Unique Approaches to Monitor Surface Water Flow in Lake County

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Project Background

- Applied for (6/10) and received (11/10) GLRI grant from US EPA to study surface water hydrology around downstream end of Glen Flora Tributary in Waukegan, IL
  - Identify and document hydrologic connections to study area
  - Quantify the flow that passes through these connections into the study area
- Goal: Inform future vegetation management, wetland and stream restoration, and redevelopment decision in Waukegan Harbor EAOC
  - Support implementation of RAP

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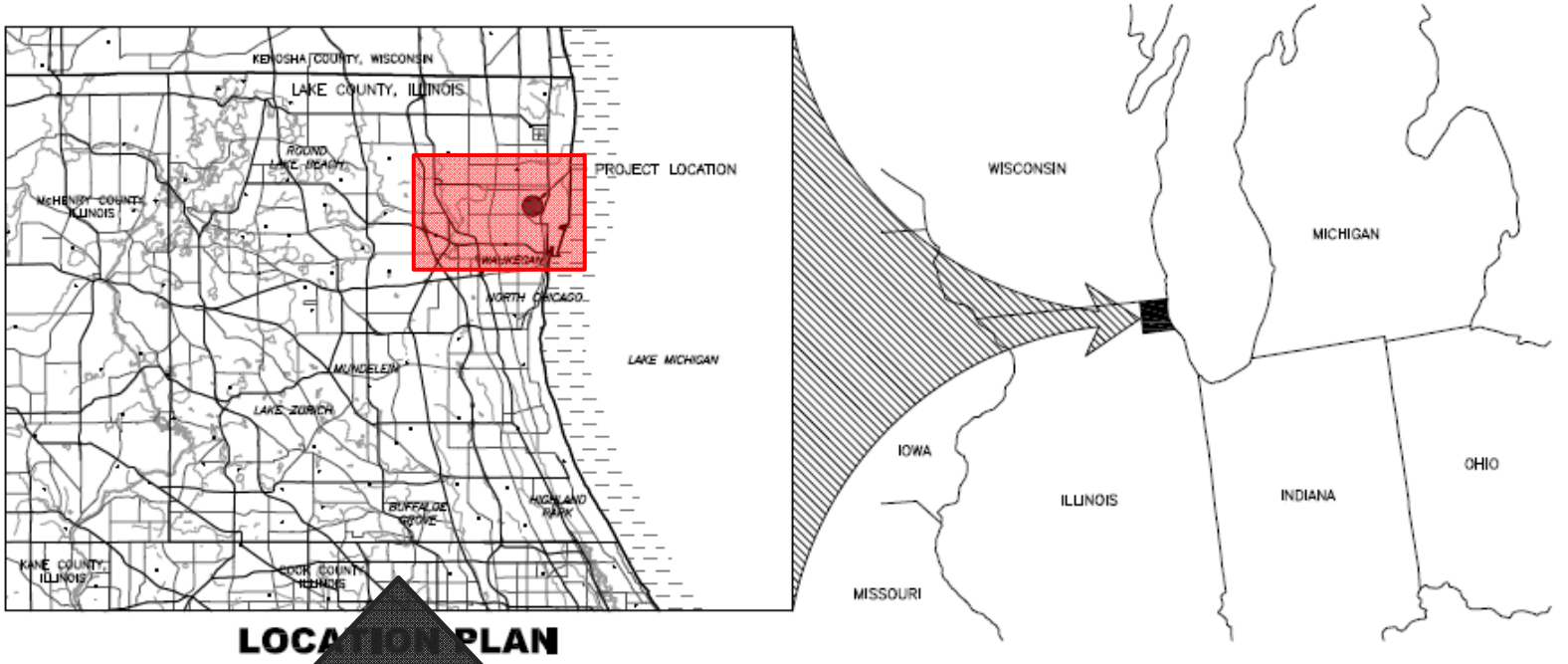
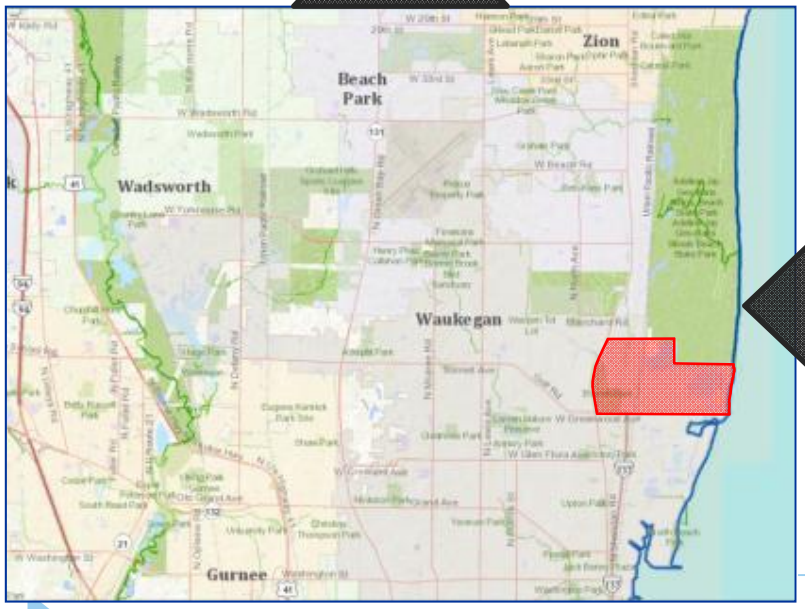


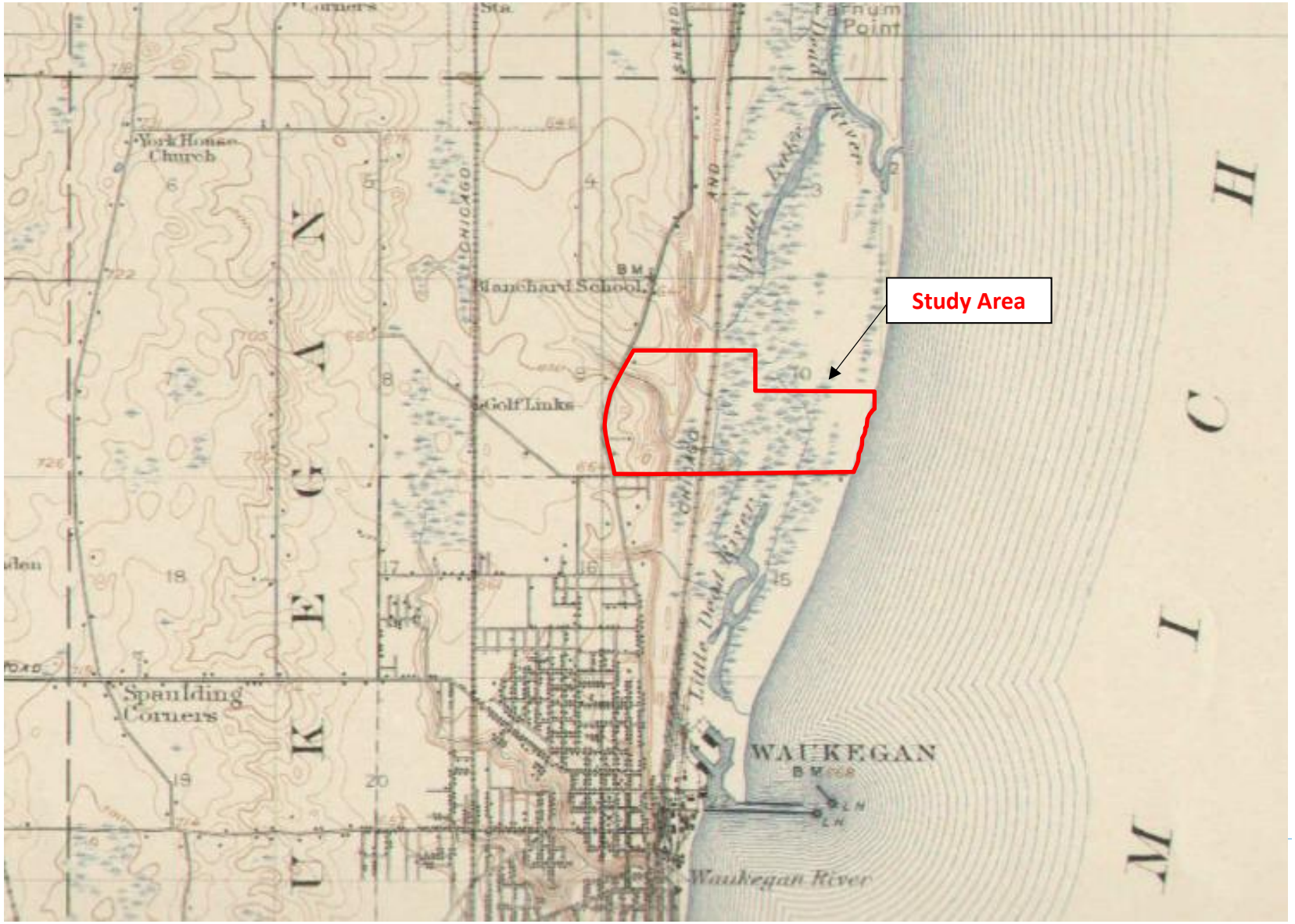
LOCATION PLAN



Current


N Sheridan Rd
Illinois Beach State Park
8
7
6
5
4
3
2
1
Former Johns Manville
Manufacturing Site
W Greenwood Ave
Amstutz Expy
Midwest Generation

Past (1908)


Study Area
York House Church
Blanchard School
Golf Links
Spaulding Corners
WAUKEGAN
Waukegan River
Farnum Point
N E G A U K E E
L I N C O L N

Future (?)

Waukegan Lakefront-Downtown Master Plan

Skidmore, Owings & Merrill LLP

Project Tasks

- SMC
  - Investigate study area and identify hydrologic connections
  - Select monitoring sites and design monitoring study
  - Identify and obtain necessary permits and landowner approvals
  - Develop QAPP
- CDM Smith
  - Review monitoring sites and study design
  - Design monitoring stations
  - Install monitoring equipment
  - Collect, download, and analyze flow monitoring data
- SMC
  - Evaluate and QA/QC flow monitoring data
  - Reporting and public outreach


Blanchard Rd
Illinois Beach State Park
#8 Open Channel
#7 Open Channel
Glen Flora Tributary
#5 Culvert
#6 Open Channel
#4 Culvert
Former Johns Manville
Manufacturing Site
#1 Open Channel
#3 Culvert
#2 Culvert
Greenwood Ave
N Sheridan Rd

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Study Challenges

- Complex hydrology
  - Ravine streams feed extensive wetland complex along foot of bluff
  - Flow paths within and leaving wetland not particularly well defined, moving north, east, south and all directions in between
- Challenging monitoring conditions
  - Shallow flow depths, intermittent flow, backwater effects, naturally dynamic ravine system
- Number of landowners
  - 6 landowners (incl. utilities, railroads, private, corporate and public landowners) = 6 landowner agreements
- USACE permit required
  - Nationwide permit (NWP) No. 5, *Scientific Measuring Devices*

Project Details

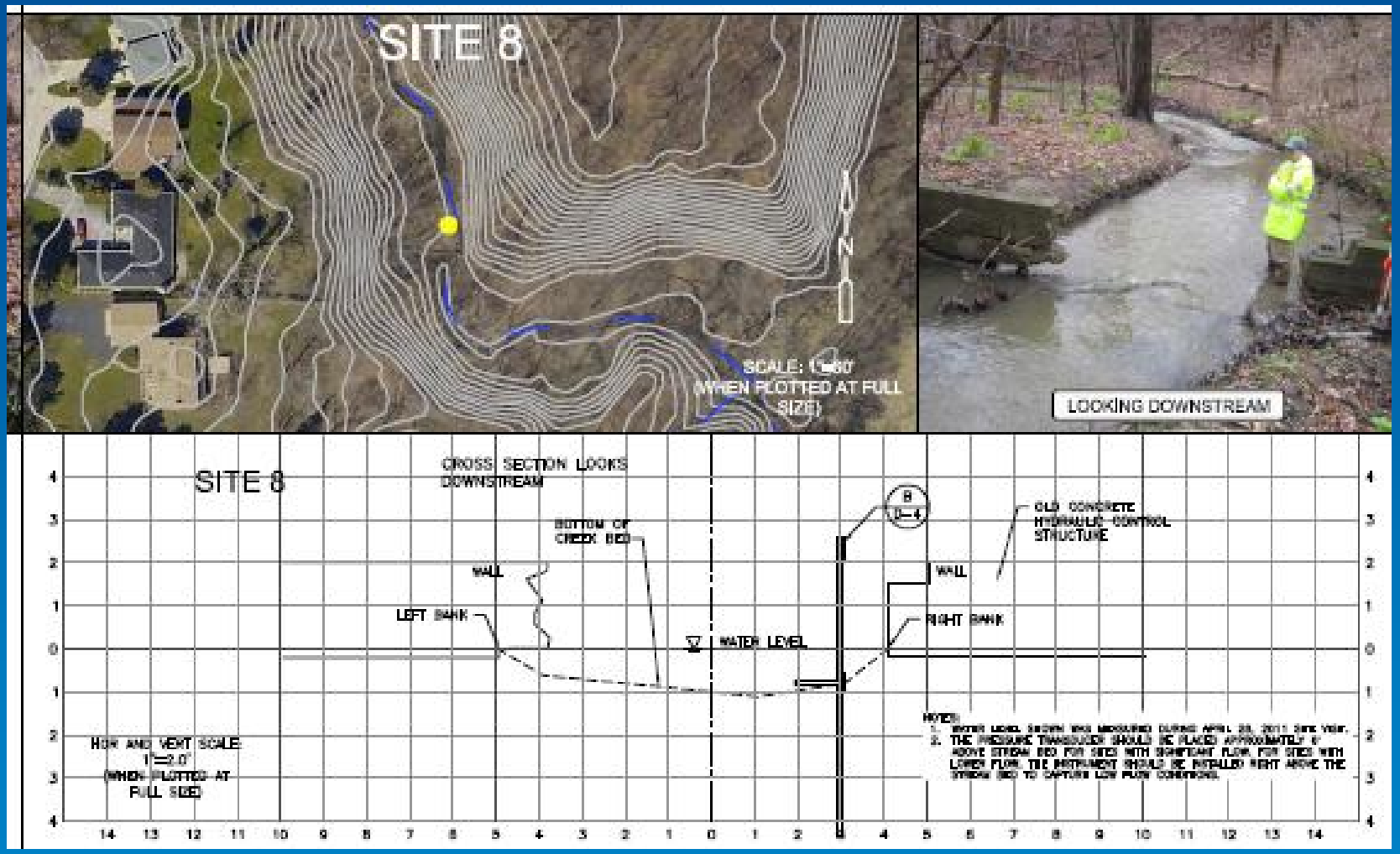
- Schedule
  - Site Investigation & Study Design 04/2011
  - Monitoring Station Design ~~05/2011~~ 06/2011
  - Equipment Installation ~~06/2011~~ 09/2011
  - Data Collection ~~06/2012~~ 10/2012
- Funding
  - $118,000 GLRI Grant + $5,000 Local Funds

- Original schedule and funding didn't account for the permits & landowner agreements that would be needed (+ 4 months)…nor the observations that would be made during wet weather conditions (+ 1 monitoring site)…

Monitoring Equipment Selection

- Site 1, 3, 4 have backwater effects, stage / discharge rating not applicable
  - Side-looking acoustic Doppler velocity meter (ADVM) supplemented with a high-accuracy pressure transducer
- Sites 2, 5 have culverts controlling the flow
  - Pressure transducers / stage discharge ratings
- Site 6 and 7 are very small channels with very shallow flows
  - Temporary flume / pressure transducer
- Site 8 pressure transducer / stage discharge rating

Design Plans



Equipment Installation

- Equipment installation was completed in just a few days
  - Crew of four
- Overall challenges
  - Remote locations - no mules
  - Field fabrication - no power outlets
  - Steep ravines
  - Water safety, weather safety - HSP was developed
  - Railroad / private property access

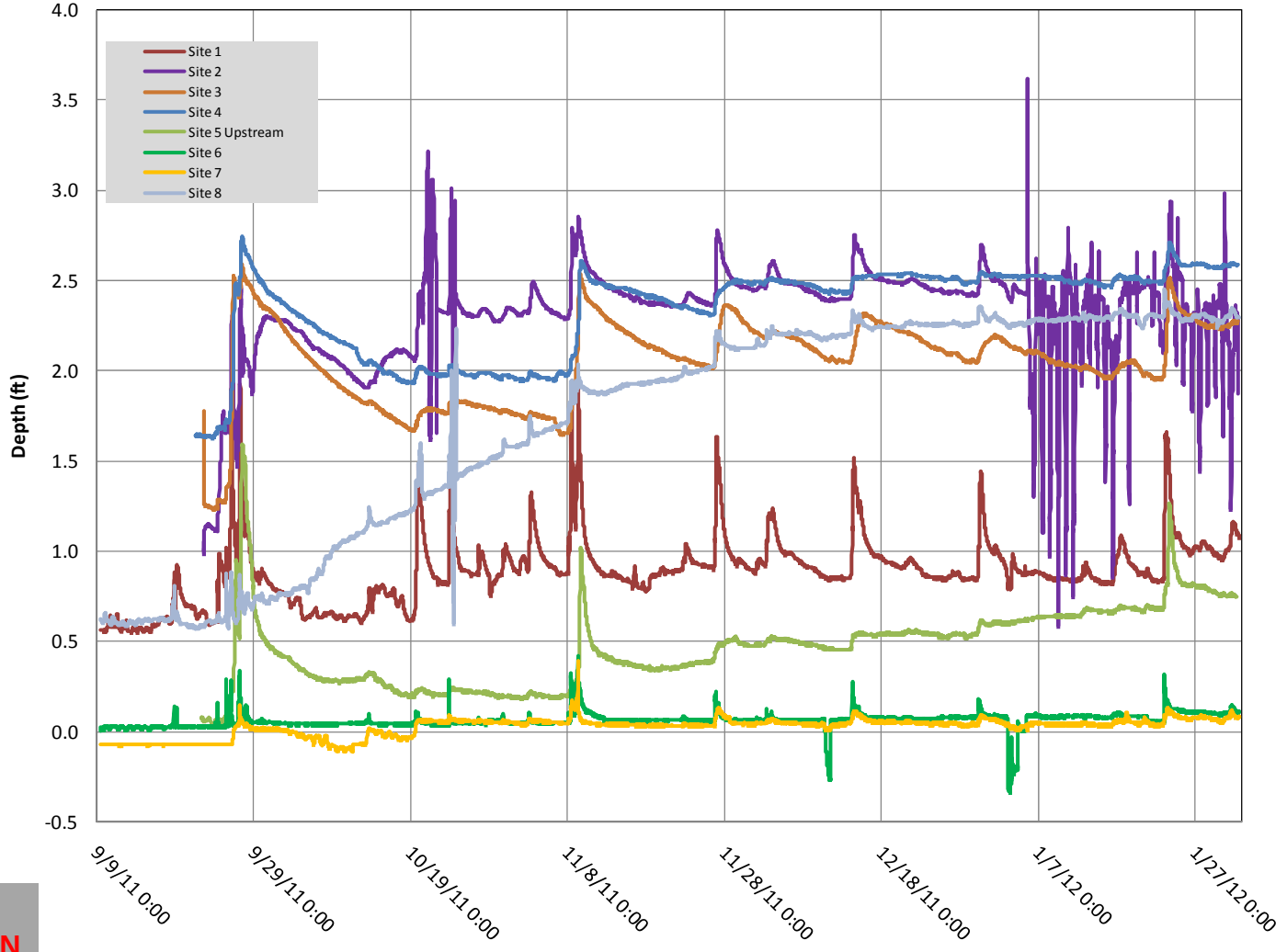
Data Collection

- Monthly site visits
- Make flow and general observations
- Download data
- Inspect and adjust instruments
- Change batteries for velocity meters

Data Collection Observations

- Seasonal changes in wetland hydrology
  - Ice
  - Leaves
  - Beavers
  - Debris dams
  - Spring/summer storms
- Conveyance changes
  - Site 8 (Ganster) is ponding
  - Culvert at Site 2 is mostly blocked and being bypassed

Data Collection Depth Data



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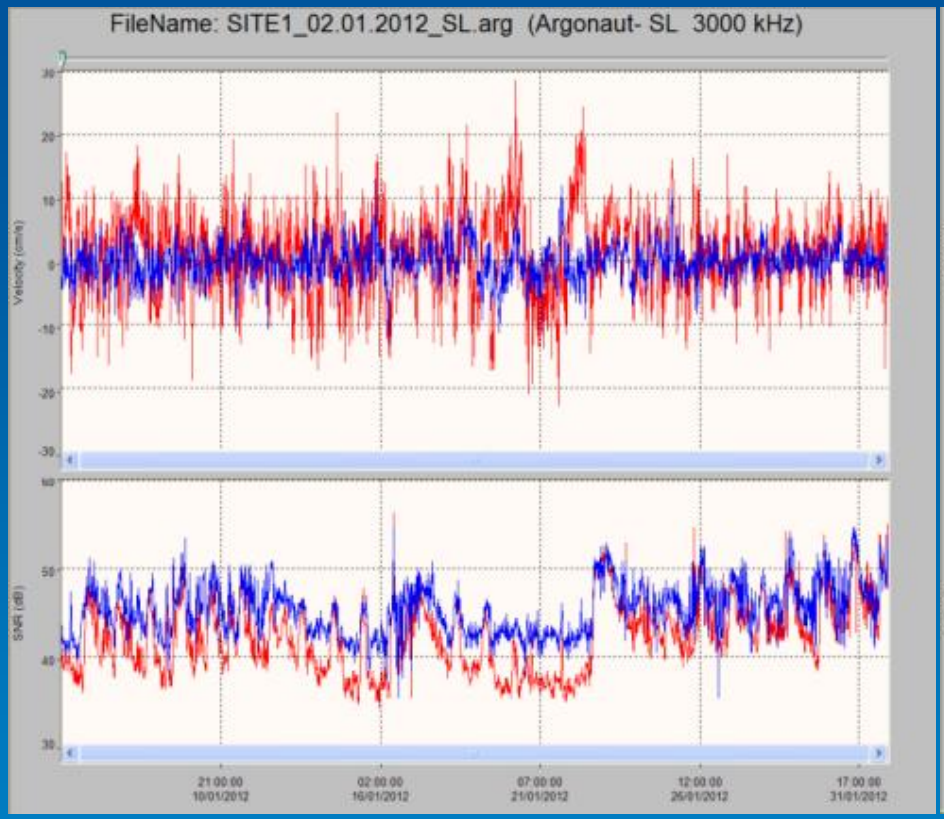
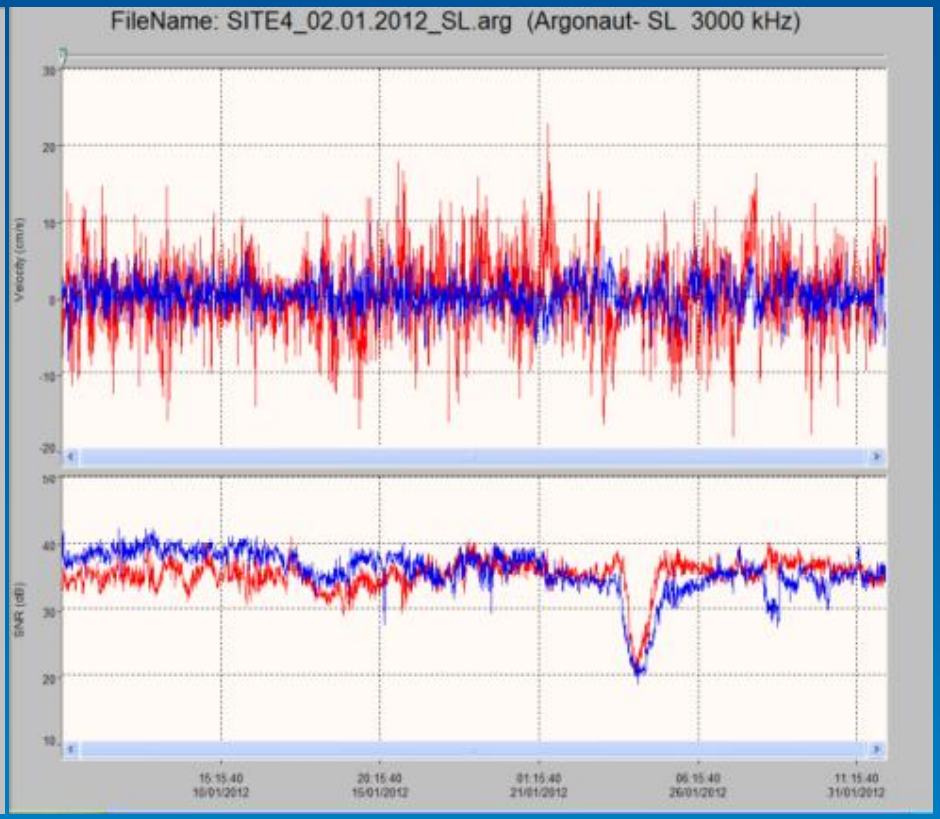
Data Collection Velocity Data





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Data Collection Flow Tracker Measurements

- To develop stage-discharge relationships at the gauge sites, we take hand held Flow Tracker flow measurements during site visits
- Most sites have had small flows to date
- Will take measurements during spring rains to capture larger flow events

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File Information	
File Name	SITE8NOV.WAD
Start Date and Time	2011/11/28 17:12:55

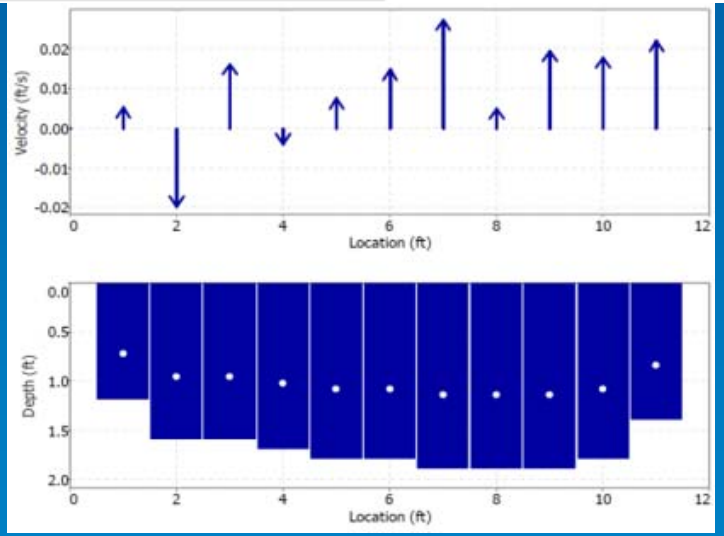
Site Details	
Site Name	
Operator(s)	SDB

System Information	
Sensor Type	FlowTracker
Serial #	P3405
CPU Firmware Version	3.7
Software Ver	2.30
Mounting Correction	0.0%

Units	(English Units)
Distance	ft
Velocity	ft/s
Area	ft^2
Discharge	cfs

Discharge Uncertainty		
Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.2%	2.1%
Velocity	3.9%	40.9%
Width	0.2%	0.2%
Method	3.6%	-
# Stations	3.9%	-
Overall	**6.7%**	**40.9%**

Summary			
Averaging Int.	40	# Stations	13
Start Edge	LEW	Total Width	12.000
Mean SNR	34.7 dB	Total Area	18.600
Mean Temp	43.01 °F	Mean Depth	1.550
Disch. Equation	Mid-Section	Mean Velocity	0.0105
		Total Discharge	**0.1945**



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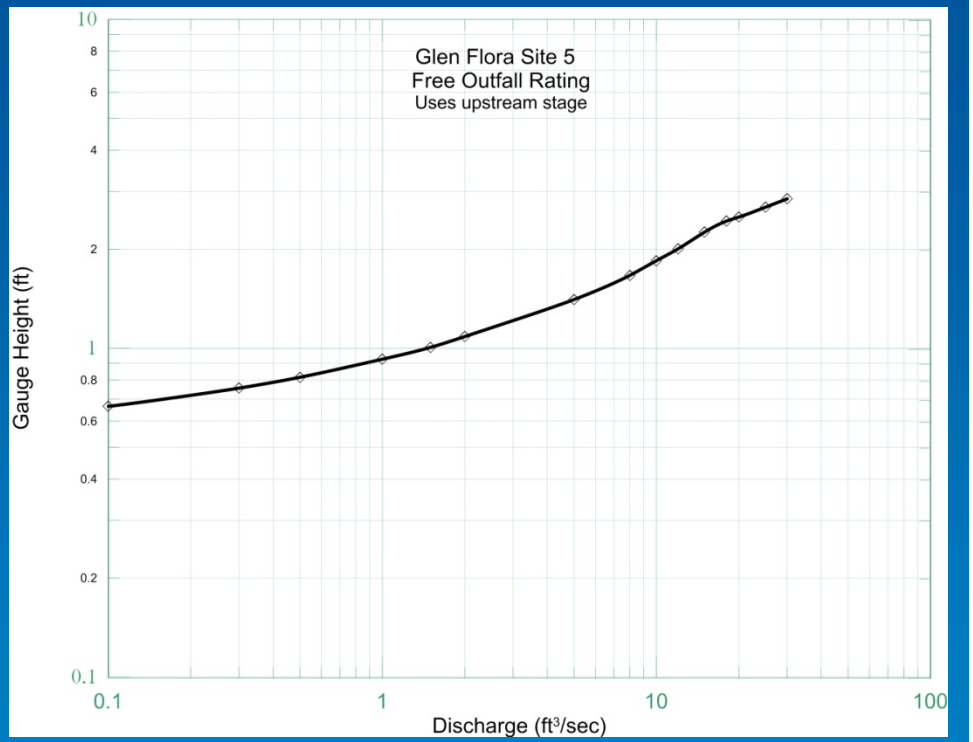
Data Collection Challenges

- Weather
  - Little rain causes low flow/no flow conditions
  - Ice can affect instruments and hydrology
    - RV anti-freeze
  - Debris dams causing blockages
- Equipment
  - Replacing and calibrating pressure transducers
  - Making sense of velocity sensor and flow tracker data

Stage – Discharge Relationships

- Ultimate goal to develop a stage discharge relationship for each meter
- This relationship will be used to determine a continuous flow record
- It will need to be revised in future based on changes in hydrology



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Questions?

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