CITY OF SOMERVILLE, MASSACHUSETTS
DEPARTMENT of ENGINEERING
JOSEPH A. CURTATONE
MAYOR

Director, Capital Projects & Planning
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Director of Engineering
RICHARD E. RAICHE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
COMBINED SEWER OVERFLOW PERMIT NO. MA0101982

2016 ANNUAL REPORT

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Activation Frequency and Discharge Volumes

In accordance with Part I, Section C, Paragraph 4, the City of Somerville maintains a meter at SOM-001A to supply direct measurement of discharges from SOM-001A, and utilizes estimates provided by the Massachusetts Water Resources Authority (MWRA) to determine discharges from SOM-007A.

SOM-001A

SOM-001A is located on the Alewife Brook at a location within the City of Cambridge where flow from the western and central portions of Somerville discharges to the MWRA's Alewife Brook Conduit via Somerville's Tannery Brook Conduit. In calendar year 2016, the CSO at this location activated a total of six (6) times, in comparison to the seven (7) activations recorded in calendar year 2015. The table below summarizes the duration and volume of each discharge as measured by the meter, and the cumulative precipitation depth, including melted snow equivalents, as reported by the National Oceanic & Atmospheric Administration for the Boston area at the time of the discharge.

Activation Dates	Duration (hours)	Volume (gal)	Cumulative Precip. (in)
10-Jan-16	0.92	343,378	1.39
30-May-16	0.17	6,486	1.13
5-Jun-16	0.17	13,417	0.91
21-Oct-16	1.42	3,299,806	1.19
15-Nov-16	0.75	430,375	0.99
29-Dec-16	0.50	101,493	1.16

SOM-007A

SOM-007A, along with MWR-205A, discharge treated effluent from the MWRA Somerville Marginal CSO screening and disinfection facility to a location upstream of the Amelia Earhart Dam on the Mystic River during mid- to high-tide conditions. Under low tide conditions, discharge from the facility is through MWR-205. While SOM-007A is permitted to Somerville under the above referenced permit, MWR-205 and MWR-205A are permitted to MWRA under Permit No. MA0103284. MWRA provides data for the SOM-007A/MWR-205A pair to Somerville. That data indicates a total of six (6) activations in calendar 2016 for a total discharge of 1.28 million gallons.

Activation Dates	Duration (hours)	Rainfall (inches)
10-Jan-16	1.48	1.47
16-Feb-16	1.35	0.92
30-May-16	1.33	1.14
29-Jun-16	0.72	0.37
21-Oct-16	0.52	1.7
30-Nov-16	0.63	1.3

Additional information regarding operation of SOM-007A/MWR-205A can be found in the MWRA's annual CSO discharge report.

MWRA Model Comparison

2016 Precipitation Evaluation

The MWRA provided an analysis of events that resulted in activations. According to data collected at the Cambridge Fresh Pond rain gauge, only the 21 October 2016 storm matches the profile of a design storm that would trigger an overflow.

Date	Rainfall (in.)	Duration (hr)	Avg. Intensity (in./hr)	Peak Intensity (in./hr.)	Storm Recurrence Interval (1-, 24- & 48-hr)
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29-Dec-16	1.04	7.75	0.13	0.32	

CSO Volume & Frequency for 2016 Precipitation

MWRA modeled the 2016 precipitation events using the MWRA model and 2016 built conditions to generate the following results.

	Reported CSO Activation		Model Predicted CSO Activation	
Date	**Discharge Volume (Mgal)**	**Activation Duration (hr)**	**Discharge Volume (Mgal)**	**Activation Duration (hr)**
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21-Oct-16	3.300	1.42	1.080	1.49
15-Nov-16	0.430	0.75		
29-Dec-16	0.101	0.42		

Only the 21 October 2016 precipitation created a CSO event according to the model; therefore, there is a disconnect between the model and actual conditions.

CSO Volume & Frequency for Typical Year Precipitation

MWRA also modeled the typical year precipitation for the 2016 system conditions. That modeling effort predicted five (5) events totaling a discharge of 4.00 million gallons. The actual activation equaled six (6) events totaling a discharge of 4.149 million gallons. Therefore, the actual metered events at SOM-001A is consistent with typical year conditions, as is the total discharge volume.

	2016 RAINFALL UNDER 2016 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2016 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
Outfall	**Activation Frequency**	**Duration (hrs)**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**
ALEWIFE BROOK							
SOM001A	1	1.49	1.08	5	4.00	3	1.67
SOM001	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM002A	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM003	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM004	Closed	N/A	N/A	Closed	N/A	Closed	N/A
UPPER MYSTIC RIVER							
SOM007A/MWR205A	6	6.03	1.28	3	1.99	3	3.48
SOM007	Closed	N/A	N/A	Closed	N/A	Closed	N/A

Alewife Brook model incorporated Cambridge's calibrated CAM004 sub-model. The CAM004 tributary area was calibrated using Cambridge CAM004 post-sewer separation flow monitoring data.

SOM007A/ MWR2015A includes portion of flow treated at Somerville Marginal facility and separate stormwater entering the Somerville Marginal Conduit (outfall) downstream of the facility. Activation frequency and volume for 2015 rainfall are from MWRA depth sensor measurements and MWRA model results, respectively.

Evaluation

While both SOM-001A and SOM-007A each registered six activations in 2016, only half of those activations were coincident, and tended to be associated with longer duration storms of sustained moderate precipitation. The three events causing only a SOM-007A activation tended to be higher overall volume events; whereas the three events causing only a SOM-001A activation tended to be shorter duration, higher peak intensity events.

The meter at SOM-001A provides data at 5-minute intervals. Two of the measured events lasted only ten minutes, and only one event, the 21 October 2016 event that was predicted by the MWRA model, had a duration of over an hour. Consequently, it is very likely that the reporting resolution afforded by the meter exceeds the prediction resolution of the model.

CSO Abatement Work Report

In 2013, the MWRA completed an upgrade to the size of the local sewer connection between Somerville's Tannery Brook Conduit and MWRA's interceptor system, and installed an underflow baffle to control the discharge of floatable materials. Additional modifications have been contemplated to follow the CAM-004 separation in Cambridge, which was completed last year; however, those modifications have not taken place.

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Conclusion

Given the analysis of the SOM-001A discharges, particularly with respect to the 5-minute reporting interval afforded by the meter, the City of Somerville will discuss the results with MWRA to determine if changes to either the monitoring plan or the system are appropriate. With the closing of CAM-004 in December 2015, it is understood that additional capacity may be available in the MWRA Alewife Brook Conduit, therefore, modifications to SOM-001A may be feasible.

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SOM-007A, along with MWR-205A, discharge treated effluent from the MWRA Somerville Marginal CSO screening and disinfection facility to a location upstream of the Amelia Earhart Dam on the Mystic River during mid- to high-tide conditions. Under low tide conditions, discharge from the facility is through MWR-205. While SOM-007A is permitted to Somerville under the above referenced permit, MWR-205 and MWR-205A are permitted to MWRA under Permit No. MA0103284. MWRA provides data for the SOM-007A/MWR-205A pair to Somerville. That data indicates a total of six (6) activations in calendar 2016 for a total discharge of 1.28 million gallons.

Activation Dates	Duration (hours)	Rainfall (inches)
10-Jan-16	1.48	1.47
16-Feb-16	1.35	0.92
30-May-16	1.33	1.14
29-Jun-16	0.72	0.37
21-Oct-16	0.52	1.7
30-Nov-16	0.63	1.3

Additional information regarding operation of SOM-007A/MWR-205A can be found in the MWRA's annual CSO discharge report.

MWRA Model Comparison

2016 Precipitation Evaluation

The MWRA provided an analysis of events that resulted in activations. According to data collected at the Cambridge Fresh Pond rain gauge, only the 21 October 2016 storm matches the profile of a design storm that would trigger an overflow.

Date	Rainfall (in.)	Duration (hr)	Avg. Intensity (in./hr)	Peak Intensity (in./hr.)	Storm Recurrence Interval (1-, 24- & 48-hr)
10-Jan-16	1.52	10.75	0.14	0.49	
30-May-16	0.72	10.5	0.07	0.34	
5-Jun-16	0.85	13.75	0.06	0.29	
21-Oct-16	1.26	6.25	0.2	0.84	6 month / 1 year
15-Nov-16	1.17	15.25	0.08	0.39	
29-Dec-16	1.04	7.75	0.13	0.32	

CSO Volume & Frequency for 2016 Precipitation

MWRA modeled the 2016 precipitation events using the MWRA model and 2016 built conditions to generate the following results.

	Reported CSO Activation		Model Predicted CSO Activation	
Date	**Discharge Volume (Mgal)**	**Activation Duration (hr)**	**Discharge Volume (Mgal)**	**Activation Duration (hr)**
10-Jan-16	0.343	0.92		
30-May-16	0.006	0.17		
5-Jun-16	0.013	0.17		
21-Oct-16	3.300	1.42	1.080	1.49
15-Nov-16	0.430	0.75		
29-Dec-16	0.101	0.42		

Only the 21 October 2016 precipitation created a CSO event according to the model; therefore, there is a disconnect between the model and actual conditions.

CSO Volume & Frequency for Typical Year Precipitation

MWRA also modeled the typical year precipitation for the 2016 system conditions. That modeling effort predicted five (5) events totaling a discharge of 4.00 million gallons. The actual activation equaled six (6) events totaling a discharge of 4.149 million gallons. Therefore, the actual metered events at SOM-001A is consistent with typical year conditions, as is the total discharge volume.

	2016 RAINFALL UNDER 2016 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2016 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
Outfall	**Activation Frequency**	**Duration (hrs)**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**	**Activation Frequency**	**Volume (MG)**
ALEWIFE BROOK							
SOM001A	1	1.49	1.08	5	4.00	3	1.67
SOM001	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM002A	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM003	Closed	N/A	N/A	Closed	N/A	Closed	N/A
SOM004	Closed	N/A	N/A	Closed	N/A	Closed	N/A
UPPER MYSTIC RIVER							
SOM007A/MWR205A	6	6.03	1.28	3	1.99	3	3.48
SOM007	Closed	N/A	N/A	Closed	N/A	Closed	N/A

Alewife Brook model incorporated Cambridge's calibrated CAM004 sub-model. The CAM004 tributary area was calibrated using Cambridge CAM004 post-sewer separation flow monitoring data.

SOM007A/ MWR2015A includes portion of flow treated at Somerville Marginal facility and separate stormwater entering the Somerville Marginal Conduit (outfall) downstream of the facility. Activation frequency and volume for 2015 rainfall are from MWRA depth sensor measurements and MWRA model results, respectively.

Evaluation

While both SOM-001A and SOM-007A each registered six activations in 2016, only half of those activations were coincident, and tended to be associated with longer duration storms of sustained moderate precipitation. The three events causing only a SOM-007A activation tended to be higher overall volume events; whereas the three events causing only a SOM-001A activation tended to be shorter duration, higher peak intensity events.

The meter at SOM-001A provides data at 5-minute intervals. Two of the measured events lasted only ten minutes, and only one event, the 21 October 2016 event that was predicted by the MWRA model, had a duration of over an hour. Consequently, it is very likely that the reporting resolution afforded by the meter exceeds the prediction resolution of the model.

CSO Abatement Work Report

In 2013, the MWRA completed an upgrade to the size of the local sewer connection between Somerville's Tannery Brook Conduit and MWRA's interceptor system, and installed an underflow baffle to control the discharge of floatable materials. Additional modifications have been contemplated to follow the CAM-004 separation in Cambridge, which was completed last year; however, those modifications have not taken place.

In 2013, the City of Somerville completed an investigation of the regulator manholes that divert high level flows from the city's connection to the MWRA Cambridge Branch interceptor to the Alewife Brook Conduit. The resulting report was submitted for review in 2014; however, no additional actions have been required.

No modifications to the city's system that connects to the Alewife Brook or the Mystic River CSO discharges have taken place in 2016. Annual reports submitted by the City of Cambridge under Permit No. 0101974 and by the MWRA under Permit No. 0103284 can provide information on modifications to the shared systems that might influence discharges from the CSOs permitted to the City of Somerville.

The City of Somerville is currently in the first year of a multiyear program to conduct a Sewer System Evaluation Study. This year, the City will conduct inspection of every manhole in the system for a total of over 3,000 inspections. Following inspection, the City will develop designs to rehabilitate any identified manhole defects to eliminate Inflow / Infiltration (I/I), and will develop a prioritized plan to conduct pipeline inspections, including cleaning and CCTV inspection. These subsequent activities are anticipated to yield further pipe rehabilitation efforts to further reduce I/I as the program continues.

Conclusion

Given the analysis of the SOM-001A discharges, particularly with respect to the 5-minute reporting interval afforded by the meter, the City of Somerville will discuss the results with MWRA to determine if changes to either the monitoring plan or the system are appropriate. With the closing of CAM-004 in December 2015, it is understood that additional capacity may be available in the MWRA Alewife Brook Conduit, therefore, modifications to SOM-001A may be feasible.

CITY OF SOMERVILLE, MASSACHUSETTS
DEPARTMENT of ENGINEERING
JOSEPH A. CURTATONE
MAYOR

Director, Capital Projects & Planning
ROBERT T. KING

Director of Engineering
RICHARD E. RAICHE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
COMBINED SEWER OVERFLOW PERMIT NO. MA0101982

2016 ANNUAL REPORT

This report has been prepared in accordance with Part I, Section D of the above referenced permit issued to the City of Somerville Department of Public Works on 11 June 2012. The permit authorizes the City of Somerville to discharge flows from two Combined Sewer Overflows (CSO), one on the Alewife Brook designated as SOM-001A, and one on the Mystic River designated as SOM-007A.

Activation Frequency and Discharge Volumes

In accordance with Part I, Section C, Paragraph 4, the City of Somerville maintains a meter at SOM-001A to supply direct measurement of discharges from SOM-001A, and utilizes estimates provided by the Massachusetts Water Resources Authority (MWRA) to determine discharges from SOM-007A.

SOM-001A

SOM-001A is located on the Alewife Brook at a location within the City of Cambridge where flow from the western and central portions of Somerville discharges to the MWRA's Alewife Brook Conduit via Somerville's Tannery Brook Conduit. In calendar year 2016, the CSO at this location activated a total of six (6) times, in comparison to the seven (7) activations recorded in calendar year 2015. The table below summarizes the duration and volume of each discharge as measured by the meter, and the cumulative precipitation depth, including melted snow equivalents, as reported by the National Oceanic & Atmospheric Administration for the Boston area at the time of the discharge.

Activation Dates	Duration (hours)	Volume (gal)	Cumulative Precip. (in)
10-Jan-16	0.92	343,378	1.39
30-May-16	0.17	6,486	1.13
5-Jun-16	0.17	13,417	0.91
21-Oct-16	1.42	3,299,806	1.19
15-Nov-16	0.75	430,375	0.99
29-Dec-16	0.50	101,493	1.16

SOM-007A

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