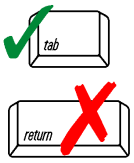
Massachusetts Department of Environmental Protection
Bureau of Water Resources – Wastewater Management Program

Combined Sewer Overflow Preliminary Public Notification Plan

1. Facility Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



City of Worcester Department of Public Works & Parks
Name of Permittee (Facility or System)

David Harris
Permittee Contact Name

Harrisd@Worcesterma.gov
Email Address

20 East Worcester Street, Worcester, MA 01604
Permittee Mailing Address

MA0102997
NPDES Permit # (only for system with a wastewater treatment plant)

508-929-1300x49001
Phone number

System contains (check all that apply):
☑ Collection system ☑ Pump station(s) ☑ Wastewater treatment plant
Location of WWTP discharge, if applicable:
60 Quinsigamond Ave. CSO Treatment Facility; outfall 001 to Mill Brook

Please attach a map with locations of discharges and affected waterbodies.

2. Identification of Environmental Justice Populations

Are there Environmental Justice (EJ) populations that would potentially be affected by your wastewater treatment plant discharge(s) or a combined sewer overflow? ☑ Yes ☐ No

If there are EJ populations that would potentially be affected, do 25% or more of households lack English-language proficiency, and at least 5% of the population has speakers who self-identify as “do not speak English very well”? ☑ Yes ☐ No

Provide a list of all languages that notification will be translated into:

Spanish, Vietnamese

Does your municipality provide translation of municipal documents in the languages listed above? ☑ Yes ☐ No

If you answered “yes” above, does your municipality’s staff provide translation of municipal documents, or are translation services outsourced?

☐ Municipal Staff ☑ Outsourced

3. Discharges, Overflows, and Public Notification Content

When public notification is required: (check box to affirm)

☑ Permittee is aware that all events covered under 314 CMR 16.03(1)(a-e) require a public notification.

Required content of public notification: (check box to affirm)

☑ Permittee is aware of all required information for public notifications under 314 CMR 16.04(10)

Permittee can meet all requirements of 314 CMR 16.04(10) ☑ Yes ☐ No

If no, please describe in detail which components the permittee is not able to meet and the measures needed to comply. Attach a schedule for compliance.

Components that cannot be met

Schedule for compliance

4. Discovery and Required Timeline for Notification

Is the permittee requesting approval to use a method other than metering to detect a discharge? (Requires approval of MassDEP Commissioner)

Attach additional information on method to detect a discharge. ☑ Yes ☐ No

Discovery of a Discharge or Overflow:

Permittee can discover an event under 314 CMR 16.04(5)(a), (b) & (c) within the required timeline? ☑ Yes ☐ No

If no, specify limitations to meeting these requirements and potential remedies, e.g., method of detection does not allow for discovery within specified timeframe, staffing, etc.:

Issuance of Public Notification:

Permittee can meet the notification requirements in 314 CMR 16.04(4) ☑ Yes ☐ No

If no, why and what measures are needed for compliance?

Continuation of Public Notification:

Permittee can meet the notification requirements in 314 CMR 16.04(7) ☑ Yes ☐ No

If no, which requirement cannot be met and what measures are needed for compliance?

Cessation of Public Notification:

Permittee can meet the notification requirements in 314 CMR 16.04(8) ☑ Yes ☐ No

If no, why, and what measures are needed for compliance?

Retraction of Public Notification:

Permittee can meet the notification requirements in 314 CMR 16.04(9) ☑ Yes ☐ No

If no, which requirement cannot be met and what measures are needed for compliance?

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5. CSO Permittee Website

Does the permittee/sewer authority have an existing website or web page where relevant information is posted? ☑ Yes ☐ No

If yes, provide the URL:

http://www.worcesterma.gov/water-sewer

Describe the subscriber-based system where the public can sign up to receive your notifications.

Subscribers can sign up via email on city website. Sign-ups and email notifications are managed through Constant Contact.

Permittee has a website and is able to meet the requirements under 314 CMR 16.05(1)(a-e)? ☑ Yes ☐ No

If no, specify limitations to meeting these requirements and potential remedies:

6. Signage

Permittee has consulted with the Board of Health/Health Departments in municipalities affected by their discharges for public access sign location points? ☑ Yes ☐ No

Attach a list of locations where signs will be installed and dates when signs will be installed.

Permittee is able to meet the signage requirements under 314 CMR 16.05(2)? ☑ Yes ☐ No

If no, specify limitations to meeting these requirements and potential remedies:

Permittee is able to meet the signage requirements under 314 CMR 16.05(3)? ☑ Yes ☐ No

If no, specify limitations to meeting these requirements and potential remedies:

7. Public Notification Recipients

Media Outlets

List the two media outlets serving the area near the discharge or outfall that the permittee will contact to provide a public notification. Include name of organization, name of contact, and contact's email address or fax number.

Worcester Telegram & Gazette newstips@telegram.com

Name of media outlet #1

Spectrum News 1 Spectrumnews1ma@charter.com

Name of media outlet #2

7. Public Notification Recipients (cont.)

If permittee has determined that an EJ population could potentially be affected by a discharge or overflow, which of these media outlets serves the EJ population? If neither does, then provide at least one additional news organization that primarily serves the EJ population(s) within the impacted municipalities. (Include name of organization, name of contact, and contact's email address or fax number.)

news@vocerohispano.com

Name of additional media outlet serving EJ population if neither media outlet above serves EJ population

See Instructions for list of **Required Public Notification Recipients** (314 CMR 16.04(4)(a)). Please attach list of your required contacts.

Certification

I attest that I have examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certifying statement. The information contained in this submittal is, to the best of my knowledge, true, accurate, and complete. I am fully authorized to make this attestation on behalf of the facility.

Sean M. Divoll	Asst. Commissioner of Water & Sewer
Print Name	Title
	March 26, 2024
Signature	Date

City of Worcester

Department of Public Works & Parks

Revised CSO Public Notification Plan Attachments and Details

March 2024

Combined Sewer Overflows

1. Background

Quinsigamond Ave CSO Storage and Treatment Facility

The Quinsigamond Ave Combined Sewer Overflow Storage and Treatment Facility (QCSOTF or Facility) is the primary combined sewer overflow (CSO) location into the Blackstone River. Except under all but the highest flow conditions, the QCSOTF provides treatment in the form of screening, settling, disinfection and dechlorination. The treated discharge then flows to the Mill Brook, an underground conduit which discharges into the Blackstone River behind the Walmart shopping plaza on Tobias Boland Way. During extreme wet weather conditions, flow can be diverted around the Facility at three locations: bypass gates located at the QCSOTF, a flood control weir structure at Grabowski Square, and a weir opening at Brosnihan Square. These bypasses may occur automatically or, in the case of the bypass gates, manually. In either automatic or manual mode, the combined sewage is not treated and it enters the Mill Brook and Blackstone River just as the treated CSO discharge does.

The QCSOTF is subject to National Pollution Discharge Elimination System (NPDES) Permit # MA0102997. The Facility is designed to pump low flows (during dry weather) to the Upper Blackstone Clean Water (UBCW) wastewater treatment plant. During wet weather the Facility can store flows and later pump them to the UBCW. Higher intensity and long duration rainfall may cause flows to increase beyond the storage capacity of the QCSOTF which then triggers the activation of the treatment mode and discharge to Mill Brook.

2. Identification of Environmental Justice Communities

A review of Environmental Justice (EJ) Community mapping indicates there are no EJ communities with English proficiency limitations in the downstream communities which may be impacted by a CSO. Within a one mile radius of the CSO outfall there are designated EJ communities with English proficiency limitations, in particular Spanish-speaking communities. There may also be a Vietnamese speaking community with English proficiency limitations in the general vicinity of the QCSOTF. CSO notifications are therefore translated into Spanish and Vietnamese**.**

- **The City of Worcester has a translation service, Language Line Solutions, that has been utilized for document translation.**
- **Each notification is issued as a single email to subscribers that includes English, Spanish and Vietnamese versions.**
- **Signage at the CSO outfall is posted as required by the City of Worcester's NPDES Permit. No translation is needed. Signage in accordance with 314 CMR 16.05(3)(a-e) has been installed at canoe launches at Tricentennial Park, 72 Blackstone Street in Sutton and at Riverview Park, Providence Road in Grafton.**

3. Discharges, Overflows and Public Notification Content

Quinsigamond Avenue CSO Storage and Treatment Facility

All CSO operations and practices are organized in order to adhere to the City's NPDES permit. Combined sewage can flow into the Facility and be stored with no discharge. Opening the effluent gates will initiate a CSO. The Facility is generally unmanned from 4:00 PM to 7:30 AM and on weekends. During forecasted extreme weather events, operators are scheduled to staff the Facility. However, a high water level in the wet well/influent channel will call out an alarm to a 24/7 manned location at the Worcester Department of Public Works & Parks (DPWP) at its E. Worcester Street location. When a high level alarm is received a call is made to staff or a contractor who would then report to the Facility. Depending on the nature of the storm and flows, the Facility may already be automatic mode treating flows before a staff person arrives and the effluent gate may be open or may have opened and closed.

All operations are monitored by a Supervisory Control and Data Acquisition (SCADA) computer system, to ensure any CSO event, activated by the opening of the effluent gates, is recorded**:**

- **A discharge can be confirmed within 4 hours by the operator checking the SCADA or observing the effluent gate position upon arrival.**
- **The effluent flow is metered so the discharge volume is measured.**
- **The SCADA system will record commencement times, cessation times and the duration of discharges.**

Bypass of the Facility can occur under certain situations. In extreme wet weather conditions, the capacity of the Facility can be overwhelmed, leading to automatic opening of the bypass gates based on water elevations in the wet well/influent channel. The bypass gates can also be manually opened when extreme flows occur that may lead to flooding of the Green Island area around the Facility. Opening the bypass gates can reduce area flooding and help protect the Facility from flood damage. The bypass gates are designed to be overtopped in extreme flow conditions or if the influent channel is blocked, restricting flow into the Facility.

The bypass channel is metered and bypasses achieved through opening the bypass gates are recorded on SCADA. This allows the operator to note the time and respond accordingly to notifications. Bypasses that occur via overtopping the bypass gates are also captured by the SCADA system. To monitor and measure bypass flows through or over the bypass gates, ultrasonic level sensors are utilized on both the upstream and downstream sides of the bypass gate. These sensors detect any flow through or over the bypass gate and are linked to the SCADA system. SCADA is programmed to calculate flow rates based on an empirical relationship between the water level differences above and below the bypass gate when the gate is open and by using a weir formula and upstream water level when the bypass gate is closed. See attached Kleinfelder memo for further details.

A bypass at the Facility has been confirmed to occur three times since 2013 when SCADA was originally installed. Details on the storm events that caused these bypasses are detailed in Table 1 below. Bypasses were confirmed by corroborating high flow elevation data with recorded CSO events.

Table 1 - Quinsigamond Ave CSO Storage and Treatment Facility Overflow Events

Date	Number of Days	Time of Storm	Duration of Storm (hours)	Amount of Precipitation (inches)	Estimated Overflow Volume (MG)
September 2, 2021	3	9:12 AM (09/01) to 3:00 AM (09/03)	31	4.41	70.288
August 19, 2021	1	9:37 AM to 4:15 PM	6.6	3.18	21.765
July 9, 2021	1	10:02 AM to 11:32 PM	13.4	2.42	36.721
				Total Overflow Volume (MG) =	128.774

Brosnihan Square

The weir opening at Brosnihan Square is approximately 5.2 feet long by 2.5 feet high and is located between the Mill Brook Conduit (MBC) and the City's Main Interceptor. The Brosnihan Square siphon outlet structure is located to the east of the weir opening. Both the Eastern and Western Interceptors converge at the siphon outlet structure, each via a 30 inch triple barrel siphon. The chamber also receives flow from a 32x42 inch sanitary sewer from Cambridge Street. The 72 inch Main Interceptor exits the siphon chamber on the south side of the structure and transports the sewer / combined sewer flow to the UBCW.
The MBC, which primarily carries stormwater flow, is located on the other side of the weir. The MBC is connected to the weir opening through an overflow brick and concrete archway. The invert of the weir opening is approximately 51 inches above the invert of the overflow archway. According to the Green Island Area Flood Study Report dated May 2016 prepared by CDM Smith, it is speculated that "the weir wall was built following construction of the CSO facilities, but that the top of the wall was left open to evaluate system performance before full closure in the event that relief would be needed in some storm events."

A total of 21 activations have occurred at the Brosnihan Square weir location since the start of the monitoring period. Camera footage confirmed that the MBC (drainage system) overflowed into the Main Interceptor/siphon outlet structure during overflow events and contributed inflow to the UBCW. It should be noted that a CSO from the sewer to the drain has not been identified throughout the monitoring period. All activations were strictly from the drain to the sewer. Based on the flow monitoring, it appears that a small storm event (i.e. less than a 1-year frequency rain event), can trigger an inflow event at the Brosnihan Square weir location. Table 2 below summarizes the inflow events.

Table 2 - Brosnihan Square Overflow Events

Date	Rainfall Total (in)	Duration (hr)	Peak Hourly Rainfall (in/hr)	Precipitation Frequency	Estimated Inflow Volume (gallons)
April 8, 2022	1.13	6	0.53	n/a	2,700
April 19, 2022	1.18	6	0.43	n/a	Not Detectable
May 28, 2022	0.75	1.5	n/a (Localized Rainfall)	n/a	4,800
June 9, 2022	1.33	3.5	0.58	1-Year 3-Hour	1,100,000
August 26, 2022	1	2	0.91	1-Year 2-Hour	290,000
September 6, 2022	3.91	36	0.57	2-Year 24-Hour	Sensor malfunction
December 23, 2022	2.29	22	0.34	1-Year 24-Hour	Sensor malfunction
April 30, 2023	2.14	30	0.36	n/a	380,000
June 28, 2023	0.61	~0.5	n/a (Localized Rainfall)	n/a	120,000
July 2-3, 2023	2.91	48	0.8	1-Year 2-day	1,300,000
July 10, 2023	2.51	24	1.17	1-Year 24-Hour	580,000
July 14, 2023	1.44	13	1	1-Year 1-Hour	153,000
July 16, 2023	1.14	15	0.72	n/a	514,000
July 18, 2023	0.73	0.5	n/a	1-Year 30-Min	165,000
July 29, 2023	0.80	3	0.46	n/a	230,000
August 8, 2023	0.40	~0.5	n/a	n/a	51,400
August 18, 2023	1.13	3	0.85	n/a	1,060,000
August 25, 2023	1.4	14	0.44	n/a	3,500
September 8, 2023	0.85	~0.5	n/a (Localized Rainfall)	1-Year 30-Min	202,000
September 11, 2023	1.17	5	0.46	n/a	593,000
September 29, 2023	2.23	17	0.35	1-Year 24-Hour	240,000
				Total Inflow Volume (gal) =	**6,989,400**

Rainfall data is collected from the City owned rain gauge installed at the Beaver Brook water pump station and is supplemented by the National Weather Service (NWS) station at the Worcester Regional Airport. Any CSO events from these locations discharge to the same discharge location as the QCSOTF. The months of July and August of 2023 have seen above average rainfall, which led to considerably more activations. These activations have allowed a better understanding of the inflow events occurring at the Brosnihan Square weir location. However, even with the above average rainfall, there appears to be a lack of high intensity storm events. The Massachusetts Department of Environmental Protection's (MassDEP) standard for assessing the risk for sanitary sewer overflows (SSOs) is a 5-year 24-hour storm. Since the start of the monitoring period, the highest intensity storm event recorded was a 2-Year 24-hour storm event, with a total rainfall of 3.91 inches. As a comparison, the 5-year, 24-hour storm produces 4.61 inches of rain with a peak intensity of 0.73 inches per hour.

As stated earlier, the estimated inflow volume is calculated using continuity equation (Q = VA). The mean velocity is recorded by the flow meter and the cross-sectional area is calculated by multiplying the width of the weir opening by the flow depth.

Grabowski Square

The weir structure at Grabowski Square is approximately 80-feet long by 3-feet high with four (4) intermediate columns to support the top of the structure, which is located between the MBC and the Combined Sewer Overflow Collector on Harding Street. The structure was designed and built in the 1980s as part of the City's Improvements to the Combined Sewerage System Project. The MBC enters the weir structure junction as a twin box concrete culvert (ranging from 11-foot 6-inch by 9-foot to 11-foot 6-inch by 5-foot) before converging with the Old Millbrook Conduit at a special structure. At this location, the MBC continues as an 8-foot by 19-foot to 13-foot by 18-foot stone arch tunnel. On the other side of the weir structure is the Overflow/Relief Connector Conduit. From the weir structure, the Overflow Connector carries combined sewer flow and runs parallel to the MBC prior to discharging to the QCSOTF.

According to the Green Island Area Flood Study Report, the original design intent of the Grabowski Square weir structure was to allow the drainage system (MBC) to overflow into the overflow collector during storm events and either be stored until the storm subsides or receive treatment at the QCSOTF prior to discharge back into the MBC downstream of the Brosnihan Square siphon structure. However, the report indicated that the hydraulic grade line (HGL) in the overflow collector may exceed the HGL in the MBC during the early part of intense storms. As a result, the overflow could occur in the direction of the drain until the HGL in the MBC rises or the HGL in the overflow collector subside.

A total of five (5) activations occurred at the Grabowski Square weir location since the start of the monitoring period. Table 3 below summarizes the overflow events.

Table 3 - Grabowski Square Overflow Events

Date	Rainfall Total (in)	Duration (hr.)	Peak Hourly Rainfall (in/hr.)	Precipitation Frequency	Estimated Overflow Volume (gallons)
June 28, 2023	0.61	~0.5	n/a (Localized Rainfall)	n/a	710,000
July 2-3, 2023	2.91	2	0.80	1-Year 2-day	3,300,000
July 14, 2023	1.44	13	1	1-Year 1-Hour	3,150,000
July 18, 2023	0.73	~0.5	n/a	1-Year 30-Min	840,000
August 18, 2023	1.13	3	0.85	n/a	2,770,000
				Total Overflow Volume (gal) =	10,770,000

The estimated overflow volume is calculated similarly at both Brosnihan Square and Grabowski Square. However, since there are five (5) openings at the Grabowski weir location separated by four (4) columns, the total estimated overflow volume is approximately five times the volume calculated from one (1) opening. This assumes that an overflow occurs at the same rate across all openings. The calculation method is as follows:

$$Q\ (single\ opening) = VA = V * (D * 15)$$
$$Q\ (entire\ weir) = Q\ (single\ opening) * 5$$

Where,
V = Mean velocity recorded by the flow meter
D = Depth of flow over the weir recorded by the flow meter

The available camera footage confirms that the overflow occurs in the direction of the drain during the early stage of storm events. The direction of the overflow became less apparent once the HGL in the MBC rises and HGL in the overflow collector subsides. For the purpose of estimating overflow volumes, it is assumed the overflow occurs only in the direction of the drain. The actual volume of overflow is likely to be less than the estimated figure due to the direction of overflow.

Worcester is currently utilizing a combination of ultrasonic level and velocity sensors (ADS Triton flow meters) and remote camera equipment to measure overflow data at both the Grabowski Square and Brosnihan Square weir locations. Overflows occur when water levels in the CSO structures rise above a certain threshold. These overflow thresholds are specific to each structure and flow meters have been programmed to trigger automatic alerts when water levels reach these thresholds. See attached Weston and Sampson memo for further details.

The meters will record the times of commencement and cessation of CSO discharges/overflow events occurring at each CSO location by monitoring water levels. The meters will also record beginning and end times for water levels exceeding the overflow threshold at each structure. Overflows can also be visually confirmed through the remote cameras located at each weir. When the Triton+ Meters detect CSO overflows or discharges, the data gathered by the meters will automatically be formatted into notifications that are relayed to the CSO Notification Webpage and to subscribers via email and text.

Calculation of Meter-Reported Discharge Volumes

The City has been actively performing volume calculations for CSO discharge events as part of their CSO Monitoring Reports since the recent installation of the meters and discovery of CSOs in 2023. Overflow data in each CSO regulator is measured by ADS Triton+ meters before being transmitted to ADS' PRISM website where it is used to calculate CSO discharge volumes. ADS Triton+ meters use weir equations to calculate discharge/bypass volumes. These equations are defined below.

Weir Equation:

$$V = .003472 * Q = .003472 * KLH^{1.5}$$

Where:

.003472 = Conversion Factor from Flow Rate to Volume
Q = Flow Rate
K = Constant
L = Weir Length
H = Water Lever in Regulator – Weir Height = Depth of Flow Above Weir

Over the course of a rain event, the QCSOTF effluent gates may open and close repeatedly as they are controlled by water levels. To avoid overwhelming the public with notifications of the start and end of each CSO, some discretion

will be used. In most circumstances, once the Facility has ceased operating for eight hours after the effluent gates close, the CSO event will be determined to have ended. However, if weather conditions indicate a resumption of heavy rains with a likelihood of the CSO recurring within ten hours of the effluent gates closing, the event will be considered to be continuing and notification updates will be issued as per the regulations.

Downstream notification of CSOs will be provided to Worcester, Millbury, Sutton, and Grafton. Based on conversations with Boards of Health and others in these communities, two canoe launches were identified as public access points on the Blackstone River in these municipalities. These locations are located at Riverview Park in Grafton and Tricentennial Park in Sutton. Worcester DPWP has provided signage to Grafton and Sutton to install at these locations.

The Quinsigamond CSO only activates during wet weather and is treated as previously described to remove trash, floatables, and solids, and to provide disinfection. The discharge from the QCSOTF joins the flow in Mill Brook, an underground conduit carrying surface water collected from most of the center of Worcester and as far north as the Town of Holden. Mill Brook, during wet weather events that trigger a CSO, carries very high flows from a large, urbanized watershed. These flows provide dilution to the treated combined sewage discharge from the Facility. Mill Brook then joins the Middle River behind the Walmart shopping plaza on Tobias Boland Way. The Middle River drains another large watershed including parts of Holden, Paxton, Leicester, Auburn, and Millbury as well as the western third of Worcester. This flow further dilutes the CSO. Just south of the CSO outfall at the Middle River is the discharge from UBCW, the regional wastewater treatment plant that provides high quality water to further dilute the CSO. Immediately below the UBCW effluent discharge channel is the Worcester Diversion Channel. During very intense or long duration rain events, the Diversion Channel intercepts flows from Kettle Brook and directs them to the Blackstone River, bypassing portions of Worcester for flood control purposes. When activated, Diversion Channel flows constitute a major input of dilution to the CSO. From this point the Blackstone River flows a turbulent path southward, with rapids adding aeration to the flow. In Sutton, at Depot Road, the River drops over the Singing Dam where it is highly aerated and turbulent, adding to “in-river” treatment of the diluted CSO. Finally, in Grafton, the first major tributary to the Blackstone River, the Quinsigamond River, joins the flow with additional waters further diluting of the CSO. Because of the high levels of dilution and aeration occurring between the CSO outfall in Worcester and confluence with the Quinsigamond River in Grafton, no communities beyond Grafton are considered to be impacted by the Worcester CSO.

In addition to Combined Sewer Overflows, the City is required to make notifications for Sanitary Sewer Overflows (SSOs) when such an overflow is caused by a lack of capacity during wet weather events. These wet weather SSOs could potentially occur in any part of the City that has stormwater infrastructure, as the SSO is expected to discharge from the sanitary sewer into the stormwater sewer in some fashion. A list of water bodies that could be affected by SSOs are listed below in Table 4, as well as the outfall abbreviations included on the City overview map for both CSOs and SSOs (from Section 1). The screening sector is also listed, which describes the general location of the outfall as well as the schedule for annual dry weather outfall screening.

Table 4 - Potential Water Bodies Affected by Wet Weather SSOs

Water Body	Outfall Abbreviations on Map	Dry Weather Screening Sector
Beaver Brook	BB	West
Coes Pond	COP	West
Coes Reservoir	CR+CRT+MORB	West
Patch Pond	CR+PP	West
Patch Reservoir	PR	West

Table 4 - Potential Water Bodies Affected by Wet Weather SSOs		
Water Body	**Outfall Abbreviations on Map**	**Dry Weather Screening Sector**
Tatnuck Brook	TB	West
Blackstone River	BR+BRT	Central
Middle River	BR+BRT+MR	Central
Curtis Pond	CP+CPT	Central
Weasel Brook	MBT+KB+WB	Central
Mill Brook	ILT+MB+IL	Central
Indian Lake	IL+FB+WAB	Central
Salisbury Pond	SP	Central
Kettle Brook	KTB+KTTB	Central
Broad Meadow Brook	BMB+BMBT	East
Lake Quinsigamond	LQ	East
O'Hara Brook	OB	East
Poor Farm Brook	PFB	East
Coal Mine Brook	CM	East
Fitz Brook	LQ	East

4. Discovery and Required Timeline for Notification Following Discharge or Overflow

Quinsigamond Ave CSO Storage and Treatment Facility

Both the effluent gates and bypass gates at the QCSOTF are on the City's SCADA system which will notify an operator if a CSO or a bypass has occurred. These flows are also metered and will calculate total flow of any CSO discharge or bypass.

- **A treated discharge can be confirmed within 4 hours by the arriving operator checking the SCADA or visibly seeing the effluent gate position upon arrival.**
- **A discharge through the open bypass gate can be determined from SCADA.**

Brosnihan Square and Grabowski Square

In order to comply with CSO Notification regulations, ADS Triton+ flow meters were installed in the bypass weir and will provide automated alerts through the City's notification system and website. See Attachment 9 for Detection and Notification SOP.

5. CSO Permittee Website

The City of Worcester website (https://www.worcesterma.gov/water-sewer/sewer-system) is utilized for all CSO and SSO notifications, postings, and related documents. A page was established dedicated to the CSO and SSO information. Constant Contact is used to manage subscriptions and email notifications. DPWP worked with the City's Technical Services Department to develop the webpage, create an on-line "sign up" for notifications, and manage the updates and information posting required by the regulations. The updated website and subscription system have been in use since July 1, 2022. Updates are made by the City's Technical Services Department with information and data supplied by the Department of Public Works & Parks, Sewer Operations Division. The compilation of discharge notifications is automatically updated with each new notification email sent.

Any member of the public can subscribe to receive automated notifications of overflow or bypass events by clicking on the "Sign Up for Alert Worcester!" link shown immediately after the first paragraph on the City's CSO Notification page (https://www.worcesterma.gov/water-sewer/sewer-system). This link will bring the user to the alert center where they can choose to be notified automatically via email.

- **The City of Worcester Department of Public Works & Parks, Sewer Operations staff works with the City's Technical Services Department to maintain the City website. The website includes:**
    - **links to subscribe to the email notification system.**
    - **links to the three most recent CSO Annual Reports as required under the City's NPDES permit.**
    - **a map showing the CSO Treatment Facility, weir locations, and outfall.**
    - **a compilation of all CSO discharge notifications issued since July 1, 2022**
    - **mention of the City's Long Term Control Plan, which is under development and will include future updates**

6. Signage

- **Signage at the CSO outfall has been installed in accordance with NPDES permit requirements.**
- **Signage in accordance with 314 CMR 16.05(3)(a-e) has been installed at canoe launches at Tricentennial Park, 72 Blackstone Street in Sutton and Riverview Park, Providence Road in Grafton.**

7. Public Notification Recipients

- **Vocero Hispano newspaper was identified by the City of Worcester's Communications Office as the primary newspaper serving the Hispanic community in Worcester. There were no known media outlets serving the Vietnamese community.**

Sanitary Sewer Overflows

Sanitary Sewer Overflows (SSOs) in Worcester subject to 314 CMR 16.00 include:

- SSOs caused by capacity limitations in the collection system during wet weather conditions (high flows). These are known as wet weather SSOs.
- SSOs failure of a sewer pumping station or associated force main at the following pumping stations which are designed to convey peak flows of 1 MGD or greater:

Table 5 Pump Stations with flows over 1 MGD

Pump Station	Waterbody
Lake Ave Pumping Station	Lake Quinsigamond
Whitla Drive Pumping Station	Lake Quinsigamond
Dunkirk Ave Pumping Station	Broad Meadow Brook
Holden Street Pumping Station	Indian Lake
Greenwood Ave Pumping Station	Blackstone River

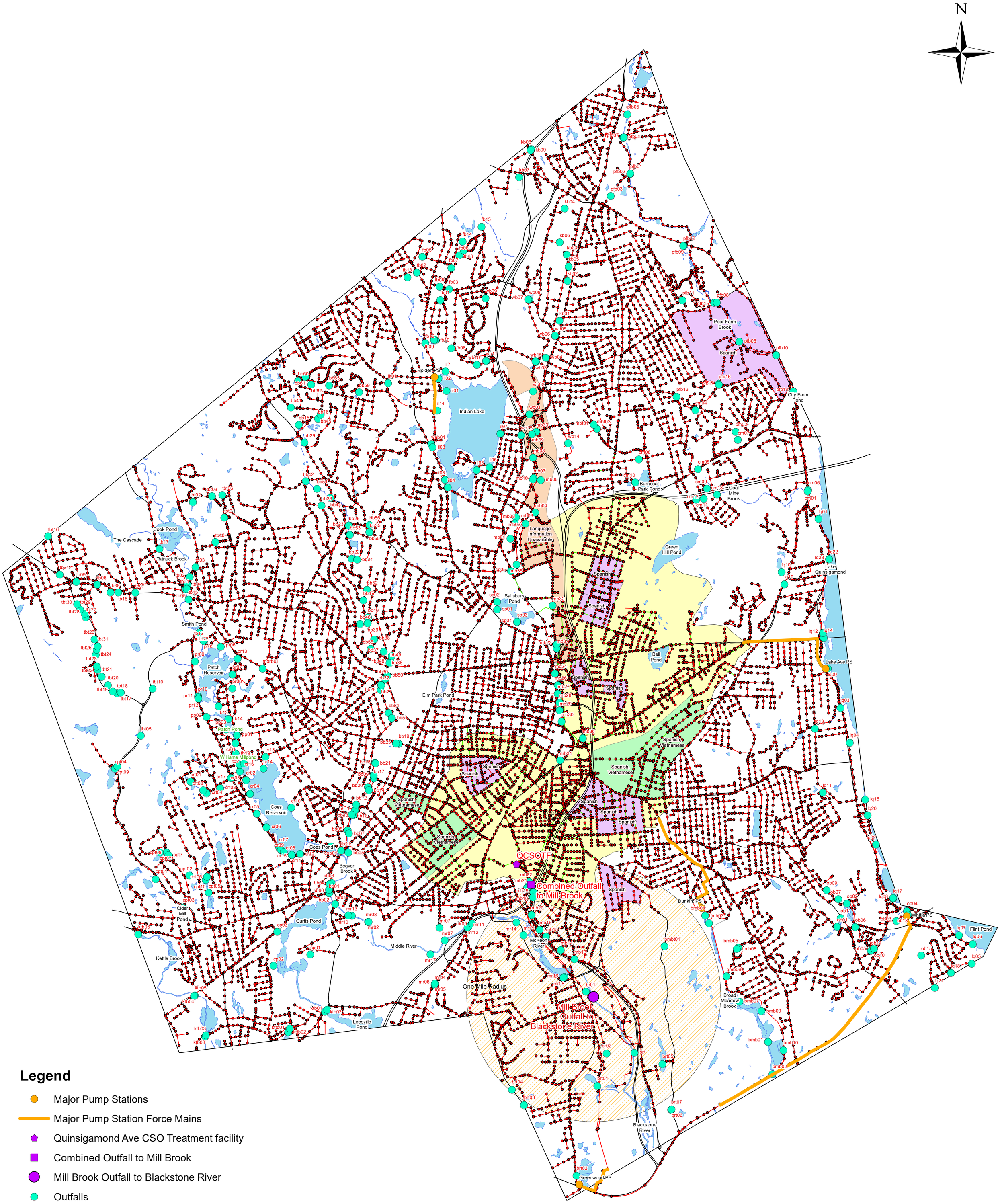
Wet weather SSOs can potentially happen anywhere in the collection system in Worcester. In most cases a wet weather SSO would be conveyed to a surface water through the separate stormwater system (MS4). The MS4 includes 350 stormwater outfalls that discharge to numerous surface waters throughout the City. Wet weather SSOs would be reported by residents or individuals noting odors or other sewage evidence or by DPWP Sewer Operations staff during routine monitoring or maintenance activities.

Because wet weather SSOs are generally unpredictable, with the potential to occur in many places throughout the City, public notification will be as specific as possible based on the location. All notifications would be posted on the City website and emailed to all subscribers to the notification program and relevant contacts on the Required Notification List. Translations for the notification would be provided in Spanish and Vietnamese, the two languages identified for EJ communities lacking English proficiency in Worcester. However, notifications to downstream communities would be specific to the location of the wet weather SSO. Similarly, downstream public water systems might need to be notified of a wet weather SSO depending on where the SSO occurs. The SSO Notification Plan Required Notification List identifies the Boards of Health and Public Water Systems that may need to be notified of a wet weather SSO.

Sewer Pumping Station/Force Main SSOs for 1 MGD stations could occur at the five stations previously mentioned in Table 5. The Lake Ave and Whitla Drive stations are situated near Lake Quinsigamond, though at different locations along the shore. A SSO from Lake Ave Pumping Station would require notification to the Shrewsbury Board of Health. A SSO from Whitla Drive Pumping Station would require notification to Shrewsbury and Grafton due to its proximity to Flint Pond, which is partially in Grafton. Note that Lake Quinsigamond is a lake, not a river. Though there is a net movement of water from north to south, this occurs over months, not hours or days. Past investigations of major SSOs from the Lake Ave Sewer Pumping Station indicate that the extent of bacterial contamination is confined to the area around the pump station. A SSO associated with the Whitla Drive Pumping Station force main could occur near Broad Meadow Brook at Route 20. In that case, Millbury would also be notified. A SSO from the Dunkirk Ave Sewer Pumping Station might impact Broad Meadow Brook, so notifications would include Millbury as a potential downstream impacted community. A SSO at the Greenwood Street pumping station would discharge to a wetland tributary to the Blackstone River so notifications would include the Millbury Board of Health. The Holden pump station is located in the north west corner of Indian Lake, so any SSO at this station would discharge to Indian Lake and would not impact any downstream community and would not require any downstream communites to be notified.

SSO notifications for all events covered by 314 CMR 16.00 would follow the same process as CSO notifications. A SSO/CSO notification page has been established on the City of Worcester website and the subscription process will be identical. The intent is to use a single subscription process and email notification for all regulated SSOs and CSOs. Subscribers will be notified of each event, regardless of their interest or location, with the exception of downstream communities and water systems only receiving site specific SSO notifications.

CSO and SSO Notification Plan



Legend

- Major Pump Stations
- Major Pump Station Force Mains
- Quinsigamond Ave CSO Treatment facility
- Combined Outfall to Mill Brook
- Mill Brook Outfall to Blackstone River
- Outfalls

Worcester EJ Language

Language

- Language Information Unavailable
- Spanish
- Spanish, Vietnamese

Combined Sewer Sector

NAME

- COMBINED SEWER AREA

Outfall Code	Water Body
BB	Beaver Brook
BMB	Broad Meadow Brook
BR (T)	Blackstone River (Tributary)
CM	Coal Mine Brook
CP (T)	Coes Pond (Tributary)
CR (T)	Coes Reservoir (Tributary)
FB	Ford Brook
IL	Indian Lake (Tributary)
KB (KTB, KTTB)	Kettle Brook (Tributary)
LQ	Lake Quinsigamond
MB	Mill Brook (Tributary)
MORB	Moore Brooke
MR	Middle River
OB	O'Hara Brook
PFB	Poor Farm Brook
PP	Patch Pond
PR	Patch Reservoir
SP	Salisbury Pond
TB	Tatnuck Brook (Tributary)
WAB	Delaney Brook
WB	Weasel Brook

CSO and SSO Notification Plan

QCSOTF

Combined Outfall to Mill Brook

Mill Brook Outfall to Blackstone River

Text

McKeon River

Blackstone River

Legend

- Quinsigamond Ave CSO Treatment Facility
- Combined Outfall to Mill Brook
- Mill Brook Outfall to Blackstone River
- Combined Sewer Effluent
- CSO Bypass Line
- Mill Brook

CAUTION

Avoid water activities during or after rainfall
Combined sewer outfall nearby

City of **Worcester**

During or after rainfall, an outfall pipe nearby may release stormwater mixed with sewage.

Sewage can contain bacteria that cause illness.

Go to the website to learn more, sign up for alerts, and see translations:
http://www.worcesterma.gov/water-sewer/sewer-system

The City of
WORCESTER
Department of Public Works & Parks

NOTIFICATION OF COMBINED SEWER OVERFLOW (CSO)

Notification #?-?

Warning: This overflow consists, or likely consists, of untreated or partially treated sewage and waste. Avoid contact with the affected water bodies for 48 hours after the overflow ceases due to increased health risks from bacteria and other pollutants. See website for more information on whether specific resource areas, such as bathing beaches, are affected.

- **Discharge Location:** Outfall #001 behind Walmart, Tobias Boland Way
- **Overflow Began:** MM/DD/YYYY HH/MM
- **Overflow Ended:** MM/DD/YYYY HH/MM
- **Estimated Volume Based on 3-Year History:** 9.7 Million Gallons
- **Actual Treated Volume Based on Metered Flow:** XX Million Gallons
- **Actual Untreated Volume Based on Measured Flow:** XX Million Gallons
- **Permittee:** City of Worcester - NPDES Permit # MA0102997
- **Waters & Areas Potentially Affected:** Blackstone River in Worcester, Millbury, Sutton and Grafton
- For additional information on combined sewer overflows in Worcester visit: https://www.worcesterma.gov/water-sewer/sewer-system

Sincerely,

DPW&P Water & Sewer Operations
18 East Worcester Street
Worcester, MA 01604
Phone: 508-929-1300
Fax: 508-799-1448

The City of
WORCESTER
Department of Public Works & Parks

NOTIFICACIÓN DE DESBORDAMIENTO DE ALCANTARILLADO COMBINADO (CSO)

Nro. de notificación #?-?

Advertencia: Este desbordamiento está compuesto, probablemente, por aguas residuales tratadas parcialmente y por residuos. Evite el contacto con las masas de agua afectadas hasta 48 horas después del cese del desbordamiento debido a la presencia de bacterias y otros contaminantes que aumentan los riesgos para la salud. Consulte el sitio web para obtener más información sobre si están afectadas determinadas zonas de recursos, como los balnearios.

- **Ubicación del vertido:** Desembocadura nro. 001 detrás de Walmart, Tobias Boland Way
- **Inicio del desbordamiento**: MM/DD/YYYY HH/MM
- **Finalización del desbordamiento**: MM/DD/YYYY HH/MM
- **Volumen calculado en función de 3 años de antecedentes:** 9.7 millones de galones
- **Volumen real tratado basado en el caudal medio:** XX millones de galones
- **Volumen real no tratado basado en el flujo medio:** XX millones de galones
- **Permisionario:** ciudad de Worcester - Nro. de permiso del Sistema Nacional de Eliminación de Descargas Contaminantes (NPDES) MA0102997
- **Aguas y áreas posiblemente afectadas:** río Blackstone en Worcester, Millbury, Sutton y Grafton
- Para obtener información adicional sobre los desbordamientos combinados de alcantarillado en Worcester, visite https://www.worcesterma.gov/water-sewer/sewer-system

Atentamente,

Operaciones de agua y alcantarillado del Departamento de Obras Públicas y Parques (DPW&P)
18 East Worcester Street
Worcester, MA 01604
Teléfono: 508-929-1300
Fax: 508-799-1448

The City of WORCESTER
Department of Public Works & Parks

THÔNG BÁO TRÀN CỐNG KẾT HỢP (CSO)

Thông Báo #?-?

Cảnh Báo: Việc tràn cống này có, hoặc có khả năng chứa nước thải và chất thải chưa được xử lý hoặc chỉ mới xử lý một phần. Hãy tránh tiếp xúc với những vùng nước bị ảnh hưởng trong vòng 48 giờ sau khi việc tràn cống ngừng lại do vi khuẩn và những chất ô nhiễm khắc làm gia tăng nguy cơ gây hại cho sức khỏe. Xem trang web để biết thông tin liệu các khu vực tài nguyên cụ thể, chẳng hạn như các bãi tắm biển, có bị ảnh hưởng hay

không.

- **Địa Điểm Xả Tràn:** Cửa Cống số 001 ở phía sau Walmart, Tobias Boland Way
- **Cống tràn bắt đầu lúc**: DD/MM/YYYY HH/MM
- **Cống tràn ngừng lại lúc**: DD/MM/YYYY HH/MM
- **Ước tính thể tích tràn dựa trên lịch sử 3 năm gần nhất**: 9.7 triệu ga-lông
- **Khối lượng xử lý thực tế dựa trên lưu lượng đo được :** XX triệu ga-lông
- **Thể tích thực tế chưa được xử lý dựa trên lưu lượng đo được:** XX triệu ga-lông
- **Bên Được Cấp Phép:**: Thành phố Worcester - Giấy Phép NPDES số MA0102997
- **Các Vùng Nước và Khu Vực Có Khả Năng Bị Ảnh Hưởng**: Sông Blackstone River ở Worcester, Millbury, Sutton và Grafton
- Để biết thêm thông tin về tình trạng tràn cống kết hợp ở Worcester, hãy truy cập https://www.worcesterma.gov/water-sewer/sewer-system

Trân trọng,

Ban Điều Hành Nước và Cống Thoát DPW&P
18 East Worcester Street
Worcester, MA 01604
Điện thoại: 508-929-1300
Fax: 508-799-1448

The City of
WORCESTER
Department of Public Works & Parks

NOTIFICATION OF SANITARY SEWER OVERFLOW (SSO)

Notification #?-?

Warning: This overflow consists, or likely consists, of untreated or partially treated sewage and waste. Avoid contact with the affected water bodies for 48 hours after the overflow ceases due to increased health risks from bacteria and other pollutants. See website for more information on whether specific resource areas, such as bathing beaches, are affected.

- **Discharge Location:** ??
- **Overflow Began:** Date/Time
- **Overflow Ended:** Date/Time
- **Initial Estimated Volume:**
- **Final Estimated Volume:**
- **Permittee:** City of Worcester
- **Waters & Areas Potentially Affected:**

Sincerely,

DPW&P Water & Sewer Operations
18 East Worcester Street
Worcester, MA 01604
Phone: 508-929-1300
Fax: 508-799-1448

CSO/SSO Notification Plan

SSO Notification Required Notification List

- MassDEP: massdep.sewagenotification@mass.gov; daniel.j.kurpaska@mass.gov
- US Environmental Protection Agency: R1.EPANotifications@epa.gov
- Massachusetts Department of Public Health: DPHToxicology@mass.gov
- The municipal board of health or the health department where the outfall or overflow is located:
    - Worcester Department of Inspectional Services: spencerc@worcesterma.gov
- The board of health of the health department for any municipality directly impacted by the discharge or overflow:
    - Millbury Board of Health: millburyboh@townofmillbury.net 508-865-4721
    - Sutton Board of Health: C.Rawinski@town.sutton.ma.us 508-865-8724
    - Grafton Board of Health: healthdept@grafton-ma.gov 508-839-5335
    - Shrewsbury Board of Health: kstockwell@shrewsburyma.gov 508-841-8384
    - Auburn Board of Health: pconway@town.auburn.ma.us 508-832-7703
    - West Boylston Board of Health: boardofhealth@westboylston-ma.gov 774-261-4075
- Any person who subscribed to receive such public advisory notifications by email or text messaging:
    - Enrollment list maintained by Constant Contact
- The public water suppliers where drinking water supplies may be affected:
    - Aquarion Water Company (Millbury) (SSO to Broad Meadow Brook, Blackstone River)
        Millbury Manager Paul Lawson: PLawson@aquarionwater.com 508-865-0555
    - Auburn Water District (SSO to Kettle Brook near James St)
        Superintendent Greg Woods: gwoods@auburnwater.com 508-832-5336
    - South Grafton Water District (SSO to Blackstone River)
        Superintendent Steve Lemoine: StevenSGWD@gmail.com 508-839-0512
    - Shrewsbury Water Department (SSO to Poor Farm Brook)
        Superintendent Dan Rowler: DRowley@shrewsburyma.gov 508-841-8506
- The Massachusetts Department of Conservation and Recreation when its water recreation properties may be affected: MEMA.StatControl@mass.gov (Lake Quinsigamond)
- The Massachusetts Division of Fisheries and Wildlife when its boat ramps and fishing piers may be affected: doug.cameron@mass.gov (Lake Quinsigamond/Flint Pond)
- Operators of any potentially affected bathing beachs, as defined in 105 CMR 445.00: *Minimum Standards for Bathing Beaches (State Sanitary Code: Chapter VII)* (Lake Quinsigamond, Coes Reservoir, Indian Lake, Bell Pond)

CSO Notification Required Notification List

- MassDEP: massdep.sewagenotification@mass.gov; Daniel.j.kurpaska@mass.gov
- US Environmental Protection Agency: R1.EPANotifications@epa.gov
- Massachusetts Department of Public Health: DPHToxicology@mass.gov
- The board of health of the health department for any municipality directly impacted by the discharge or overflow:
    - Millbury Board of Health: millburyboh@townofmillbury.net 508-865-4721
    - Sutton Board of Health: C.Rawinski@town.sutton.ma.us 508-865-8724
    - Grafton Board of Health: healthdept@grafton-ma.gov 508-839-5335
- Any person who subscribed to receive such public advisory notifications by email or text messaging:
    - Enrollment list maintained by Constant Contact
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    - Aquarion Water Company (Millbury)
        Millbury Manager Paul Lawson: PLawson@aquarionwater.com 508-865-0555
    - South Grafton Water District
        Superintendent Steve Lemoine: StevenSGWD@gmail.com 508-839-0512
- The Massachusetts Department of Conservation and Recreation when its water recreation properties may be affected: MEMA.StatControl@mass.gov
- The Massachusetts Division of Fisheries and Wildlife when its boat ramps and fishing piers may be affected: doug.cameron@mass.gov

TECHNICAL MEMORANDUM

DATE: January 10, 2023

SUBJECT: Quinsigamond Avenue Combined Sewer Overflow Storage and Treatment Facility:
Bypass Flow Monitoring Approach
City of Worcester, Massachusetts

OVERVIEW

This memo is prepared for the City of Worcester Department of Public Works & Parks (City) as a supplement to the City's letter sent to MassDEP on June 14, 2022, requesting approval to use a method other than metering to estimate discharge volume during bypass events at the Quinsigamond Avenue Combined Sewer Overflow Storage and Treatment Facility. MassDEP provided the City with interim approval for this approach in their July 1, 2022 letter pending the following additional information (emphasis added):

> The city did not provide an alternative method for estimating the volume of the discharge per 314 CMR 16.04; therefore, **the city shall submit a proposal of an alternative method for estimating the volume of discharge** as part of the final CSO Public Notification Plan due January 12, 2023, per 314 CMR 16.06(2). The **final CSO Notification Plan shall include a definitive schedule as to when the alternative method shall be implemented and online**. The city shall comply with the final plan and schedule as approved by MassDEP.

The intent of this memo is to provide the additional information requested by MassDEP detailing the alternative method to be used and a definitive implementation schedule.

There are two bypass gates at the facility and the configuration of the gates allows for flow to overtop them if the water level exceeds the height of the gates within the bypass conduit. Consequently, there are two flow conditions that can occur during a bypass event, and each will require a distinct approach to estimating discharge volume. These include the following:

1. Bypass gates are open.
2. Bypass gates are closed, and flow overtops them.

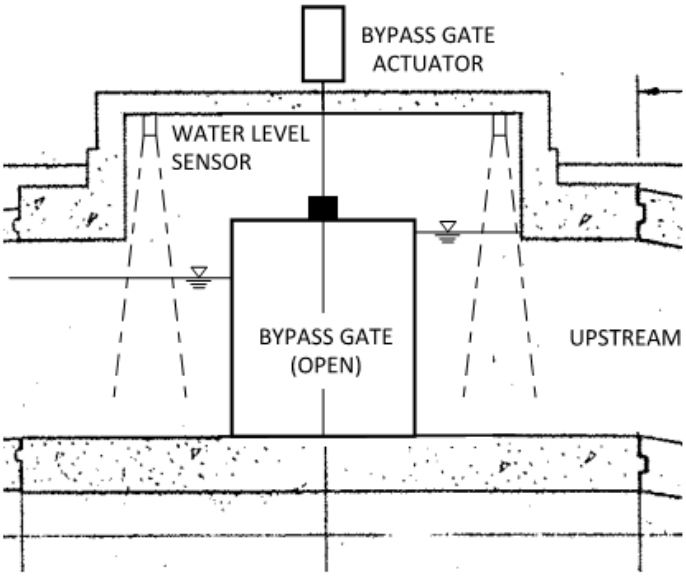
In both conditions, the alternative method for estimating the discharge volume during a bypass event will rely on existing empirical relationships (two total) between flow rate and water levels upstream and/or downstream of the bypass gates. Two new water level sensors will be installed on each side of the bypass gates to measure the water level. The water level sensors will also be integrated with the facility's existing

SCADA system. The SCADA system will be programmed with each empirical relationship to calculate the bypass flow rates. The two bypass gates are electrically actuated butterfly style, each 7' wide and 9' high, and the SCADA system tracks a "percent open" value for each gate. Both bypass gates are typically called to open during a bypass event, which takes approximately 90 seconds to fully open or close.

To estimate total volume of bypass flow during an event, the event duration will be tracked and recorded. The bypass event start and end time criteria will depend on which flow condition(s) occur and are described below for each condition.

Ultrasonic level sensors are proposed for this application because they can be quickly installed and mounting them above the flow channel enables easier access for maintenance. The sensors will always be online and recording water surface elevations, so the City can readily detect and correct failures before bypass events occur. Flow monitoring sensors which are installed below the water surface, such as flow-area sensors, are more difficult to install and maintain. Failures of these sensors may be more difficult to detect, as they do not provide meaningful measurements when the bypass conduit is empty. When these sensor failures are detected, corrective maintenance may be delayed due to the confined space entry requirements of the bypass conduit. If corrective maintenance is required during a storm event, the ultrasonic sensors would be accessible while any sensor installed below the water level would not.

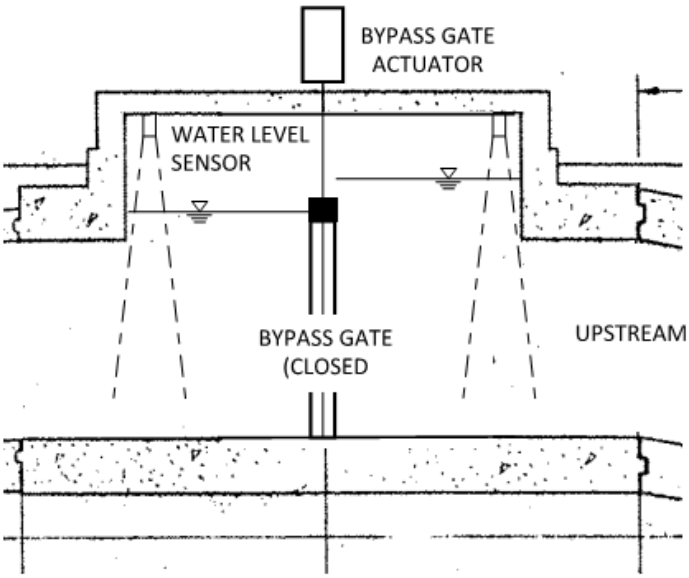
Condition 1 Diagram (not to scale):
Bypass gates are open.



In Condition 1, shown in the diagram above, an existing empirical relationship between flow and head loss through a 7' wide butterfly gate will be used to estimate the bypass flow rate. The head loss through the gate will be estimated using the difference in water level measured by the upstream and downstream water level sensors. To maintain a conservative estimate, gates will be considered fully open for the entire period from when they are called to open to when they fully close. Under this condition, the facility's

SCADA system will track the time when the given bypass gate is called to open and when the gate subsequently closes fully, the difference of which will be recorded as the duration of the bypass event.

Condition 2 Diagram (not to scale):
Bypass gates are closed, and flow overtops them.



Under Condition 2, shown in the diagram above, data from the upstream water level sensor will be used to estimate the bypass flow rate. The flow during such a bypass event will be estimated using a broad-crested weir condition where the height of water above the weir is provided by the upstream water level sensor. The bypass event start time will be recorded as the moment the upstream water elevation first exceeds the top of the gates and the bypass event will end when the water elevation has fallen below the top of the gates.

Total volume discharged during the bypass event can be determined by multiplying the average flow during the bypass event with the event duration. If multiple flow conditions occur during a single bypass event, the earliest bypass start time and latest bypass end time will be used to estimate the bypass event duration.

The City plans to complete the proposed project according to the following schedule, as developed for the City's recent Sewage Notification Assistance Grant application to MassDEP:

1. Engineering Design (6 weeks):	February 13 to March 24, 2023
2. Coordinate scope of work, pricing, and schedule with City on-call vendors (3 weeks)	March 27 to April 14, 2023
3. Lead time for vendors to procure materials and schedule personnel (4 weeks)	April 10 to May 5, 2023
4. Installation, programming, and testing (4 weeks)	May 8 to June 2, 2023

427 Main Street, Suite 400, Worcester, MA 01608
Tel: 508.762.1676

MEMORANDUM

TO:	Jay Fink, Commissioner, Department of Public Works & Parks
FROM:	Frank Occhipinti, PE
DATE:	October 31, 2023
SUBJECT:	Flow and Weir Wall Monitoring

Project Background

In 2022, the City of Worcester retained Weston & Sampson to install two (2) sets of flow meters and remote camera equipment to monitor two (2) weir locations in the City's sewer/combined sewer and drainage collection system. The two (2) weirs are located at Brosnihan Square off Route 146 and Grabowski Square on Harding Street. Figures 1 and 2 provide a schematic of the two (2) weir locations. The goal of this project was to identify potential large inflow sources to the City's sanitary sewer system.

The weir opening at Brosnihan Square (see Photo 1) is approximately 5.2-feet long by 2.5-feet high located between the Millbrook Conduit (MBC) and the City's Main Interceptor. The Brosnihan Square siphon outlet structure is located to the east of the weir opening. Both the Eastern and Western Interceptor converge at the siphon outlet structure, each via a 30-inch triple barrel siphon. The chamber also receives flow from a 32-x42-inch sanitary sewer from Cambridge Street. The 72-inch Main Interceptor exits the siphon chamber on the south side of the structure and transports the sewer/combined sewer flow to the Upper Blackstone Wastewater Treatment Facility (UBWWTF).

Photo 1 - Brosnihan Square Weir

Photo 2 - Overflow Archway

The Millbrook Conduit (MBC), which primarily carries stormwater flow, is located on the other side of the weir. The MBC is connected to the weir opening through an overflow brick and concrete archway (see Photo 2). The invert of the weir opening is approximately 51 inches above the invert of the overflow archway. According to the Green Island Area Flood Study Report dated May 2016 and prepared by CDM Smith, it is speculated that perhaps "the weir wall was built following construction of the CSO facilities, but that the top of the wall

was left open to evaluate system performance before full closure in the event that relief would be needed in some storm events."

The weir structure at Grabowski Square (see Photo 3 below) is approximately 80-feet long by 3-feet high and four (4) intermediate columns support the top of the structure, which is located between the MBC and the Combined Sewer Overflow Collector on Harding Street. The structure was designed and built in the 1980s as part of the City's Improvements to Combined Sewerage System Project. The MBC enters the weir structure junction as a twin box concrete culvert (ranging from 11-foot 6-inch by 9-foot to 11-foot 6-inch by 5-foot) before converging with the Old Millbrook Conduit at a special structure. At this location, the Millbrook Conduit (storm drain) continues as an 8-foot by 19-foot to 13-foot by 18-foot stone arch tunnel. On the other side of the weir structure is the Overflow/Relief Connector Conduit. From the weir structure, the Overflow Connector carries combined sewer flow and runs parallel to the MBC prior discharging to the Quinsigamond Ave Combined Sewer Overflow Treatment Facility (QACSOTF)

Photo 3 - Grabowski Square Weir Structure

According to the Green Island Area Flood Study Report, the original design intent of the Grabowski Square weir structure was to allow the drainage system (MBC) to overflow into the overflow collector during storm events and either be stored until the storm subsides or receive treatment at the QACSOTF prior to discharge back into the MBC downstream of Brosnihan Square siphon structure. However, the report indicated that the hydraulic grade line (HGL) in the overflow collector may exceed the HGL in the MBC during the early part of intense storms. As a result, the overflow could occur in the direction of the drain until the HGL in the MBC rises or the HGL in the overflow collector subside.

Monitoring Result Summary

Both sets of the flow meters and remote camera equipment were installed on March 22, 2022 at the two (2) weir locations. The flow meters are equipped with depth and velocity sensor, and the flow rates are calculated using continuity equation ($Q = VA$, where A is the cross sectional area of flow, and V is the mean velocity). Rainfall data is collected from the City owned rain gauge installed at the Beaverbrook

pump station and supplemented by the National Weather Service (NWS) station at the Worcester Regional Airport.

Brosnihan Square – A total of 21 activations has occurred at the Brosnihan Square weir location since the start of the monitoring period. The camera footage confirmed that the MBC (drainage system) overflowed into the Main Interceptor/siphon outlet structure during overflow events and contributed a significant amount of inflow to the UBWWTF. It appears that a small storm event (i.e. less than a 1-year frequency rain event), can trigger an inflow event at the Brosnihan Square weir location. Table 1 below summaries the inflow events.

Table 1 - Brosnihan Square Overflow Events

Date	Rainfall Total (in)	Duration (hr)	Peak Hourly Rainfall (in/hr)	Precipitation Frequency	Estimated Inflow Volume (gallons)
April 8, 2002	1.13	6	0.53	n/a	2,700
April 19, 2022	1.18	6	0.43	n/a	Not Delectable
May 28, 2022	0.75	1.5	n/a (Localized Rainfall)	n/a	4,800
June 9, 2022	1.33	3.5	0.58	1-Year 3-Hour	1,100,000
August 26, 2022	1	2	0.91	1-Year 2-Hour	290,000
September 6, 2022	3.91	36	0.57	2-Year 24-Hour	Sensor malfunction
December 23, 2022	2.29	22	0.34	1-Year 24-Hour	Sensor malfunction
April 30, 2023	2.14	30	0.36	n/a	380,000
June 28, 2023	0.61	~0.5	n/a (Localized Rainfall)	n/a	120,000
July 2-3, 2023	2.91	48	0.8	1-Year 2-day	1,300,000
July 10, 2023	2.51	24	1.17	1-Year 24-Hour	580,000
July 14, 2023	1.44	13	1	1-Year 1-Hour	153,000
July 16, 2023	1.14	15	0.72	n/a	514,000
July 18, 2023	0.73	0.5	n/a	1-Year 30-Min	165,000
July 29, 2023	0.80	3	0.46	n/a	230,000
August 8, 2023	0.40	~0.5	n/a	n/a	51,400
August 18, 2023	1.13	3	0.85	n/a	1,060,000
August 25, 2023	1.4	14	0.44	n/a	3,500
September 8, 2023	0.85	~0.5	n/a (Localized Rainfall)	1-Year 30-Min	202,000
September 11, 2023	1.17	5	0.46	n/a	593,000
September 29, 2023	2.23	17	0.35	1-Year 24-Hour	240,000
				Total Inflow Volume (gal) =	6,989,400

It should be noted that the month of July and August of 2023 has seen above average rainfall, which led to considerably more activations and allowing the City to have a better understanding of the inflow events occurring at the Brosnihan Square weir location. However, even with the above average rainfall, there appears to be a lack of high intensity storm event. The Massachusetts Department of Environmental Protection's (MassDEP) standard for assessing the risk for sanitary sewer overflows (SSOs) is a 5-year 24-hour storm. Since the start of the monitoring period, the highest intensity storm event recorded was a 2-Year 24-Hour storm event, with a total rainfall of 3.91 inches. As a comparison, the 5-year, 24-hour storm produces 4.61 inches of rain with a peak intensity of 0.73 inches per hour.

As stated earlier, the estimated inflow volume is calculated using continuity equation (Q = VA). The mean velocity was recorded by the flow meter and the cross sectional area is calculated by multiplying the width of the weir opening by the flow depth recorded by the flow meter.

Grabowski Square – A total of 5 activations occurred at the Grabowski Square weir location since the start of the monitoring period. Table 2 below summaries the overflow events.

Table 2 - Grabowski Square Overflow Events

Date	Rainfall Total (in)	Duration (hr.)	Peak Hourly Rainfall (in/hr.)	Precipitation Frequency	Estimated Overflow Volume (gallons)
June 28, 2023	0.61	~0.5	n/a (Localized Rainfall)	n/a	710,000
July 2-3, 2023	2.91	2	0.8	1-Year 2-day	3,300,000
July 14, 2023	1.44	13	1	1-Year 1-Hour	3,150,000
July 18, 2023	0.73	~0.5	n/a	1-Year 30-Min	840,000
August 18, 2023	1.13	3	0.85	n/a	2,770,000
				Total Overflow Volume (gal) =	10,770,000

The estimated overflow volume is calculated similarly to the method used for the Brosnihan Square weir. However, since there are five (5) openings at the Grabowski weir location separated by four (4) columns, the total estimated overflow volume is approximately five times the volume calculated from one (1) opening. This assumes that an overflow occurs at the same rate across all openings. The calculation method is as follows:

$$Q\ (single\ opening) = VA = V * (D * 15)$$
$$Q\ (entire\ weir) = Q\ (single\ opening) * 5$$

Where,
V = Mean velocity recorded by the flow meter
D = Flow recorded by the flow meter

The available camera footage confirms that the overflow occurs in the direction of the drain during the early stage of storm events. The direction of the overflow became less apparent once the HGL in the MBC rises and HGL in the overflow collector subsides. For the purpose of estimating overflow volumes, it is assumed the overflow occurs only in the direction of the drain. The actual volume of overflow is likely to be less than the estimated figure due to the direction of overflow. In addition, it should be noted that the City had no knowledge of the activations prior to installation of the metering equipment.