Swimming in Data

Collaboration to Collect, Review, and Effectively Use Data

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Agenda

- MWRA's Post Construction Compliance Monitoring Project
- Collection, Review, and Effective Use of Data
- The Future of Data

Post Construction Compliance Monitoring Project (PCCMP)

– Project purpose:
  - To assess the attainment of the levels of CSO control set forth in the Authority's Long Term Control Plan (LTCP)

– LTCP:
  - $911 million program that began in 1987
  - Reduced CSO discharge 86%

– PCCMP:
  - Project began on November 8, 2017

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Performance Assessment Tasks

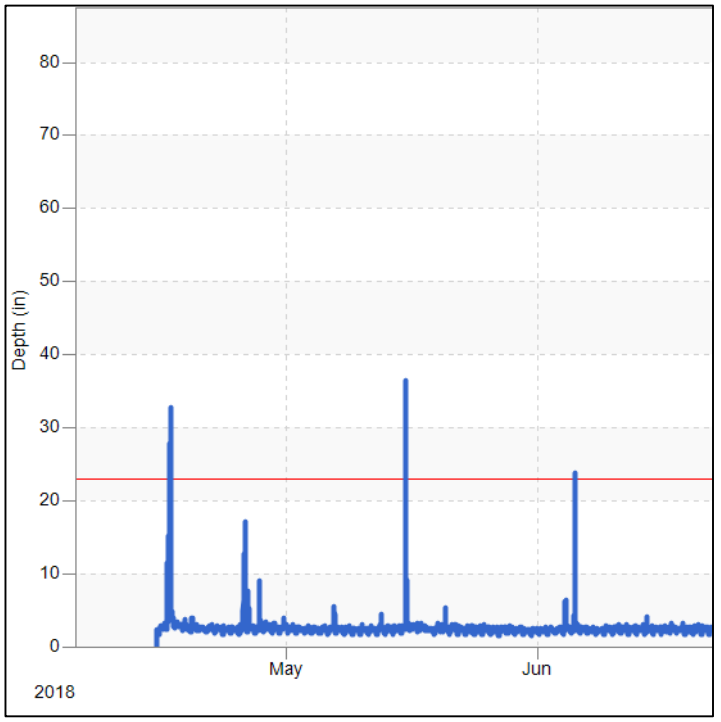
– Inspect CSO regulators addressed in the LTCP

Closed outfall (top), former CSO discharge that now discharges stormwater, only (bottom)

Performance Assessment Tasks

- Inspect CSO regulators addressed in the LTCP

- Collect meter data at active CSO regulators



Meter data at an active CSO regulator

Performance Assessment Tasks

- Inspect CSO regulators addressed in the LTCP
- Collect meter data at active CSO regulators
- Upgrade and improve calibration of hydraulic model using data collected

InfoWorks ICM Model

Performance Assessment Tasks

- Inspect CSO regulators addressed in the LTCP
- Collect meter data at active CSO regulators
- Upgrade and improve calibration of hydraulic model using data collected
- Receiving water quality modeling and assessment

Charles River

Mystic River

Performance Assessment Tasks

- Inspect CSO regulators addressed in the LTCP
- Collect meter data at active CSO regulators
- Upgrade and improve calibration of hydraulic model using data collected
- Receiving water quality modeling and assessment
- Assess system performance for CSO control

Performance Assessment Data

1. Collection

- What data are needed?
- What data sources are available?
- What methodologies can be employed to collected data?

2. Review

- Do the data make sense?
- Are there trends in the data?
- Do other sources of data corroborate this data?

3. Effectively Use

- How can the data be used?
- How can the data be further analyzed?
- How does this inform our understanding of the system?

Swimming in Data

15-min flow data

Community meters

Interceptor meters

Historical Data

Temporary meters

GIS data

15-min velocity data

SCADA Data

Meter Data

5-min depth data

Existing Data

Storm Reports

Facility Data

Measure-downs

Regulator Data

Record Drawings

Operations

Rim measurements

Basemaps

Project Data

Regulator inspections

Model Input Data

Pipe diameters

Community models

Tides

Temperature

Overflow elevations

Rainfall Data

Groundwater

20 rain gauges

Evaporation

Collection → Review → Effectively Use

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Community Knowledge

- CSO community meetings
- System knowledge
- Record drawings
- Existing collection system models
- Additional metering data

Boston Water and Sewer Commission

City of Cambridge

City of Chelsea

City of Somerville

Collection → Review → Effectively Use

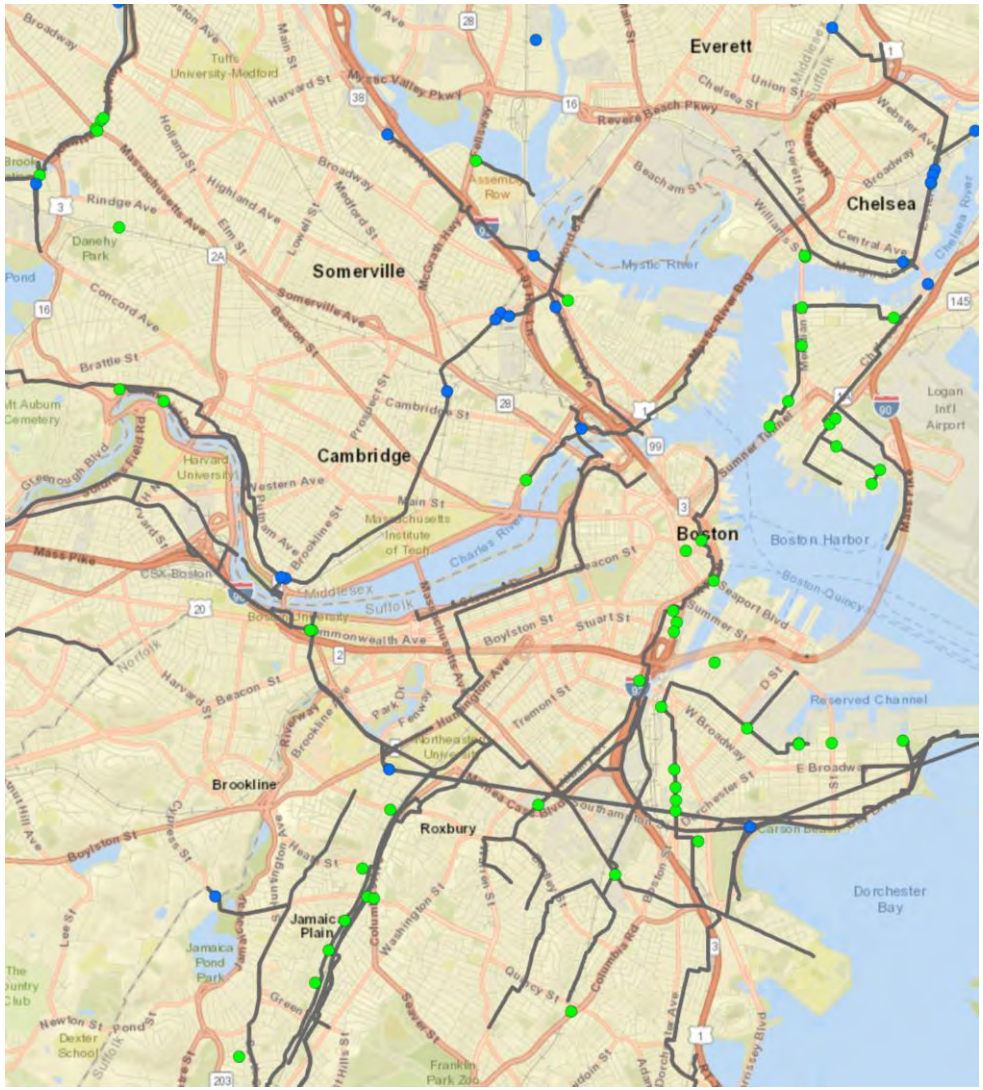
Regulator Data

- ✓ Open/Closed Regulator

Closed outfall (top), former CSO discharge that now discharges stormwater, only (bottom)

Regulator Data

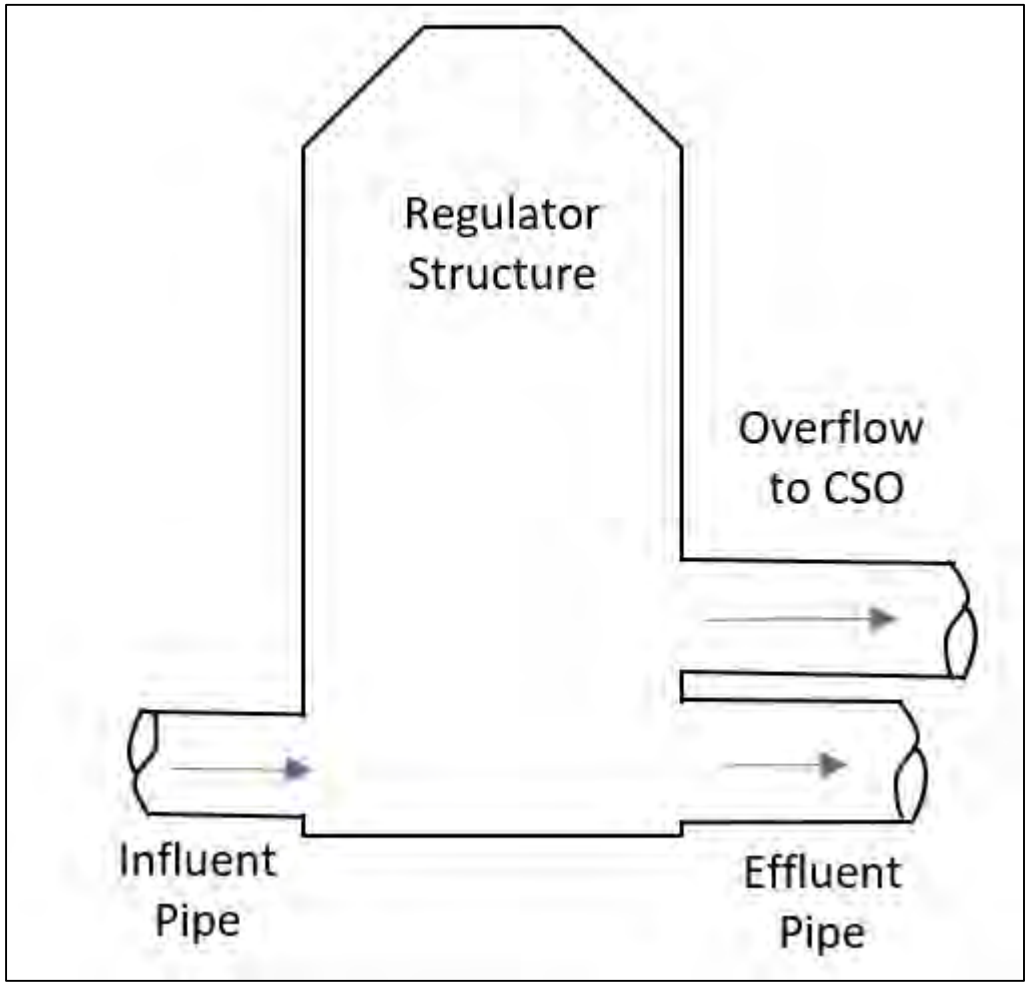
- ✓ Open/Closed Regulator
- ✓ Meter Installation



Metered regulator locations
CSO meters (green), interceptor meters (blue)

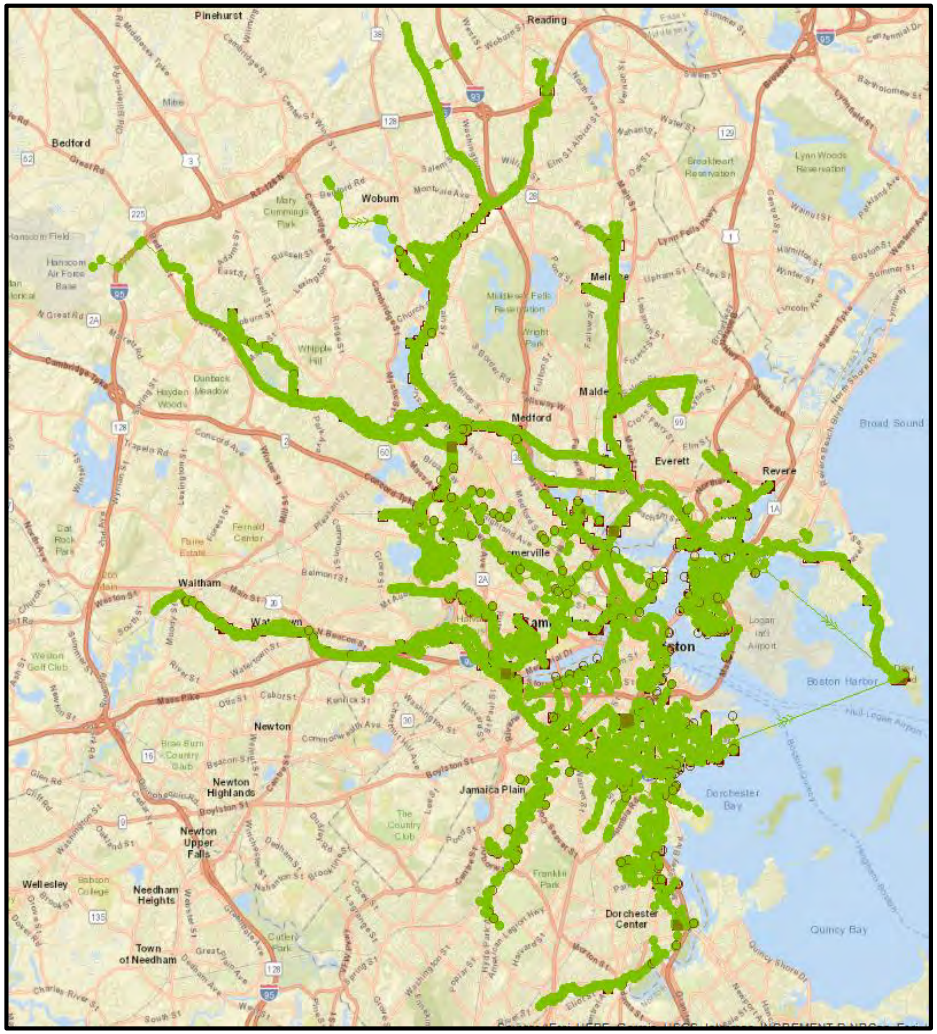
Regulator Data

- ✓ Open/Closed Regulator
- ✓ Meter Installation
- ✓ Regulator Measurements
  - ➢ Pipe sizes
  - ➢ Overflow height
  - ➢ Rim elevations



Model Data

- Temperature
- Tides
- Evapotranspiration
- Rainfall
- Metered depth, velocity, flow data for calibration



InfoWorks ICM Model

Do the data make sense?

Data need to be checked for accuracy before they are used

- Do the data make sense?
- Are there trends in the data?
- Do other sources corroborate this data?

Consequences of using bad or inaccurate data

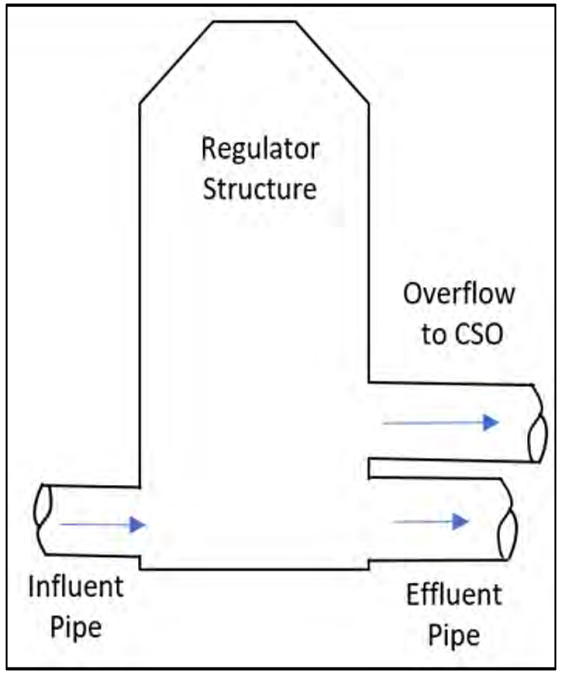
- Over/under reporting metered overflows
- Incorrect model results
- Misrepresenting the physical regulator configuration in the model
- Additional coordination, meetings, and field visits

Data Review Examples

Data Type

Rainfall Data

Regulator Measurements



Metering Data

Collection → **Review** → Effectively Use

Data Review Examples: Rainfall

Data are compared to multiple sources of information to corroborate and validate measurements

Data Type	Rainfall
Measurement	It rained 2 inches in East Boston

Green dot indicates rain gauge location

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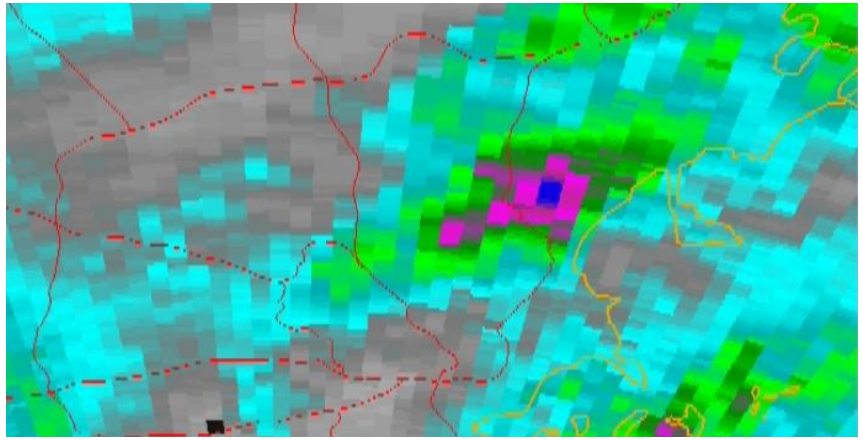

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Conclusion	It likely rained 2 inches in East Boston

Green dot indicates rain gauge location

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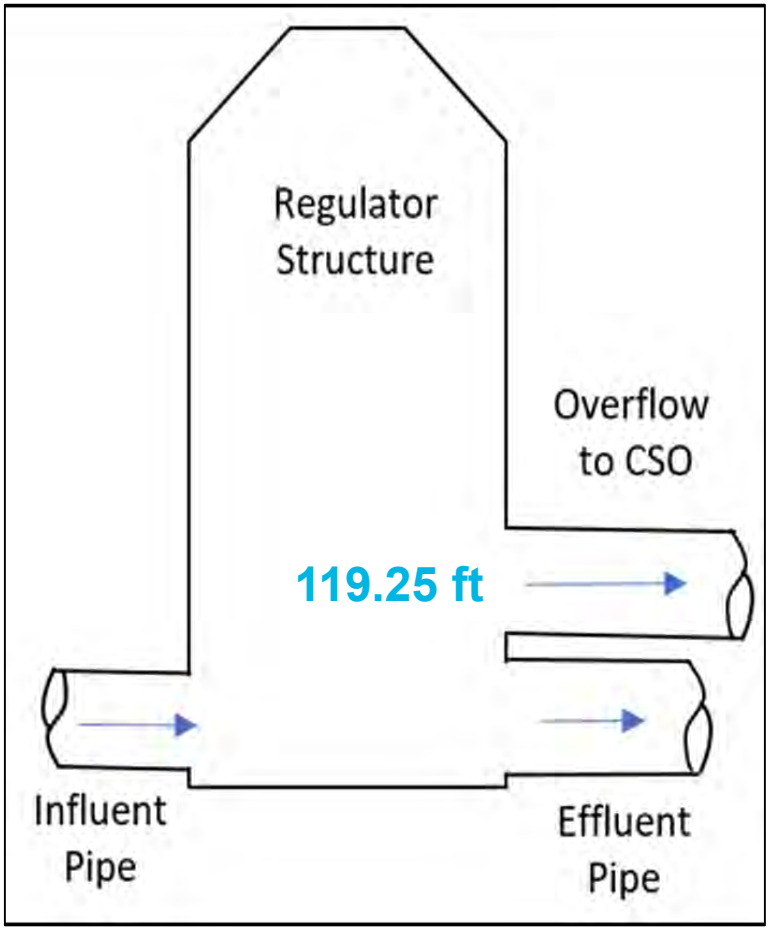
Data Type	Field Measured Overflow Elevations
Field Measurement	The overflow elevation is 119.25 ft (MDC)



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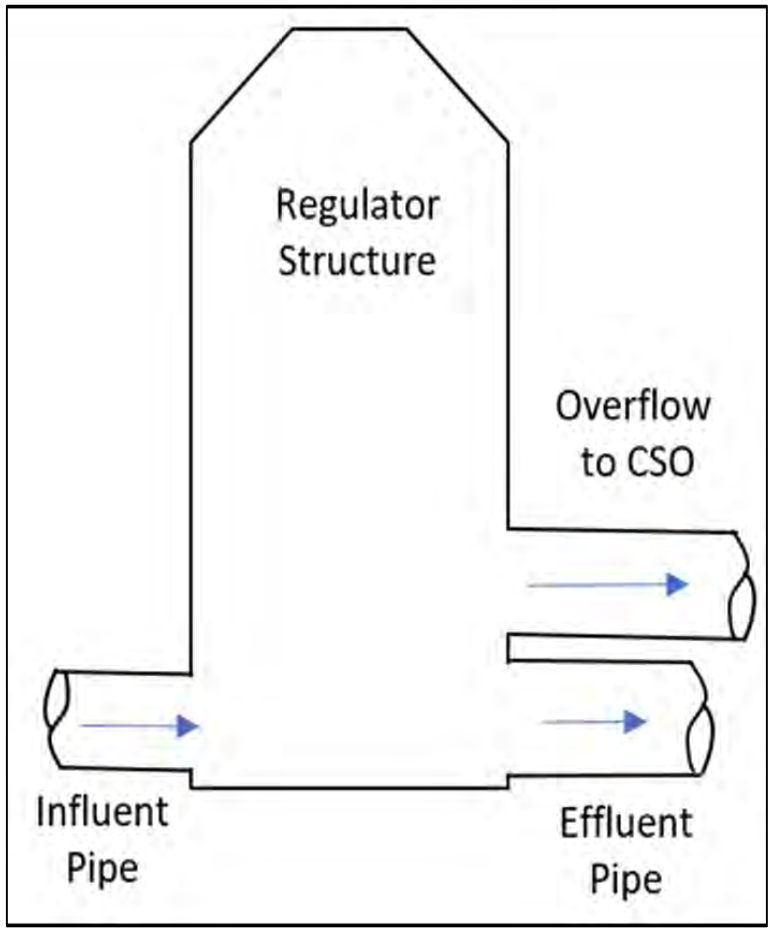

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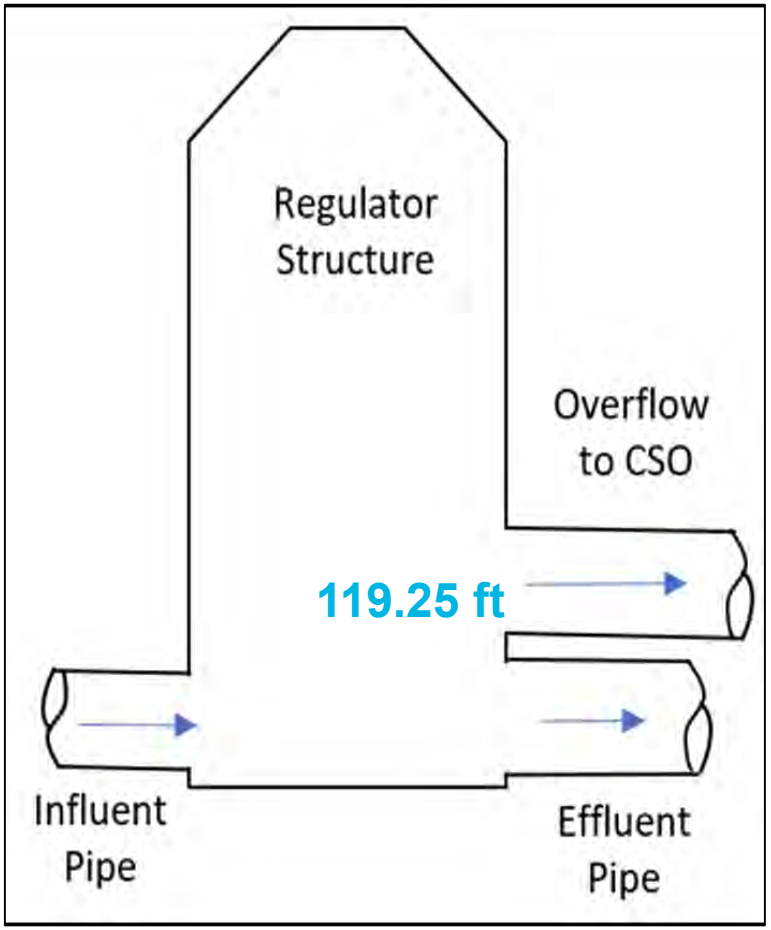

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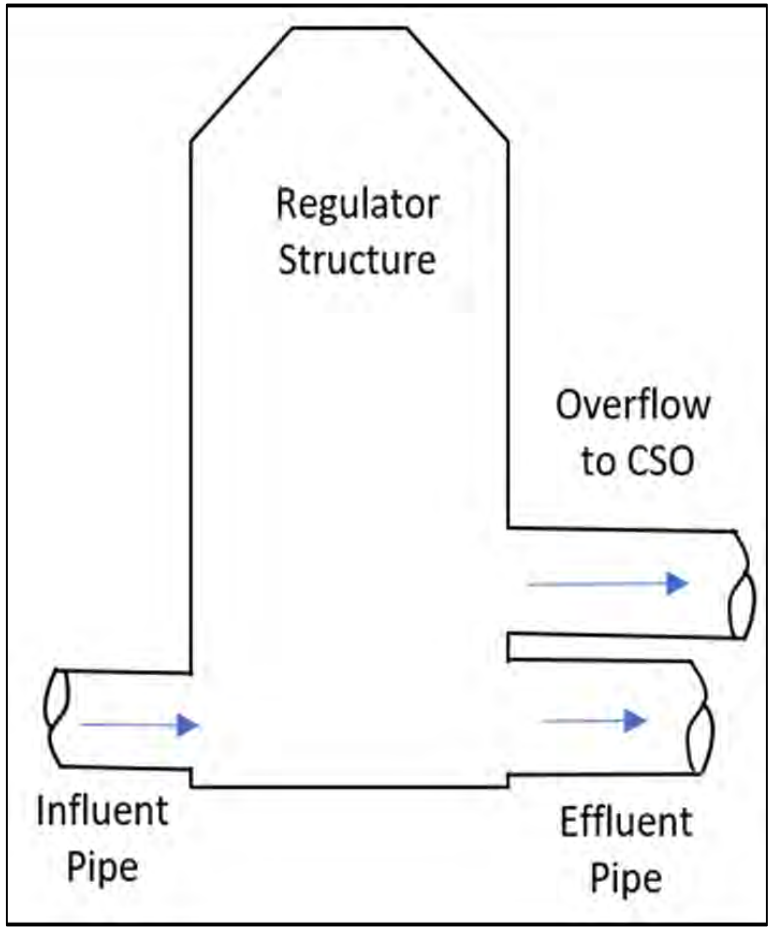
Comparison Data Shows:	➢ Record drawing shows 119.25 ft ➢ Community model shows 119.25 ft
Conclusion	High confidence in measured overflow elevation



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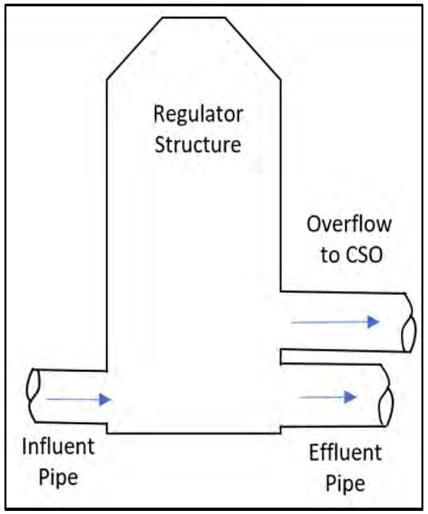
Comparison Data Shows:	--Level meter in the influent pipe exceeded the overflow elevation --Storm event was low intensity, long duration --Event is consistent with scattergraphs of previous events
Conclusion	There is high confidence in the metered overflow

Consequences of Poor Data

Data Type

Rainfall Data

Regulator Measurements



Metering Data

Potential Consequences

- Incorrect understanding of rainfall depth/intensity that likely causes CSO activations
- Modeled and metered activations do not match

- Incorrect overflow elevation, over/under predict CSO activations
- Poor understanding of hydraulics of the regulator

- Under/over estimate activation frequency, durations, volume of CSO discharge
- Calibrate hydrology to incorrect inflow values

Collection → **Review** → **Effectively Use**

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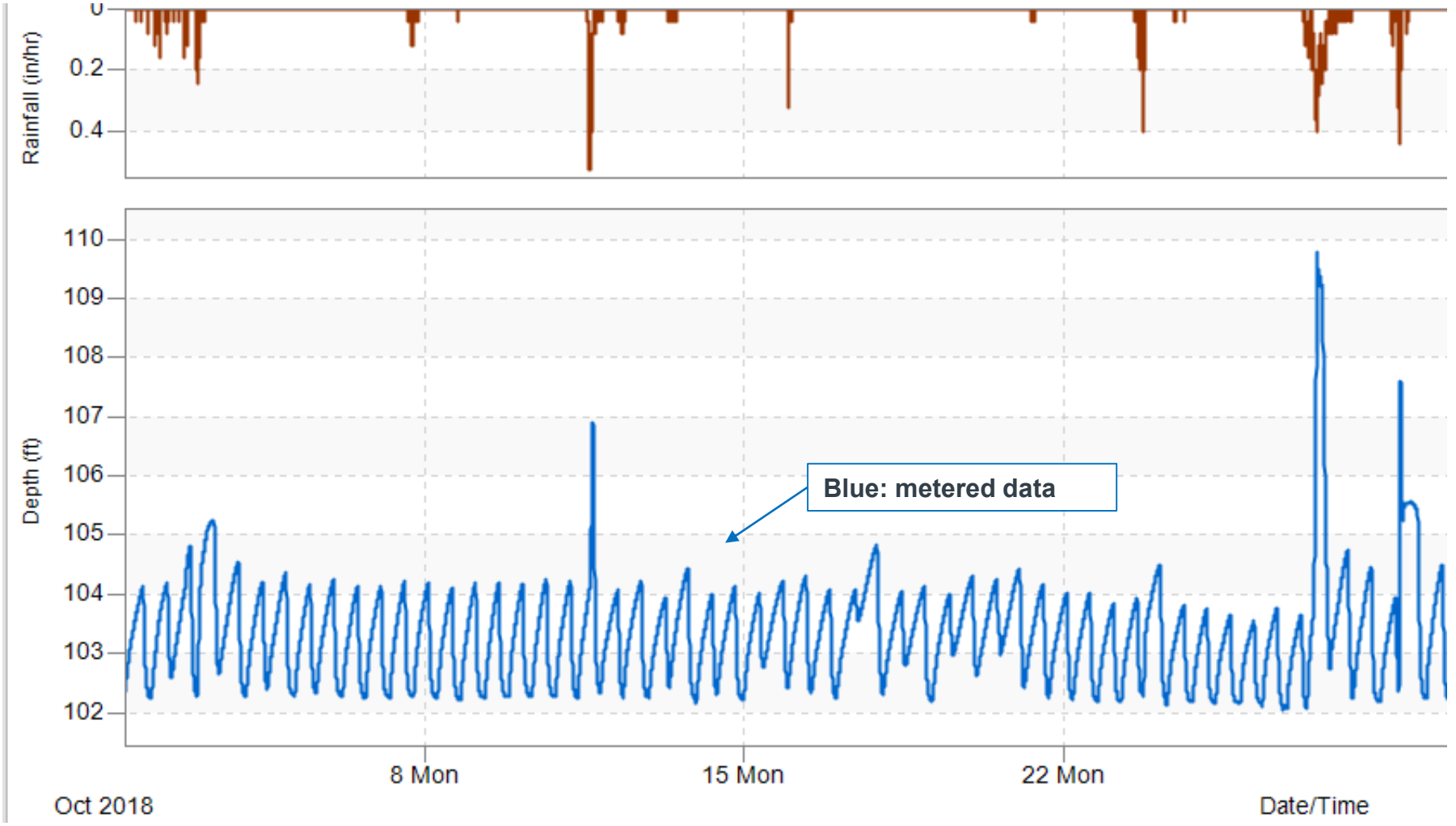
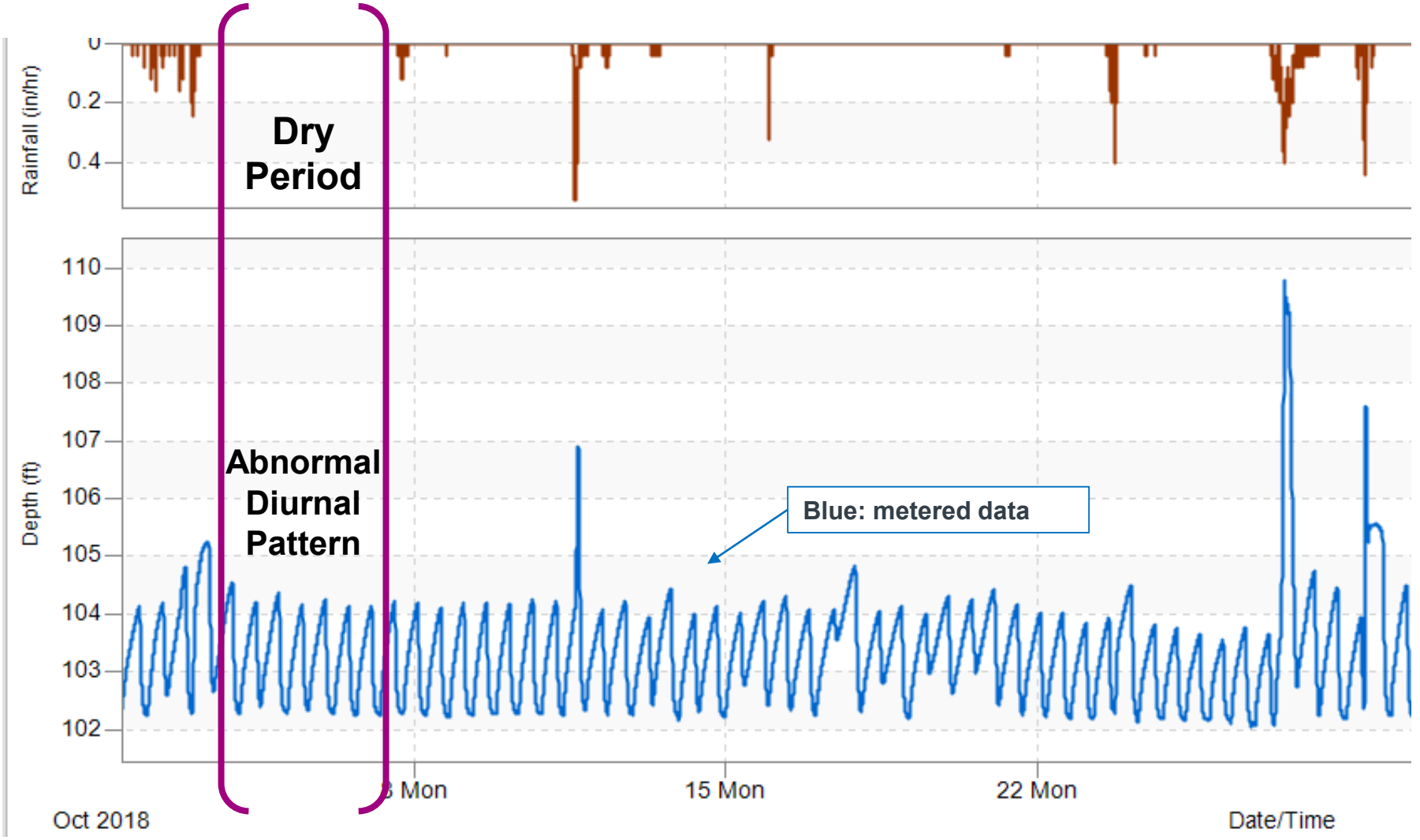
Data Trends & Anomalies: Meter Data



Data Trends & Anomalies: Meter Data



Collection → Review → Effectively Use

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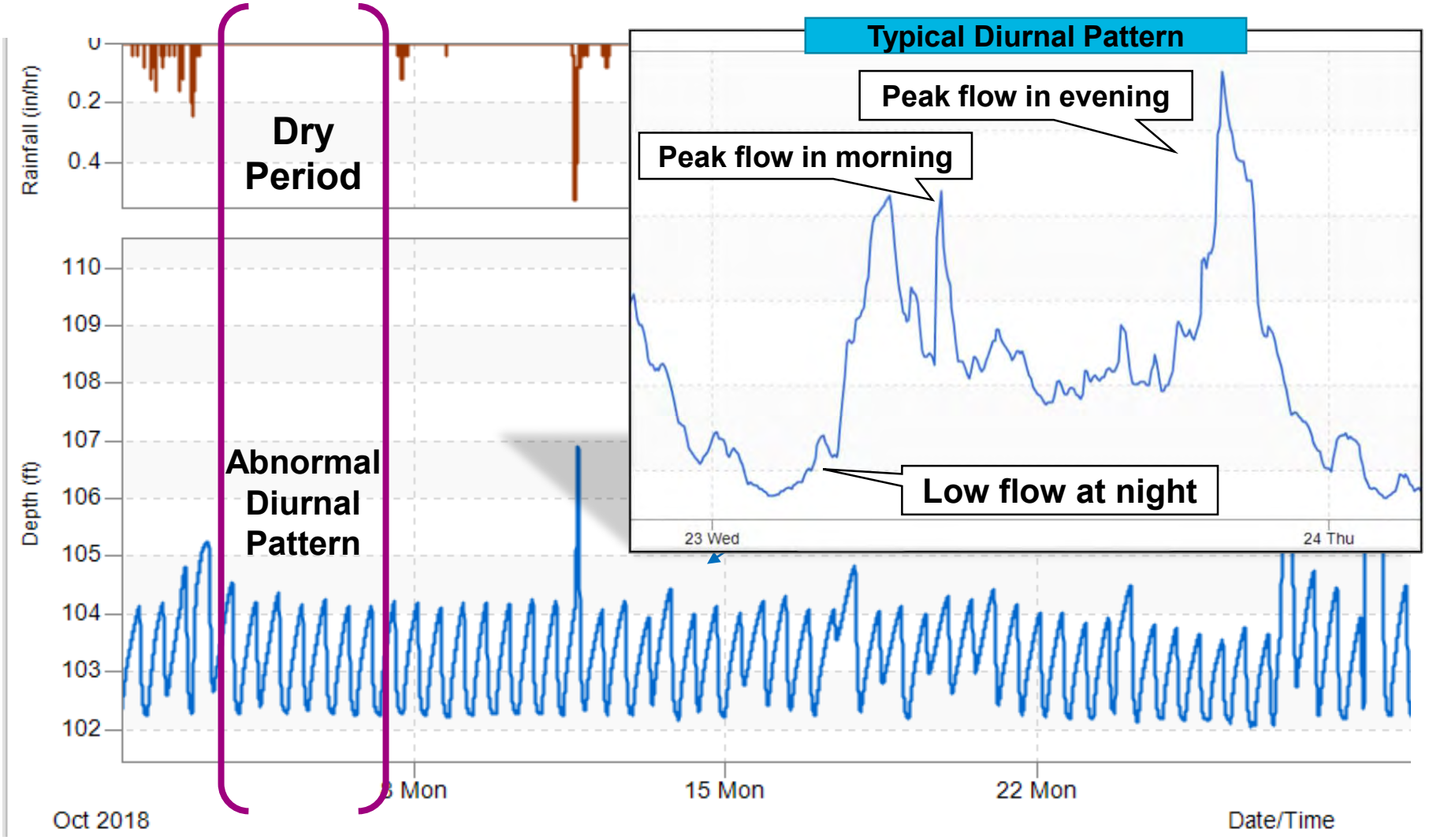

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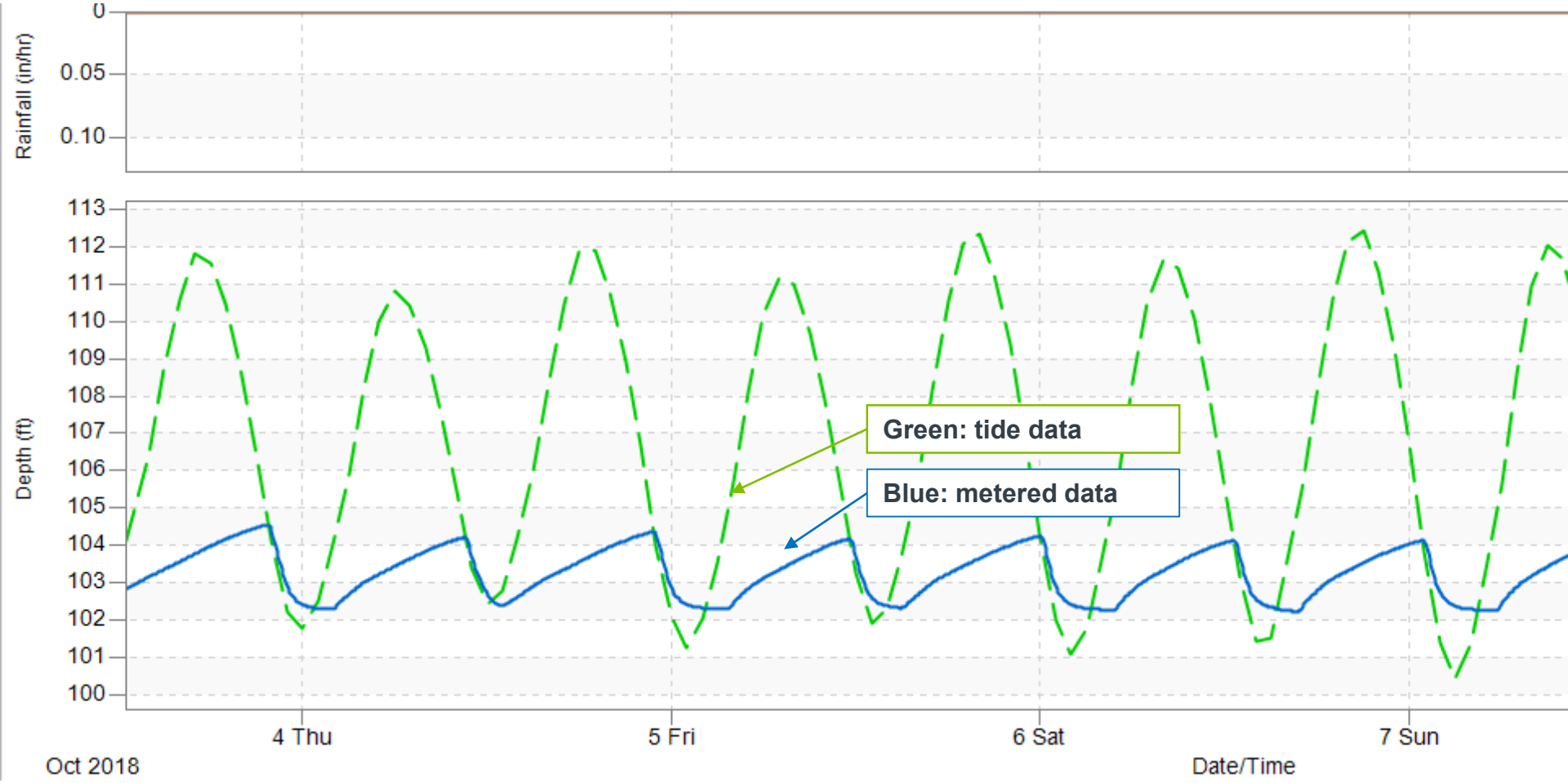

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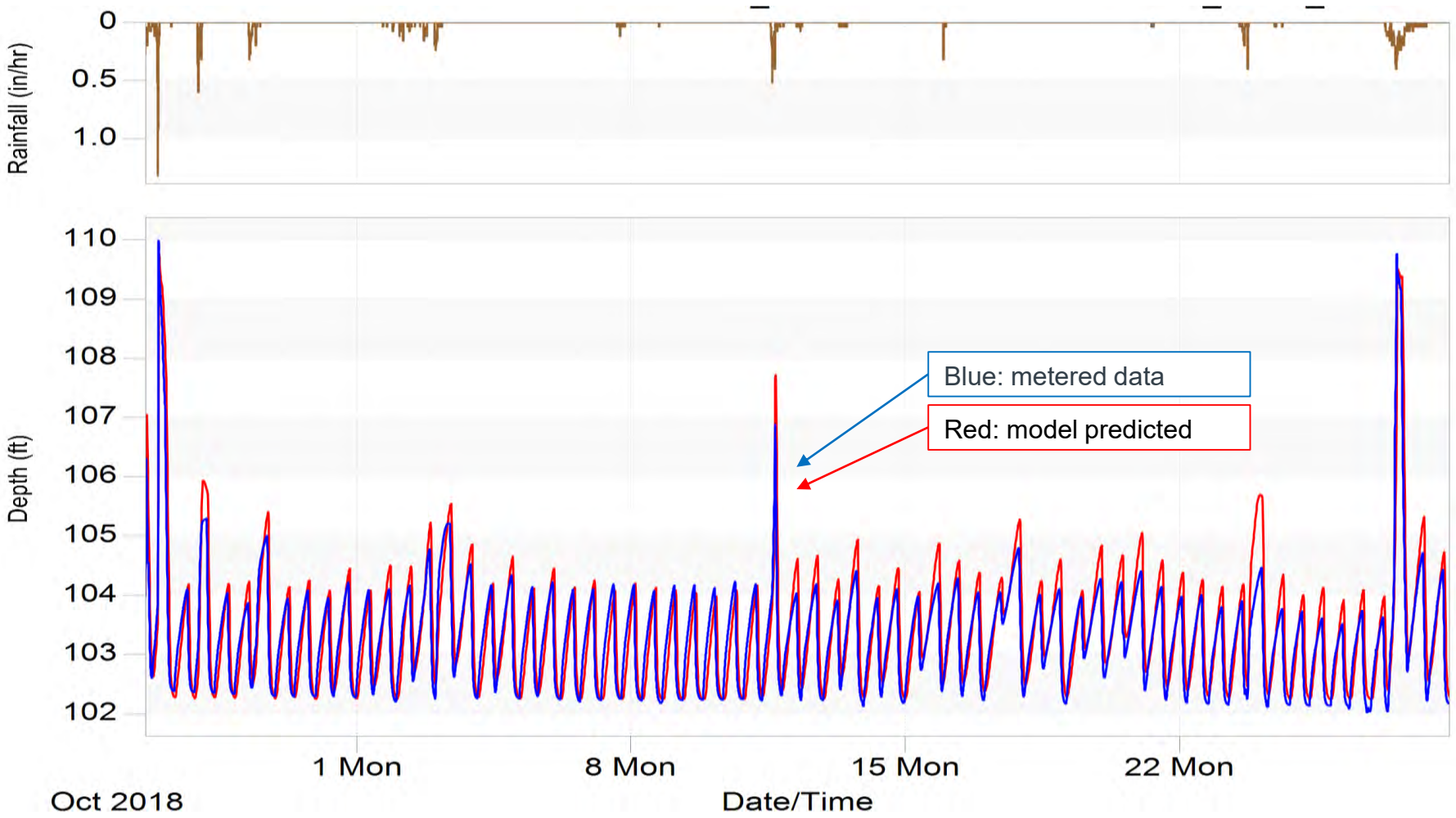
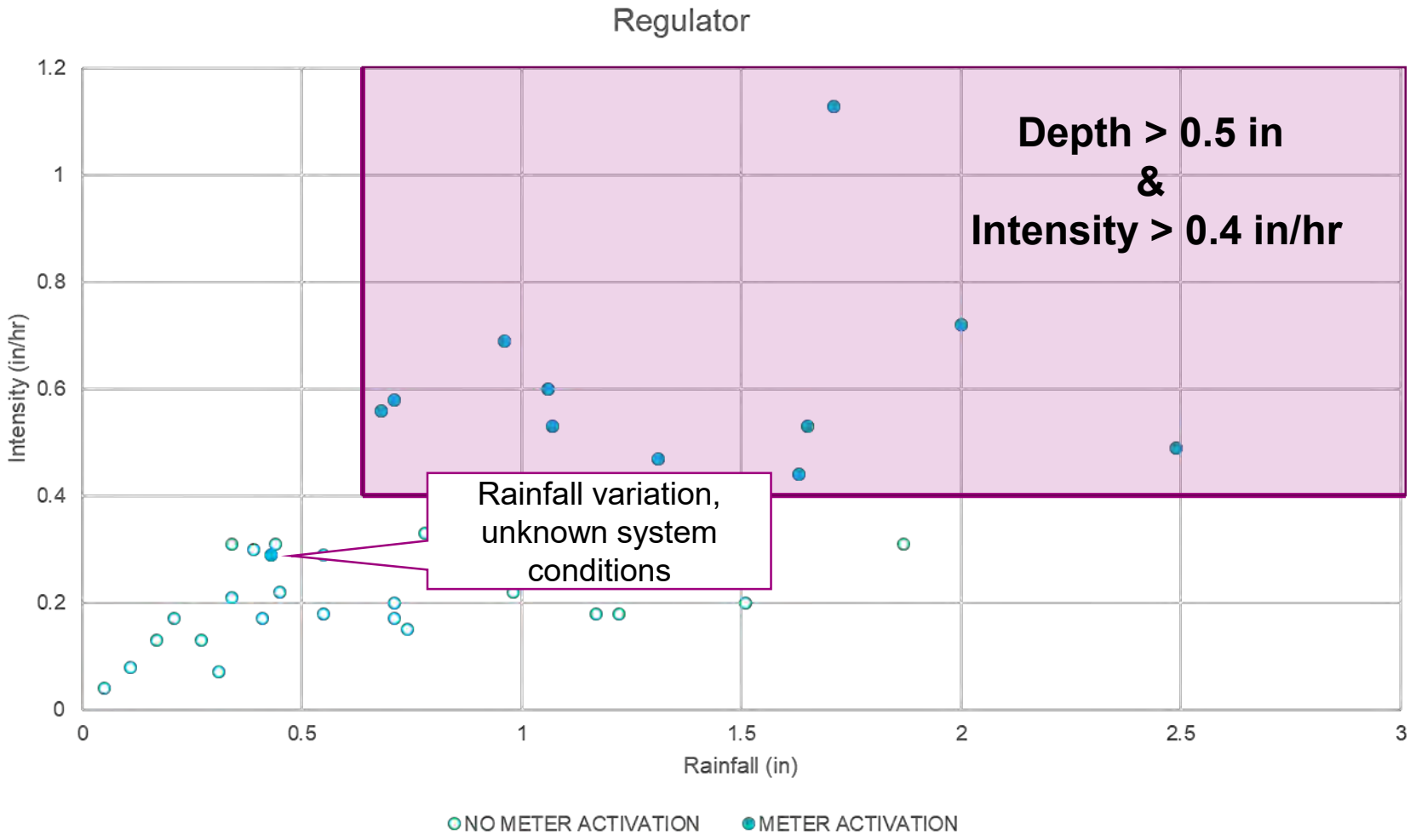


Data Trends & Anomalies: Overflow Scattergraphs



As more data are collected, the rainfall depth and intensity to cause a CSO overflow can be more accurately approximated

Collection → **Review** → Effectively Use

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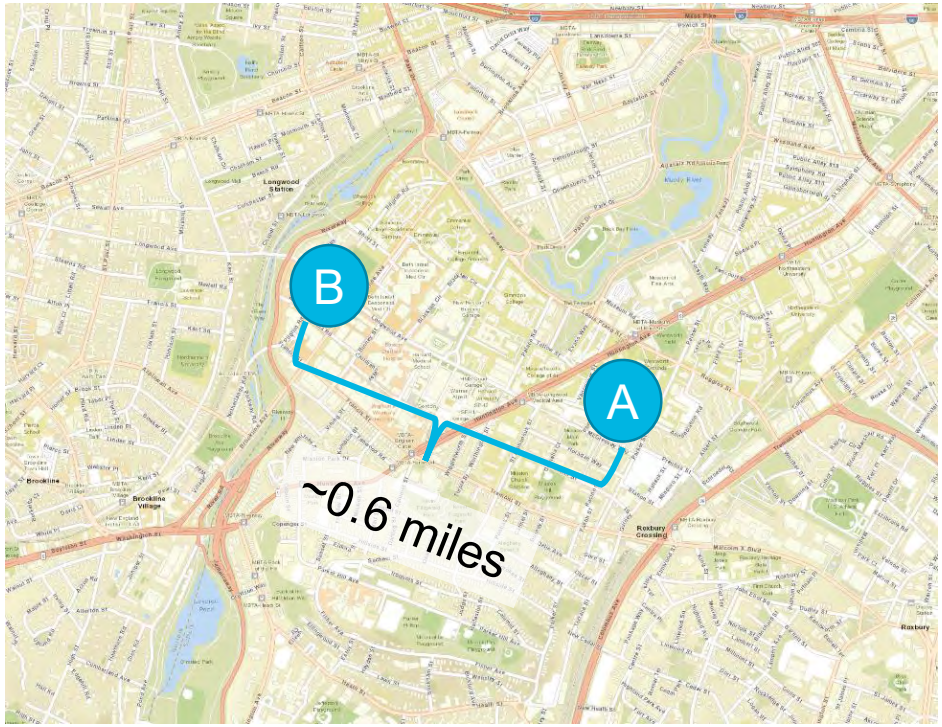
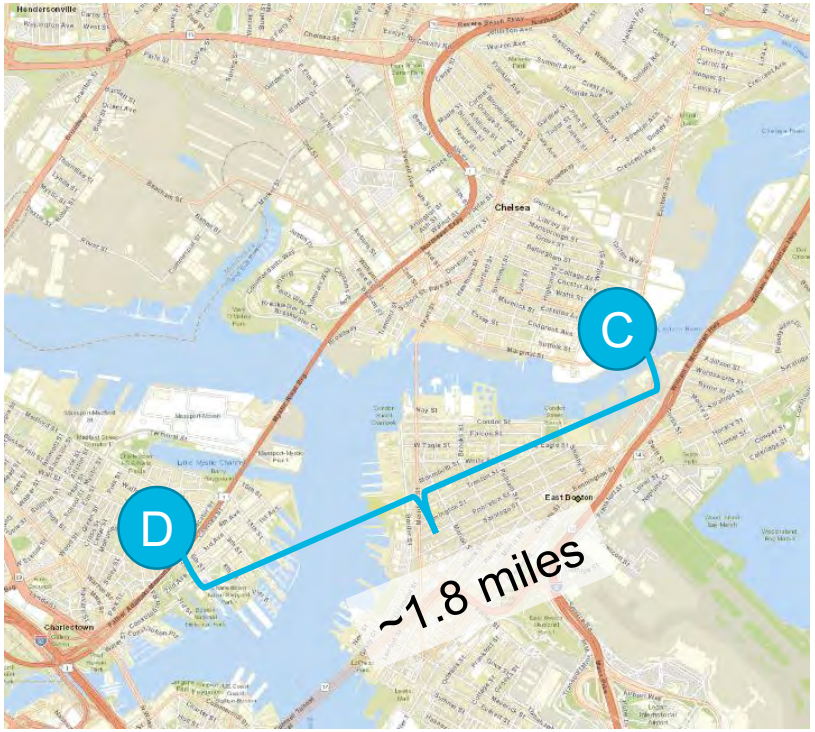
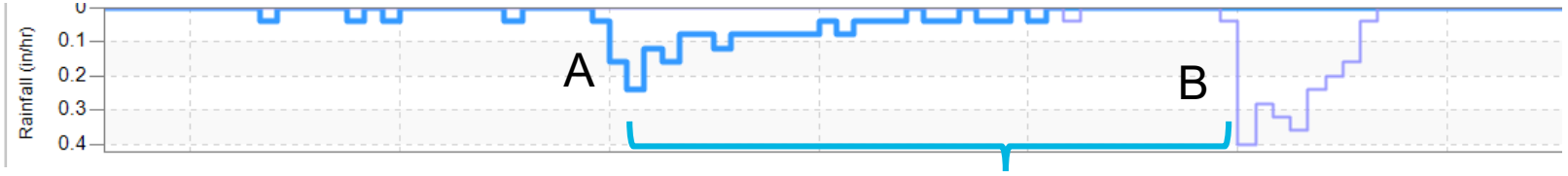
Data Trends & Anomalies: Temperature Impacts on Rainfall

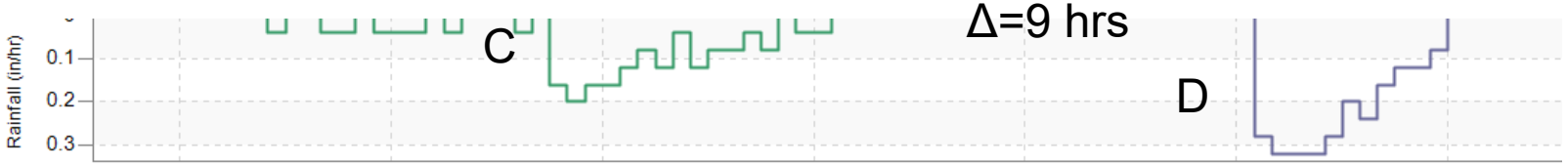




Rain Gauges
A=blue
B=purple



Rain Gauges
C= green
D= black



Collection → **Review** → Effectively Use

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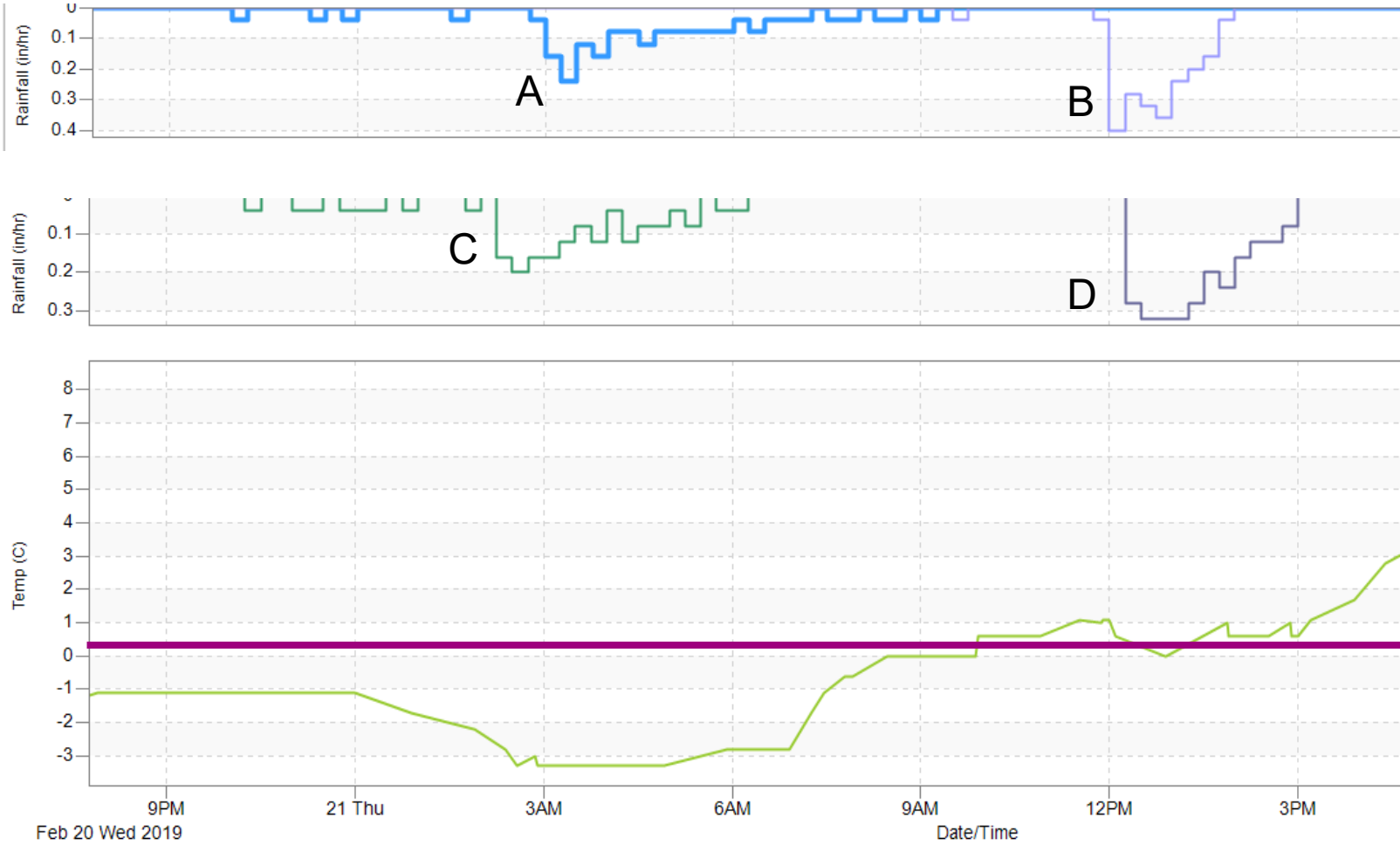
Data Trends & Anomalies: Temperature Impacts on Rainfall

Rain Gauges
A=blue
B=purple

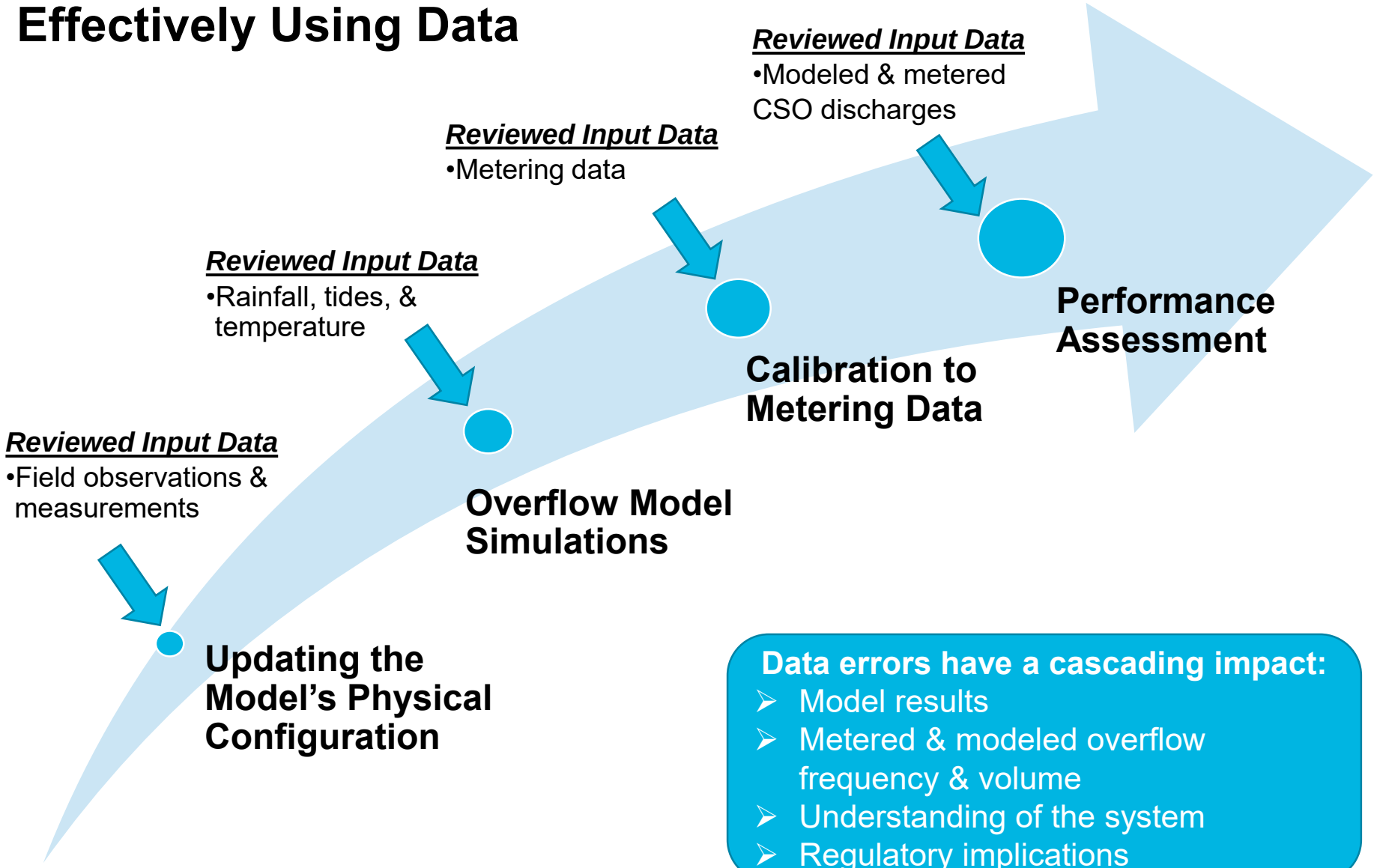
Rain Gauges
C= green
D= black

Temperature (^{0}C)



- Significant time difference in response between gauges A/C and B/D
- Higher intensity response seen by B/D once temperature was above freezing
- Investigation found that A & C were heated gauges, while B & D were not

Effectively Using Data



Data errors have a cascading impact:

- Model results
- Metered & modeled overflow frequency & volume
- Understanding of the system
- Regulatory implications

Collection → Review → Effectively Use

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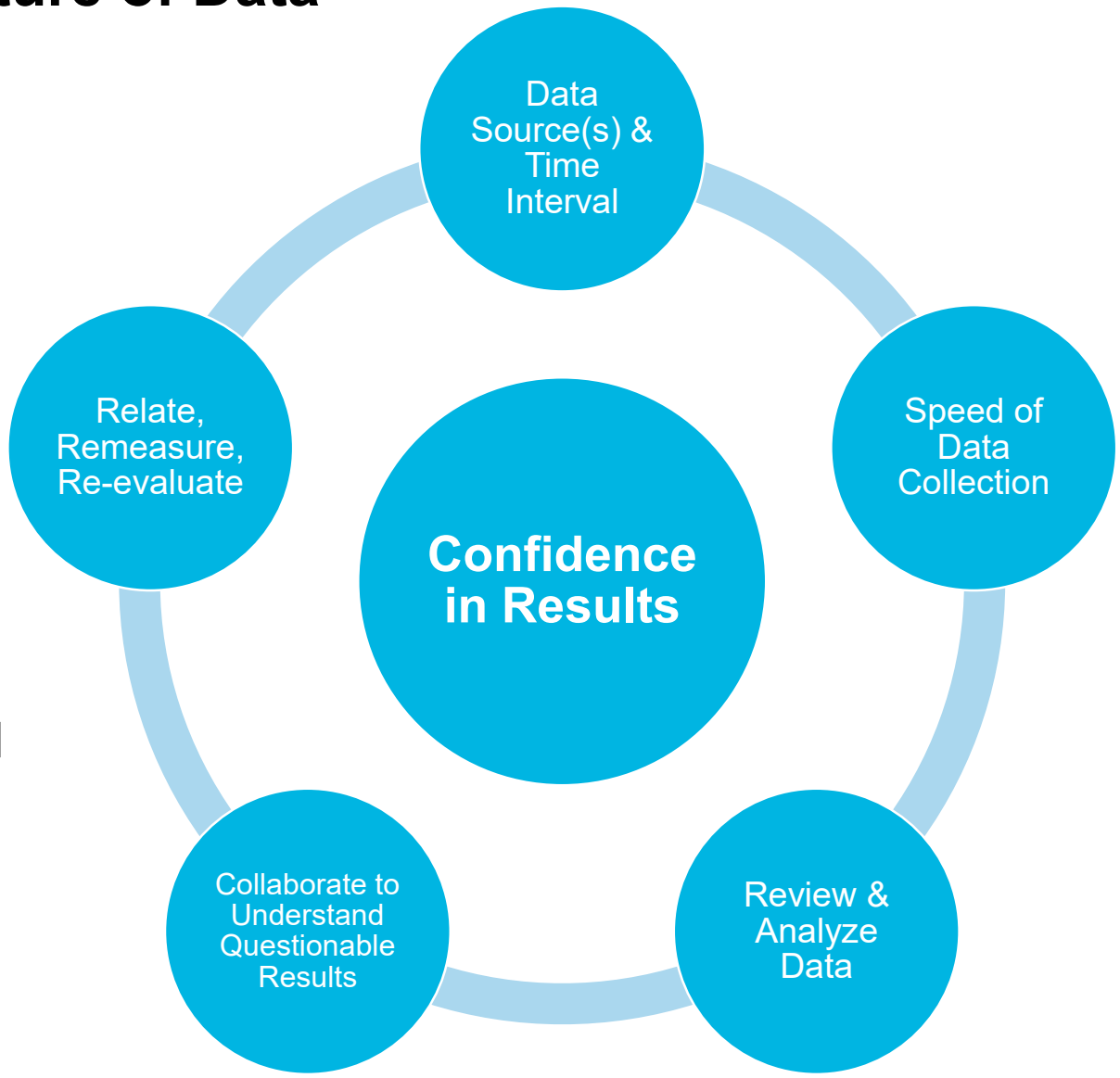
Conclusion: Impacts on Post Construction Monitoring Program

- Confidence in data leads to confidence in the model and understanding of the system

- How the data are understood and used provides a more accurate performance assessment

Conclusion: The Future of Data

- Speed and volume of data collection is increasing
- More data require additional effort to evaluate
- Data always need to be reviewed, analyzed, and validated before use



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