Application of Level Meters at CSO Locations to Provide Real-time Data on System Performance

Shawn T. Syde, P.E.
Karilyn Heisen, P.E.
Constantine Karos

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Presentation Outline

- Overview
- History of CSO Estimates and Monitoring in New Bedford
- Level Sensor/Weir Equation Approach
- Benefits of Approach
- Issues Identified
- Future of Monitoring

New Bedford Collection System 101

- System constructed primarily between 1850s and 1960s
- 350 miles of pipe ranging in size from 6-in to 96-in serving approximately 100,000 people in three communities
- 29 pumping stations
- 11.5 miles of force/pressure mains
- 74 regulators flowing to 27 outfalls
- Intertwined network of interceptors, weirs, and pumping stations configured to maximize flow capture and conveyance to City's WWTP

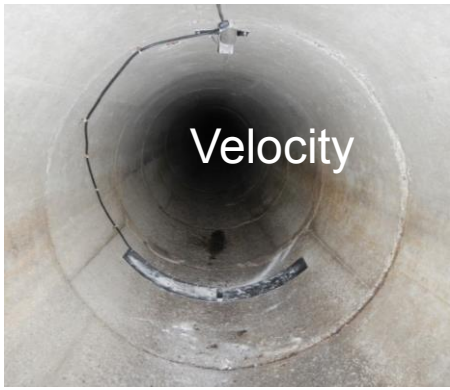
CSO Monitoring Approach

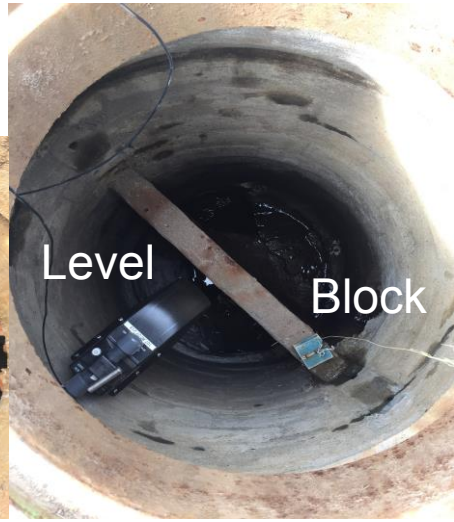
<u>1990s-2018 CSO Block Program</u>

- Block regulators where possible

<u>2018-2020 Pilot Study (5 meters)</u>

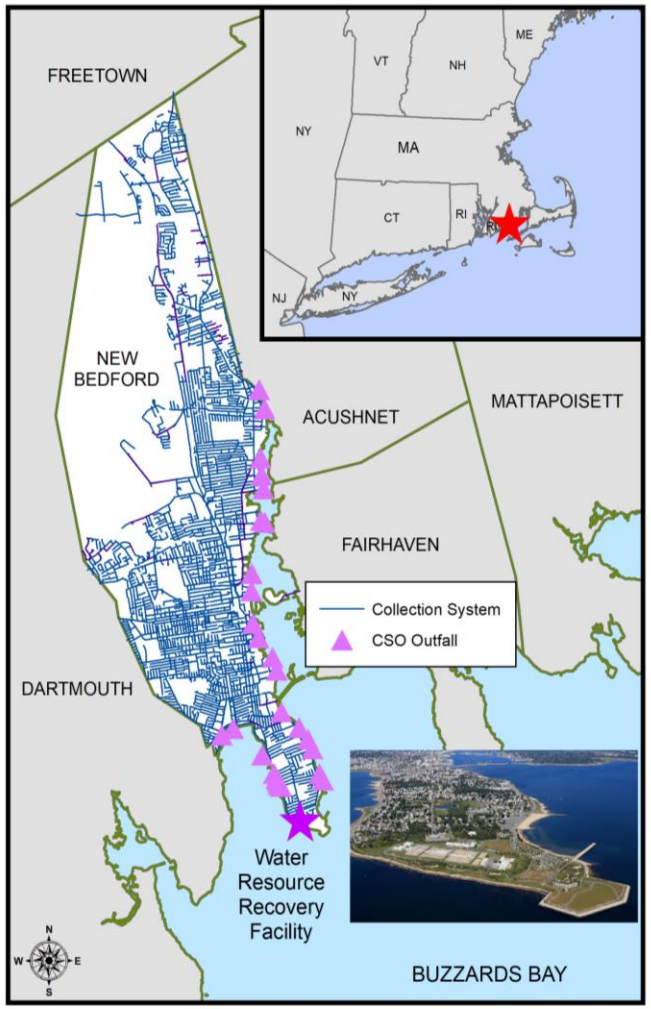
- Evaluated types of meters
  - Area velocity meters
  - Level meters
- Evaluated meter locations and installation approaches
  - Outfalls
  - Regulators
  - Field conditions
- Study concluded water level meters located at CSO regulators most effective





CSO Monitoring Program

- Since 2020
  - 32 water level meters
  - 2 rain gauges
- In 2022,
  - 20 additional meters
  - 1 additional rain gauge
- Monitors frequency and magnitude of CSO activation
- Developing a digital twin computer model (2021 – ongoing)
- Flow/volume calculated from combination of SWMM model and water level and weir/pipe equations



Operations and Maintenance

- Smart Alerts
  - Overflow activity
  - Approaching overflow levels
  - Trending of dry weather flow depths
  - Deviations between simulated and observed
- Targeting O&M activities proactively
- Improved collaboration between departments
- QA/QC of system data and model

CSO Model: Digital Twin Approach

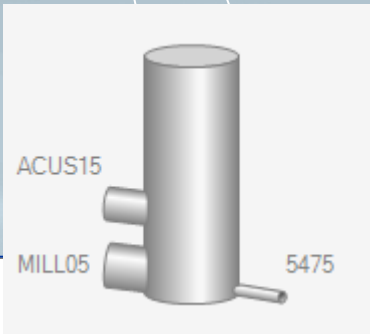
- Better utilize monitoring data and model for improved system understanding, operations and management
- Evaluate actual system performance compared to expected
- Proactively recognize and address system O&M issues
- Evaluate effectiveness of system improvements
- Data to support targeted improvements
- Assist with CSO event reporting
- Quality control of system data and model

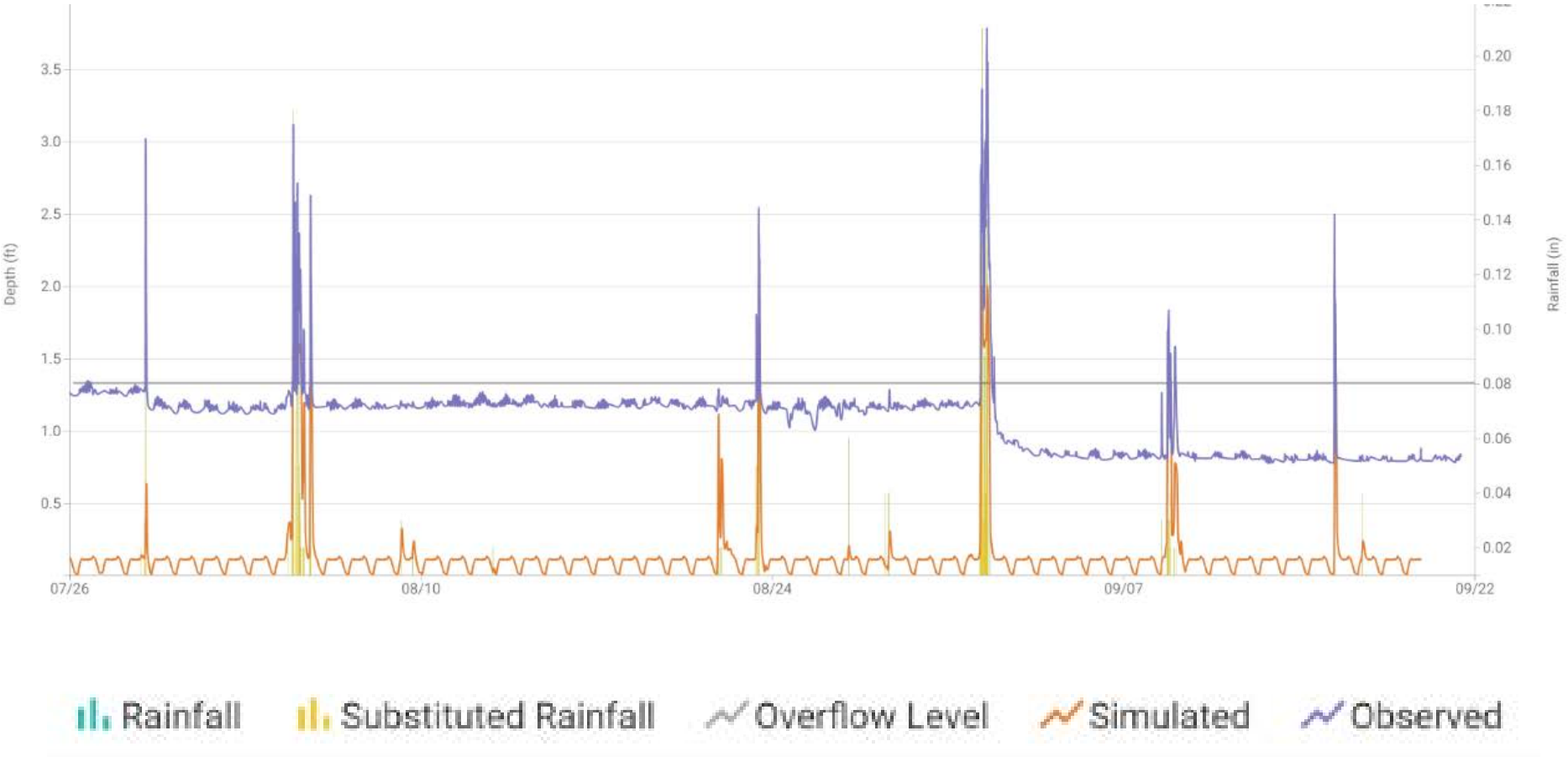
Benefits to Remote System Monitoring

- Efficiently manage system and report on CSOs in real-time
- Provides verification record that is not available for block testing which may have data entry errors
- Allows for pro-active maintenance vs. reactive
- Improved storm management practices
- Can be used to understand “why” something is happening not just “know” it is happening
- Evaluate Integrated Plan project effectiveness
- Reflects current field conditions compared to SWMM model calibrated to a point in time

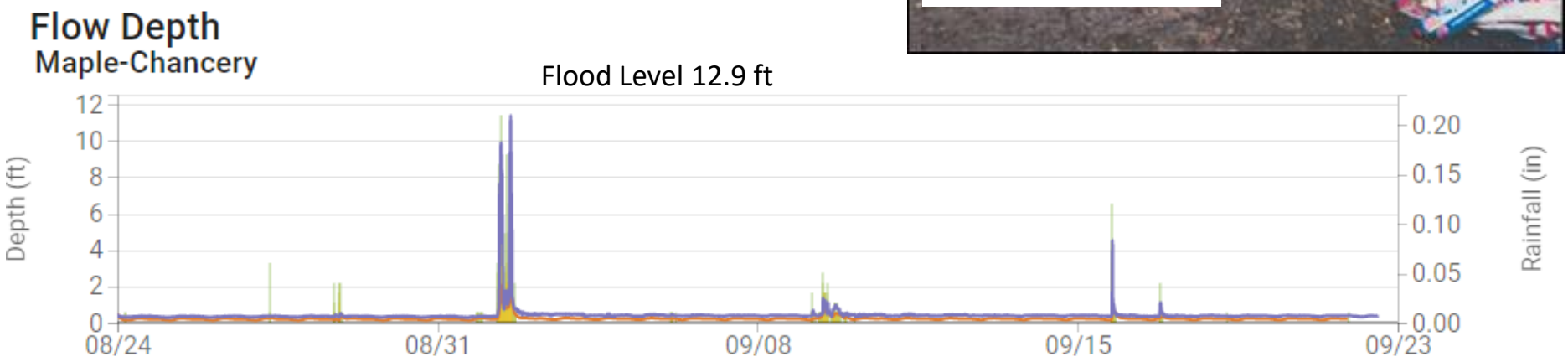
Benefits – O&M – Upstream of Pump Station Bar Rack

Benefits – Real-time System Changes

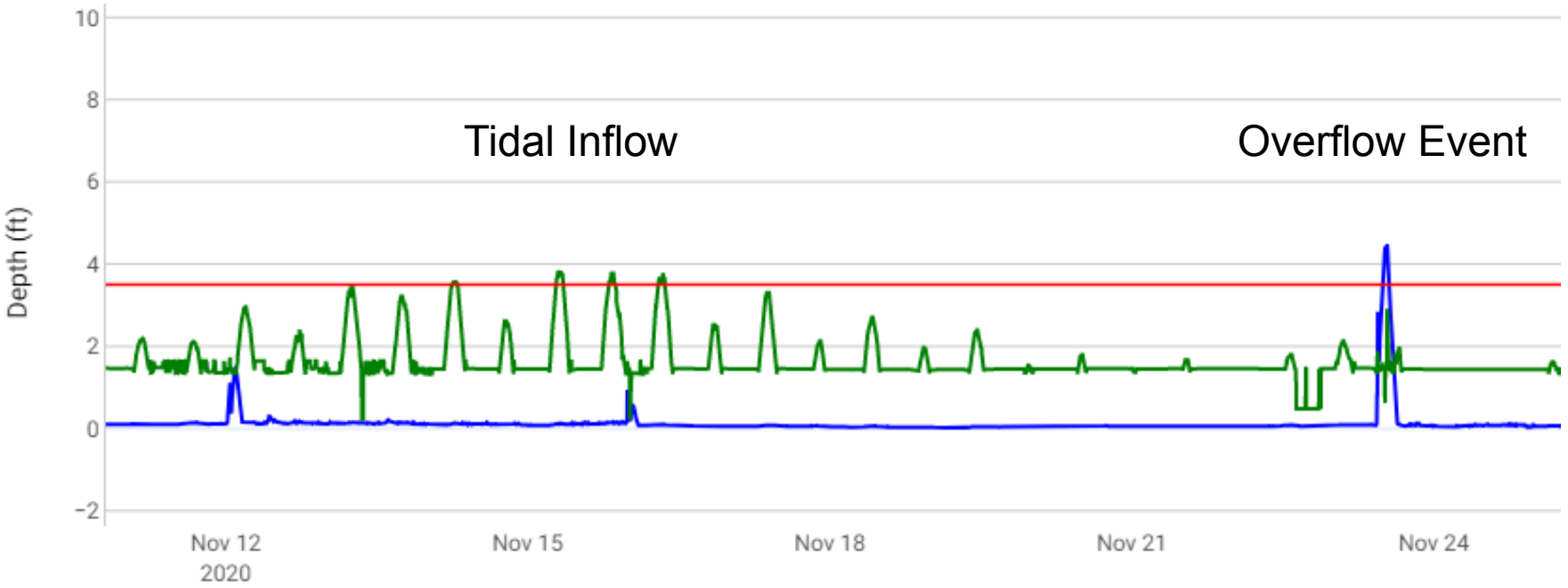




Benefits - Wet Weather Flooding Protection



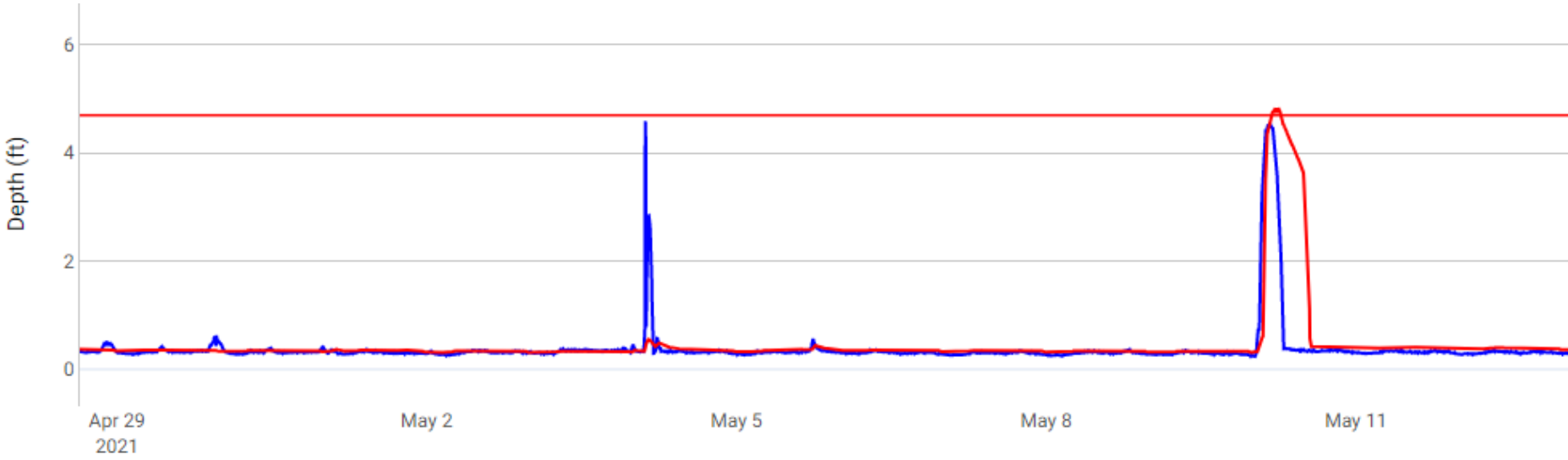
Benefits – Tidal Inflows to the System



Meter in Outfall Meter Upstream of Weir Weir Height

Benefits – Pump Station Operations

- Identify changes in Pump Station operation

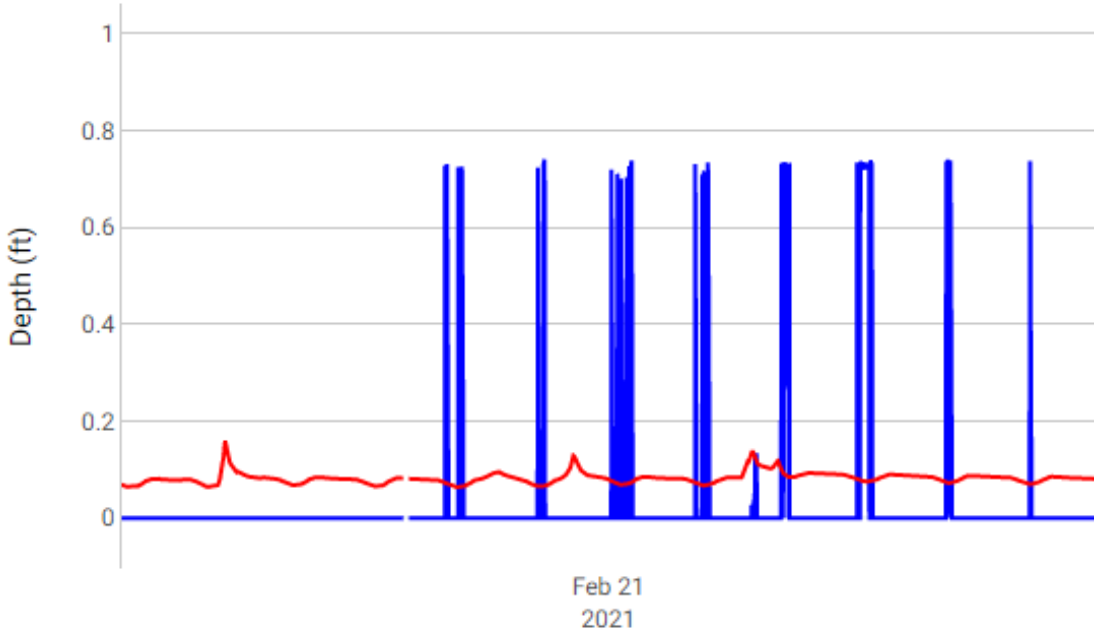


Issues with Remote System Monitoring

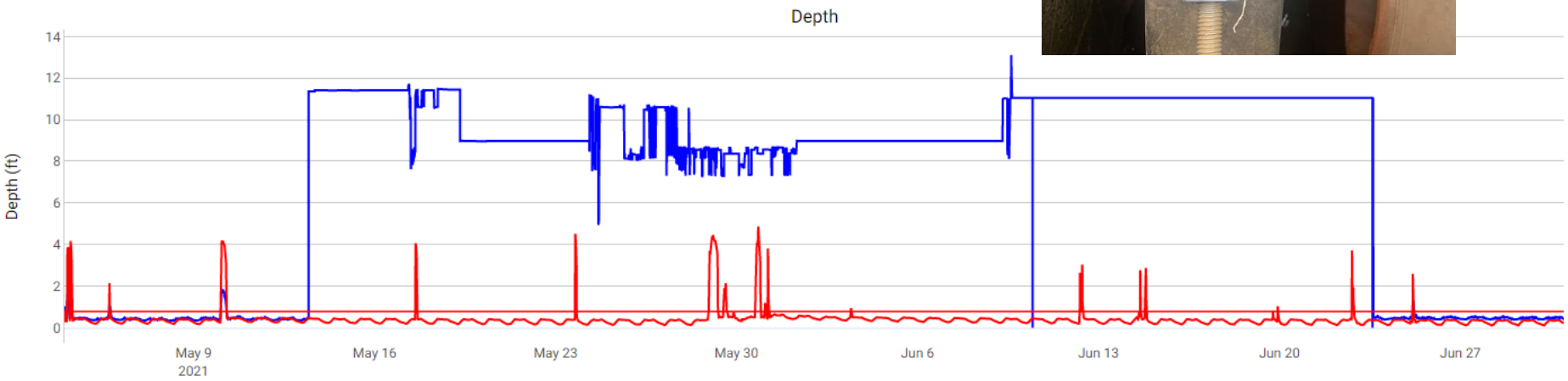
- Expensive to implement
- Meter malfunctions and meter communication issues
- Technical staff with capabilities needed to review data and manage the system
- One size doesn't fit all and not all locations may be able to be metered
- System configuration may impact meter(s) placement
- SWMM model may not represent true field conditions due to hyper local rainfall and changes in system operation & maintenance

Issues - Placement

- Incorrect placement on edge of flow channel



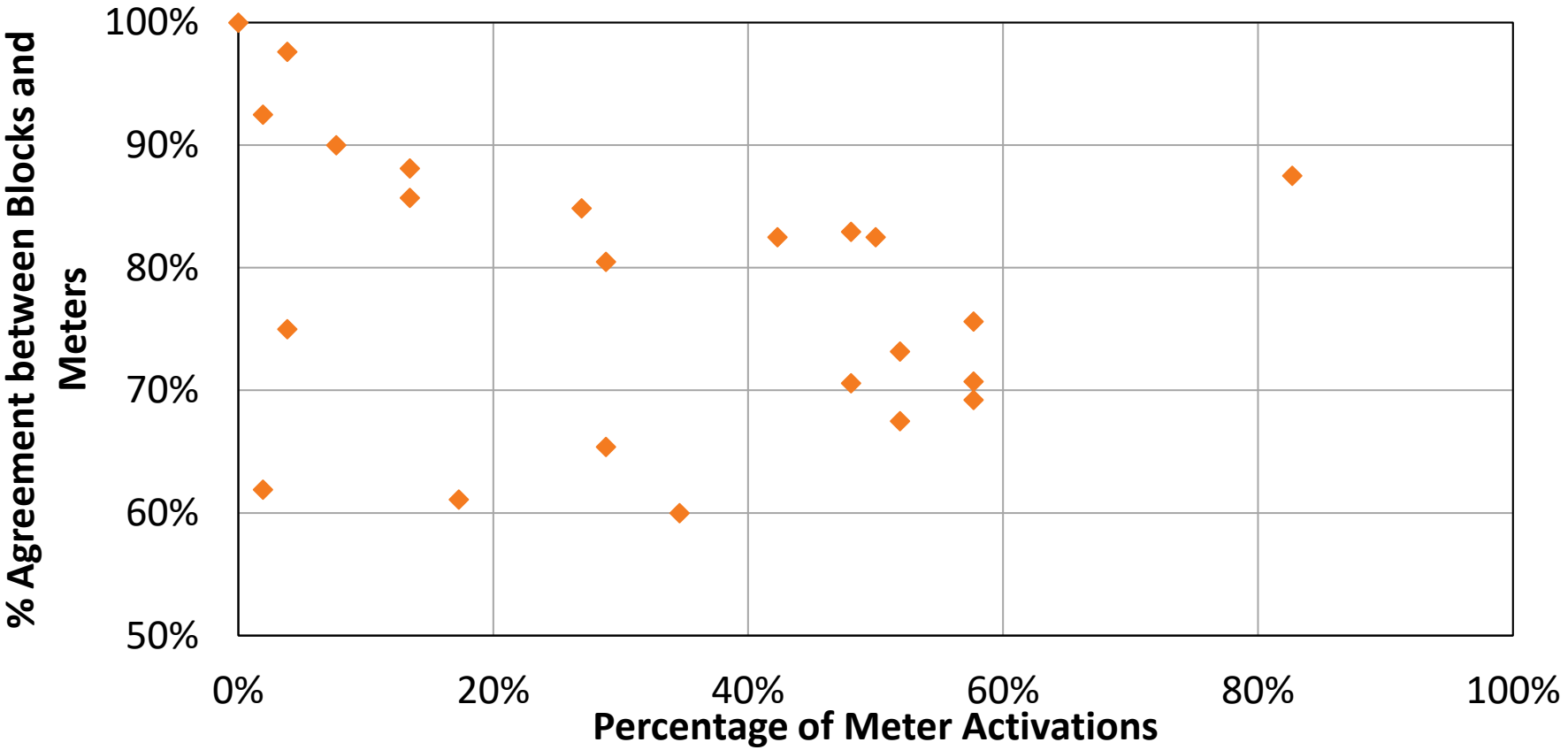
Issues – Malfunctions/Manhole Access



Issues – Weir Equations

- Uneven weirs
- Downstream gates
- Tailwater issues

Comparison of Blocks and Level Meters



Future of Remote Monitoring

- Meter data provides record for verification of data
- Upstream of weir allows for identification of meter issues before CSO events occur
- Real-time data to compare to digital twin
  - Whether the system performed as expected and, if not, where it deviated
  - Whether implementation of planned improvements would minimize impacts
  - Calculated volume and measured duration of overflow events
- Reduced labor for CSO monitoring and reporting allowing staff to focus on system improvements
- Predictive analysis of system performance from rainfall events

Next Steps for the City

- Verify weir configuration and equations to estimate overflows and incorporate tailwater
- Continue meter deployment
- SWMM Model updates to reflect changes to system
- Real-time notification
- Revise O&M procedures to utilize information from system

Acknowledgements

Questions

Karilyn Heisen, P.E.
Senior Water Resources Engineer
heisenkj@cdmsmith.com

Shawn T. Syde, P.E.
City Engineer
shawn.syde@newbedford-ma.gov