CAMBRIDGE COMBINED SEWER OVERFLOW (CSO) FLOATABLE CONTROL EVALUATION REPORT

CAMBRIDGE, MA

PROJECT NUMBER:
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CAMBRIDGE, MA

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1 EXECUTIVE SUMMARY

In August 2024, the Massachusetts Department of Environmental Protection (MassDEP) issued two updates for the Final Determination to Adopt a Water Quality Standards Variance (Variance) for Combined Sewer Overflow (CSO) Discharges to the Alewife Brook/Upper Mystic River Basin and to the Lower Charles River/Charles Basin, respectively. These Variances were later approved by the United States Environmental Protection Agency (EPA). The Variances detail regulatory requirements for municipalities discharging into the Alewife Brook/Upper Mystic River Basin and the Lower Charles River/Charles Basin. As part of the City of Cambridge's (City) compliance with the Variances, the City completed a review of technologies available to combat floatables in CSO discharges. Both Variances state that the City must complete an evaluation to assess the effectiveness of the current floatables control and identify recommendations for improvements.

"Floatables" refers to debris, trash, and other floating solid material that may be present in CSO discharges and represent one of the most visible pollutants that can impact downstream receiving bodies of water. Methods for combating floatables can include preventing floatables from entering the combined sewer system at the source, installing structural controls within the system or regulator itself to capture floatables, or installing technologies to capture floatables at the CSO outfall itself. The following report discusses technologies that have precedent in floatables control design and may be considered by the City of Cambridge to bolster existing floatables controls in their combined sewer system. Floatables are not specific to combined sewer systems and also present a concern within stormwater systems as well. This report does not evaluate stormwater floatables control in detail.

The City is committed to mitigating floatables throughout the system, including at CSO regulators and outfalls. Based on public feedback and the frequency of CSO events, CAM401A was chosen for the field observations performed as part of this evaluation. The City also analyzed the following floatables control best management practices (BMPs) for CSOs in this report: catch basin (CB) modifications, street sweeping, public education and outreach, baffles, screens, dynamic baffles, self-cleaning bar screens, hydrodynamic separators, netting, and containment booms. For each BMP, details describing cost, operation and maintenance requirements, and likely effectiveness were reviewed. Regulatory and permitting requirements were also examined as part of this evaluation.

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The existing source control program for floatables works to reduce floatable debris in the Alewife Brook and Charles River from both combined and separated sources throughout Cambridge. Therefore, the City intends to emphasize existing floatables control protocols and BMPs through the following:

1. Continue the public education program around stormwater management.
2. Continue to investigate the presence of hoods on CBs tributary to CSO outfalls through the CB inspection and cleaning program, with particular attention to CAM401A (given that it has been noted through public commentary).
3. Continue to respond to the SeeClickFix reports and complaints received.
4. Continue with the monthly inspection of the CSO regulators.

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2 EVALUATION BACKGROUND

2.1 CSO VARIANCE

On August 30, 2024, MassDEP issued updates for the Final Determination to Adopt a Water Quality Standards Variance for Combined Sewer Overflow Discharges to the Alewife Brook/Upper Mystic River Basin and to the Lower Charles River/Charles Basin, respectively. These Variances were later approved by EPA. The Alewife Brook/Upper Mystic River Basin Variance was issued to the City of Cambridge, City of Somerville, and the Massachusetts Water Resources Authority (MWRA). The Lower Charles River/Charles Basin Variance was issued to the City of Cambridge and MWRA. The City of Cambridge, the City of Somerville, and MWRA are responsible for the investigation of their respective CSO outfalls. The Variances require the City to take steps to reduce CSO events and mitigate their impact. MassDEP reached out to watershed advocacy groups for input on the Variance. Advocacy groups raised concerns about floatables associated with the outfalls. As a result, the Variance requires that the City compile this report, which evaluates floatables originating from the collection system in the vicinity of CSO structures and identifies potential best management practices for reducing floatables from CSO outfalls. The Variance also requires that the City implement the recommendations identified by the evaluation.

2.2 PUBLIC INVOLVEMENT

Prior to issuing the Variance, MassDEP held a public comment period on the Variance. MassDEP received extensive feedback from watershed associations and members of the general public. Commenters expressed strong concern over the continued discharge of untreated sewage and the failure of existing floatables controls, particularly at CAM401A near the Alewife MBTA Station. Multiple submissions documented visible pollution, including toilet paper and other sanitary waste, and called for enforcement of existing requirements, installation of post-discharge containment measures (e.g., booms or netting), and periodic cleanup. Additional recommendations included implementation of green stormwater infrastructure, public notification systems for sewage discharges, and educational campaigns to reduce wet weather inflow. A record of public comments regarding the Variance can be found at the following link: https://www.mass.gov/doc/response-to-public-comments-on-the-2019-cso-variance-determinations/download

Of the nine (9) existing CSOs owned and managed by the City, CAM401A is the most active. The CAM401A regulator is situated on Sherman Street. The nearly one-mile-long CSO overflow pipeline also

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receives stormwater contributions from residential and commercial properties along its route to the discharge outfall behind the Alewife MBTA Station (as shown in **Figure 1**). CAM401A is the only CSO outfall where public concern about floatables was raised in recent years.

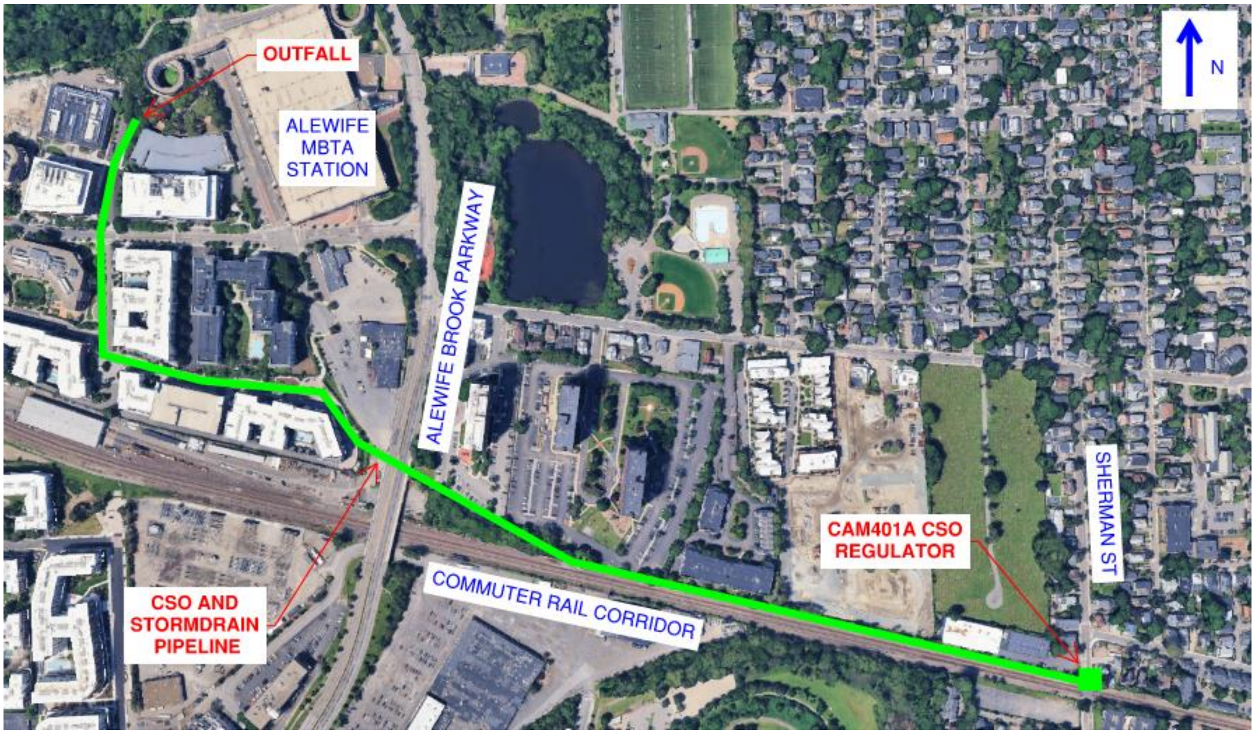

Figure 1: CAM401A CSO Regulator and Outfall Pipeline

Watershed Associations continue to raise awareness regarding the receiving water and the concern around floatable discharges from CSOs. An example of online articles published on the topic includes the following: https://savethealewifebrook.org/blog/

2.3 REPORT CONTENTS

Chapter 3: Overview of Floatables Controls – This section explains the process by which floatables enter sewer systems. It describes situations that improve or worsen floatables. It ends with a description of common floatable control BMPs used in wastewater collection systems.

Chapter 4: Existing Floatables Conditions – This section describes the configuration and condition of the City's seven active CSOs (two CSOs are temporarily closed). It includes a description of existing floatable controls at each CSO.

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Chapter 5: Floatables Controls Evaluation – This section discusses the basis of design for the existing floatables control at the City's CSOs. It assesses the applicability of empirical models to inform on conditions that may impact baffle efficiency and details site visits conducted to evaluate the presence of floatables during wet and dry weather periods.

Chapter 6: Considerations for System Floatables Control – This section presents existing regulations and permitting considerations that may impact floatables control within the City's wastewater collection system.

Chapter 7: Findings and Recommendations – This section summarizes the findings from the floatables control evaluation and provides recommendations to further enhance floatables control.

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3 OVERVIEW OF FLOATABLE CONTROLS

"Floatables" refers to debris, trash, and other floating solid material that may be present in CSO discharges and represent one of the most visible pollutants impacting receiving waters. Floatables in sewer systems originate from a variety of sources, including improperly flushed items such as wipes, sanitary products, and packaging materials; debris washed into storm drains during rainfall; oil from vehicles; leaves; and litter discarded along streets and sidewalks. Floatables also enter the sewer system when debris left along roads and paths washes into storm drains during precipitation events. There are no criteria for the minimum size of floatables. However, this report focuses on floatables large enough to be visible to the human eye.

During dry-weather operation of combined sewer systems, floatables originating in storm sewers are combined with sanitary sewer flow and brought to the wastewater treatment plant and filtered out with bar screens or similar technology during preliminary treatment. However, during some wet weather events, combined sewer floatable debris may breach regulator structure weirs and be conveyed into waterways.

While this report focuses on floatables generation within the combined sewer system and at outfalls, they are not the sole contributors. Effective mitigation strategies must also account for other significant sources, including stormwater runoff from areas adjacent to the receiving water bodies, as well as littering.

Options for controlling floatables in combined sewers typically fall within three main categories:

1. Source Controls
2. In-System Controls
3. End-of-Pipe Controls

Source controls are focused on preventing trash and debris from entering the combined sewer system to begin with, either from non-structural BMPs or structural controls on inlets and CBs that convey flow into receiving water bodies. In-system controls are centralized floatable controls within the combined sewer system itself, such as at the regulator structure, that prevent floatables from leaving the system and being discharged into waterways. Lastly, end-of-pipe controls are located at the outfall location and are external to the combined sewer system and collect floatable debris before they are washed away into the receiving

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waterbody, creating a centralized location for maintenance and disposal of floatable debris. Specific options for each type of floatable control are presented below.

3.1 SOURCE CONTROL TECHNOLOGIES

Source control methods for reducing floatable debris fall into two categories: structural, which require physical modifications to the combined sewer system, and non-structural. A combination of structural and non-structural options for floatables control is discussed in Sections 2.1.1 – 2.1.3.

3.1.1 Structural (Catch Basin Modifications)

CBs can serve as an entry point for floatables, sediments, and debris to the combined sewer system and therefore represent an opportunity to collect floatables closer to their source. CB inlets are generally covered with a grate and are designed to limit large debris from entering the combined sewer system; however, additional steps can be taken to make CBs more resistant to passing floatables downstream to outfalls. Modifications to CBs aim to prevent floatables from entering the sewer lateral and entering the combined sewer system. Examples include:

- Placing a hood (also called a trap) over the CB outlet
- Creating a submerged outlet that is connected to the combined sewer system via a riser
- Placing a trash bucket below the inlet grate to catch debris and allow water to flow around

CB hoods and submerged outlets both operate by raising the water surface in the CB above the fully submerged outlet point, taking advantage of the buoyant nature of floatable debris to keep floatable material from reaching the CB outlet. Trash buckets are slotted buckets that sit directly below CB openings, allowing water to freely pass through to the CB sump while retaining larger floatable debris that cannot pass through the bucket’s openings. Examples of all three CB modifications are included in **Figure 2**.

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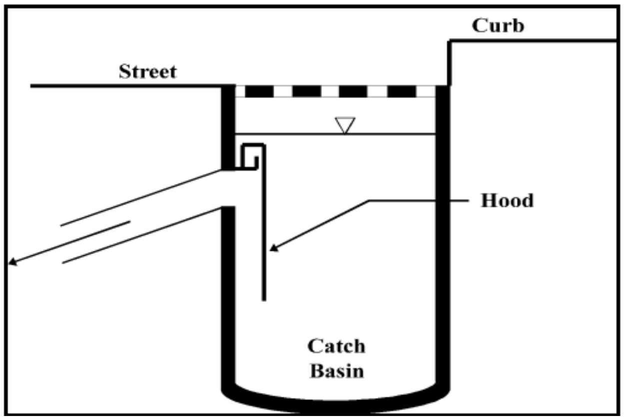

Figure 2: Graphical depiction of CB retrofitted with hood (left) and example of CB hood installed with captured floatable debris (right)
Source: EPA 832-F99-008

CB modifications are an effective floatable control and have demonstrated up to an 85% reduction in litter entering the combined sewer system per CB; however, the method creates significant maintenance needs as debris is collected across the watershed at every inlet point. To avoid clogging and inlet restrictions, a robust program to clear the buildup of debris in CBs is required if this method is used.

3.1.2 Non-Structural - Street Sweeping

Street sweeping of parking lots and curbed streets is an effective way to prevent trash and other debris from making it to the combined sewer system inlets and CBs during storm events. Sweeping should be completed using vacuum sweepers, which can collect both large debris and fine dust and sediment, and (if possible) is recommended to be completed monthly for areas of concern. Street sweeping is typically a requirement of communities that have separated stormwater systems and need to comply with the Massachusetts General Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) permit, so existing programs could be expanded (if funds are available) to aid in floatable control within the combined sewer service areas as well.

While sweeping can effectively remove trash from entering the combined sewer system, because it is an intermittent practice, it is not recommended as the sole floatables control practice to be employed. Rather, sweeping can supplement structural practices to capture floatables and debris and help reduce the maintenance requirements by lowering the loading of floatables to the system.

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3.1.3 Non-Structural - Public Education and Outreach

Another non-structural best management practice to prevent floatables and debris from making it to the combined sewer system is public education and outreach. Programs to educate the public about litter, stormwater runoff, and the potential impacts to downstream receiving bodies can help make residents aware of the importance of properly disposing of debris and help lessen the loading of floatables in the combined sewer system. This can include signage on CBs to make it clear that runoff can drain to waterbodies, social media campaigns, or school programs to teach about the importance of pollution prevention. Similar to street sweeping, public education and outreach is not a standalone management practice to address floatables but rather helps lessen the loading to other practices. For communities that also have separated stormwater sewer systems and are regulated by the Massachusetts General MS4 NPDES permit, public education and outreach programs should already be in place that cover similar topics within the separated sewer areas. These programs can be expanded to include relevant signage in the combined sewer service areas and include materials focused on floatable debris pollution.

3.2 IN-SYSTEM CONTROL TECHNOLOGIES

3.2.1 Baffles

Baffles are vertical panels, typically constructed of either steel or concrete, that are affixed to the top of a CSO regulator and placed at an elevation just below the height of the regulating weir. This forces the water surface above the baffle during discharge events, causing floatable materials to be caught behind the baffle. Following the discharge event, floatable material will remain within the combined sewer system and be conveyed to the wastewater treatment plant. Underflow baffles, where flow is forced below the baffle, are the only type of baffle applicable for floatable controls.

Baffles are a simple and low-cost technology that can be applied to most CSO regulators, including both new construction and retrofit of existing ones. Stainless steel baffles are typically used to retrofit existing regulators for ease of installation, while concrete (a cheaper option) is typically recommended for new construction. Because debris theoretically should be conveyed away from the regulator following an event, required maintenance is minimal.

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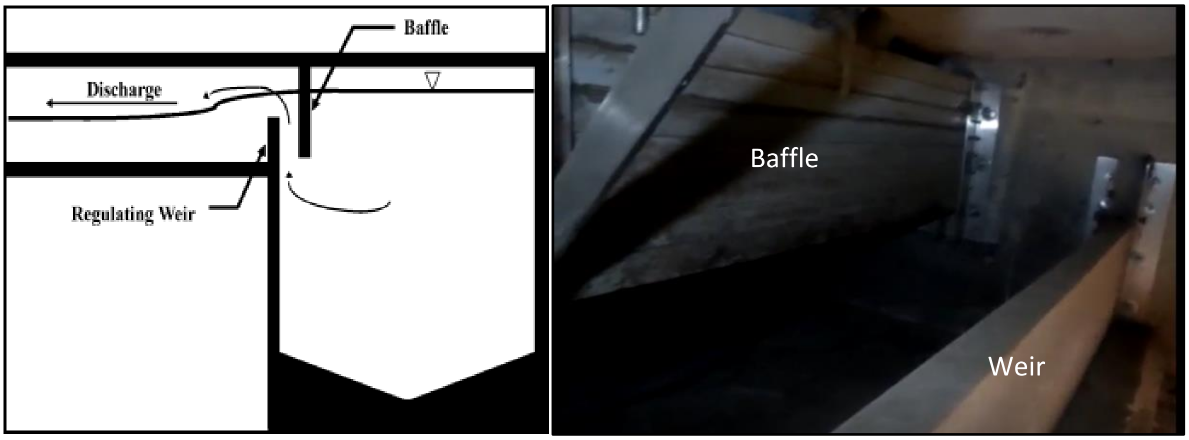

Figure 3: Graphical depiction of baffle upstream of regulator weir (left) and example of baffle installed at a regulator weir (right)*; Source: EPA 832-F99-008 (left) and Somerville DPW (right)*

3.2.2 Screens

Screens are placed within the combined sewer system to capture floatables and debris prior to reaching the regulator and outfall. Screens can be located within the collection system itself, placed in manholes or other drainage structures to capture debris before being flushed downstream, or as an end-of-pipe solution at the outfall point. In either case, maintenance access should be considered before installing a screen.

Screens are comprised of a grid of metal bars that physically prevent debris from flowing through the combined sewer system. The size of the grid can vastly change the capture potential of the system, with measured performance ranging between 25 and 90% of material captured, depending on the grid size. Typically, in combined sewer applications, a grid size opening larger than 1 inch is used because smaller sizes result in clogging and more frequent maintenance. Screens with these larger openings are typically referred to as bar screens.

Maintenance for screens is significant because the buildup of debris on the screens can reduce the hydraulic capacity of the system and cause clogging. Maintenance is recommended following every overflow event. Therefore, when placing a bar screen within a combined sewer system, access for maintenance must be considered.

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Figure 4: Example bar screen installation within a combined sewer system manhole

3.2.3 Proprietary Controls

In addition to the technologies discussed thus far, proprietary products are available that employ technologies such as baffles, screens, and nets to control floatables and improve maintenance of the systems. Proprietary controls typically carry a higher cost than the other technologies discussed, but can come with reduced need for maintenance, personnel, and higher performance. Some examples of products available include:

- <u>Dynamic Baffles:</u>
  Dynamic baffles are situated within combined sewer system structures and use a buoyant frame to adjust to the level of flow within the combined sewer system. This allows the floatables control to be employed in both low and high flow conditions. Unlike traditional baffles, which are typically placed at regulator weirs to ensure flow reaches the baffle, dynamic baffles can be used in-line with the combined sewer system to provide multiple points of floatables control. An example of a dynamic baffle is shown in **Figure 5**.

- <u>Self-Cleaning Bar Screens:</u>
  Self-cleaning screens are mechanically raked, typically using rakes attached to a looped chain, to remove the buildup of debris on the surface of the screen. These systems are typically paired with a pressure transducer to measure the pressure in the system and indicate via pressure

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drops when clogging of the screen starts to occur, therefore triggering the need for the screen to be cleared.

- Hydrodynamic Separators
  Hydrodynamic separators, or swirlers and vortex units, use a cylindrical chamber to separate trash and solids from incoming flows. The chamber causes flow to induce a circular pattern where the change in velocity causes solids to drop out of the flow and settle. This, paired with screens and baffles over the lower outlet, serves the dual purpose of removing solids and capturing floatables and trash within the system.

Figure 5: Dynamic Baffle (L), Mechanically Cleaned Screen (C), and Hydrodynamic Separator (R)

3.3 END-OF-PIPE CONTROL TECHNOLOGIES

3.3.1 Netting

Nets can be used as an end-of-pipe solution to capture any large debris or floatables that make it through the regulator during a CSO discharge. Nets can either be suspended via a metal frame within an outfall regulator to catch debris in-line, or installed floating in the receiving water body to capture debris outside of the regulator. If they are located in the receiving water body at the outfall point of a CSO regulator, permitting may be challenging due to the potential impact on aquatic habitat. Nets should also not be placed in locations with high recreational activity due to potential damage to the system.

Nets can be designed to a variety of sizes to reduce the frequency of maintenance needed to clear debris; however, if installed outside of the regulator buildup of floatables can be highly visible to the public. Regular maintenance is required to empty debris to avoid clogging of outfalls. Because they are

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an end-of-pipe solution, nets can work well in tandem with other in-system and source control solutions, providing a last line of defense against floatables reaching the receiving body of water.

Figure 6: End-of-pipe netting system.
Source: Learn About Aquatic Trash | US EPA

3.3.2 Containment Booms

Containment booms are floating structures that create a continuous barrier across a water body and intercept floatables from the surface. Similar to netting, they are an end-of-pipe solution that can create a highly visible accumulation point of debris while preventing floatables from migrating further downstream in the receiving bodies of water. Booms are typically anchored to structures installed on the shores and include curtains that extend below the surface of the water to act as a baffle across an open water body.

Trash that accumulates behind containment booms needs to be cleared on a regular basis, either manually or using a skimmer vessel that can retrieve debris from the water surface. As an end-of-pipe solution, containment booms are also effective in tandem with upstream solutions. This can minimize the frequency of required maintenance and allow the boom to serve as a last line of defense against floatables.

As with nets, containment booms located within the receiving water body can be an impediment to recreation due to the physical barrier on the surface that they pose. Additionally, containment booms

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cannot be used during winter months in water bodies that regularly freeze, as the boom is required to float on the water surface to be effective.

Figure 7: Containment boom floating on water surface. Floatables are trapped on one side of the boom. *Source: Learn About Aquatic Trash | US EPA*

3.4 FLOATABLE CONTROLS BMP SUMMARY TABLE

Table 1. BMP Summary Table

BMP	Description	Pros	Cons	Cost Range
Catch Basin Modifications	Source control. Raises CB water surface above outlet point. Examples include: hood, outlet connected to combined sewer via riser, slotted bucket below inlet grate.	Up to 85% reduction in litter entering combined sewer system per CB.	Requires routine and distributed maintenance to clear debris buildup.	$1,000-$3,000
Street Sweeping	Source control. Vacuum sweepers which can collect both large debris and fine dust and sediment.	Existing programs could be expanded to aid combined sewer service area.	Requires consistent, high-frequency sweeping for BMP to be effective; cannot stand alone as a control.	Staff time
Public Education	Source control. Can include signage on CBs, social media campaigns, or school programs.	Existing stormwater and sewer education programs could expand to include relevant signage and materials for combined sewer service areas.	Cannot stand alone as a control, only as a supplement to additional structural controls.	Staff time
Baffles	In-system control. Vertical panels (typically steel or concrete) affix to CSO regulators and extend below top of weir. Flow travels under baffle, which catches floatables.	Low-maintenance – self-flushing, and contained at single point at regulator. Simple and low-cost technology. Retrofitting existing systems is an option.	Likely to require structure modification to achieve required flow paradigm	$70,000 - $100,000 + installation and structure modifications where required

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BMP	Description	Pros	Cons	Cost Range
Dynamic Baffles	Proprietary in-system control. These baffles use a buoyant frame to adjust to the level of flow within the CSO, allowing floatables to control for varying flow heights.	Low-maintenance, self-flushing. Adjusts to low or high flow for continuous floatables control. Can be used in-line with the combined sewer system instead of just at regulator weirs like static baffles.	Likely to require structure modification to achieve required flow paradigm	$25,000 - $50,000 + installation and structure modifications where required
Screens	In-system control. Can be located within the collection system, in manholes or other drainage structures, or as end-of-pipe solutions. Bar screens (grid opening greater than 1") typically used in combined sewers.	Maintenance only required at point locations. Measured performance between 25 and 90% of material captured depending on grid size.	Regular maintenance required, recommended after every storm event. Smaller grid sizes require more frequent maintenance and cause clogging. Access for maintenance must be considered.	$1,000 - $5,000
Self-Cleaning Bar Screens	Proprietary in-system control. These screens are mechanically raked with rakes attached to a loop chain, typically connected to a pressure transducer which senses clogging.	Maintenance only required at point locations. Self-cleaning function reduces maintenance and clogging frequency, decreasing reasonable grid size to catch finer materials.	More expensive than simple screen options. Self-cleaning screens systems larger and therefore less flexibly installed than other screen options. Requires mechanical power source.	$200,000 - $400,000 + installation and structure modifications where required
Hydrodynamic Separators	Proprietary in-system control. Also known as swirlers or vortex units, these are cylindrical chambers that induce circular flow to settle solids while capturing floatables with screens and baffles over the outlet.	Maintenance required only at point locations. Dual function of solid settling and floatables capture.	Regular maintenance required.	$70,000 - $100,000
Netting	End-of-pipe control. Can be suspended via metal frame within outfall regulators, or floating in receiving water body to catch floatables.	Maintenance only required at point locations. Can work well in tandem with other in-system controls, providing last line of defense.	Regular maintenance required. May present permitting challenges due to potential impact on aquatic habitat. Unsuitable for locations with heavy recreational activity due to potential system damage. Floatable build-up can be highly visible if netting installed outside of regulators.	$700 - $1,500, plus maintenance
Containment Booms	End-of-pipe control. Floating structures create a continuous surface barrier to intercept floatables. Typically anchored to on-shore structures and include curtains extending below the water surface.	Maintenance only required at point locations. Can work well in tandem with other in-system controls, providing last line of defense.	Regular maintenance required. My impeded recreation due to physical surface barrier. Unsuitable for winter use in water bodies that regularly freeze. Buildup of floatables can be highly visible to the public.	$1,000-$2,000, plus maintenance

**Note: Cost are based on compiled information from vendor inquiries across April through August 2025 and prior construction projects. These costs are approximations for planning purposes and may not reflect actual costs from specific project improvements. For maintenance cost (performed by staff when possible), assumed $3,000 per day for a 2-person crew. Otherwise, vendor service and maintenance contracts may be available for each product at negotiated rates.*

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4 EXISTING FLOATABLE CONTROLS

The City manages nine CSO outfalls. Seven outfalls are active and two are temporarily closed (CAM009 and CAM011). The locations of the CSO outfalls are shown in **Figure 8**. The figure also shows CSO outfalls managed by the City of Somerville and MWRA. Of the seven active CSOs managed by Cambridge, four discharge into the Alewife Brook and three into the Charles River.

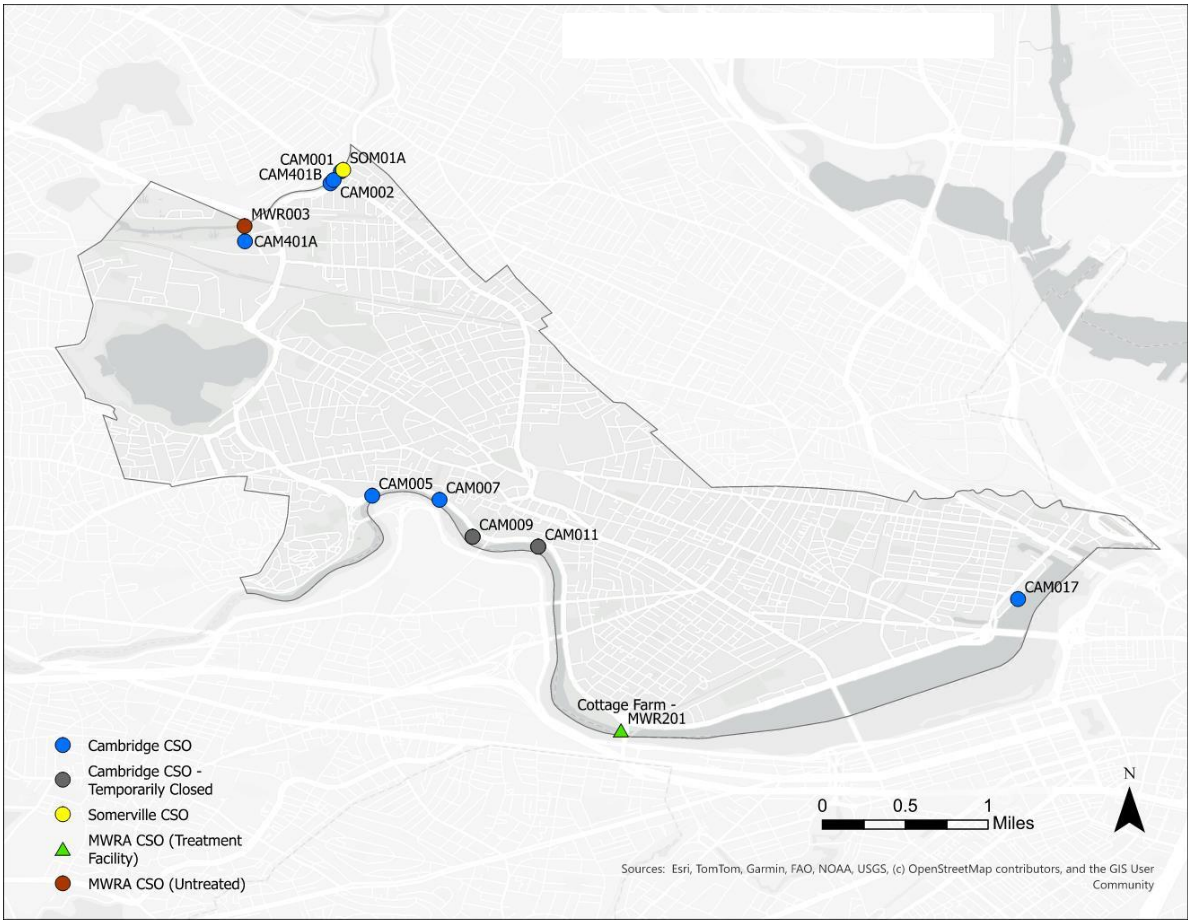

Figure 8: Active CSOs within Cambridge

4.1 CITY OPERATIONS AND SOURCE CONTROLS

Non-structural controls serve as a major component of the City's floatable control strategy, with several programs helping reduce the amount of floatables that flow to the combined sewer system at the source. These controls include CB cleaning programs, street sweeping programs, public outreach and education, and volunteer programs that encourage residents to help in reducing floatable contributions.

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Additionally, CB hoods are used throughout the city as a distributed structural control that aims at source reduction of floatables.

Catch Basin Cleaning:

The City has developed a CB cleaning program that optimizes routine inspections, cleaning, and maintenance of CBs with the goal of ensuring that no CB is more than 50% full at any given time. Inspections also allow the City to collect data on the depth of sumps and the presence/condition of hoods. The program is a requirement of the MS4 NDPES permit, which regulates stormwater discharges from the City's separated stormwater system, but the maintenance aids in collecting and removing floatable debris at scale throughout the City. In addition, a pollution prevention BMP initiated by the City includes the replacement of CBs that do not have a sump.

The City uses the Cartegraph Asset Management Program to track all CB cleaning. The data collected allows maintenance crews to adjust the frequency of cleaning for CBs based on observed levels of debris and floatable material.

Catch Basin Hoods:

CB hoods are used throughout the City and can help trap floatable debris in the CBs and prevent it from flowing through the combined or separated stormwater systems. Hoods are installed at all CBs.

Street Sweeping:

The City maintains a monthly street sweeping program that runs from April through December, which aids in removing debris from the roadways and helps reduce the load of floatables that wash into CBs during storm events. Bike lanes and primary corridors are swept weekly. The City squares (Harvard, Kendall, Central, Inman, and Porter) are swept daily. Street sweeping occurs in both the combined and separated sewer service areas and, in addition to aiding with floatables, is a requirement of the City's MS4 NPDES permit. Hand crews assist in the removal of materials during all sweeping operations. During the months of April, July, and November, the City initiates a program that utilizes vacuum sweeping in tandem with mechanical cleaning. The City's street sweeping program is cited as a model for other communities.

City Waste Disposal Services:

The City maintains robust curbside recycling, yard waste, and composting programs. These are collected on a weekly basis. Within City squares, litter barrels are emptied twice daily on weekdays and three times daily on weekends. The City also has multiple Hazardous Material Collection Days implemented by

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the Department of Public Works. The implementation of these programs mitigates floatable generation at the source.

Public Outreach Programs:

The City of Cambridge already has public education and outreach materials and program information on its Stormwater Management website, as highlighted in **Figure 9**. These programs focus on ways that residents can reduce the pollutant load that they contribute to storm drains, including keeping trash and other floatable debris from entering the City's stormwater systems. The City has developed several educational materials tailored to residential, commercial, and industrial properties. These are distributed through online campaigns, neighborhood, and City events. Additionally, signage on CBs is used to notify the public that systems potentially drain to the river and could contribute to pollution. Residents may report illegal dumping through the City's SeeClickFix application.

Additionally, the City has partnered with the Mystic River Watershed Association to launch the Storm Stewards initiative—a community-based program aimed at reducing street flooding and improving water quality in local waterways. With over 5,800 municipally owned storm drains, maintaining system functionality during wet weather events is a significant undertaking. Storm Stewards empowers residents and business owners to adopt storm drains in their neighborhoods, committing to monthly inspections and debris removal, particularly ahead of rainfall. This effort helps prevent blockages, reduces pollutant transport to Alewife Brook and the Charles River, and complements municipal maintenance operations. To support public engagement, the City promotes the program through social media outreach and provides educational resources via its website, encouraging widespread participation and reinforcing the importance of source control in urban stormwater systems.

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Figure 9: Screenshots of the City of Cambridge's Stormwater Management website, highlighting existing public education and outreach programs that include responsible waste management (L) and the city's Storm Stewards program (R).

4.2 EXISTING FLOATABLES CONTROL AT CSO OUTFALLS

In addition to the non-structural controls described in Section 4.1, structural floatable control measures are installed in each of the combined sewer overflow structures upstream of the City's outfalls. The design and location of the floatable control measures are detailed below.

4.2.1 CAM001

The CAM001 regulator is located next to Alewife Brook Parkway across from 29 Foch St. The regulator consists of three parts: two adjacent manhole chambers and a weir structure, as shown in **Figure 10**. Flow from the Cambridge sewer system enters the first manhole chamber from the southeast. During typical dry weather conditions and most rainfall events, water exits the east chamber through a 12" diameter underflow into the adjacent chamber to the northeast. Flow is then conveyed into the MWRA interceptor through a 12" diameter pipe. During some wet weather events, when the elevation in the first structure exceeds the weir elevation (15.2 CCB), an overflow occurs via the 15" VCP outfall pipe into the Alewife Brook.

A hood on the upstream end of the outfall pipe, located in the chamber, serves as the floatables control in the CAM001 regulator. The top of the weir elevation is 1.85' above the bottom of the hood (see profile in **Figure 9**), thereby preventing floatables are prevented from continuing into the outfall during wet weather. When the water level in the chamber recedes, floatables are then conveyed through the

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underflow into the adjacent chamber and then into the MWRA interceptor to the Deer Island Treatment Plant, where they are screened out during preliminary treatment.

The CAM001 regulator is located within the right-of-way of the Alewife Brook Parkway, which is owned by the Department of Conservation and Recreation (DCR). The outfall is located along the Alewife Brook, which is also owned by DCR.

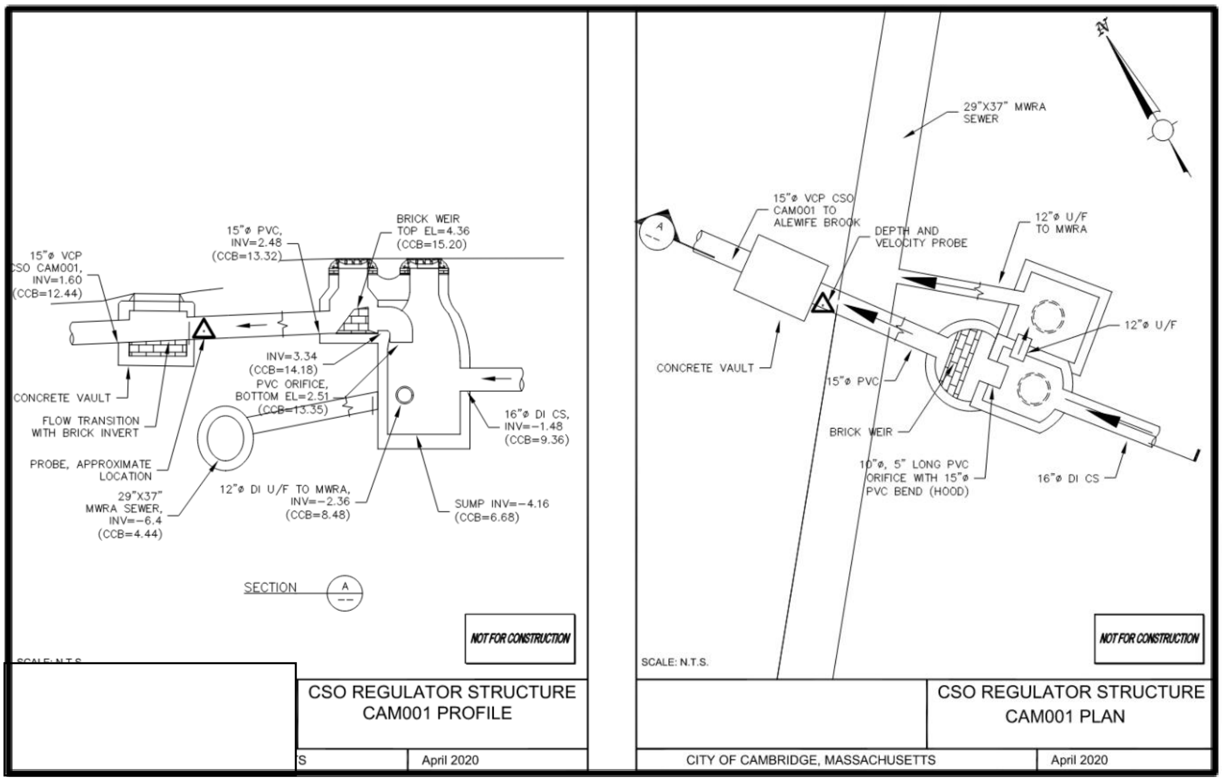

Figure 10: Plan and Profile View of CAM001

4.2.2 CAM002

The CAM002 regulator is located adjacent to Alewife Brook in the intersection of Alewife Brook Parkway and Massachusetts Avenue. A plan and profile of the CAM002 regulator is shown below in **Figure 11**. Flow from the Cambridge sewer system enters a manhole chamber from the southeast. During typical dry weather conditions and most rainfall events, flow is conveyed west into another chamber and through a 15” underflow pipe that discharges into the 29”x37” Metropolitan combined sewer pipe. This flow is conveyed to the Deer Island Treatment Plant, where floatables are screened out during preliminary treatment. During wet weather events, if the depth in the upstream chamber exceeds the El. 14.29 CCB, water is conveyed northeast into a 36” pipe that discharges into the 66” diameter MWRA interceptor to

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the Deer Island Treatment Plant, where again, floatables are screened out during preliminary treatment. During some wet weather events, if the elevation in the downstream chamber reaches the invert of the CAM002 outfall pipe (El. 16.3 CCB), flow will be conveyed into the Alewife Brook via the 42” diameter outfall pipe. wife Brook via the 42” diameter outfall pipe.

A stainless-steel baffle for floatables control is installed several inches in front of the outfall pipe and at the same elevation as the outfall pipe. The baffle prevents solids from entering the outfall pipe when the flow is surcharged in the chamber. CAM002 is located in a right-of-way owned by the City of Cambridge.

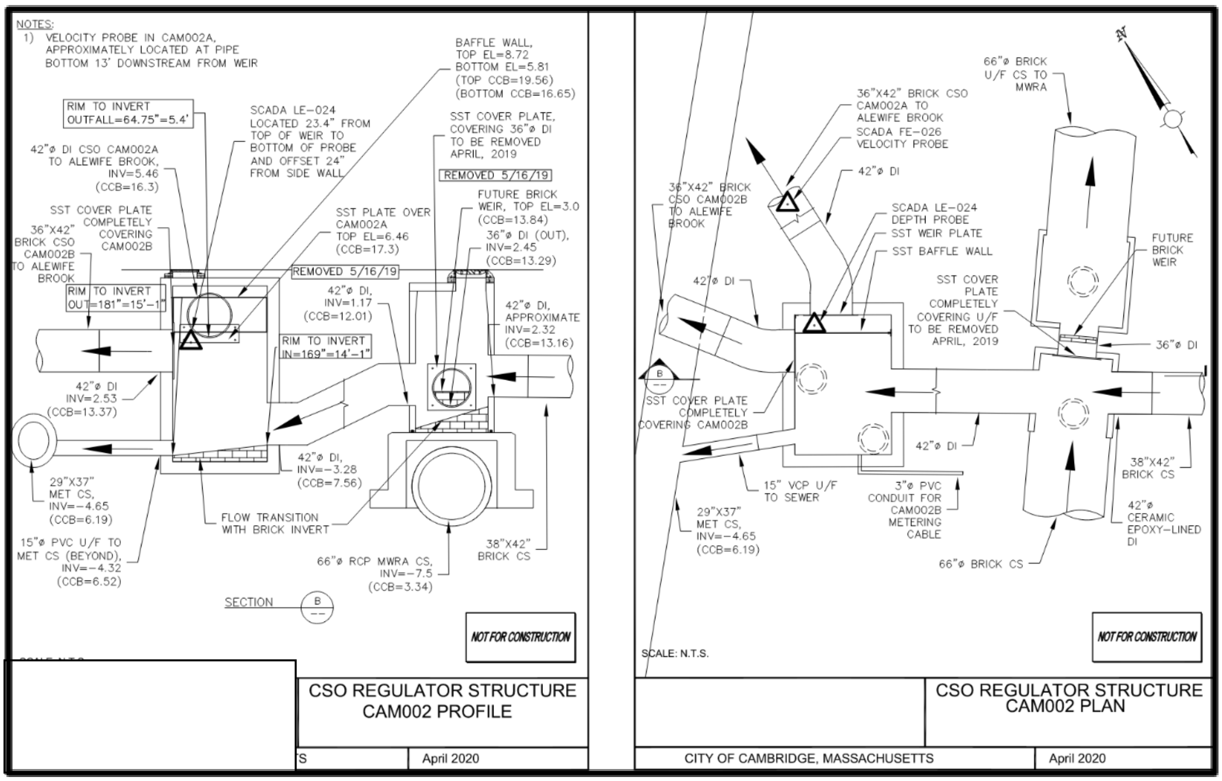

Figure 11: Plan and Profile View of CAM002

4.2.3 CAM401A

CAM401A is located on Sherman Street across from 40 Sherman Street. The CSO regulator plan and profile are shown below in **Figure 12**. Flow enters the structure from the south through the Cambridge sewer system via one 45”x55” pipe and one 48” pipe. During typical dry weather conditions and most rainfall events, flow travels north through the structure into a 60”x66” pipe. This flow is conveyed to the Deer Island Treatment Plant, where floatables are screened out during preliminary treatment. During wet weather events when the water elevation in the regulator exceeds the static weir height (El. 17.04 CCB),

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flow is conveyed west through brush screens affixed to the weir wall. Flow then passes through flap valves prior to entering the 96”x76” outfall conduit that discharges into the Alewife Brook.

A stainless-steel baffle is affixed to the regulator walls immediately in front of the brush screens and to an elevation below the static weir wall. The baffle, along with the brush screens, are designed to intercept floatables before they enter the outfall pipeline. The outfall pipeline runs for approximately 4,200 feet before ultimately discharging into the Alewife Brook with multiple stormwater connections feeding into it. These connections to the 401A outfall pipe create pathways for floatable materials to enter the system downstream of the floatable controls in the 401A regulator upstream.

The CAM401A regulator is located within the Sherman Street right-of-way, which is owned by the City of Cambridge. The outfall location is on property owned by the Massachusetts Bay Transit Authority (MBTA).

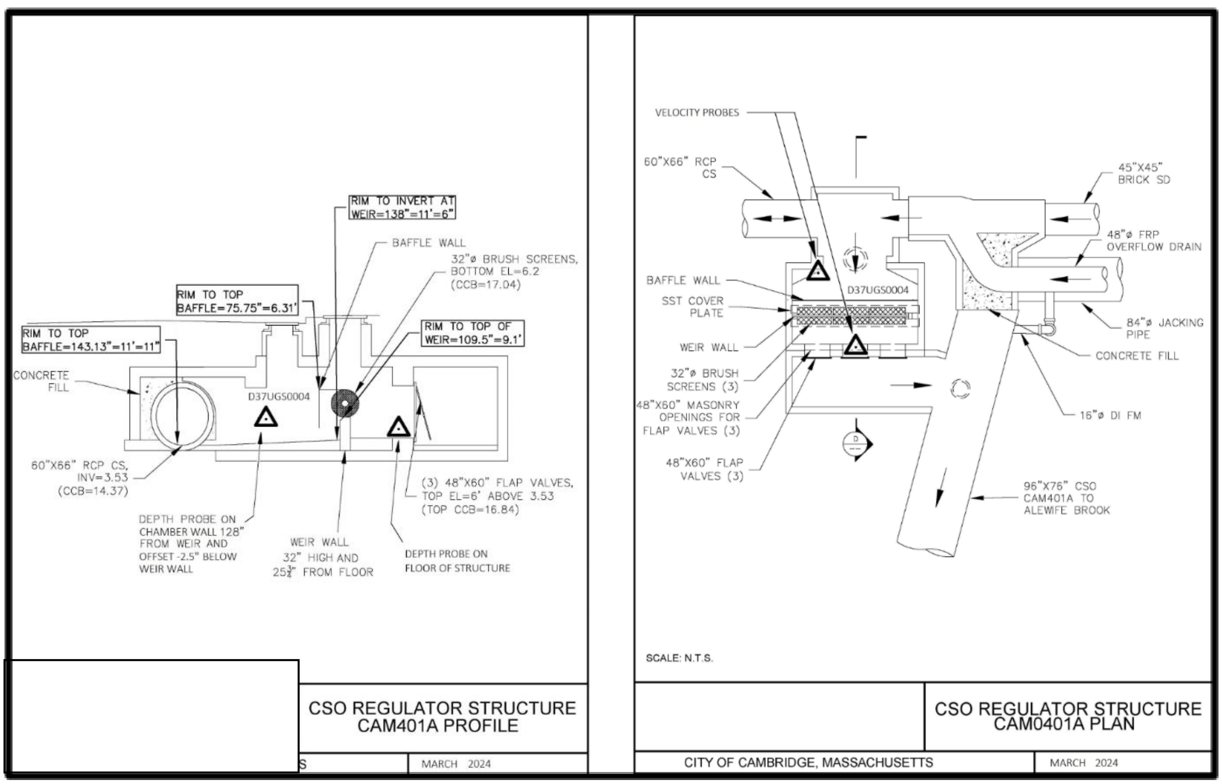

Figure 12: Plan and Profile View of CAM401A

4.2.4 CAM401B

CAM401B outfall is located adjacent to Alewife Brook at the intersection of Alewife Brook Parkway and Massachusetts Avenue. The regulator is shown below in **Figure 13**. Flow from the Cambridge sewer

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system enters the regulator structures from the southeast along Massachusetts Avenue. During typical dry weather conditions and most rainfall events, flow is conveyed northeast through an 18” pipe that discharges into a 66” MWRA Pipe. This flow is conveyed to the Deer Island Treatment Plant, where floatables are screened out during preliminary treatment.

During wet weather events, when the elevation in the structure exceeds the invert elevation of the 30” outfall pipe (El. 14.14 CCB), flow discharges to the Alewife Brook via the outfall pipe. A stainless-steel baffle is mounted across the width of the structure in front of the outfall pipe. The bottom of the baffle extends 1.2’ below the CSO pipe invert, and the top of the baffle is just above the crown of the outfall pipe. The baffle helps to prevent floatables from entering the Alewife Brook via the 401B regulator.

The CAM401B regulator is located within the Massachusetts Avenue right-of-way, which is owned by the City of Cambridge. The outfall pipe is located on land owned by DCR.

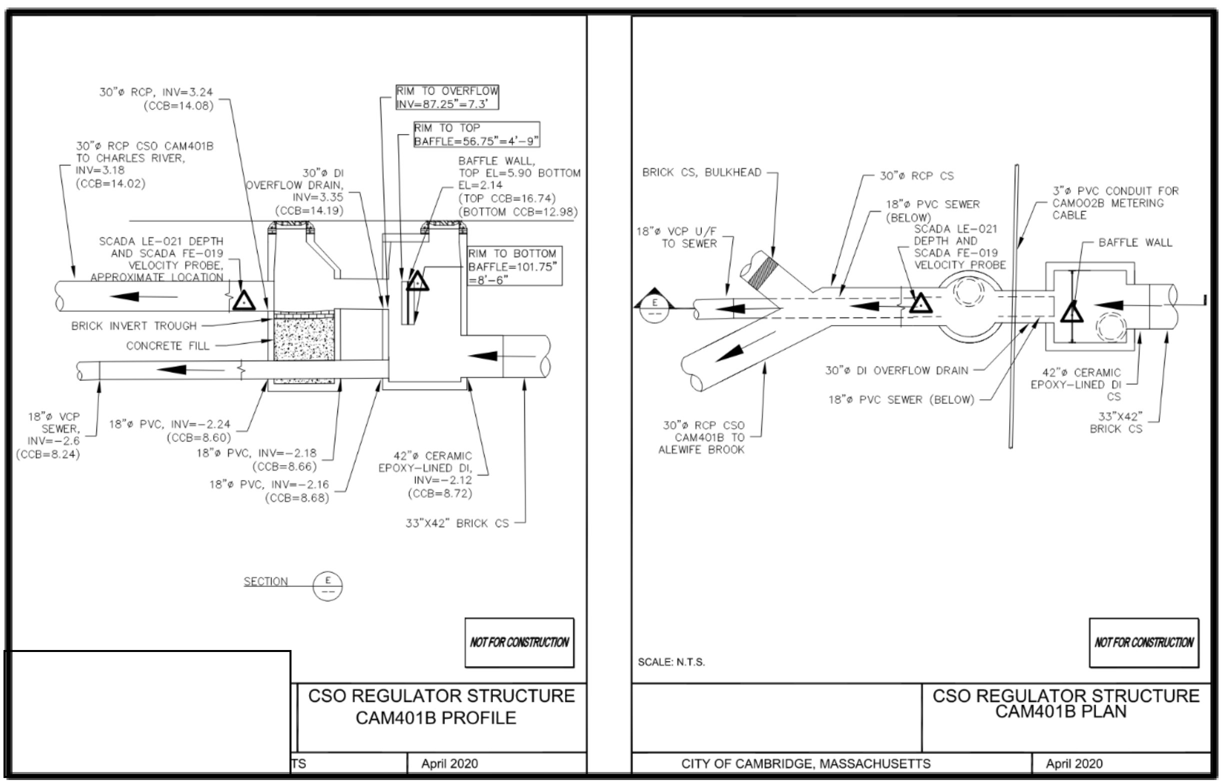

Figure 13: Plan and Profile View of CAM401B

4.2.5 CAM005

CAM005 is located adjacent to the Charles River, behind 330 Mt Auburn Street. The regulator is shown below in **Figure 14**. Flow from the Cambridge sewer system enters the regulator structure through a 54”

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pipe from the west. During typical dry weather conditions and most rainfall events, water travels north, connects with a 30" Cambridge sewer and a 24"x28" MWRA sewer, both from the west, and is conveyed through an MWRA 42" interceptor pipe into the Cottage Farm CSO Treatment facility, where screens are designed for removal of floatables.

During some wet weather events, when the elevation in the CAM005 regulator structure exceeds the static weir elevation (El. 14.29 CCB), flow is conveyed into the 54" outfall pipe to the south and discharges to the Charles River.
A baffle wall is installed at the west face of the regulator, where the 54" combined sewer connects to the structure. The baffle wall serves to mitigate floatables from entering the CAM005 outfall pipe during wet weather.

The CAM005 regulator is located partially within the Mount Auburn Street right of way owned by the City of Cambridge and partially on land owned by Mount Auburn Hospital. The outfall pipe is located on DCR land.

The MWRA is in the process of redesigning and updating the configuration of CAM005 to reduce CSO overflows in the system.

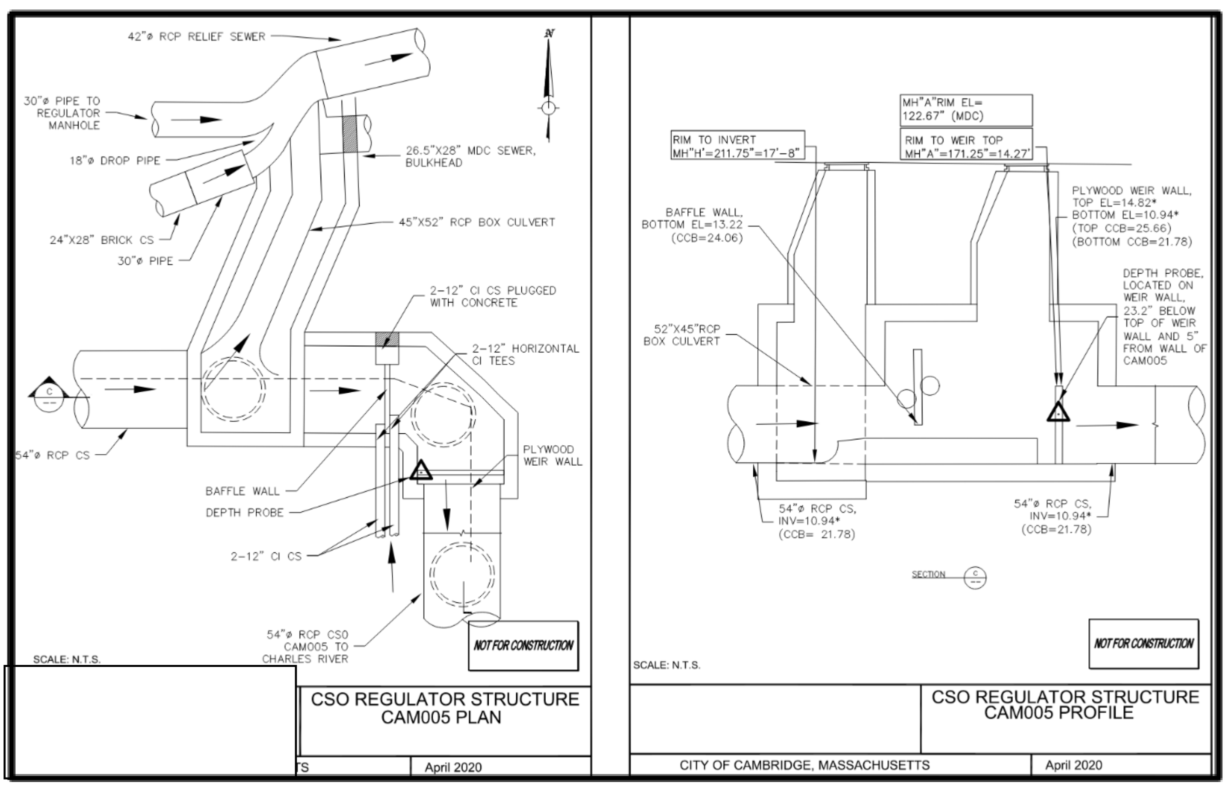

Figure 14: Plan and Profile View of CAM005

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4.2.6 CAM007

CAM007 is located adjacent to the Charles River across the street from 993 Memorial Drive. The regulator is shown below in **Figure 14**. Flow from the Cambridge sewer system enters the regulator through one 36" and one 48" pipe from the north. Water from the MWRA system enters the regulator through a 42" pipe from the west. During typical dry weather conditions and most rainfall events, flow is conveyed east and exits the regulator through an MWRA 60" pipe. This flow is conveyed to the Cottage Farm CSO Treatment facility, where screens are designed for the removal of floatables. During wet weather events, when the elevation exceeds the static weir elevation in the CAM007 regulator (El. 13.15 CCB), flow is conveyed over the weir and into the 56" outfall pipe that discharges to the Charles River.

A baffle wall extends across the width of the regulator upstream of the weir wall. The baffle extends over 1 foot below the weir crest elevation to almost 1 foot above for control of floatables. A flap gate installed on the outfall pipe downstream of the weir also serves to promote floatables control.

Both the CAM007 regulator and outfall are located on land owned by DCR.

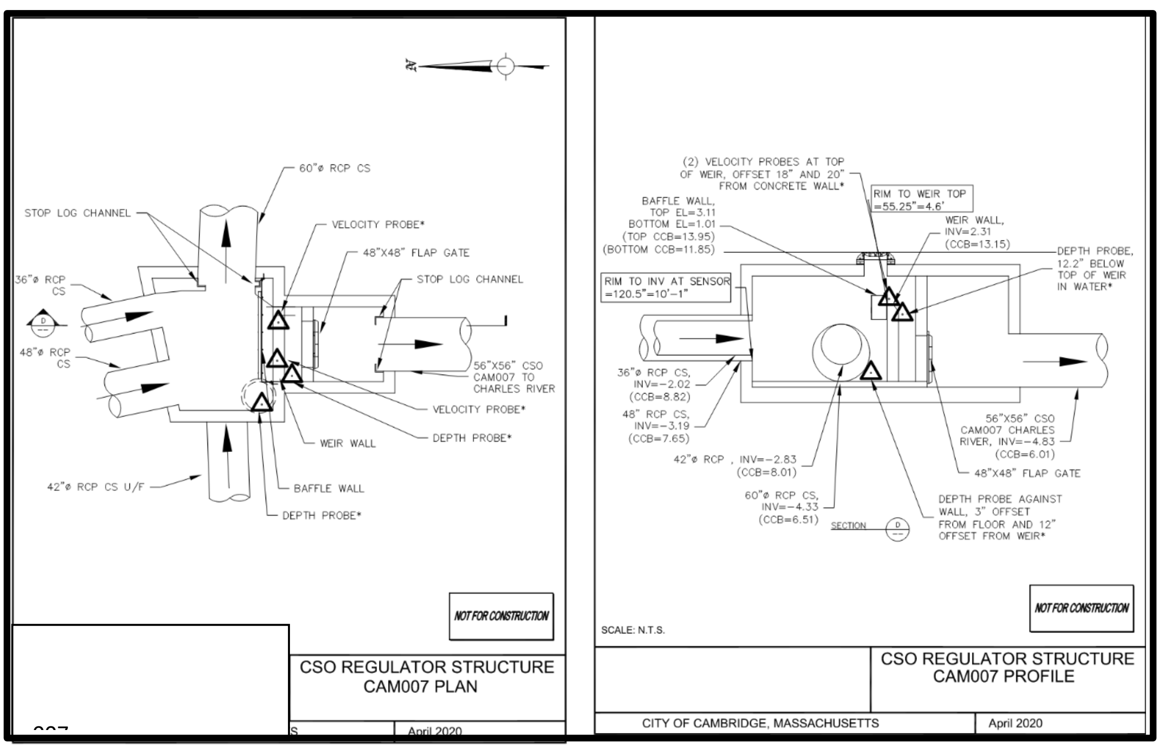

Figure 15: Plan and Profile View of CAM007

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4.2.7 CAM017

CAM017 is located adjacent to the Charles River across the street from 70 Cambridge Parkway. The regulator is shown below in **Figure 15**. The regulator controls both combined sewer and storm drain discharges. Combined sewer flow enters the regulator through one 96”x100” pipe from the west. During typical dry weather conditions and most storm events, the combined sewer flow exits northeast through a 72”x84” MWRA underflow pipe. This flow is conveyed to the Deer Island Treatment Plant, where floatables are screened out during preliminary treatment.

During some wet weather events, when the elevation in the regulator structure exceeds the elevations of the three bending weirs in the CAM017 regulator structure, flow is conveyed into the 90”x96” CSO outfall pipe and into the Charles River. Storm drain flows are also conveyed into the CAM017 outfall pipe through one 24” pipe and one 36” pipe south of the CAM017 regulator structure, directly into the 90”x96” CSO outfall pipe.

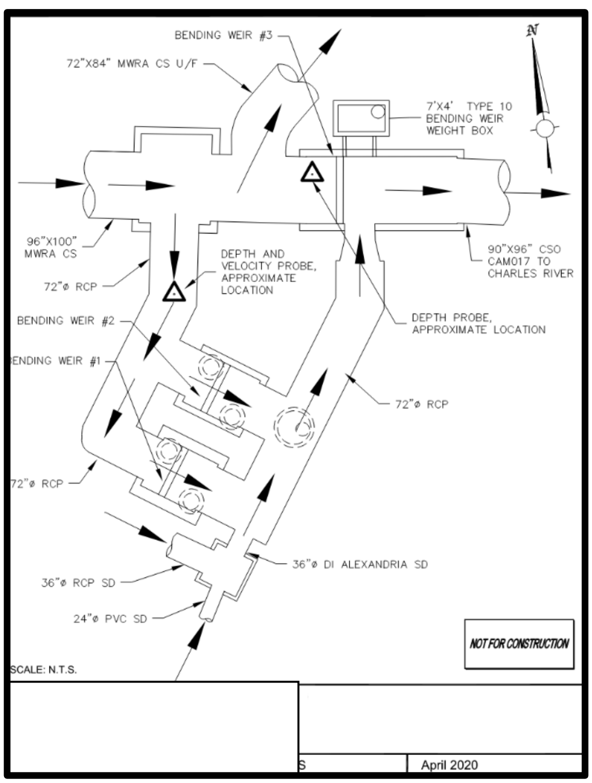

Figure 16: Plan View of CAM017

In the two bending weirs in the southern portion of the CAM017 structure (Bending Weir #1 and #2), 12” high stainless-steel baffles are mounted on the face of the incoming 6’ pipes at the crown of each conduit to promote floatables control. In addition to these baffles, the CAM017 bending weir structure was designed to optimize the retention of combined sewer flow and floatables during a range of storm events. Bending weirs are hydraulically proven to promote floatables control more effectively than static weirs. While no baffles are installed in the CAM017 regulator, the bending weirs were designed to promote floatables control while still maintaining the benefits to the hydraulic grade line and level of service in the Cambridge system and to optimize the flow to treatment during a range of rainfall events.

The CAM017 regulator is within the right-of-way of way of Land Boulevard and Binney Street intersection, which is owned by the City of Cambridge. The outfall is located on land owned by DCR.

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5 FLOATABLE CONTROLS EVALUATION

5.1 BASIS OF DESIGN REVIEW

Existing floatable controls at the City's CSOs were selected based on an analysis completed for MWRA in 1996 that sought to control floatables throughout the MWRA system (Metcalf-Eddy, 1996). The report assessed available controls at the time and then determined the feasibility of installation within each regulator that did not already have associated floatable controls. For all locations, skimmer vessels and containment booms were not considered due to the potential for the surface water freezing at the outfalls, which would render the technologies ineffective. The control technologies included underflow baffles, manually cleaned bar screens, end-of-pipe and in-line nets, and horizontal discharge screens. **Table 2** outlines the results of the 1996 MWRA analysis, including the technologies deemed feasible for installation within each outfall regulator, with the highest scoring technology shown in red.

Table 2. Appropriate Structural Controls for Cambridge CSO Outfalls (Metcalf-Eddy, 1996)

Outfall ID	Control Technology				
	Underflow Baffles	Manually Cleaned Bar Screens	End-of-Pipe Nets	In-Line Nets	Horizontal Discharge Screens
CAM001	X*	X	X		X
CAM002	*Not assessed in the report*				
CAM401A	X*	X	X		X
CAM401B	X*	X	X		X
CAM005	*Not assessed in the report*				
CAM007	X	X	X	X	X
CAM017	X*	X	X		
CAM009	X*	X	X	X	
CAM011	X				

**Baffles were shown to be the most feasible and economic for installation; however, baffle efficiency may not be sufficient for the design flows predicted. The second-highest ranking alternative was noted in each of these cases if baffles proved ineffective for floatable control.*

For all locations, non-structural controls are also recommended to reduce the potential floatable load that enters each regulator at the source. The efficacy of each of the structural control technologies

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recommended by the report would be significantly increased when paired with upstream non-structural controls. The floatable controls recommended in the 1996 MWRA report remain the existing controls outlined in Section 4 of this report.

5.2 EMPIRICAL EVALUATION OF EFFECTIVENESS

A methodology for the hydraulic evaluation of baffle performance does exist, based on research conducted by Newman et al. (2001). Such research identified a methodology for calculating the volume of debris collection in CSO structures based on the rate of change in the elevation of the surface water in a structure. This method of calculation is not applicable to the City's regulator structures, however, due to the atypical nature of the regulator geometry, including the existing incoming and outgoing pipes at varying orientations and the existence of regulator weirs (static and bending), scrub brushes, baffles, and other physical elements at each site. The turbulent flow conditions associated with the varied geometry of CSO structures and high average flow conditions during CSO events do not lend themselves to standard calculations of the volume of floatables collected.

5.3 FIELD OBSERVATIONS

As part of the floatables control assessment for the City's CSOs, field data were collected through targeted site visits to the CAM401A regulator, outfall, and surrounding infrastructure. Observations were conducted during both dry and wet weather conditions to evaluate the presence, movement, and potential sources of floatable materials. The July 31–August 1, 2025 visit coincided with a 1.65-inch rainfall event, providing an opportunity to assess system behavior during a rain event that had the potential to trigger a CSO. Despite surcharged conditions and active flow observed near the regulator, no floatables were detected immediately downstream of the CSO regulator, at the beginning of the outfall pipeline.

A similar inspection on September 4, 2025, conducted under dry-weather conditions, focused on the CAM401A outfall and downstream canal banks. While no floatables were observed in the canal water, small to moderate amounts of trash—including plastic fragments, glass, and miscellaneous debris—were embedded in sediment along the shoreline. A natural strainer formed by vegetation downstream of the outfall had captured additional trash, suggesting episodic transport of floatables through the system. The presence of an encampment near the outfall may also contribute to localized debris accumulation, highlighting the need for ongoing monitoring and community engagement.

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Figure 17: (L) CAM401A outfall during dry weather on Sept. 04, 2025. No floatables present in receiving water. (R) Encampment located on the banks of the receiving water body. This is a potential source of debris along the banks of the receiving water.

Upstream CB inspections revealed some storm drainage structures lacking hoods, which are known to reduce floatables entry into the sewer system. Of the six CBs inspected in the vicinity of Cambridgepark Drive and the connector road that the CAM401A pipeline traverses, only D45CBN2019 had a hood. Notably, catch basin D45CBN2013 was heavily clogged with debris and surrounded by multiple floatable items, including water bottles and cans. Other catch basins showed signs of minor floatables presence, such as cigarette butts and small litter. These findings underscore the importance of upstream source control measures and routine maintenance to prevent floatables from entering the combined sewer network and ultimately discharging into receiving waters.

Figure 18: (L) Catch Basin D45CBN2013 was found to be full of debris with floatable options scattered across the grating. (R) Catch basin D45CBN2019 was the only CB inspected that was connected to storm water pipes upstream of the CAM401A outfall with a hood installed.

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6 CONSIDERATIONS FOR SYSTEM FLOATABLES CONTROL

6.1 REGULATORY CONSIDERATIONS

6.1.1 Water Quality Standard Variance

In line with the Clean Water Act, Massachusetts published the Massachusetts Surface Water Quality Standards. These standards are set forth in 314 CMR 400. The standard categorizes all water bodies into "classes" based on their intended use. Each class of water body must meet certain water quality metrics to safely support its intended use. MassDEP regulates the types and volumes of discharges into each water body to ensure that the required water quality standards are met. The Charles River and Alewife Brook are Class B water bodies, and as a result, CSOs are prohibited.

In instances where it is infeasible to meet discharge requirements, MassDEP provides a Water Quality Standard Variance. The City of Cambridge received a Water Quality Standard Variances for CSO discharges into the Alewife Brook and Charles River, as it is technically infeasible to eliminate CSO overflows in these locations at this time. As discussed in Section 2, the variances are the basis for this report.

As part of the Variance, the City must mitigate the effects of CSO outfalls and work to minimize CSO discharge volume and frequency. The Variance requires that the City research and report on possible floatable control measures to mitigate floatables at each of the City's CSO outfalls. It also requires that the City implement the most feasible floatable control approach identified. The City will continue to meet the requirements set forth in the variance as it implements the recommendations contained herein.

6.1.2 NPDES CSO Permit - Floatables

The NPDES CSO Permit is a national program that regulates point-source pollutant discharges to waters of the United States. NPDES permits establish both acceptable pollutant levels in a discharge and establish specific technologies that must be used to limit CSO pollutant discharges. The permits also set forth monitoring and reporting requirements for discharges. In Massachusetts, the NPDES CSO Permit is administered by EPA.

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In 2009, the EPA issued a NPDES CSO permit to the City of Cambridge for the City's CSOs (US EPA, 2009). Since the issuance of the CSO permit, two of the CSOs have been permanently closed (CAM004 and CAM400). An additional two CSOs are currently temporarily closed (CAM009 and CAM011). The control of solid and floatable materials in CSOs is one of the Nine Minimum Controls required as part of the NPDES CSO permit. While no specific limits on floatables are listed, Cambridge is required to implement measures to mitigate floatables and solids in CSOs, and may not discharge septage, holding tank wastes, or other material that contains floatables to the combined sewer during wet weather when there is a risk of CSOs.

Additionally, the permit limits CSO volume and frequency which reduces the release of floatables. It also requires monthly inspection of CSO regulators. Frequent inspections ensure that floatables do not build up within the regulators. Finally, the NPDES permit orders that the City remain in compliance with Water Quality Standards Variances issued by MassDEP, which mandates that floatable control measures be identified and implemented.

6.1.3 NPDES CSO Permit - Maintenance

The City is required to adhere to its NPDES CSO Permit (No. MA0101974), which became effective in September 2009. This permit mandates that the City continue to implement the Nine Minimum Control measures and lists specific activities that must be undertaken to meet these measures. As part of the City's program to address the nine minimum control measures, the City conducts CB cleaning with the goal of ensuring that no CB is more than 50% full at any given time. This reduces the quantity of floatables in the sewer system, reducing the likelihood of floatable release. Furthermore, the NPDES permit requires monthly inspection of the CSO structure. With such frequent inspection, the City can ensure trash does not build up within the structure. Finally, the permit requires that the City conduct regular street sweeping, which removes trash on the road before it can enter CBs.

6.2 PERMITTING CONSIDERATIONS

The Wetlands Protection Act (310 CMR 10.00) requires projects within a 100-foot wetlands buffer or 200-foot riverfront buffer to submit a Notice of Intent to the local Conservation Commission. Except for CAM401A and CAM005, all CSO regulators are within these areas. As a result, any construction projects to improve floatables control are required to file with the local Conservation Commission, unless the project occurs at CAM401A and CAM005.

The City of Cambridge must obtain permits from DCR to perform construction activities on regulators and outfalls located on DCR land. Active CSO regulators on DCR land include CAM001, CAM002, and

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CAM007. Active CSO outfalls on DCR land include CAM001 CAM002, CAM401B, CAM005, CAM007, CAM017. Permit applications must include an access permit application form, complete engineering plans, documentation of any other permits required for the work, traffic management plans, and any other information requested by DCR on the project.

Permits are obtained through the DCR online portal. In addition to the online application process, a plotted plan set must be mailed to DCR. The permit application fee is $50. Additional fees are charged based on the project type and scope of the project work. There is no defined permit timeline in the DCR construction permit regulations.

The discharge piping for CAM401A and CAM005 traverses under property owned by others and may require additional permitting and easement negotiations. For CAM005, coordination with Mount Auburn Hospital and 1010 Memorial Drive Tenants Corporation will be required. For CAM401A, coordination may be needed with multiple property owners, depending on where access is required. In addition, the CAM401A discharge pipe passes under land owned by DCR, the MBTA, and the Massachusetts Department of Transportation (MassDOT). As such, work on that pipe may require permits from these entities.

6.3 PUBLIC COLLABORATION

Addressing the origin of floatable generation requires a coordinated effort between municipal agencies and the public. Increasing public awareness is a critical component of source control. The City could continue its educational campaigns that highlight the consequences of littering and improper disposal practices. This may include targeted social media messaging, visual infographics, and interactive content that encourages responsible behavior. Additionally, updating the city's website to include clear guidance on floatables prevention, sewer system impacts, and community involvement opportunities would further support public engagement and long-term pollution reduction.

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7 FINDINGS AND RECOMMENDATIONS

There is no indication that the City's CSO regulators and outfalls are currently an appreciable source of floatables in the Alewife Brook and Charles River. During dry weather flow and under most rainfall events, CSOs do not contribute flow to these water bodies, and during wet weather flow events, as outlined, each regulator structure has elements of floatables control included in its design. It is the case that during larger storm events, the potential for floatables to enter the water bodies from the Cambridge sewer system persists, and the City is responsible for monitoring this source of floatables.

The existing source control program for floatables works to reduce floatable debris in the Alewife Brook and Charles River from both combined and separated sources throughout Cambridge. Therefore, the City intends to emphasize existing floatables control protocols and BMPs through the following:

1. Continue the public education program around stormwater management.
2. Continue to investigate the presence of hoods on CBs tributary to CSO outfalls through the CB inspection and cleaning program, with particular attention to CAM401A (given that it has been noted through public commentary).
3. Continue to respond to the SeeClickFix reports and complaints received.
4. Continue with the monthly inspection of the CSO regulators.

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