Massachusetts Water Resources Authority

CSO Post-Construction Monitoring and Performance Assessment

Public Briefing
May 28, 2020

WebEX Recorded

Presenters

MWRA Presenters

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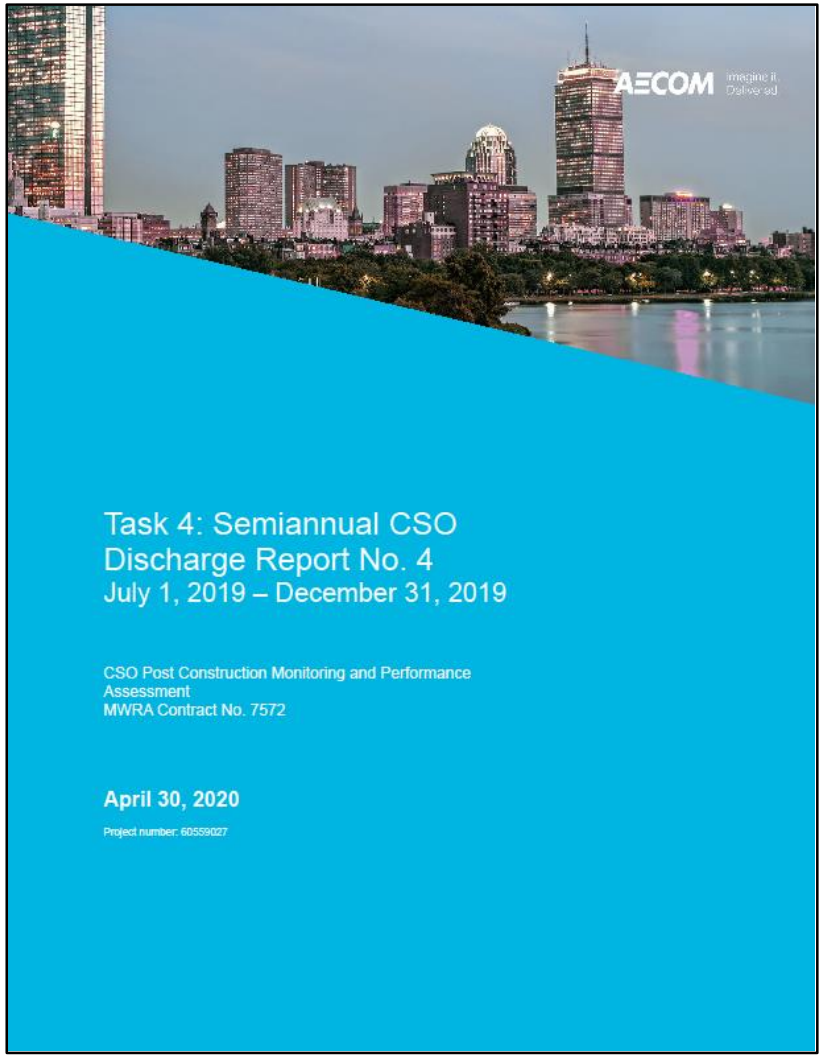
CSO Performance Assessment Goals

- Verify whether the Long-Term Control Plan goals are attained
    - Closed CSO outfalls
    - South Boston beaches: 25-year storm
    - Typical Year activation frequency and discharge volume goals at remaining active outfalls
- Verify compliance with WQS; assess the water quality impacts of remaining CSO discharges to CSO variance waters
- Issue a final report in December 2021 in compliance with Schedule Seven
    - CSO Performance Assessment
        - Water Quality Assessment

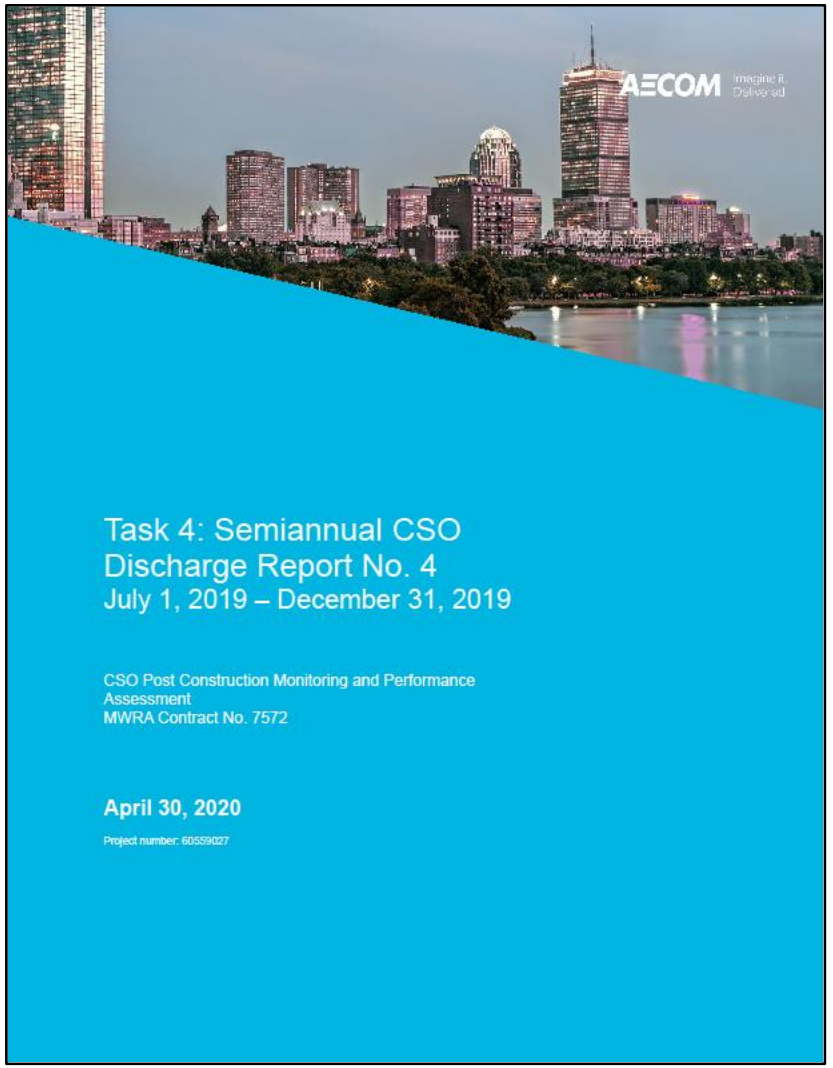
CSO Performance Assessment Progress to Date

- Commenced assessment: Nov 2017
- Completed CSO regulator inspections: Winter/Spring 2018
- Commenced collection of rainfall and CSO meter data: Apr 2018
- Completed Hydraulic Model updates and recalibration: Jan 2020



CSO Performance Assessment Progress to Date (cont.)

- Modeled current (2019) Typical Year Performance and compared to LTCP goals: Feb 2020
- Conducting site-specific overflow activity investigations: Ongoing
- Developing receiving water models of Lower Charles River and Alewife Brook/Upper Mystic River and perform water quality sampling: Ongoing



CSO Performance Assessment Remaining Work

- Continue to collect and analyze rainfall and CSO meter data

  (permanent CSO meters, temporary CSO meters, interceptor and facility meters, and community meters)

- Continue to quantify and compare CSO discharges from meter data and model predictions

- Continue to verify modeled system conditions, model predictions and Typical Year performance

- Continue site-specific overflow activity investigations; implement adjustments that help meet LTCP goals

CSO Performance Assessment Remaining Work (cont.)

- Complete the development and calibration of receiving water models for Lower Charles River and Alewife Brook/Upper Mystic River: Dec 2020
- Complete water quality assessments: Sep 2021
- Issue final reports: Dec 2021

MWRA Hydraulic Model and Typical Year Performance

The hydraulic model has been used in CSO planning since 1992 to evaluate CSO control alternatives, set LTCP performance objectives, and track system performance.

- Conversion from SWMM to InfoWorks in 2003
- Annual updates and model verification
- Major, system-wide recalibration in 2019
- The updated and recalibrated model has been used to compare the existing system's Typical Year CSO performance with the LTCP Typical Year goals.

Hydraulic Model Updates and Recalibration

Model updates to 2018 system conditions

- Confirmed or updated modeled system conditions from inspections in 2018
- Coordinated with CSO communities: community models, meter data, site-specific investigations

2018 model calibration and verification

- Adjusted model parameters to calibrate against meter data collected Apr-Sep 2018
- Verified calibrated model predictions against meter data collected Oct-Dec 2018

Model updates to 2019 system conditions

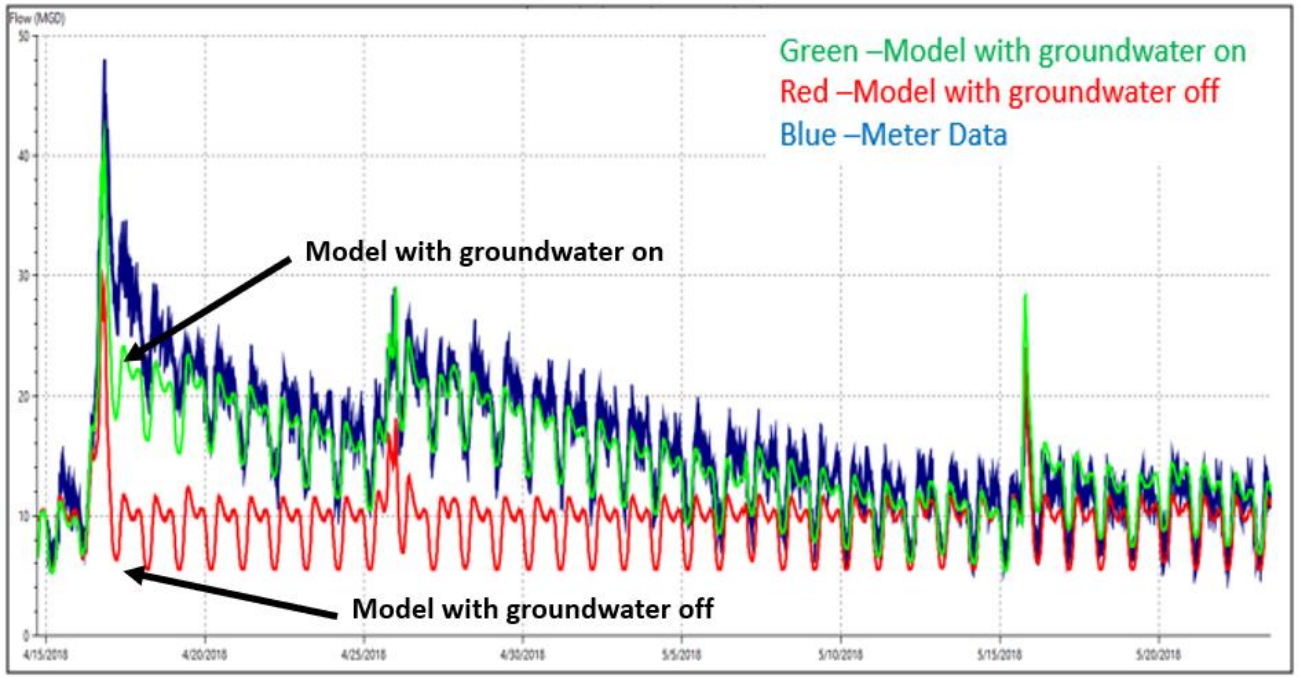
- Adjusted model to reflect system changes in 2019: outfalls CAM002 and SOM01A

2019 model verification

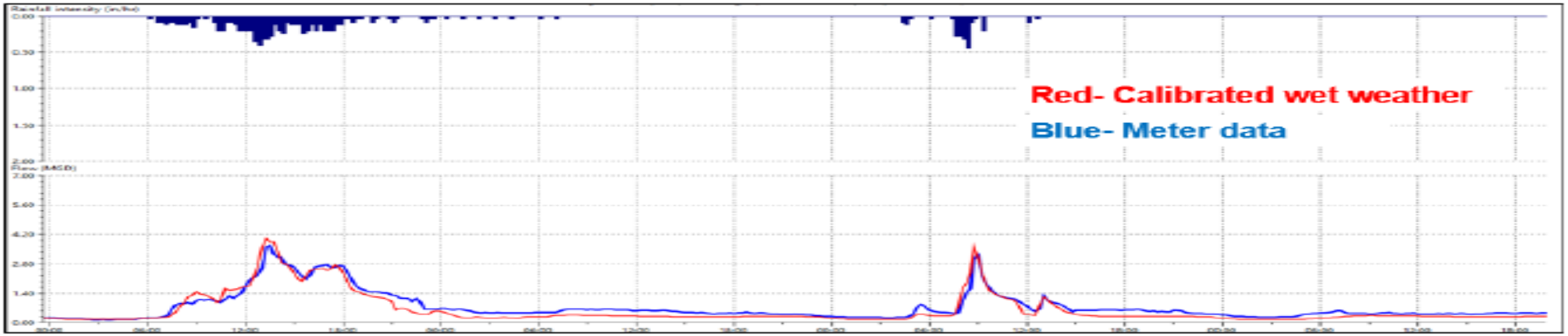
- Verified model predictions against meter data collected in 2019

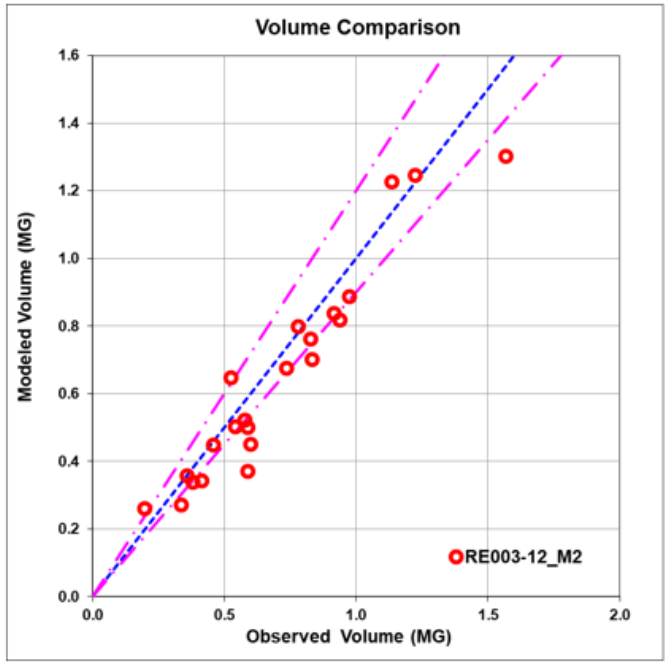
Calibration Adjustments

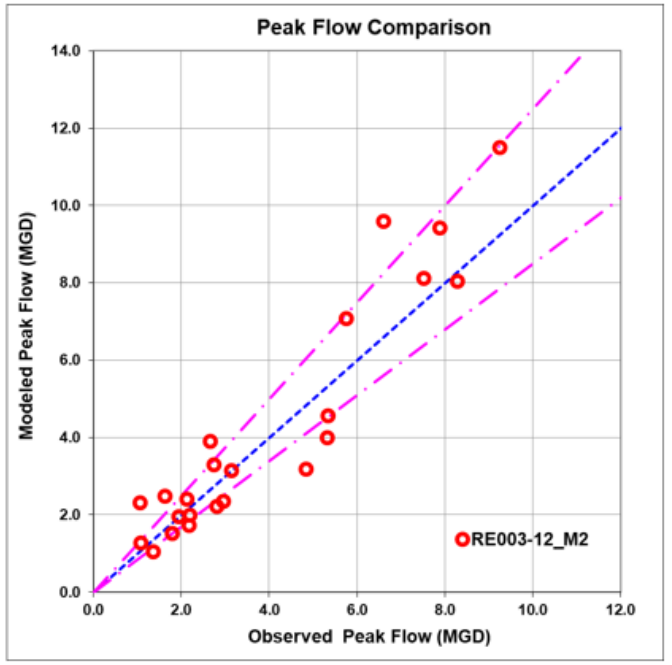
- Hydrologic Parameters (flow quantity)
  - Subcatchment width increases
  - Percent impervious increases
  - Groundwater additions
- Hydraulic Parameters (flow control)
  - Overflow elevation decreases
  - Dry weather connection size decreases
  - Head loss increases at connections



Verifying Hydraulic Model Calibration







Factors Affecting Model Calibration and Model Predictions

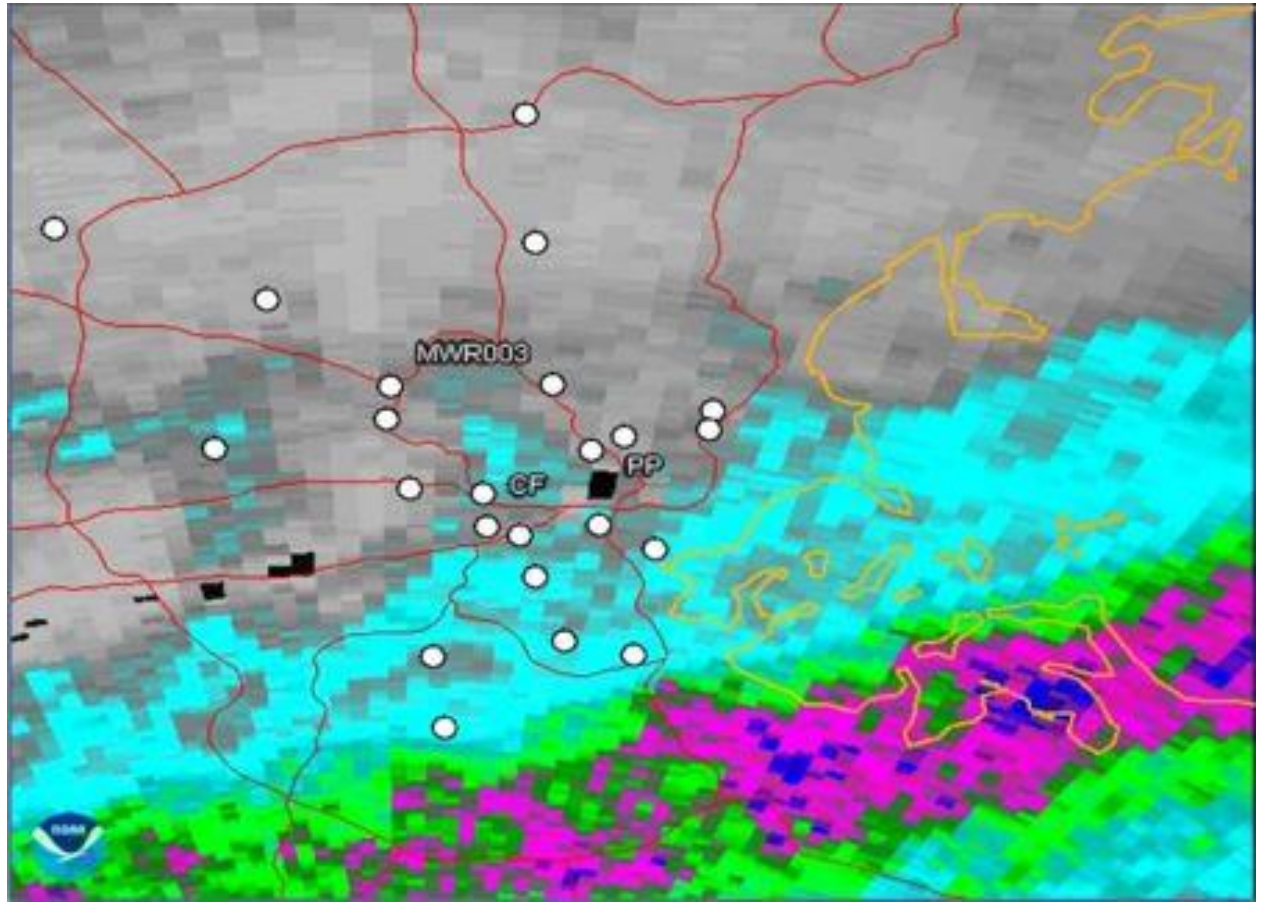
Factors affecting model calibration and ability to predict CSO discharges:

- rainfall inputs/spatial variation, meter data accuracy, approximations of system conditions (e.g., sediment), and hydraulic parameters (e.g. head loss coefficients)

Hydraulic model limitations:

- Complex hydraulic conditions
- Predictions during small activations not as good as large storm events

Every storm is different!



Rainfall spatial variability 9/28/18

Assessment of Calibrated Model Performance

For rainfall in the period April 15, 2018 through December 31, 2019:

- 98% of the events for which the model predicted no overflow were confirmed by the measurements. Only 2% of the times when the model predicted no overflow did the measurements indicate that an overflow occurred.

- For small events (less than 0.1 MG discharge), 68% of the activations predicted by the model were confirmed by measurements. For medium and large events, the percent agreement was larger, up to 91% for large events.

- In general, the model slightly over-predicted activation frequency: The frequency at which the model did not predict a measured activation (2%) was much smaller than the frequency at which the model predicted an activation that did not occur (28%).

The model reasonably estimates the total activations and volumes measured at the CSO regulators, thereby providing a level of confidence that the model can be used to represent system performance, particularly over an extended period.

Model Use Through the Performance Assessment

The calibrated hydraulic model will be used for:

- Comparisons of CSO discharge predictions with measured discharges
- Evaluation of potential system and operational adjustments
- Evaluation of the system's Typical Year performance and comparison with LTCP goals
- CSO inputs to the receiving water models

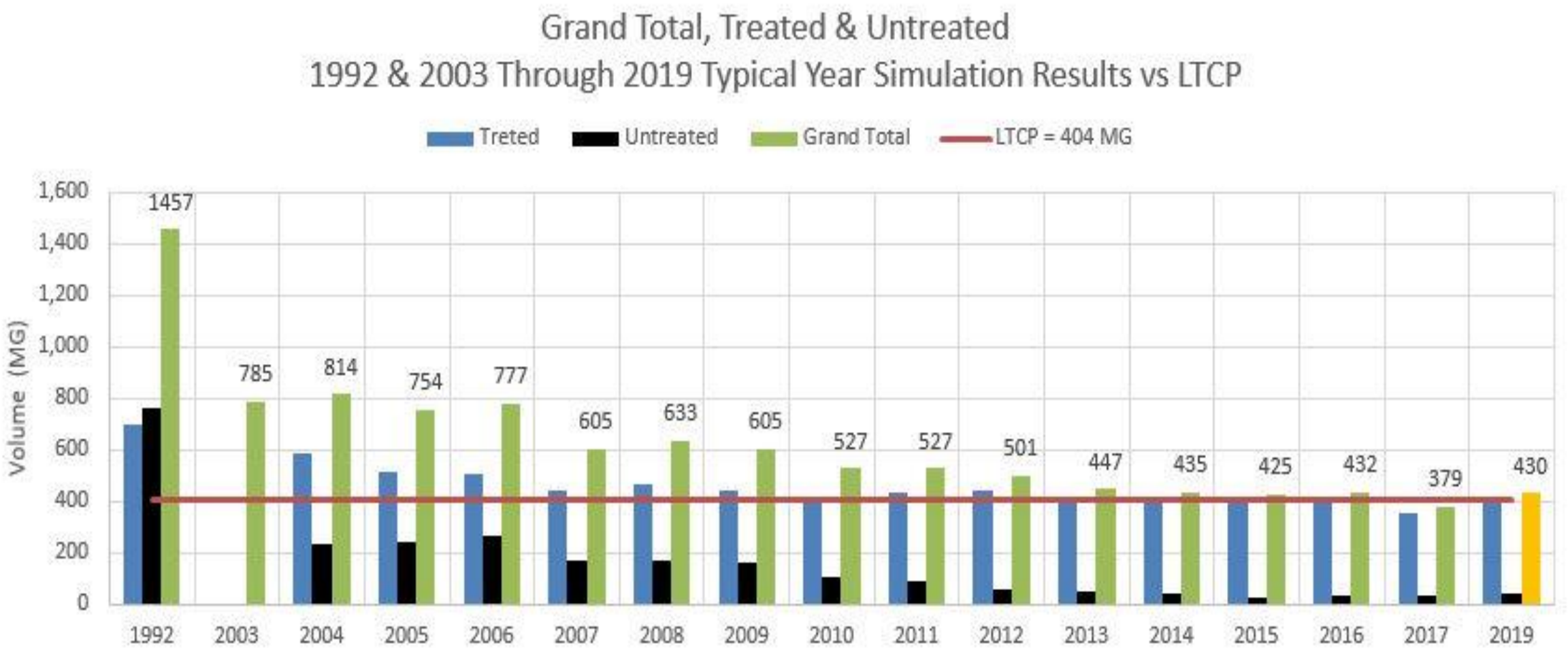
Verifying Attainment of LTCP Goals

- CSO discharges are eliminated or "effectively eliminated" at 40 of the original 84 outfalls.

CHE002 Overflow Sealed in 2014

- South Boston Tunnel provides 25 year storm level of CSO control (and 5-year capture of separate stormwater) along the beaches.

Tracking Attainment of LTCP Goals – Typical Year Performance



Transport/Treatment Upgrades
CSO Optimization

S. Dorchester Bay & Stony Brook Sewer Separation

South Boston Tunnel Tunnel & East Boston Relief

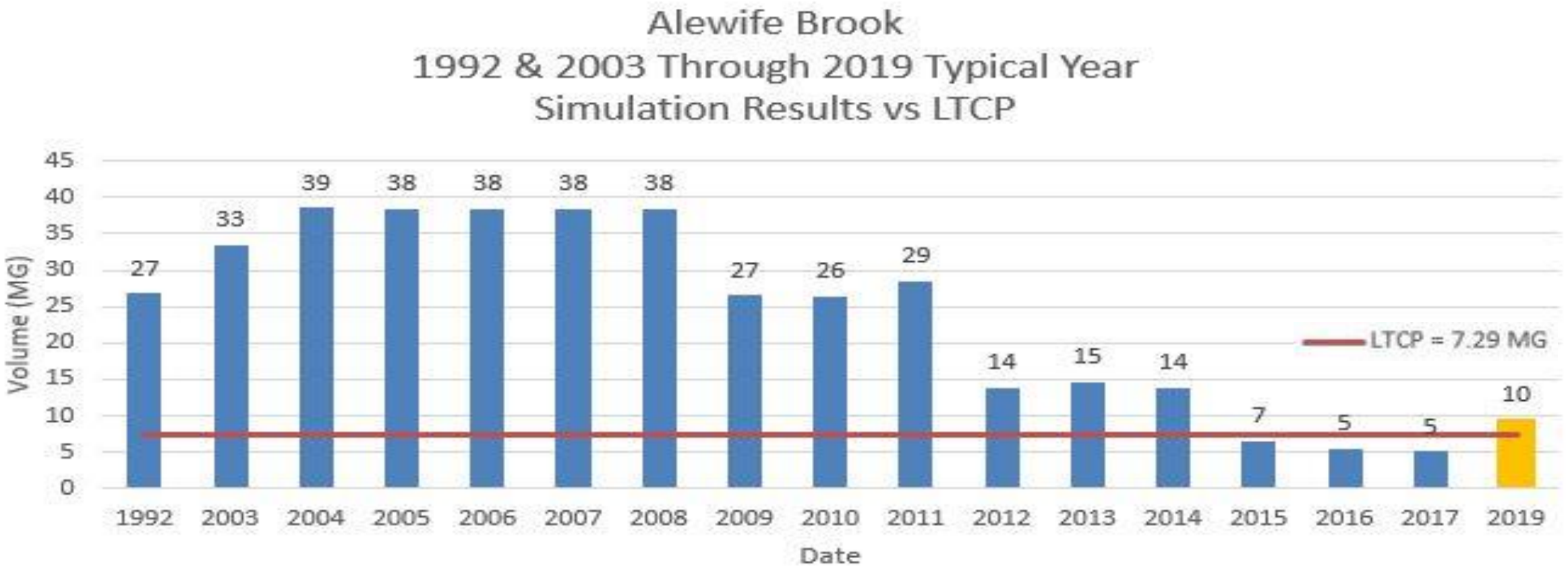
Reserved Channel & CAM004 Sewer Separation

Model Recalibration

Tracking Attainment of LTCP Goals – Typical Year Performance

Outfall	1992 SYSTEM CONDITIONS[1]		2019 SYSTEM CONDITIONS (Before Model Calibration)		2019 SYSTEM CONDITIONS (After Model Calibration)		LONG TERM CONTROL PLAN[2]	
	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
ALEWIFE BROOK								
CAM001	5	0.15	1	0.03	1	0.02	5	0.19
CAM002	11	2.73	0	0.00	0	0.00	4	0.69
MWR003	6	0.67	4	0.79	3[3]	1.60[3]	5	0.98
CAM004	20	8.19	Closed	N/A	Closed	N/A	Closed	N/A
CAM400	13	0.93	Closed	N/A	Closed	N/A	Closed	N/A
CAM401A	18	2.12	2	0.49	10	3.59	5	1.61
CAM401B			5	0.58	5	0.73	7	2.15
SOM001A	10	11.93	4	2.38	6	3.60	3	1.67
SOM001	0	0.00	Closed	N/A	Closed	N/A	Closed	N/A
SOM002	0	0.00	Closed	N/A	Closed	N/A	N/I[4]	N/I[4]
SOM002A	0	0.00	Closed	N/A	Closed	N/A	Closed	N/A
SOM003	0	0.00	Closed	N/A	Closed	N/A	Closed	N/A
SOM004	5	0.09	Closed	N/A	Closed	N/A	Closed	N/A
TOTAL		**26.81**		**4.27**		**9.54**		**7.29**

Tracking Attainment of LTCP Goals – Typical Year Performance



Extensive field inspections and Alewife project reassessment

Interim P.S. improvements

Sub-system model updates and recalibration

CAM004 Sewer Separation and Alewife Wetland

Model recalibration

Site-Specific Investigations

Investigations into higher CSO activity and potential mitigation measures:

East Boston Outfalls

- Impact of nozzle restrictions
- BWSC sewer separation projects

Somerville-Marginal CSO Facility Outfalls MWR205 and SOM007A/MWR205A)

- Upstream stormwater flows (e.g. GLX impacts)
- Stop plank assessment and tide gate repairs
- CSO Variance required evaluations

Cottage Farm CSO Facility (Outfall MWR201)

- Cambridge partial sewer separation

Outfall BOS070 (Fort Point Channel) Regulators

- BWSC South Boston Interceptor sediment removal contract

CSO Variances and Court Milestone Extension

June 4, 2019: MWRA filed a motion with the Court seeking a one-year extension of the final milestone. Motion was assented to by all parties and ultimately granted by the Court.

July 19, 2019: MWRA, MA OAG, and DOJ appeared before the Court and submitted an agreement related to the one-year extension.
The agreement stipulated:

- AECOM's Receiving Water Model Workplan
- Issuance of 5-year WQS variances by MassDEP

CSO Variance Conditions

Condition	Schedule
Receiving Water Quality Monitoring	- Report by July 15 each year
CSO Performance Assessment	- Semiannual progress reports - Public meetings May 2020, May 2021 and Feb 2022
Assessment of CSO WQ Impacts	
- Implement Receiving Water Model Workplan	
- Submit Final CSO WQ Impact Report	- Submit Final Report by Dec 31, 2021
Notification to Public of CSO Discharges and Impacts	
- Outfall and Public Access Signs	
- Joint Press Releases	- Issue by Apr 15 each year
- CSO Subscriber-Based Notification System	- Implement by Dec 31, 2020
Other Actions to Minimize CSO Discharges	
- Nine Minimum Controls	- Continuous
- Additional System Optimization Measures	[See next slide]
- I/I Technical Assist. and Green Infrastructure	- Continuous
Updating CSO Control Planning	- Scope and schedule by Apr 1, 2022 - Final Recommended Plan by Dec 31, 2023.

CSO Variance Required Project Evaluations

- Alewife Brook P.S. Optimization
- CSO Optimization: CSO regulators tributary to Charles River and Alewife Brook/Upper Mystic River
- Somerville-Marginal CSO Facility

Public Notification of CSO Discharges

- Charles and Alewife/Mystic Variances require rapid notification about CSOs in Variance waters
  - MWRA will expand existing web site
    - http://www.mwra.com/harbor/html/cso_reporting.htm
    - currently includes MWRA CSO facility activations
    - will add untreated MWRA CSOs
- Subscriber based alerts - Not "live" yet - plan to start this summer
  - Links to Cambridge and Somerville web sites
  - Chelsea sends out email notifications (permit requirement)
  - Boston is separately working on a system for notifications about their CSOs

Receiving Water Model and Water Quality Assessments

Lower Charles River and Alewife Brook/Upper Mystic River

Consultant Services (Receiving Water Modeling)

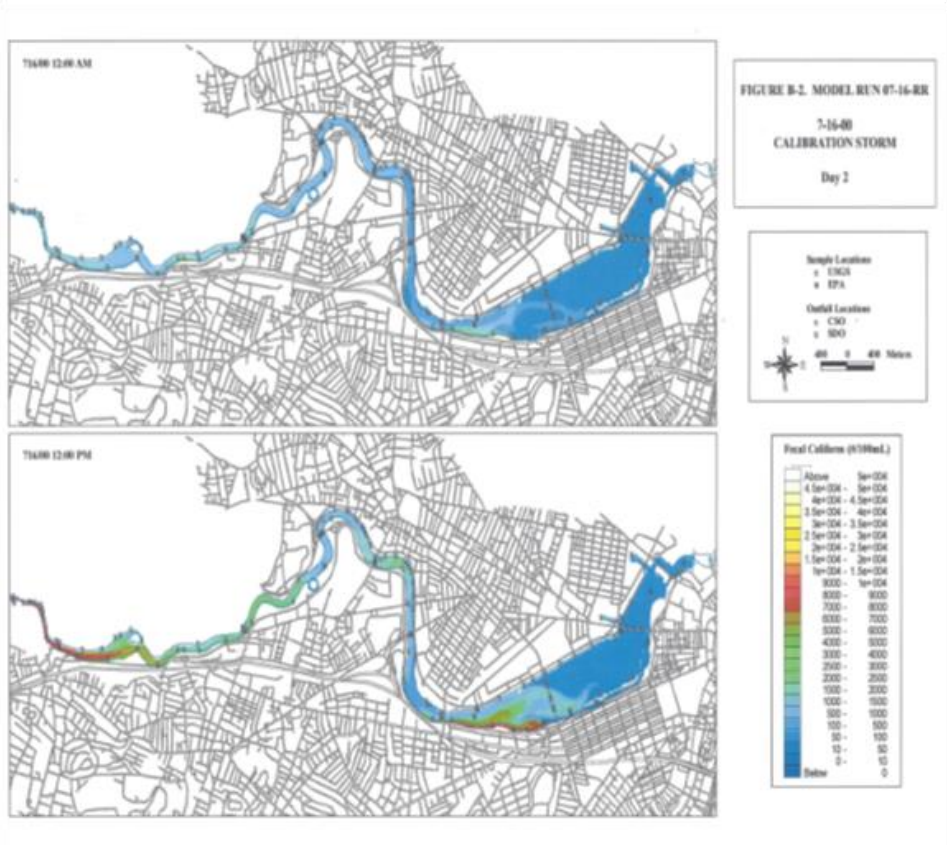
- Update and calibrate receiving water quality models
- Assess updated water quality conditions, including remaining CSO impacts
- Run model simulations of CSO control scenarios

MWRA In-House Activities (WQ Data Collection)

- Continue in-stream sampling, with emphasis in Charles and Alewife/Upper Mystic
- Conduct updated CSO and stormwater sampling
- Coordinate data collection with communities

Receiving Water Modeling

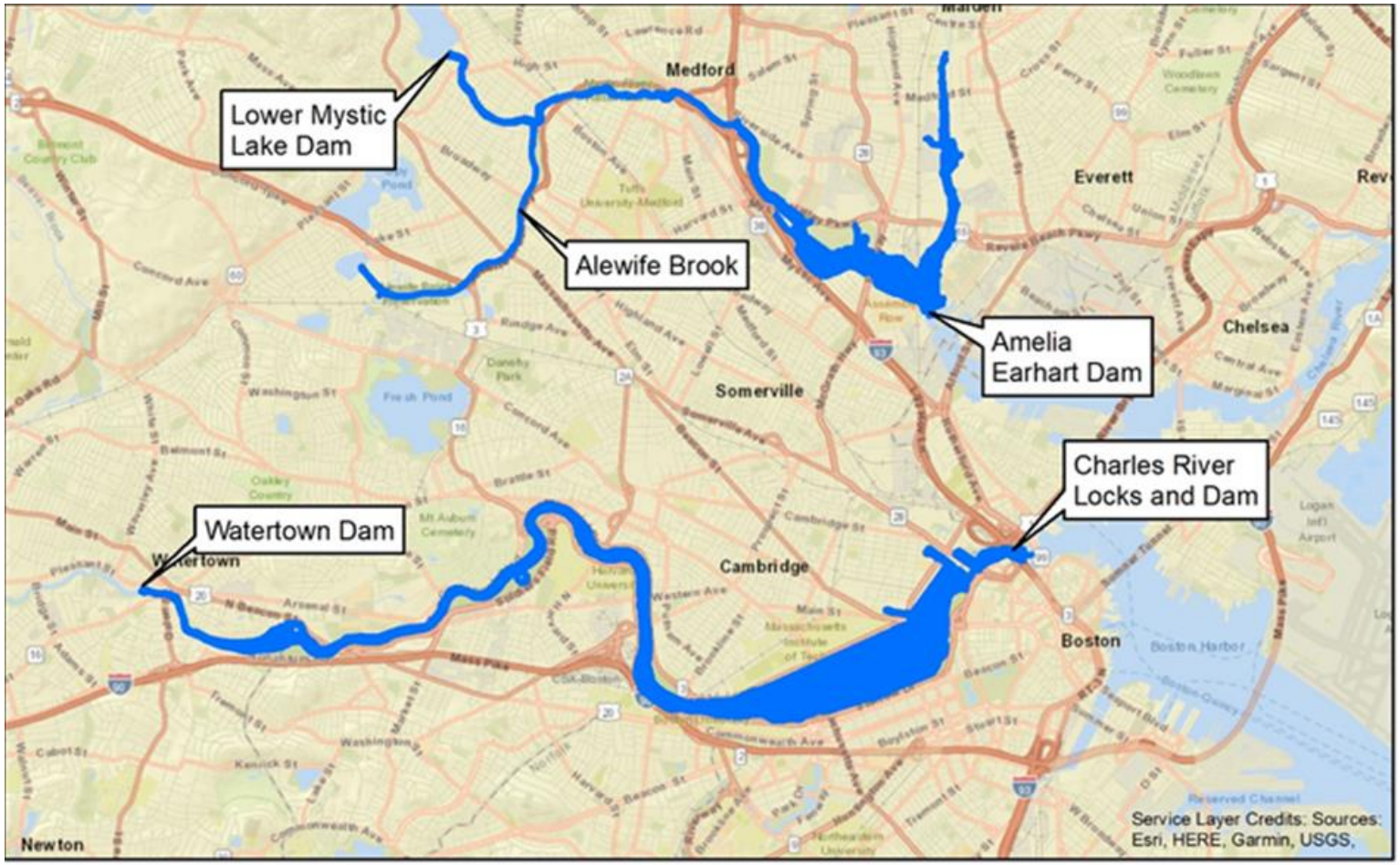
- Update prior models to more current platforms
- Update with current information on stormwater and CSO sources and loads.
- Calibrate with current in-stream WQ data (a calibration report will be provided)
- Perform model simulations
- Provide WQ Assessment Report (Sep 2021)
- The model will allow for the assessment of remaining CSO (vs non-CSO) impacts on water quality in the variance areas.



Receiving Water Models and Data Sources

Charles River – 2 dimensional model, Deltares Delft 3D

Alewife/Mystic – 1 dimensional model, InfoWorks ICM



Receiving Water Model Inputs

Parameter	Charles River[1]	Alewife Brook/Upper Mystic[1]
Bathymetry	MIT surveys (2015-17)	FEMA measurements (2003)
Upstream boundary flow	Waltham USGS gauge	InfoWorks ICM Mystic River Basin Model
Upstream boundary water quality	Calibrated buildup/washoff model	MWRA monitoring (2019-20)
CSO flows	MWRA calibrated hydraulic system model (2019)	
CSO quality	Cottage Farm and Prison Point CSO Facility influent monitoring (2017-20)	MWRA monitoring (2019-20)
Stormwater flows	• BWSC Drain Model • USGS Charles River Stormwater Model • Cambridge Stormwater Model	InfoWorks ICM Mystic River Basin Model
Stormwater quality	• BWSC Stormwater Model (2012-16) • USGS monitoring data (1999-2000) • BWSC monitoring (2020-21) • Cambridge monitoring (2019-20)	• MWRA monitoring (2019-20) • Cambridge monitoring (2019-20) • Somerville monitoring (2020)

Receiving Water Sampling

- Receiving Water Quality Program in the Variance areas:
  - First implemented in 1989
  - Bacteria, 17 locations in Charles, 16 locations Alewife/Mystic.
  - Schedule has varied over time, minimum 20 sample events per year

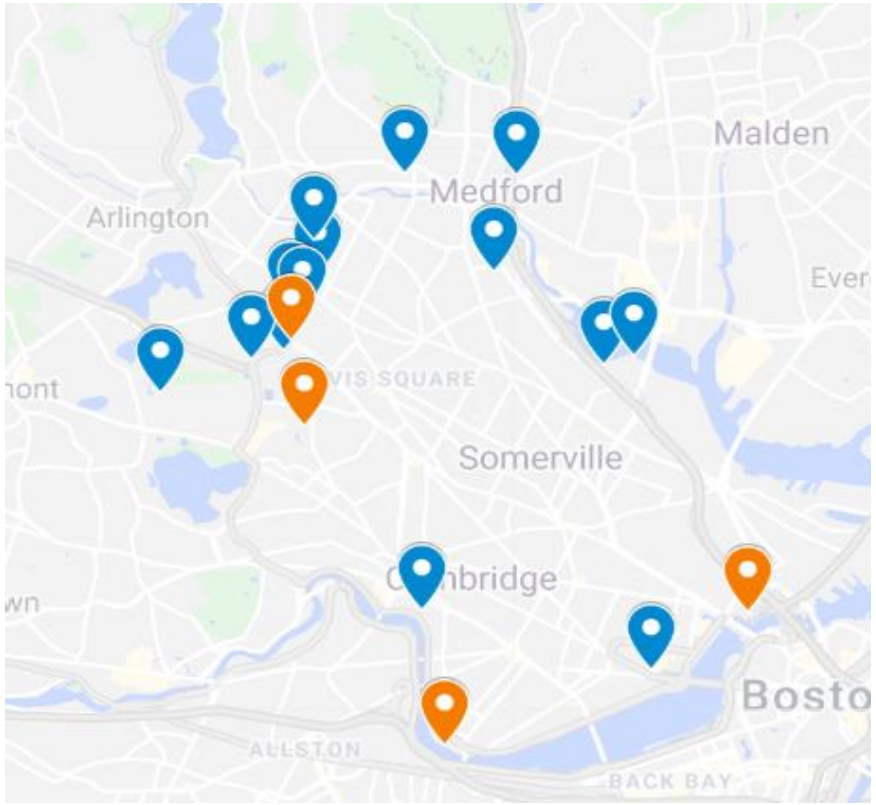
- During 2017-2019 – conducted sampling for 5 consecutive days following storm events:
  - Total of 45 storm based sampling events

Storm Based Sampling – 2018 and 2019

Charles River	Alewife Brook/Upper Mystic River
2018: 8 storms, ~ 1,200 bacteria samples tested	**8 storms, ~ 1,200 bacteria samples tested**
➢ 4 storms with Cottage Farm activations	➢ 7 storms with CSO activations in Alewife
➢ 1 storm with other CSO activations	➢ 1 storm with no CSO
➢ 3 storms with no CSO	
2019: 7 storms, over 1,200 bacteria samples tested	**2019: 8 storms, nearly 1,300 bacteria samples tested**
➢ 4 storms with Cottage Farm activations	➢ 6 storms with CSO discharges
➢ 3 storms with other CSO activations (from model)	➢ 2 storms with no CSO
➢ 0 storms with no CSO	

Stormwater and CSO Sampling Plan

- MWRA, Cambridge and Somerville will collect stormwater samples to provide updated estimates of stormwater quality inputs to the model:
  - MWRA collecting SW samples from 3 sites in Medford and 2 sites in Arlington
  - Cambridge collecting SW samples from 2 sites on Alewife, 2 on Charles.
  - Somerville will collect SW samples from 5 sites.
  - Summer 2019-Summer 2020



- MWRA is also collecting samples of untreated CSO:
  - Two locations in Alewife Brook
  - Influent samples from 2 CSO treatment facilities in Charles have been collected since 2017

Receiving Water Modeling Schedule

- Kick-off meeting: August 2019
- Model Development and Calibration: October 2020
- Water Quality Assessment Report: September 2021

Water Quality Assessment Approaches

- Calibrated model can be applied to current conditions
  - Design storms
  - Entire typical year
- Separate out effects of CSOs, stormwater, boundary conditions
  - Where loads are uncertain, estimate range of potential impacts
- Visual presentation of results
  - Alewife - bacteria counts vs distance at various times during/after storm
  - Charles - contour plots of bacteria at various times
- Tabulate duration of exceedance of bacterial water quality standards
  - Due to different sources
  - Under different weather conditions

Summary: CSO Control Accomplishments and Remaining Work

- 183 of 184 Federal Court milestones achieved
- 35 LTCP projects completed 1996-2015
- 87% CSO volume reduction since 1988; 40 of 84 outfalls closed

- Prior to model recalibration, predictions were closer to LTCP goals
- Continuing efforts towards LTCP goals
- Evaluate WQ impacts of remaining CSO discharges in variance waters

For More Information

- Semiannual Progress Reports
- CSO Annual Discharge Estimates and Rainfall Analyses (April 30)
- Annual Water Quality Monitoring Summary Reports (July 15)

All are posted on MWRA.com

MWRA CSO Performance Assessment