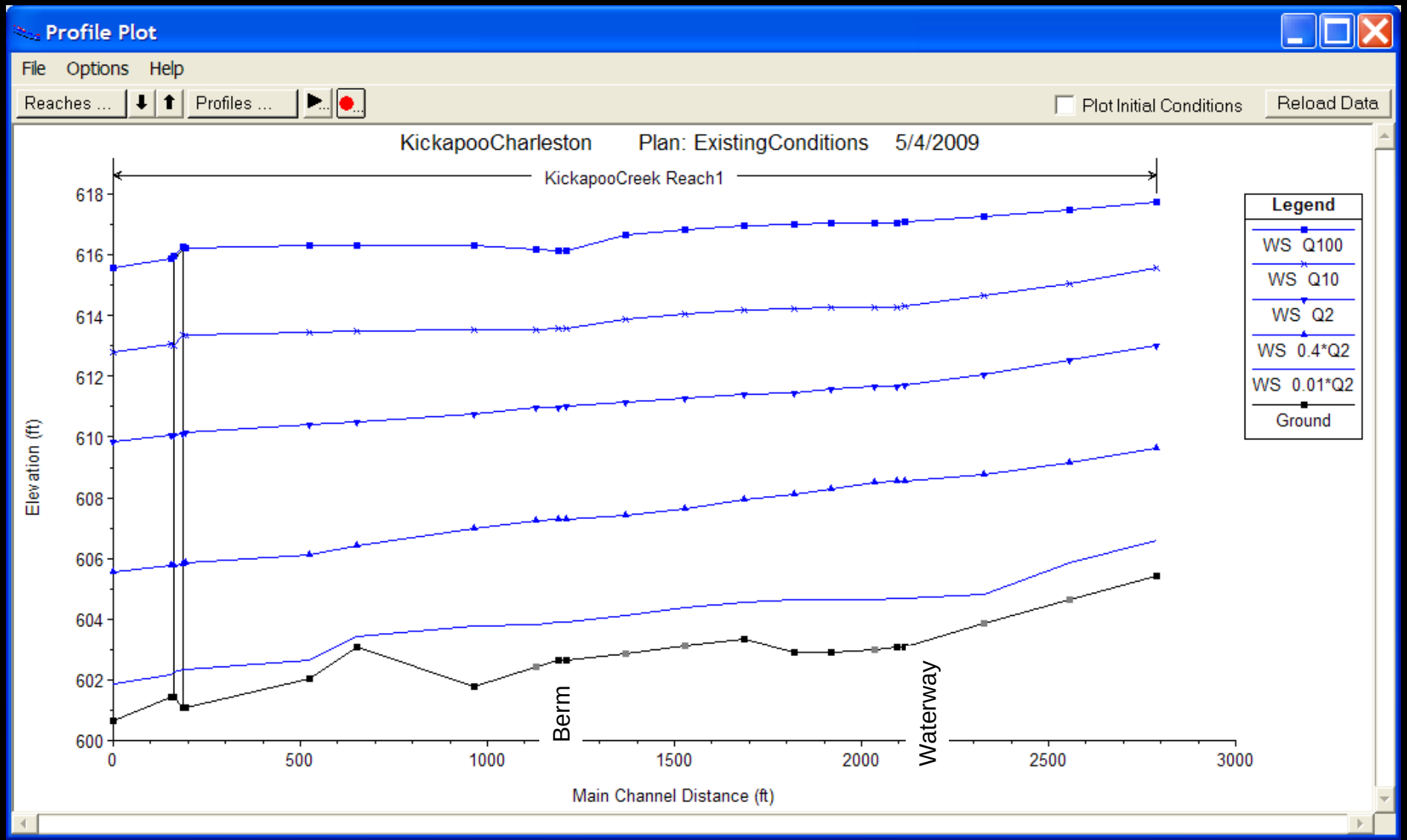


Charleston Model Built with Downstream Bridge



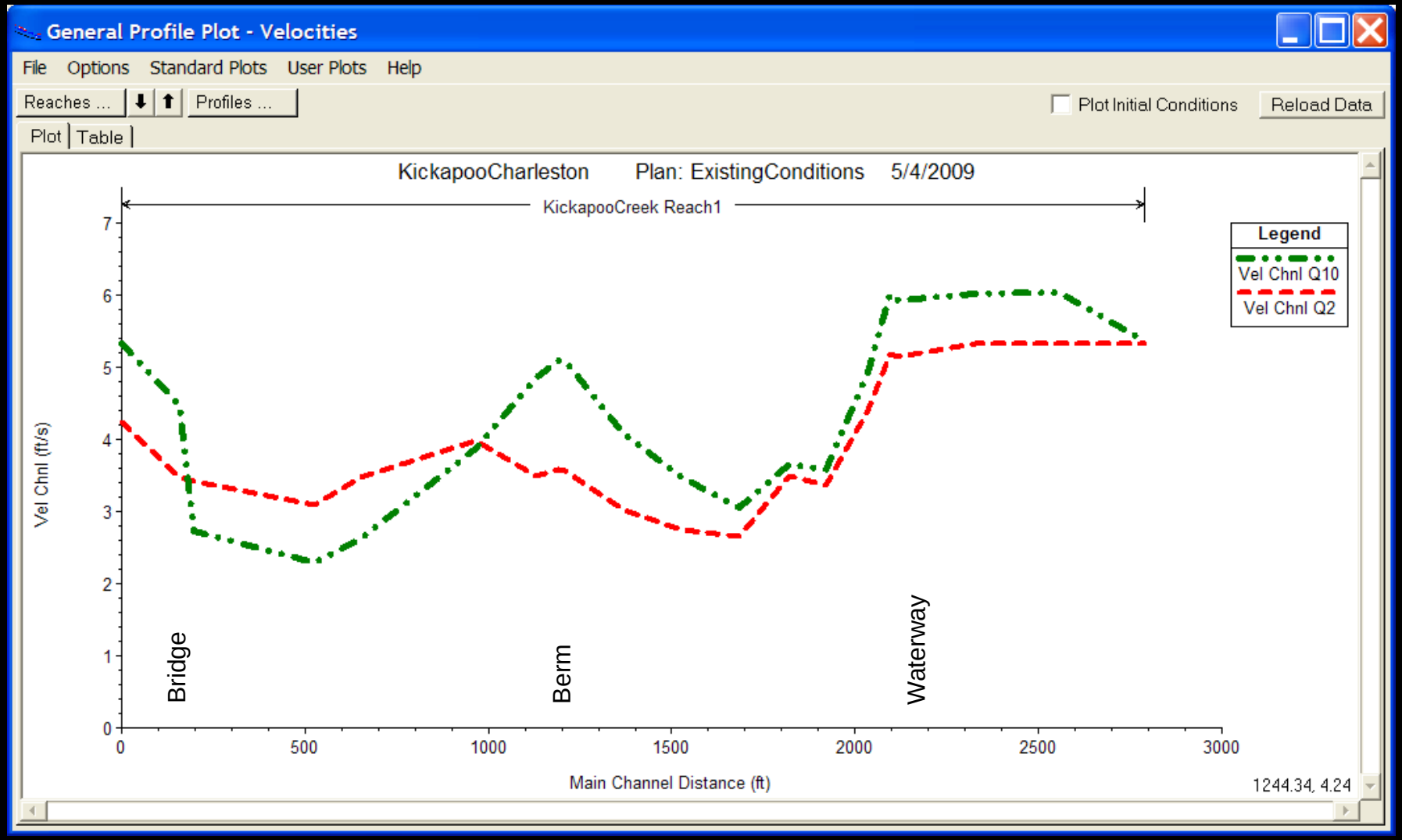
Existing Conditions WS Profile View

Q100, Q10, Q2, 0.4xQ2, and 0.01xQ2



Existing Conditions VELOCITY

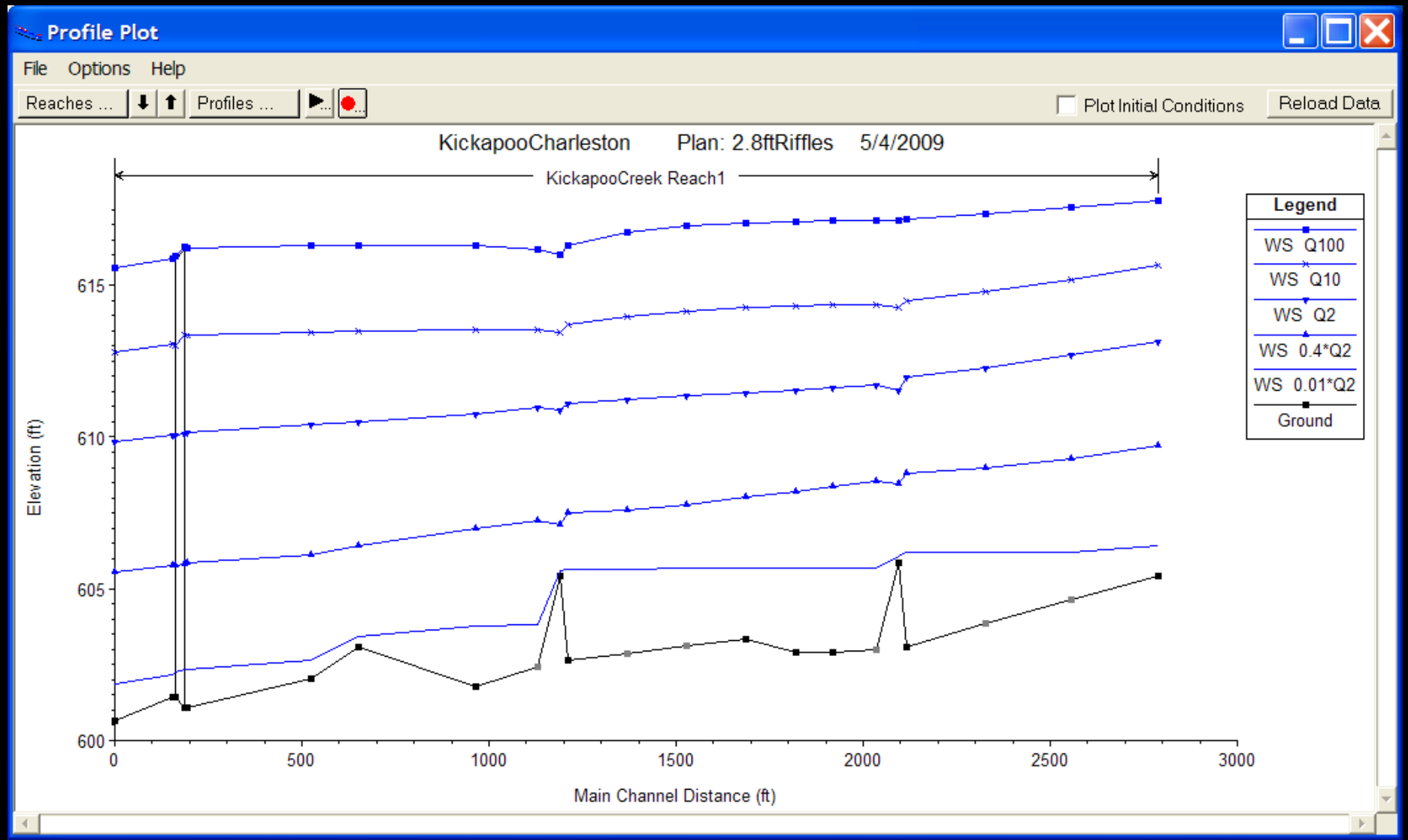
Q2 and Q10 (Not Enough to Only Look at Q2)



Rock Riffle Alternative Modeled

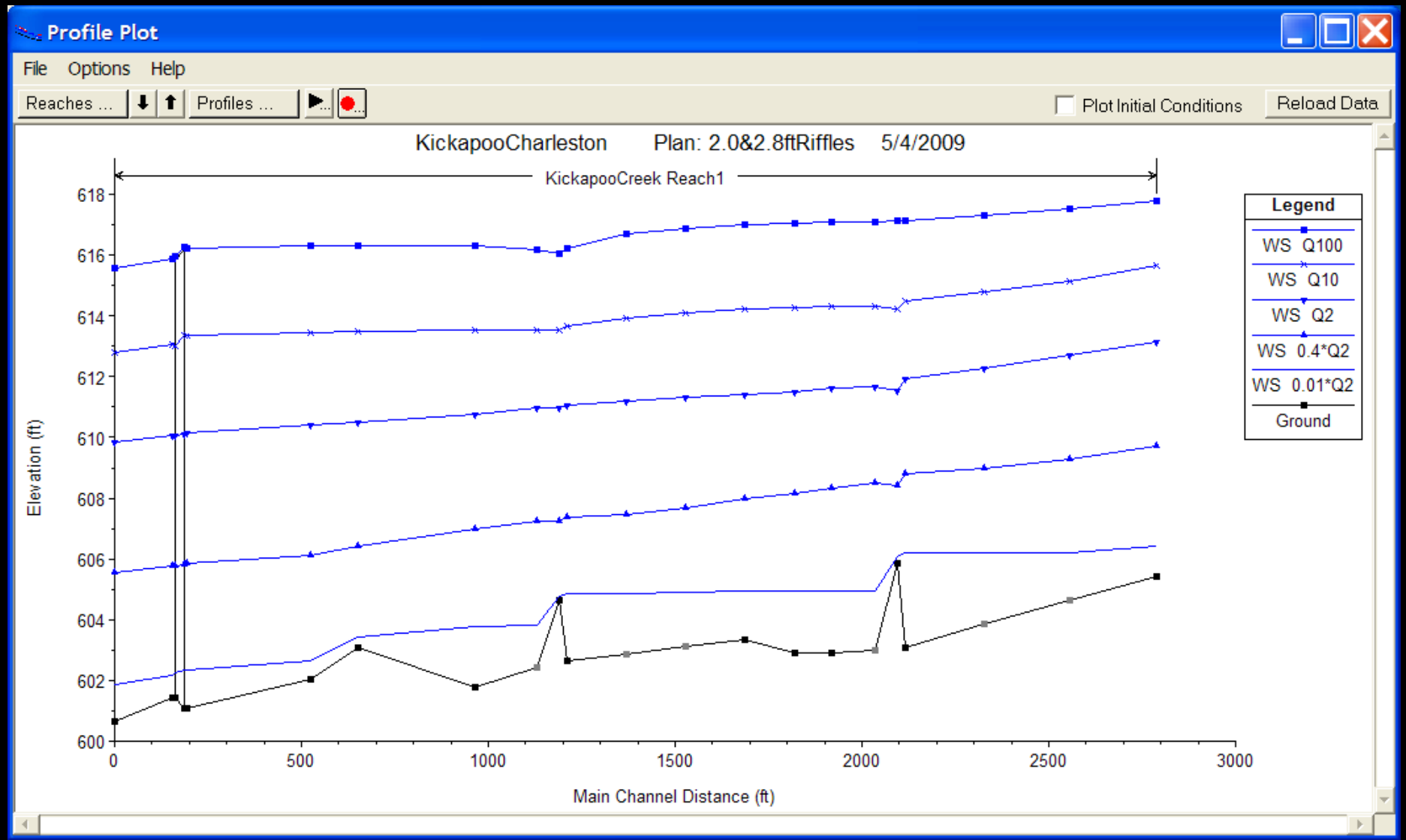
2.8 ft Riffles WS Profile View

Q100, Q10, Q2, 0.4xQ2, and 0.01xQ2



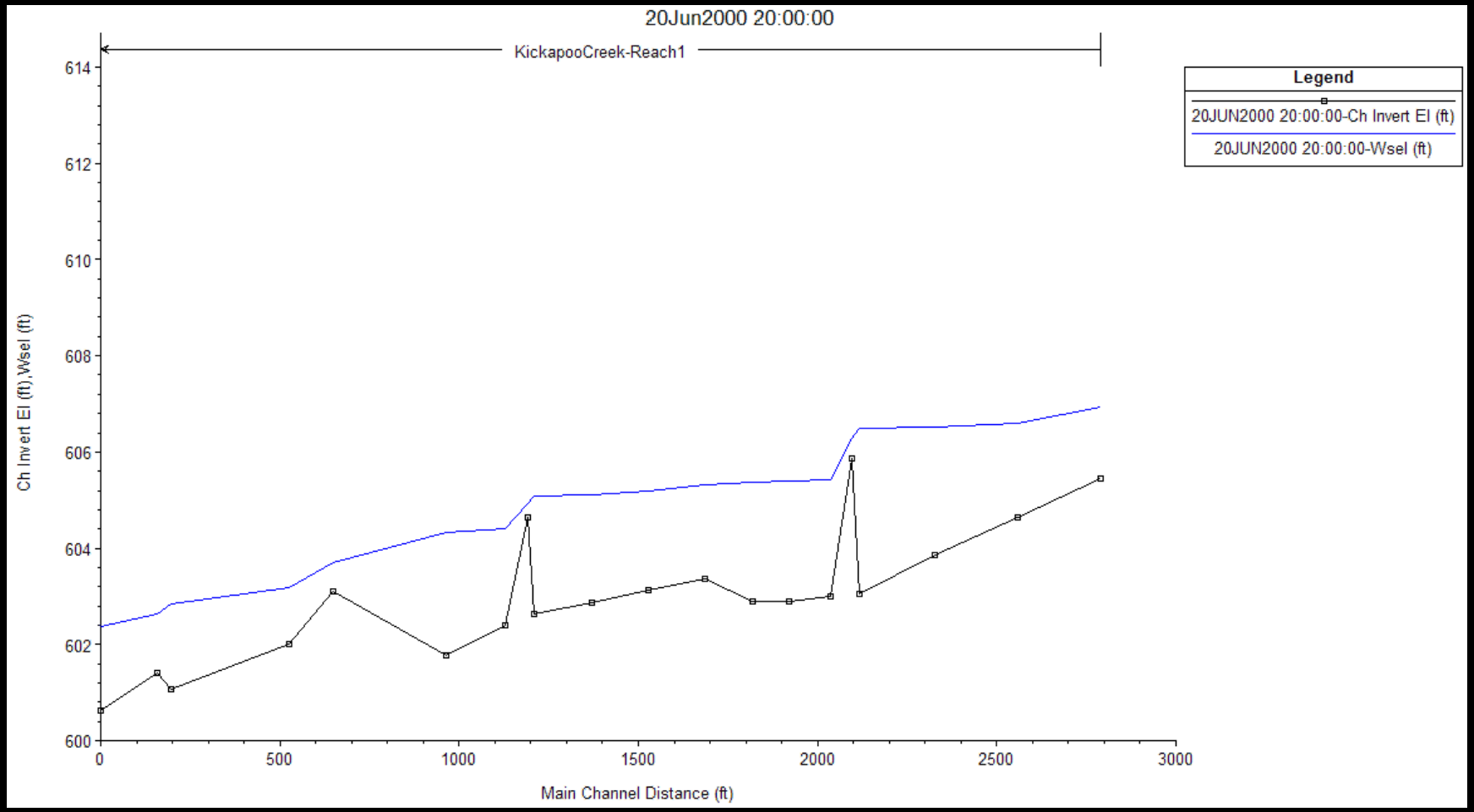
2.0 and 2.8 ft Riffle WS Profile View

Q100, Q10, Q2, 0.4xQ2, and 0.01xQ2



2.0 and 2.8 ft Riffle Sediment Modeling

2-yr storm video



Conditions May 2011

Summary

- Hydrology
  - streamstats.usgs.gov
- Hydraulic and Sediment Modeling
  - Many scenarios quickly tried
  - Not as difficult as you might think
  - Extended demo offer
- Monitoring
  - Repeated surveys
  - Sediment gaging