Making a Major Impact with Water Management Technology: How South Bend, IN Saved Hundreds of Million Dollars and Reduced Overflows by 70%

Tuesday, January 26, 2021
1:00 – 1:45 PM ET

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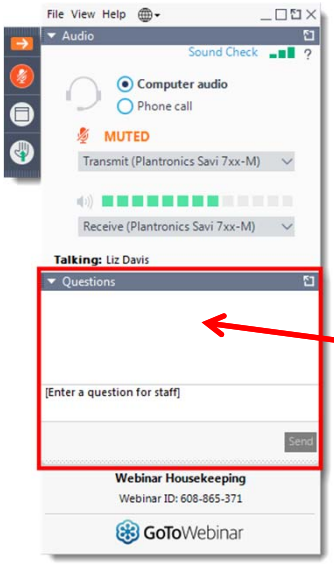
How to Participate Today



- **Audio Modes**
  - Listen using Mic & Speakers
  - Or, select "Use Telephone" and dial the conference (please remember long distance phone charges apply).
- **Submit your questions using the Questions pane.**
- **A recording will be available for replay shortly after this webcast.**

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Making A Major Impact with Water Management Technology: How South Bend, IN Saved Hundreds of Million Dollars and Reduced Overflows by 70%

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Xylem

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Xylem: focused on solving the world's water issues

A WATER INDUSTRY LEADER WITH GLOBAL REACH …

- Leading global water technology provider based in USA
- Approximately 16,800 global employees
- Headquarters: Rye Brook, NY; ~350 global locations
- Doing business in 150+ countries on 6 continents
- ~$5.2B in 2019 revenue

Our Vision: To create a world in which water issues are no longer a constraint to health, prosperity and sustainable development

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Welcome

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South Bend CSO History

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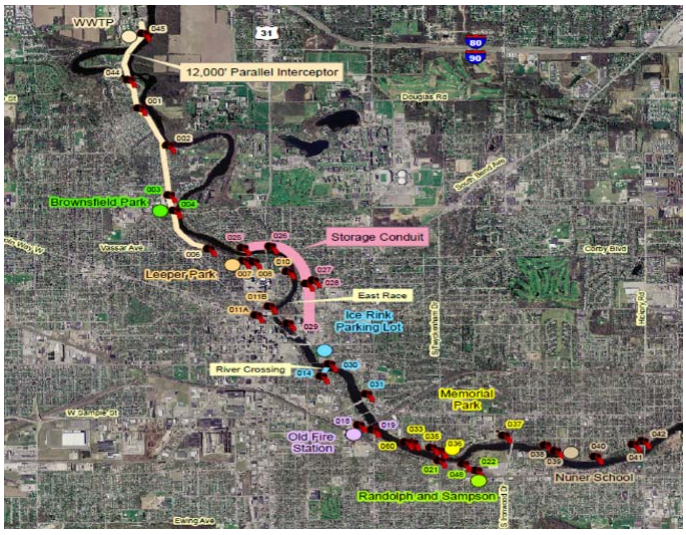
South Bend's CSO Program



Phase 1 (Completed)
- Strategic sewer separation
- Smart Sewer Program
- Plant capacity improvement

Phase 2 (in current Consent Decree)
- All gray infrastructure
  - 7 Storage tanks
  - 1 Storage conduit
  - 1 Parallel interceptor
- No smart or green infrastructure

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Smart Sewer Program

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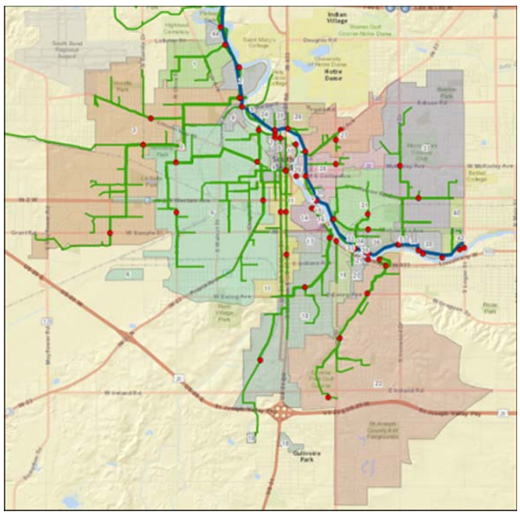
Step 1: Turn on the Lights



- Installed 2009
- Monitor all regulators
- Monitor interceptor and key trunklines
- Track performance of retention basins

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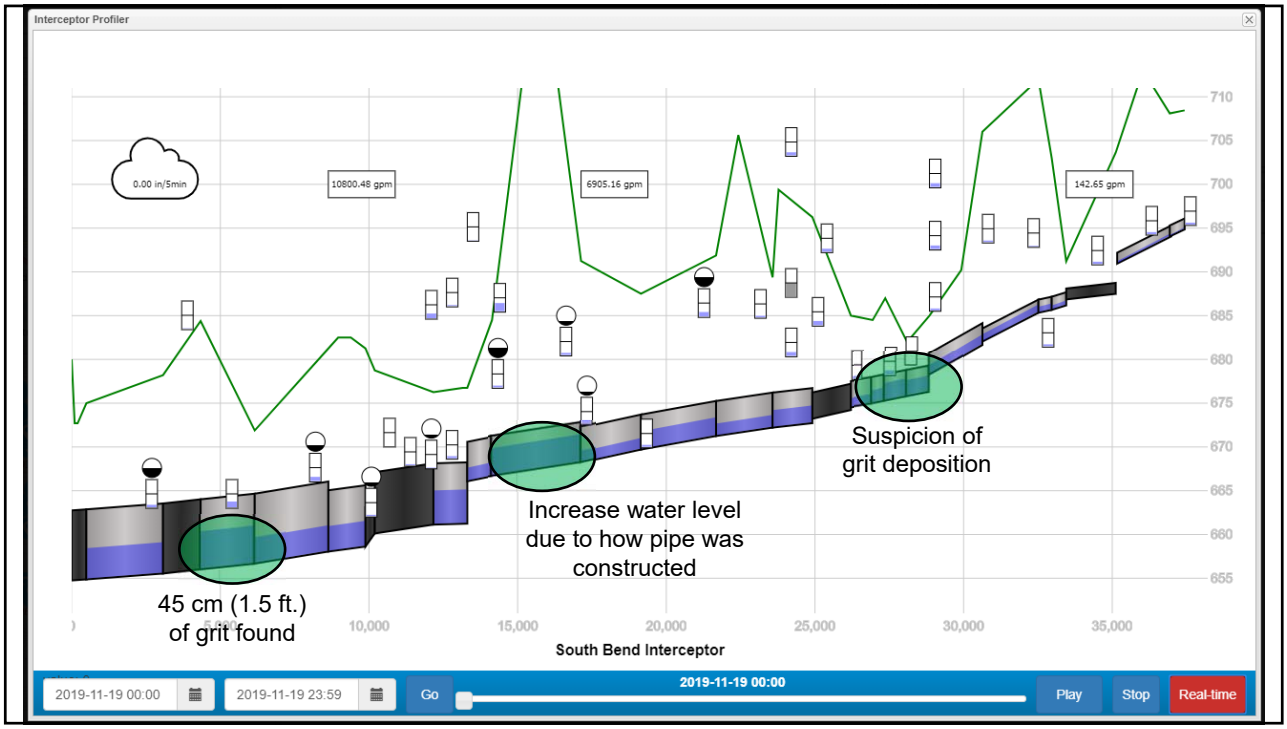

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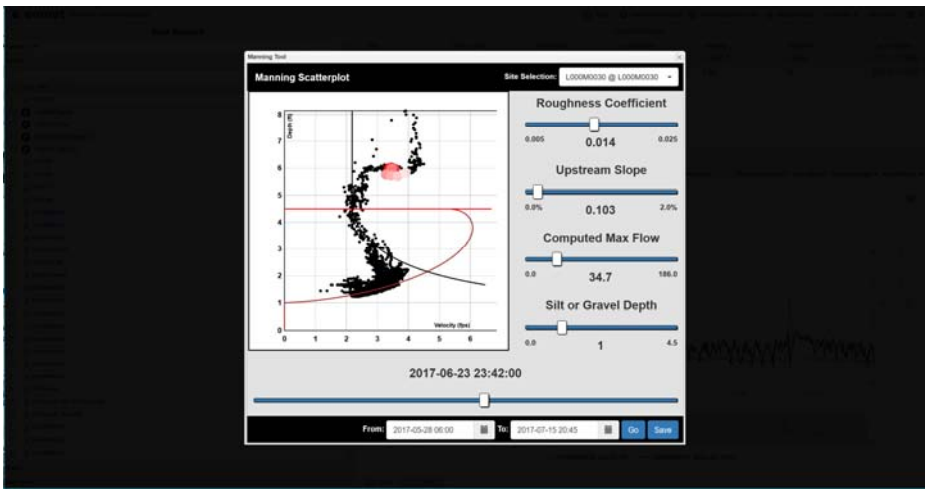
Manning's Dashboard



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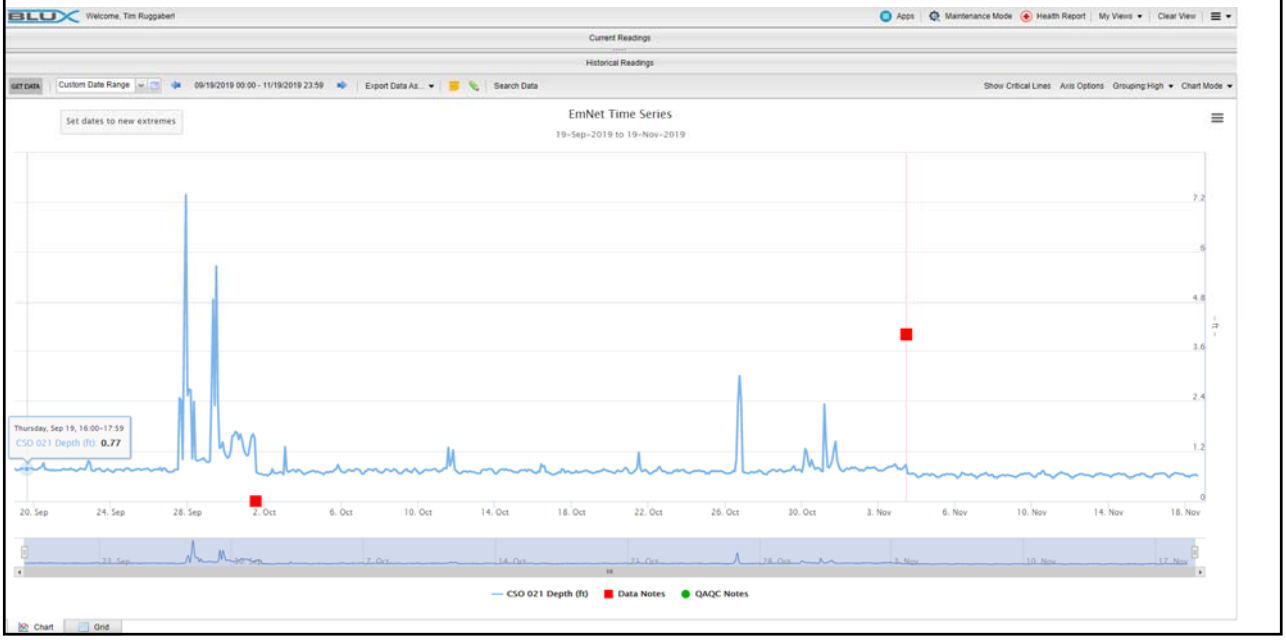
Proactive Maintenance



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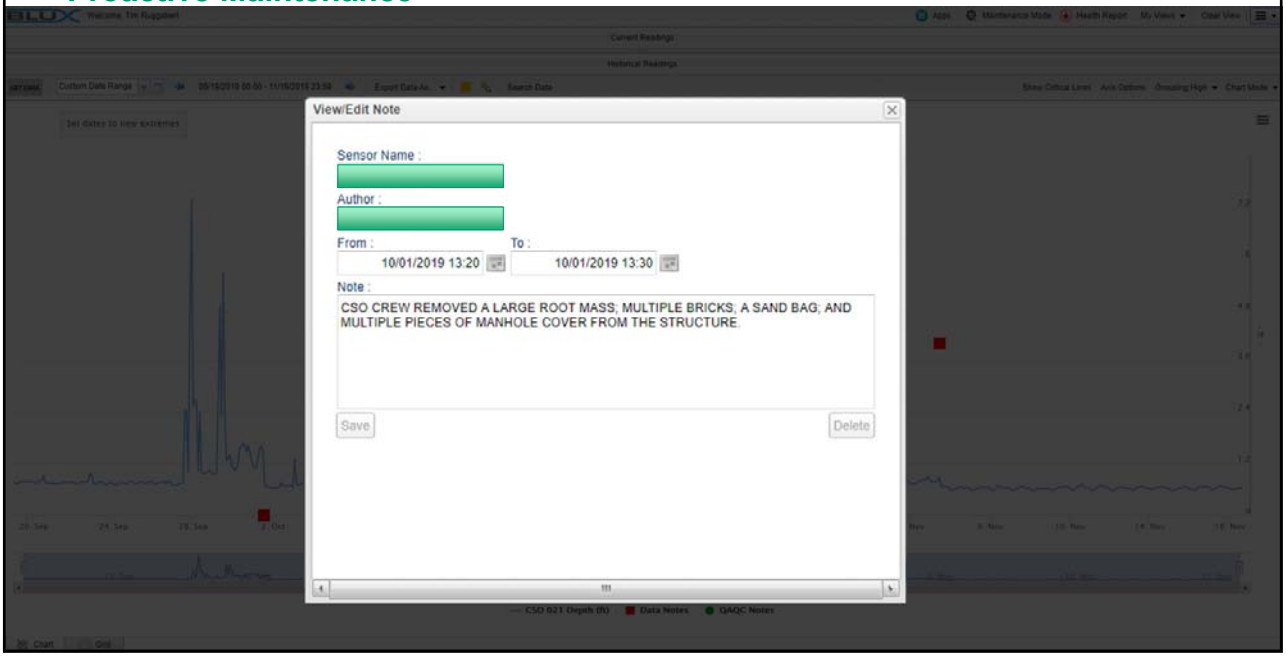
Proactive Maintenance



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Some Material Removed from the South Bend Sewers

Increase your capacity by optimizing what you already had

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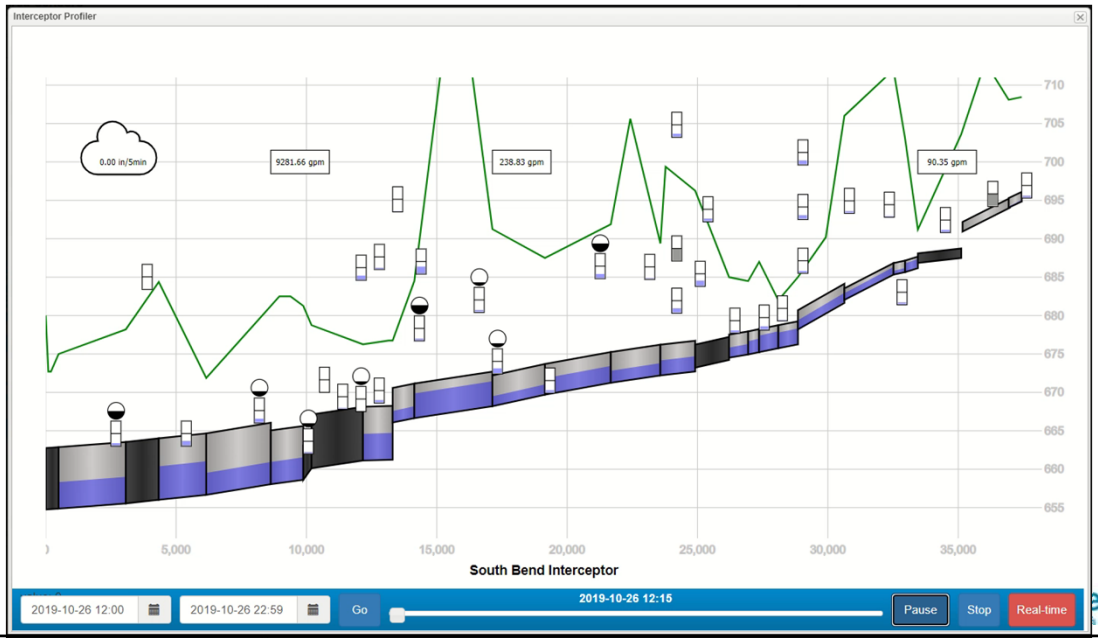
Globally Coordinated Control



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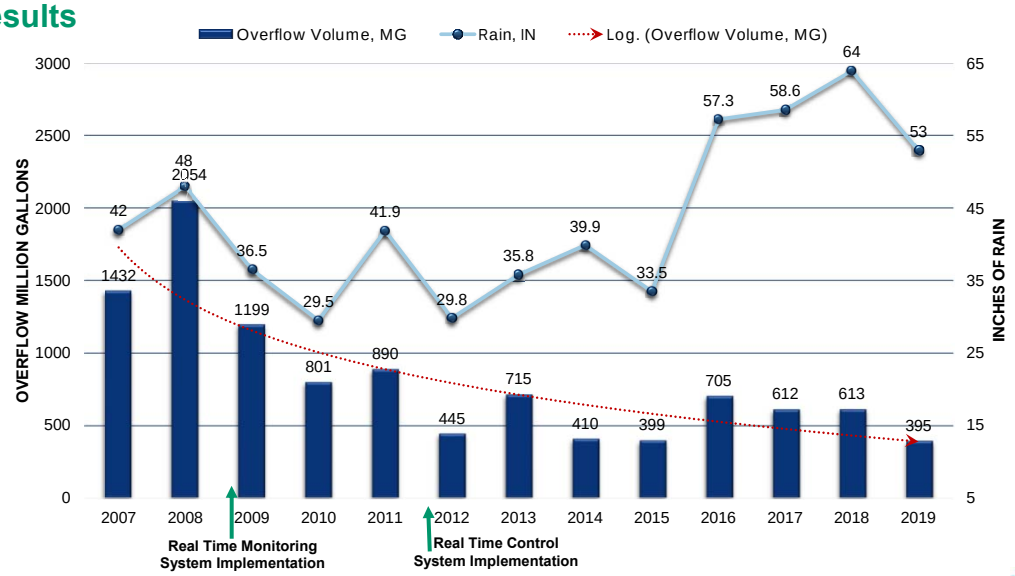
Results



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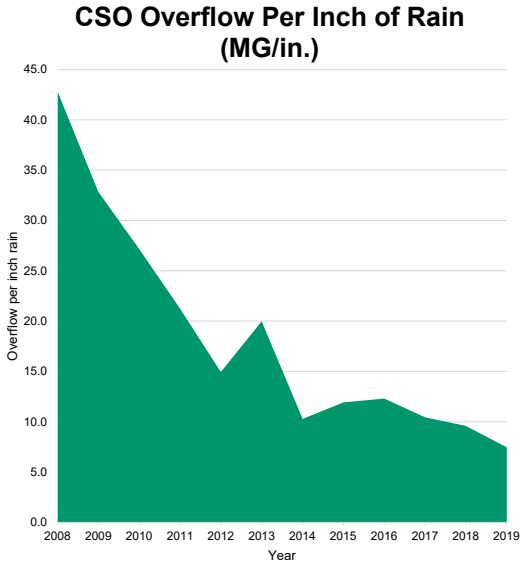
Year	Rain (Inches)	CSO (MGs)	CSO Overflow Per Inch of Rain (MGs)
2008	48	2054	42.8
2009	37	1199	32.8
2010	30	801	27.2
2011	42	890	21.2
2012	30	445	14.9
2013	36	715	20.0
2014	40	410	10.3
2015	34	399	11.9
2016	57	705	12.3
2017	59	612	10.4
2018	64	613	9.6
2019	53	395	7.5



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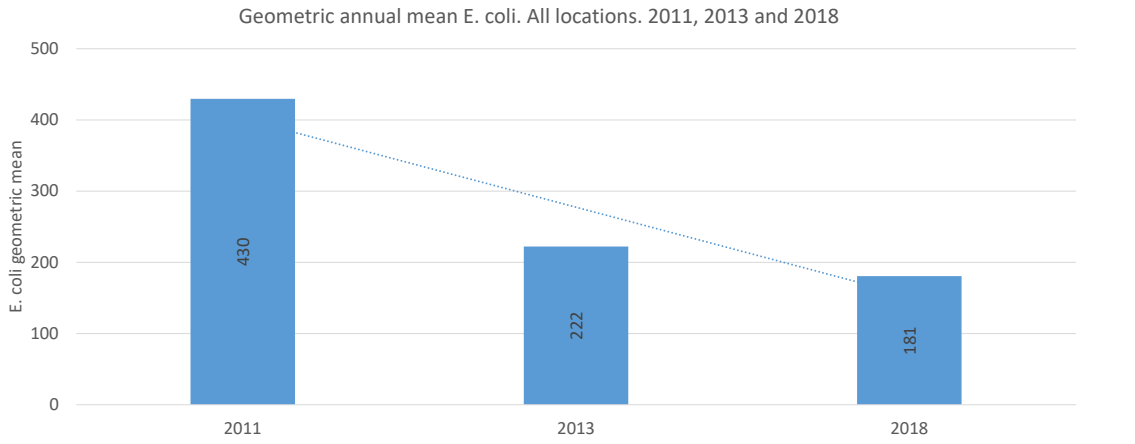
South Bend – E. Coli Reduction (58% decrease)



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South Bend - CSO Long Term Control Plan Pivot

Considering the totality of the reduction from 2011 to 2018, **84%** of that reduction was achieved by 2013. From the end of 2013 to the end of 2018, just **16%** of the overall 2011 to 2018 reduction occurred.

The significance of this timing is that it points to the smart sewer system and not the prescribed Phase 1 LTCP projects as being the projects that led to the successes in E. coli and CSO volume reduction.

Implication:

We're about to go down the wrong road for Phase 2.

We are being directed down there by State and Federal Regulators (EPA, IDEM, DOJ).

Successes achieved were due to South Bend innovation NOT due to Regulatory enforcement actions.

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Wastewater Network Optimization in Action

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Revising the Plan

1. Data-driven maintenance created increased capacity;
2. New hyper-accurate model shows deficiencies in old LTCP model;
3. Real Time Control exceeded expectations in reducing overflows;
4. Federal LTCP builds infrastructure but does not address the problem.

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Long Term Control Plan Update- What's Changed from the Last Time?

Sewer sensors ✚ Time ➡ System knowledge

System knowledge ➡ Informing model with real data

(Data enabled model ✚ Global control logic ✚ Optimization modelling) X 10,000's of simulations ➡ Next generation data drive alternatives

Next generation data driven alternatives ✚ Green stormwater infrastructure ➡ Smarter Alternative for a Greener Environment (SAGE)

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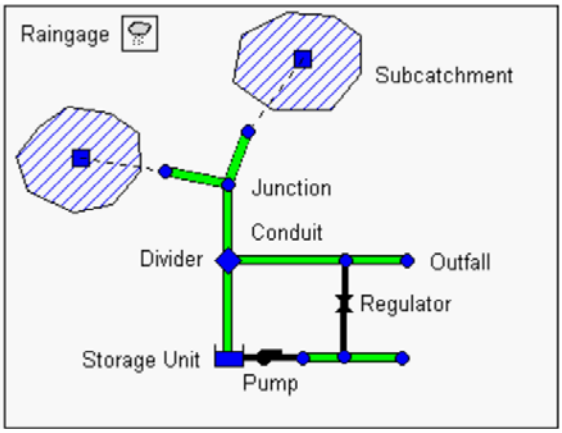
Standard Modeling Approach

- Hardest part: modeling how much of a drop of water will get into the sewer and when it will get there.
- Heavily influenced by antecedent conditions.
- Calibrations can cost millions of dollars and need to be redone every few years.
- Each model run can take days.



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Machine Learning Enabled Analysis

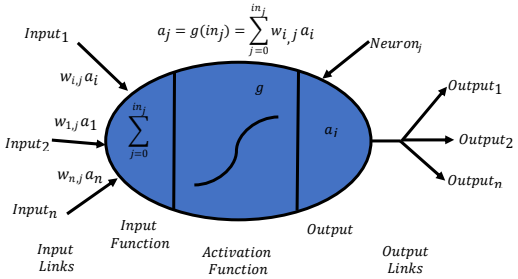
Cognitive Hydraulic Response System (CHRS)

Artificial Neural Network correlating rainfall to sewer flow

Implicitly includes antecedent conditions, groundwater changes, etc.

Embed in models

Accurate and Quick



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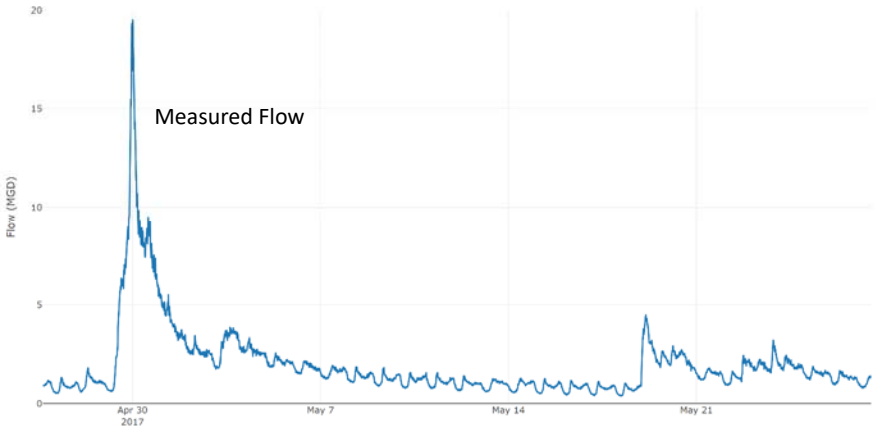
CHRS Training



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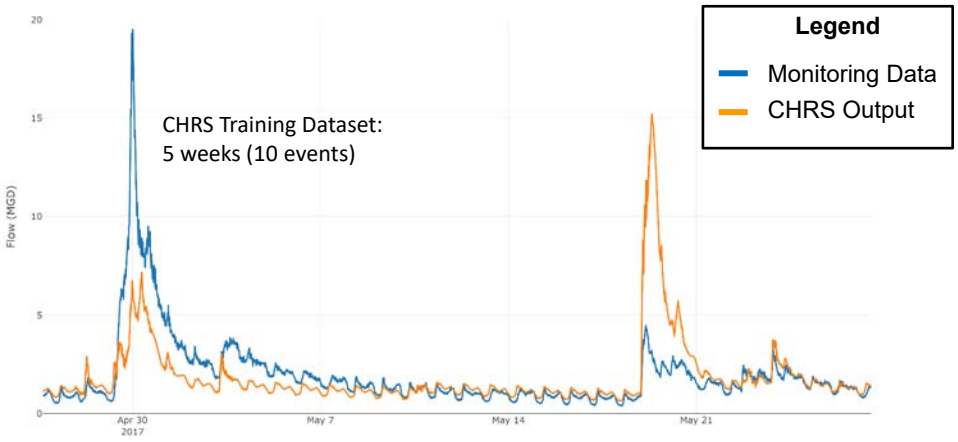
CHRS Training



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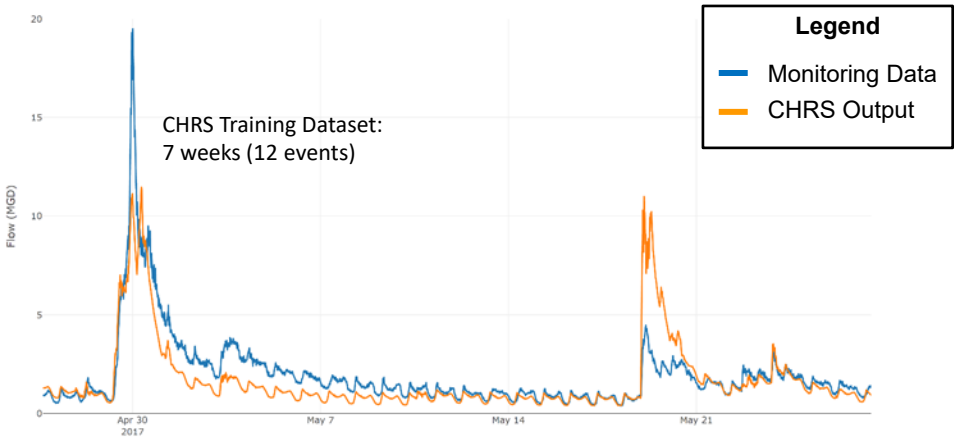
CHRS Training



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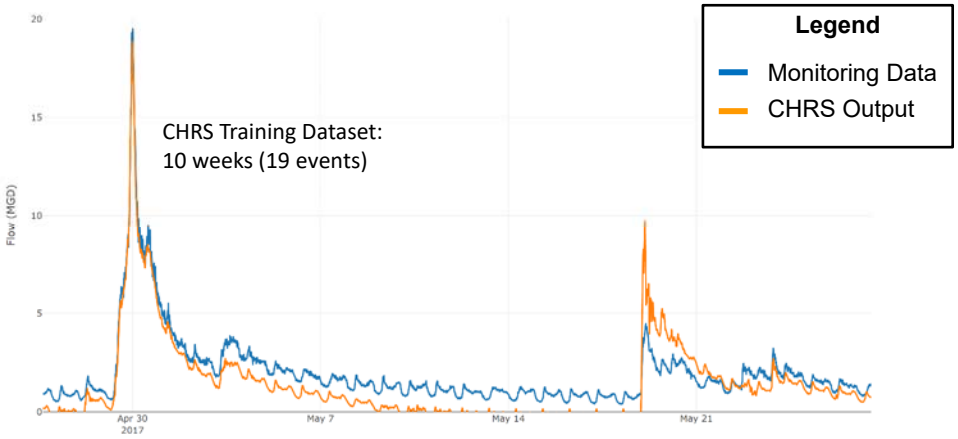
CHRS Training



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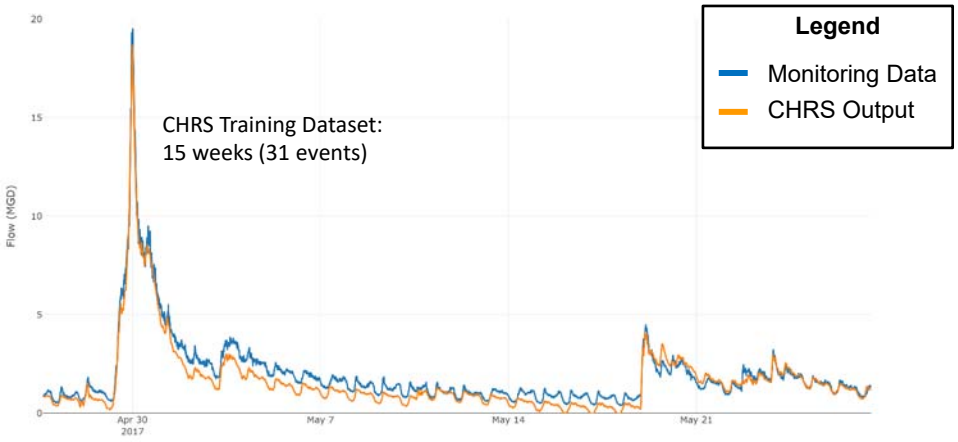
CHRS Training



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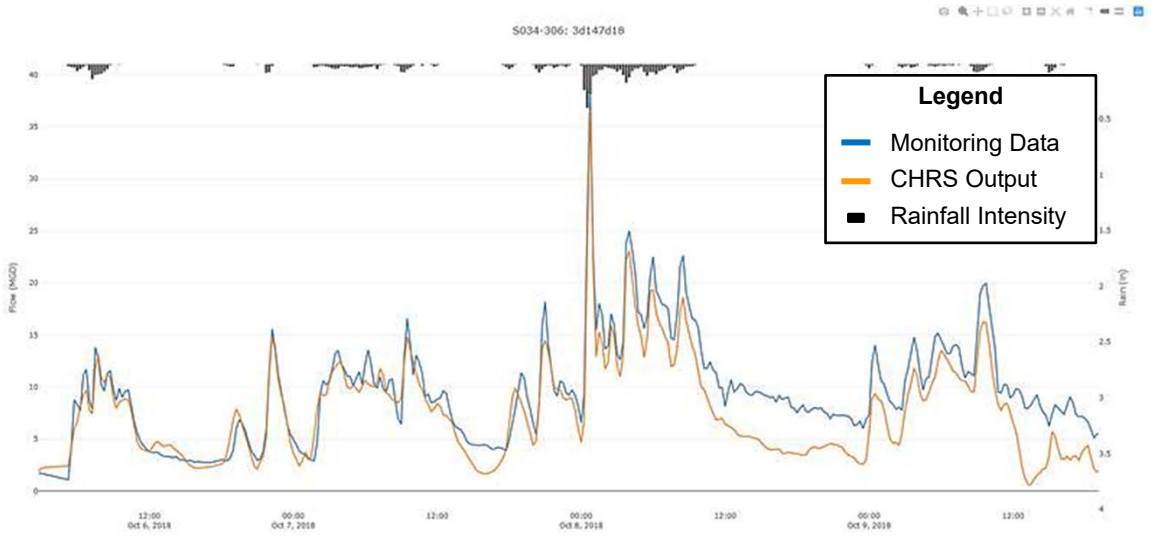
CHRS Implementation – Final Result



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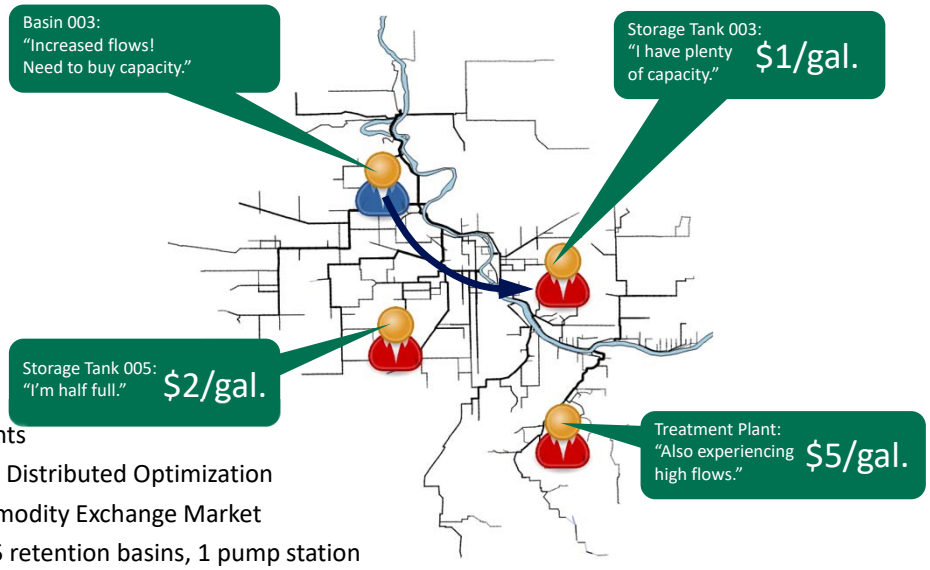
Market Based Control Algorithms



Software Agents

Market-Based Distributed Optimization

Emulate Commodity Exchange Market

8 regulators, 5 retention basins, 1 pump station

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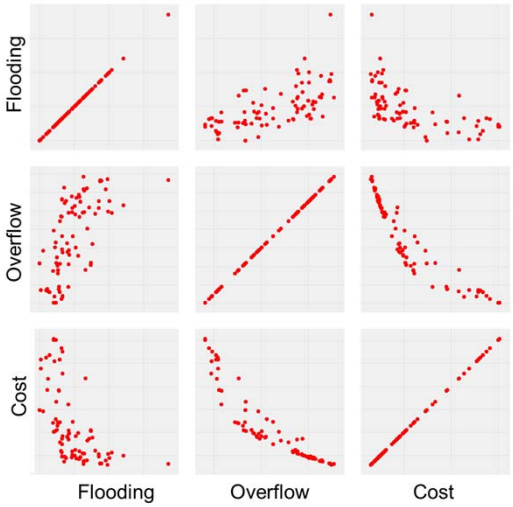
Water Quality Based Optimization

Step 1 – Define Water Quality Goal

- # of hours of E. coli non-compliance
- Measured at IN/MI stateline

Step 2 – Update Hydrologic/Hydraulic Model

- Develop a CHRS enhanced model
- Identify all potential infrastructure options
- Develop globally coordinated control logic for all options
- Auto export key results
- Start with subset of storms, then do typical year



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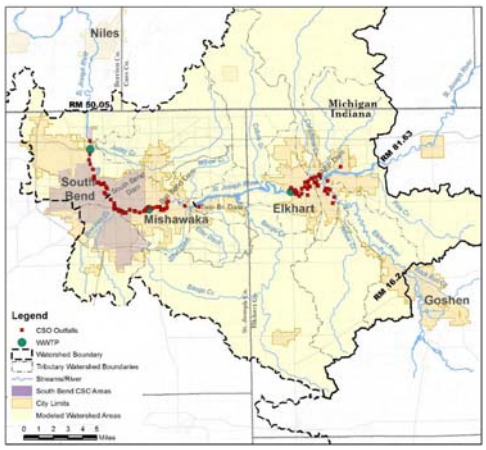
Water Quality Based Optimization

Step 3 – Update Water Quality River Model

Includes hydraulics, Water Quality, and fate/transport

- Different pollutant concentrations depending on source
  - WWTPs
  - Stormwater
  - Untreated CSO
  - Partially treated CSO
  - Disinfected CSO
- Developed executable to accept timeseries outfall flows, classify them, run model, extract results, and give KPI



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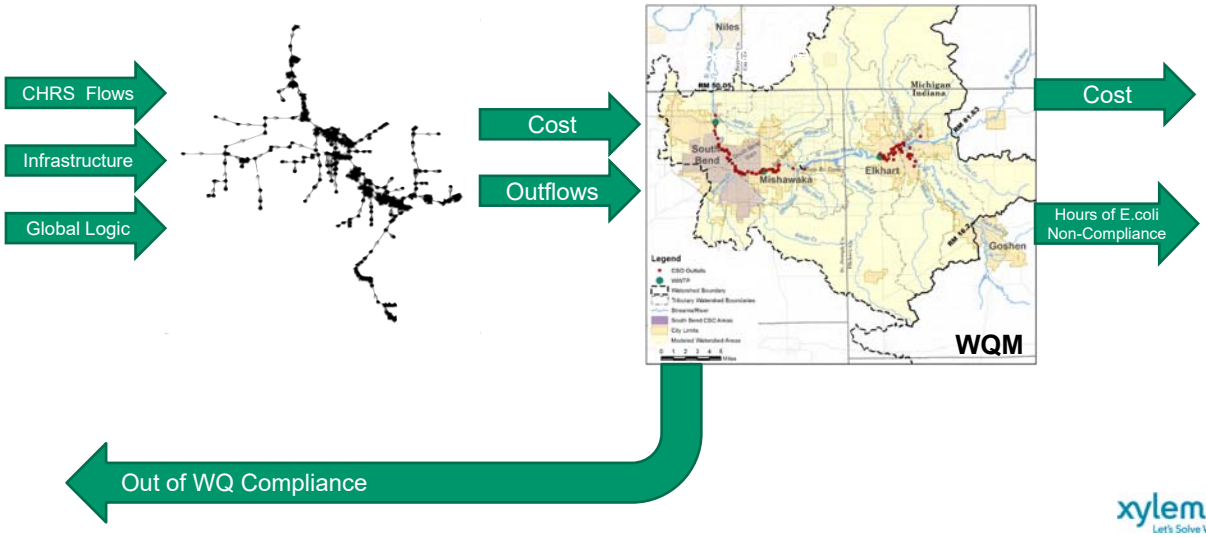
Water Quality Based Optimization



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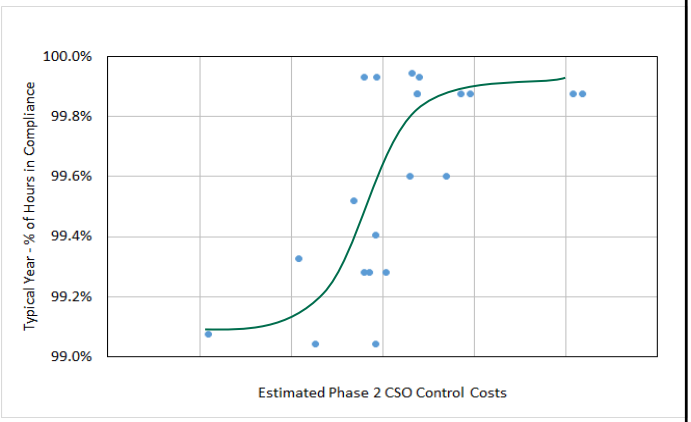
Water Quality Based Optimization

Multiple compliant plans

Examine secondary criteria

- Michigan standards
- Indiana standards
- # of activations
- Public impact



Submitted updated plan to regulators

Have completed negotiations

Finalizing approvals

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Key Results and Learning

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Updated Recommended Plan

Plan Criteria	Current Conditions	Current LTCP	SAGE Plan*
Green infrastructure plans (#CSO basins)	0	0	9
No. CSO storage locations	0	9	4
Total storage volume (MG)	0	24.4	13.4
Captures at least 85% of wet weather combined sewage volume per year	YES (89%)	YES (96%)	YES (99%)
WWTP capacity (MGD)	77	100	100
Number of overflows (Typical Year)	NA	13	3
Cost to implement LTCP (additional amounts)	$0	$713M	$276M
Residential indicator % (<1 low, 1-2 mid, > 2 high)	N/A	3.69	2.3

*Smarter Alternative for a Greener Environment

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Why Go With SAGE Plan?

- $437m less expensive
- Will result in 12% less E. Coli in St. Joseph River compared to the 2011 Consent Decree Plan
- Less frequent overflows (emissions) compared to today and compared to the 2011 Consent Decree Plan
- Less community disruption (4 vs 9 storage locations)
- Substantial green infrastructure

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End Goal: Save the St. Joseph River

Steelhead

Longnose Gar

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PUBLIC WORKS

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Looking Ahead

- In final steps of completing negotiations with the regulators
- WWTP expansion is underway
- Piloting real time optimization of WWTP operations using BLU-X
- Linking collection system operation with WWTP operations

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