



MASSACHUSETTS WATER RESOURCES AUTHORITY

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April 30, 2010

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Kevin Brander, P.E.
Section Chief, Municipal Services Section
DEP Northeast Region Office
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Subject: CSO Discharge Estimates and Rainfall Analyses for Calendar Year 2009

Dear Mr. Borci and Mr. Brander:

Enclosed please find documentation of the Massachusetts Water Resources Authority's (MWRA) estimates of combined sewer overflow (CSO) discharges in its service area during calendar year 2009. This information is submitted in part to comply with conditions in the CSO variances to the Massachusetts Surface Water Quality Standards for the Alewife Brook/Upper Mystic River and the Lower Charles River/Charles River Basin issued to MWRA by the Department of Environmental Protection in September and October 2007, respectively. MWRA is also providing the enclosed documentation to the Boston Water and Sewer Commission (BWSC) and the cities of Cambridge, Chelsea and Somerville. The documentation includes:

Table 10: Summary of 2009 and Typical Year Model Simulation Results, and Comparison to Typical Year Long-Term CSO Control Plan

Table 10 presents estimated CSO activations and volumes for all CSO outfalls for storms during calendar year 2009. For most outfalls, the estimates were developed using the MWRA InfoWorks sewer system model (see exceptions below), by simulating each of the rainfall events in 2009. For the simulations, MWRA updated the model to accurately reflect changes to system conditions by incorporating CSO projects and other system changes that were completed prior to or during the year.

At four outfalls associated with treatment facilities, the discharge estimates (activation frequency, duration and volume) for year 2009 storms are from measurements at the

facilities, instead of model results. These locations include the four MWRA CSO treatment facilities (Cottage Farm MWR201, Prison Point MWR203, Somerville-Marginal MWR205, and Union Park MWR215). The activation frequencies and durations at outfalls SOM007A/MWR205A and BOS019 are from MWRA depth sensors at the overflow weirs, but the estimated annual volumes at these two outfalls are from the model predictions.

Table 10 also compares the results of a Typical Year simulation using 2009 system conditions to the activation frequencies and annual volumes in the approved CSO Long-Term Control Plan (“LTCP”) as defined in Exhibit B to the Second Stipulation of the United States and the Massachusetts Water Resources Authority on Responsibility and Legal Liability for Combined Sewer Overflow Control in the Federal District Court Order in the Boston Harbor Case (as amended in May 2008). This comparison allows a tracking of progress towards meeting the long-term control levels as MWRA and its CSO member communities continue to implement the LTCP.

Table 1: Comparison of Frequency of Rain Events Within Selected Ranges of Total Rainfall, Typical Year Versus 2009

Table 2: Comparison of Storms with Greater than 2 Inches of Total Rainfall, Typical Year Versus 2009

Table 3: Comparison of Storms with Peak Intensities Greater than 0.40 Inch/Hour, Typical Year Versus 2009

These rainfall analyses were developed to support a comparison of the estimated discharges in the 2009 rainfall events with the predicted discharges for a Typical Year to understand the relative magnitude of the 2009 discharge estimates and how they were affected by actual rainfall.

From an initial review of the CSO discharges estimates, a comparison with Typical Year discharge predictions, and review of the rainfall analyses, MWRA has determined the following:

- Ongoing implementation of the long-term CSO control plan continues to improve system performance and reduce CSO discharges in line with and toward the long-term levels of control for each outfall.
- The 2009 CSO discharge estimates are reasonable for the actual rainfall characteristics and sewer system conditions that existed during that year. Generally, the 2009 rainfall events fell within the range of Typical Year rainfall events for several rainfall characteristics, shown below. Some storms fell outside the range and

had higher rainfall amount and/or greater average or peak rainfall intensity, including the storms on July 23-24 and September 11.

On a receiving water by receiving water basis (Table 10), spatial variation of rainfall contributed to lower or higher discharges compared to the Typical Year and, at some outfalls, subsystem sensitivity to larger storms (e.g. July 23-24 and September 11) is a likely factor that contributed to higher discharges than the Typical Year predictions (e.g. Outfall BOS057 and other outfalls hydraulically related to the BWSC Albany Street and New Boston Main interceptors and MWRA’s Columbus Park Headworks).

	Total Volume	Untreated Volume	Treated Volume	Cottage Farm	Prison Point	Somerville Marginal	Union Park
Typical Year 2008 System	633	165	468	44	288	73	63
Typical Year 2009 System	605	161	444	23*	281	76	63
2009 Rainfall 2009 System	606	195	411	58*	250	74	29

Note: Volumes in million gallons (MG). Treatment facility volumes for 2009 storms are from facility records.

* Cottage Farm Brookline Connection project was completed in June 2009 and affected discharges in storms after June. Typical Year prediction assumed completed project benefits for the entire year.

The lower Typical Year predictions for 2009 system conditions are due primarily to the reduction in treated CSO volume from the Cottage Farm CSO Facility as a result of the Cottage Farm/Brookline Connection project, which MWRA completed in June 2009. Although the Cottage Farm/Brookline Connection project was completed in June 2009, the typical year model assumes that the project benefits were realized for the entire year, which results in an estimated 2009 typical year discharge amount that is lower than the volume from the actual 2009 rainfall and system conditions. In addition, Typical Year discharges at Alewife Brook outfalls were reduced with interim improvements to the pumps and pump operations at the Alewife Brook Pumping Station.

Lower Typical Year discharge at Prison Point and higher Typical Year discharge at BOS057 from 2008 to 2009 are the result of a change to the model configuration of a gate (to a smaller open position) that allows flows from the Bulfinch Triangle area of Boston into MWRA’s Boston Marginal Conduit, which flows to the Prison Point facility. This gate reconfiguration in the model was based on new information, not a recent system change. Conditions at both Prison Point and BOS057 are expected to change significantly (lower CSO discharges) with the completion of the Bulfinch Triangle Sewer Separation project in July 2010.

Outfall BOS010, formerly plugged, was cleaned by BWSC and is now operational. This outfall provides additional system relief that has increased the total volume of CSO discharge from the East Boston outfalls that discharge to the Upper Inner Harbor and has

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partially shifted overflows from East Boston outfalls that discharge to the Lower Inner Harbor.

If you have questions regarding the enclosed documentation, please do not hesitate to contact me at 617-788-4359.

Very truly yours,

Michael J. Hornbrook
Chief Operating Officer

cc: David Kubiak, MWRA

TABLE 10. SUMMARY OF 2009 AND TYPICAL YEAR MODEL SIMULATION RESULTS, AND COMPARISON TO TYPICAL YEAR LONG TERM CSO CONTROL PLAN

Outfall	2009 RAINFALL UNDER 2009 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2009 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
	Activation Frequency	Duration (hrs)	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
ALEWIFE BROOK							
CAM001	0	0.00	0.00	0	0.00	5	0.19
CAM002	6	6.72	0.30	8	1.81	4	0.69
MWR003	0	0.00	0.00	1	0.07	5	0.98
CAM004	7	22.48	2.75	10	5.89	To be closed	N/A
CAM400	6	7.51	0.13	8	0.63	To be closed	N/A
CAM401A	0	0.00	0.00	5	1.46	5	1.61
CAM401B	18	70.19	7.08	22	8.47	7	2.15
SOM001A	6	11.83	2.06	9	8.21	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
TOTAL		118.73	12.31		26.53		7.29
UPPER MYSTIC RIVER							
SOM007A/MWR205A ⁽¹⁾	4	2.18	0.92	9	2.05	3	3.48
SOM007	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		2.18	0.92		2.05		3.48
MYSTIC/CHELSEA CONFLUENCE							
MWR205 (Somerville Marginal Facility) ⁽²⁾	23	68.70	74.16	25	76.01	39	60.58
BOS013	39	137.46	4.69	34	5.10	4	0.54
BOS014	3	3.34	0.48	6	1.31	0	0.00
BOS015	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS017	0	0.00	0.00	0	0.00	1	0.02
CHE002	0	0.00	0.00	0	0.00	4	0.22
CHE003	0	0.00	0.00	0	0.00	3	0.04
CHE004	0	0.00	0.00	0	0.00	3	0.32
CHE008	0	0.00	0.00	0	0.00	0	0.00
TOTAL		209.49	79.33		82.42		61.72
UPPER INNER HARBOR							
BOS009	35	134.72	5.06	30	5.46	5	0.59
BOS010 ⁽⁶⁾	34	120.88	11.19	38	16.79	4	0.72
BOS012	47	201.93	12.42	38	13.37	5	0.72
BOS019 ⁽¹⁾	2	4.78	0.56	2	0.27	2	0.58
BOS050	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS052	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS057	5	18.48	18.46	7	7.76	1	0.43
BOS058	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS060	0	0.00	0.00	1	0.04	0	0.00
MWR203 (Prison Point) ⁽²⁾⁽³⁾	16	63.07	250.46	18	281.46	17	243.00
TOTAL		543.86	298.15		325.14		246.04
LOWER INNER HARBOR							
BOS003	10	29.98	7.88	11	10.41	4	2.87
BOS004	31	101.08	7.39	23	8.07	5	1.84
BOS005	0	0.00	0.00	3	0.08	1	0.01
BOS006 ⁽⁷⁾	Closed	N/A	N/A	Closed	N/A	4	0.24
BOS007 ⁽⁷⁾	Closed	N/A	N/A	Closed	N/A	6	1.05
TOTAL		131.07	15.27		18.57		6.01

TABLE 10. SUMMARY OF 2009 AND TYPICAL YEAR MODEL SIMULATION RESULTS, AND COMPARISON TO TYPICAL YEAR LONG TERM CSO CONTROL PLAN

Outfall	2009 RAINFALL UNDER 2009 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2009 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
	Activation Frequency	Duration (hrs)	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
CONSTITUTION BEACH							
MWR207	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		N/A	N/A		N/A		N/A
FORT POINT CHANNEL							
BOS062	0	0.00	0.00	0	0.00	1	0.01
BOS064	3	13.12	0.76	3	0.25	0	0.00
BOS065	4	15.63	9.65	4	3.08	1	0.06
BOS068	3	11.96	2.75	4	0.99	0	0.00
BOS070							
BOS070/DBC	4	15.69	39.86	7	14.67	3	2.19
MWR215 (Union Park) ⁽²⁾	4	17.73	29.05	16	63.34	17	71.37
BOS070/RCC	5	16.89	13.61	6	6.53	2	0.26
BOS072	1	0.66	0.01	0	0.00	0	0.00
BOS073	1	1.21	0.09	1	0.02	0	0.00
TOTAL		92.90	95.77		88.88		73.89
RESERVED CHANNEL							
BOS076	24	78.59	15.14	21	10.35	3	0.91
BOS078	13	25.82	5.18	16	4.80	3	0.28
BOS079	7	15.29	0.90	9	1.02	1	0.04
BOS080	44	167.21	13.62	35	11.55	3	0.25
TOTAL		286.92	34.85		27.72		1.48
NORTHERN DORCHESTER BAY							
BOS081	15	32.94	3.08	17	2.78	0 / 25 year	N/A
BOS082	10	18.40	2.99	10	2.93	0 / 25 year	N/A
BOS083 ⁽⁸⁾	0	0.00	0.00	3	0.10	0 / 25 year	N/A
BOS084	8	19.18	2.30	10	2.23	0 / 25 year	N/A
BOS085	3	7.05	1.14	6	0.47	0 / 25 year	N/A
BOS086	3	6.36	2.06	6	0.37	0 / 25 year	N/A
BOS087	0	0.00	0.00	0	0.00	0 / 25 year	N/A
TOTAL		83.94	11.57		8.88		0.00
SOUTHERN DORCHESTER BAY							
BOS088/BOS089 (Fox Point)	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS090 (Commercial Point)	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		N/A	N/A		N/A		N/A
UPPER CHARLES							
BOS032	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS033	Closed	N/A	N/A	Closed	N/A	Closed	N/A
CAM005	1	0.70	0.03	3	1.38	3	0.84
CAM007	1	0.66	0.01	2	0.25	1	0.03
CAM009 ⁽⁴⁾	Closed	N/A	N/A	Closed	N/A	2	0.01
CAM011 ⁽⁴⁾	Closed	N/A	N/A	Closed	N/A	0	0.00
TOTAL		1.36	0.04		1.63		0.88

TABLE 10. SUMMARY OF 2009 AND TYPICAL YEAR MODEL SIMULATION RESULTS, AND COMPARISON TO TYPICAL YEAR LONG TERM CSO CONTROL PLAN

Outfall	2009 RAINFALL UNDER 2009 SYSTEM CONDITIONS			TYPICAL-YEAR RAINFALL UNDER 2009 SYSTEM CONDITIONS		TYPICAL-YEAR RAINFALL W/ LONG TERM CSO CONTROL PLAN	
	Activation Frequency	Duration (hrs)	Volume (MG)	Activation Frequency	Volume (MG)	Activation Frequency	Volume (MG)
LOWER CHARLES							
BOS028	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS042	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS049	0	0.00	0.00	0	0.00	To be closed	N/A
CAM017	0	0.00	0.00	1	0.50	1	0.45
MWR010	0	0.00	0.00	0	0.00	0	0.00
MWR018	2	2.72	1.13	0	0.00	0	0.00
MWR019	1	0.98	0.14	0	0.00	0	0.00
MWR020	1	0.66	0.02	0	0.00	0	0.00
MWR021	Closed	N/A	N/A	Closed	N/A	Closed	N/A
MWR022	Closed	N/A	N/A	Closed	N/A	Closed	N/A
MWR201 (Cottage Farm) ⁽²⁾	4	23.27	57.50	8	23.14	2	6.30
MWR023	0	0.00	0.00	1	0.02	2	0.13
SOM010	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		27.63	58.79		23.66		6.88
NEPONSET RIVER							
BOS093	Closed	N/A	N/A	Closed	N/A	Closed	N/A
BOS095	Closed	N/A	N/A	Closed	N/A	Closed	N/A
TOTAL		N/A	N/A		N/A		N/A
BACK BAY FENS							
BOS046 ⁽⁵⁾	0	0.00	0.00	1	1.57	2	5.38
TOTAL		0.00	0.00		1.57		5.38
Total Treated			411		444		381
Total Untreated			195		161		28
GRAND TOTAL			606		605		410

- (1) Activation frequency and volume for 2009 rainfall are from MWRA depth sensor measurement and MWRA model results, respectively.
- (2) Activation frequency and volume for 2009 rainfall are from MWRA facility records (measurements).
- (3) MWRA has formally recommended to EPA, DEP and the Federal Court that the long-term level of control for Prison Point be revised to 17 activations and 243 million gallons in a typical year, in accordance with "Proposed Modifications of Long-Term Level of Control for the Prison Point CSO Facility - April 2008."
- (4) The City of Cambridge closed outfalls CAM009 and CAM011 in November 2007, and continues to monitor upstreams hydraulic effects.
- (5) Volumes represent model predicted total discharges at outfall BOS046, including stormwater.
- (6) BWSC completed the cleaning of outfall BOS010.
- (7) BWSC has permanently closed outfalls BSO006 and BOS007 in East Boston as part of sewer separation and development plans in the tributary areas, although the outfalls were assumed to remain active in the long-term CSO control plan.
- (8) CSO discharge volume at the outfall BOS083 has been directed to the outfall BOS084 as part of the construction of the North Dorchester Bay Storage Tunnel.

RAINFALL CHARACTERISTICS

TABLE 1. COMPARISON OF FREQUENCY OF RAIN EVENTS WITHIN SELECTED RANGES OF TOTAL RAINFALL, TYPICAL YEAR VERSUS 2009

Conditions	Total Rainfall (inches)	Total Number of Storms	Number of Storms by Volume				
			Volume < 0.25 inches	Volume 0.25 to 0.5 inches	Volume 0.5 to 1.0 inches	Volume 1.0 to 2.0 inches	Volume \geq 2.0 inches
Typical Year	46.8	93	49	14	16	8	6
Ward Street	43.12	98	52	17	13	12	4
Columbus Park	51.54	96	43	16	22	12	3
Chelsea Creek	45.33	112	62	15	21	12	2
Fresh Pond (from USGS)	44.46	118	67	20	17	11	3

TABLE 2. COMPARISON OF STORMS WITH GREATER THAN 2 INCHES OF TOTAL RAINFALL, TYPICAL YEAR VERSUS 2009

Rain Gauge	Storm No.	Date	Duration (hours)	Total Rainfall (inches)	Average Intensity (inch/hour)	Peak Intensity (inch/hour)	Storm Recurrence Interval (24-hour)
Typical Year	87	12/11/92	50	3.89	0.08	0.20	1y
	59	8/15/92	72	2.91	0.04	0.66	3m
	67	9/22/92	23	2.76	0.12	0.65	1y
	83	11/21/92	84	2.39	0.03	0.31	3m
	41	5/31/92	30	2.24	0.07	0.37	3m-6m
	69	10/9/92	65	2.04	0.03	0.42	<3m
Ward Street Headworks (BO-DI-1)	59	7/23/09	14	2.89	0.21	0.64	1y
	68	9/11/09	29.75	2.51	0.08	0.71	6m
	83	11/14/09	29.25	2.31	0.08	0.46	3m-6m
	71	10/1/09	165.5	2.15	0.01	0.25	<3m
Columbus Park Headworks (BO-DI-2)	69	9/11/09	36	3.51	0.10	0.97	2-5y
	58	7/23/09	16.5	3.14	0.19	0.63	2y
	83	11/14/09	29.3	2.11	0.07	0.54	3m
Chelsea Creek Headworks (CH-BO-1)	68	7/23/09	33	2.70	0.08	0.47	6m-1y
	81	9/11/09	30	2.15	0.07	0.86	3m-6m
Fresh Pond (from USGS)	64	7/23/09	15	2.44	0.16	0.40	6m
	103	11/14/09	27.75	2.40	0.09	0.40	6m
	87	9/11/09	32.25	2.22	0.07	0.57	3m-6m

TABLE 3. COMPARISON OF STORMS WITH PEAK INTENSITIES GREATER THAN 0.40 INCHES/HOUR, TYPICAL YEAR VERSUS 2009

Rain Gauge	Storm No.	Date	Duration (hours)	Total Rainfall (inches)	Average Intensity (inch/hour)	Peak Intensity (inch/hour)	Storm Recurrence Interval (1-hour)
Typical Year	74	10/23/92	4	1.18	0.29	1.08	1-2y
	57	8/11/92	11	0.87	0.08	0.75	6m-1y
	59	8/15/92	72	2.91	0.04	0.66	3m-6m
	67	9/22/92	23	2.76	0.12	0.65	3m-6m
	35	5/2/92	7	1.14	0.16	0.63	3m-6m
	63	9/9/92	1	0.57	0.57	0.57	3m
	61	9/3/92	13	1.19	0.09	0.51	< 3m
	42	6/5/92	18	1.34	0.07	0.44	< 3m
	69	10/9/92	65	2.04	0.03	0.42	< 3m
Ward Street Headworks (BO-DI-1)	68	9/11/09	29.75	2.51	0.08	0.71	6m
	59	7/23/09	14.00	2.89	0.21	0.64	3m-6m
	6	1/23/09	0.50	0.56	1.12	0.56	< 3m
	64	8/20/09	0.75	0.5	0.67	0.50	< 3m
	56	7/11/09	3.75	1.01	0.27	0.48	< 3m
	83	11/14/09	29.25	2.31	0.08	0.46	< 3m
	22	4/6/09	10.00	1.18	0.12	0.45	< 3m
	54	7/1/09	24.50	1.55	0.06	0.43	< 3m
Columbus Park Headworks (BO-DI-2)	69	9/11/09	36.00	3.51	0.10	0.97	1-2y
	58	7/23/09	16.50	3.14	0.19	0.63	3m-6m
	79	10/24/09	23.75	1.33	0.06	0.56	< 3m
	83	11/14/09	29.25	2.11	0.07	0.54	< 3m
	27	4/6/09	11.75	1.38	0.12	0.47	< 3m
	32	5/4/09	32.00	1.12	0.04	0.46	< 3m
	52	6/30/09	38.00	1.53	0.04	0.46	< 3m
	60	7/30/09	1.50	0.47	0.31	0.45	< 3m
	55	7/11/09	3.75	0.85	0.23	0.41	< 3m
Chelsea Creek Headworks (CH-BO-1)	81	9/11/09	30.00	2.15	0.07	0.86	6m-1y
	29	3/26/09	4.00	0.70	0.18	0.66	3m-6m
	70	7/30/09	1.75	0.84	0.48	0.65	3m-6m
	68	7/23/09	33.00	2.70	0.08	0.47	< 3m
	63	7/1/09	25.00	1.71	0.07	0.44	< 3m
	71	7/31/09	9.50	0.77	0.08	0.43	< 3m
Fresh Pond (from USGS)	68	7/30/09	9.50	0.85	0.09	0.59	3m-6m
	87	9/11/09	32.25	2.22	0.07	0.57	3m
	53	7/1/09	25.75	1.88	0.07	0.55	< 3m
	23	4/6/09	10.50	1.35	0.13	0.44	< 3m
	69	7/31/09	10.00	0.98	0.10	0.43	< 3m
	64	7/23/09	15.00	2.44	0.16	0.40	< 3m
	103	11/14/09	27.75	2.40	0.09	0.40	< 3m