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January 31, 2023

Susannah L. King
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Todd J. Borci
Office of Environmental Stewardship
US EPA New England
5 Post Office Square Suite 100 (OES 04-4)
Boston, MA 02109-3912

Re: Charles River and Alewife Brook/Upper Mystic River CSO Variances
Annual Report on Progress of Additional CSO System Optimization Measures

Dear Ms. King and Mr. Borci:

The Massachusetts Water Resources Authority ("MWRA") is pleased to submit the attached annual report for 2022, on the progress of combined sewer overflow ("CSO") "Additional System Optimization" measures. MWRA is required to evaluate these measures in accordance with conditions established in the *Final Determination to Adopt a Variance for Combined Sewer Overflow Discharges to Charles River Basin* and the *Final Determination to Adopt a Variance for Combined Sewer Overflow Discharges to Alewife Brook/Upper Mystic River Basin*, dated August 30, 2019 ("Variances"). Specifically, subsection E.2. of the Variances require, in relevant part, as follows: "[b]eginning in 2021 and on or before January 31 of each year until the end of this Variance, MWRA shall submit to MassDEP and EPA and shall post on its website, progress reports on the implementation of the Additional System Optimization measures."

MWRA has now completed all four of the Additional System Optimization measures to be studied under the Variances, with the intent of evaluating whether implementation of these measures will improve CSO performance and water quality. A summary of these reports and further progress on the projects that have resulted from these studies are included in the attached progress report. MWRA continues to perform remaining activities as set forth in the other conditions in the Variances, including collection system maintenance, water quality sampling and reporting requirements, and public notification of CSO discharges.

Please do not hesitate to contact me, at dave.coppes@mwra.com, should you have questions or need additional information.

Very truly yours,

David W. Coppes, P.E.
Chief Operating Officer

cc: Frederick Laskey, Executive Director
Carolyn Fiore, Deputy Chief Operating Officer
Rebecca Weidman, Director, Environmental and Regulatory Affairs
John Colbert, P.E., Chief Engineer
Betsy Reilley, Director, Environmental Quality
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MWRA CSO Variances
Additional System Optimization Measures

Progress Report as of January 31, 2023

MWR205 & SOM007/MWR205A Somerville Marginal CSO Reduction Project, Study and Preliminary Design

Variance Milestones: Notice to Proceed December 2020 | Report December 2021

Summary Description:
Evaluate alternatives and feasibility of reducing CSO activation frequency and volume at the Somerville Marginal CSO Treatment Facility and associated CSO outfalls SOM007A/MWR205A, and MWR205, including:

- Construction of dry weather connection relief/control from the City of Somerville's CSO regulator RE071A to MWRA's Somerville-Medford Branch Sewer
- Relocation of MassDOT I-93 drainage from upstream to downstream of the Somerville-Marginal facility to reduce the frequency and volume of facility activations

Progress to Date:

As stated in last year's report, to satisfy this requirement, MWRA submitted on December 29, 2021, the Somerville-Marginal CSO Facility Evaluation report and the Somerville Marginal CSO Facility New Pipe Connection Preliminary Design Assessment report https://www.mwra.com/cso/variances/122721-somerville.pdf. A brief summary of the report's findings is provided as follows:

MWRA evaluated relocating the Ten Hills and I-93 storm drain areas downstream of the facility which modeling predicted would reduce the volume at outfall MWR205 by approximately 7 MG in a typical year, with no change to the activation frequency. This alternative also was predicted to reduce the volume at the Prison Point CSO Facility by approximately 6 MG, with no change to the activation frequency. However, these modest reductions in volume were not sufficient to bring the Somerville Marginal Facility into attainment with the LTCP goal for volume. Given flows through the Somerville Marginal CSO facility are disinfected, diverting stormwater flows around the facility would also increase the stormwater bacterial load to the receiving waters. Since other alternatives were subsequently identified that provided better performance at the Somerville Marginal Facility by maximizing system capacity, the alternative to divert the upstream stormwater directly to the Mystic River was not recommended for further evaluation.

MWRA evaluated relieving the existing 18-inch dry weather flow connection using a larger diameter pipe from the Somerville Marginal Interceptor to the MWRA's Somerville-Medford Branch Sewer. Initial modeling predicted a substantial reduction in the discharge volume at the Somerville Marginal CSO Facility. Additional consideration of other alternatives that could result in similar benefits led to a more effective and constructible approach to take advantage of available capacity in the MWRA's sewer during some storm events, which included evaluation of a new or supplemental interceptor connection and control gate. Two alternatives for this new interceptor connection were evaluated.

Option 1 consisted of adding a new connection with a control gate between the 85 x 90-inch influent line to the Somerville Marginal CSO Facility and the Somerville-Medford Branch Sewer. The control gate would limit flows to the interceptor during larger storm events, and would be controlled based on level set points monitored at three locations. Option 2 consisted of providing a connecting chamber between

an existing 42-inch storm drain tributary to the 85 x 90-inch influent combined sewer and the interceptor, with a similar control gate. Both options had similar CSO reduction benefits, including bringing the discharge volume from Somerville Marginal CSO Facility (MWR205) to within approximately 2 to 3 MG (3-5%) of the LTCP target and reducing the discharge from the high tide discharge into the Upper Mystic River (SOM007A/MRW205A) to within approximately 0.2 MG of the LTCP goal. Model predictions also indicated that the activation frequency would drop from 30 to 18 activations at MWR205, well below the LTCP target of 39 and would meet the activations goal of 3 per year at SOM007A/MWR205A. Although both options showed increases to the treated discharge volume at Prison Point, an overall reduction of CSO discharge (29 MG) was predicted from hydraulically connected CSO discharges.

MWRA retained Hazen and Sawyer to further evaluate the two options and prepare a preliminary design and cost estimate as documented in the December 29, 2021 submittal. The recommendation is to move forward with Option 2, connecting to the existing 42-inch storm drain. The preliminary design will be further refined to determine how best to make this connection to existing sewers. The construction cost associated with the recommended alternative was estimated to be approximately $1.2M.

Since submittal of our 2021 progress report, MWRA with the assistance of Hazen and Sawyer has advanced the design of the connection chamber and required modifications to the Somerville Marginal CSO facility to enable the control and powering of the new gate to the 60% design level. Although assumptions have been made based on available geotechnical information, to finalize the design, an additional boring was required in the vicinity of the new connection chamber. Given the close proximity of the geotechnical boring to the highway surrounding the proposed connection chamber, a MassDOT road occupation permit was required to continue with the geotechnical investigation. This permit was applied for on April 4, 2022, and received on November 17, 2022. The boring was completed toward the end of January 2023. The 100% design submittal is expected from Hazen and Sawyer in April 2023, followed by advertisement and bidding in early summer of 2023. The construction notice to proceed is anticipated this summer, with construction completion in summer of 2024.

Alewife Brook Pump Station Optimization Evaluation Project
Variance Milestones: Notice to Proceed April 2020 | Report: April 2021

Summary Description:
Evaluate maximizing beneficial use of enhanced pumping capacity at the recently rehabilitated Alewife Brook Pump station to lower wastewater elevations in the upstream collection system and potentially reduce CSO activations and volumes at upstream CSO outfalls discharging to Alewife Brook.

Progress to Date:
As reported in last year's report, on April 27, 2021, MWRA issued the Final Alewife Brook Pump Station Optimization Evaluation report https://www.mwra.com/cso/variances/042721-alewife.pdf. A brief summary of the report's findings is provided as follows.

An alternative ABPS operating strategy was developed based on the collection, analyses, and synthesis of ABPS record drawings, operational history and SCADA station data, field-collected data from pump performance tests, hydraulic model runs, and refined field implementation of initial proposed alternative operations strategies.

Model results suggested that an alternative operating strategy of lowering the wetwell at the start of a storm event, would result in marginal improvements to the reduction of CSO activation frequency and discharge volume for the six outfalls tributary to the Alewife Brook. A comparison of the typical year model using the final wet weather ABPS operating strategy indicated a total reduction in CSO volume of 0.25 million gallons.

Although providing only nominal improvement in CSO discharge volumes, the report recommended the final wet weather ABPS operating strategy be implemented into the station's controls, given the noted wet weather pump operation was greatly improved with no observed pump cycling as the wet well level fluctuated, as determined through field trials. A reduction in cycling provided a more stable operation and should result in reduced fatigue/wear on the pumps, which can extend the service life, reducing station maintenance cost. An additional benefit noted is a reduction in the risk of the wet weather pumps being simultaneously triggered OFF, followed by a quick rise in the wet well prior to the pumps cycling ON that could potentially impact upstream CSOs.

The new operating strategy has since been incorporated in the station controls via the MWRA SCADA system. The station now has two operating strategies: the existing operating strategy for dry weather flow conditions and the final wet weather ABPS operating strategy for storm events.

CSO System Optimization for Alewife Brook, Study and Preliminary Design
Variance Milestones: Notice to Proceed December 2020 | Report December 2022

Summary Description:
Using the calibrated hydraulic model and coordinating technical evaluations with the cities of Cambridge and Somerville, MWRA will conduct system optimization evaluations at the remaining active regulators tributary to CSO outfalls discharging to the Alewife Brook watershed.

Progress to Date:
As reported in last year's report, MWRA commenced the CSO optimization investigations for Alewife Brook CSO outfalls in August 2020, ahead of the variance's December 2020 milestone. MWRA coordinated these efforts with the departments of public works in Cambridge and Somerville. MWRA's consultant reviewed the CSO regulator configurations and modeled hydraulic performance. MWRA had initially focused efforts on outfalls that it forecasted would not attain the LTCP activation and volume goals by December 2021. Various alternatives have been evaluated and documented in Semiannual Reports 6 and 7, as well as the Final CSO Post Construction Monitoring and Performance report submitted on December 29, 2021. CAM401A was brought in line with LTCP volume and activation goals after substantial sediment removal within the hydraulically connected system leaving SOM001A as the only remaining CSO not meeting LTCP volume and activation goals discharging to Alewife Brook.

During 2022, further optimization evaluations were performed for all six CSOs (CAM001, CAM002, MWR003, SOM001A, CAM401A, and CAM401B) that can discharge to the Alewife Brook. The findings of these evaluations were submitted in the Alewife Brook and Lower Charles River System Optimization Evaluations Report on December 29, 2022, and posted to MWRA's website. https://www.mwra.com/cso/variances/122922-alewife-charles.pdf.

In summary, using the hydraulic model, overflow volumes by storm from the Typical Year were tabulated for each outfall, along with the predicted volumes from the 2-year and 5-year, 24-hour design storms. Profiles of the peak hydraulic grade line through the regulators were also developed. The model was then used to assess the impacts of incrementally raising the weirs and/or increasing the size of the dry weather flow connections at the regulators associated with these outfalls. Upstream and downstream systems were evaluated for adverse hydraulic impacts resulting from the modeled change in weir height or connection size.

For the Alewife Brook, no additional optimization measures were recommended for any of the remaining six CSO outfalls (CAM001, CAM002, CAM401A, CAM401B, MWR003, and SOM001A). This was due to model predictions of the following with the optimization measures in place:

- increases in the system's water surface levels to unacceptable elevations near the ground surface, especially during larger storm events (i.e., adverse hydraulic impacts);

- shifting the CSO volumes or activations to other Alewife brook overflows; and

- small CSO improvements with significant construction concerns, as well as community impacts and costs to implement (CAM001 & CAM401A).

CSO System Optimization for Lower Charles River, Study and Preliminary Design
Variance Milestones: Notice to Proceed December 2020 | Report December 2022

Summary Description:
Using the calibrated hydraulic model and coordinating technical evaluations with the City of Cambridge and the Boston Water and Sewer Commission, MWRA will conduct system optimization evaluations at the remaining active regulators tributary to CSO outfalls discharging to the Charles River watershed.

Progress to Date:
As reported in last year's report, MWRA commenced the CSO optimization investigations for Charles River CSO outfalls in August 2020, ahead of the variance's December 2020 milestone. MWRA coordinated these efforts with the department of public works in Cambridge and the Boston and Water Sewer Commission (BWSC). MWRA initially focused efforts on outfalls that it forecasted would not attain the LTCP activation and volume goals by December 2021. Various alternatives have been evaluated and documented in Semi Annual Reports 6 and 7 as well as the Final CSO Post Construction Monitoring and Performance report submitted on December 29, 2021, for CSO discharges from MWR201 (Cottage Farm), MWR018, MWR019, and MWR020, and CAM005.

During 2022, further optimization evaluations were performed for all eight CSO outfalls that can discharge untreated CSO to the Charles River, and one outfall that can discharge treated CSO. The remaining untreated CSOs include CAM005, CAM007, CAM017, MWR010, MWR018, MWR019, MWR020, and MWR023, while the treated discharge is from the MWRA's Cottage Farm facility at outfall MWR201. The findings of these evaluations were submitted in the Alewife Brook and Lower Charles River System Optimization Evaluations Report on December 29, 2022, and posted to MWRA's website. https://www.mwra.com/cso/variances/122922-alewife-charles.pdf.

In summary, using the hydraulic model, overflow volumes by storm from the Typical Year were tabulated for each outfall, along with the predicted volumes from the 2-year and 5-year, 24-hour design storms. Profiles of the peak hydraulic grade line through the regulators were also developed. The model was then used to assess the impacts of incrementally raising the weirs and/or increasing the size of the dry weather flow connections at the regulators associated with these outfalls. For the Cottage Farm CSO facility, potential modifications to facility operations were evaluated. Upstream and downstream systems were evaluated for adverse hydraulic impacts resulting from the modeled change in weir height or connection size.

For the Charles River, outfall CAM005 was the only outfall recommend for further optimization. No optimization measures were recommended at the remaining outfalls along the Charles River (outfalls CAM007, CAM017, MWR010, MWR018, MWR019, MWR020, MWR201 [Cottage Farm CSO facility], and the regulators upstream of outfall MWR023). Increasing the weir height or the regulator connection capacity resulted in unacceptable increases in the system's water surface levels to elevations near the ground surface, especially during larger storm events (i.e., adverse hydraulic impacts). Further adjustments to the operational activation and deactivation levels at Cottage Farm were found to provide minimal benefit. However, the analysis of outfall CAM005 showed that raising the weir at regulator

RE051 by 1 foot and lengthening the weir to 10 feet would reduce the CSO activation frequency and volume without creating adverse impacts on the hydraulic grade line in up to a 10-year 24-hour storm.

Optimization of the weir at CAM005 will continue to be evaluated. Given the likely non-standard configuration of the weir, CFD modelling may be needed to confirm the hydraulic performance. Due to the location of the regulator structure in the driveway of the Mt Auburn Hospital, access is limited and the proposed modifications would need to be installed manually from inside the structure. Additional information will be gathered on the regulator structure by conducting a laser scan. In addition, further analysis of the optimal configuration for the raised and lengthened weir, including assessment of materials of construction and further analysis of the hydraulics through CFD modelling or detailed system monitoring, as well as a construction feasibility analysis is under consideration.