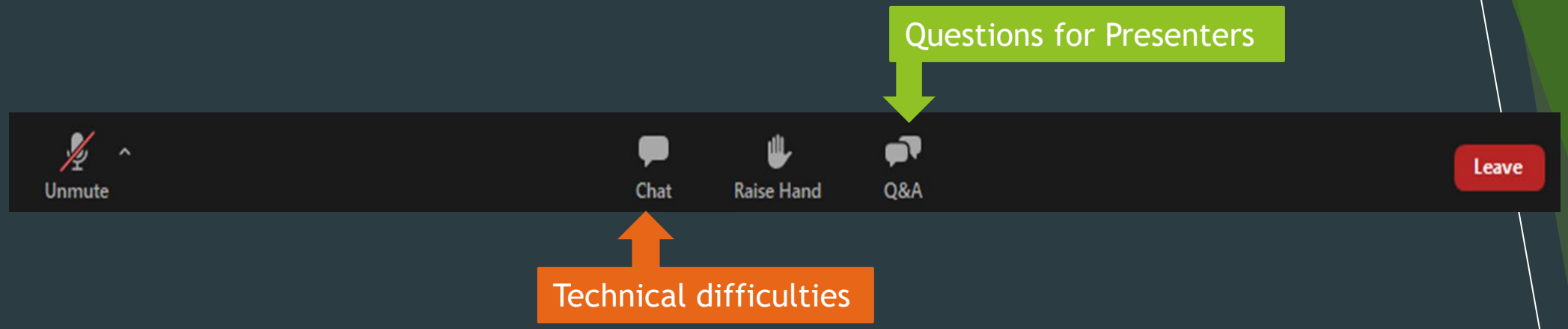
Smart Sewer Systems and Smart Data Infrastructure

October 14, 2021

Webinar Logistics



- **To ask a question:** Type your question in the Q&A box. We will take questions at the end of the webinar.
- **Technical difficulties:** If you are having technical difficulties, please send a message through the Chat to Katie Harrison (Zoom Support), or email Kathryn.Harrison@erg.com.
- **Slides:** A PDF of these slides are available in the Chat.
- **Recording:** Please note that we are recording this webinar and will make it available via EPA's website: https://www.epa.gov/npdes/combined-sewer-overflows-policy-reports-and-training.

Disclaimer

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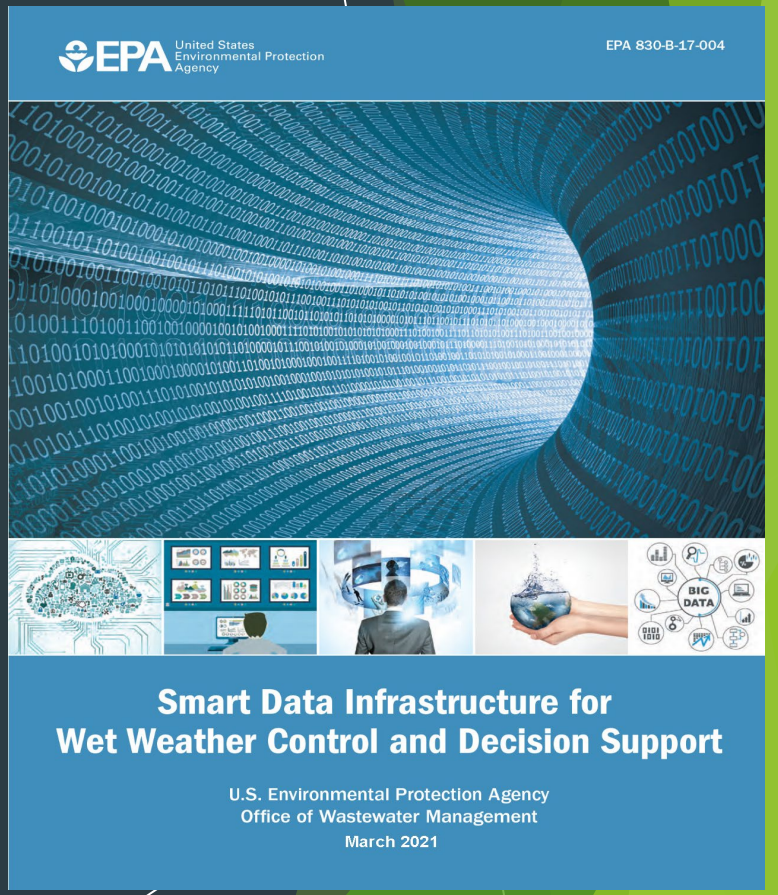
Technical Assistance

- U.S. EPA can provide a range of assistance including the following:
  - EPA's small CSO community spreadsheet-based tools
    - CSO Model
    - Long-Term Control Plan Review Checklist
    - Post-Construction Compliance Monitoring Checklist
  - Regulatory/compliance questions
  - Troubleshooting operation and maintenance problems
  - Asset management training
  - Smart sewer and smart data infrastructure training
  - Monitoring and modeling training

If you are interested or have questions, please contact Mohammed Billah, Kathryn Kazior and EPA's contractors Adam Orndorff and Sam Arden

Smart Data Infrastructure for Wet Weather Control and Decision Support

- Share how municipalities, utilities, and related organizations can use advanced technologies and monitoring data to support both wet weather control and decision-making in real time or near real time
- This document highlights the technologies currently available and provides case studies to describe some of the possible ways municipalities and utilities implement the technologies
- https://www.epa.gov/sites/default/files/2018-08/documents/smart_data_infrastructure_for_wet_weather_control_and_decision_support_-_final_-_august_2018.pdf



Tim Braun

Xylem Inc.

Clean Water Utility Challenges

Utility managers must make key operational decisions today and plan infrastructure investments for generations to come.

Customer and Community

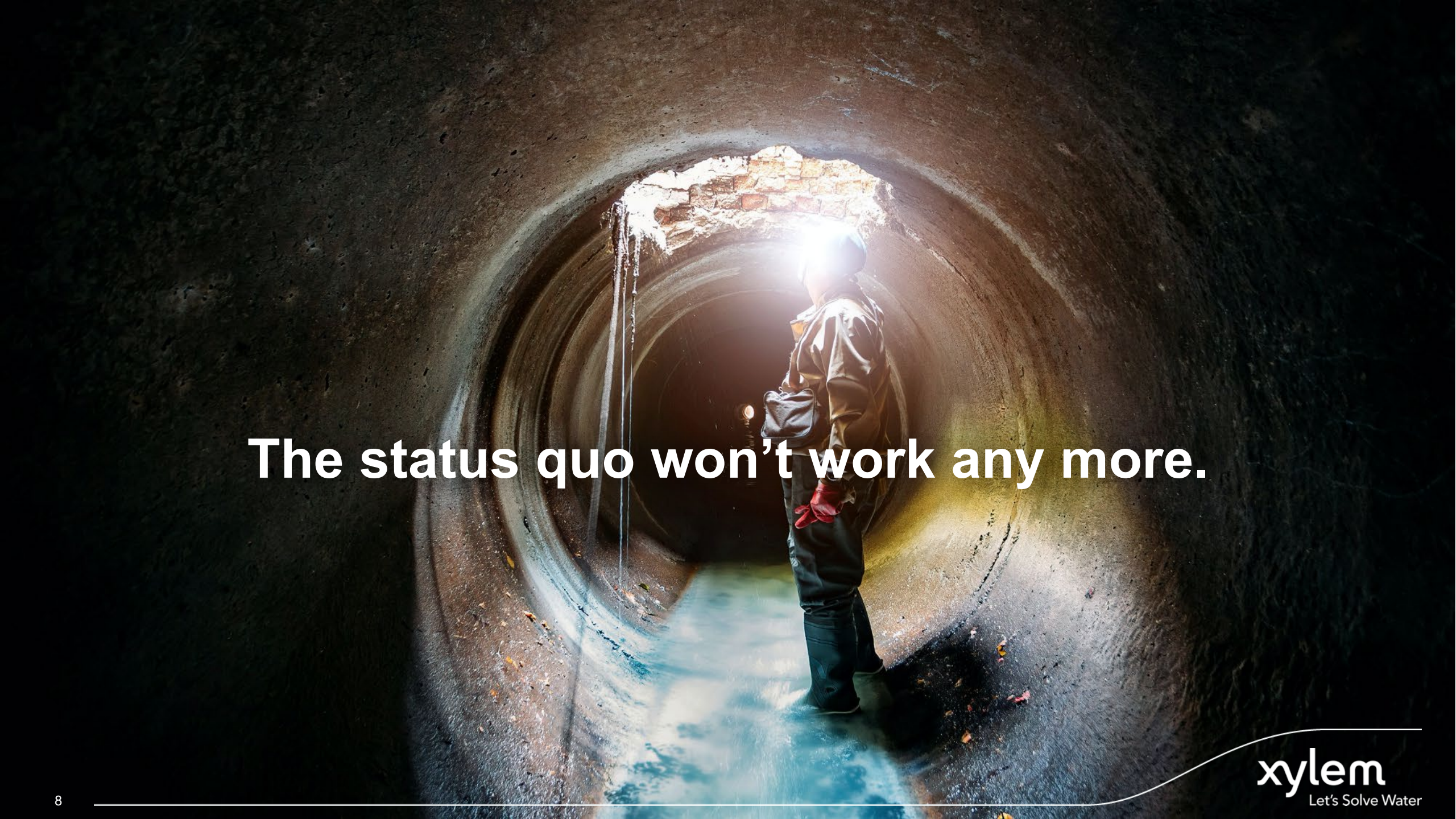
- Serve all rate-payers equitably
- Protect the most vulnerable
- Protect property, deliver high level of service, instill trust

Regulatory and Environmental

- Minimize/eliminate sewage discharges to the environment, and to public or private property
- Protect and serve the treatment plant

CapEx

- Building capital improvement programs to serve current and future generations



xylem
Let’s Solve Water

There is no shortage of data – unlocking it is the challenge

CURRENT STATE

Many digital solutions are one-size-fits-all
yet out-of-the-box software doesn't adapt to solve complex operational wastewater network problems.

Hydraulic models are a start
but mathematical representations alone don't tell the whole story. Utilities require actionable insights based on live, dynamic conditions.

The path to optimized wastewater network performance

Create Visibility
to network capacity, in real-time, to address challenges as they arise

Predict Flows
with confidence based on dynamic network activity

Optimize Capacity
with scalable, data-driven and actionable intelligence

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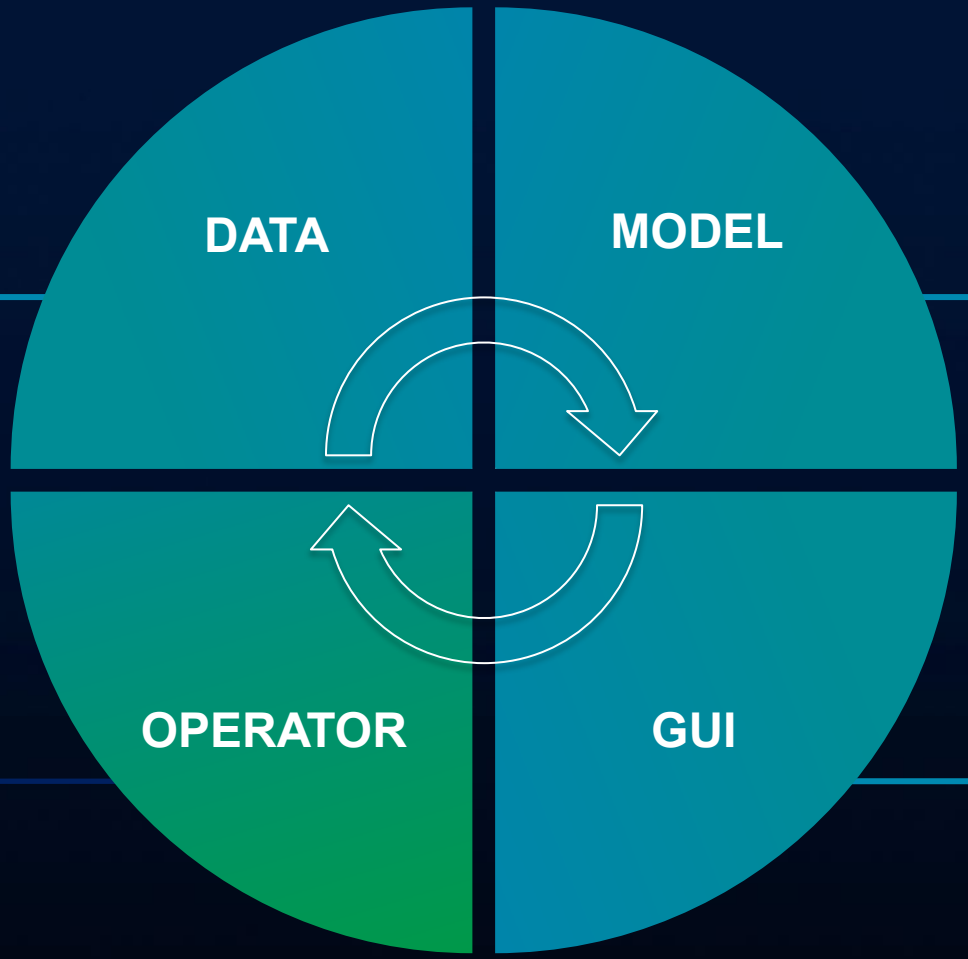
Real Time Decision Support System

Framework for building RT-DSS in urban water infrastructure and treatment works

- *Sensor Data*
- *Enterprise Data*
- *Forecast Data*
- *Collect, Manage, Host*



- *Hydraulic & Hydrological*
- *DW/WW Plants*
- *Risk/Consequence of Failure*
- *Digital Twin*

- *System Knowledge*
- *Actionable Guidance*
- *Ultimate Decision Maker*
- *Supervisory Oversight*

- *Interactive Data Analytics Tools*
- *RT-DSS Dashboards*
- *GIS Mapping of Large Datasets*
- *Data-Driven Intelligence*

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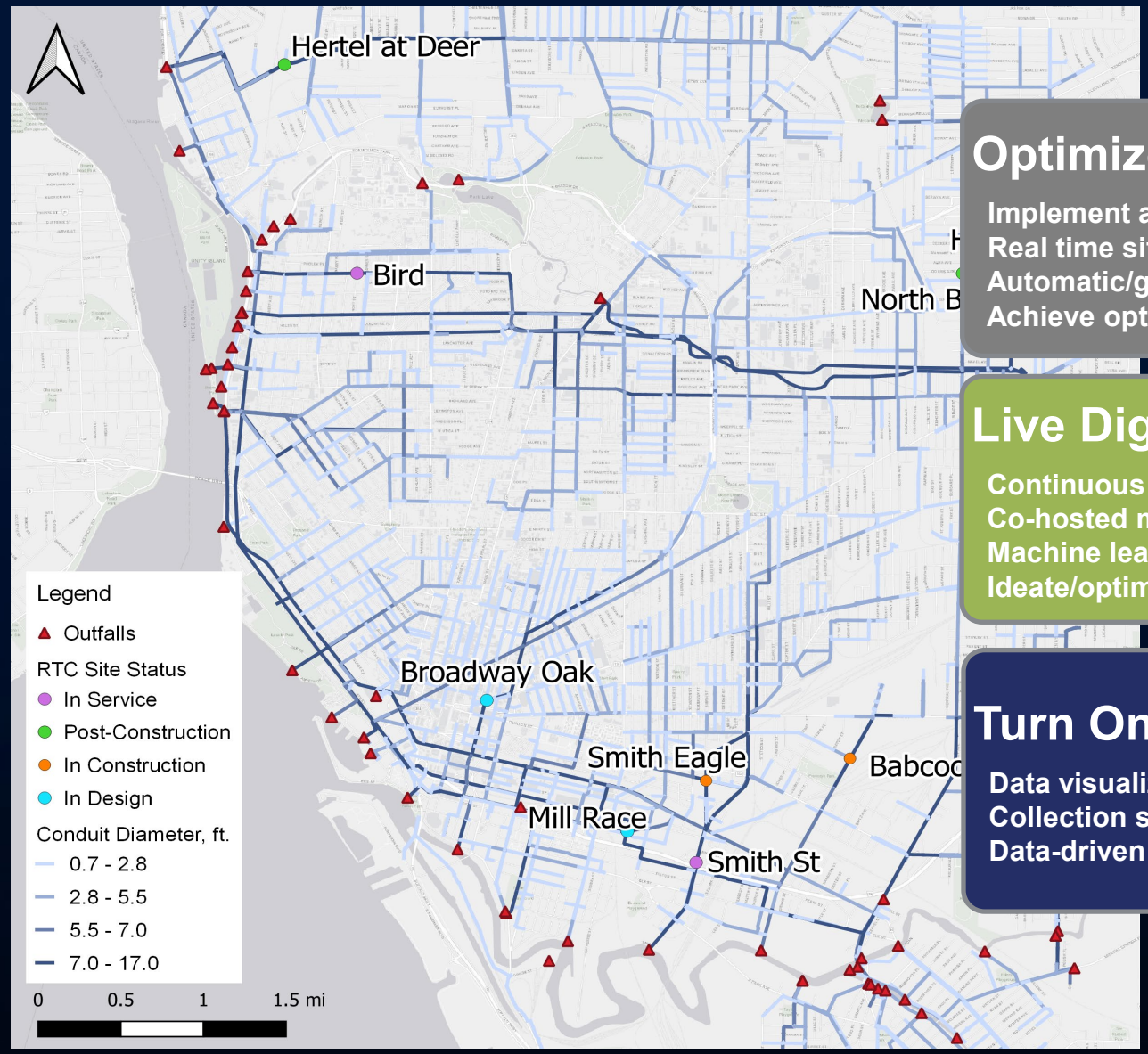
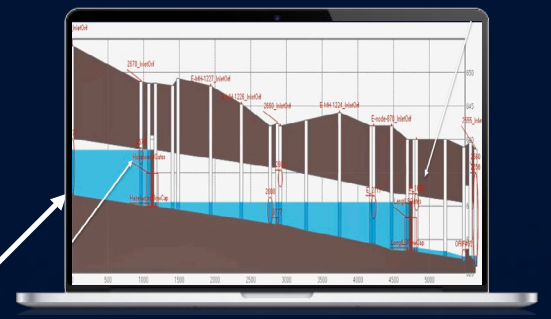
RT-DSS Roadmap



Optimize & Operate

Implement and operate coordinated control
Real time situational awareness
Automatic/guidance mode
Achieve optimal system performance



Live Digital Twin

Continuous real time modeling
Co-hosted models & sensor data
Machine learning hydrology calibration
Ideate/optimize for coordinated control

Turn On the Lights!

Data visualization/mapping
Collection system user interface
Data-driven predictive maintenance

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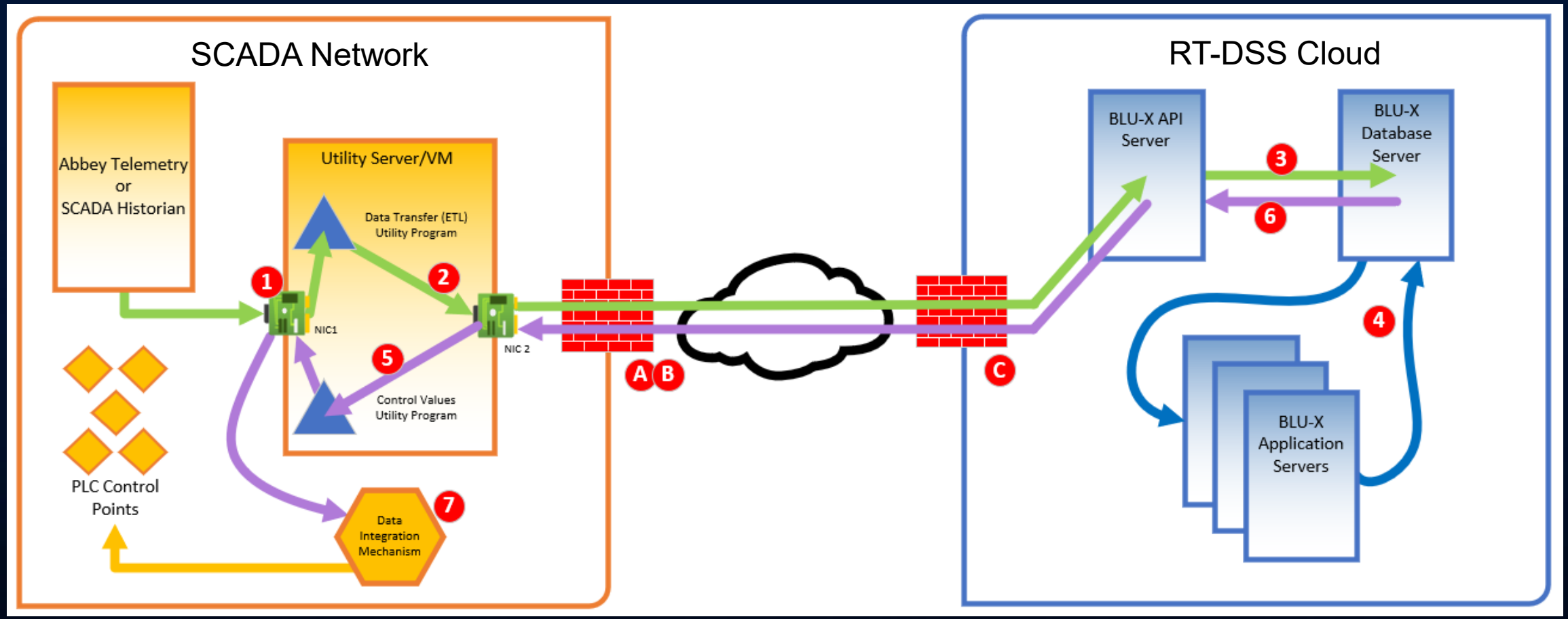
Let's Solve Water

Sample RT-DSS Architecture



The Next Big Category in Water!

FUTURE STATE

RT-DSS is the next big industry category

Dozens of communities have already paved the way, demonstrating the power of decision science applied to legacy infrastructure and built on the foundation of existing IT assets.

How did we live without it?

The communities utilizing RT-DSS/Smart Data Infrastructure already can't imagine life without it.

Regulatory support

The regulatory agencies have supported this framework and approach for years validated by recent events.

Kieran Fahey

City of South Bend, Indiana

Reimagining Wastewater and Stormwater Solutions through…

Smart Sewer Systems and Smart Data Infrastructure

CITY OF SOUTH BEND
PUBLIC WORKS

South Bend

Who we are and our financial resources	The Consent Decree (2012)
Pop: 101,000	An $863 Million price tag. Add on financing costs and its >$1 Billion. **$10,000 per resident, or $25,000 per household** 1 in 5 households would pay 10% of their household income just toward their water bill
MHI: $38,943 (35% < USA)	
Per capita income $22,119 (32% < USA)	
30% households have income <$20K	
1 in 4 are “persons in poverty”	
And sewer rates have already risen 384% since 2004 to keep pace with infrastructural needs.	


R-33
I.30.1

South Bend

Area: Almost 42 square miles (large area considering population)

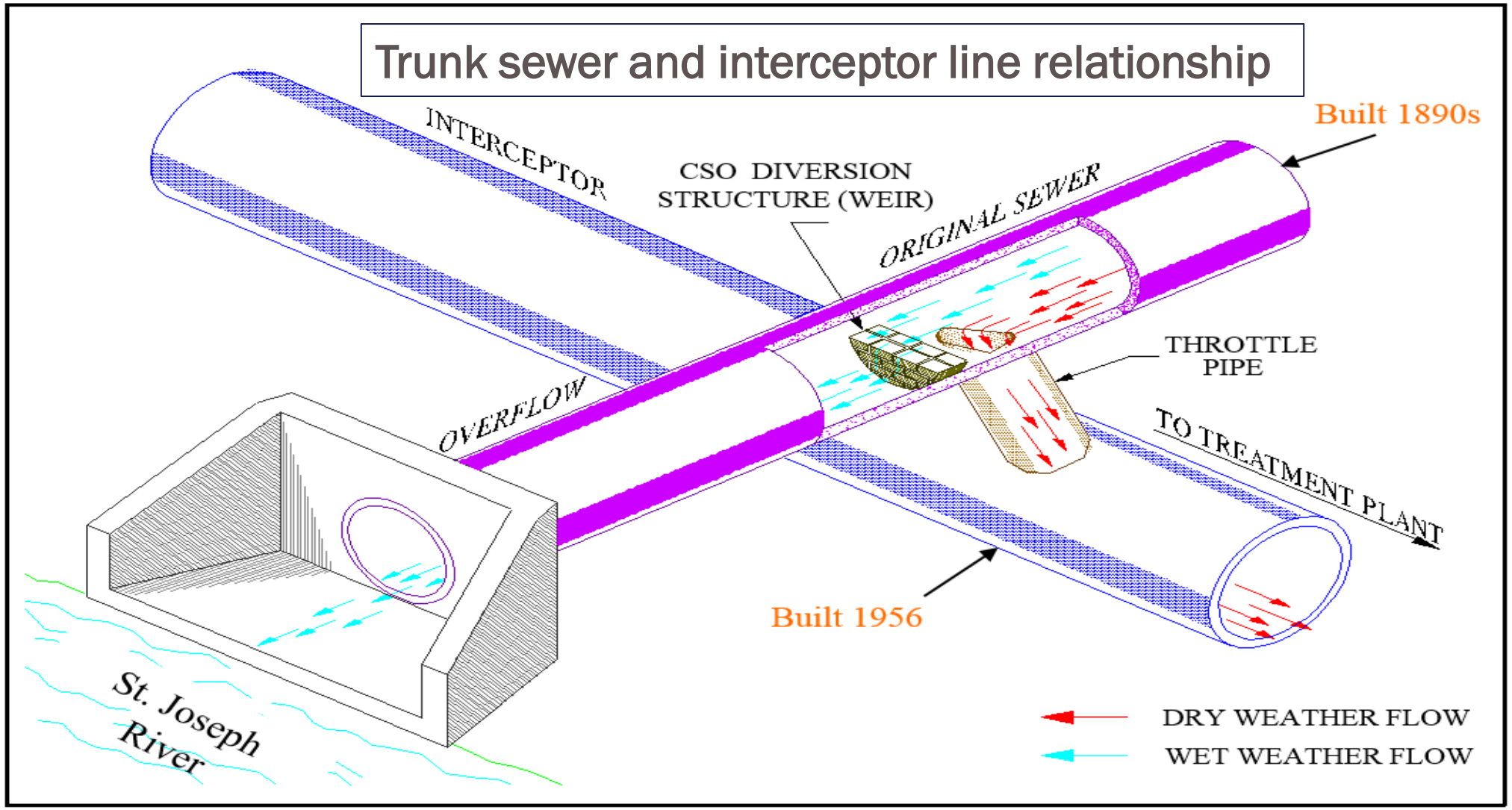
Population: 101,000

- In 42 sq miles, it doesn't always rain the same in every neighborhood.

- Six rain gauges prove this.

- **This creates an opportunity.**

Trunk sewer and interceptor line relationship



South Bend

- This Trunk line/Interceptor interaction point happens at 35 locations across the City.

- Therefore there are 35 locations across the 42 sq miles of South Bend- this is important because it means we can assert control at these points.

South Bend

Real time control _RTC

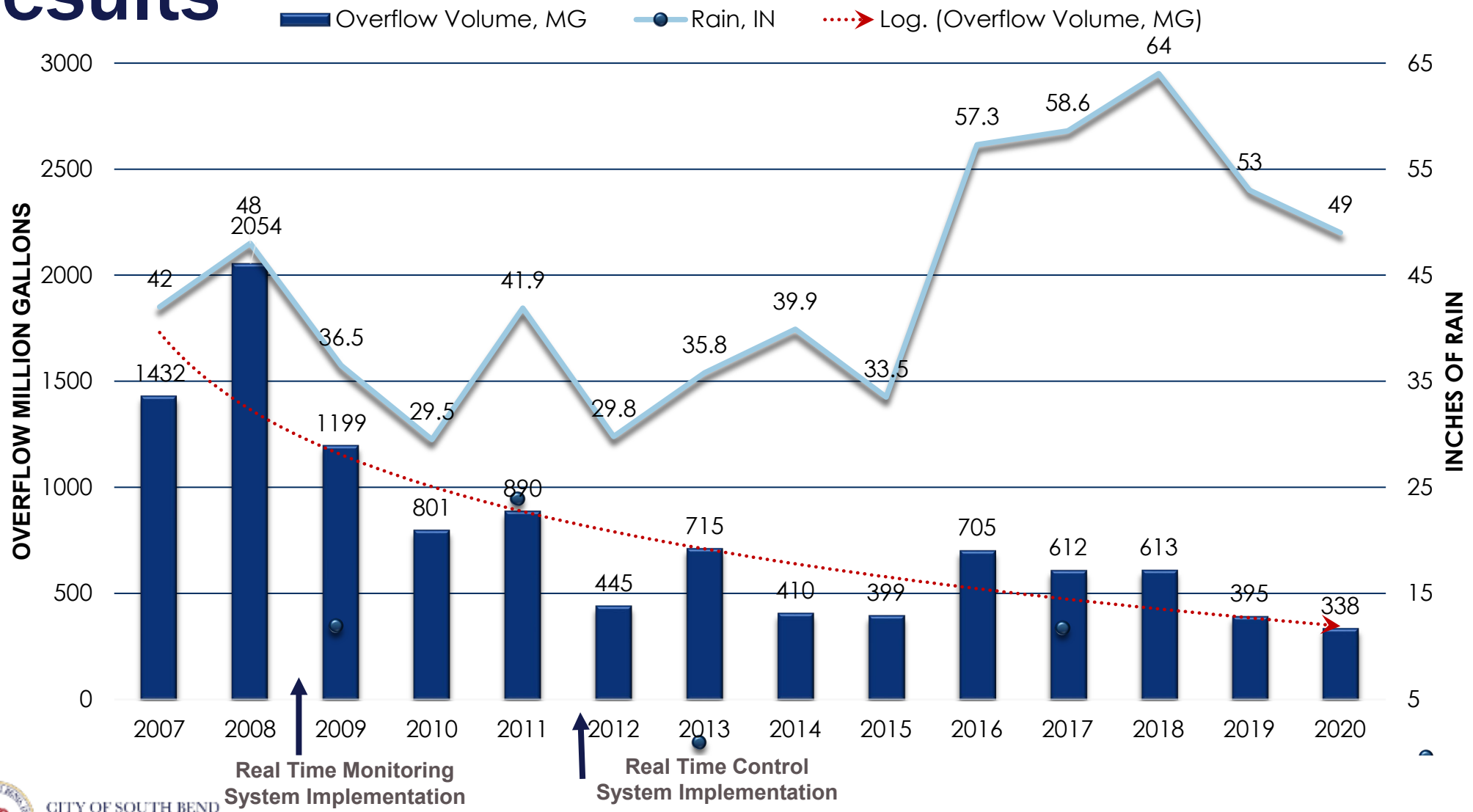
Smart valves on the throttle lines that connect the trunk sewer to the interceptor allocate interceptor capacity to the trunk lines that need it most.

In summary, they work by ensuring that the capacity of the interceptor is given to the trunk lines that are about to (otherwise) overflow. Trunk lines that are not near overflow (due to previously mentioned differences in rainfall across the City) get less capacity. The network of sensors talk to one another and make these allocation decisions.

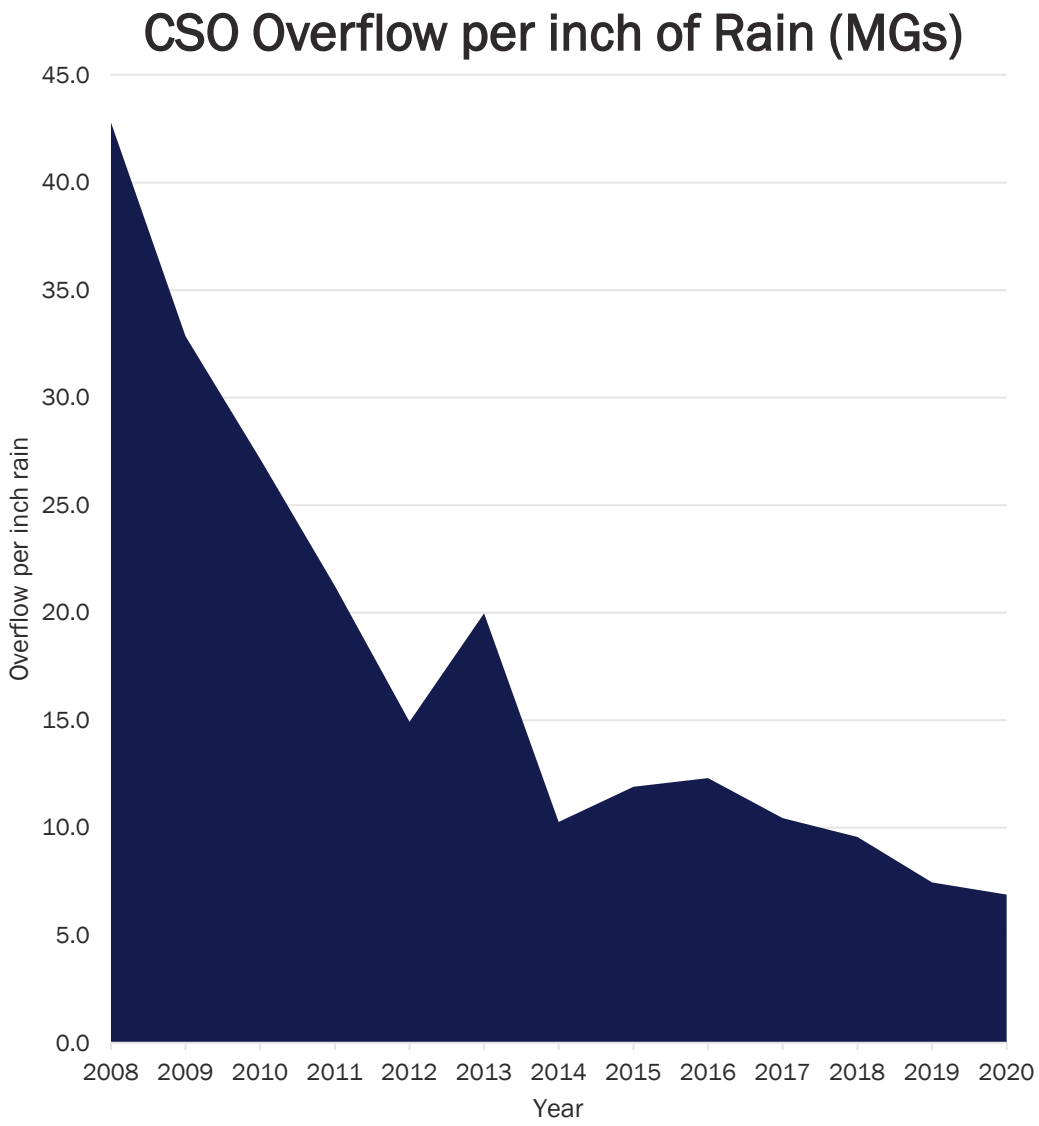
Examples of material removed from the South Bend collection system due to Smart Sewer Data

Increase your capacity by optimizing what you already had

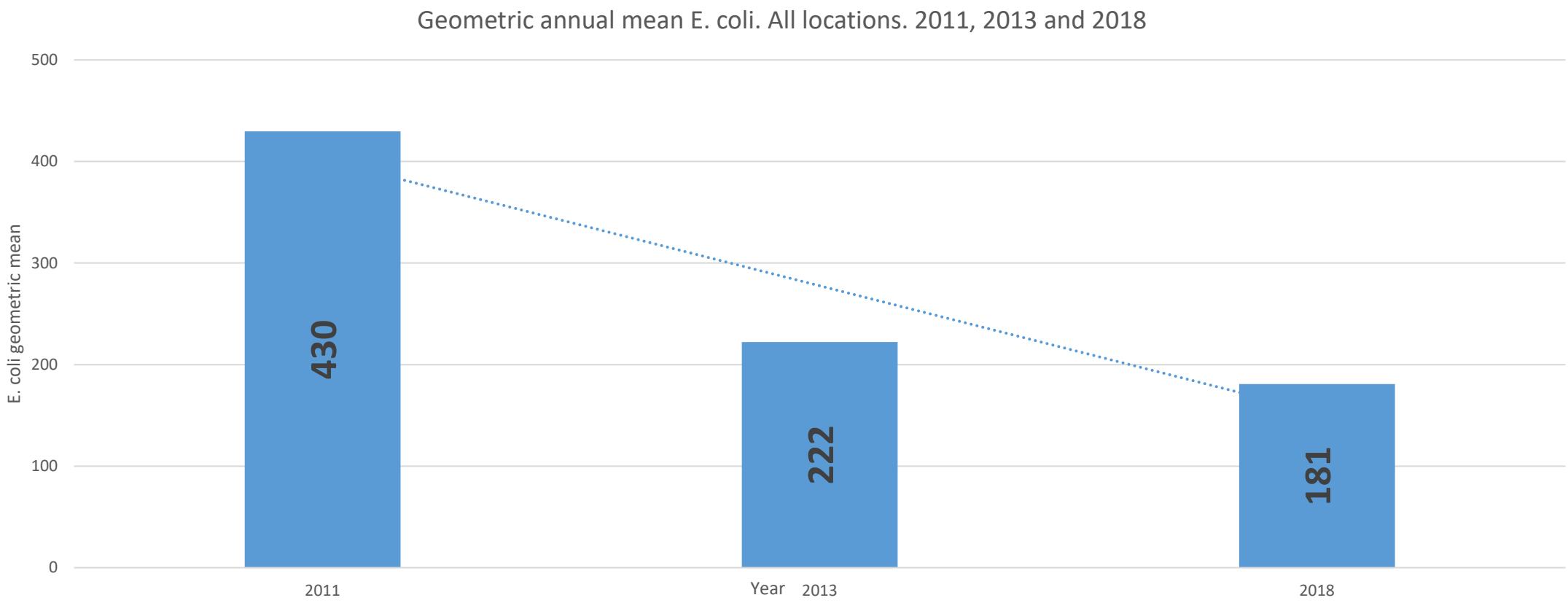
Results


Overflow Volume, MG
Rain, IN
Log. (Overflow Volume, MG)
OVERFLOW MILLION GALLONS
INCHES OF RAIN
3000
2500
2000
1500
1000
500
0
65
55
45
35
25
15
5
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
1432
2054
1199
801
890
445
715
410
399
705
612
613
395
338
42
48
36.5
29.5
41.9
29.8
35.8
39.9
33.5
57.3
58.6
64
53
49
Real Time Monitoring System Implementation
Real Time Control System Implementation

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
2020	49	338	6.9



E. Coli reduction (58% decrease)



Revising the Plan

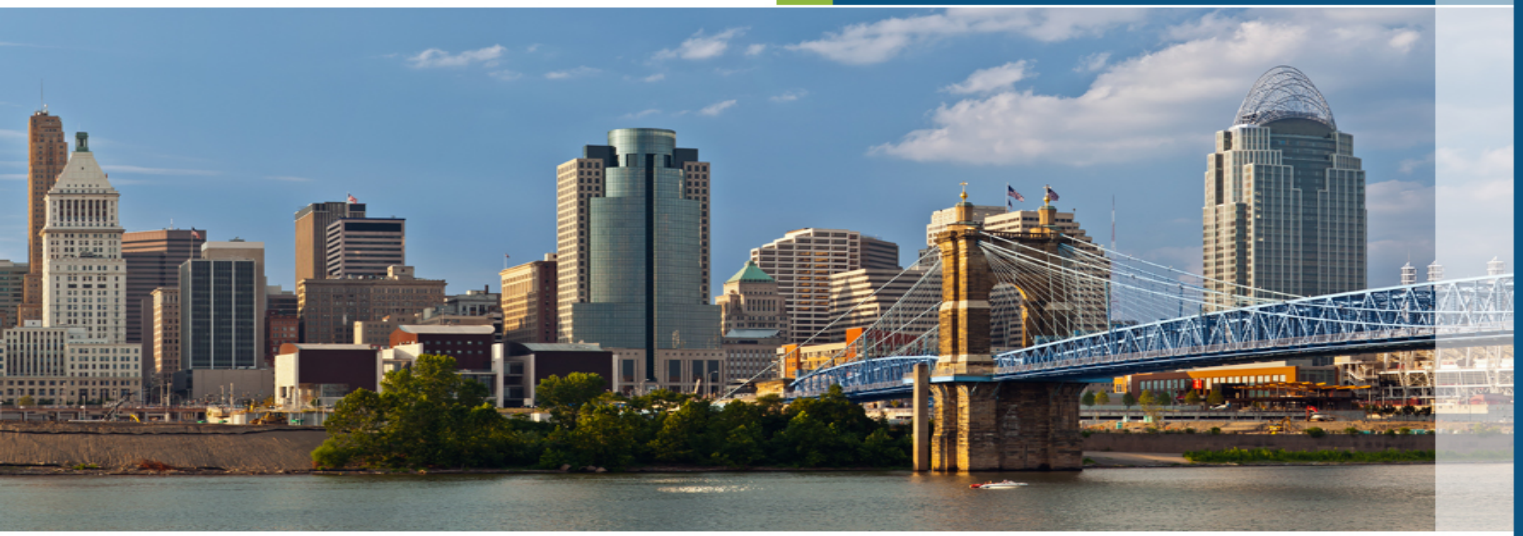
1. Data-driven maintenance created increased capacity;
2. New hyper-accurate model shows deficiencies in old LTCP model;
3. Real Time Control exceeded expectations in reducing overflows;
4. Federal LTCP builds infrastructure but does not address the problem.

SAGE is better how?

- $437m less expensive;
- 99.96% wet weather capture versus 75.8% currently (about the same as 2011 CD);
- Will result in 12% less E. Coli in River compared to the 2011 CD;
- Less frequent overflows (emissions) compared today and compared to 2011 CD;
- Less community disruption (3 vs 7 storage tanks);
- No construction on our Flagship downtown parks (Leeper & Howard);
- Developed with community input.

Reese Johnson

Metropolitan Sewer District of Greater Cincinnati, Ohio



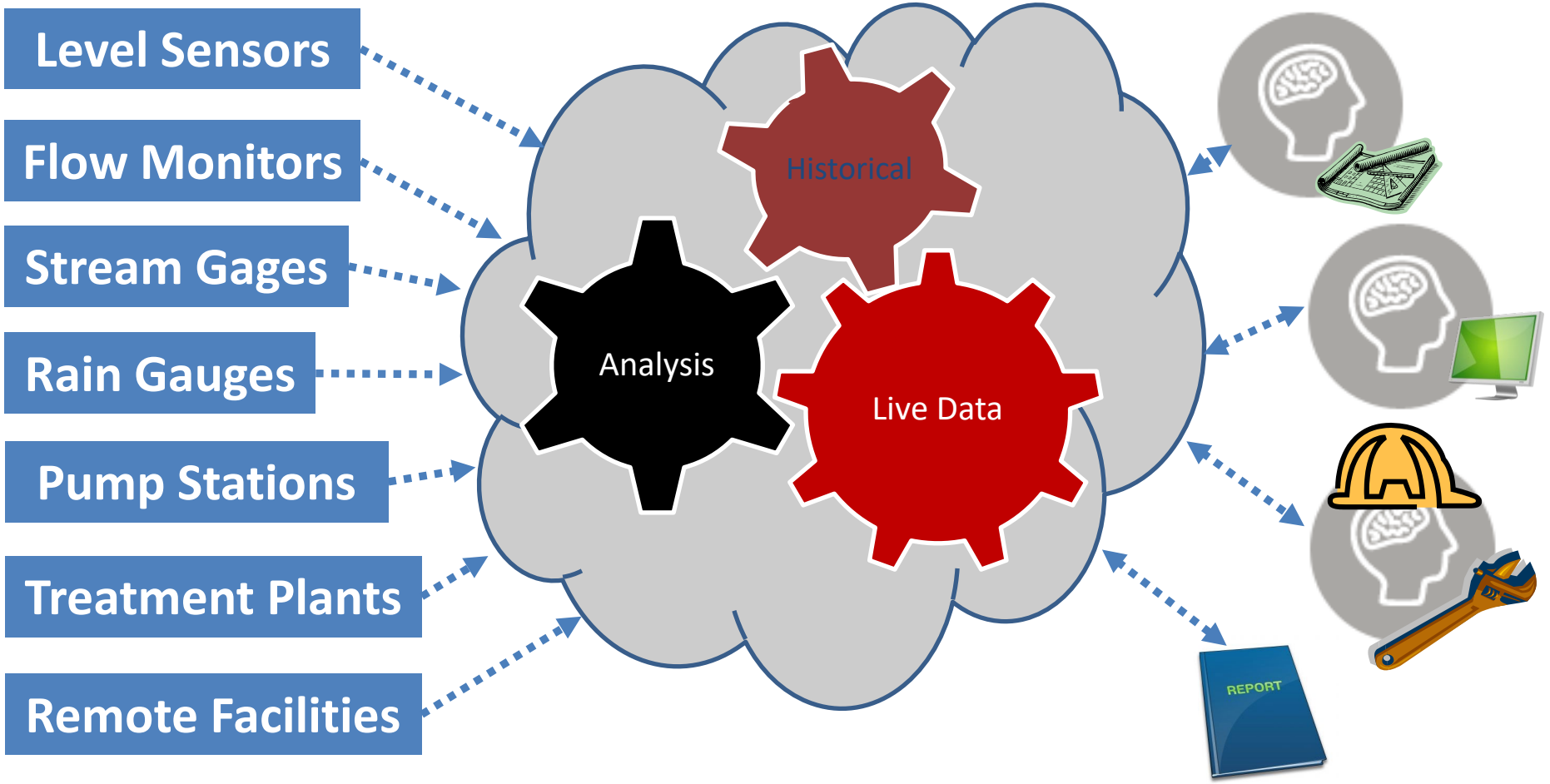
A New Road to Compliance

The Cincinnati *Smart Sewers* Story

METROPOLITAN SEWER DISTRICT of greater CINCINNATI

System-wide Operational Optimization

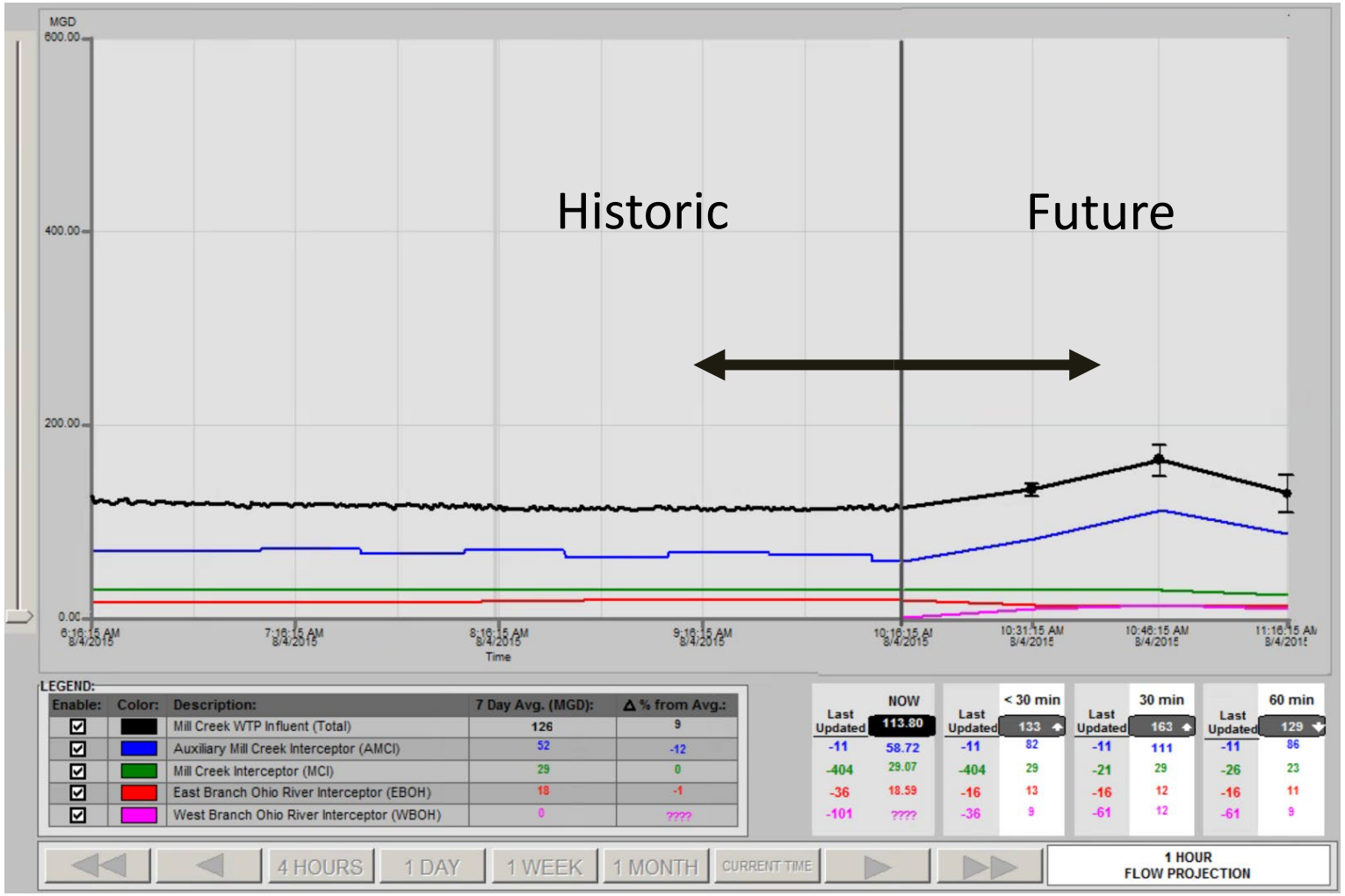
Cloud-based SCADA for Watershed



“Smart Sewer” Achieved Results Without Additional Construction

- Improved Treatment Plant Operations
- Reduced Overflows from the Collection System
- Maximized Use of Existing Assets
- Maximization of Conveyance and Treatment
- Basin-wide Optimization

Projects Future Flows to WWTP



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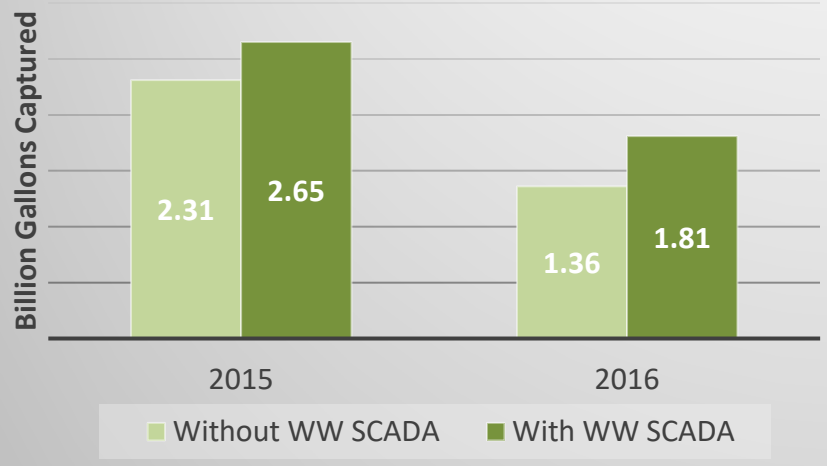
Reduces Overflows



Leveraged Data at 4 Wet Weather Facilities:

1st Year, added real-time monitoring capabilities:

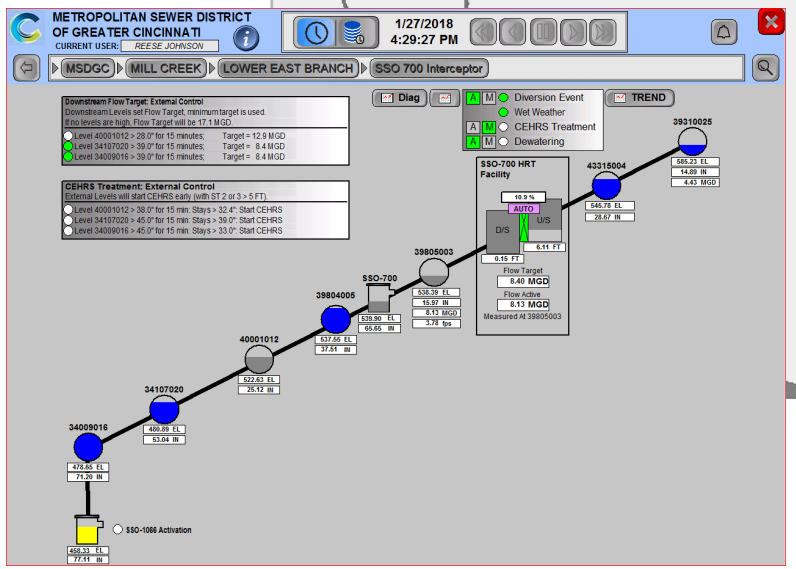
15% improvement

2nd Year, added real-time control capabilities:

33% improvement

METROPOLITAN SEWER DISTRICT of greater CINCINNATI

Maximizes Existing Assets



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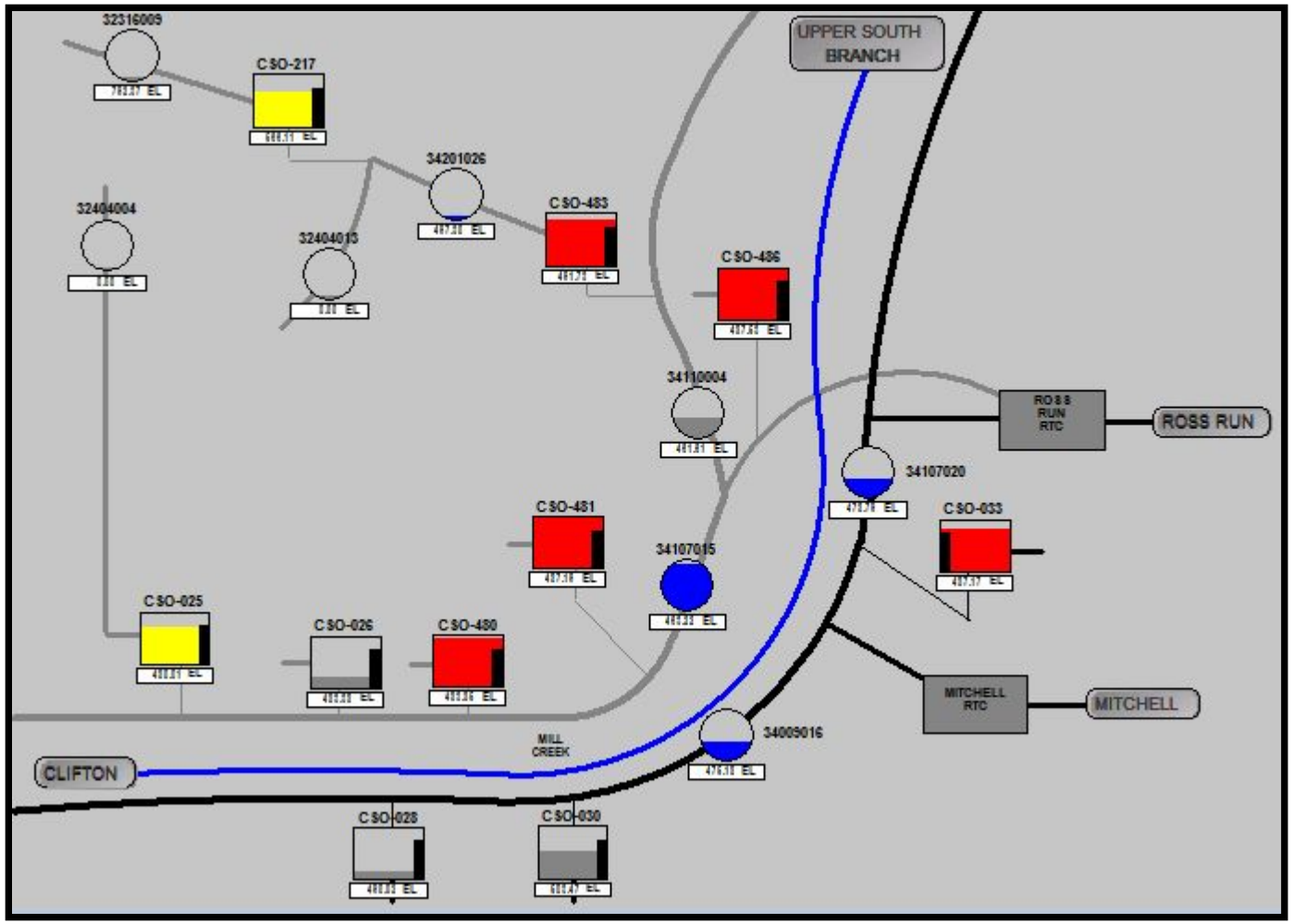
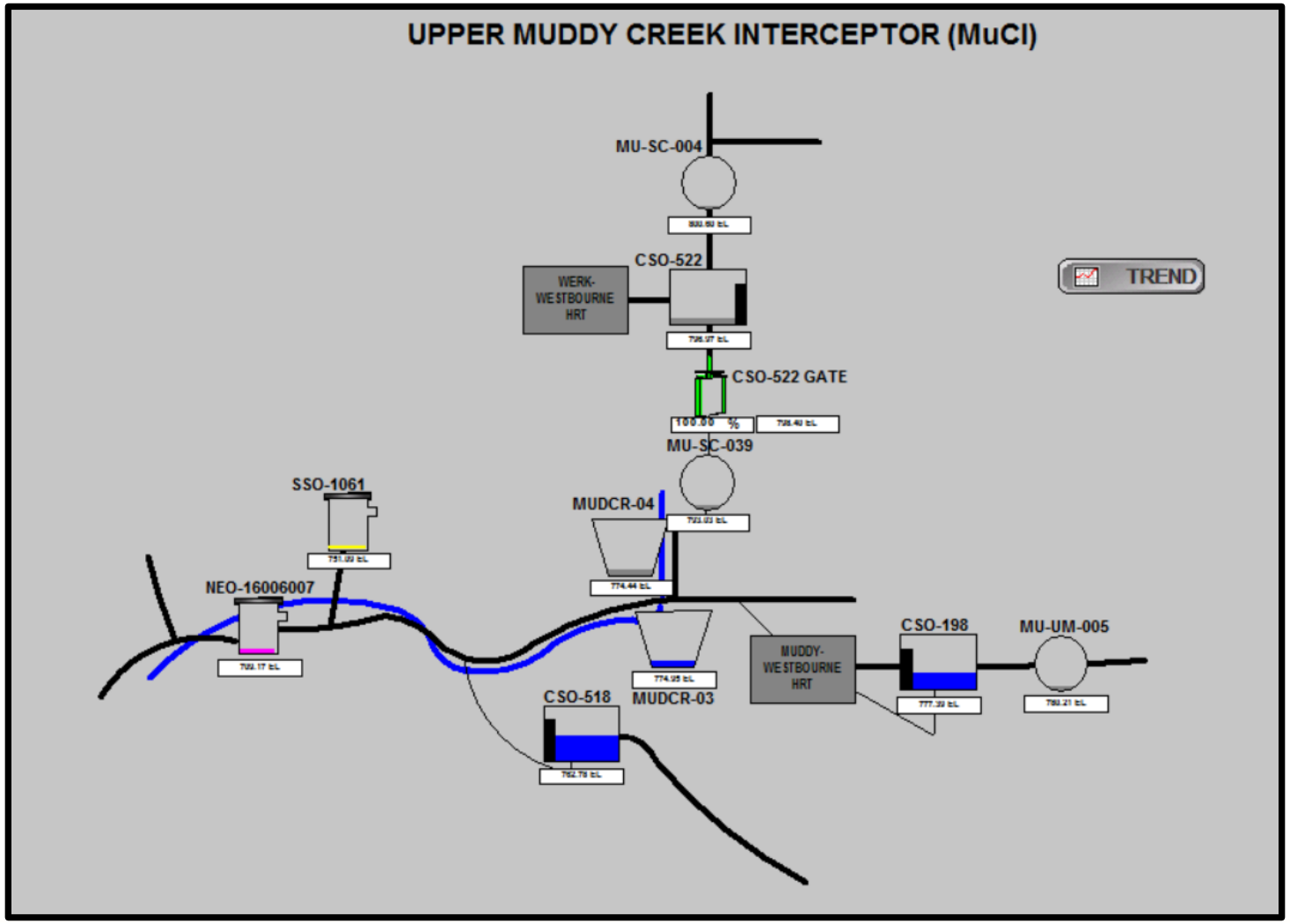
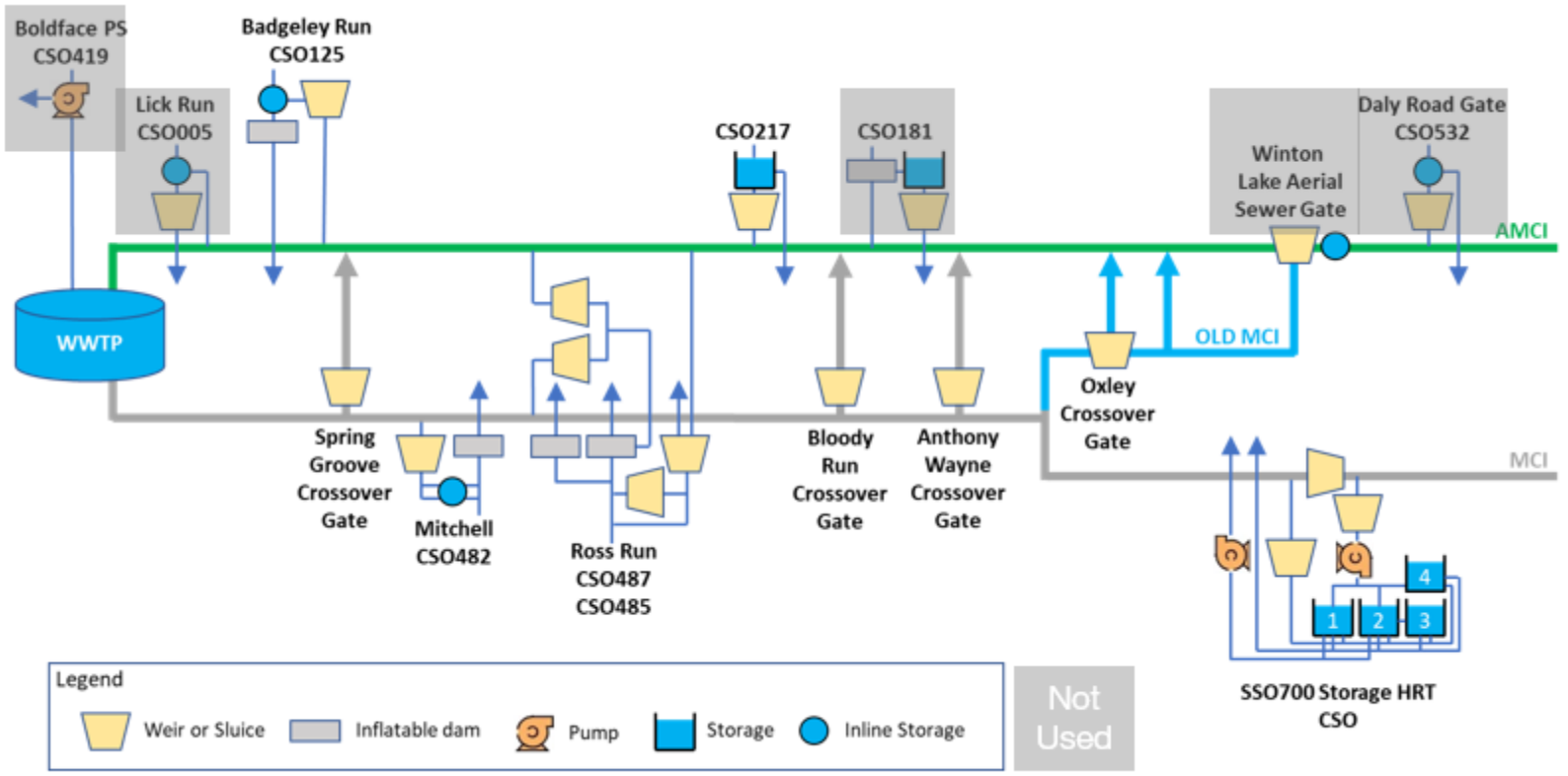
DUC's to Maximize Flow to Treatment



Coordination of Upstream Flows



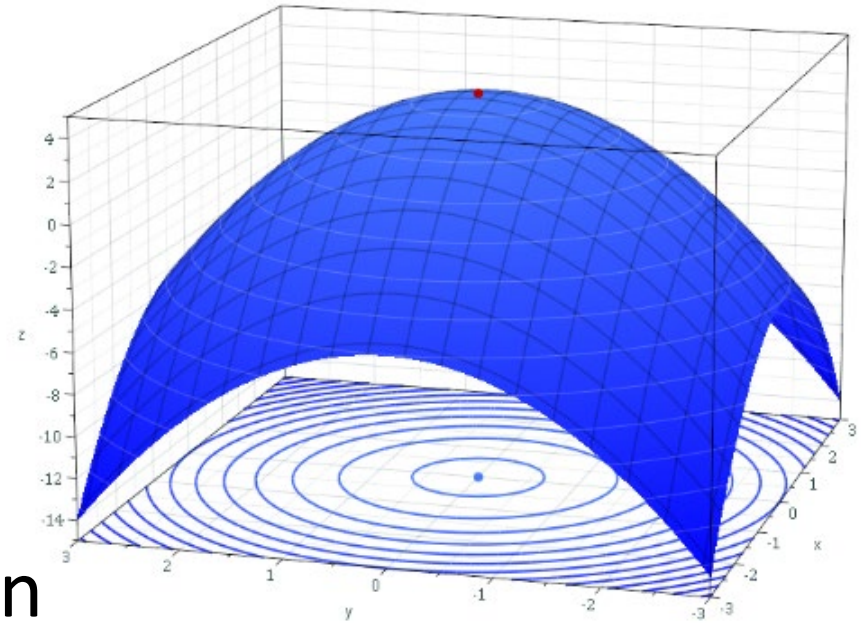
Optimize an Entire Basin



METROPOLITAN SEWER DISTRICT of greater CINCINNATI

Capabilities of a Smart Sewer

- Harness *real-time* data
- Leverage the *entire* system
- Control the *most impactful* outfalls
- Account for the *spatial variation* of rainfall
- *Basin-wide* Coordination



Empower New and Modified Projects to Meet Consent Decree Goals at a Lower Cost

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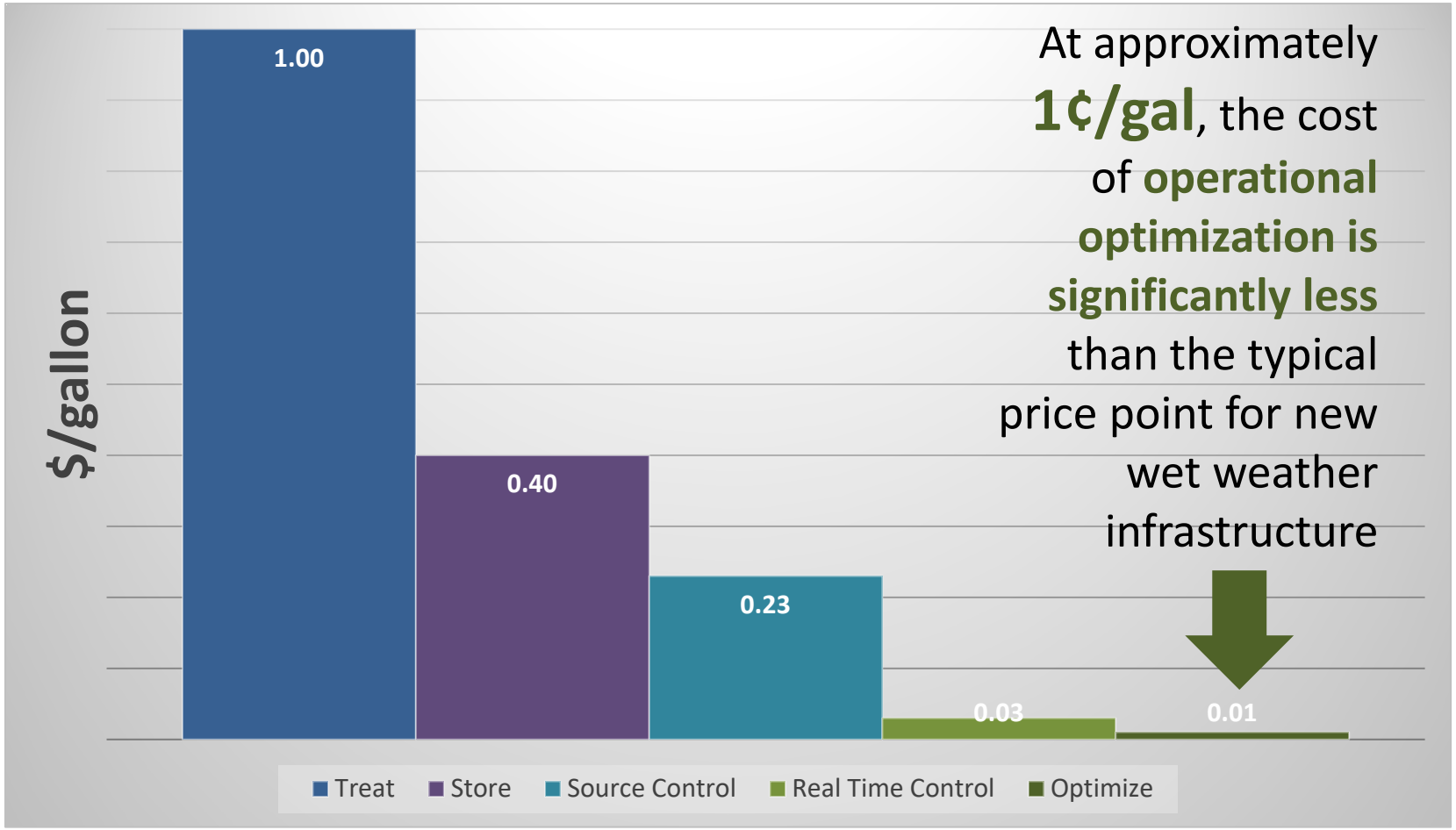
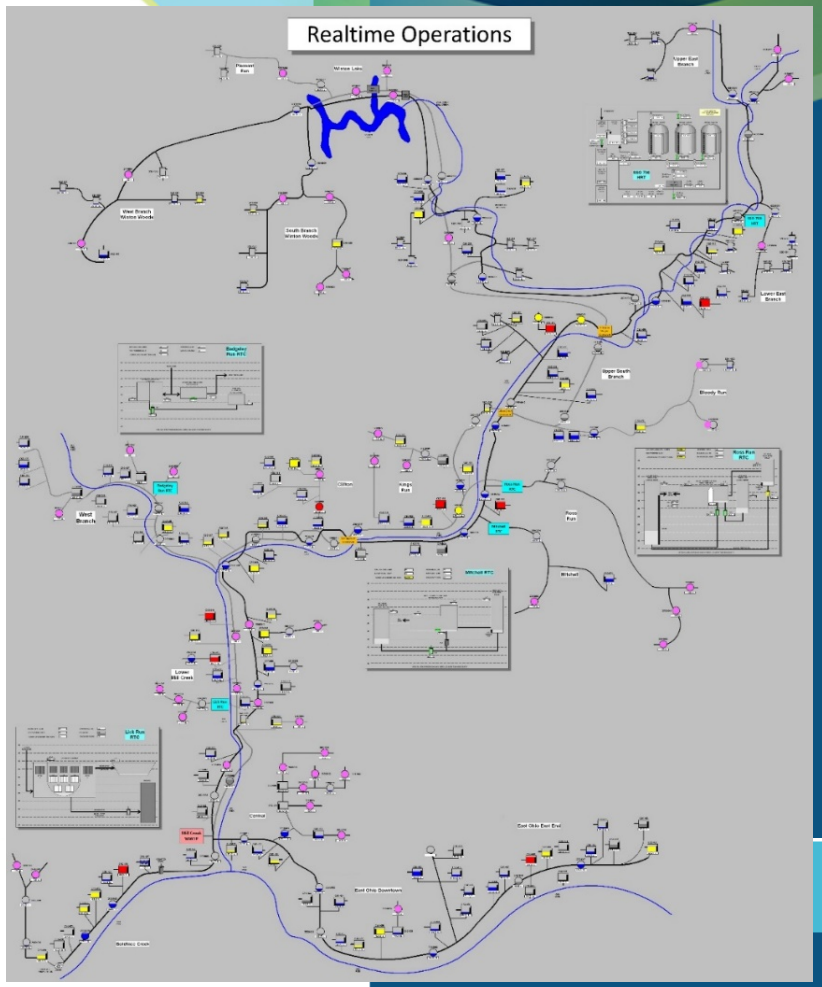
Smart Sewers Make Dollars and Sense



METROPOLITAN SEWER DISTRICT of greater CINCINNATI

Potential Roadmap to a Smart Sewer

- Look First at Your Existing Assets
- Demonstrate (not Pilot), Start Small
- Leverage the Cloud
- Measure the Benefit



The Cincinnati *Smart Sewers* Story

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METROPOLITAN SEWER DISTRICT of greater CINCINNATI

Questions and Answers