

Draft Work Plan

To Determine the Loading Rate of Floatable and Settleable Trash and Debris Discharged from the New York City Municipal Separate Storm Sewer System (MS4)

August 2017

Prepared in accordance with
SPDES Permit Number NY-0287890
Part IV.I.3

NYC

NYC Environmental Protection

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1.0 INTRODUCTION

The City of New York's (City) Municipal Separate Storm Sewer System (MS4) Permit requires the development of a floatable and settleable trash and debris (herein referred to as "floatables") management program as part of the Stormwater Management Program (SWMP). In particular, the MS4 Permit requires the submission of a work plan "to determine the loading rate of floatable and settleable trash and debris discharged, including land-based sources, from the MS4 to waterbodies listed as impaired for floatables" (New York State Department of Environmental Conservation, 2015). This work plan includes a literature search of methods employed by other municipalities, the proposed methodology for New York City, and a discussion as to why the selected method is best for conditions in New York City.

2.0 REVIEW OF METHODOLOGIES TO DETERMINE LOADING RATES

The City has conducted a literature review of methods employed by other municipalities to determine the loading rate of floatables from separate storm sewer systems. As the control of floatables is not a common provision of MS4 permits, and trash TMDLs are similarly infrequent, only a few municipalities have attempted to determine a floatables loading rate. Those municipalities with published methodologies include San Francisco, Los Angeles County, Baltimore City and County, and Washington, D.C. Each of these municipalities is subject to trash TMDLs except San Francisco, and each of these municipalities has calculated loading rates that include both MS4 and combined sewer areas, except Los Angeles, which includes MS4 only. Additionally, the City has studied the loading rate of floatables in connection with combined sewer overflows (CSOs).

In general, each municipality conducted field monitoring to determine representative floatables loading rates for various land use types, and then applied those representative rates by land use in each catchment area to generate the overall annual loading rate by area. Municipalities selected this method because associating floatables loading rates with land use provided a logical way to extrapolate loading rates from readily available information. However, some municipalities found that land use alone was not a good predictor of loading rate, and attempted to account for other factors such as median income, proximity to "downtown" (high commuter activity) areas, frequency of street sweeping and rainfall. Table 1 summarizes the different methods that each of the other municipalities used to determine loading rates. The following sections provide additional information about the methods used by each municipality.

Table 1. Factors Included in Determination of Floatables Loading Rate

Municipality	Metric	Field Sampling	Land Use	Median Income	Rainfall	Street Sweeping
Los Angeles, CA	Volume	Yes	Yes	No	No	No
Baltimore City, MD	Weight	Yes	Yes	No	Yes (2)	No
Baltimore County, MD	Weight	Yes	Yes	No	Yes (2)	No
Washington, D.C.	Weight	Yes	Yes	No	Yes (2)	No
San Francisco, CA	Volume	Yes	Yes	Yes (1)	Yes (3)	Yes (3)

Notes:
(1) Used in conjunction with certain land use types
(2) Monitoring period rates per inch of rainfall normalized to long-term annual rainfall
(3) Application of ratio of frequency of rainfall and street sweeping

2.1 Los Angeles County, California

Los Angeles utilized a method to determine floatables loading rates based on land use. Field monitoring was performed between 2002 and 2004 at about 175 sites, with each site consisting of two to four storm-drain inlet structures fitted with full-capture devices (perforated plates) designed to prevent any items larger than 5 mm from exiting the structure for hourly intensities up to the one-year return period. Each site was characterized according to land use in its catchment area, with five land use categories: industrial, commercial, open/parks, high-density residential, and low-density residential. Field monitoring involved quantifying the uncompressed volume of trash accumulated in the structure since the prior cleanout, with sediment and vegetation excluded. Los Angeles expressed the observed loading rate for each site as gallons per day of accumulation per acre of catchment.

2.2 Baltimore City and County, Maryland

Baltimore City and Baltimore County determined floatables loading rates using a method based upon the Los Angeles method. However, Baltimore City and Baltimore County followed different field monitoring practices and, as described below, reduced the calculation method to reflect just two land-use types, urban and non-urban (forest).

Baltimore City monitored five stormwater outfall locations to represent two of the City's three major watersheds. No stations were sampled in the Baltimore Harbor watershed due to lack of accessibility, high wet-weather flows, and limitations regarding the catchments available for characterization. Field monitoring involved collecting trash accumulated in capture devices at each outfall every two weeks. Field crews separated trash from vegetation, drained liquid from containers, and allowed the trash to air dry before measuring the trash weight. Baltimore City then calculated the observed loading rate for each outfall as weight of floatables per day of accumulation per acre of catchment.

Baltimore County monitored trash generated over a one-year period at 17 stormwater management facilities (detention ponds) and at 20 in-stream sites. The County selected in-stream sites based on their suitability for monitoring stormwater trash, safe access, and the upstream area being predominately one land use category. Monitoring at in-stream sites involved marking out a 500-foot section of the stream from which field crews collected all trash at the start of the study and then on a monthly basis. In addition to excluding vegetative debris, draining all liquids from containers, and allowing the trash to air dry, the field crews also separated the trash into five categories (plastic bottles, glass bottles, aluminum cans, bulk "dumped" items, and other). Field crews measured dry weight for each category and counted the number of items in each of the bottle and can categories.

Baltimore County expressed the observed loading rates for each site as gallons per day of accumulation per acre of catchment. Variability between sites led Baltimore to consider just two land use categories: urban and non-urban (forest).

2.3 Washington, District of Columbia

Washington, D.C. utilized a floatables loading rate methodology similar to that of Los Angeles and Baltimore. Using this methodology, D.C. conducted field monitoring at 10 outfall locations and 30 in-stream locations. Field crews collected trash from nets installed on the monitored outfalls after each storm event, and from 500-foot segments along the in-stream sites on a quarterly basis. Field crews quantified the visible trash, excluding vegetative debris, emptying liquids from containers, and allowing the trash to air dry. Field crews also separated the trash into 44 item-type categories and counted each. D.C. then calculated an estimate of total weight based on standardized weights for each item type.

Each site was characterized according to its catchment's predominant upstream land use, based on seven different land use categories (roadways, institutional, commercial, industrial, high-density residential, low-density residential, and open space/parks). For each site, D.C. calculated the observed loading rate as the accumulated trash weight per acre per inch of rainfall during the accumulation period, and then developed average loading rates for each land use category. D.C. then calculated the overall loading rate by applying each land use category's loading rate (in terms of trash weight per acre of that land use per inch of rainfall) for the total acreage of that land use in the municipality and for the total long-term average rainfall (inches per year).

2.4 San Francisco, California

San Francisco utilized a floatables loading rate methodology that, while based upon land use, also accounted for other drivers such as income level, site-specific factors, and the relative frequency of street sweeping and rainfall.

Field monitoring involved 159 stormwater inlet structures, each draining a catchment with at least 70 percent of its area representing one of 10 different categories: low-, mid-, and high-income retail; low-, mid-, and high-income residential; industrial; commercial; urban park; and schools. Each monitored site was retrofitted with a full-capture device (perforated plate) designed to prevent any items larger than 5 mm from exiting the structure for hourly intensities up to the one-year return period. During the monitoring period, field crews cleaned out all accumulated material from the inlet structure, allowed it to air dry, and separated it into eight material/item categories (plastic recyclable beverage containers, plastic single-use bags, plastic foam food ware, plastic other, paper, metal, other trash, and non-trash debris such as sediment and vegetation). Field crews would then measure the dry weight, uncompressed volume, and item counts (for trash categories).

San Francisco generated field monitoring results by site and by catchment category. Initial results indicated that there was a high variability of observed loading rates, even within a particular catchment category. San Francisco interpreted this to mean that its calculation method had not taken into account other driving factors. In order to account for this variability, San Francisco refined the method to distinguish between the monitored “trash-loading rate” from the catchment to the receiving water and the “trash-generation rates” within the catchment. The difference between the two is the “trash-interception rate,” whereby some of the generated trash is captured via street sweeping or other controls, preventing material from discharging to the receiving water. Only trash remaining on the street is available for rainfall to transport to the stormwater inlet structures. San Francisco adjusted the loading rates to account for these processes by applying a factor based upon the relative frequency of street sweeping and rainfall in each catchment area.

In calibrating the refined method’s results for trash-loading rate, San Francisco incorporated other refinements to manually adjust for geographic variations in loading rates. San Francisco conducted a final, limited validation of the refined method using floatables loading measurements for one cleanout period at two sites.

2.5 New York City, New York

As documented in its 2005 Citywide Comprehensive Floatables Plan - Modified Facility Planning Report, New York City Department of Environmental Protection (DEP) performed floatables monitoring to identify the sources of floatables pollution in New York Harbor and to understand the processes affecting how the City generates and controls floatables. While there are many ways floatables can reach a waterway including, but not limited to, illegal dumping, shoreline activities, direct disposal or wind action, this study determined that floatables discharging from the storm sewer system are consistent with street litter. However, this conclusion would need to be looked at further as other studies have found that the amount of floatables entering the storm sewer system is rainfall dependent but does not necessarily depend on the source (Walker and Wong, December 1999). The amount of trash that enters the sewer system depends on the energy available to re-mobilize and transport deposited litter on street surfaces rather than the amount of litter deposited on street surfaces.

The 2005 DEP study also concluded that land use was not a good predictor of street-litter levels. Based upon various field studies, DEP developed a model capable of calculating floatables loadings from combined and/or separately sewered areas. This model is based upon the following primary inputs for a given catchment:

1. Street-litter generation rate, in terms of quantity (item count, weight, or visible area) per year. This rate was calculated for study-baseline conditions using a build-up/wash-off submodel given:
   a. Average annual litter level, in terms the City's "Street & Sidewalk Cleanliness Ratings"
   b. Street-sweeping schedule (and litter-removal efficiency of sweeping)
   c. Annual occurrences of storms with at least 0.2 inches of rainfall (and litter-transport efficiency of such storms to flush litter into catch basins)
2. Total length of curb in the catchment
3. Percentage of hooded and non-hooded catch basins in catchment (and associated floatables-removal efficiency of each)
4. Percentage of catchment that is tributary to end-of-pipe controls such as booms or nets (and associated floatables-removal efficiency of each)

During implementation of its catch basin hooding program, DEP applied this model to track the floatables loading rate, relative to baseline conditions, on an annual basis. Along with other measures, such as yields at end-of-pipe facilities and observed levels of floatables at various locations in New York Harbor and along shorelines, the model results satisfied annual reporting requirements associated with the CSO control program.

3.0 ADVANTAGES AND DISADVANTAGES OF DIFFERENT METHODOLOGIES

The survey of municipalities that estimate floatables loading rates revealed a range of methods, from simple, per-day rates based solely on urban or non-urban land uses, to complex calculations based on multiple catchment categories including land use and median income, and adjusted to account for street-sweeping frequency and rainfall. Differences between the methodologies do offer advantages and disadvantages. This section describes some of the key areas in which the methodologies differ and the advantages and disadvantages of the different approaches.

3.1 Metrics for Floatables Quantity and Loading Rates

The metric(s) selected for characterization of floatables is an important aspect related to the methodology selected to determine the floatables loading rate. Floatables refers to a class of varied materials that is not easily quantified and for which there is no “standard method” of analysis. Metrics used to quantify floatables include item counts, volume, drained weight, and visible surface-area measurements. Once collected, floatables are most easily described in terms of volumes or weights. However, weight metrics are susceptible to skewing from lightweight materials (such as polystyrene) and heavier materials (such as glass or wet materials). Volume metrics can also be skewed by large-area / small-volume materials (such as plastic sheeting) or the presence of natural materials (such as leaves) that are not the target of a floatables loading rates estimate, but these instances are typically less likely or, in the case of leaves, limited to a relatively short period of time.

Another difference in the commonly applied metric for loading rate is whether to express the rate in terms of “per day” or “per inch of rain.” Some municipalities, such as San Francisco, Washington D.C., and New York, see a clear relationship between loading rates and rainfall. Other municipalities, such as Los Angeles, do not see a significant correlation between loading rates and rainfall. While differences in weather patterns may in part explain this situation, direct deposition of litter into catch basins (such as by pedestrians and/or mechanical street sweeping equipment) and the practice of associating per-day catch basin accumulations with per-day discharges may be the reasons for this apparent discrepancy. To some extent, expressing loading rates as an annual average helps to even out seasonal variations in wet weather and the associated variation in loading rates.

3.2 Inclusion of Various Factors Affecting Floatables Loading Rate

Other municipalities’ studies to monitor and analyze floatables loading rates clearly demonstrated that floatables loading rates are highly variable from site to site and over time. The most comprehensive studies acknowledged that the primary factors affecting loading rates are litter-generation rates, litter-removal rates, and rainfall, while secondary factors include population, land use, street-sweeping methods and frequency, storm-sewer infrastructure (such as numbers and types of catch basins), and storm-sewer maintenance activities (such as catch basin cleaning). Because litter-generation rates are dependent upon human behavior, public education and enforcement of anti-littering laws, as well as litter-basket deployment and servicing, can also affect loading rates.

The studies also indicated that the relationships between the various factors can be dynamic and difficult to characterize. The simplest methods determine loading rates solely on the basis of land use. The advantage of this approach is that land use is a readily available parameter. Baltimore’s approach to land use was simplest, using only two categories for catchment land use (urban and non-urban). Los Angeles, Washington D.C., and San Francisco utilized up to seven different land use categories. Although the intent of using multiple land uses was to explain more of the variation in loading rates between different sites, most studies acknowledged that land use alone is a poor predictor of loading rate.

Some municipalities attempted to account for additional factors in their calculation of loading rate. San Francisco performed a correlation analysis and determined that adding median income level to further distinguish catchment land use improved the predictive capability of its method. San Francisco and Washington D.C. determined that accounting for rainfall also improved the results. San Francisco recognized that accounting for street sweeping and rainfall frequency also improved the prediction of loading rate from the catch basins because these actions directly impact the portion of litter on the streets that is captured via sweeping versus flushed into the catch basins.

The primary differences between the methods adopted to determine loading rate were the factors used to differentiate the loading rates from site to site, and over time. The simplest methods based loading rates solely on land use, while the most complex methods attempted to account for other factors, such as median income, street sweeping frequency and rainfall. DEP's approach was unique among this group because DEP based its method on measures of street litter level, rather than on land use as a surrogate for street litter level.

4.0 PROPOSED METHODOLOGY FOR NEW YORK CITY

This section presents an overview of the approach that the City proposes to determine the floatables loading rate from MS4 outfalls to floatables-impaired waterbodies, a justification for the proposed approach, and specifics on the methodology to implement the proposed approach. Per the Program Development Compliance Schedule in Part IV.O of the City's MS4 Permit, the City will submit a schedule for completing the floatables loading rate determination within three months after DEC approves the final work plan.

4.1 Overview of Proposed Approach

The City's proposed methodology is a hybrid approach that combines field measurements and model analysis. Using this approach, the City proposes to take field measurements of floatables discharged from catch basins representing various categories of sites that comprise the MS4 drainage areas. This data can then be used to extrapolate a floatables loading rate. In conjunction with field measurements, the City will use an updated version of DEP's existing floatables model to check the results of the field monitoring and to account for downstream in-water controls such as booms. Figure 1 below describes schematically the application of the existing floatables model to the City's MS4.

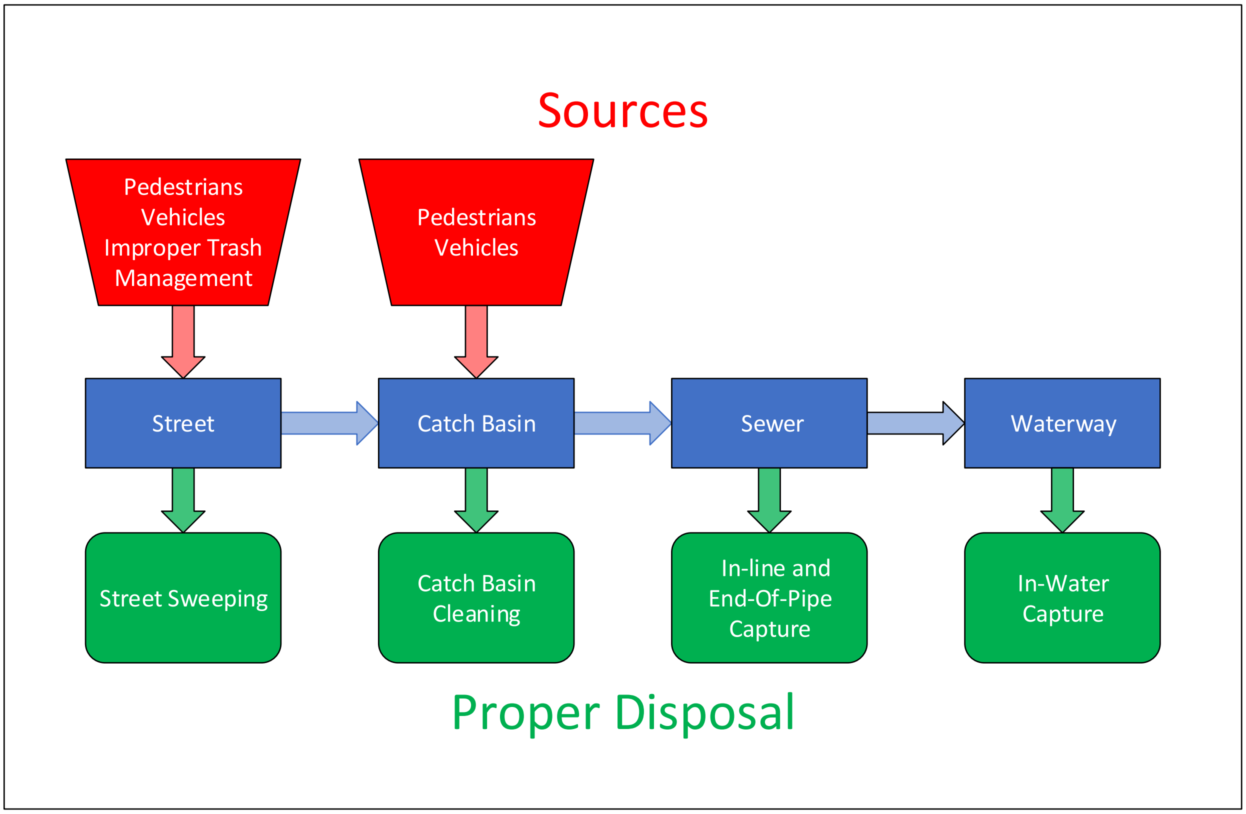

Figure 1. Schematic of MS4 Floatables Sources, Transport, Controls and Fate

4.2 Justification for Proposed Approach

As described in Section 3.0, the approaches utilized by other municipalities for determining floatables loading rates involve a range of complexities in terms of methodologies and factors affecting loading rates. The City's proposed approach, which combines the field measurement component of approaches utilized by other municipalities with the work done by DEP in the past, is suitable for determining floatables loading rates based on the following reasons:

- **Considers factors beyond land**. Other municipalities found that land use alone was not a good predictor of floatables loading rate. Where the surveyed municipalities characterized the monitored sites based on catchment land use, the City would select monitoring sites based upon important factors already understood to impact floatables discharge rates from catch basins in New York City. These factors include catchment characteristics (such as litter levels) and catch-basin attributes (such as presence of a hood).
- **Utilizes institutional knowledge and already developed tools.** DEP has previously studied floatables sources and effectiveness of existing floatables controls. Through a combination of field studies and modeling, DEP has developed

both an understanding of processes and models to estimate the impact of those processes on floatables loading rates.

- **Provides opportunities to update previous assessments.** Through targeted, focused field studies, the City can update its understanding of how floatables discharge rates are related to differences in certain factors such as street litter levels and existing floatables controls.
- **Isolates floatables contribution at the entry point to the MS4.** The proposed field monitoring will focus on characterizing the type and quantity of floatables entering the MS4 from the catch basins. This methodology avoids logistical difficulties and inaccuracies associated with monitoring outfalls in tidal systems, and allows characteristics of floatables to be determined for different areas.

4.3 Methodology to Implement Proposed Approach

In summary, the City's proposed methodology involves the following steps:

1. Selection of representative sites at which to conduct field monitoring
2. Field monitoring using proposed metrics to measure floatables discharge rates from catch basin sites comprising the various site categories within New York City's MS4 areas
3. Analysis of field measurements to determine unit loading rates by site category
4. Establishment of weather and other conditions suitable for calculation of floatables loadings from MS4 areas
5. Application of unit loading rates to individual catch basins, and summation of the results by MS4 outfall and by waterbody, for each waterbody designated as impaired due to floatables.

The following sections describe each of these steps in detail.

4.3.1 SELECTION OF REPRESENTATIVE SITES FOR FIELD MONITORING

In order to represent the full range of factors affecting floatables generation, interception, and loading for MS4 areas in New York City, the City has developed 20 site categories to be included in the field monitoring program. Each site category represents a unique combination of several different representative classes of catchment characteristics and catch basin attributes, or a unique land use.

<u>Catchment Characteristics</u>

Catchment characteristics include street-litter level and street-sweeping frequency. Street-litter levels directly impact the quantity of floatable material available for discharge into catch basins, and so monitoring sites will be selected to represent each of three different street-litter levels (high, medium, low). Because street-sweeping frequency directly impacts the portion of street litter that is captured versus carried into catch basins during storms, the City will also select monitoring sites to represent each of three different street-sweeping frequencies. Preliminary analysis suggests categories of high, medium, and low frequency may be appropriate, but these may change on further analysis of MS4 areas. For example, categories of high, medium/low, and none may better represent conditions in the MS4. Together with rainfall conditions, street-sweeping frequency and street-litter level represent the secondary factors from which street-litter generation can be gauged.

Catch Basin Attributes

The catch basin attribute that most directly impacts the discharge rate of floatables to storm sewers (and hence to receiving waters) is the presence of hoods. Catch basin hoods are designed to prevent sewer gases from venting through the catch basin. Because the hoods shield the catch basin's pipe outlet, they also prevent floatable items from entering the sewer system. Where present, catch basin hoods are effective at retaining floatables in catch basins; therefore, monitoring sites will be selected to represent both hooded and unhooded catch basins.

Land Use

Finally, the City will include two additional categories to represent catch basins located within certain land uses. These land use categories include arterial highways under the jurisdiction of the New York City Department of Transportation (DOT) and parks under the jurisdiction of New York City Department of Parks and Recreation (DPR). The proposed work plan includes monitoring of catch basins located in these land uses to characterize representative loading rates from catch basins in these site categories.

Catch basins along arterial highways and within parks may not share characteristics with standard DEP designs and maintenance practices. As a result, none of the other site category criteria may be representative of these catch basins. Additionally, limited information about litter levels is available in these areas. The catch basins in these areas were not included in previous DEP floatables studies because they were not previously subject to SPDES permit requirements on floatables control. However, these catch basins are now covered by the MS4 Permit and are therefore included in this methodology.

Site Categories for Field Monitoring

Table 2 lists the 20 site categories proposed for the field monitoring program. With three different catch basin sites per category, the proposed field monitoring program will include 60 monitored sites.

Table 2. Site Categories for Monitoring MS4 Catch Basin Discharges

Category	Catch Basin Attributes	Street Litter Level	Street Sweeping Frequency	Site Count per Category
1	Hooded	High	High	3
2	Hooded	High	Med	3
3	Hooded	High	Low	3
4	Hooded	Med	High	3
5	Hooded	Med	Med	3
6	Hooded	Med	Low	3
7	Hooded	Low	High	3
8	Hooded	Low	Med	3
9	Hooded	Low	Low	3
10	Unhooded	High	High	3
11	Unhooded	High	Med	3
12	Unhooded	High	Low	3
13	Unhooded	Med	High	3
14	Unhooded	Med	Med	3
15	Unhooded	Med	Low	3
16	Unhooded	Low	High	3
17	Unhooded	Low	Med	3
18	Unhooded	Low	Low	3
19	Arterial Highway	Typical	N/A	3
20	Within Parks	Typical	N/A	3
	Total number of catch basin sites to monitor			**60**

The City will select specific sites for the field monitoring program based upon a combination of desktop analyses and field verification. Desktop analysis will identify candidate areas based upon information made available to DEP. Areas with high, medium, and low litter levels will be identified based on geographical assessments (“heat maps”) developed using information including:

1. Recent, annual-average Street & Sidewalk Cleanliness Ratings data, which indicate the relative quantity of litter based on visual ratings conducted twice per month on about five percent of city blockfaces by the New York City Mayor’s Office of Operations
2. Litter information from the Street Conditions Observation Unit (SCOUT) of the Mayor’s Office of Operations
3. Catch-basin cleaning frequency and similar information that DEP logs, which can be used to track the build-up of debris in DEP catch basins.

The City will identify MS4 areas with different street sweeping frequencies based on mechanical sweeper routes and schedules maintained by the New York City Department of Sanitation (DSNY), information concerning sweeping in Business Improvement Districts (BIDs) in MS4 areas, and, as applicable, information concerning sweeping programs such as Ready Willing and Able (RWA). Similarly, the City will use DEP's catch basin database to identify individual catch basins with hoods or no hoods. Finally, the City will also apply desktop analyses to identify potentially suitable catch basin locations along arterial roadways and within parks that drain directly to priority waterbodies that are impaired for floatables.

In order to confirm the suitability of candidate sites for inclusion in the monitoring program, the City will visit each site to ensure that it can perform sampling safely and that site conditions match the intended category.

4.3.2 FIELD MONITORING AND METRICS

The City proposes a field monitoring program that will quantify floatables loading rates using suitable metrics. These metrics include a definition of floatables, methods of quantifying floatables in a manner allowing for scalability, and expression of rates in terms of suitable time-periods. This section describes each of these metrics, as well as the general sampling procedure.

Definition of Floatables

The City's MS4 permit refers to control of "floatable and settleable trash and debris." This language is consistent with the definition of floatables that DEP adopted for prior floatables studies. As defined in DEP's 2005 Citywide Comprehensive Floatables Plan - Modified Facility Planning Report, floatables are "manmade materials, such as plastics, papers, or other products which when improperly disposed of onto streets [or] into catch basins […] can ultimately find their way to [waterbodies] and may create nuisance conditions with regard to aesthetics, recreation, navigation, and waterbody ecology […]." For clarity, it is noted that "floatables" include materials that are settleable as well as those that may float on the water surface or are neutrally buoyant, and acknowledged that such materials may float or sink depending on the ambient conditions to which they are subject. In this context, "floatables" does not include natural materials, vegetation, oil and grease, or sediments and small particles.

Floatables Metric

The City proposes to express floatables quantity in terms of volume. Volume is the most appropriate floatables metric for three important reasons. First, volume is already established as a metric associated with trash (as collected in garbage cans, dumpsters, trucks, barges, and landfills). Second, volume describes both the visual and spatial impact of floatables, and can better represent the impact on wildlife than weight. Third, unlike item count or surface area, volume is relatively simple to measure in large quantities, and is not as susceptible as weight to skewing due to complicating factors such as water content, heavy material such as glass bottles, or light material such as Styrofoam containers. As in prior studies, the City proposes to record other measures, such as weight, item counts, etc., for purposes of establishing typical relationships between metrics.

Rate Metrics for Time Period

New York City proposes expressing loading rates in terms of annual average periods. Expressing the loading rate as an annual average helps to normalize seasonal and weather-related variations. Nevertheless, year-to-year variations in loading rate will occur due to differences in the number, timing, and intensity, of storm events. As a result, describing loading rates based on long-term average rainfall patterns will help to highlight the impact of operational factors (such as littering behavior, street sweeping practices, and catch basin retrofits) on year-to-year changes in loading rates.

Field Monitoring Protocols

New York City proposes field monitoring protocols to capture floatables in catch basin discharges to the MS4 using mesh strainer baskets deployed in MS4 manholes, as depicted schematically in Figure 2. Field crews will collect samples with a frequency suitable to characterize accumulated amounts in dry periods and in wet periods. Floatables collected from each site will be separately sorted to remove sediment and vegetation, quantified at a central processing site, and recorded. This protocol is consistent with the techniques used in DEP's previous floatables study. The City will select a monitoring period that allows for a minimum of 10 storms with at least 0.2 inches of rainfall to be monitored and seasonal differences to be captured.

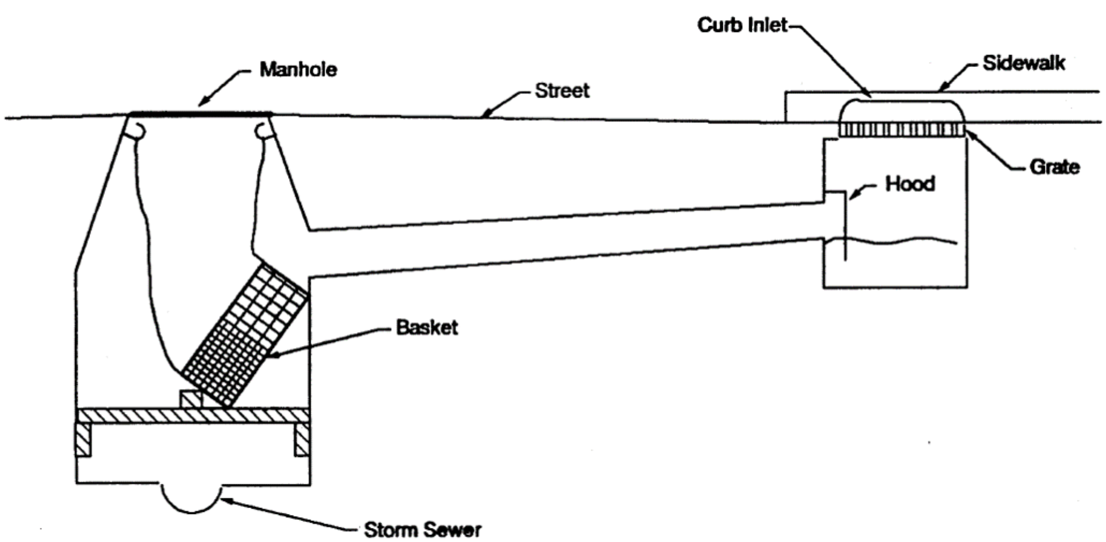

Figure 2. Sampling of Catch Basin Discharges to Sewer

4.3.3 ANALYSIS TO DETERMINE UNIT LOADING RATE BY SITE CATEGORY

In order to develop a unit loading rate that can be scaled appropriately, the results of the field monitoring program will require analyses to normalize the size of the catchment upstream of the monitored site as well as the number of days and/or amount of rainfall during the accumulation period. The City will calculate unit loading rates for each site category.

As indicated in DEP's previous floatables investigations, the length of curb (curb feet) in a catchment more closely correlates to floatables load than the area (acreage) of the catchment does. This is not surprising, because most street litter is located within 18 inches of the curb[1], and because most streets are crowned, with slopes downward to either side of the street, so that drainage is toward and along the curb to the catch basin. As a result, the City proposes using catchment curb length to normalize the measured discharge.

Similarly, the City anticipates that days of accumulation between qualifying storm events will correlate to the quantity of material discharged, and therefore proposes using days of accumulation (or inversely, frequency of qualifying storms) to normalize the measured discharge. As a result, these analyses will require information regarding rainfall during the accumulation period at each monitored site. For this purpose, the City proposes to utilize the nearest-available rain gauge from the rain-gauge networks maintained by the National Weather Service, DEP, USGS, and other reputable organizations, as well as radar rainfall information available from the National Weather Service.

The City will analyze the resulting unit (normalized) loading rates to confirm scalability and adherence to scientific principles (such as mass balance) and relationships established during prior floatables studies (such as relative capture in hooded versus unhooded catch basins).

Given an MS4 catch basin's site category's unit loading rate, catchment size (curb miles), and rainfall pattern (long-term average year), the catch basin's overall floatables load can then be calculated. The following two steps describe that process.

4.3.4 ESTABLISH CONDITIONS FOR CALCULATION OF LOADING RATE

While measured loading rates reflect conditions during the field monitoring program, the expression of loading rates from particular MS4 outfalls or to particular waterbodies will be most useful if applied using certain conditions that may be used as a baseline for

[1] New York City Law requires the adjacent property owner to clean the curb area 18" into the street.

comparison in the future. For this purpose, the City proposes using long-term average rainfall patterns, as determined from National Weather Service rain-gauge data and as applied using the model. The City can also use the model to specify other conditions, such as degree of catch basin hooding, street-litter levels, etc., as necessary, to develop an appropriate baseline condition.

4.3.5 CALCULATION OF LOADING RATE

In order to calculate the total floatables loading rate for a specific priority waterbody for floatables, DEP proposes the following:

1. For each catch basin in the MS4 area
    a. Identify the unit loading rate corresponding to that catch basin's site category. Unit loading rate is expressed in terms of floatables volume per length of curb per days of accumulation (or per number of storms) per year.
    b. Apply the unit loading rate for that catch basin to calculate the annual floatables load, in terms of volume, by multiplying the unit loading rate by:
        i. The length of curb in the catch basin's catchment.
        ii. The number of days of accumulation (or number of storms) in the baseline year.
2. Sum the calculated loading rates for each catch basin to determine the total loading rate for the MS4 outfall. This will be a total volume per year.

To calculate the total floatables loading rate from MS4 areas to a particular waterbody, the above procedure would be repeated for each MS4 outfall discharging to the waterbody, and then the sum of these would then represent the total MS4 loading rate to the waterbody.

After developing the unit loading rates as described in the preceding section, DEP will analyze available information on both existing and historical conditions regarding New York City's floatables-control actions. The current level of floatables control in MS4 areas reflects changes implemented in various New York City programs, such as the catch basin hooding program (completed in 2010 but ongoing per SPDES permit requirements) and the recently launched annual catch basin inspection program (required by City local law through the end of fiscal year 2019), as well as enhanced street-sweeping programs and extensive public education and media campaigns. The City will evaluate the impact of these programs on MS4 loading rates before making a recommendation of a particular baseline loading rate year, against which progress toward a reduction goal will be assessed.

5.0 REFERENCES

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