Targeting O&M through Model Calibration

The Metropolitan District Commission, Hartford, CT

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The Metropolitan District

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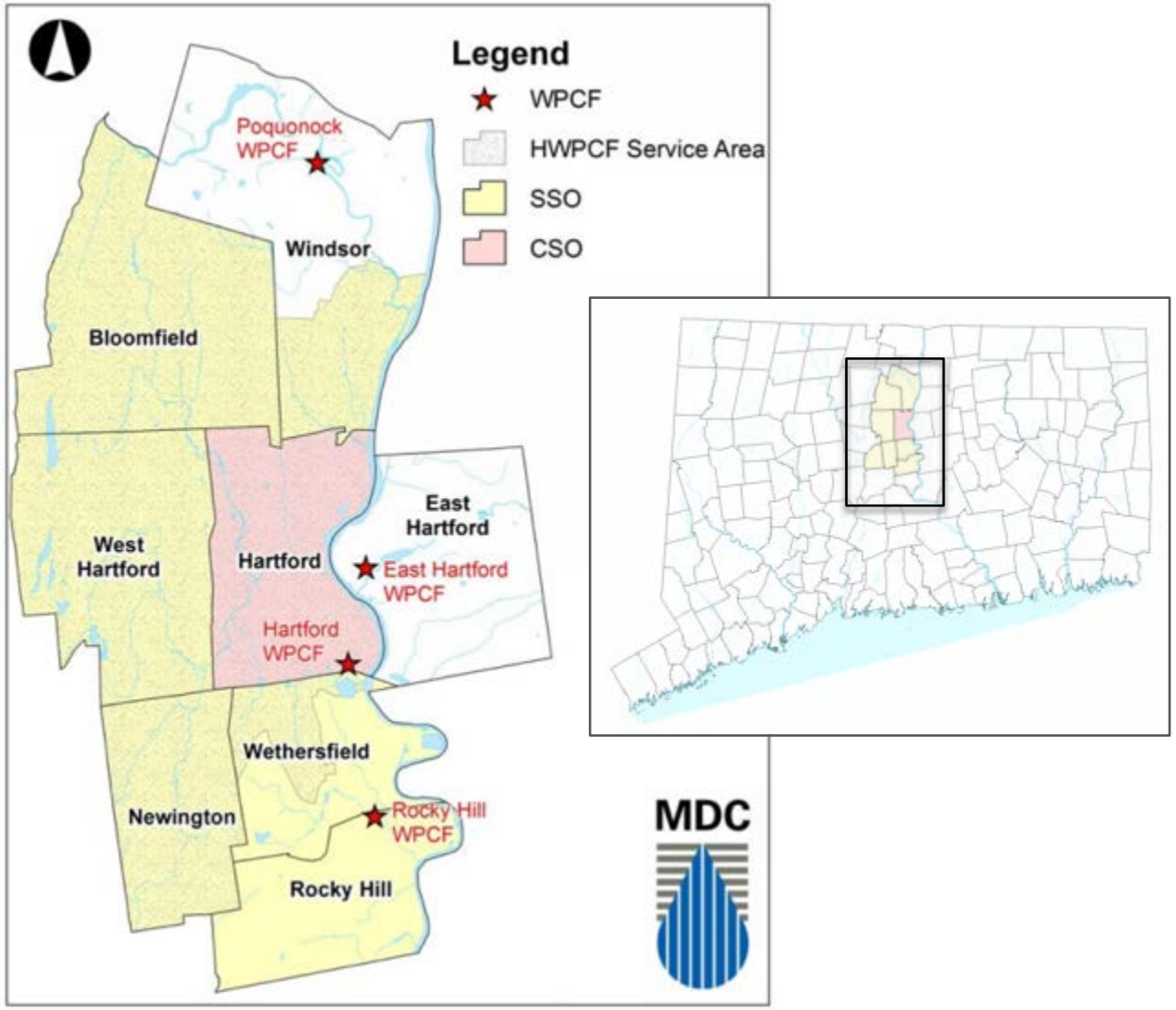
2018 Combined Sewer Overflow & Wet Weather Issues Specialty Conference

The Metropolitan District Commission (MDC)

- Nonprofit, specially chartered municipal corporation created by CT General Assembly in 1929
- Provides to member municipalities:
  - Water treatment and distribution
    - Also supplies treated water to portions of Glastonbury, South Windsor, Farmington, East Granby, and Portland under special agreements
  - Sewer and household hazardous waste collection services
  - Wastewater treatment at four water pollution control facilities



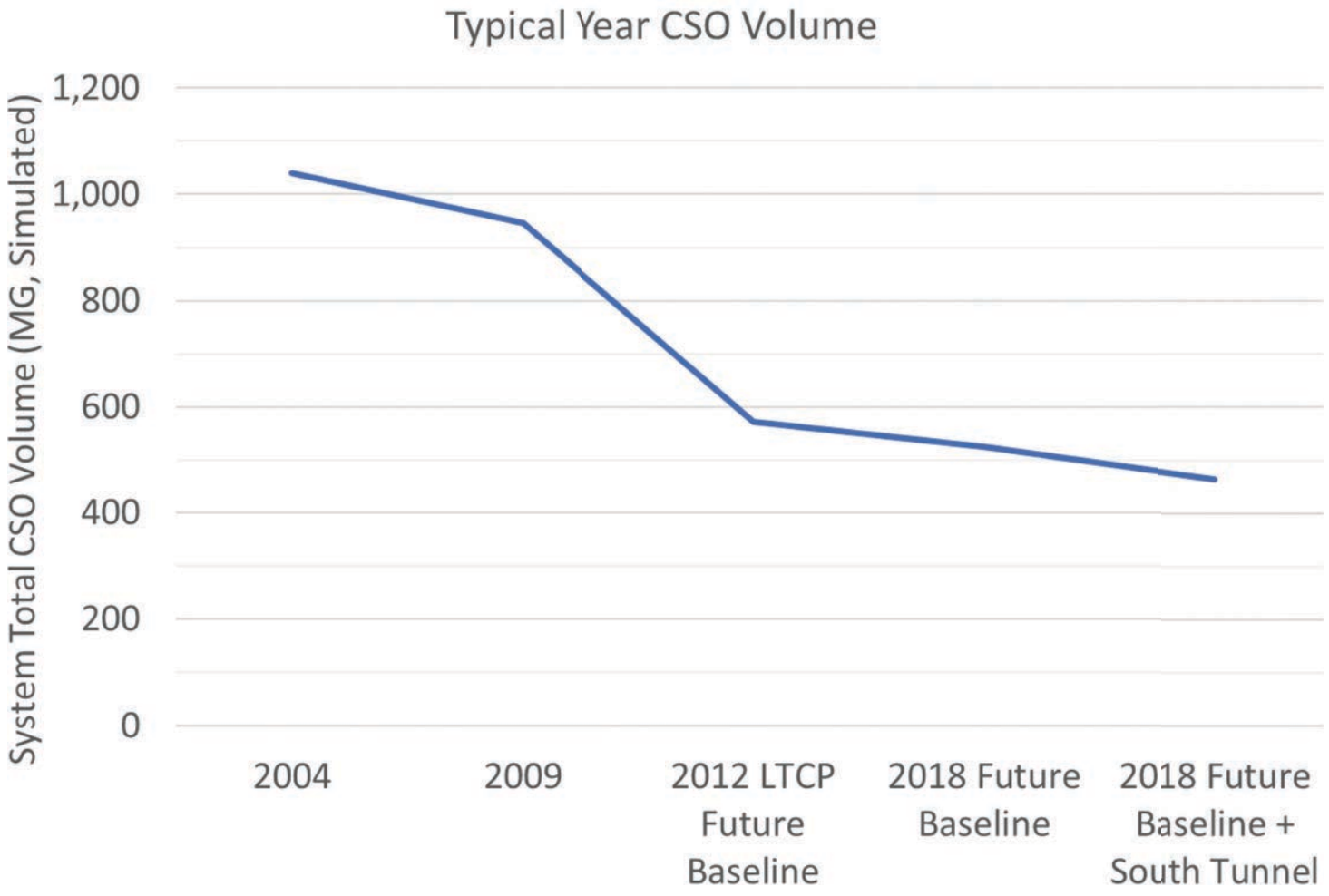
The Clean Water Project (CWP)

Clean Water Project
the choice is clear

CWP Goals

1. Reduce the CSOs to streams and rivers
2. Eliminate CSO outfalls to Wethersfield Cove and North Branch of the Park River
3. Reduce nitrogen discharged to the Connecticut River
4. Address SSOs outside of Hartford

CWP Progress and Ongoing Efforts



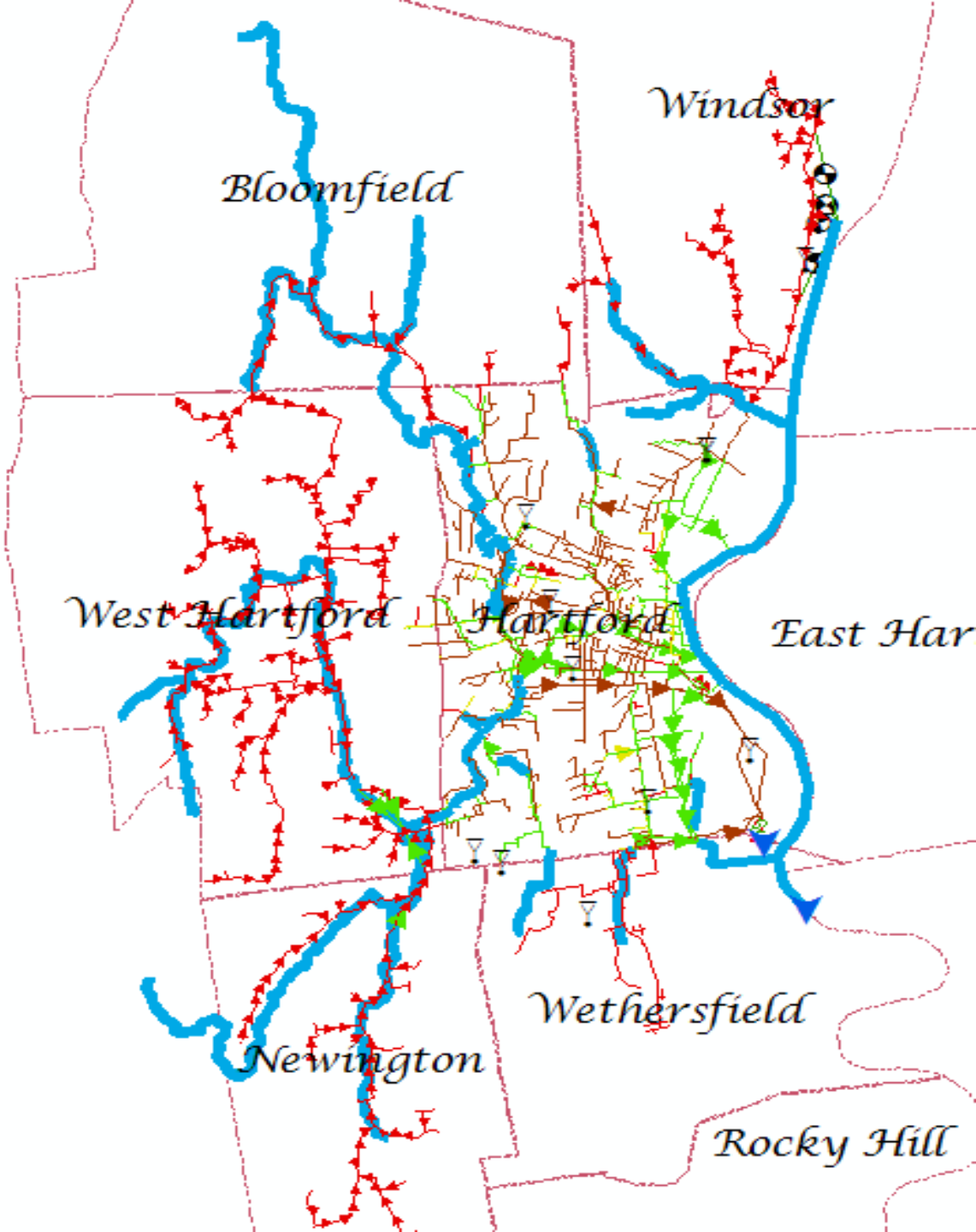
Future Baseline and South Tunnel

- Expand HWPCF capacity to 200mgd
- 670 acres of sewer separation
- Reduce stormwater inflow and groundwater infiltration (I/I)
- Tunnel storage and conveyance

Next LTCP update in 2018 is part of Integrated Plan

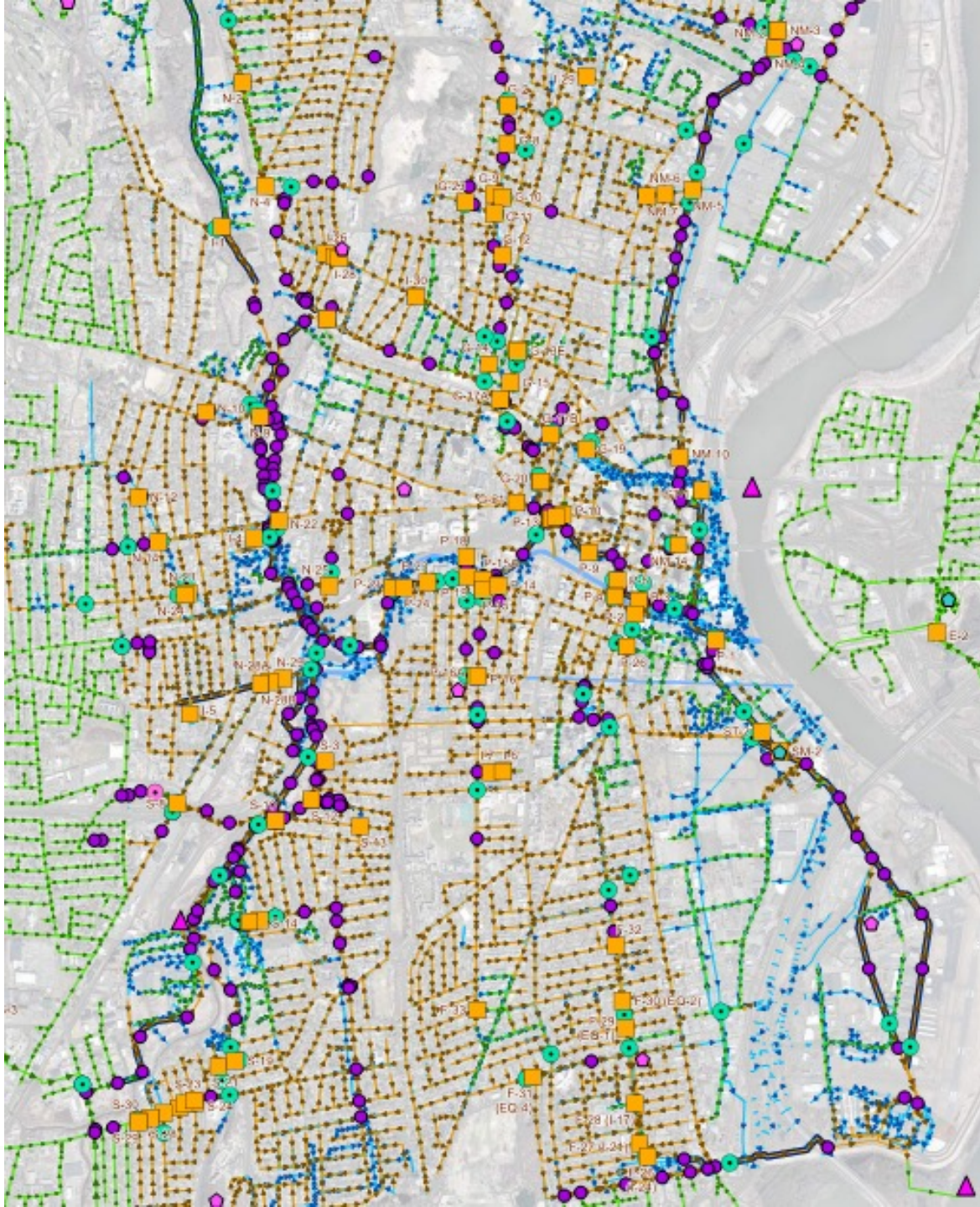
MDC SWMM Model

- **Combined** and **sanitary** sewers and **storm drains** in Hartford
- **Sanitary sewers** in surrounding communities of West Hartford, Newington, Windsor, Bloomfield, and Wethersfield
- **Park River** watershed and **conduit system**
- **Connecticut River**
- Flood control pump stations/procedures
- Hartford Water Pollution Control Facility
- Updated many times over four decades!



2016-2017 Model Calibration

- 2016 March - November
  - 144 temporary flow meters (CSL)
- 2017 March – May
  - 42 temporary flow meters (CSL)
- Additional Data Collected
  - 12 permanent flow meters (MDC)
  - 7 rain gages (MDC)
  - 85 overflow alarm level sensor (MDC)
  - USGS stream gages
  - Manhole surveys
  - Regulator inspections
  - Multi-sensor inspection of all large-diameter pipes
  - MDC operations maintenance logs
  - Record drawings

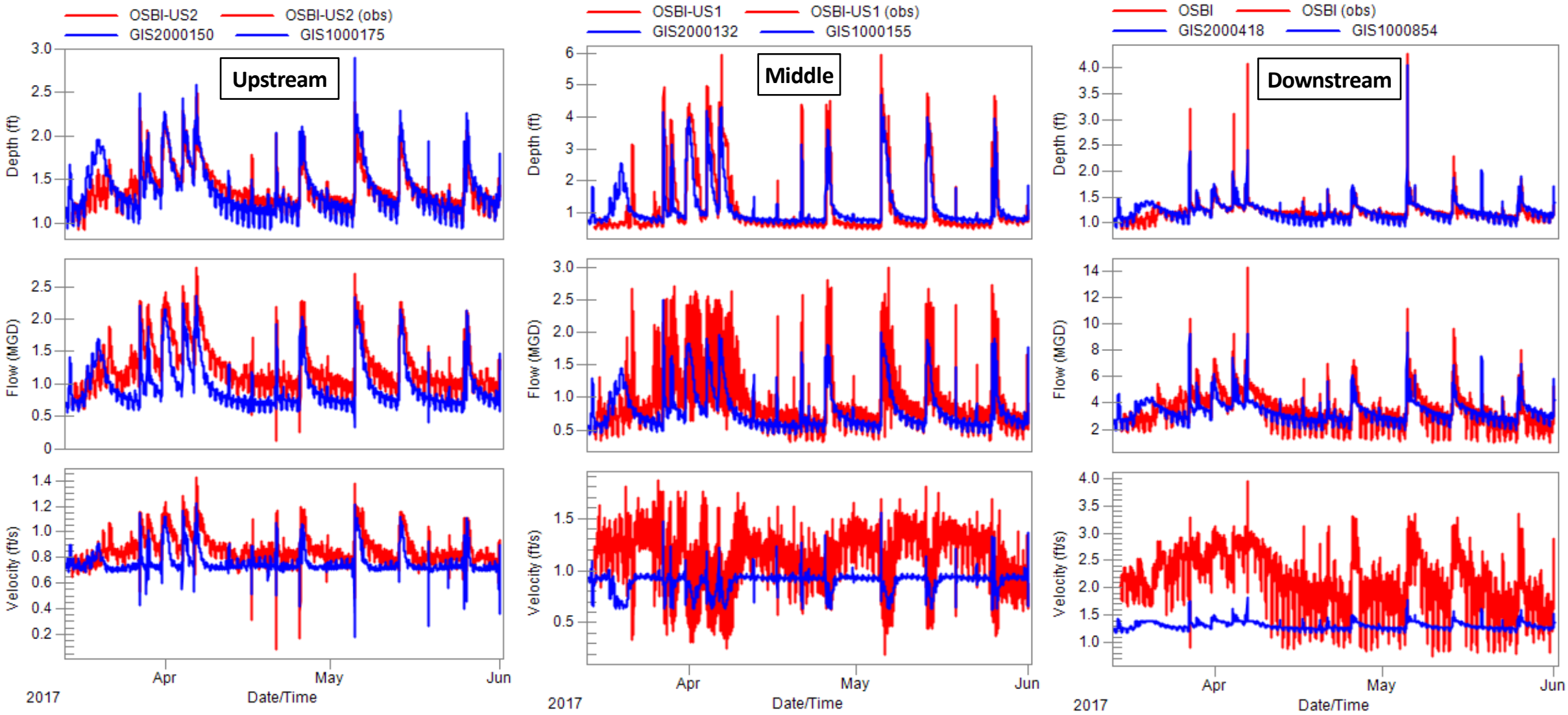


Model Update and Calibration Parameters

From Available Data	Calibration Parameter
Hydraulics ▪ Pipe configuration, dimensions, & inverts ▪ Regulator configuration and dimensions ▪ Sediment depth & pipe condition	Hydraulics ▪ Dry weather inflow ▪ Manning's roughness (n) ▪ Form loss (k) ▪ Sediment depth ▪ Orifice and weir coefficients
Catchment Properties ▪ Routing ▪ Surface elevation ▪ Threshold elevation ▪ Imperviousness ▪ Slope	Catchment Properties ▪ Contributing area ▪ Width (flow length) ▪ Percent routed ▪ Aquifer parameters ▪ Soil parameters ▪ Groundwater parameters

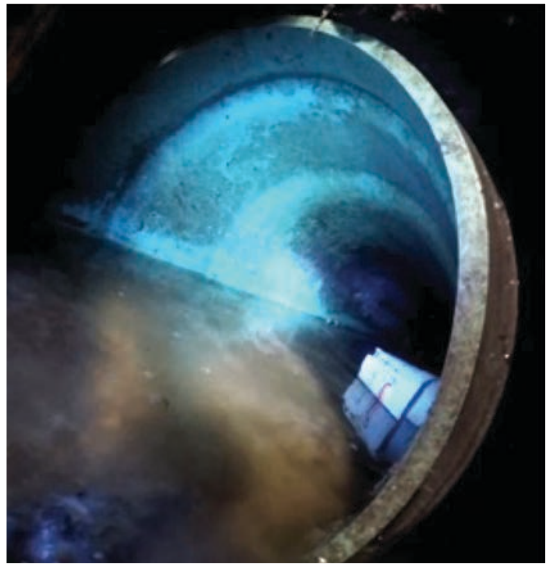
Calibration Procedure

Red = Meter
Blue = Model



Examples of O&M Issues Discovered

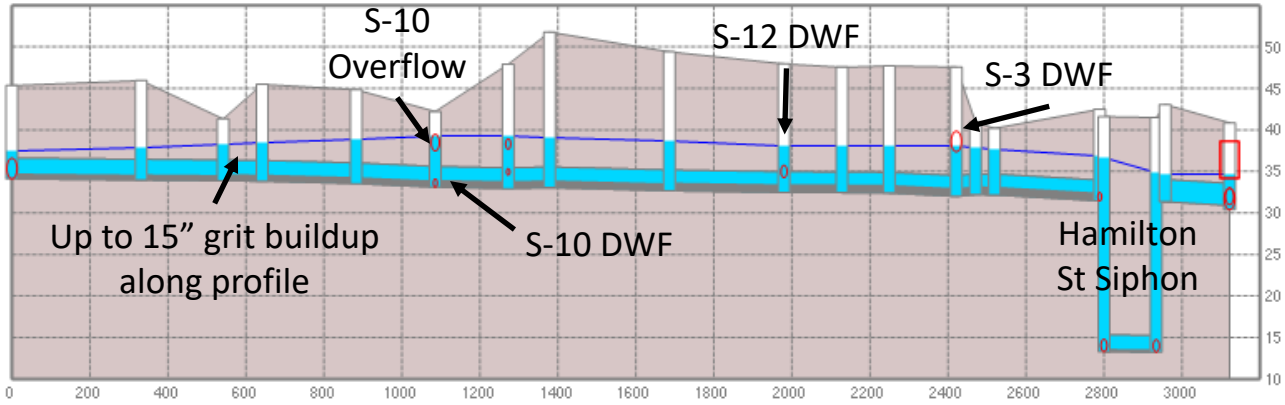
- Sediment buildup
- Pipe blockages
- Collapsed pipes
- Hydraulic restrictions
- Hydraulic jumps
- Sensor placement



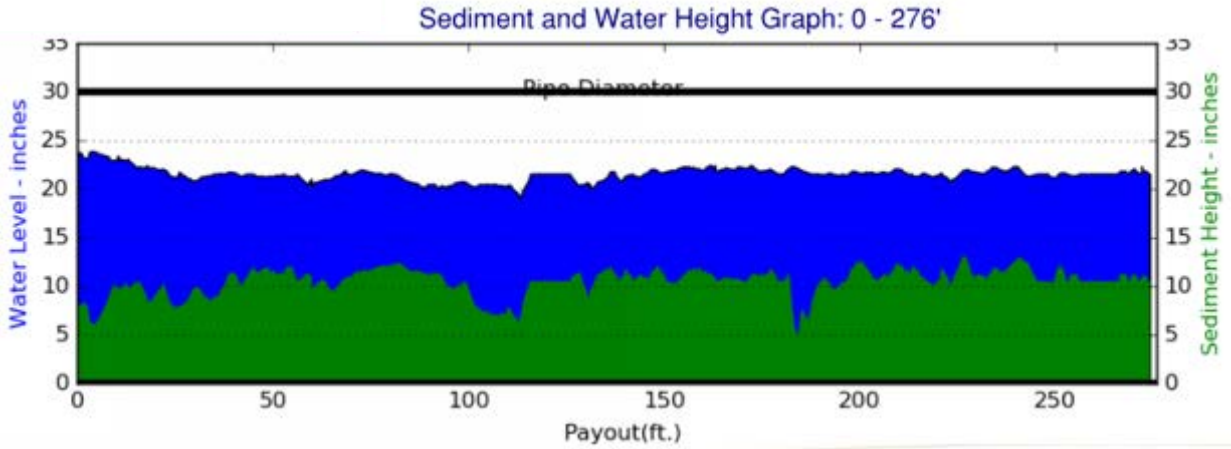
Sediment Buildup

- Model underpredicted water level and overflow frequency
  - Required up to 15” of sediment in the 30” interceptor and high losses to match data
- Interceptor prioritized in system-wide multi-sensor inspections
  - Heavy sediment discovered
  - Blockage discovered in siphon barrel
  - Prioritized for interceptor cleaning

Model profile of OSBI during 5/5/17 storm

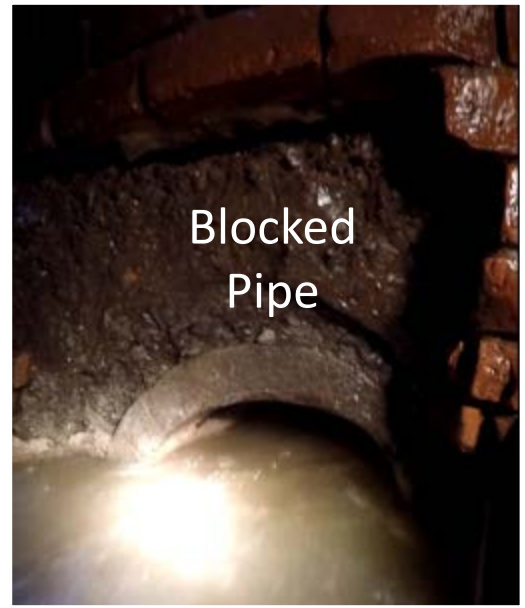


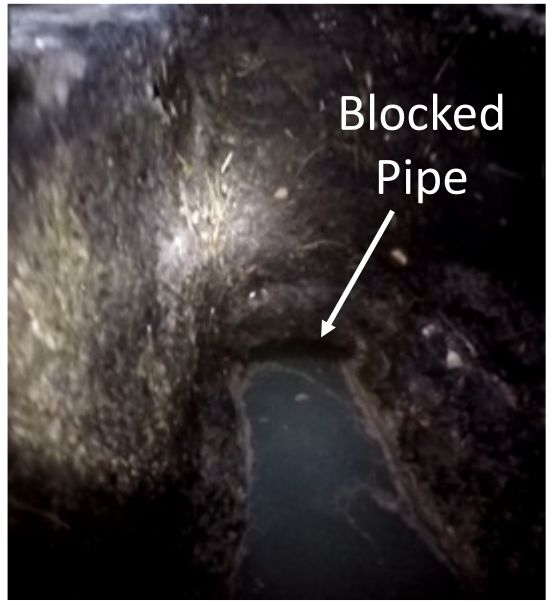
Heavy sediment buildup in OSBI multi-sensor inspection



Pipe Blockages

- Model underpredicted overflow frequency and duration
  - Excessive losses required to achieve match
- Locations prioritized during system-wide inspections
  - Grease and debris blockages were found in over 20 CSO regulators
  - Multiple siphon blockages discovered
  - Prioritized for cleaning



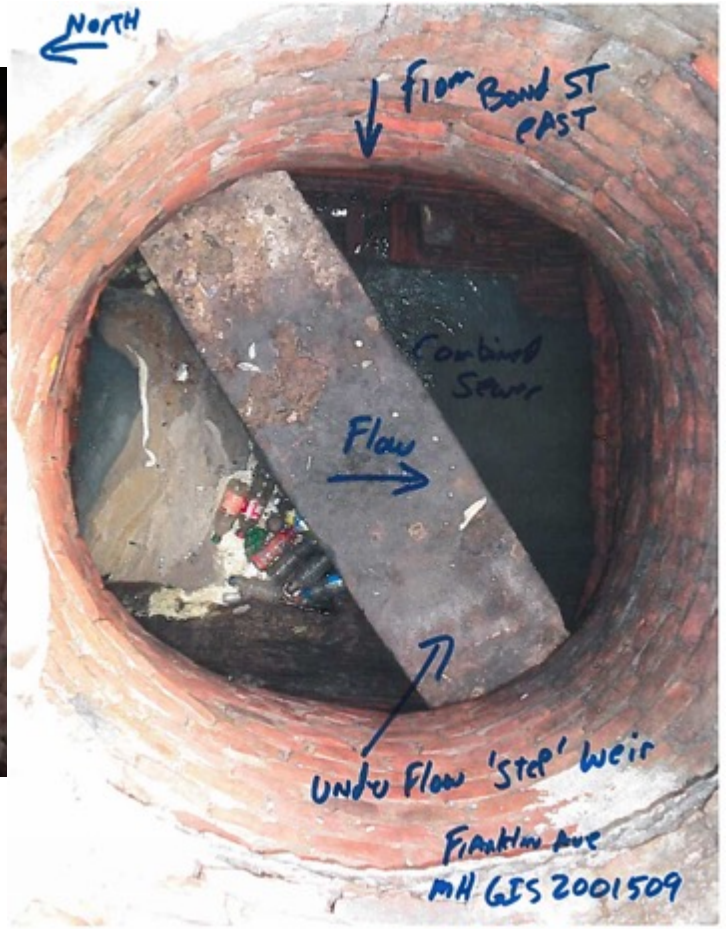


Hydraulic Restrictions

- Model unable to simulate frequent interceptor surcharge
- Partial wall discovered during field inspection
- Added weir and orifice to the model
- Calibrated opening dimensions to reproduce meter data

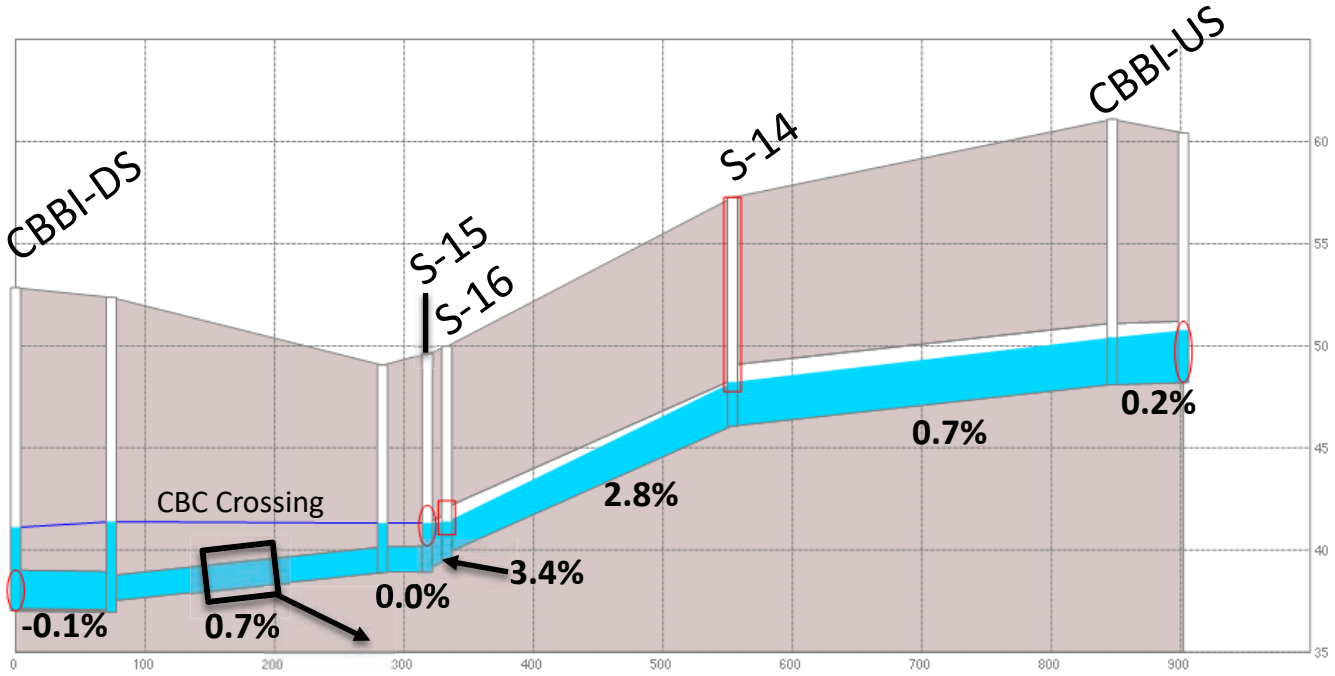
View from CCTV

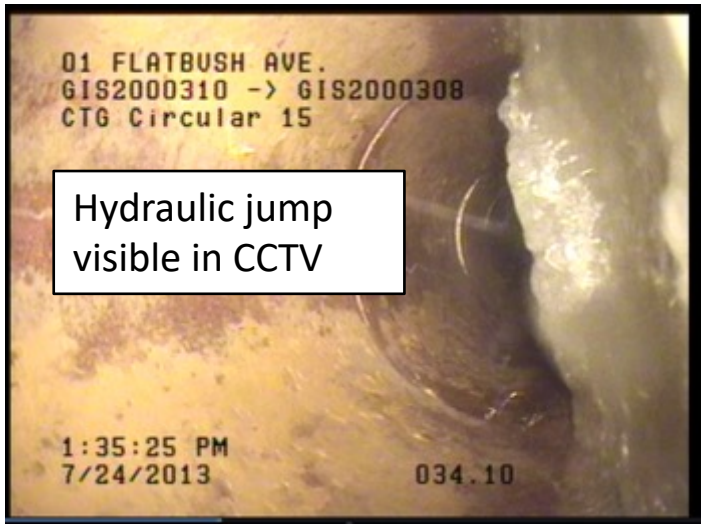
View from manhole



Hydraulic Jumps

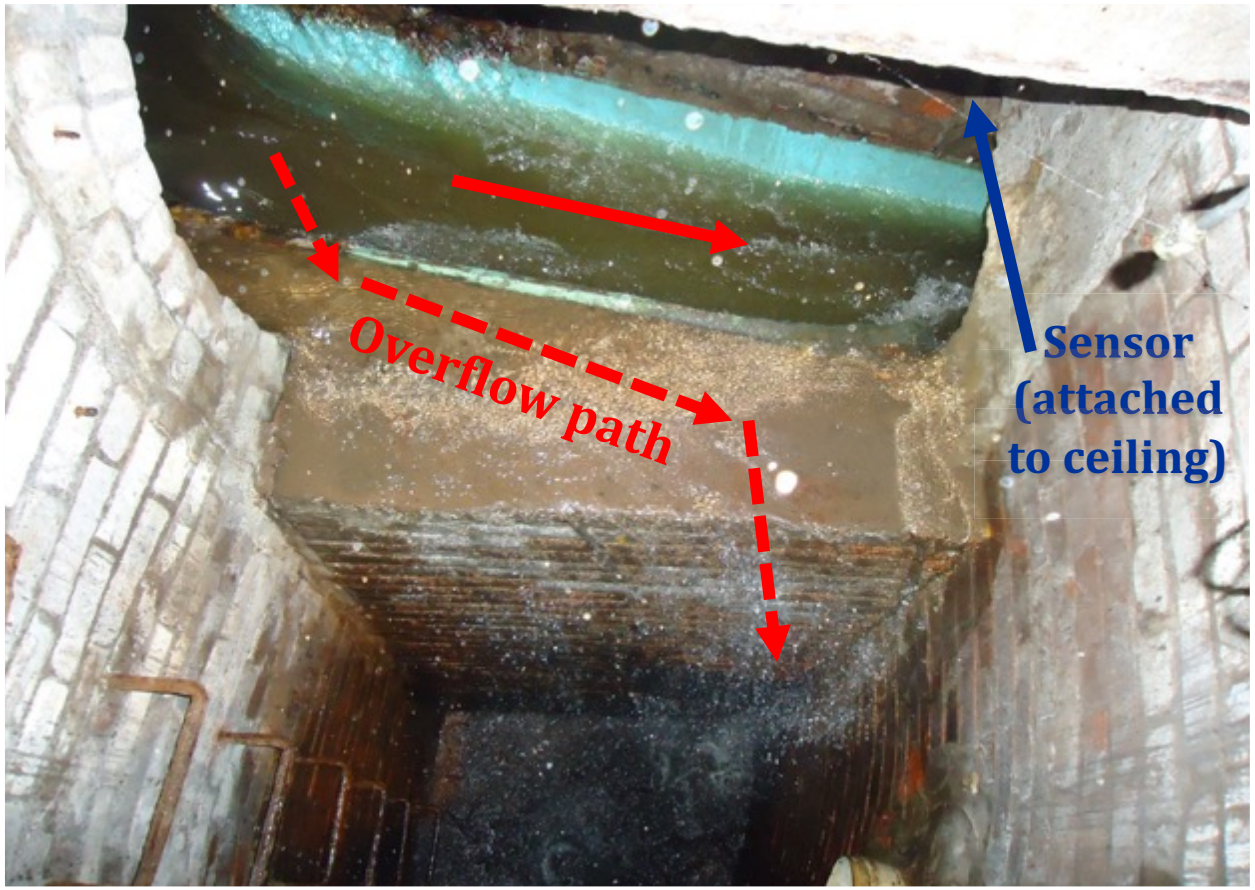
- 3 regulators and 2 temporary meters installed within 1,000 ft of each other on Flatbush Ave
- Challenging to match all 5 meters in each storm
- Drastic change in pipe slope
- Model simulates hydraulic jump
  - Visible in CCTV
- Further wet weather investigations planned





Overflow Alarm Sensor Placement

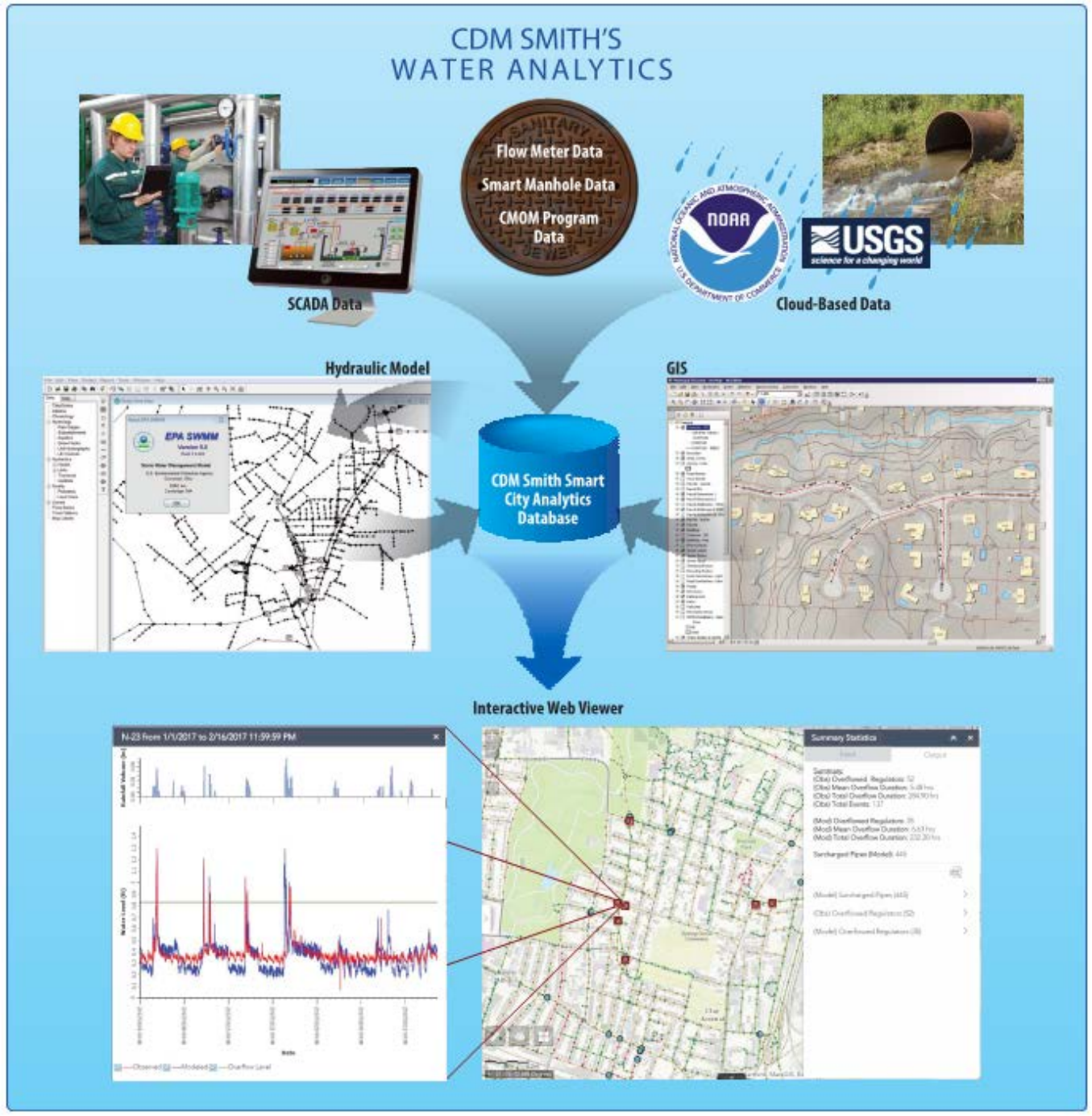
- Model overpredicting overflow frequency at N-10
  - Great match at nearby temporary meter
- Sensor located on downstream end of long side-flow weir
- Wet weather investigations confirmed overflow path at upstream end of regulator
- Sensor to be moved to properly record overflow



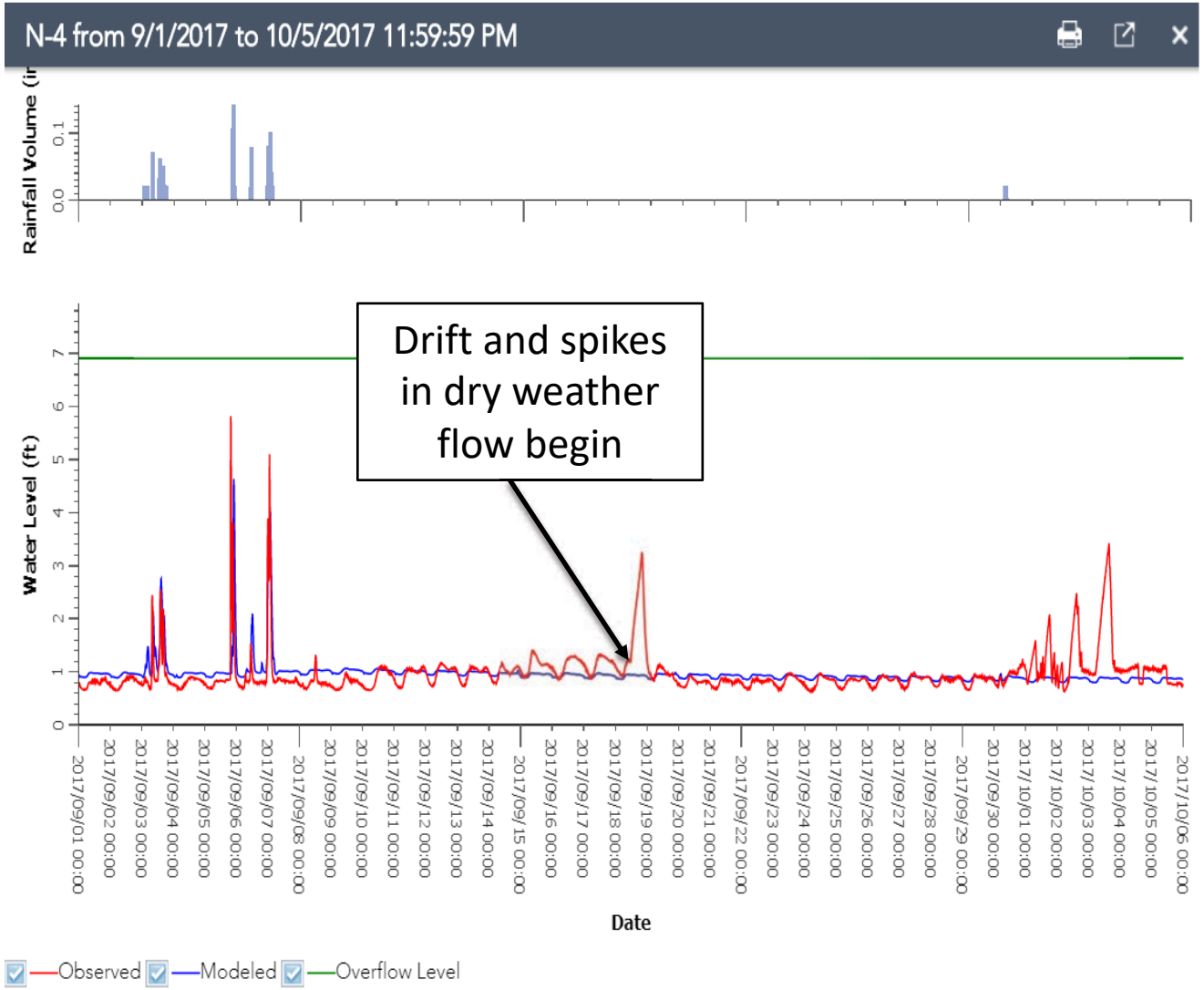
CDM Smith Water Analytics

Unleash the power of your data.

- **Integrates** real-time (**new**) system data into one platform for improved monitoring and understanding
- **Targets** O&M activities
- **Captures** institutional knowledge and facilitates collaboration
- **Manages** risk through daily validation of system performance
- **Analyze effectiveness** of proposed and implemented projects



Collapsed Pipe



Acknowledgements

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